2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid
Workshop Manual

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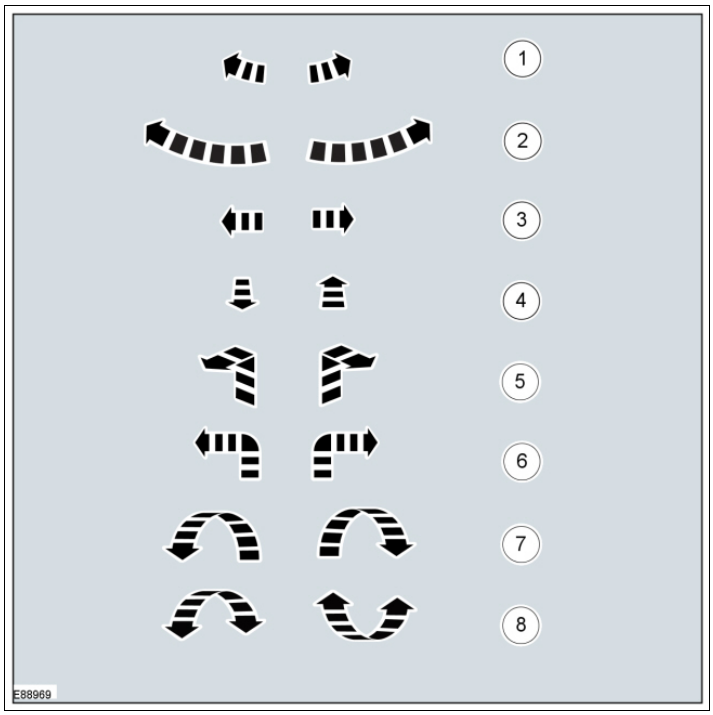
02: Frame and Mounting

Symbols Glossary

Symbols are used inside the graphics and in the text area to enhance the information.

Movement Symbols

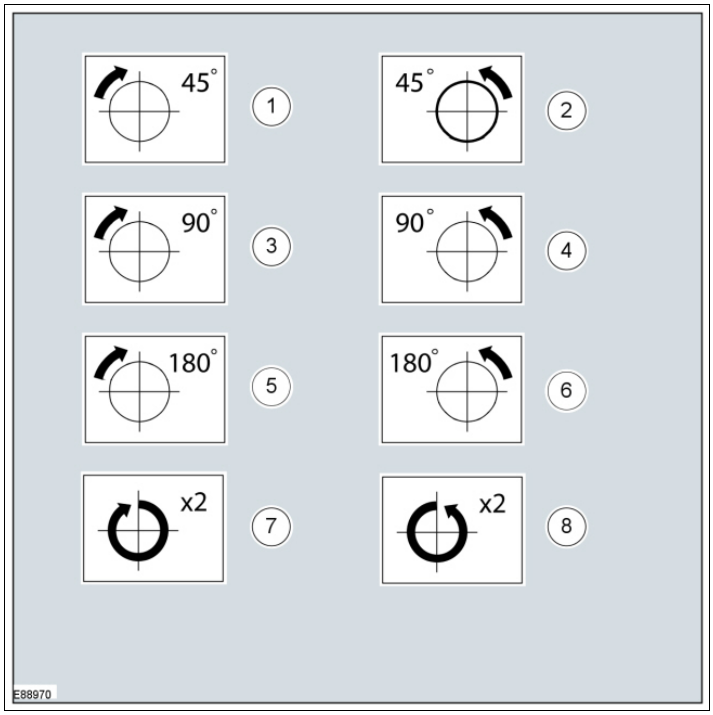
Movement symbols provide detailed information to a required component movement. These component movements can be rotational or 1-3 dimensional movements.



Item	Description
1	Minor component movement clockwise or counterclockwise
2	Major component movement clockwise or counterclockwise
3	Component movement to the left, right, up, or down
4	Component movement towards or away
5	3 dimensional component movement
6	2 dimensional component movement
7	3 dimensional component rotation
8	3 dimensional component cycling

Turn Symbols

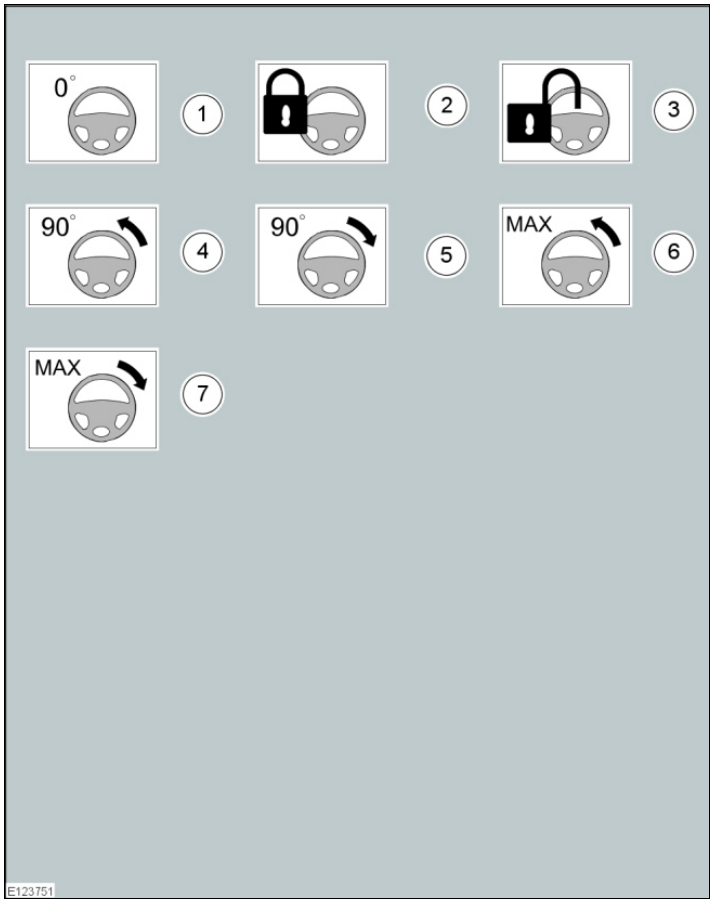
Turn symbols are used to provide further information on the direction or angle of component turns.



Item	Description
1	Turn the component clockwise through 45°
2	Turn the component counterclockwise through 45°
3	Turn the component clockwise through 90°
4	Turn the component counterclockwise through 90°
5	Turn the component clockwise through 180°
6	Turn the component counterclockwise through 180°
7	Turn the component clockwise through 2 complete turns
8	Turn the component counterclockwise through 2 complete turns

Steering Wheel Symbols

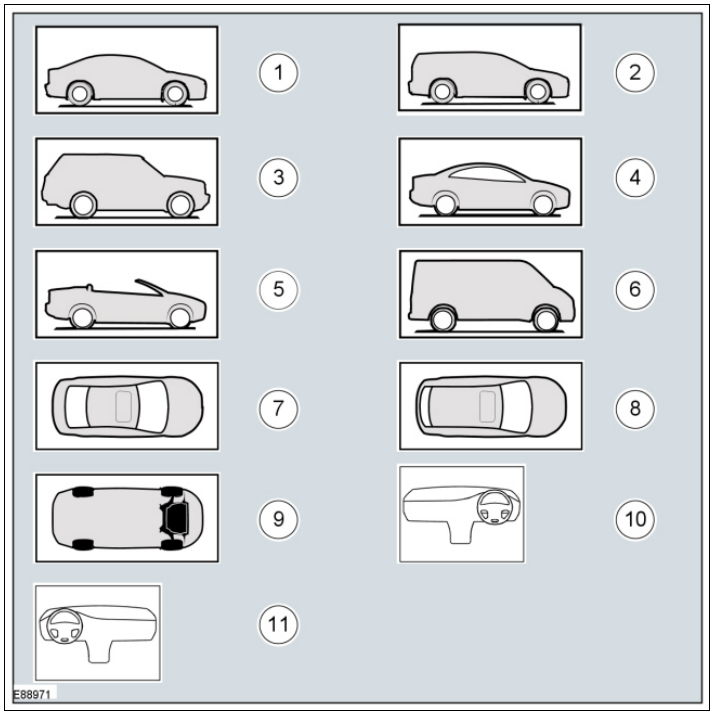
Steering wheel symbols are used to provide further information to a required steering wheel position or steering column lock status.



Item	1	Steering wheel in straight ahead position
2	Steering column locked	
3	Steering column unlocked	
4	Rotate steering wheel 90° left from center	
5	Rotate steering wheel 90° right from center	
6	Turn steering wheel fully counterclockwise to stop	
7	Turn steering wheel fully clockwise to stop	

Body Types

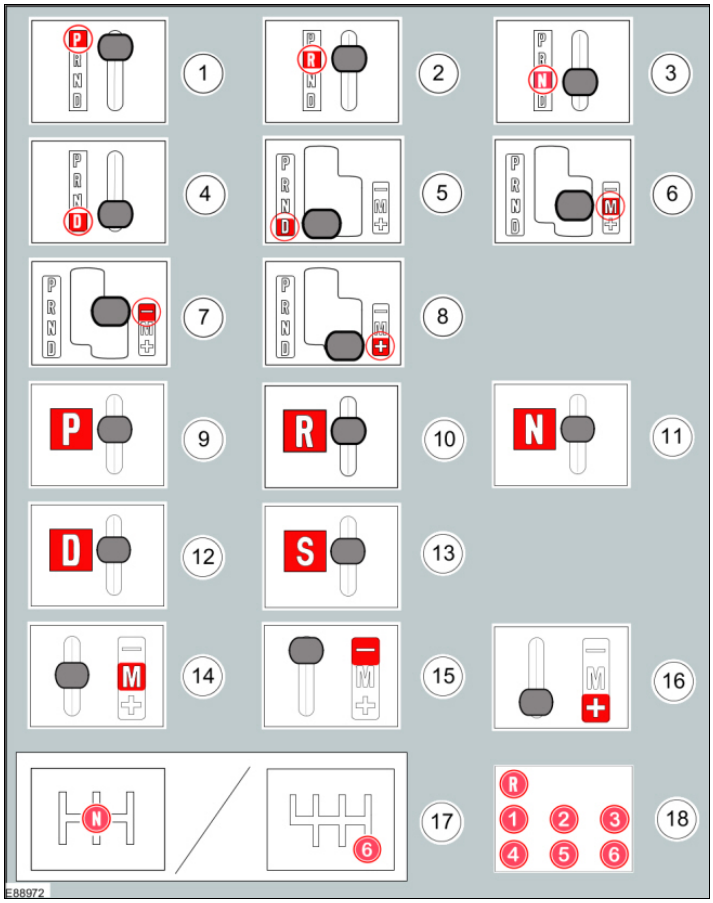
Body type symbols are used to identify different body configurations.



Item	Description
1	3, 4, 5-door body style
2	Wagon body style
3	Sport Utility Vehicle (SUV) body style
4	Coupe body style
5	Convertible body style
6	Van body style
7	3, 4, 5-door body style - Top View
8	Wagon body style - Top View
9	Underbody view
10	Right-hand drive (RHD) vehicle
11	Left-hand drive (LHD) vehicle

Gearshift Lever Position Symbols

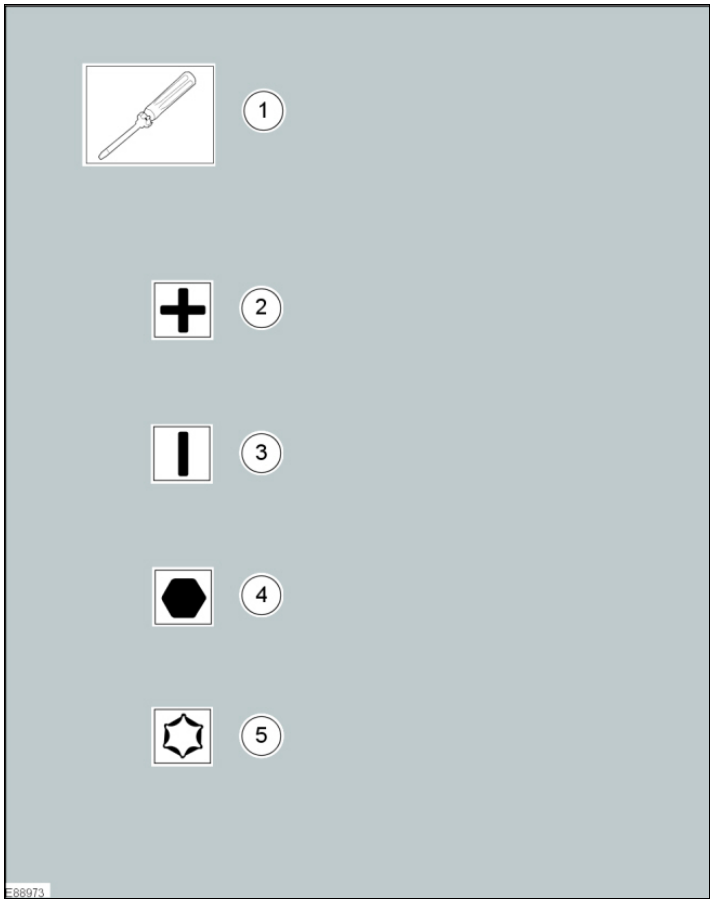
Gearshift lever position symbols are used to show the gear position required for the procedure.



Item	Description
1	Set the selector lever to the park (P) position
2	Set the selector lever to the reverse (R) position
3	Set the selector lever to the neutral (N) position
4	Set the selector lever to the drive (D) position
5	Set the selector lever with manual shift option to the drive (D) position
6	Set the selector lever with manual shift option to the manual (M) position
7	Set the selector lever with manual shift option to the shift down (-) position
8	Set the selector lever with manual shift option to the shift up (+) position
9	Set the manual shift lever to the neutral (N) position
10	Set the manual shift lever to indicated gear position (all possible gears shown here)

Screwdriver Symbols

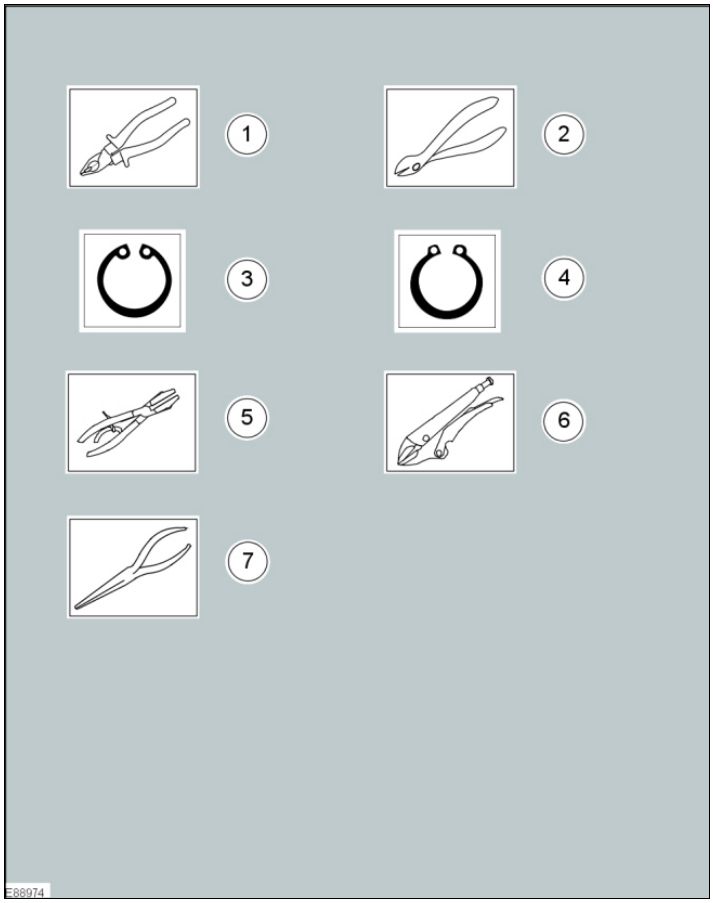
The screwdriver symbols are used to indicate which screwdriver bit is required for the procedure step.



Item	Description
1	Screwdriver
2	Phillips or cross-bladed screwdriver
3	Flat-bladed screwdriver
4	Hexagonal or Allen screwdriver
5	TORX screwdriver

Plier Symbols

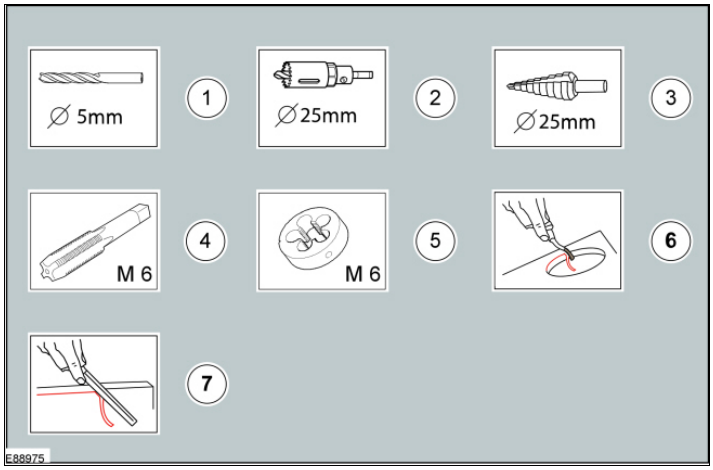
The plier symbols are used to indicate which plier is required for the procedure step.



Item	Description
1	Combination pliers
2	Side cutter pliers
3	Internal snap-ring pliers
4	External snap-ring pliers
5	Hose clamping pliers
6	Locking pliers
7	Long or Needle-nosed pliers

Drilling and Threading Tool Symbols

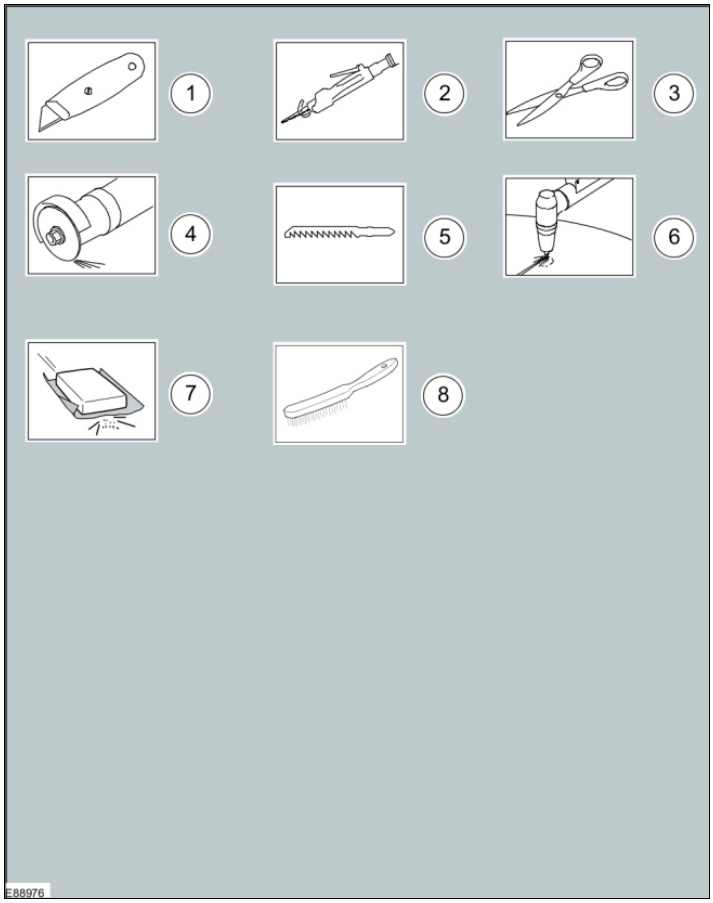
The drilling or threading tool symbols are used to indicate which type and size drill, thread-cutting device, or file is required for the procedure.



Item	Description
1	Drill bit with a specified diameter
2	Hole saw with a specified diameter
3	Stepped drill bit using a specified step diameter
4	Tap with a specified diameter
5	Die with a specified diameter
6	File or de-burring tool for circular holes
7	File or de-burring tool

Cutting Tool Symbols

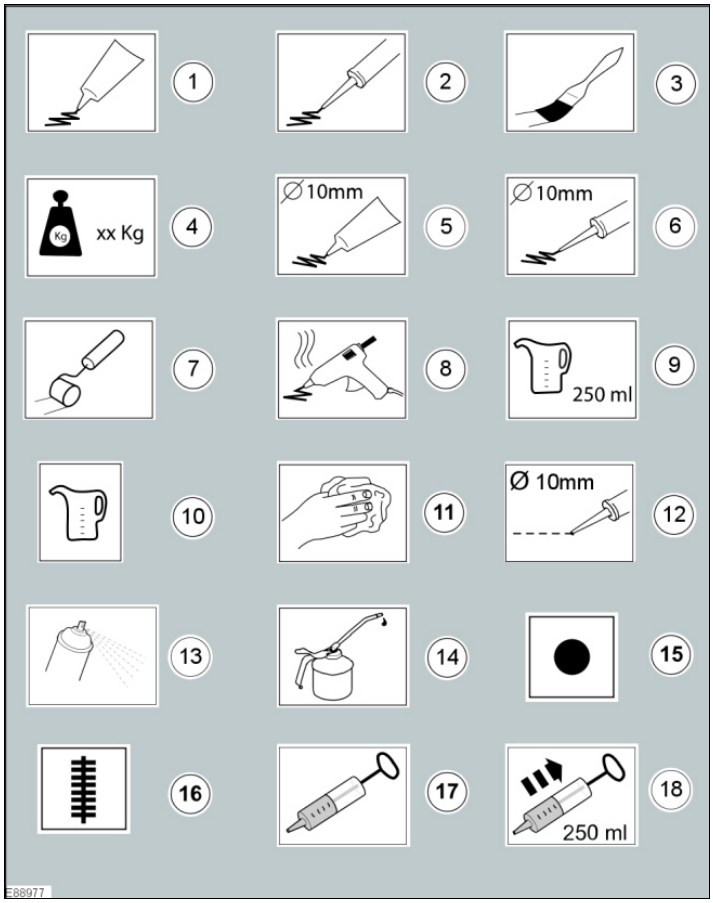
The cutting tool symbols are used to indicate which type of cutting tool is used for the procedure.



Item	Description
1	Box-cutter or cutting knife
2	Pneumatic body saw
3	Scissors
4	Grinder
5	Jig saw
6	Plasma cutter
7	Sanding block or paper
8	Drill through the indicated number of body layers with the specified diameter drill bit
9	Drill through the indicated number of body layers with an appropriate size drill bit
10	Drill through first body layer with the specified diameter drill bit
11	Drill through first body layer with an appropriate size drill bit
12	Wire brush

Apply Chemicals, Lubricants, or Clamping Load Symbols

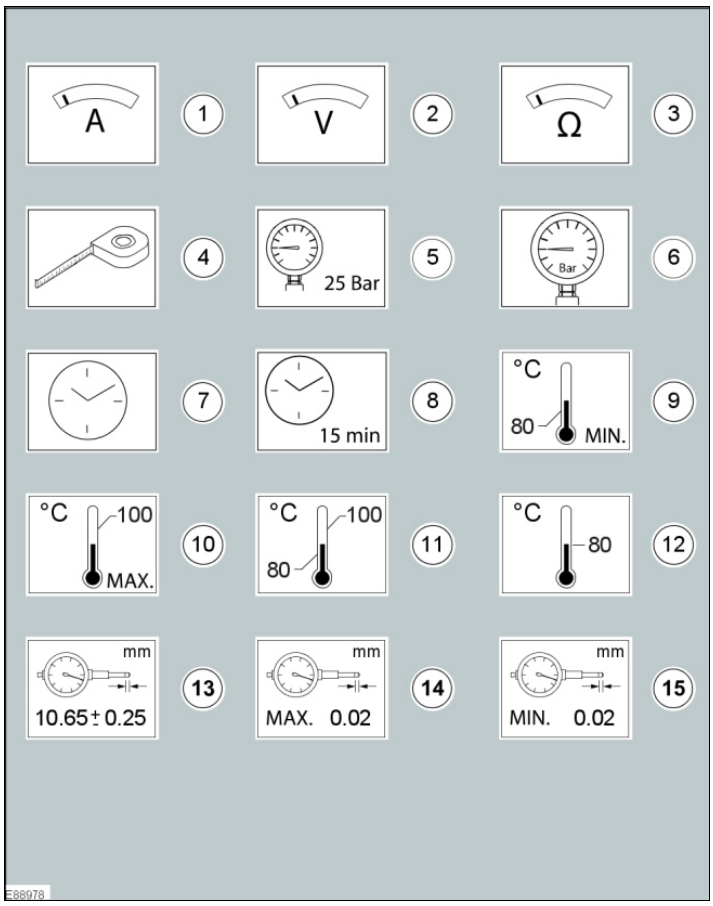
The apply chemicals, lubricants or clamping load symbols are used to direct the application of chemicals, lubricants, or loads for the procedure.



Item	Description
1	Apply a bead from the specified tube
2	Apply a bead from the specified cartridge
3	Apply the specified chemical with a brush
4	Apply the specified clamping load to the specified component
5	Apply the specified diameter bead from the specified tube
6	Apply the specified diameter bead from the specified cartridge
7	Apply the specified chemical with a roller
8	Apply hot glue to the specified component
9	Apply the specified amount of fluid
10	Apply the fluid
11	Clean the specified component with the specified material
12	Apply a broken bead of the specified diameter
13	Apply the specified chemical with a spray can
14	Apply the specified lubricant to the specified component
15	Spot weld the specified component
16	Apply a continuous line of weld to the specified component
17	Apply the fluid with a syringe
18	Extract the fluid with a syringe

Measurement Symbols

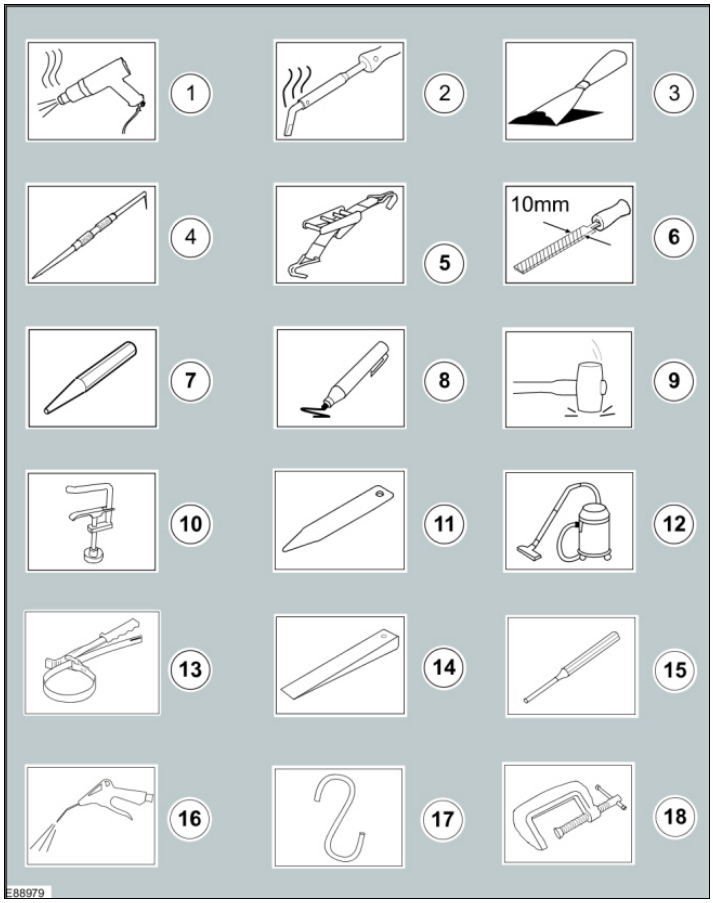
The measurement symbols are used to show which measurement will be made at a specified point.



Item	Description
1	Measure the amperage using a digital multimeter
2	Measure the voltage using a digital multimeter
3	Measure the resistance using a digital multimeter
4	Measure the length or distance
5	Check that the specified pressure is available using a suitable pressure gauge
6	Measure the pressure at the specified port using a suitable pressure gauge
7	Measure the time with a stopwatch
8	Wait for the indicating amount of time
9	The minimum temperature for the specified task
10	The maximum temperature for the specified task
11	The allowable temperature range for the specified task
12	The required temperature for the task
13	Measure for the specified movement
14	Measure for movement not to exceed specified amount
15	Measure for the miniumum-specified movement

General Equipment Symbols

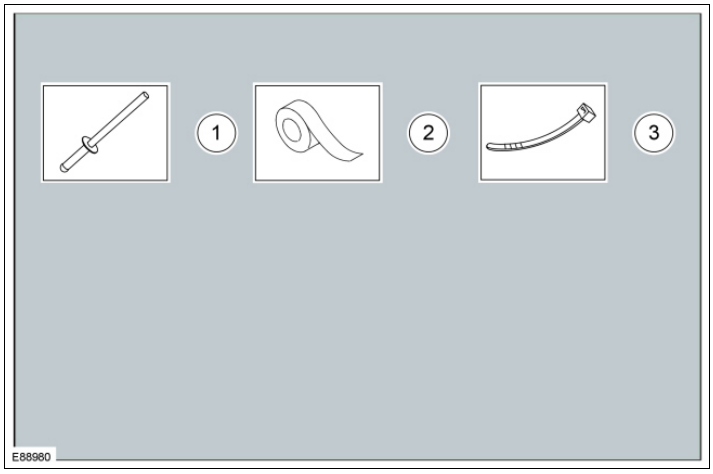
The general equipment symbols specify which general equipment is used to carry out the procedure.



Item	Description
1	Hot air gun
2	Soldering iron
3	Putty knife or scraper
4	Awl or scriber
5	Hold-down or securing strap
6	File with specified size
7	Center punch
8	Marker
9	Metal Inert Gas (MIG) welder
10	Hose clamp
11	Trim tool
12	Shop vacuum
13	Strap wrench
14	Wedge
15	Pin punch

Material Symbols

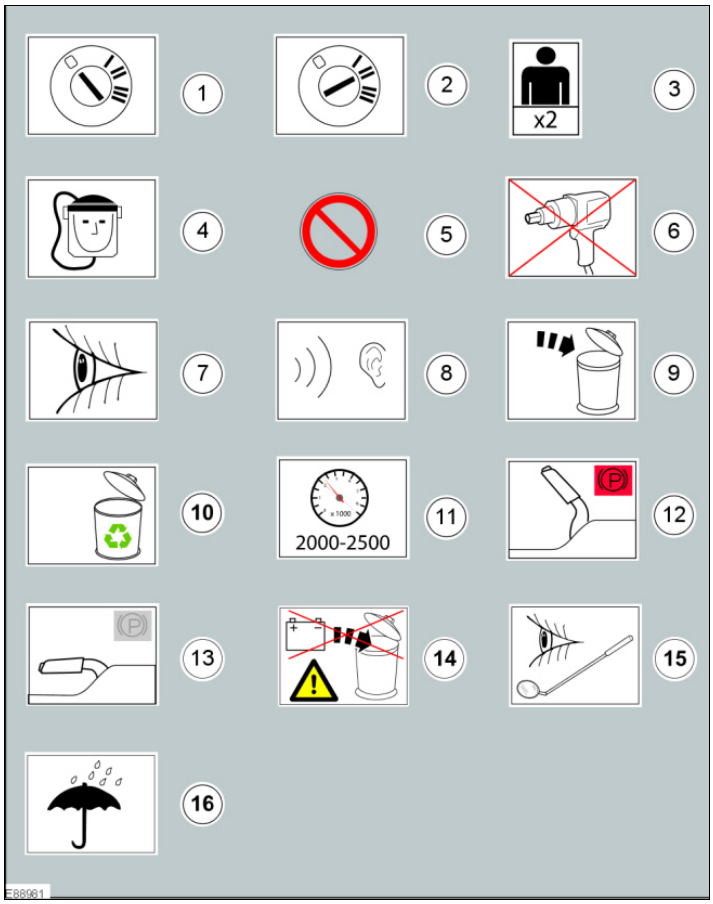
The material symbols are used to indicate where to use the specified material.



Item	Description
1	Remove or install a pop-rivet
2	Apply tape to specified area
3	Remove or install a cable tie

Miscellaneous Symbols

These symbols provide miscellaneous information required for the procedure.

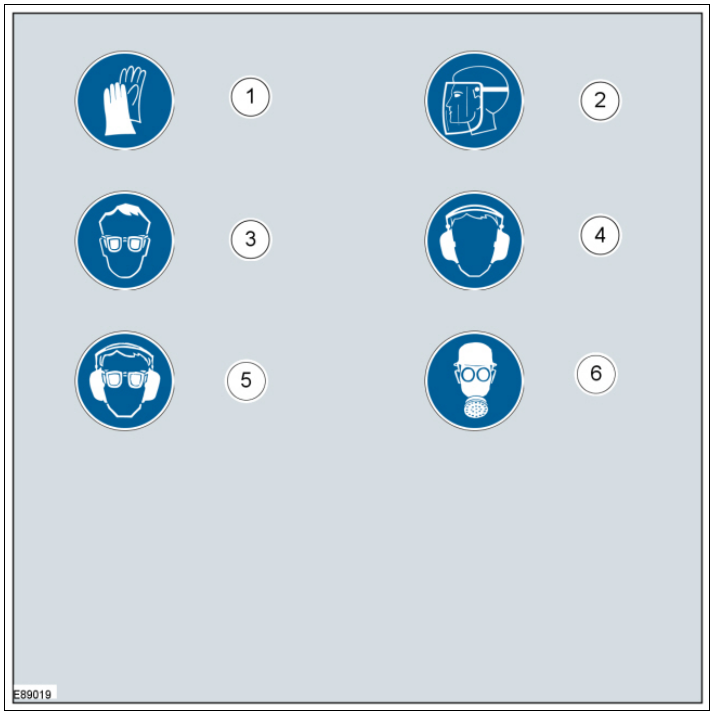


Item	Description

1	Turn Ignition off
2	Turn Ignition on (run position)
3	This procedure requires the specified number of technicians
4	Respirator or self-contained breathing apparatus
5	Prohibited action used in combination with another symbol
6	Do not use power tools
7	Visual inspection
8	Noise check
9	Dispose the specified component
10	Dispose the specified component
11	Set engine speed to the specified RPM
12	Firmly apply the parking brake
13	Fully release the parking brake
14	Special disposal required
15	Visually inspect using a mirror
16	Area or component must be dry

Mandatory Protective Equipment

The protective equipment symbols indicate required safety equipment to avoid or reduce health and safety risks.

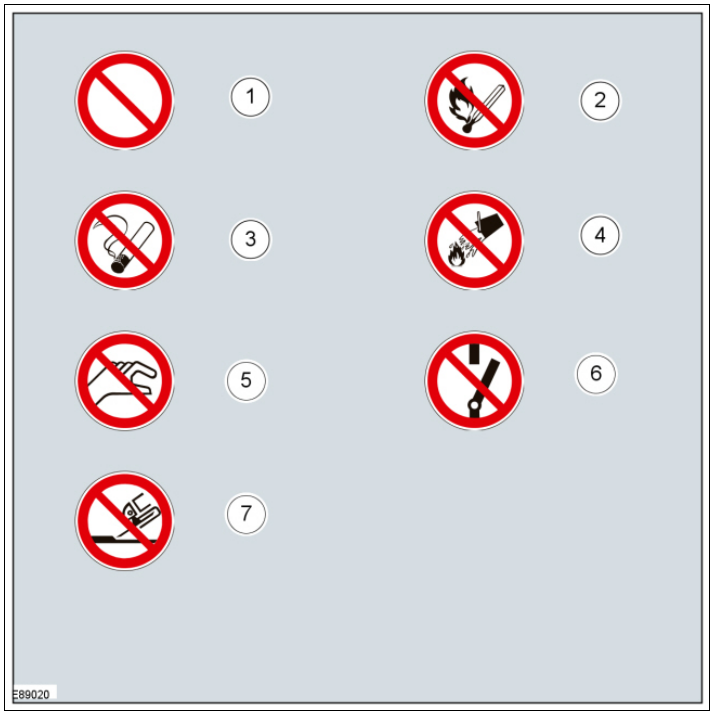


Item	Description
1	Wear protective gloves
2	Wear face shield
3	Wear safety goggles

4	Wear ear protection
5	Wear safety goggles and ear protection
6	Wear a respirator

Prohibition Symbols - Health, Safety, and Component Care

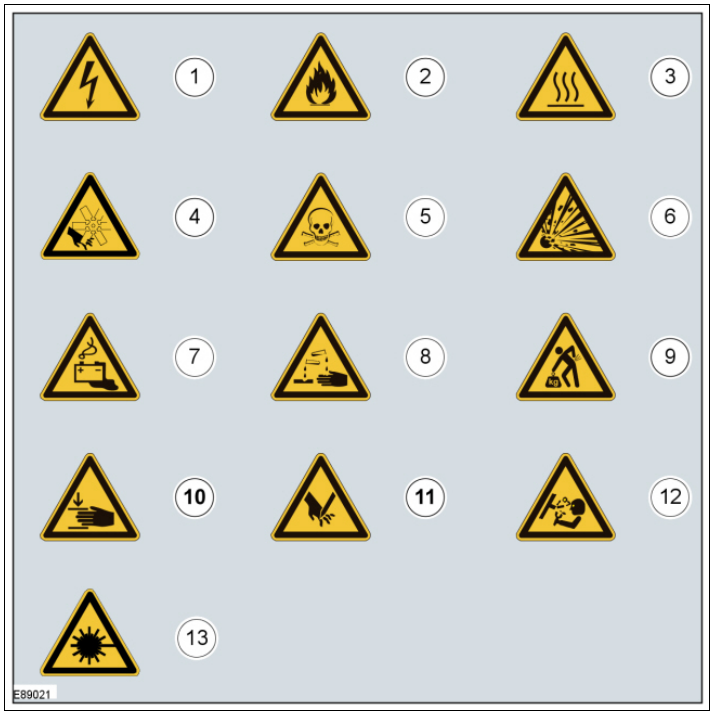
The prohibition symbols are used to prohibit specified actions to avoid safety hazards or component damage.



Item	Description
1	Prohibited action used in combination with another symbol
2	No open flames
3	No smoking
4	No water
5	Do not touch
6	Do not switch
7	No grinding

Warning Symbols - Health and Safety Warnings or Component Care

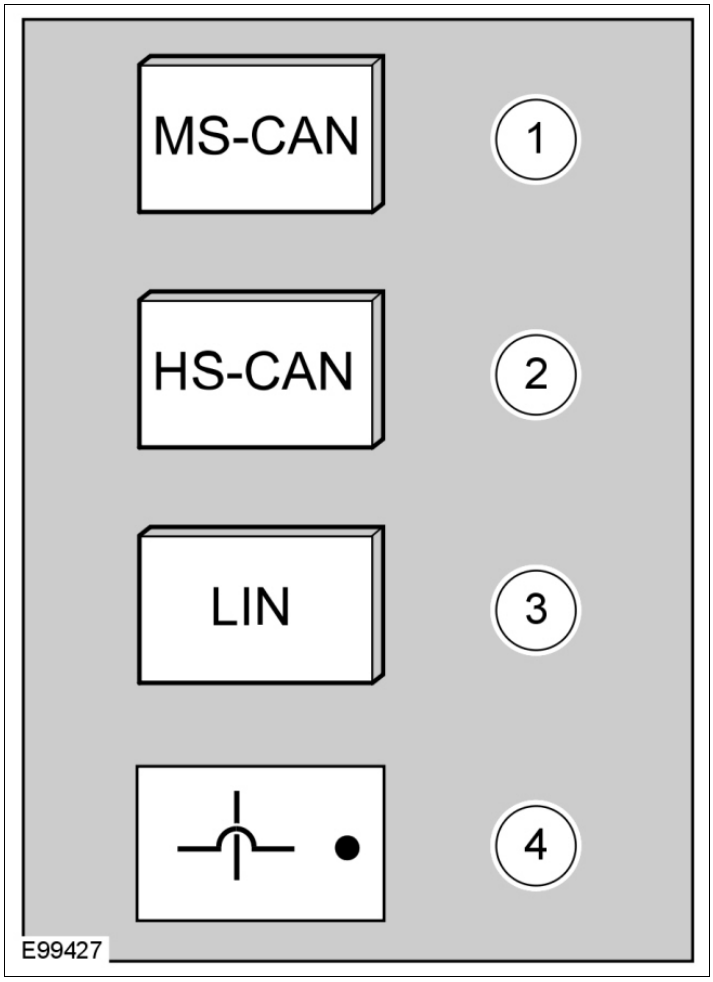
The warning symbols are used to avoid hazardous conditions and to avoid component damage.



Item	Description
1	Hazardous voltage or Electrical shock or Electrocution danger
2	Fire hazard or highly flammable
3	Burn hazard or hot surface
4	Device has automatic start-up
5	Toxic
6	Explosive material
7	Battery hazard
8	Corrosive material
9	Lifting hazard
10	Hand crush or force from above hazard
11	Cutting of fingers or hand hazard
12	Pressure hazard
13	Invisible laser radiation. Do not view directly with optical instruments (magnifiers). Class 1M laser product.

System Diagram Symbols

The symbols provide Information about networks or wiring.



Item	Description
1	Medium Speed Controller Area Network
2	High Speed Controller Area Network
3	Local Interconnect Network
4	Wires cross but are not connected

Using This Manual

Introduction

This manual describes and directs repair procedures for this vehicle model year. It includes diagnostics for all vehicle systems except driveability and emission control. Refer to the separate Powertrain Control/Emissions Diagnosis (PC/ED) manual for driveability and emission control diagnostics.

Information is organized into groups, with sections that have subsections dividing them.

Warnings, Notices, and Notes in This Manual

Warnings provide information to avoid personal injury and to make sure service actions on critical safety systems are performed correctly.

Notices provide information to avoid damage to the vehicle or a component.

Notes provide information critical for a complete and effective repair.

Warnings that apply to an entire system or workshop manual section are located in section 100-00 Description and Operation Safety Warnings .

Warnings, Notices, or Notes that apply to an entire procedure will be placed at the beginning of the procedure.

Warnings, Notices, or Notes that apply to a single step are placed at the beginning of the step. Those that apply to a group of steps will be placed at the first step requiring it.

Vehicle and Engine Orientation Identifiers

LH and RH vehicle designations are oriented from the driver's seat position looking forward. LH and RH engine designations are oriented from the flywheel position looking towards the crankshaft pulley.

How to Use Diagnostic Information

DTC and Symptom Charts

Module DTC Charts are used to begin and direct the diagnosis of a DTC. Symptom Charts contain concern symptoms and direct solutions either in the chart or in a linked Diagnostic Routine. Both DTC and Symptom Charts may provide the solution within the chart, or provide a link to the appropriate Diagnostic Routine.

In some sections, the Symptom Chart is preceded by a Preliminary Inspection which must be followed prior to using the Symptom Chart

Using Module DTC Charts

This Workshop Manual contains diagnostics for DTCs set by vehicle modules. Driveability and emission DTCs are covered in the separate Powertrain Control/Emissions Diagnosis (PC/ED) manual. If a PCM-set DTC is not listed in the Workshop Manual, it is serviced in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

DTC diagnostics are found in both on-line and printed publications and are used as follows:

- On-line publications: Using the left side menu, click on the Master DTC Chart link to view the vehicle module DTC charts. Each module has a chart with links or in-chart solutions for all DTCs diagnosed in the Workshop Manual.
- Printed publications: Use the DTC index in the rear of the book.

Diagnostic Methods

Diagnostic Methods provides information to support diagnosing Ford vehicles. Diagnostic strategies, diagnostic tool support information, and advanced circuit testing methods are included. REFER to Diagnostic Methods .

Diagnostic Routines

Diagnostic Routines provide information to determine the root cause of concerns addressed in either a DTC Chart or Symptom Chart. Each Diagnostic Routine contains:

- Diagnostic Overview
  - ♦ Wiring Diagram References (as applicable)
  - ♦ Normal Operation and Fault Conditions
  - ♦ Visual Inspection and Diagnostic Pre-checks
- Tool Table (as applicable)
- Material Table (as applicable)
- Pinpoint Test Steps

Component Tests

Component Tests are used to separately analyze a single common component in a system. The test will determine if the part is functioning correctly.

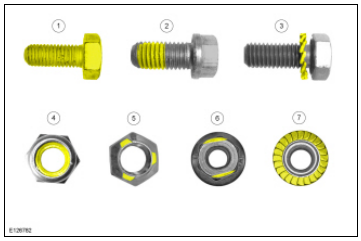
Mechanical Procedures Such As Removal and Installation

Reuse Of Fasteners, Seals, Or Gaskets

The following is a list of assumptions made in the reuse of fasteners, seals, or gaskets.

- Seals and gaskets must be replaced unless otherwise specified.
- Standard fasteners are reused unless otherwise specified.
- Fasteners with self-locking features must be replaced unless otherwise noted. Reminder text may or may not be included with the procedure step. Examples of fastener coatings or fasteners with mechanical locking (with the locking features highlighted yellow) are shown in illustration 1.
- Torque to yield bolts (bolts with more than one stage of tightening torque and a final torque angle specification) must be discarded and new torque to yield bolts installed unless otherwise stated within the procedure.

Illustration 1 - self-locking coatings or locking feature are highlighted yellow



Graphics

Illustrations in this manual may be used to replace written step instructions. Color-coding (see color scheme in this document) is used to communicate the required step action or actions. Service action icons (see Symbols Glossary) are used to add additional information regarding the required action.

- The color scheme in a step graphic (an illustration used in removal or installation steps) indicates servicing information as follows:
  - Fasteners (including panel retainers) or electrical connectors - Magenta (Purple)
  - Target component that is to be removed - Blue
  - Components that must be removed prior to the target component shown in blue - Brown or Green
  - Components placed aside for access, but not removed; highlighted areas such as inspection areas, adjustments or measurements - Yellow
  - Essential Special Service Tools (ESSTs) and other tools - Pale Blue
  - Chemical or Sealer apply areas - Alternating blue and white dashes (see illustration 4)
  - Sectioned or cut-away areas - Red
  - Remaining components - Grey

Callouts in graphics indicate removal (or tightening) order, or identify individual instructions in substeps of the same number (such as different torque values).

Arrows containing x numbers (Illustration 2) indicate the number of identical fasteners or connectors to be removed or installed in the graphic.

In Illustration 2, two identical fasteners are indicated by the x2 arrow, with another arrow illustrating a third fastener of a different type. Because the different fasteners require different torques, callouts are used to identify those two torque values in the associated step text. The hose clamp is another fastener to be removed. The yellow coloring of the hose indicates it is to be moved aside (not removed).

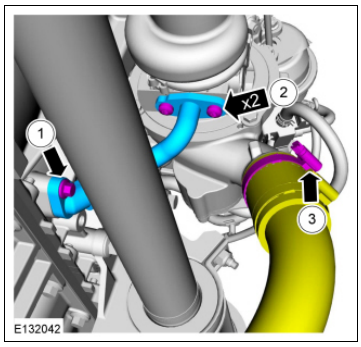
The following written steps would be necessary if the illustration did not have color coding:

1. Remove the engine oil pipe fastener at the engine connection.

2. Remove the two engine oil pipe fasteners from the turbocharger and remove the pipe.

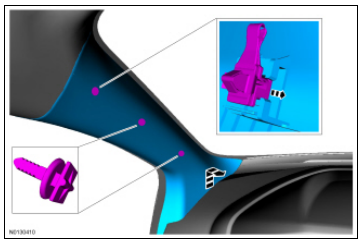
3. Remove the air inlet hose from the turbocharger and position aside.

Illustration 2



Hidden fasteners, such as panel retainers, are identified in the illustration by a magenta disc. An inset detail view illustrating the fastener type may be included (Illustration 3).

Illustration 3 - Note motion arrow at panel bottom; it indicates to lift panel up, then move inward to remove



Symbols

Symbols may be used inside graphics or in the text area to communicate service actions. The following examples demonstrate the use of some of these symbols. REFER to Symbols Glossary for a complete symbols list with explanations.

In the Illustration 4 example, service action symbols are shown as used to direct the application of sealer, lubricant, weight, tape or cleaning detergent to a component. In this example a bead diameter of "xx" millimeters is prescribed. The blue and white dashes indicate where the material is applied.

Illustration 4

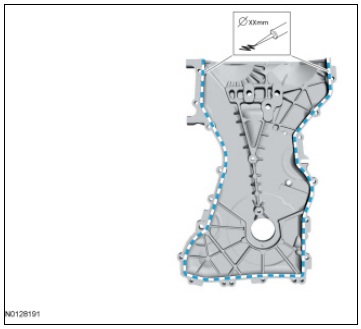


Illustration 5 is an example of location symbols used to show the location of a component tem within the vehicle.

Illustration 5

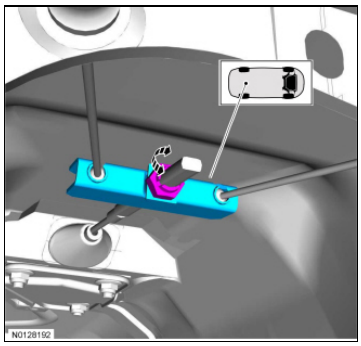
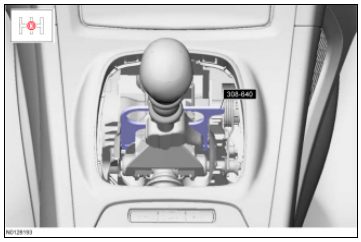


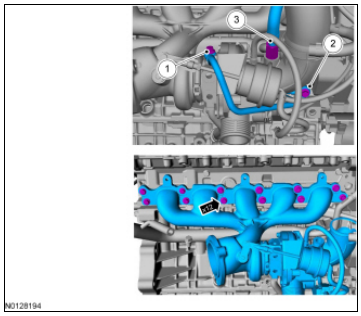
Illustration 6 shows how gearshift lever or selector lever position symbols may be used to indicate the gearshift lever or selector lever position required. The required Essential Special Service Tool to align the shift mechanism is shown in pale blue and identified by ESST number.

Illustration 6



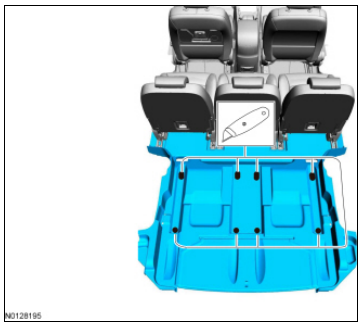
Callouts or arrows may be used to identify components for supporting special information, such as a required sequence or to indicate a number of identical components. Illustration 7 shows a removal order in the top graphic and the bottom graphic indicates 12 identical bolts.

Illustration 7



Standard tool symbols direct the use of standard tools to perform a service action, such as the cutting of carpet shown in Illustration 8. Tool symbols may include dimensional values (for example, a drill with a specified diameter).

Illustration 8



Safety Warnings

Heating, Ventilation and Air Conditioning Safety Warnings

⚠ WARNING: Take the following precautions when repairing an air conditioning system containing R-134a:

- Always wear safety goggles.
- Avoid contact with liquid refrigerant R-134a. R-134a vaporizes at approximately -25°C (-13°F) under atmospheric pressure and will freeze skin tissue.
- Never allow refrigerant R-134a gas to escape in quantity in an occupied space. It will displace the oxygen needed to support life.
- Never use a torch in an atmosphere containing R-134a gas. R-134a is non-toxic at all normal conditions, but it decomposes when exposed to high temperatures such as a torch flame. During decomposition it releases irritating and toxic gasses (as described in the Material Safety Data Sheet from the manufacturer). Decomposition products are hydrofluoric acid, carbon dioxide and water.

Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before disconnecting any heater water hoses, shut OFF the engine and wait until engine is fully cool. Failure to comply with this warning may result in serious injury or burns from hot liquid escaping from the engine cooling system.

⚠ WARNING: Use extreme care and observe all safety and service precautions related to the use of refrigerants as outlined on refrigerant tank and on recovery and charging equipment. Failure to follow these instructions may result in serious personal injury.

Battery System Service Warnings

⚠ WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Before carrying out maintenance on the starting system, disconnect the battery ground cable from the frame to completely isolate the starter from the dual frame-mounted batteries. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Batteries contain sulfuric acid and produce explosive gases. Work in a well-ventilated area. Do not allow the battery to come in contact with flames, sparks or burning substances. Avoid contact with skin, eyes or clothing. Shield eyes when working near the battery to protect against possible splashing of acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes, then get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always lift a plastic-cased battery with a battery carrier or with hands on opposite corners. Excessive pressure on the battery end walls may cause acid to flow through the vent caps, resulting in personal injury and/or damage to the vehicle or battery.

⚠ WARNING: Do not get underneath the frame-mounted battery when disconnecting or connecting the auxiliary battery safety straps. The battery is heavy and could fall. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Battery posts, terminals and related accessories contain lead and lead components. Wash hands after handling. Failure to follow these instructions may result in serious personal injury.

Brake System Service Warnings

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Do not breathe dust or use compressed air to blow dust from storage containers or friction components. Remove dust using government-approved techniques. Friction component dust may be a cancer and lung disease hazard. Exposure to potentially hazardous components may occur if dusts are created during repair of friction components, such as brake pads and clutch discs. Exposure may also cause irritation to skin, eyes and respiratory tract, and may cause allergic reactions and/or may lead to other chronic health effects. If irritation persists, seek medical attention or advice. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Remove air pressure from the air brake system prior to servicing the system. Attempting to service the air brake system while it is under pneumatic pressure may result in serious injury from unexpected hose whip, component movement or component propulsion.

⚠ WARNING: Always install new brake shoes or pads at both ends of an axle to reduce the possibility of brakes pulling vehicle to one side. Failure to follow this instruction may result in uneven braking and serious personal injury.

Body and Frame Service Warnings

⚠ WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: On vehicles equipped with Safety Canopy® options, prior to carrying out any sectioning repairs near the roof line or sail panel areas of the vehicle, remove the Safety Canopy® module and related components. Failure to comply may result in accidental deployment or damage to the Safety Canopy®. Refer to Section 501-20B . Failure to follow these instructions may result in serious injury to technician or vehicle occupant(s).

⚠ WARNING: Do not cut or grind body side components within 50 mm (1.96 in) of restraint anchoring points. Welding within 50 mm (1.96 in) of restraint anchoring points may result in incorrect operation of restraint devices. For additional restraints anchoring location information, refer to Section 501-20A and Section 501-20B . Failure to follow these instructions may result in serious injury to vehicle occupant(s).

⚠ WARNING: Do not carry out body side sectioning repairs in areas of laser welds. Factory laser

welds cannot be duplicated with conventional welding equipment and structural integrity may be compromised. Failure to follow this instruction may result in serious injury to vehicle occupant(s).

⚠ WARNING: Do not carry out body side sectioning repairs in areas of door hinge or striker anchoring points. Welding within 50 mm (1.96 in) of door hinge or striker locations may compromise structural integrity during a collision. Failure to follow these instructions may result in serious injury to vehicle occupant(s).

⚠ WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to the original production configuration. A new RCM and sensors must be installed whether or not the air bags have deployed. Failure to follow these instructions may result in serious personal injury or death in a crash.

⚠ WARNING: Do not permanently remove the trailer hitch. The trailer hitch is an integral part of the vehicle frame. Always reinstall the hitch before delivery of the vehicle to the customer. Failure to follow this instruction may compromise vehicle crash integrity and increase the risk of personal injury in a rear end collision.

⚠ WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

Engine Cooling System Service Warnings

⚠ WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

Fuel System Service Warnings

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be

ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Contact with exposed fuel injector wiring, if energized, may result in electric shock. Use care when working on or around energized fuel injector wiring. Fuel injector wiring supplies high voltage to operate the fuel injectors. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Remove the fuel filler cap slowly. The fuel system may be under pressure. If the fuel filler cap is venting vapor or if you hear a hissing sound, wait until it stops before completely removing the fuel filler cap. Otherwise, fuel may spray out. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not work on the fuel system until the pressure has been released and the engine has cooled. Fuel in the high-pressure fuel system is hot and under very high pressure. High-pressure fuel may cause cuts and contact with hot fuel may cause burns. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Avoid contact with fuel during a visual inspection for fuel leaks with the engine running. Do not work on the fuel system until the pressure has been released and the engine has cooled. Fuel in the high-pressure fuel system is hot and under very high pressure. High-pressure fuel may cause cuts and contact with hot fuel may cause burns. Failure to follow these instructions may result in serious personal injury.

General Service Warnings

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

⚠ WARNING: Always wear eye protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.

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

⚠ WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Use tools, not fingers, to hold flagnuts. Flagnuts may slip or spin unexpectedly when removing fasteners. Failure to follow this instruction may result in injured fingers.

⚠ WARNING: Keep solvents away from ignition sources. Solvents may be flammable and can ignite or explode if not handled correctly. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Use only a type-D fire extinguisher to extinguish magnesium fires. Never attempt to use a type-A, -B, -C extinguisher, or water, as these items are ineffective and may accelerate a magnesium fire. Failure to follow these instructions may result in serious personal injury.

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

⚠ WARNING: Identify the correct jacking points by locating the triangle stamped into the uni-body sheet metal or vehicle frame. Raising a vehicle in any other location may result in vehicle shifting or falling. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Install only FCC-approved radio transmitting equipment. See your authorized radio dealer for the correct transmitter. Use of incorrect transmitting equipment may cause the vehicle to malfunction or stall, resulting in loss of power brake and power steering assist. Failure to follow these instructions may result in serious personal injury to vehicle occupant(s).

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

⚠ WARNING: Do not operate the engine with the hood open until the fan blade has been examined for possible cracks and separation. A damaged fan can separate during operation. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Do not stand in line with or near the engine cooling fan blade when revving the engine. A damaged fan can separate during operation. Failure to follow this instruction may result in serious personal injury.

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

⚠ WARNING: Turn OFF the ignition switch for a minimum of 5 minutes before removing high-voltage cables. High-voltage cables and wiring are orange in color. The nominal high-voltage traction battery voltage (HVTB) is 330 V DC. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Vehicles with engine auto start-stop technology may start automatically with the

ignition on. Make sure the ignition is off when servicing or working in close proximity to rotating engine parts. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Wear high-voltage insulated safety gloves and a face shield when working with high-voltage batteries or cables. The high-voltage insulated safety gloves should be of the appropriate safety and protection rating. Inspect the gloves before use and always wear them with the leather outer glove. Any hole in the rubber insulating glove is a potential entry point for high-voltage. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Depower the high-voltage traction battery (HVTB) before carrying out any removal or installation procedures affecting the high-voltage battery system. Failure to follow this instruction may result in serious personal injury or death.

⚠ WARNING: Secure the torque converter in the transmission during removal or installation. The torque converter is heavy and may result in injury if it falls out of the transmission. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: When using compressed air, never let air pressure exceed 172 kPa (25 psi) and always wear safety glasses. Compressed air may cause foreign material or parts to become airborne. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Wear protective gloves when handling components or parts that have pointed or sharp edges. Failure to follow this instruction may result in serious personal injury.

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

⚠ WARNING: Disconnect the window regulator motor connector before working inside the vehicle doors. Service actions inside the door (such as door latch, handle or lock cylinder service) or operating the remote keyless entry (RKE) fob may activate the windows on vehicles equipped with global open/close. Serious injury to hands or arms may occur if a window motor is activated during service. Failure to follow these instructions may result in serious personal injury.

Safety Restraints Service Warnings

⚠ WARNING: Anytime the Safety Canopy® or side air curtain module has deployed, a new headliner and new A-, B- and C-pillar upper trim panels and attaching hardware must be installed. Remove any other damaged components and hardware and install new components and hardware as needed. Failure to follow these instructions may result in the Safety Canopy® or side air curtain module deploying incorrectly and increases the risk of serious personal injury or death in a crash.

⚠ WARNING: Deploy all supplemental restraint system (SRS) devices (air bags, pretensioners, load limiters, etc.) outdoo with all personnel at least 9 meters (30 feet) away to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: The fire suppression system backup power supply must be depleted before lifting the vehicle or when repairing or replacing any of the following:

- Fire suppression system components
- Components located near the fire suppression manual switch

- Fuel tank and components located near the fuel tank
- Rear axle and components located near the rear axle

To deplete the backup power supply, disconnect the battery and wait at least 1 minute. Be sure to disconnect all auxiliary batteries and power supplies (if equipped). Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to the original production configuration. A new RCM and sensors must be installed whether or not the air bags have deployed. Failure to follow these instructions may result in serious personal injury or death in a crash.

⚠ WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

⚠ WARNING: Never probe the electrical connectors on airbag, Safety Canopy® or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

⚠ WARNING: Never put any type of fastener or tie strap around any part of a Safety Canopy® module, side air curtain module or interior trim panel. This will prevent the Safety Canopy® or side air curtain module from deploying correctly. Failure to follow this instruction may increase the risk of serious personal injury or death in a crash.

⚠ WARNING: Always tighten the fasteners of the restraints control module (RCM) and impact sensor (if equipped) to the specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.

⚠ WARNING: Always carry or place a live Safety Canopy®, or side air curtain module, with the module and tear seam pointed away from your body. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.

⚠ WARNING: Always deplete the backup power supply before repairing or installing any new front or side air bag supplemental restraint system (SRS) component and before servicing, removing, installing, adjusting or striking components near the front or side impact sensors or the restraints control module (RCM). Nearby components include doors, instrument panel, console, door latches, strikers, seats and hood latches. Refer to the Description and Operation portion of Section 501-20B for location of the RCM and impact sensor(s). To deplete the backup power supply energy, disconnect the battery ground cable and wait at least 1 minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped). Failure to follow these instructions may result in serious personal injury or death in the event of an accidental deployment.

⚠ WARNING: Always install new brake shoes or pads at both ends of an axle to reduce the possibility of brakes pulling vehicle to one side. Failure to follow this instruction may result in uneven braking and serious personal injury.

⚠ WARNING: Do not paint any airbag trim covers or deployment doors. Paint may cause the airbag to deploy incorrectly. Failure to follow this instruction may increase the risk of serious personal injury or death in a crash.

Tire and Wheel Service Warnings

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

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

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

⚠ WARNING: Never inflate a tire that has been run flat without first removing the tire from the wheel to inspect for damage. A damaged tire can fail during inflation. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Do not hit the wheel or tire with a metallic hammer. This action may damage the wheel or tire, resulting in tire or wheel failure. Failure to follow this instruction may result in serious personal injury to the technician or vehicle occupant(s).

⚠ WARNING: When a wheel is installed, always remove any corrosion, dirt or foreign material present on the mounting surface of the wheel and the mounting surface of the wheel hub, brake drum or brake disc. Make sure that any fasteners that attach the rotor to the hub are secured so they do not interfere with the mounting surfaces of the wheel. Failure to follow these instructions when installing wheels may result in the wheel nuts loosening and the wheel coming off while the vehicle is in motion, which could result in loss of control, leading to serious injury or death to vehicle occupant(s).

⚠ WARNING: Inflating tires to pressures that exceed maximum tire inflation rating on tire sidewall may result in tire failure and serious personal injury to the technician or vehicle occupant(s).

⚠ WARNING: Only use replacement tires that are the same size, load index, speed rating and type (such as P-metric versus LT-metric or all-season versus all-terrain) as those originally provided by Ford. The recommended tire and wheel size may be found on either the Safety Compliance Certification Label or the Tire Label, which is located on the B-pillar or edge of the driver's door. If the information is not found on these labels, consult a Ford dealer. Use of any tire or wheel not recommended by Ford can affect the safety and performance of the vehicle, which could result in an increased risk of loss of vehicle control, vehicle rollover, personal injury and death. Additionally, the use of non-recommended tires and wheels could cause steering, suspension, axle or transfer case/power transfer unit failure.

⚠ WARNING: Do not mount tube-type tires on tubeless wheels or tubeless tires on tube-type wheels. Incorrect combinations could result in tire separation from wheel and may result in serious injury to vehicle occupant(s).

⚠ WARNING: Cracked wheels can be dangerous. Deflate tires on cracked wheels prior to removal of wheels from the vehicle. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Retighten wheel nuts within 160 km (100 mi) after a wheel is reinstalled. Wheels can loosen after initial tightening. Failure to follow this instruction may result in serious injury to vehicle occupant(s).

⚠ WARNING: Retighten wheel nuts within 160 km (100 mi) after a wheel is reinstalled. For dual rear

wheel (DRW) only, a second retightening is required within 800 km (500 mi). Wheels can loosen after initial tightening. Failure to follow this instruction may result in serious injury to vehicle occupant(s).

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

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

⚠ WARNING: Never use wheels different than the original equipment. Additionally, never use wheel nuts different than the original equipment. Failure to follow these instructions may result in damage to the wheel or mounting system. This damage could cause the wheel to come off while the vehicle is being driven, which could result in serious personal injury or death to vehicle occupant(s).

⚠ WARNING: Do not weld or peen wheels. A wheel needing such repairs must have a new wheel installed. Failure to follow these instructions may result in wheel failure and serious personal injury.

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

Diagnostic Methods

⚠ WARNING: Before beginning any service procedure in this section, refer to Safety Warnings in Section 100-00 . Failure to follow this instruction may result in serious personal injury.

Effective Diagnostic Techniques

The following diagnostic process is critical for consistently successful diagnoses. Random methods work inconsistently and often lead to multiple repairs and the accompanying frustration.

- Understand and verify the **symptom** .
  - ♦ Understanding a symptom requires understanding normal operation.
  - ♦ Duplicate the concern. Re-create the same conditions that demonstrated the original concern (road testing may be necessary).
- Determine the responsible **system** .
  - ♦ Gather data, such as a visual inspection and an OASIS report.
  - ♦ Perform system tests, such as pressure tests or DTC retrieval.
- Identify the responsible **component** .
  - ♦ Test the suspect component and related parts.
- Determine the root **cause**
  - ♦ Examine related components (wiring faults, misalignments, incorrect adjustments) that may be the actual cause or may have caused the component failure.
  - ♦ Repair all related faults to avoid repeat failures.
  - ♦ Verify the repair has corrected the concern (and not created any new ones) using the identical conditions that demonstrated the original concern.

Diagnostic Scan Tool Testing

Network Test

Performing a network test is always recommended for analysis of electronic system concerns. Always solve network issues before addressing individual symptoms or DTCs.

Recommended Practice: REFER to Symptom Chart in Section 418-00 to diagnose a network outage or no response from an individual module (or modules).

DTC Retrieval

Generally, a good diagnostic strategy is to resolve all on-demand codes related to the system concern. Retrieving all continuous DTCs can also be beneficial to understand historic issues or issues outside of the suspect system that may be affecting your concern. On-demand testing should be done to ensure the fault represented by a continuous DTC is still present.

Continuous Memory Diagnostic Trouble Codes (CMDTCs)

Modules that produce diagnostic trouble codes have a program that evaluates system conditions, normally while the vehicle or system is in use. Module inputs can be checked for values indicating an electrical fault with the monitoring circuit or component. Module outputs can be monitored for correct function. Codes are stored when predefined limits are exceeded and retained even if the ignition is turned off (generally DTC-retention is for 40+ ignition cycles). Not all continuous codes have a matching on-demand code - and

vice versa; this varies with different modules. For example, some network communication codes are continuous only. It is important to note that the presence of a continuous DTC does not guarantee that the fault currently exists.

Ford On-Demand DTCs

Ford Motor Company modules have a unique feature that performs a special diagnostic program at the request of the technician (using a scan tool). This "On-demand" diagnostic program can exercise system outputs not normally running when the car is parked and record observed faults. These diagnostic codes are communicated to the scan tool; they are not recorded in module memory. An on-demand test is an effective tool for evaluating real input and output conditions during module activity - activity that might not normally be occurring during service bay conditions. For example, an air suspension module on-demand test can run the compressor, vent the system, and observe the report from the height sensor even when the car is already at correct trim height and not requiring height adjustment.

Network Communication DTCs

Network DTCs (U-prefix codes) are often a result of intermittent concerns such as damaged wiring or low battery voltage occurrences. Additionally, vehicle repair procedures (such as module reprogramming or diagnostics with modules disconnected) often set network DTCs. Replacing a module to resolve a network DTC is unlikely to resolve the concern. To prevent recurrence of intermittent network concerns, inspect all network wiring, especially in-line and module connectors; test the vehicle battery.

Recommended practice: Clear the DTC and retest. If the DTC repeats, test the vehicle communication network.

DTC Nomenclature (SAE J2012 and ISO 14229)

Many modules use 5-character DTCs followed by a 2-character failure-type code. The failure-type (sometimes called "fault byte") digits provide information about specific fault conditions such as opens or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

Integrated Diagnostic System (IDS) Scan Tool Usage

If The IDS Scan Tool Does Not Communicate With The Vehicle

The IDS scan tool first attempts to communicate with the PCM. After establishing communication with the PCM, the scan tool then attempts to communicate with all other modules on the vehicle.

1. Verify the scan tool operation with a known good vehicle.

2. Verify the ignition is ON.

3. If an IDS session cannot be established with the vehicle (IDS may state "No communication can be established with the PCM"):
    - Choose "NO" when the scan tool prompts to retry communication.
    - Enter either a PCM part number, tear tag, or calibration number to identify the vehicle and start a session.
        - The PCM part number can be determined from OASIS -- choose "HVBoM" from the OASIS page and search for the PCM part number
        - The PCM part number and 4-character tear tag are printed on the PCM label.
    - Establish a session based on the PCM information (above).

4. Using the tool box menu, run the network test.
    - Determine if all modules on the network are unresponsive or if only the PCM does not communicate.
    - **Recommended practice:** REFER to Symptom Chart in Section 418-00 to diagnose the network outage or no response from the PCM.

Measuring Automotive Circuits

Wiring Pin (Terminal) Fit And The Use Of Rotunda Flex Probes

- To avoid wiring pin (terminal) damage, Rotunda Flex Probes NUD105-R025D must be used to connect test equipment or jumper wires to pins (terminals).
- Male to female pin (terminal) fit is critical for connection reliability.
    - ♦ Pin (terminal) fit may be checked by using the mating pin (terminal) to test for normal separation force (a damaged pin or terminal will have very low separation force from the mating pin or terminal)
    - ♦ Correctly checking the separation force of small pins (terminals) may require removal of the connector terminal guide/retainer if it adds drag to the pin (terminal) insertion or removal
- Replace damaged connectors or pins (terminals).
    - ♦ Use the Wiring Diagram connector view (cell 150) to identify the correct replacement connector with pigtail.
    - ♦ Use the Wire Harness Terminal Repair Guide to identify and order the correct replacement pin and pigtail. Available through Ford Dealers, REFER to FMC dealer website, or REFER to www.fcs.dealersonnection.com/wire .

Checking Power-Providing Circuits

- Measuring a power wire with the intended load disconnected using a DMM will only find open circuits (open fuse or wire).
- **Recommended practice:** Circuits carrying approximately 200-1000 mA* may be loaded with the specified test light SGT27000. Measure circuit voltage with a DMM while the test light is connected and illuminated. A reduction in the voltage present during test-light-loading indicates excessive circuit resistance.
- **Recommended practice:** Circuits carrying more than one ampere* should be loaded with a device requiring similar current (e.g., a headlamp bulb may be effective). A reduction in the voltage present during loading indicates excessive resistance.
- *Circuit current is matched to wire gauge/size; Examples:
    - ♦ Conductor sizes of 24 gauge (.5 mm) or smaller are generally used to carry approximately 1 ampere (1000 mA) or less. Use of the test light to load these circuits is appropriate.
    - ♦ Conductor sizes of 20 gauge (.8 mm) or larger are generally used to carry approximately 5 amperes (5000 mA) or more. Match the substitute load (measure substitute load current first as necessary) to this current level.

Checking Ground-Providing Circuits

- The best method of checking ground circuits is to measure the circuit voltage drop during component operation (or attempted operation).
- An ohmmeter may be accurately used if the battery has been disconnected.
- **Recommended practice:** Expect less than 2 ohms for most small diameter (18 gauge and smaller) wires.
- Ohmmeter low-resistance resolution (approximately 0.1 ohm) limits its use to circuits carrying less than approximately 5 amperes (this is due to the fact that very small resistances, undetectable by a DMM , cause significant voltage loss in higher current circuits).
- DMM ohmmeter readings are easily corrupted by the normal voltage present (battery connected) in

many ground circuits.

- **Recommended practice:** Reverse the leads and check for changes in the measurement. Reversing the DMM lead connections should never change the resistance measurement (unless the circuit contains a semi-conductor). Measurement (non-semi-conductor) differences when leads are interchanged at the test points indicate invalid test results. The presence of voltage corrupts the reading, and causes the meter reading to change when the leads are reversed.

Checking Circuit Continuity

- **Recommended practice:** Expect less than 2 ohms of resistance for most wires.
- Ohmmeter low-resistance resolution (approximately 0.1 ohm) limits its use to circuits carrying less than approximately 5 amperes. This is due to the fact that very small resistances, below the resolution of a DMM , cause significant voltage loss in higher current circuits.
- The DMM applies a small amount of voltage to the circuit or component to calculate resistance. As a result, DMM ohmmeters are very sensitive to any level of voltage present. Voltage present in the circuit will corrupt the DMM reading.

Checking For Unintended Continuity (Shorts) To Other Circuits

- A DMM ohmmeter may be used to detect undesired circuit connections to:
  - Ground
  - Other unpowered circuits
- **Recommended practice:** Expect greater than 10,000 ohms of resistance between two separate circuits; the best result is an open circuit DMM indication (no detected resistance).
- Shorts to voltage are checked with a DMM voltmeter
- **Recommended practice:** Turn ignition on (with battery connected) and measure the circuit for any voltage present (none should be present)

Checking Circuits By Back-Probing A Connector

- Back-probing should be performed only when directed by a service manual diagnostic routine. Never back-probe safety restraint deployable devices such as airbags or belt pretensioners. Back-probing is a testing method of last resort and should only be employed where a diagnostic step requires a circuit to be tested under actual operating conditions. Back-probing is a risky testing method due to the uncertainty of the probe connection and the possibility of damaging terminals.
- Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors and subsequent electrical faults.
  - Use Rotunda Back-Probe Pins POMA6411 to assist in making a good test connection and to prevent connector or terminal damage during back-probing.
- Do not test for the presence of voltage at a single point where zero volts is a possible result (you cannot tell the difference between a bad probe contact and a zero volt result).
- Do not test for continuity/opens (using a DMM ohmmeter) between two points (you cannot tell the difference between bad probe contacts and an open circuit).
- Back-probing may be used where the circuit must be analyzed with the voltage-drop method (if the circuit carries greater than 5 amperes and no other means of testing will definitively eliminate circuit resistance as a possible fault). A zero-volt result indicates incorrect test conditions (no current flow) or bad back-probe connections.
- Occasionally, module failure mode behavior will change the operation of a circuit when it is opened for testing. Back-probing is an acceptable remedy for these testing dilemmas.

Circuit Analysis Using Jumper Wires (Creating Substitute Circuits)

- Jumper wires may be employed for circuit analysis.
- **Cautions:**
    - ♦ Always use fused jumper wires - the recommended universal-testing jumper wire fuse is 2-5 amperes; larger fuse ratings should be used only in special circumstances.
    - ♦ Use flex probes or equivalent to prevent connector terminal damage (flex probes are not intended to carry higher currents necessary to operate motors such as a cooling fan or blower motor).
    - ♦ Follow workshop manual testing directions when using jumper wireso avoid component or harness damage due to incorrect jumper connections.
    - ♦ Never repair a circuit by adding a new wire in parallel to the old one (overlaying the circuit) without fully understanding what caused the circuit to fail. Always find, examine, and repair the fault to correct the root cause and to repair any adjacent wiring that has been damaged.

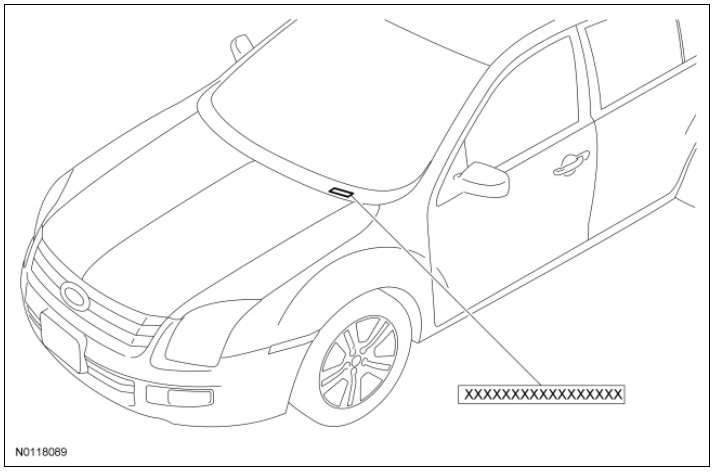
Checking Modules

- Generally, module failure rate is very low and therefore replacement modules usually do not resolve the root cause. Incorrect replacement of a module is often the result of inadequate testing.
    - ♦ Understand the correct module function.
    - ♦ Make sure programmable parameters are set correctly for the function in question (see the list in Section 418-01).
    - ♦ Resolve DTCs first - as directed by Diagnostic Routines.
    - ♦ Test all inputs, both hard-wired and networked.
    - ♦ Test outputs (see "Checking module switching circuits" below).
    - ♦ Check applicable TSBs for module software changes (flash programming).
- Checking module switching circuits.
    - ♦ Using the scan tool module-output command function (e.g., IDS Output State Control) to activate components is a fast way to confirm an output is capable of being switched on by the module. Testing that reveals normal module-output function confirms the need to analyze the module inputs.
    - ♦ Don't apply ground or power directly to module-switched components with jumper wes (unless directed by a workshop manual procedure), as the component can be damaged by a direct connection to ground/power.

Identification Codes

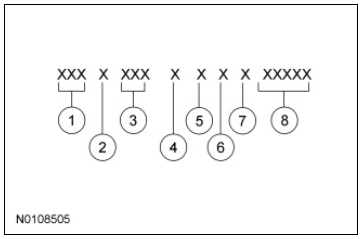
Vehicle Identification Number (VIN)

Vehicle Identification Number (VIN) Tag Locator



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

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



Item	Description
1	World Manufacturer Identifier (WMI)
2	Restraint system type
3	Vehicle line and series type
4	Engine type
5	Check digit
6	Model year
7	Assembly plant
8	Production sequence number

World Manufacturer Identifier (WMI)

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

- 3FA - Ford, Mexico, passenger car
- 3LN - Lincoln, Mexico, passenger car

Restraint System Type

The fourth VIN position identifies the vehicle restraint system used.

- D - Active safety belts, all positions with driver, front passenger air bags and driver side knee bolster
- H - Active safety belts, all positions, driver and front passenger air bags and driver and front passenger side impact air bags

Vehicle Line and Series Type

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

- L2G - Lincoln, Front Wheel Drive (FWD)
- L2J - Lincoln, All-Wheel Drive (AWD)
- L2L - Lincoln, Hybrid FWD
- P0C - Ford, SEL, AWD
- P0D - Ford, Sport, AWD
- P0G - Ford, S, FWD
- P0H - Ford, SE, FWD
- P0J - Ford, SEL, FWD
- P0L - Ford, Hybrid SEL, FWD

Engine Type

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

- 3 - ATK-CVC, 2.5L, 4-valve Gas/Electric (Hybrid)
- A - 2.5L, Dual Overhead Camshaft (DOHC), 4-cylinder, Duratec
- C - 3.5L, DOHC , V6
- G - 3.0L, Overhead Camshaft (OHC), V6, Duratec

More specific engine information can be found on the engine tag. For additional information, refer to Section 303-01A , Section 303-01B , Section 303-01C or Section 303-01D .

Check Digit

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

Model Year

The tenth VIN position is the model year code.

- C - 2012

Assembly Plant

The eleventh VIN position is the assembly plant code.

- R - Hermosillo Assembly (Hermosillo, Mexico)

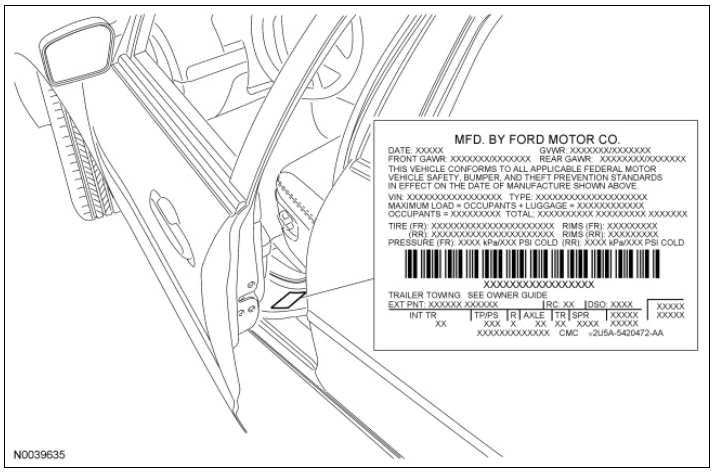
Build Sequence

VIN positions 12 through 17 are an alphanumeric code for the vehicle build sequence. This is also the vehicle serial and warranty number. These 6 characters are also found on the engine block and transmission.

- 100001-599999 - Ford
- 600001-999999 - Lincoln

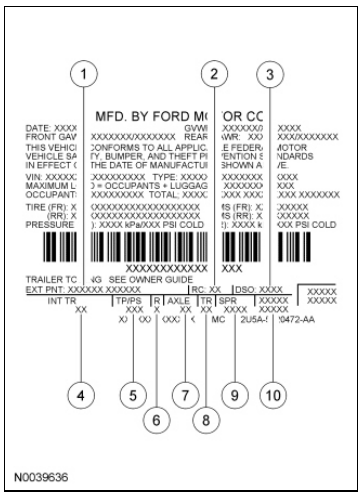
Vehicle Certification (VC) Codes

Vehicle Certification (VC) Label Locator



The upper portion of the Vehicle Certification (VC) label contains the manufacturer's name, the month and year of manufacture, the certification statement and the Vehicle Identification Number (VIN). It also includes Gross Vehicle Weight Rating (GVWR). The VC label is located on the LH door jamb.

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



Item	Description

1	Exterior paint code
2	Region code
3	District Special Order (DSO)
4	Interior trim code
5	Tape/paint stripe code
6	Radio code
7	Axle code
8	Transmission code
9	Spring code
10	Powertrain calibration information

Exterior Paint

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

Exterior Color Codes

- HT - Cinnamon
- JY - Ginger Ale
- JZ - Crystal Champagne
- R2 - Red Candy Tint
- SZ - Blue Flame
- UA - Ebony
- UG - White Platinum (tri-coat)
- UJ - Sterling Gray Metallic
- UN - Steel Blue
- UX - Ingot Silver Metallic
- WS - White Suede (tri-coat)

Interior Trim

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

Interior Trim Type

- A - Perforated leather/SOHO grain le- F-appearance cloth, Ford
- D - B-cloth, Ford
- F - Verona leather, Ford
- L - Hero perforated leather, Lincoln
- M - Perforated leather, Lincoln
- T - E-cloth, Ford
- V - Variation perforated leather, Ford
- Z - Premium perforated leather, Lincoln

Interior Trim Color

- B - Blue, Ford
- C - Camel, Ford
- G - Ginger, Ford
- H - Cashmere, Lincoln
- L - Medium Light Stone, Ford

- R - Red, Ford
- S - Light Camel, Lincoln
- W - Charcoal Black, Ford/Lincoln

Tape/Paint Stripe

Tape and paint stripe codes do not apply.

Radio Type

Radio type codes are as follows:

- B - AM/FM stereo, in-dash 6-disc CD changer, MP3 and clock
- F - AM/FM stereo, CD player, MP3 and clock
- N - AM/FM stereo, in-dash single disc CD changer with navigation system

Axle Ratio Codes

The axle ratios are:

- 25 - 2.57 - Ford
- 30 - 3.06 - Ford
- 32 - 3.21 - Ford
- 33 - 3.33 - Ford, Lincoln
- 43 - 4.39 - Ford

Transmission Type

Transmission type codes are as follows:

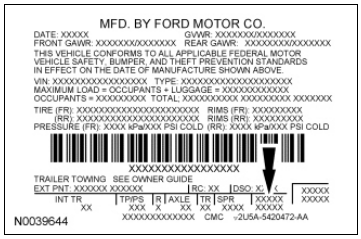
- 6 - 6-speed manual transmission (Mazda G6M) - Ford
- B - 6-speed automatic transmission (Aisin F21) - Ford, Lincoln
- H - Continuously Variable Transaxle (CVT) - Ford Hybrid, Lincoln Hybrid
- W - 6-speed automatic transmission (6F) - Ford

Refer to the transmission tag information in Section 307-01A Section 307-01B , Section 307-01C or Section 308-00 .

Spring Code

Spring codes are listed as a 2-part code. The first 2 characters identify the front springs. Characters 3 and 4 identify the rear springs. Front spring base part number is 5310, rear spring base part number is 5560.

Powertrain Calibration Information

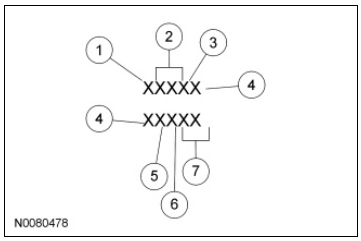


NOTE: Powertrain calibration information is limited to a maximum of 5 characters per line on the Vehicle Certification (VC) label. Because of this, calibration identification consisting of more than 5 characters will

wrap to the second line on the VC label.

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

Powertrain Calibration Information



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

Model Year

- 7 - 2007
- 8 - 2008
- 9 - 2009
- A - 2010
- B - 2011
- C - 2012

Vehicle Line

- DE - Ford, Lincoln

Transmission

- 1 - Automatic transmission
- 2 - Manual transmission

Unique Calibration

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

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

Fleet Code

- 0 - Certification (U.S. 4K, final sale in export markets)
- 1 - Heavy duty gas engine/Dyno
- 2 - Fast-Automobile Manufacturers' Association, U.S.
- 3 - Alternative Durability Protocol, U.S.
- 4 - Not assigned
- 5 - Not assigned
- 6 - Evaporative Emission (EVAP)
- 7 - Mileage accumulation, aging endurance durability
- 8 - On-Board Diagnostic (OBD)
- 9 - Not assigned

Certification Region

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

Revision Level (not printed on label)

- 91-99 - Hardware calibration levels
- 01-04 - Preliminary levels
- 00 - Job 1 production (initial calibration)
- 05-09 - Pre-job 1 revisions to calibrations
- 10-89 - Post-job 1 revisions to calibrations
- 0B - Durability test level
- BD - OBD intermediate level (pre-05)

Jacking and Lifting

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

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

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

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

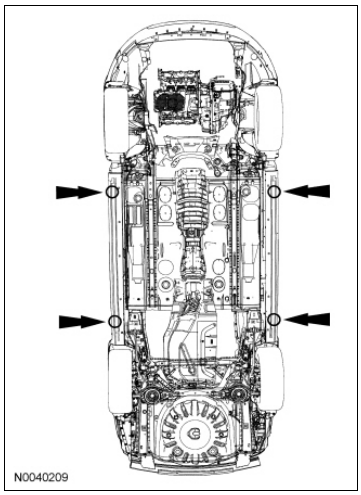
NOTICE: **The jack provided with the vehicle is intended to be used in an emergency for changing a deflated tire. To avoid damage to the vehicle, never use the jack to hoist the vehicle for any other purpose.**

NOTICE: **To prevent possible damage to the underbody, do not drive the vehicle onto the drive-on lift without first checking for possible interference, or damage may occur.**

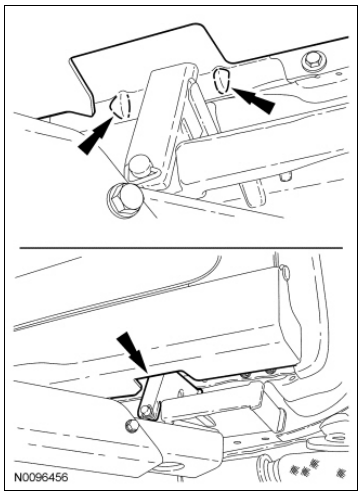
NOTICE: **Damage to the suspension, exhaust or steering linkage components may occur if care is not exercised when positioning the hoist adapters prior to lifting the vehicle.**

NOTICE: **To prevent possible damage to the Sport package trim when lifting with a hoist, position the hoist pad on the pinch weld as indicated.**

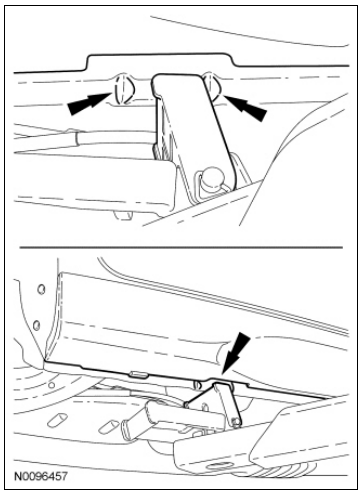
Jacking and Lifting Points



Lifting Points - Front



Lifting Points - Rear



Maintenance Schedules - Gasoline Engines

For Maintenance Schedule information, refer to the Scheduled Maintenance Guide chapter in the Owner's Guide.

Also available at:

- www.motorcraftservice.com and select Owner Guides.

Maintenance Schedules - Hybrid

For Maintenance Schedule Information, refer to the Scheduled Maintenance Guide chapter in the Owner's Guide.

Also available at:

- www.motorcraftservice.com and select Owner Guides.

Noise, Vibration and Harshness (NVH)

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

Acceptable NVH

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

Glossary of Terms

Amplitude

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

Boom

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

Buffet/Buffeting

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

Buzz

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

Chatter

A pronounced series of rapidly repeating rattling or clicking sounds.

Chirp

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

Chuckle

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

Click

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

Clonk

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

Clunk/Driveline Clunk

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

Conductor

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

Cycles Per Second

Cycles per second. Same as hertz (Hz).

Cracks

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

Creak

A metallic squeak.

Cycle

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

Decibel (dB)

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

Drone

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

Drumming

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

Flutter

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

Frequency

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

G-force

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

Gravelly Feel

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

Grind

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

Hertz (Hz)

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

Hiss

Steady, high-frequency noise. Vacuum leak sound.

Hoot

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

Howl

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

Hum

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

Intensity

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

Knock

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

Moan

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

Ping

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

Pitch

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

Pumping Feel

A slow, pulsing movement.

Rattle

A random and momentary or short-duration noise.

Reactor

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

Roughness

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

Rustling

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

Shake

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

Shimmy

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

Shudder

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

Slap

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

Squeak

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

Squeal

A long-duration, high-pitched noise.

Tap

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

Thump

A dull beat caused by 2 items striking together.

Tick

A rhythmic tap, similar to a clock noise.

Tip-In Moan

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

Transient

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

Vibration

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

Whine

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

Whistle

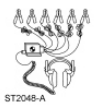
High-pitched noise with a very narrow frequency band. Examples of whistle noises are a turbocharger or air flow around an antenna.

Wind Noise

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

Noise, Vibration and Harshness (NVH)

Special Tool(s)

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

Diagnostic Theory

The shortest route to an accurate diagnosis results from:

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

The diagnosis and correction of NVH symptoms requires:

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

Diagnostic Procedure Overview

Qualifying the symptom by the particular sensation present can help narrow down the cause. Always use the

"symptom" to "system" to "component" to "cause" diagnosis technique. This diagnostic method divides the problem into related areas to correct the customer concern.

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

Tools and Techniques

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

a. Test drive the vehicle with the vibration sensor inside the vehicle.
b. Place the sensor in the vehicle according to feel.
    - ♦ If the condition is felt through the steering wheel, the source is most likely in the front of the vehicle.
    - ♦ A vibration that is felt in the seat or floor only will most likely be found in the driveline, drive axle or rear wheels and tires.
c. Record the readings. Also note when the condition begins, when it reaches maximum intensity and if it tends to diminish above/below a certain speed.
    - ♦ If a vibration symptom is vehicle speed related, the tire and wheel rpm/frequency and driveshaft frequency should be calculated.
    - ♦ If a vibration symptom is engine speed related, the engine, engine accessory and engine firing frequencies should be calculated.
    - ♦ Frequencies with an amplitude reading of 0.06 Gs or less are barely perceptible NVH levels. No corrective action is necessary.
d. Place the vibration sensor on or near the suspect area outside the vehicle.
e. Continue the road test, driving the vehicle at the speed the symptom occurs and take another reading.
f. Compare the readings.
    - ♦ A match in frequency indicates the problem component or area.
    - ♦ An unmatched test could indicate the symptom is caused by the engine, torque converter or engine accessory. Use the diagnostic tools in the rpm mode and check if symptom is rpm related.

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

NVH Analyzer (Vetronix)

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

- Interface with the vehicle's computer system

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

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

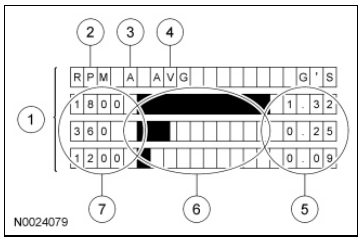
The second is for noise diagnosis. This mode measures noise from 1 or 2 microphones simultaneously. All noise measurements are in decibels (dBs). All frequency bands used for noise measurements are the same as for the vibration measurements, up to 1,000 Hz.

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

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

Electronic Vibration Analyzer (EVA)

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



Item	Description
1	Electronic Vibration Analyzer (EVA) screen
2	Frequency mode displayed in rpm or Hz
3	Active sensor input (A or B)
4	Current active mode

5	G-force indicators or the strongest frequencies in descending strength of each vibration
6	Strength of each vibration
7	Frequency in rpm/Hz of each vibration

Record the readings taken with the diagnostic tool.

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

Vibrate Software®

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

- Enter the vehicle information. Vibrate will do all the calculations and display a graph showing tire, driveshaft and engine vibrations.
- Print a Vibration Worksheet graph. The printed graph is to be used during the road test.
- Road test the vehicle at the speed where the vibration is most noticeable. Record the vibration frequency rpm and the engine rpm on the worksheet graph. The point on the graph where the vibration frequency rpm reading and the engine rpm reading intersect indicates the specific component group causing the symptom.
    - A frequency measurement tool capable of measuring vibration frequency and engine rpm will be needed.
- Provides graphics of diagnostic procedures to aid in testing components.

Reed Tachometer

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

Sirometer

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

Combination EngineEAR/ChassisEAR

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

EngineEAR Basic Unit

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

Mechanic's Stethoscope

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

Squeak and Rattle Repair Kit

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

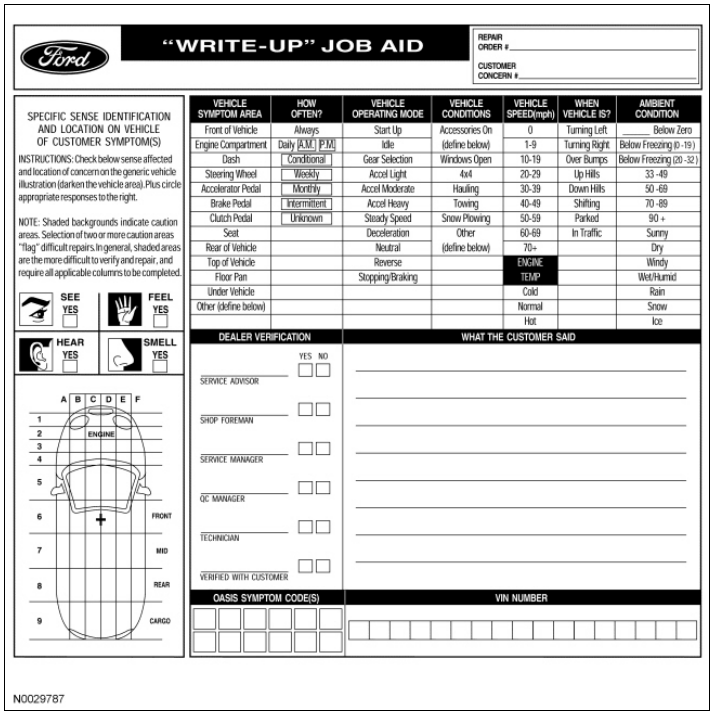
- PVC (soft foam) tape
- Urethane (hard foam) tape
- Flocked (black fuzzy) tape
- UHMW (frosted) tape
- Squeak and rattle oil tube
- Squeak and rattle grease tube

Ultrasonic Leak Detector

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

Write-Up Job Aid

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



1: Customer Interview

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

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

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

2: Pre-Drive Check

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

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

3: Preparing for the Road Test

Observe the following when preparing for the road test:

- Review the information recorded on the write-up job aid. It is important to know the specific symptom the customer has with the vehicle.
- Do not be misled by the reported location of the noise/vibration. The cause can actually be some

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

4: Verify the Customer Concern

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

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

5: Road Test

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

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

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

symptoms.
- The Vehicle Cold Soak Procedure helps to identify symptoms occurring during initial start-up and when an extended time lapse occurs between vehicle usage.

Slow Acceleration Test

To carry out this test, proceed as follows:

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

Heavy Acceleration Test

To carry out this test, proceed as follows:

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

Neutral Coast Down Speed Test

To carry out this test, proceed as follows:

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

Downshift Speed Test

To carry out this test, proceed as follows:

- Shift into a lower gear than the gear used when carrying out the Slow Acceleration Test.
- Drive at the engine rpm where the symptom occurs.
- The symptom is engine speed related if duplicated while carrying out this test. This eliminates the tires, wheels, brakes and the suspension components as sources.

- If necessary, repeat this test using other gears and NEUTRAL to verify the results.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Steering Input Test

To carry out this test, proceed as follows:

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

Brake Test

To carry out this test, proceed as follows:

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

Road Test Over Bumps

To carry out this test, proceed as follows:

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

Neutral Engine Run-Up (NERU) Test

To carry out this test, proceed as follows:

- Install a tachometer.

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

Drive Engine Run-Up (DERU) Load Test

To carry out this test, proceed as follows:

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

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

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

Engine Accessory Test

To carry out this test, proceed as follows:

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

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

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

- Remove the accessory drive belt(s).
- Increase the engine rpm to where the symptom occurs.
- If the vibration/noise is duplicated when carrying out this test, the belt(s) and accessories are not sources.

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

Vehicle Cold Soak Procedure

To carry out this procedure, proceed as follows:

- Test preparations include matching customer conditions (if known). If not known, document the test conditions: gear selection and engine rpm. Monitor the vibration/noise duration with a watch for up to 3 minutes.
- Park the vehicle where testing will occur. The vehicle must remain at or below the symptom temperature (if known) for 6-8 hours.
- Before starting the engine, conduct a visual inspection under the hood.
- Turn the key on, but do not start the engine. Listen for the fuel pump, ABS and air suspension system noises.
- Start the engine.
- Isolate the vibration/noise by carefully listening. Move around the vehicle while listening to find the general location of the vibration/noise. Then, search for a more precise location by using a stethoscope or EngineEAR.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Classify NVH Symptom

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

Noise Symptoms

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

It is the first clue that the identified source of noise might be a reactor and that further investigation is needed to diagnose a possible noise transfer path concern. Based on the results from the road test, make a determination of which action in the symptom chart to take first.

Vibration Symptoms

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

Order of Vibration

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

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

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

Relationship of Vibration Frequency to Order of Vibration

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

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

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

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

Frequency Calculations

Calculating Tire and Wheel Frequency

For a vibration concern, use the vehicle speed to determine tire/wheel frequency and rpm. Calculate tire and wheel rpm and frequency by carrying out the following:

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

Tire Speed and Frequency Chart

Tire Diameter	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz
mm (in)	@ 16 km/h (10 mph)	@ 80 km/h (50 mph)	@ 97 km/h (60 mph)	@ 113 km/h (70 mph)
483 (19)	182	910/15	1,092/18	1,274/21
508 (20)	173	865/14	1,038/17	1,211/20
533 (21)	165	825/14	990/16	1,155/19
560 (22)	158	790/13	948/16	1,106/18
585 (23)	151	755/13	906/15	1,057/18
610 (24)	145	725/12	870/14	1,015/17
635 (25)	139	695/12	834/14	973/16
660 (26)	134	670/11	804/13	938/16
685 (27)	129	645/11	774/13	903/15

710 (28)	124	620/10	744/12	868/14
735 (29)	119	595/10	714/12	833/14
760 (30)	115	575/10	690/11	805/13
785 (31)	111	555/9	666/11	777/13
810 (32)	108	540/9	648/11	756/13
835 (33)	105	525/9	630/10	735/12
864 (34)	102	510/8	612/10	714/12

Calculating Driveshaft Frequency

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

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

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

Calculating Engine Frequency

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

Calculating Engine Accessory Frequency

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

Calculate engine accessory frequency by performing the following steps:

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

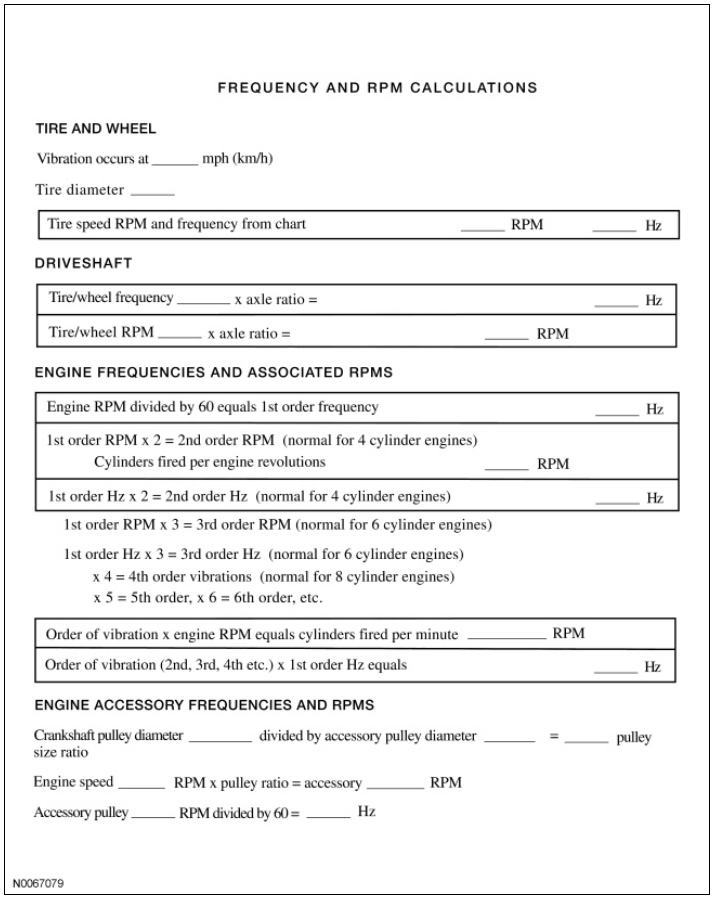
Calculating Engine Firing Frequency

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

Calculate engine firing frequency by performing the following steps:

- Multiply the engine rpm where the vibration symptom occurs by the number of cylinders fired with each crankshaft revolution. For example, a vehicle with a 6-cylinder engine experiences a vibration concern at 2,400 rpm. The engine is firing the cylinders at 7,200 times per minute (3 multiplied by 2,400).
- Divide this number by 60 (the number of seconds in a minute) to obtain the engine firing frequency. In this example, the engine firing frequency is 120 Hz (7,200 divided by 60) at 2,400 rpm.

Frequency and RPM Calculations Worksheet



FREQUENCY AND RPM CALCULATIONS

TIRE AND WHEEL

Vibration occurs at _____ mph (km/h)

Tire diameter _____

Tire speed RPM and frequency from chart	_____ RPM	_____ Hz

DRIVESHAFT

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

ENGINE FREQUENCIES AND ASSOCIATED RPMS

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

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

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

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

ENGINE ACCESSORY FREQUENCIES AND RPMS

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

Engine speed _____ RPM x pulley ratio = accessory _____ RPM

Accessory pulley _____ RPM divided by 60 = _____ Hz

N0067079

Harshness Symptoms

Harshness is customer perception which gives the impression of no isolation from the tire/wheel and suspension system. Harshness may be caused by road conditions, temperature changes, component damage and/or incorrect customer modifications on original components/specifications. Customers usually experience harshness when the vehicle is driving over bumps or potholes and in cold weather conditions. Harshness can also be experienced with excessive tire pressure, sporty tires, heavy-duty springs and shocks, or other vehicle modifications. Some aftermarket tires, even with the correct size, may change vehicle behavior and produce

customer concerns. The first step in diagnosing a harshness concern is to determine if the concern was experienced only in certain specific operating conditions, such as large potholes or extremely cold weather. In these cases, harshness should be considered normal. A known good vehicle can be driven under the same conditions and the rides can be compared to determine whether the concern is normal or vehicle specific. The second step is to check tire pressure and make sure it was set within vehicle specifications. The third step is to inspect for aftermarket or modified components and determine if they are the cause of the harshness complaint. If the harshness concern persists after the above steps, it is possible that some components are damaged. Based on the results from the road test, make a determination of which action in the symptom chart to take first.

NVH Symptom Chart Categories

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

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

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

Vehicle-Speed Related Vibrations

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

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

Symptom Chart - Tire-Speed Related Vibrations

Symptom Chart - Tire-Speed Related Vibrations

Symptom Chart - Driveshaft-Speed Related Vibrations

Symptom Chart - Driveshaft-Speed Related Vibrations
NOTE: Any assembly that is out of balance will only cause a first order vibration, it will not cause a higher order vibration.

ConditionPossible SourcesAction

- First order driveshaft vibration

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

Symptom Chart - Engine-Speed Related Vibrations

Symptom Chart - Engine-Speed Related Vibrations
NOTE: When an engine-speed related vibration is present, engine, engine accessory and engine firing calculations should be carried out.

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

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

ConditionPossible SourcesAction

- 0.5 order engine vibration
- Engine
- REFER to Section 303-00 .
- First through sixth order engine vibration
- Engine
- REFER to Section 303-00 .
- Transmission/transaxle

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

Symptom Chart - Noise, Air Leaks or Water Leaks

Symptom Chart - Noise, Air Leaks or Water Leaks

Symptom Chart - Harshness

Symptom Chart - Harshness

Material

Item	Specification	Fill Capacity
3MTM Strip Caulk - Black 051135-08578	WSB-M4G32-C	-
Seam Sealer TA-2	-	-
Clear Silicone Rubber TA-32	ESB-M4G92-A	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	-
Silicone Spray Lubricant XL-6	ESR-M13P4-A	-
Trim and Weatherstrip Adhesive TA-14-A	-	-

Insulation

Insulation is used as a sound-deadener to reduce exterior road and powertrain noises from the interior of the vehicle. Mastic insulators are also used as insulation. For information on the location of the mastic insulators, refer to Section 501-35 . Insulation is installed:

- under the roof.
- above and below the instrument panel.
- at the cowl side panels.
- over the front and rear floor pans.
- inside the A-, B- and D-pillar sections.
- behind the rear quarter trim panel.

It has heat-bondable mastic deadeners for improved NVH characteristics.

 P>

Body Sealer Types And Applications

Seam Sealer

Seam Sealer TA-2 or equivalent:

- is a heavy-bodied, non-sag adhesive/sealer for use on standing cosmetic seams, truck bed seams, tooled door skin seams and floor pans.
- can be used on water leaks and noise concerns.

Clear Silicone Rubber

Clear Silicone Rubber TA-32 or equivalent meeting Ford Specification ESB-M4G92-A:

- does not run.
- is fast drying.
- remains semi-elastic.
- can be used for sealing water leaks, noise concerns, remounting trim and repairing torn weatherstripping.

Silicone Gasket and Sealant

Silicone Gasket and Sealant TA-30 or equivalent meeting Ford specification WSE-M4G323-A4:

- is a form-in-place gasket and multi-purpose adhesive/sealant.
- is a room temperature curing silicone rubber.

Caulking Cord

3MTM Strip Caulk-Black 051135-08578 or equivalent meeting Ford specification WSB-M4G32-C:

- is a heavy-bodied, plastic base with a filler.
- is commonly known as perma-gum.
- is used on spot-weld holes and between surfaces not sealed with a gasket.

Weatherstrip Adhesive

Trim and Weatherstrip Adhesive TA-14-A or equivalent:

- is a quick drying, strong adhesive designed to hold weatherstripping onto all body panels and surrounding metal.

Silicone Lubricant

Silicone Spray Lubricant XL-6 or equivalent meeting d specification ESR-M13P4-A:

- is used to keep the door and the window weatherstrip pliable and soft.
- makes the door easier to close.
- retards weatherstrip squeaks.
- retards weatherstrip wear.

- helps retain door window alignment by reducing friction between the glass frame and the rubber weatherstrip.
- should not be used prior to painting.

Body System

Material

Item	Specification
Seam Sealer TA-2	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Inspection and Verification

Dust and Water Leaks

Most dust and water leaks occur due to missing or mis-installed body sealer or components. The source of the leak is detected by:

- pressurizing the vehicle and testing with soapy water.
  - ♦ Locate and tape off the body vents.
  - ♦ Turn the blower motor on the high position.
  - ♦ Turn the air recurculation to the off mode.
  - ♦ Close the windows and doors.
  - ♦ Open the hood and spray soapy water along body seams and grommete sure to test the areas arround the A-pillar at the fender and the hood hinge area.
  - ♦ Check for bubbles.
- inspecting for a dust pattern or water path near and above the area in question.
- removing any trim or carpet in the general area of the leak.
- road testing or water-hose testing the vehicle.
- placing a bright light under the vehicle, removing any necessary trim or carpet and inspecting the interior of the body at joints and weld lines.

Wind Noise

Most wind noise leaks occur at the corners of the windows or in the doors. Wind noise is detected by driving the vehicle at highway speeds or at speeds as specified by the customer. The vehicle should be driven in 4 different directions, with all the windows CLOSED, the radio OFF and the A/C blower motor OFF.

Squeak and Rattle

Squeak and rattle noises are generally caused by loose parts, contact or relative movement between 2 surfaces or loose wires and connectors. The source of the noise can be detected by stopping movement of the suspect part by hand or by using dampening or low friction materials.

Symptom Chart - NVH

Symptom Chart - NVH

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

ConditionPossible SourcesAction

- Draft/wind noise and water leak around door perimeter
- Loose fit seal
- PINCH seal carrier to improve retention on seal flange.
- Seal installed incorrectly
- REINSTALL the seal.
- Door misaligned
- REALIGN the door. CHECK door gaps and fit in door opening and ADJUST as necessary. REFER to Section 501-03 .
- Scuff plate installed incorrectly
- REINSTALL the scuff plate.
- Seal or seal pushpins damaged
- INSTALL a new seal/pushpins.
- Sheet metal joints in door or door opening
- SEAL leaks with silicone gasket and sealant.
- Draft/wind noise and water leak around glass run
- Door glass misaligned
- ADJUST door glass.
- Glass run installed incorrectly
- REINSTALL glass run.
- Leak path behind glass run
- INSTALL foam rope behind glass run.
- Glass run channel spread wide
- PINCH glass run channel to reduce size of opening.

- Glass run damaged
- INSTALL a new glass run.
- Draft/wind noise and water leak at inner belt line
- Belt line seal installed incorrectly on flange
- ADJUST seal. (Do not bend the flange.)
- No contact with side glass
- ADJUST door glass.
- No contact with glass runs at both ends of belt line seal
- ADJUST belt line seal or ADD foam at seal ends.
- Belt line seal damaged
- INSTALL a new seal.
- Draft/wind noise and water leak at outer belt line
- Belt line seal installed incorrectly on flange (no glass contact)
- ADJUST seal.
- Belt line seal does not contact the glass
- ADJUST door glass.
- No contact with glass runs at both ends of belt line seal
- ADJUST belt line seal or ADD foam at seal ends.
- Belt line seal damaged
- INSTALL a new seal.
- Draft/wind noise at inner door handle/speaker opening
- Hole in weathershield
- SEAL hole with suitable tape.
- Weathershield misaligned
- REALIGN weathershield. INSTALL a new weathershield if pressure sensitive adhesive fails.
- Exterior door handle seal misaligned/damaged
- REALIGN or INSTALL a new seal as necessary. REFER to Section 501-14 .

- Speaker or speaker seal missing or damaged
- INSTALL a new door speaker.
- Draft/wind noise and water leaks at floor pan and grommets
- Missing or damaged plugs/grommets
- CHECK plugs/grommets for correct installation or damage. INSTALL new plugs/grommets if necessary.
- Road noise
- Missing mastic insulators
- CHECK for missing mastic insulators. REFER to Section 501-35 .
- Missing body insulators
- CHECK for missing body insulators.
- Rattles in body/doors and instrument panel
- Loose wires/cables
- CHECK that all wires/cables are correctly routed and inserted in correct retainers.
- Loose objects/components in door wells, pillars quarter trim panels
- CHECK doors by carefully striking underside of doors with a rubber mallet while listening for rattles in doors and pillars. REMOVE or TIGHTEN loose objects/components.
- Buzz from instrument panel components
- IDENTIFY which components of the instrument panel are buzzing. SECURE/FASTEN components as necessary, ADD foam or felt as needed if rattle persists.
- Door drain holes collecting water
- Holes clogged with mud or road tar
- CLEAN drain holes of foreign material with a punch or screwdriver. CHECK drain holes regularly.
- Wind noise from exterior rear view mirror
- Exterior mirror housing misaligned
- REALIGN with edges shingled to airflow, with no gaps.
- Mirror sail gasket folded/misaligned
- REINSTALL with gasket unfolded and aligned correctly.
- Mirror housing trim cap installed incorrectly

- REINSTALL with edges shingled to airflow.
- Air leak through mirror housing hinge
- Fully ENGAGE mirror into its operating position. USE foam to block air path through hinge.
- Inner sail trim installed incorrectly
- REINSTALL sail trim. ADJUST door trim.
- Inner sail gasket/barrier installed incorrectly
- REINSTALL trim cover with gasket/barrier aligned correctly.
- Air path through wiring bundle/fastener access holes
- BLOCK air path(s) with foam/tape.
- Exposed fastener access hole on mirror housing/sail
- INSTALL a new cap if missing.
- Rattle/vibration from exterior rear view mirror
- Mirror glass adjustment screws loose
- REMOVE mirror glass and TIGHTEN mirror glass adjustment motor screws. REFER to Section 501-09 .
- Mirror mounting nuts loose
- TIGHTEN mirror mounting nuts. REFER to Section 501-09 .
- Aftermarket air deflector/stone shields
- If possible, REMOVE aftermarket air deflector/stone shield, then ROAD TEST vehicle. If concern is no longer present, ADVISE customer that aftermarket component was causing concern.
- Draft/wind noise and water leak around perimeter of all fixed glass
- Gaps in the sealant bead
- APPLY approved sealant.
- Air traveling up windshield molding along A-pillar
- INSTALL foam rope full length of the A-pillar.
- Gaps in sealant bead of windshield/rear glass
- RESEAL windshield/rear glass. REFER to Section 501-11 .
- Windshield/rear glass misaligned or not installed correctly

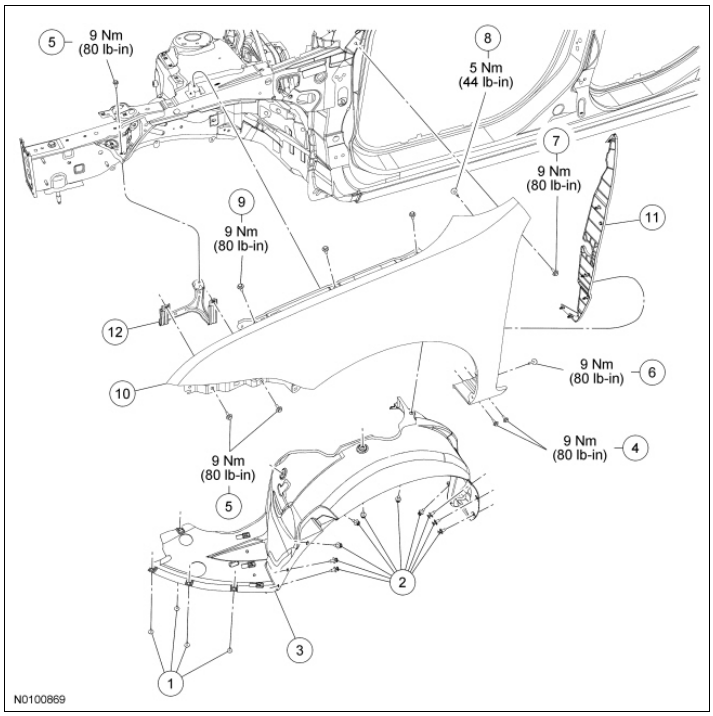
- REINSTALL windshield/rear glass. REFER to Section 501-11 .
- Rear hood seal at base of windshield misaligned/damaged
- REALIGN or INSTALL a new seal as necessary.
- Draft noise at cowl
- Cowl seal misaligned/damaged
- REALIGN or INSTALL a new seal as necessary.
- Draft/water leak or noise from roof opening panel
- Roof opening panel/components
- REFER to Section 501-17 for diagnosis.
- Wind noise created by airflow over or behind body panels
- Fender splash shield misaligned
- REALIGN fender splash shield.
- Body panel misaligned (exposed edge)
- REALIGN appropriate body panel.
- Hood misaligned (front margin)
- CHECK hood gaps and fit. ADJUST hood as necessary.
- Front grille edge noise
- APPLY foam in hollow areas behind louvers.
- Wind noise created by grille opening panel
- Grille relationship to leading edge on hood
- If possible, ADJUST grille opening panel forward to eliminate wind noise.
- Sharp edges due to material imperfections
- REMOVE sharp edges (no damage to visible surface).
- Wind noise from air extractor (body vent)
- Air extractor housing seated incorrectly
- REINSTALL air extractor housing.
- Air extractor housing or flaps damaged

- INSTALL a new air extractor.
- Wind noise from bug shield/exterior windshield sun visor
- Turbulence created by location and shape
- DETERMINE if an OEM part or aftermarket. If aftermarket ADVISE customer accordingly. If OEM, VERIFY correctly installed. If noise is abnormal, REPAIR or INSTALL new as required.

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C line retaining bolt	6	-	53
Fender lower bolts	9	-	80
Fender rear lower bolt	9	-	80
Fender rear upper bolt	9	-	80
Fender support brace bolts	9	-	80
Fender upper bolts	9	-	80
Fender upper rear inner bolt	5	-	44
Hood hinge-to-body bolts	22	16	-
Hood hinge-to-hood bolts	22	16	-
Hood latch bolts	12	-	106
Hood striker bolts	12	-	106
Radiator grille support bolts		-	106
Windshield washer reservoir retaining bolt	7	-	62
Wiper mounting arm and pivot shaft assembly bolts	5	-	44
Wiper pivot arm nuts	20	-	177

Front End Body Panels - Exploded View



Item	Part Number	Description
1	W706805	Splash shield screw (4 required)
2	W712196	Splash shield pin-type retainer (10 required)
3	5416034 RH/ 5416035 LH	Splash shield
4	W505421	Fender lower bolts
5	W505421	Fender support brace bolt
6	W505421	Fender rear lower bolt
7	W505421	Fender rear upper bolt
8	W505421	Fender upper rear inner bolt
9	W505421	Fender upper bolt (3 required)
10	16005 RH/ 16006 LH	Fender
11	16E132 RH/ 16E133 LH	Fender baffle
12	16A023 RH/ 16A024 LH	Fender support brace

1. For additional information, refer to the procedures in this section.

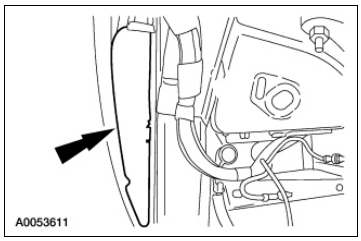
Fender

Removal and Installation

All vehicles

1. Remove the front fender splash shield. For additional information, refer to Fender Splash Shield in this section.

2. Remove the fender baffle.



3. Remove the upper rear inner fender bolt.
   - To install, tighten to 5 Nm (44 lb-in).

4. Remove the 2 lower fender bolts.
   - To install, tighten to 9 Nm (80 lb-in).

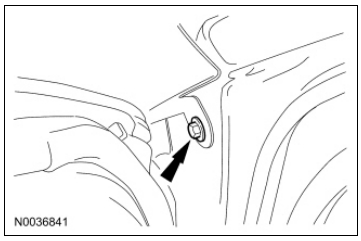
Fusion only

5. Remove the side turn signal lamp. For additional information, refer to Section 417-01 .

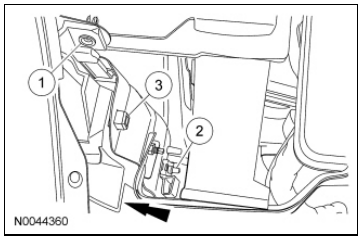
All vehicles

NOTE: The front door must be open to gain access to the rear fender bolt.

6. Remove the upper rear fender bolt.
   - To install, tighten to 9 Nm (80 lb-in).



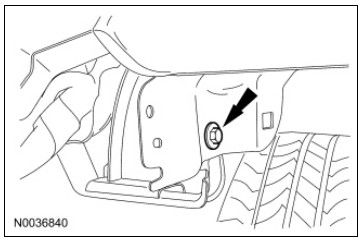
7. Remove the bumper cover bracket from the front fender.
   1. Remove the screw.
   2. Remove the bolt.
   3. Pull outward to release the clip.



8. **NOTE:** Two bolts are required for Fusion and Milan, one bolt is required for MKZ.

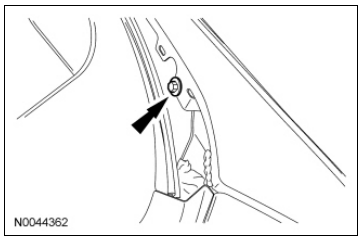
   Remove the fender support brace bolt.

   - To install, tighten to 9 Nm (80 lb-in).



9. Remove the pushpin from the front fender to headlamp.

10. Remove the upper rear inner fender bolt.
    - To install, tighten to 5 Nm (44 lb-in).



11. Remove the 3 upper fender bolts and the front fender.
    - To install, tighten to 9 Nm (80 lb-in).

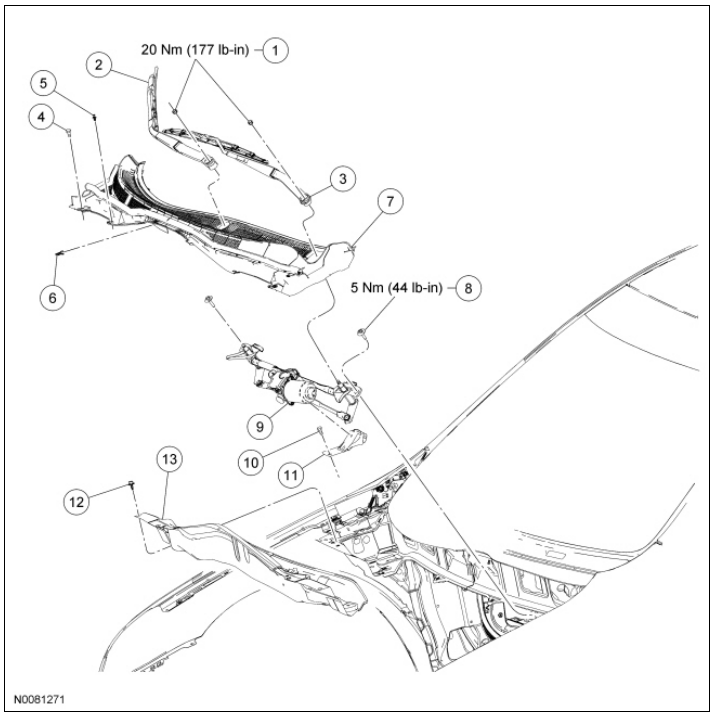
12. To install, reverse the removal procedure.

Fender Splash Shield

Removal and Installation

1. Remove the fender splash shield screws.
2. Remove the 11 fender splash shield pin-type retainers.
3. Remove the fender splash shield.
4. To install, reverse the removal procedure.

Cowl Panel Grille



Item	Part Number	Description
1	W520403-S	Wiper pivot arm nuts (2 required)
2	17526	Wiper pivot arm
3	17526	Wiper pivot arm
4	W701121-S	Cowl panel grille bolt (2 required)
5	1502316-A	Pin-type retainer (4 required)
6	W709919	Cowl panel retaining clip (2 required)
7	5402010	Upper cowl panel grille
8	W701121	Wiper mounting arm and pivot shaft assembly bolt (2 required)
9	17508	Wiper mounting arm and pivot shaft assembly
10	W707717	Cowl panel center brace bolt (3 required)
11	54022A06	Cowl panel center brace
12	W707717	Lower cowl panel grille bolt (10 required)
13	5402000-A	Lower cowl panel grille

Upper cowl panel grille

1. Remove the 2 wiper pivot arms nuts.
   - To install, tighten to 20 Nm (177 lb-in).

2. Remove the LH and RH wiper pivot arms.

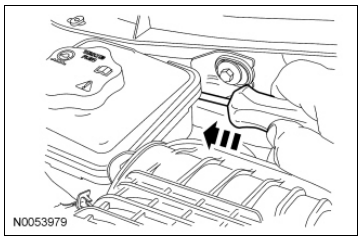
3. Remove the 4 pin-type retainers from the upper cowl panel grille.

4. Remove the 2 bolts from the upper cowl panel grille.
    - To install, tighten to 10 Nm (89 lb-in).

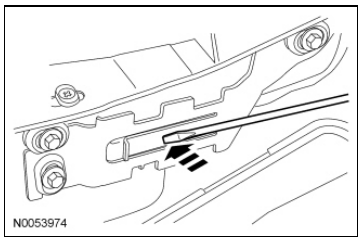
5. Remove the 2 retaining clips and the upper cowl panel grille.

3.5L only

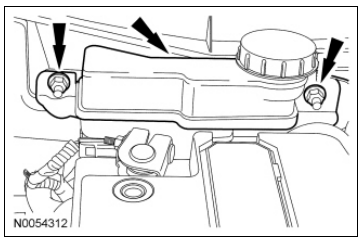
6. Insert a flat-blade screwdriver behind the power steering reservoir.



7. Push the retainer rearward to remove the power steering reservoir and position the power steering reservoir aside.

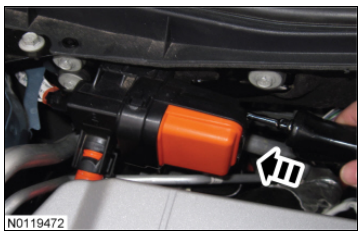


8. Remove the 2 brake fluid reservoir retainers and position the brake fluid reservoir aside.
    - To install, tighten to 10 Nm (89 lb-in).

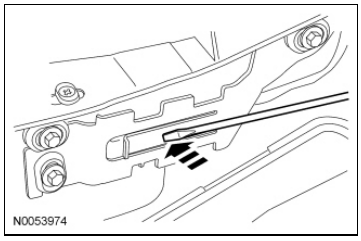


Hybrid only

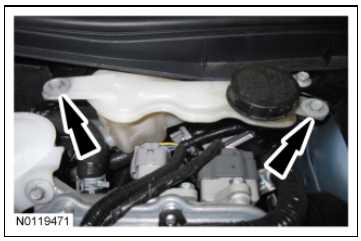
9. Insert a flat-blade screwdriver behind the high voltage junction box.



10. Push the retainer rearward to remove the high voltage junction box and position the high voltage junction box aside.



11. Remove the 2 brake fluid reservoir bolts and position the brake fluid reservoir aside.
    - To install, tighten to 10 Nm (89 lb-in).



Lower cowl panel grille

12. Remove the wiper mounting arm and wiper pivot shaft assembly in the following sequence.
    1. Disconnect the electrical connector.
    2. Remove the 2 bolts.
        - To install, tighten to 5 Nm (44 lb-in).

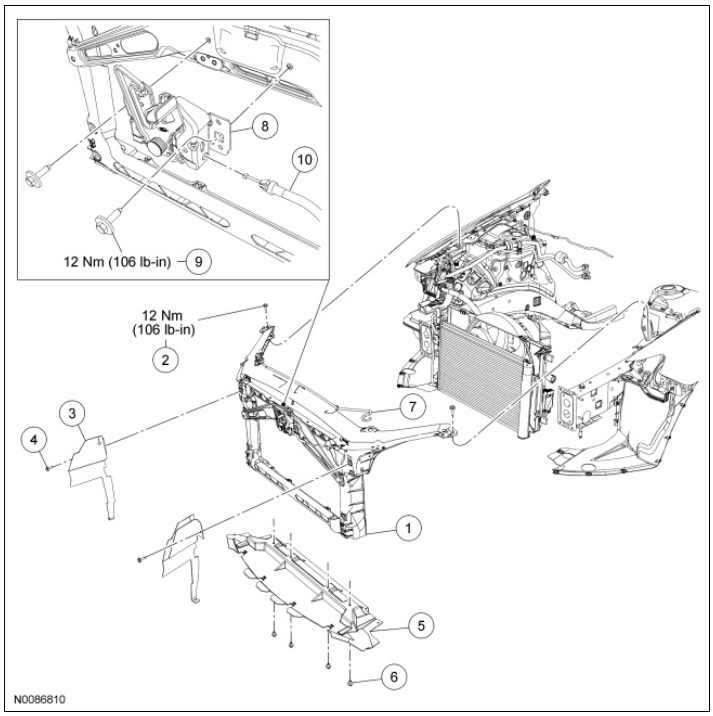
13. Remove the 3 bolts and the lower cowl panel center brace.
    - To install, tighten to 10 Nm (89 lb-in).

14. Remove the 10 lower cowl panel grille bolts.
    - To install, tighten to 10 Nm (89 lb-in).

15. Remove the lower cowl panel grille.

16. To install, reverse the removal procedure.
    - Adjust the pivot arms. For additional information, refer to Section 501-16 .

Radiator Grille Support



Item	Part Number	Description
1	16138	Radiator grille support
2	W505425	Radiator grille support bolt (2 required)
3	8311 LH/ 8310 RH	Air deflector
4	-	Air deflector pushpin (2 required)
5	8327	Lower air deflector
6	N807389	Lower air deflector scrivet (4 required)
7	5416826	Hood prop rod
8	16700	Hood latch
9	N808727	Hood latch bolt (2 required)
10	16916	Hood release cable

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** Applies to 3.5L engines only.

   Remove the Air Cleaner (ACL) outlet pipe and ACL assembly. For additional information, refer to Section 303-12C .

3. Disconnect the hood security switch electrical connector.

4. Remove the windshield washer reservoir retaining bolt.
   - To install, tighten to 7 Nm (62 lb-in).

5. Remove the A/C line retaining bolt.

6. Remove the front headlamps. For additional information, refer to Section 417-01 .

7. **NOTE:** This step is necessary to relieve stress from the radiator grille support prior to removal.

   Using a suitable hood prop tool, prop and support the hood. Latch the vehicle hood prop rod into position on the radiator grille support.

8. Remove the front bumper. For additional information, refer to Section 501-19 .

9. Remove the front impact severity sensor and release the harness clip. For additional information, refer to Section 501-20B .

10. Disconnect the ambient air temperature sensor electrical connector and harness clip. Position the harness aside.

11. Disconnect the hood latch release cable from the latch assembly.

12. Remove the hood latch bolts.
    - To install, tighten to 12 Nm (106 lb-in).

13. Remove the cooling module retaining clip screws and release the clips.

14. Remove the radiator grille support bolts (3 each side) and remove the support.
    - To install, tighten to 12 Nm (106 lb-in).

15. To install, reverse the removal procedure.
    - Transfer all necessary components.

Torque Specifications

Description	Nm	lb-ft	lb-in
Door check arm-to-body bolt	25	18	-
Door check arm-to-door nuts	12	-	106
Door hinge-to-body bolts	25	18	-
Door hinge-to-door bolts	30	22	-
Door latch striker plate bolts	22	16	-
Luggage compartment lid hinge-to-body bolts	25	18	-
Luggage compartment lid hinge-to-luggage compartment lid nuts	25	18	-
Luggage compartment lid striker plate bolts	22	16	-

Door Alignment - Front

All alignments

1. Remove the door latch striker plate.

Front door in and out, up and down alignment

2. Loosen, but do not remove, the front door hinge-to-front door fasteners enough to allow door alignment.

Front door fore, aft and tilt alignment

3. Remove the front fender. For additional information, refer to Section 501-02 .

4. Loosen, but do not remove, the upper front door hinge-to-body fasteners enough to allow door alignment.

5. Loosen, but do not remove, the lower front door hinge-to-body fasteners enough to allow door alignment.

All alignments

6. Adjust the door. For additional information, refer to Section 501-35 .

7. Tighten the door fasteners.
   - Tighten the front door hinge-to-front door bolts to 30 Nm (22 lb-ft).
   - Tighten the front door hinge-to-body bolts to 25 Nm (18 lb-ft).

Front door fore, aft and tilt alignment

8. Install the front fender. For additional information, refer to Section 501-02 .

All alignments

9. Install and adjust the door striker as necessary. For additional information, refer to Section 501-35 .
   - Tighten the door latch striker plate bolts to 22 Nm (16 lb-ft).

Door Alignment - Rear

All alignments

1. Remove the door latch striker plate.

Rear door in and out, up and down alignment

2. Loosen, but do not remove, the rear door hinge-to-rear door fasteners enough to allow door alignment.

Rear door fore, aft and tilt alignment

3. Position aside the B-pillar panel.

4. Loosen, but do not remove, the upper rear door hinge-to-body fasteners enough to allow door alignment.

5. Loosen, but do not remove, the lower rear door hinge-to-body fasteners enough to allow door alignment.

All alignments

6. Adjust the door. For additional information, refer to Section 501-35 .

7. Tighten the door fasteners.
   - Tighten the rear door hinge-to-rear door bolts to 30 Nm (22 lb-ft).
   - Tighten the rear door hinge-to-body bolts to 25 Nm (18 lb-ft).

Rear door fore, aft and tilt alignment

8. Install the B-pillar trim panel.

All alignments

9. Install and adjust the door striker as necessary. For additional information, refer to Section 501-35 .
   - Tighten the door latch striker plate bolts to 22 Nm (16 lb-ft).

Luggage Compartment Lid Alignment

1. Remove the luggage compartment lid struts.

2. Loosen the 4 luggage compartment lid hinge-to-body bolts.

3. Adjust the luggage compartment lid as necessary.
   - For additional information, refer to Section 501-35 .

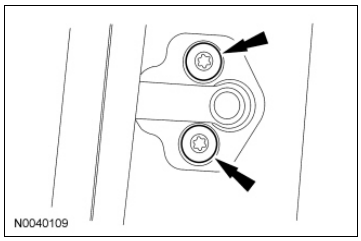
4. Tighten the 4 luggage compartment lid hinge-to-body bolts.
   - Tighten to 25 Nm (18 lb-ft).

5. Install the luggage compartment lid struts.

Striker Adjustment

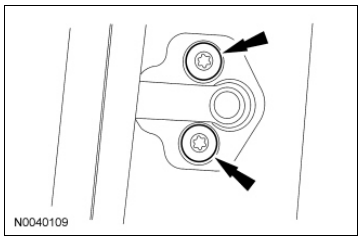
NOTE: Before adjusting the door latch striker plate, verify that the door can be closed easily and fits tightly.

1. Loosen the door latch striker bolts.



2. Reposition the door latch striker plate from side-to-side or up and down as necessary.

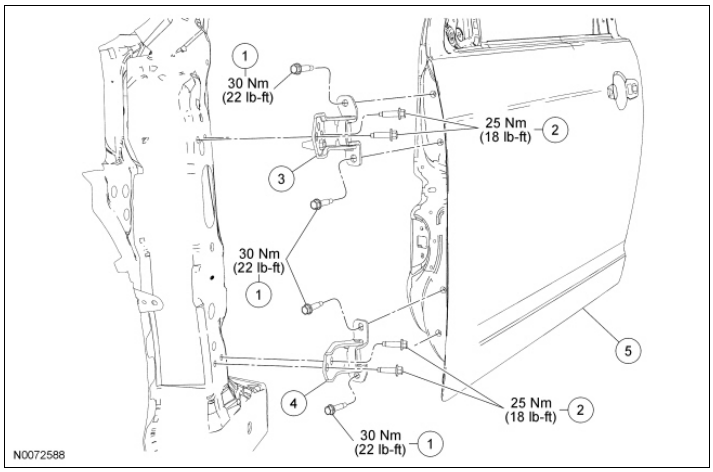
3. Tighten the door latch striker plate bolts.
   - Tighten to 22 Nm (16 lb-ft).



4. Check the adjustment of the door. For additional information, refer to Section 501-35 .
   - Repeat the procedure as necessary.

Door

NOTE: Front door shown, rear door similar.



Item	Part Number	Description
1	W711119	Hinge-to-door bolts
2	W506023	Hinge-to-body bolts
3	5422800	Upper hinge
4	5422810	Lower hinge
5	5420124	Front door

Removal and Installation

1. Remove the door check arm-to-body bolt.
   - To install, tighten to 25 Nm (18 lb-ft).

2. ***NOTICE:*** **To avoid damaging the door, this step requires an assistant.**

   NOTE: To minimize the possibility of cross threading, hand start all fasteners during the installation.

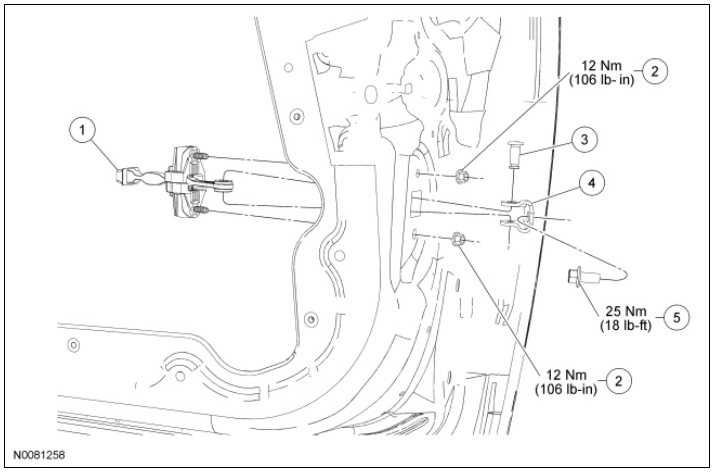
   Mark the position of each hinge and remove the hinge-to-door bolts.

   - To install, tighten to 30 Nm (22 lb-ft).

3. Remove the front door.

4. To install, reverse the removal procedure.
   - If necessary, align the door. For additional information, refer to Door Alignment - Front or Door Alignment - Rear in this section.

Door Check Arm



Item	Part Number	Description
1	5423552	Door check arm
2	W520111	Door check arm-to-door nuts
3	-	Door check arm-to-check arm bracket (part of 5423552)
4	-	Door check arm bracket (part of 5423552)
5	W707375	Door check arm-to-body bolt

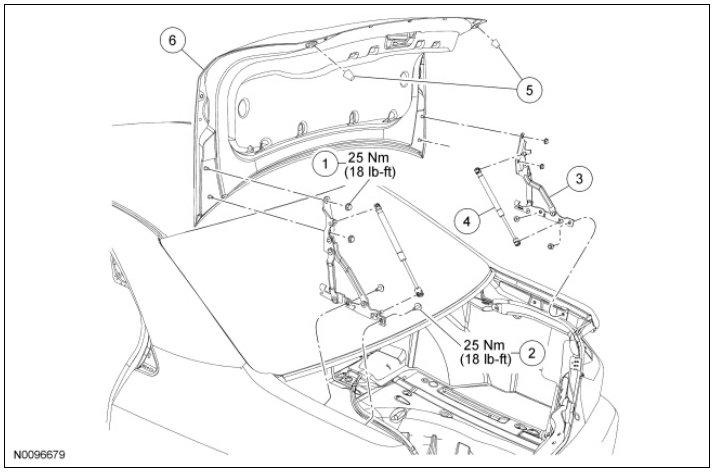
1. Remove the door trim panel. For additional information, refer to Section 501-05 .

2. Remove the door check arm-to-body bolt.
   - To install, tighten to 25 Nm (18 lb-ft).

3. Remove the door check arm-to-door nuts.
   - To install, tighten to 12 Nm (106 lb-in).

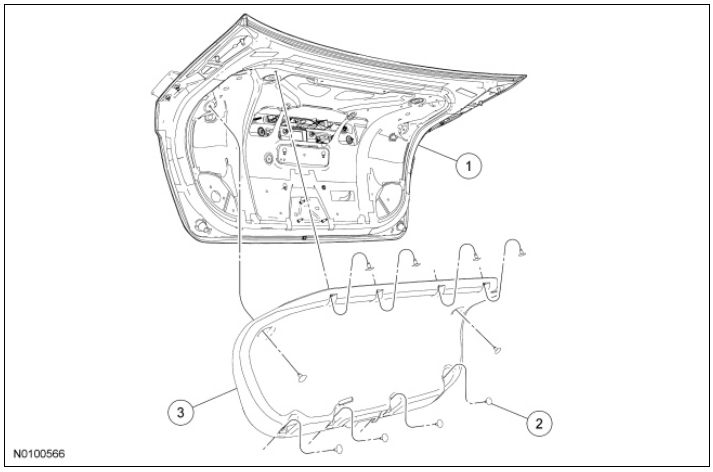
4. To install, reverse the removal procedure.

Luggage Compartment Lid



Item	Part Number	Description
1	N811478-S	Hinge-to-luggage compartment lid nut (4 required)
2	W503931	Hinge-to-body bolt (4 required)
3	42700 RH/ 42701 LH	Luggage compartment lid hinge
4	54406A10	Luggage compartment lid assist strut (RH/LH)
5	W712985	Luggage compartment bumper (2 required)
6	40110	Luggage compartment lid

Luggage Compartment Lid Trim Panel



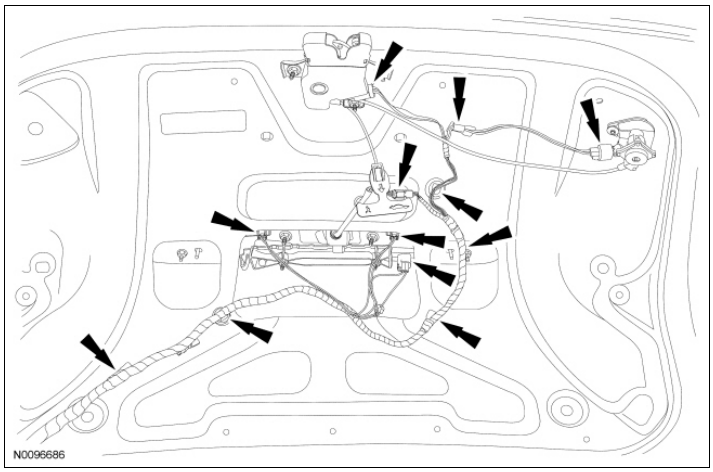
Item	Part Number	Description
1	40110	Luggage compartment lid

2	W706635	Luggage compartment lid trim panel pin-type retainer (10 required)
3	45594	Luggage compartment lid trim panel

1. Open the luggage compartment lid.

2. Remove the luggage compartment lid trim panel and pin-type retainers.

3. Disconnect the electrical connectors and remove the wiring harness clips from the luggage compartment lid.



4. Remove the luggage compartment lid lift struts.

5. With the help of an assistant, remove the hinge-to-luggage compartment lid nuts.
   - To install, tighten to 25 Nm (18 lb-ft).

6. With the help of an assistant, remove the luggage compartment lid.

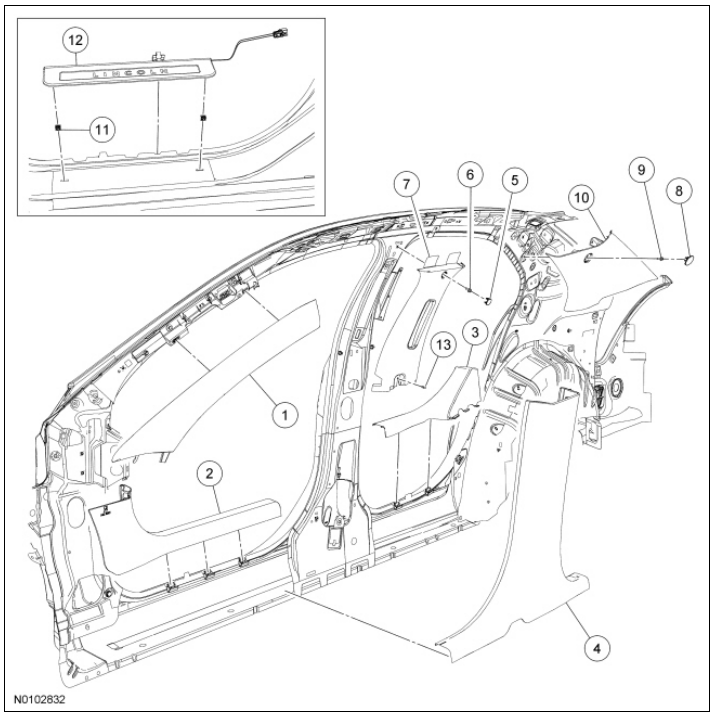
7. To install, reverse the removal procedure.

8. Adjust the luggage compartment lid as necessary. For additional information, refer to Luggage Compartment Lid Alignment in this section.

Torque Specifications

Description	Nm	lb-ft	lb-in
Assist handle bolts	5	-	44
Child seat tether anchor bolts	22	16	-
D-ring bolt	40	30	-

Interior Trim - Exploded View



Item	Part Number	Description
1	03598 RH/ 03599 LH	A-pillar trim panel
2	13208 RH/ 13209 LH	Front door scuff plate (with Inertia Fuel Shutoff (IFS) switch emblem shown, others similar)
3	13228 RH/ 13229 LH	Rear door scuff plate
4	24346 RH/ 24347 LH	B-pillar lower trim panel
5	672A40A	B-pillar trim panel screw cover
6	W705604	B-pillar trim panel screw
7	24356 RH/ 24357 LH	B-pillar upper trim panel
8	672A40B	C-pillar trim panel screw cover
9	W705604	C-pillar trim panel screw
10	52018 RH/ 52019 LH	C-pillar trim panel
11	-	Scuff plate trim panel - front, lighted outer clip (part of 5413208) (2 required)
12	5413208	Scuff plate trim panel - front, lighted outer

1. For additional information, refer to the procedures in this section.

&nnbsp;

A-Pillar Trim Panel

NOTE: The A-pillar trim panel is a one-time-use. If removed, a new A-pillar trim panel must be installed.

1. **NOTE:** When removing the A-pillar trim panel, use a gentle side-to-side rocking motion to free the clip from the trim panel.

   Remove the A-pillar trim panel and the clip from the sheet metal.

2. To install, reverse the removal procedure.
   - Align attachment clips to the holes and snap the new A-pillar trim panel in place.

B-Pillar Trim Panel

Removal and Installation

1. Position the front seats in the full forward position.

2. **NOTE:** Inspect the safety belt D-ring cover for damage. If the safety belt D-ring cover does not remain in place, install a new cover.

   Remove the safety belt D-ring cover and remove the D-ring bolt.

   - To install, tighten to 40 Nm (30 lb-ft).

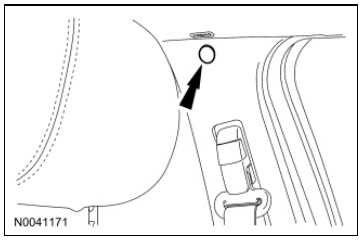
3. Position the front and rear door weatherstrips aside.

4. Remove the front door scuff plate trim panel. For additional information, refer to Scuff Plate Trim Panel - Front in this section.

5. Remove the rear door scuff plate trim panel. For additional information, refer to Scuff Plate Trim Panel - Rear in this section.

6. Remove the lower B-pillar trim panel.
   - Lift the lower area of the lower B-pillar trim panel and pull inward toward the center of the vehicle.
   - Slide the lower B-pillar trim panel down to disengage it from the upper B-pillar trim panel.

7. Remove the upper B-pillar trim panel.
   - Remove the screw cover.
   - Remove the screw.
   - Remove the push-pin with the B-pillar trim panel.



8. To install, reverse the removal procedure.

C-Pillar Trim Panel

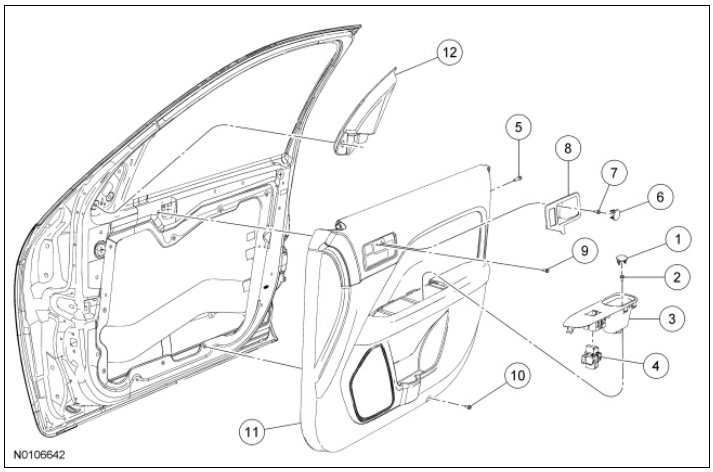
Removal and Installation

1. Position the rear door weatherstrip aside.
2. Remove the screw cover.
3. Remove the screw.
4. Remove the C-pillar trim panel.
5. To install, reverse the removal procedure.

Door Trim Panel - Front

Fusion

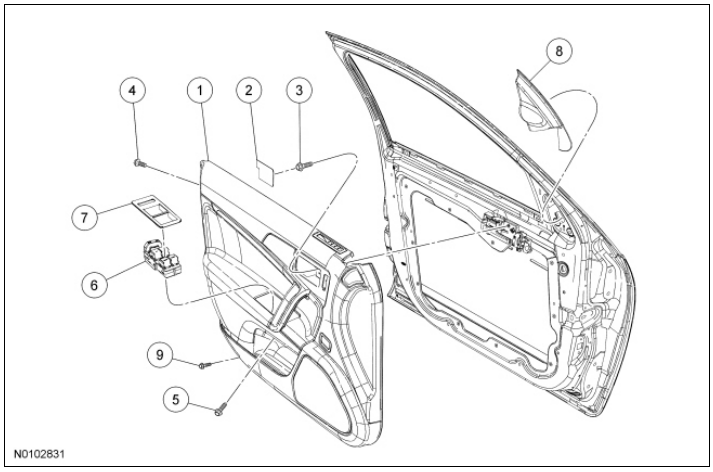
NOTE: RH shown, LH similar.



Item	Part Number	Description
1	047A74	Front door inside handle bezel screw cover
2	W505153	Front door inside handle bezel screw
3	54266B	Front door inside handle bezel
4	14529B	Front door window switch
5	W707745	Front door trim panel upper screw
6	22621 LH/ 22620 RH	Front door inside handle screw cover
7	W505942	Front door inside handle screw
8	22621 LH/ 22620 RH	Front door inside handle bezel
9	W709494	Front door trim panel center screw
10	W706476	Front door trim panel lower screw
11	5423942	Front door trim panel
12	17K709	Front door trim sail panel

MKZ

NOTE: LH shown, RH similar.



Item	Part Number	Description
1	5423942	Front door trim panel
2	5424057	Front door inside handle escutcheon screw cover
3	W505942	Front door inside handle escutcheon screw
4	W707745	Front door trim panel upper screw
5	W712297	Front door trim panel center screw
6	14529	Front door trim panel multiswitch
7	14524	Front door trim panel multiswitch bezel
8	17K709	Front door trim panel sail panel
9	W707745	Front door trim panel lower screw

Removal and Installation

All vehicles

1. Remove the front door inside handle screw cover.

2. Remove the front door inside handle screw.

Fusion

3. Remove the front door inside handle bezel screw cover.

4. Remove the front door inside handle bezel screw.

5. Remove the front door inside handle bezel.
   - Lift upward on the rear of the front door inside handle bezel.
   - Disconnect the electrical connector.

All vehicles

6. Remove the front door trim panel upper screw.

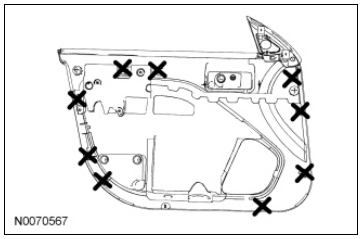
7. Remove the front door trim panel lower screw.

8. Remove the front door trim panel center screw.
   - Fusion is located behind the inside door handle bezel.
   - MKZ is located above the map pocket.

9. **NOTE:** The back of the front door trim panel shown with the location of the pin-type retainers.

   Remove the front door trim panel.

   - Pull the front door trim panel outward to release the pin-type retainers.
   - Disconnect the electrical connector.

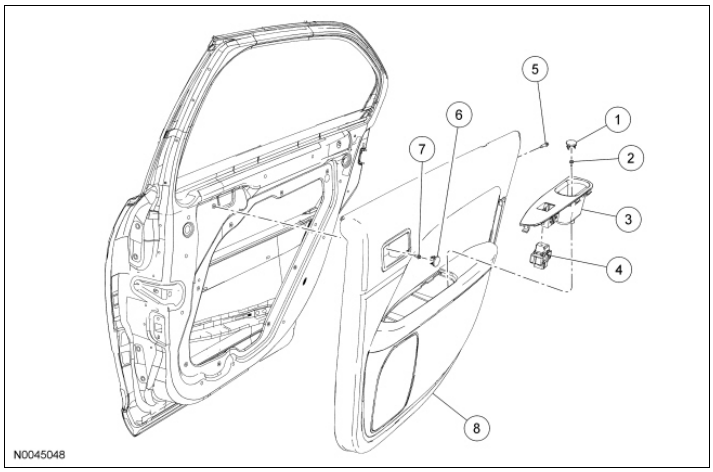


10. To install, reverse the removal procedure.

Door Trim Panel - Rear

Fusion

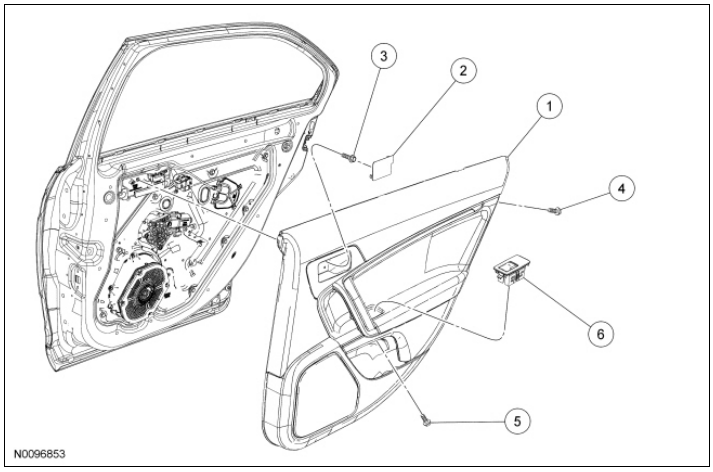
NOTE: RH shown, LH similar.



Item	Part Number	Description
1	047A74	Rear door inside handle bezel screw cover
2	W505153	Rear door inside handle bezel screw
3	54266	Rear door inside handle bezel
4	14529	Rear door window switch
5	W707745	Rear door trim panel upper screw
6	22620 RH/ 22621 LH	Rear door handle screw cover
7	W505942	Rear door handle screw
8	5427406	Rear door trim panel

MKZ

NOTE: RH shown, LH similar.



Item	Part Number	Description
1	5427406	Rear trim panel
2	5424056	Rear door inside handle escutcheon bolt cover
3	W505942	Rear door inside handle escutcheon bolt
4	W707745	Rear door trim panel upper screw
5	W712297	Rear door trim panel lower screw
6	14529	Rear door trim panel switch

Removal and Installation

All vehicles

1. Remove the rear door inside handle bolt cover.

2. Remove the upper rear door inside handle bolt.

Fusion

3. Remove the rear door handle screw cover.

4. Remove the rear door handle screw.

5. Remove the rear door inside handle bezel.
   - Lift upward on the rear of the rear door inside handle bezel.
   - Disconnect the electrical connector.

All vehicles

6. Remove the rear door trim panel upper screw.

MKZ

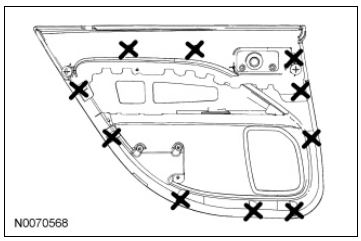
7. Remove the rear door trim panel lower screw.

All vehicles

8. **NOTE:** The back of the rear door trim panel shown with the location of the rear door trim panel pin-type retainers indicated.

   Remove the rear door trim panel.

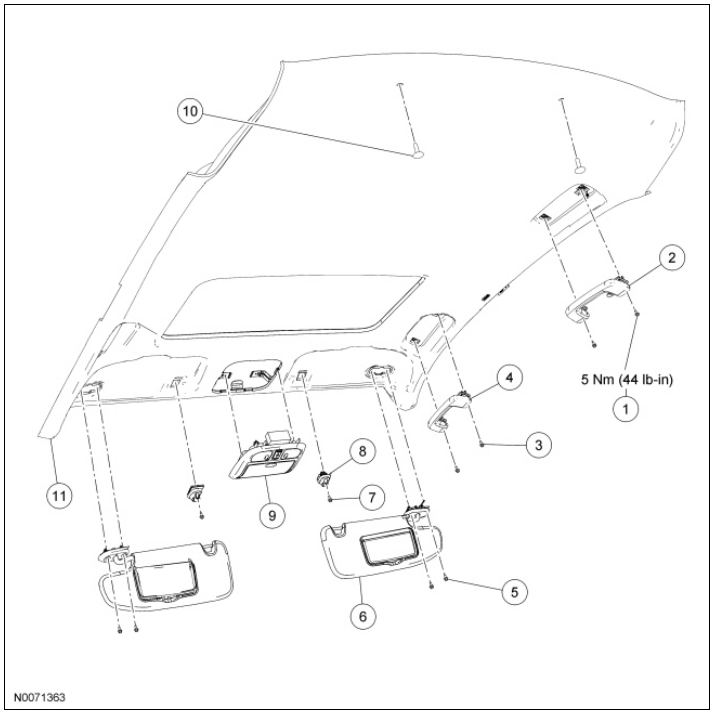
- Pull the rear door trim panel outward to release the rear door trim panel pin-type retainers.



9. To install, reverse the removal procedure.

Headliner

NOTE: Headliner with moonroof shown, headliner without moonroof similar.



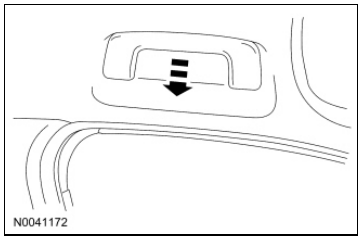
Item	Part Number	Description
1	W504265	Assist handle bolt (2 required)
2	31406B RH/ 31407B LH	Rear assist handle
3	W504265	Assist handle bolt (2 required)
4	31406A RH/ 31407A LH	Front assist handle
5	W505003	Sun visor screw (2 required)
6	04104 RH/ 04105 LH	Sun visor
7	W505003	Sun visor arm clip screw
8	04132	Sun visor arm clip
9	519A70	Overhead console
10	W709571	Pushpin retainer (2 required)
11	51916	Headliner

Removal and Installation

1. Remove the driver seat and rear seat cushion. For additional information, refer to Section 501-10 .

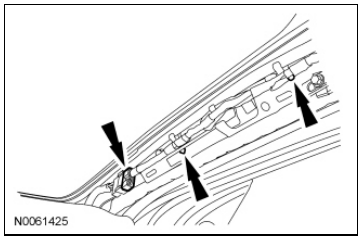
2. Position the passenger seat fully rearward and recline fully.

3. Open the assist handle covers.
   - Remove the bolts and remove the handles.
     - ♦ To install, tighten to 5 Nm (44 lb-in).



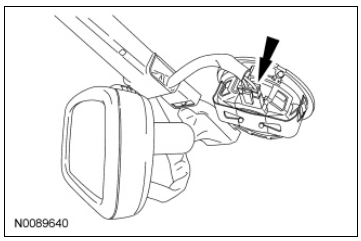
4. Remove the A-pillar trim panels. For additional information, refer to A-Pillar Trim Panel in this section.

5. Disconnect the wire harness connector and the 2 pushpins.

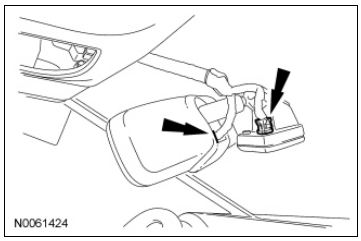


6. If equipped, remove the rain sensor cover.
    - Pull the rain sensor cover outward off the windshield.

7. If equipped, disconnect the rain sensor electrical connector.



8. If equipped, disconnect the automatic dimming rear view mirror and compass electrical connectors.



9. Remove the B-pillar trim panels. For additional information, refer to B-Pillar Trim Panel in this section.

10. Remove the C-pillar trim panels. For additional information, refer to C-Pillar Trim Panel in this section.

11. Remove the overhead console.
    - Disconnect the electrical connector.

12. Remove the sun visor clips.

13. **NOTE:** The sun visor wiring is secured to the headliner and cannot be separated in vehicle.

Remove the 4 sun visor screws and lower the sunvisors.

14. Remove the 2 headliner pushpin retainers at the rear.

15. If equipped, position the headliner forward to gain access to disconnect the roof opening panel motor electrical connector.

16. ***NOTICE:*** **To avoid damaging the headliner, an assistant is required to support the sun visors for this step.**

    Remove the headliner through the LH rear door.

17. **NOTE:** Obtain the 3M Duramix 4747 Super Fast Adhesive commercially. The 3M Duramix 4747 Super Fast Adhesive is a 2-part adhesive in a 50 ml dual-tube applicator. Depending on the size of the headliner and optional wire harness(es), the purchase of two to five 50 ml tubes is suggested.

    If installing a new headliner, transfer the wire harness in the following sequence:

    1. Using a suitable marking tool, mark the new headliner with the routing and exit points of the wire harness from the original headliner.
    2. Carefully remove the wire harness from the original headliner.
    3. ***NOTICE:*** **Make sure not to damage the wire harness when cutting the excess adhesive from the wire harness.**

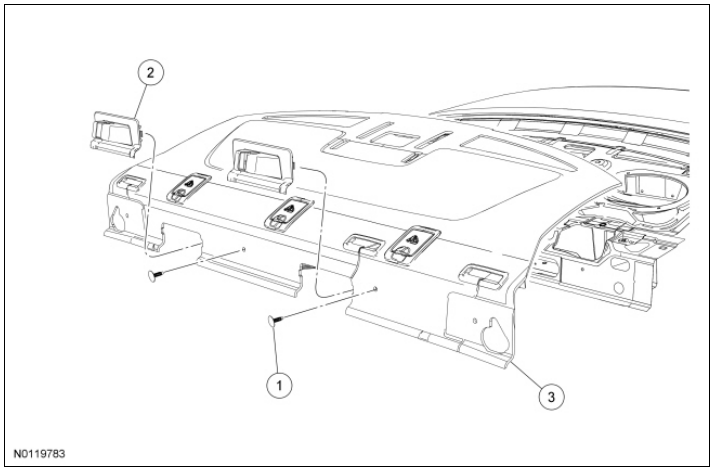
       Cut and remove any excess adhesive from the wire harness.
    4. Position the wire harness onto the new headliner and check that the harness has enough length to be connected to the body/roof connectors. Apply tape to temporarily hold the wire harness in that position on the headliner.
    5. **NOTE:** The 3M Duramix 4747 Super Fast Adhesive will set in 20 seconds. Continually make sure that the wire harness is routed correctly when applying the adhesive.

       Apply the 3M Duramix 4747 Super Fast Adhesive in the same location as the factory installed adhesive along the full length of the wire harness-to-headliner to avoid any NVH concern(s).
    6. Transfer all necessary components.

18. To install, reverse the removal procedure.

Parcel Shelf

NOTE: Fusion shown, MKZ and Hybrid similar.



Item	Part Number	Description
1	W706635	Parcel shelf pushpin (2 required)
2	63874	Parcel shelf seat back latch cover (2 required)
3	46668	Parcel shelf

Removal and Installation

1. Remove the C-pillar trim panels. For additional information, refer to C-Pillar Trim Panel in this section.
2. Remove the rear seat bolsters. For additional information, refer to Section 501-10 .
3. Fold the rear seats down.
4. Pull the seat back latch covers forward and remove from the vehicle.
5. Remove the high mounted stoplamp. For additional information, refer to Section 417-01 .
6. Remove the 2 pushpins.
7. Thread the seat belts through the guides.
8. To install, reverse the removal procedure.

Scuff Plate Trim Panel - Front

Removal and Installation

NOTE: On the MKZ, there is an outer lighted scuff plate. For additional information, refer to Scuff Plate Trim Panel - Front, Lighted Outer .

1. Pull the front inboard section of the scuff plate trim panel outward to release the 1 retaining clip.
2. **NOTE:** The 3 retaining clips must stay attached to the door weather strip and pinch weld.

   Lift the scuff plate trim panel straight up to release the scuff plate trim panel from the 3 retaining clips.
3. To install, reverse the removal procedure.
   - Align the scuff plate trim panel into the clips and snap into place.

Scuff Plate Trim Panel - Front, Lighted Outer

Removal and Installation

NOTE: The front lighter outer scuff plate is only available on the MKZ.

1. Remove the front door scuff plate. For additional information, refer to Scuff Plate Trim Panel - Front in this section.

2. Remove the B-pillar lower trim panel. For additional information, refer to B-Pillar Trim Panel in this section.

3. Disconnect the scuff plate trim panel electrical connector located behind the lower B-pillar trim panel.

4. ***NOTICE:*** **To avoid damage to the scuff plate trim panel, remove any retaining clips from the body and attach them to the scuff plate trim panel before installing.**

   Remove the front, lighted outer scuff plate trim panel by lifting straight up and releasing the 2 retaining clips from the body.

5. To install, reverse the removal procedure.
   - Align the retaining clips to the body and snap in place.

Scuff Plate Trim Panel - Rear

Removal and Installation

1. **NOTE:** The 2 retaining clips must stay attached to the door weather strip and pinch weld.

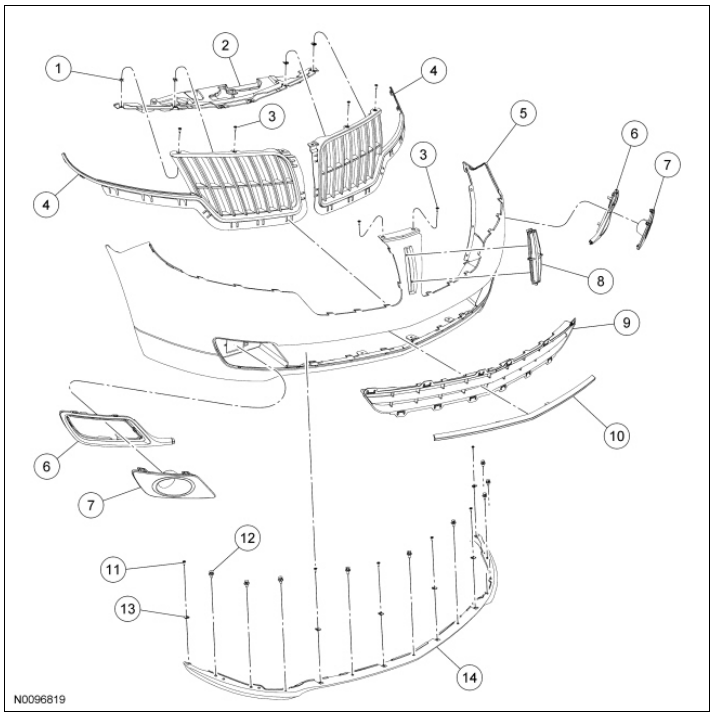
   Lift the rear scuff plate trim panel straight up to release the rear scuff plate trim panel from the 2 retaining clips.

2. To install, reverse the removal procedure.
   - Align the rear scuff plate trim panel into the clips and snap into place.

Torque Specifications

Description	Nm	lb-in
Luggage compartment lid applique nuts	5	44
Spoiler-to-luggage compartment lid nuts	6	53

Radiator Grille - MKZ



Item	Part Number	Description
1	N802539	Upper radiator air deflector J-clip (4 required)
2	8A164	Upper radiator air deflector
3	W706805	Upper radiator grille screws (6 required)
4	8150-B LH/ 8150-A RH	Upper radiator grille
5	17C831	Front bumper cover
6	17K946-A LH/ 17K947-A RH	Fog lamp bezel trim
7	17K946-B LH/ 17K947-B RH	Fog lamp bezels
8	8B262	Badge
9	8150-C	Lower center radiator grille
10	8150-D	Lower center radiator grille moulding
11	W706805	Front bumper cover valance screw (6 required)
12	W711035	Front bumper cover valance pin-type retainer (9 required)
13	N802539	Front bumper cover valance J-clip (6 required)
14	17B635	Front bumper cover valance

Removal and Installation

All radiator grilles

Section 501-19 .

Upper radiator grille

2. Remove the 6 upper radiator grille screws.

3. Remove the upper radiator deflector.

4. Remove the upper radiator grille.

Lower radiator grille

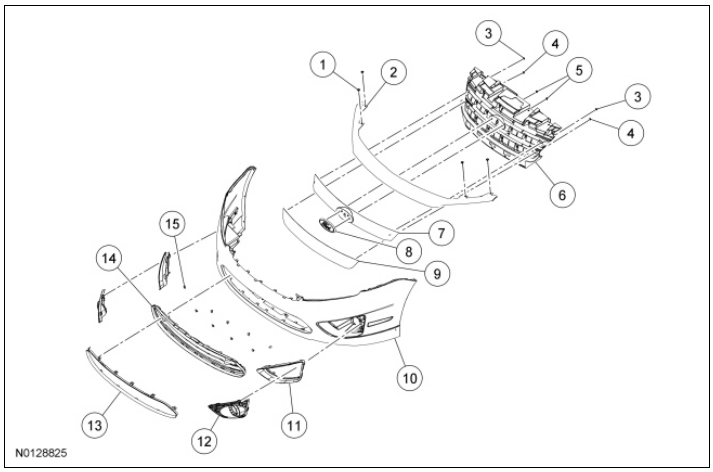
5. Pull outward to remove the lower radiator grille moulding.

6. Remove the lower center radiator grille.
   - Remove the lower center radiator grille from the clips on the bumper cover.
   - Remove the lower center radiator grille from the bumper cover.

All radiator grilles

7. To install, reverse the removal procedure.

Radiator Grille - Fusion



Item	Part Number	Description
1	50980	Pin-type retainer (4 required)
2	8150-A	Upper radiator grille
3	W707501	Center radiator grille nuts (2 required)
4	W707501	Lower radiator grille nuts (2 required)
5	W707501	Badge nut (2 required)
6	8A164	Radiator grille reinforcement
7	8150-B	Center radiator grille
8	8B262	Badge
9	8150-C	Lower radiator grille
10	17C831	Front bumper cover
11	17K946-J LH/ 17K947-J RH	Fog lamp bezel moulding
12	17K946-F LH/ 17K947-F RH	Fog lamp bezel
13	17K945	Lower bumper grille moulding
14	8150-D	Lower bumper grille
15	-	Lower bumper grille moulding clip (9 required) (part of 17K945)

Upper radiator grille

1. Remove th pin-type retainers.
2. Press the tabs to release the upper radiator grille from the radiator grille reinforcement and remove the upper radiator grille.

Center and lower radiator and lower bumper grilles

3. Remove the front bumper cover. For additional information, refer to Section 501-19 .

Center and lower radiator grilles

4. Press the tabs to release the radiator grille reinforcement and remove the radiator grille reinforcements.

Center radiator grille

5. Remove the center radiator grille nuts.
6. Remove the center radiator grille.

Lower radiator grille

7. Remove the lower radiator grille nuts.
8. Remove the lower radiator grille.

Lower bumper grille

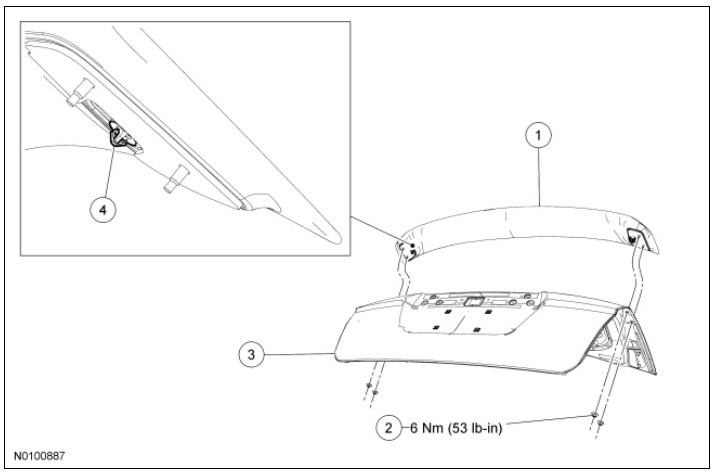
9. Remove the lower bumper grille moulding clips.
10. Remove the lower bumper grille moulding.
11. Press the tabs to release the lower bumper grille from the front bumper cover.
12. Remove the lower bumper grille from the bumper cover.

All vehicles

13. To install, reverse the removal procedure.

Spoiler

Fusion



Item	Part Number	Description
1	40602	Spoiler
2	N621926-S	Spoiler nut (4 required)
3	40110	Luggage compartment lid
4	-	Spoiler pin-type retainer (2 required) (part of 40602)

Removal and Installation

1. Open the luggage compartment lid.

2. If equipped, disconnect the spoiler electrical connector.

3. Remove the spoiler-to-luggage compartment lid nuts.
   - To install, tighten to 6 Nm (53 lb-in).

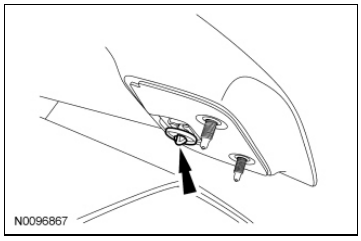
4. **NOTE:** The spoiler is attached to the luggage compartment lid with double-sided tape. New tape must be installed during installation.

   Position a piano wire, or equivalent tool, between the spoiler and the luggage compartment lid.

5. Cut the double-sided tape.

NOTE: There are 2 pin-type retainers on the bottom of the spoiler. If the pin-type retainers break during removal, a new spoiler must be installed.

6. Slide a suitable tool between the luggage compartment lid and the spoiler at each end until contact is made with the pin-type retainers. Push in the pin-type retainer and pull up on the spoiler to release the spoiler from the luggage compartment lid.

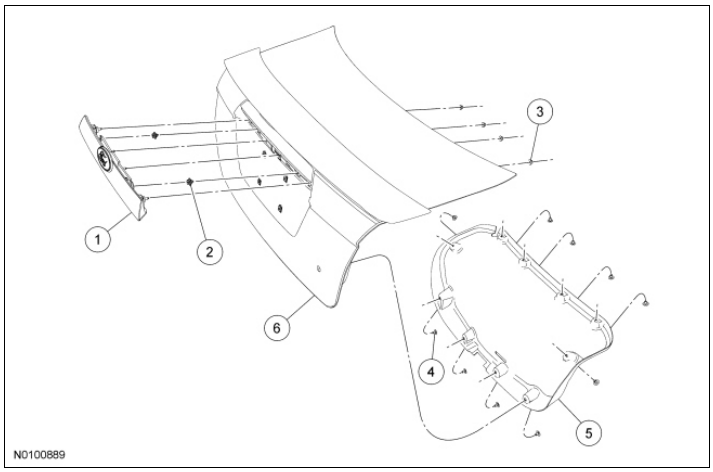


7. Remove the spoiler.

8. **NOTE:** Clean the mounting surfaces of the luggage compartment lid and the spoiler prior to installing. Press along the front edge of the spoiler after securing the fasteners to make sure of correct tape adhesion.

   To install, reverse the removal procedure.

Applique - Luggage Compartment Lid



Item	Part Number	Description
1	42509	Luggage compartment lid applique
2	-	Luggage compartment lid applique pin-type retainer (part of 42509)
3	W709764	Luggage compartment lid applique nut (4 required)
4	W706635	Luggage compartment lid trim panel pin-type retainer (12 required)
5	45594	Luggage compartment lid trim panel
6	40110	Luggage compartment lid

Removal and Installation

1. Remove the luggage compartment lid trim panel pin-type retainers.

2. Remove the luggage compartment lid trim panel.

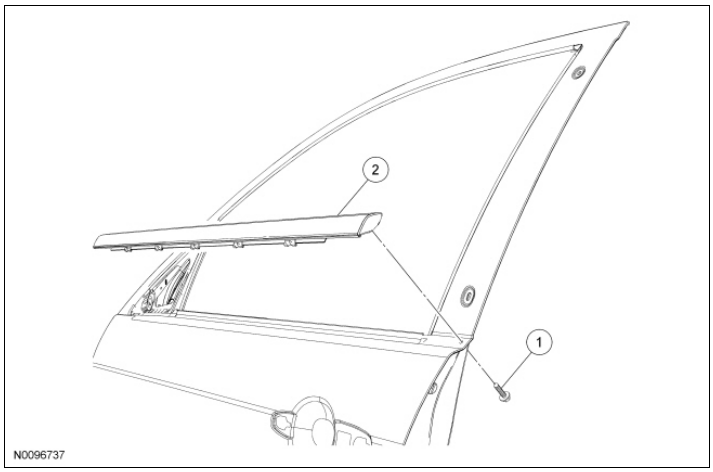
3. Disconnect the luggage compartment lid applique electrical connectors.

4. Remove the luggage compartment lid applique nuts.
   - To install, tighten to 5 Nm (44 lb-in).

5. Remove the luggage compartment lid applique.
   - Squeeze the tabs on the luggage compartment lid applique pin-type retainer to release it from the luggage compartment lid.

6. To install, reverse the removal procedurei>

Beltline Moulding - Front Door

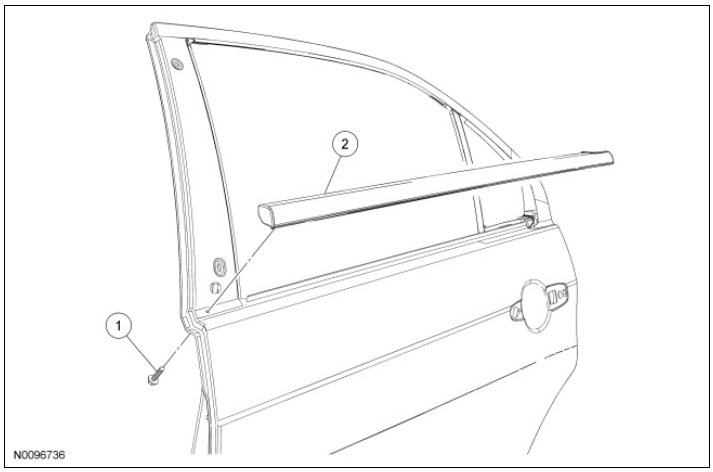


Item	Part Number	Description
1	-	Front door beltline moulding screw (part of 21453)
2	21453	Front door beltline moulding

Removal and Installation

1. Remove the front door beltline moulding screw.
2. Starting at the rear of the moulding, pull upward to release the moulding from the door.
3. Pull rearward to remove the beltline moulding.
4. To install, reverse the removal procedure.

Beltline Moulding - Rear Door

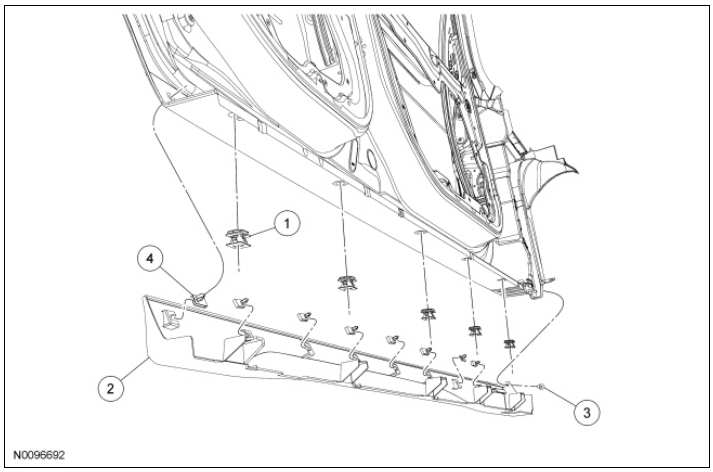


Item	Part Number	Description
1	-	Rear door beltline moulding screw (part of 25597)
2	25597	Rear door beltline moulding

Removal and Installation

1. Remove the beltline moulding screw.
2. Starting at the front of the moulding, pull upward to release it from the door.
3. Pull forward to release the beltline moulding from the quarter window trim.
4. To install, reverse the removal procedure.

Rocker Panel Moulding



Item	Part Number	Description
1	-	Rocker panel moulding lower clip (5 required) (part of 10154 LH/ 10155 RH)
2	10154 LH/ 10155 RH	Rocker panel moulding
3	W505421	Rocker panel moulding pin-type retainer
4	-	Rocker panel moulding upper clip (8 required) (part of 10154 LH/ 10155 RH)

Removal and Installation

1. Remove the rocker panel pin-type retainer.
2. Pull downward on the rocker panel lower clip flanges to release them from the body.
3. Pull outward on the rocker panel moulding to release the rocker panel upper clips from the body.
4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Exterior mirror mounting nuts	8	71

Rear View Mirrors

The main components of the exterior rear view mirrors are:

- Exterior mirror control switch
- Exterior mirror cover
- Exterior mirror glass
- Exterior mirror glass adjustment motors
- Exterior mirror plastic housing
- Exterior mirror glass with blind spot monitoring indicator (optional)
- Heated exterior mirror glass (optional)
- LH exterior auto-dimming mirror glass (optional)
- Memory exterior mirrors (optional)
- Puddle lamps (optional)

For information on the puddles lamps, refer to Section 417-01 .

For information on the blind spot monitoring system, refer to Section 419-04 .

Exterior Mirrors

Heated Exterior Mirrors

The power exterior rear view mirrors are available with a heated mirror glass feature, which heats the mirror glass to remove frost, snow, ice and condensation. The rear window defrost switch controls the operation of the heated exterior rear view mirrors. The heated exterior mirrors should be warm to the touch after 4 minutes of operation.

Memory Exterior Mirrors

The memory mirror function recalls the preferred positioning of the LH and RH exterior mirror glass. The preferred positioning of the LH exterior mirror glass is retained in the Driver Door Module (DDM) memory, while the preferred positioning of the RH exterior mirror glass is retained in the Driver Seat Module (DSM) memory. The memory mirror function is activated by the door mounted switches or the Remote Keyless Entry (RKE) transmitter. When a memory position is recalled by the operator, the LH and RH exterior mirror glass will automatically adjust to the preferred position. The DDM and DSM are capable of setting a DTC for the memory mirror system when a system concern exists. For information on the DDM , refer to Section 501-14 . For information on the DSM and Memory Position Programming, refer to Section 501-10 .

LH Auto-Dimming Mirror

The LH exterior mirror may be equipped with an auto-dimming feature. This feature automatically reduces the glare caused by headlamps reflecting in the mirror. To provide increased visibility when backing up, the LH exterior mirror will automatically return to a high reflectance mode whenever the vehicle is in REVERSE.

Interior Mirror

The vehicle can be equipped with one of the following interior rear view mirrors:

- Interior rear view mirror
- Interior auto-dimming rear view mirror with compass (optional)
- Interior auto-dimming rear view mirror with compass and video display (optional)

Interior Rear View Mirror

The interior rear view mirror consists of a mirror glass and housing. The interior rear view mirror mounts to an interior rear view mirror bracket at the upper center of the windshield glass. The interior rear view mirror can be adjusted left, right, up and down using the 2 pivot points on the support arm. The interior rear view mirror can be adjusted from a day position to a night position to reduce unwanted glare caused by headlamps reflecting in the mirror. Adjusting the interior rear view mirror day/night tab, located at the bottom of the interior rear view mirror, rearward will adjust the interior mirror to the night position. Adjusting the interior rear view mirror day/night tab forward will adjust the interior mirror to the day position.

Interior Auto-Dimming Rear View Mirror

The interior rear view mirror may be equipped with an auto-dimming feature. The interior auto-dimming rear view mirror feature automatically reduces the glare caused by headlamps reflecting in the interior rear view mirror. The auto-dimming feature is activated when the ignition is in the RUN or ACC position. The interior auto-dimming rear view mirror adjusts the reflectance level of the interior rear view mirror glass to eliminate unwanted glare. The reflectance level of the mirror glass is variable and depends on the amount of rear glare in relation to ambient light conditions in front of the interior mirror. When the forward sensor detects daytime conditions, the rearward sensor is inactive and the interior rear view mirror stays in a high reflectance mode. When the forward sensor detects nighttime conditions, the rearward sensor is active and detects glare from the headlights of vehicles approaching from the rear or other glare-producing light sources. To provide increased visibility when backing up, the interior rear view mirror will automatically return to a high reflectance mode whenever the gear selector is in REVERSE.

On vehicles equipped with a compass, the interior rear view mirror will be equipped with an integrated compass module. For compass information, calibration or diagnostics, refer to Section 413-01 .

On vehicles equipped with a rear-mounted object detection camera, a video image will be displayed on the LH side of the interior rear view mirror glass when the gear selector is in REVERSE. For information on the rear-mounted object detection system, refer to Section 413-13 .

Rear View Mirrors - Exterior

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

The movement of the LH and RH exterior mirror glass is controlled by the exterior mirror control switch and the LH and RH exterior mirror motors. Adjusting the exterior mirror switch to the LH or RH position determines which exterior mirror motor will be controlled. The exterior mirror control switch logic is the selected movement request from the exterior mirror control switch. When the exterior mirror control switch is adjusted to the left, right, up or down position, the exterior mirror control switch will supply voltage and ground to the selected exterior mirror motor to move the exterior mirror glass to the desired position.

Only vehicles equipped with memory exterior rear view mirrors are capable of setting DTCs.

The exterior mirrors use a jumper harness between the vehicle wireness connector and the exterior mirror motor. The exterior mirror jumper harness is integral to the exterior mirror. If a concern with the exterior mirror jumper harness exists and cannot be repaired, a new exterior mirror must be installed.

Heated Exterior Mirror

The rear window defrost switch controls the operation of the heated exterior mirror glass. The heated exterior mirror glass only operates when the rear window defrost system is ON. The heated exterior mirror glass power is supplied by the rear window defrost relay through Smart Junction Box (SJB) fuse 9 (10A), which isolates the heated exterior mirror system from the rear window defrost system in the event of a concern. The heated exterior mirrors should be warm to the touch after 4 minutes of operation.

LH Auto-Dimming Mirror

The interior auto-dimming rear view mirror controls the reflectance level of the LH exterior mirror to eliminate unwanted glare. The reflectance level of the mirror glass is variable and depends on the amount of rear glare in relation to ambient light conditions in front of the interior mirror. To provide increased visibility when backing up, the interior rear view mirror glass and LH exterior mirror glass will automatically return to a high reflectance mode whenever the gear selector is in REVERSE.

For information and diagnostics, refer to Rear View Mirrors - Interior in this section.

Memory Exterior Mirror

The memory mirror function recalls the preferred positioning of the exterior mirror motors when the gear selector is in PARK or NEUTRAL and the door mounted switches or Remote Keyless Entry (RKE) transmitter are activated.

Each exterior mirromotor is equipped with a potentiometer, which the Driver Door Module (DDM) and Driver Seat Module (DSM) use to monitor the position of the mirrors. The DDM constantly tracks LH mirror motor position. The DSM constantly tracks RH mirror motor position. When a mirror motor position is stored in memory by the operator, the module will retain this position in memory for future recall. The position of the mirror motors are stored within the DDM and DSM memory as long as the modules retain power. When a memory position is recalled by the operator, the DDM and DSM will power the exterior mirror motors simultaneously and monitor the potentiometer circuits. When the stored memory position is reached, the DDM and DSM will remove power from the exterior mirror motors. If the exterior mirror control switch is operated during a memory recall, the DDM and DSM will stop the memory recall and respond to the exterior mirror control switch command.

For information on the DDM , refer to Section 501-14 .

For information on the DSM and Memory Position Programming, refer to Section 501-10 .

Puddle Lamps

The exterior mirrors may be equipped with puddle lamps, which will illuminate when the interior lights are turned on by opening a door or by pressing the unlock button on the remote transmitter, if equipped. For information on the mirror-mounted puddle lamps, refer to Section 417-01 .

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Exterior mirror • Exterior mirror control switch • Exterior mirror cover • Exterior mirror glass	• Smart Junction Box (SJB) fuse 12 (7.5A) • Power Distribution Box (PDB) fuse 38 (10A) • Circuitry • Driver Door Module (DDM) • Driver Seat Module (DSM) • Exterior mirror control switch • Exterior mirror glass • Exterior mirror motor • Exterior mirror • Loose or corroded connections • Bent pins

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the DDM or the DSM .

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the DDM and DSM .

9. If the DTCs retrieved are related to the concern, go to Driver Door Module (DDM) DTC Chart or Driver Seat Module (DSM) DTC Chart. For all other DTCs, refer to Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Exterior Mirrors or GO to Symptom Chart - NVH .

DTC Charts

Driver Door Module (DDM) DTC Chart

DTC	Description	Action
B1667	Mirror Driver Up/Down Motor Stalled	GO to Pinpoint Test D .
B1668	Mirror Driver Right/Left Motor Stalled	GO to Pinpoint Test D .
B1733	Mirror Driver Vertical Switch Circuit Failure	GO to Pinpoint Test D .
B1737	Mirror Driver Horizontal Switch Circuit Failure	GO to Pinpoint Test D .
B1741	Mirror Passenger Vertical Switch Circuit Failure	GO to Pinpoint Test D .
B1745	Mirror Passenger Horizontal Switch Circuit Failure	GO to Pinpoint Test D .
B2223	Driver Mirror Drive Circuit Failure	GO to Pinpoint Test D .
B2320	Driver Mirror Horizontal Feedback Potentiometer Circuit Failure	GO to Pinpoint Test D .
B2322	Driver Mirror Horizontal Feedback Potentiometer Circuit Short to Battery	GO to Pinpoint Test D .
B2324	Driver Mirror Vertical Feedback Potentiometer Circuit Failure	GO to Pinpoint Test D .
B2326	Driver Mirror Vertical Feedback Potentiometer Circuit Short to Battery	GO to Pinpoint Test D .

All other DTCs	-	REFER to Section 501-14 .

Driver Seat Module (DSM) DTC Chart

DTC	Description	Action
B1669	Mirror Passenger Up/Down Motor Stalled	GO to Pinpoint Test D .
B1670	Mirror Passenger Right/Left Motor Stalled	GO to Pinpoint Test D .
B2224 /TD>	Passenger Mirror Drive Circuit Failure	GO to Pinpoint Test D .
B2312	Passenger Mirror Horizontal Feedback Potentiometer Circuit Failure	GO to Pinpoint Test D .
B2314	Passenger Mirror Horizontal Feedback Potentiometer Circuit Short to Battery	GO to Pinpoint Test D .
B2316	Passenger Mirror Vertical Feedback Potentiometer Circuit Failure	GO to Pinpoint Test D .
B2318	Passenger Mirror Vertical Feedback Potentiometer Circuit Short to Battery	GO to Pinpoint Test D .
All other DTCs	-	REFER to Section 501-10 .

Symptom Chart - Exterior Mirrors

Symptom Chart - Exterior Mirrors

Symptom Chart - NVH

Symptom Chart - NVH

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

ConditionPossible SourcesAction

- Exterior mirror vibrates/loose
- Exterior mirror mounting nuts loose
- TIGHTEN the exterior mirror mounting nuts to the specified value located in the Torque Specifications table.
- Exterior mirror glass loose
- PRESS the center of the exterior mirror glass up, down, left and right to make sure that the exterior mirror glasss seated correctly. If the exterior mirror glass is still loose, REMOVE the exterior mirror

glass and INSPECT the exterior mirror backing plate for damage. If the exterior mirror backing plate is damaged, INSTALL a new exterior mirror glass. REFER to Exterior Mirror Glass in this section.

- Aftermarket air deflector/stone shields
- If possible, REMOVE aftermarket air deflector/stone shield, then ROAD TEST the vehicle. If concern is no longer present, ADVISE customer that aftermarket components were causing undesired vibration.
- Wind noise
- Foam gasket between the exterior mirror and door frame is missing or damaged
- VERIFY that the foam gasket is present and in good condition. If necessary, REPOSITION the foam gasket between the exterior mirror and door frame.
- Exterior mirror is not correctly fitted to the door
- VERIFY that there are no gaps between the exterior mirror and the door. If necessary, LOOSEN the exterior mirror nuts and REPOSITION the exterior mirror.
- Exterior mirror cover
- VERIFY that the exterior mirror cover is not loose or broken. If necessary, INSTALL a new exterior mirror cover. REFER to Exterior Mirror Cover in this section.

Pinpoint Tests

Pinpoint Test A: The Mirrors are Inoperative - Non-Memory Mirrors

Refer to Wiring Diagrams Cell 124 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Mirrors for schematic and connector information.

Normal Operation

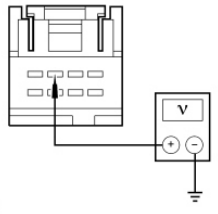
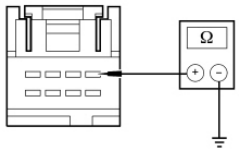
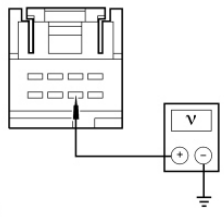
Under normal operation, the exterior mirror control switch receives power through circuit SBP12 (GN/RD) and ground through circuit GD126 (BK/WH). The exterior mirror control switch uses circuit CPM23 (GY) as the common circuit for both exterior mirror motor up/down and right/left movement.

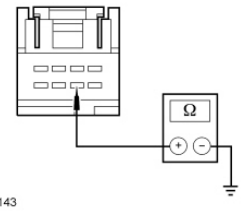
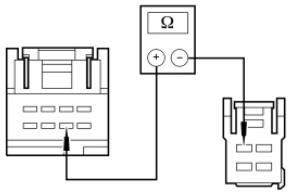
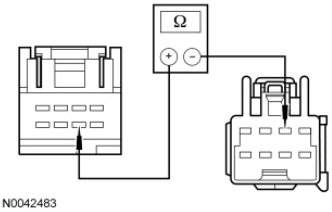
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Exteor mirror control switch

PINPOINT TEST A: THE MIRRORS ARE INOPERATIVE - NON-MEMORY MIRRORS

Test Step	Result / Action to Take
A1 CHECK THE VOLTAGE TO THE EXTERIOR MIRROR CONTROL SWITCH	

• Ignition OFF. • Disconnect: Exterior Mirror Control Switch C527. • Measure the voltage between exterior mirror control switch C527-3, circuit SBP12 (GN/RD), harness side and ground.  N0006111 • **Is the voltage greater than 10 volts?**	**Yes** GO to A2 . **No** VERIFY Smart Junction Box (SJB) fuse 12 (7.5A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
A2 CHECK GROUND TO THE EXTERIOR MIRROR CONTROL SWITCH	
• Measure the resistance between exterior mirror control switch C527-1, circuit GD126 (BK/WH), harness side and ground.  N0006112 • **Is the resistance less than 5 ohms?**	**Yes** GO to A3 . **No** REPAIR the circuit. TEST the system for normal operation.
A3 CHECK CIRCUIT CPM23 (GY) FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between exterior mirror control switch C527-6, circuit CPM23 (GY), harness side and ground.  A0073142 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to A4 .
A4 CHECK CIRCUIT CPM23 (GY) FOR A SHORT TO GROUND	

• Ignition OFF. • Measure the resistance between exterior mirror control switch C527-6, circuit CPM23 (GY), harness side and ground.  A0073143 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A5 . **No** REPAIR the circuit. TEST the system for normal operation.
A5 CHECK CIRCUIT CPM23 (GY) FOR AN OPEN	
• Disconnect: LH Exterior Mirror C516 (without heated mirrors) or C517 (with heated mirrors). • **Without heated mirrors:** Measure the resistance between exterior mirror control switch C527-6, circuit CPM23 (GY), harness side and LH exterior mirror C516-2, circuit CPM23 (GY), harness side.  N0042484 • **With heated mirrors:** Measure the resistance between exterior mirror control switch C527-6, circuit CPM23 (GY), harness side and LH exterior mirror C517-2, circuit CPM23 (GY), harness side.  N0042483 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

Pinpoint Test B: A Single Mirror is Inoperative - Non-Memory Mirrors

Refer to Wiring Diagrams Cell 124 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Mirrors for schematic and connector information.

Normal Operation

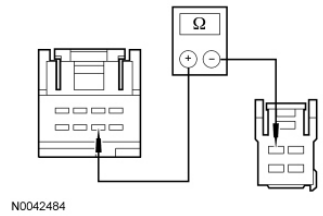
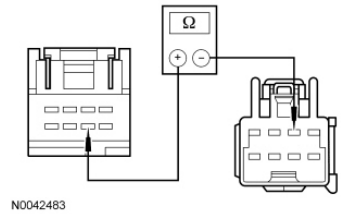
Under normal operation, the exterior mirror control switch uses circuit CPM23 (GY) as the common circuit for both exterior mirror down/up and left/right movement.

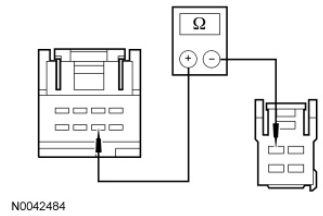
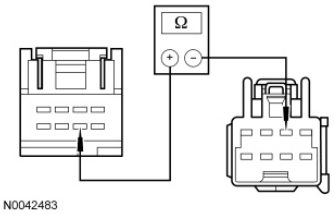
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Exterior mirror control switch
- Exterior mirror motor
- Exterior mirror

PINPOINT TEST B: A SINGLE MIRROR IS INOPERATIVE - NON-MEMORY MIRRORS

Test Step	Result / Action to Take
B1 CHECK THE LH MIRROR OPERATION	
• Operate the LH exterior mirror using the exterior mirror control switch. • **Does the LH exterior mirror operate?**	**Yes** GO to B2 . **No** GO to B4 .
B2 CHECK THE EXTERIOR MIRROR CONTROL SWITCH	
• Ignition OFF. • Disconnect: Exterior Mirror Control Switch C527. • Carry out the Exterior Mirror Control Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the exterior mirror control switch pass the component test?**	**Yes** GO to B3 . **No** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the system for normal operation.
B3 CHECK CIRCUIT CPM23 (GY) FOR AN OPEN	
• Disconnect: RH Exterior Mirror C622 (without heated mirrors) or C625 (with heated mirrors). • **Without heated mirror:** Measure the resistance between exterior mirror control switch C527-6, circuit CPM23 (GY), harness side and RH exterior mirror C622-2, circuit CPM23 (GY), harness side.	**Yes** CHECK the RH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for open circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new RH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new exterior mirror motor. REFER to Exterior Mirror Motor in this section. TEST the system for normal operation.

 N0042484 • **With heated mirror:** Measure the resistance between exterior mirror control switch C527-6, circuit CPM23 (GY), harness side and RH exterior mirror C625-2, circuit CPM23 (GY), harness side.  N0042483 • **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit. TEST the system for normal operation.
B4 CHECK THE EXTERIOR MIRROR CONTROL SWITCH	
• Ignition OFF. • Disconnect: Exterior Mirror Control Switch C527. • Carry out the Exterior Mirror Control Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the exterior mirror control switch pass the component test?**	**Yes** GO to B5 . **No** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the system for normal operation.
B5 CHECK CIRCUIT CPM23 (GY) FOR AN OPEN	
• Disconnect: LH Exterior Mirror C516 (without heated mirrors) or C517 (with heated mirrors). • **Without heated mirror:** Measure the resistance between exterior mirror control switch C527-6, circuit CPM23 (GY), harness side and LH exterior mirror C516-2, circuit CPM23 (GY), harness side.	**Yes** CHECK the LH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for open circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new LH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new exterior mirror motor. REFER to Exterior Mirror Motor in this section. TEST the system for normal operation. **No**

 N0042484 • **With heated mirror:** Measure the resistance between exterior mirror control switch C527-6, circuit CPM23 (GY), harness side and LH exterior mirror C517-2, circuit CPM23 (GY), harness side.  N0042483 • **Is the resistance less than 5 ohms?**	REPAIR the circuit. TEST the system for normal operation.

Pinpoint Test C: A Single Mirror Does Not Operate Correctly - Non-Memory Mirrors

Refer to Wiring Diagrams Cell 124 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Mirrors for schematic and connector information.

Normal Operation

Under normal operation, the exterior mirror control switch uses circuits CPM16 (BN/BU), CPM17 (BU/GN), CPM20 (BN/WH), CPM21 (YE/VT) and CPM23 (GY) to control the exterior mirror motor movement. The exterior mirror switch controls the LH exterior mirror motor movement by switching voltage and ground to circuits CPM16 (BN/BU), CPM17 (BU/GN) and CPM23 (GY). The exterior mirror switch controls the RH exterior mirror motor movement by switching voltage and ground to circuits CPM20 (BN/WH), CPM21 (YE/VT) and CPM23 (GY).

Mirror Movement

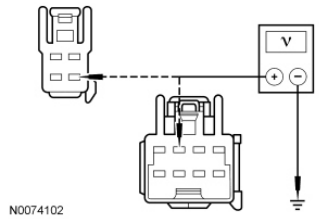
- When the LH/RH exterior mirror motor receives ground through circuit CPM16 (BN/BU)/CPM20 (BN/WH) and power through circuit CPM23 (GY), the LH/RH exterior mirror motor will operate rightward.
- When the LH/RH exterior mirror motor receives power through circuit CPM16 (BN/BU)/CPM20 (BN/WH) and ground through circuit CPM23 (GY), the LH/RH exterior mirror motor will operate leftward.
- When the LH/RH exterior mirror motor receives ground through circuit CPM17 (BU/GN)/CPM21 (YE/VT) and power through circuit CPM23 (GY), the LH/RH exterior mirror motor will operate upward.
- When the LH/RH exterior mirror motor receives power through circuit CPM17 (BU/GN)/CPM21 (YE/VT) and ground through circuit CPM23 (GY), the LH/RH exterior mirror motor will operate downward.

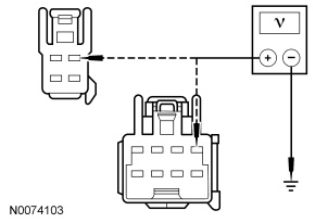
This pinpoint test is intended to diagnose the following:

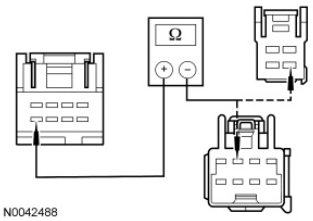
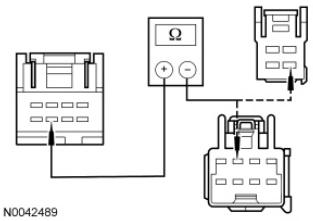
- Wiring, terminals or connectors
- Exterior mirror control switch
- Exterior mirror motor
- Exterior mirror

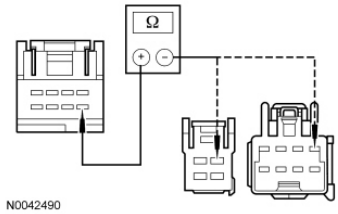
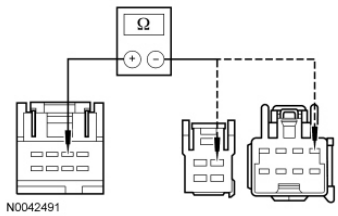
PINPOINT TEST C: A SINGLE MIRROR DOES NOT OPERATE CORRECTLY - NON-MEMORY MIRRORS

Test Step	Result / Action to Take
C1 CHECK THE MIRROR MOVEMENT (RIGHT/LEFT)	
• Operate the RH and LH exterior mirrors in the right and left direction using the exterior mirror control switch. • **Do the exterior mirrors move left and right?**	**Yes** GO to C2 . **No** GO to C3 .
C2 CHECK THE MIRROR MOVEMENT (DOWN/UP)	
• Operate the RH and LH exterior mirrors in the down and up direction using the exterior mirror control switch. • **Do the exterior mirrors move up and down?**	**Yes** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation. **No** GO to C4 .
C3 CHECK THE VOLTAGE TO THE INOPERATIVE MIRROR	
• Ignition OFF. • Disconnect: Inoperative LH Exterior Mirror C516 (without heated mirrors) or C517 (with heated mirrors). • Disconnect: Inoperative RH Exterior Mirror C622 (without heated mirrors) or C625 (with heated mirrors). • **NOTE:** Position the exterior mirror control switch to the LH or RH position. • **Without heated mirrors:** While operating the exterior mirror control switch in the LEFT position, measure the voltage between ground and exterior mirror: ♦ **LH:** C516-3, circuit CPM16 (BN/BU), harness side.	**Yes** CHECK the RH or LH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for open circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new RH or LH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new RH or LH exterior mirror motor. REFER to Exterior Mirror Motor in this section. TEST the system for normal operation. **No** GO to C5 .

♦ **RH:** C622-3, circuit CPM20 (BN/WH), harness side. • **NOTE:** Position the exterior mirror control switch to the LH or RH position. • **With heated mirrors:** While operating the exterior mirror control switch in the LEFT position, measure the voltage between ground and exterior mirror: ♦ **LH:** C517-3, circuit CPM16 (BN/BU), harness side. ♦ **RH:** C625-3, circuit CPM20 (BN/WH), harness side.  • **Is the voltage greater than 10 volts?**	
C4 CHECK THE VOLTAGE TO THE INOPERATIVE MIRROR	
• Ignition OFF. • Disconnect: Inoperative LH Exterior Mirror C516 (without heated mirrors) or C517 (with heated mirrors). • Disconnect: Inoperative RH Exterior Mirror C622 (without heated mirrors) or C625 (with heated mirrors). • **NOTE:** Position the exterior mirror control switch to the LH or RH position. • **Without heated mirrors:** While operating the exterior mirror control switch in the DOWN position, measure the voltage between ground and exterior mirror: ♦ **LH:** C516-1, circuit CPM17 (BU/GN), harness side.	**Yes** CHECK the RH or LH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for open circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new RH or LH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new RH or LH exterior mirror motor. REFER to Exterior Mirror Motor in this section. TEST the system for normal operation. **No** GO to C6 .

♦ **RH:** C622-1, circuit CPM21 (YE/VT), harness side. • **NOTE:** Position the exterior mirror control switch to the LH or RH position. • **With heated mirrors:** While operating the exterior mirror control switch in the DOWN position, measure the voltage between ground and exterior mirror: ♦ **LH:** C517-1, circuit CPM17 (BU/GN), harness side. ♦ **RH:** C625-1, circuit CPM21 (YE/VT), harness side.  • **Is the voltage greater than 10 volts?**	
C5 CHECK CIRCUIT CPM16 (BN/BU) OR CPM20 (BN/WH) FOR AN OPEN	
• Disconnect: Exterior Mirror Control Switch C527. • **Inoperative LH mirror:** Measure the resistance between exterior mirror control switch C527-8, circuit CPM16 (BN/BU), harness side and LH exterior mirror: ♦ **without heated mirror:** C516-3, circuit CPM16 (BN/BU), harness side. ♦ **with heated mirror:** C517-3, circuit CPM16 (BN/BU), harness side.	**Yes** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

 N0042488 • **Inoperative RH mirror:** Measure the resistance between exterior mirror control switch C527-7, circuit CPM20 (BN/WH), harness side and RH exterior mirror: ♦ **without heated mirror:** C622-3, circuit CPM20 (BN/WH), harness side. ♦ **with heated mirror:** C625-3, circuit CPM20 (BN/WH), harness side.  N0042489 • **Is the resistance less than 5 ohms?**	
C6 CHECK CIRCUIT CPM17 (BU/GN) OR CPM21 (YE/VT) FOR AN OPEN	
• Disconnect: Exterior Mirror Control Switch C527. • **Inoperative LH mirror:** Measure the resistance between exterior mirror control switch C527-5, circuit CPM17 (BU/GN), harness side and LH exterior mirror: ♦ **without heated mirror:** C516-1, circuit CPM17 (BU/GN), harness side. ♦ **with heated mirror:** C517-1, circuit CPM17 (BU/GN), harness side.	**Yes** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

 • **Inoperative RH mirror:** Measure the resistance between exterior mirror control switch C527-2, circuit CPM21 (YE/VT), harness side and RH exterior mirror: ♦ **without heated mirror:** C622-1, circuit CPM21 (YE/VT), harness side. ♦ **with heated mirror:** C625-1, circuit CPM21 (YE/VT), harness side.  • **Is the resistance less than 5 ohms?**	

Pinpoint Test D: The Memory Mirror is Inoperative

Refer to Wiring Diagrams Cell 124 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Mirrors for schematic and connector information.

Normal Operation

Under normal operation, the exterior mirror control switch receives power from circuit SBP12 (GN/RD) and ground from circuit GD126 (BK/WH). The exterior mirror control switch uses circuits CPM16 (BN/BU), CPM17 (BU/GN), CPM20 (BN/WH), CPM21 (YE/VT) and CPM23 (GY) to send input signals to the Driver Door Module (DDM). The DDM controls the LH exterior mirror motor movement by supplying the appropriate power and ground to circuits CPM27 (GY/BU), CPM28 (BU/BN) and CPM29 (GN). The DDM communicates with the Driver Seat Module (DSM) through the Medium Speed Controller Area Network (MS-CAN) whenever the DDM receives an input signal from the exterior mirror control switch for the RH mirror. The DSM controls the RH exterior mirror motor movement by supplying the appropriate power and ground to circuits CPM31 (YE/GY), CPM33 (WH/VT) and CPM34 (WH/BN).

The memory mirror system uses feedback potentiometers, located in the LH and RH exterior mirror motors, in order to track the movement and position of the LH and RH exterior mirror motors. The DDM supplies the LH exterior mirror feedback potentiometer reference voltage through circuit LPM30 (GY/VT) and ground through circuit RPM30 (YE). The DSM supplies the RH exterior mirror feedback potentiometer reference voltage through circuit LPM30 (GY/VT) and ground through circuit RPM30 (YE). The DDM receives feedback from the LH exterior mirror feedback potentiometer through left/right circuit VPM35 (YE/BU) and

up/down circuit VPM36 (BN/YE). The DSM receives feedback from the RH exterior mirror feedback potentiometer through left/right circuit VPM37 (BU/OG) and up/down circuit VPM38 (BN/GN).

DTC Description	Fault Trigger Conditions
• B1667 Mirror Driver Up/Down Motor Stalled	Incorrect mirror motor position reported to the DDM during On-Demand Self Test.
• B1668 Mirror Driver Right/Left Motor Stalled	Incorrect mirror motor position reported to the DDM during On-Demand Self Test.
• B1669 Mirror Passenger Up/Down Motor Stalled	Incorrect mirror motor position reported to the DSM during On-Demand Self Test.
• B1670 Mirror Passenger Right/Left Motor Stalled	Incorrect mirror motor position reported to the DSM during On-Demand Self Test.
• B1733 Mirror Driver Vertical Switch Circuit Failure	Mirror switch failure detected by the DDM when switch is activated.
• B1737 Mirror Driver Horizontal Switch Circuit Failure	Mirror switch failure detected by the DDM when switch is activated.
• B1741 Mirror Passenger Vertical Switch Circuit Failure	Mirror switch failure detected by the DDM when switch is activated.
• B1745 Mirror Passenger Horizontal Switch Circuit Failure	Mirror switch failure detected by the DDM when switch is activated.
• B2223 Mirror Driver Drive Circuit Failure	Short to ground or battery.
• B2224 Mirror Passenger Drive Circuit Failure	Short to ground or battery.
• B2312 Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	Open or short to ground.
• B2314 Mirror Passenger Horizontal Feedback Potentiometer Circuit Short to Battery	Short to battery.
• B2316 Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	Open or short to ground.
• B2318 Mirror Passenger Vertical Feedback Potentiometer Circuit Short to Battery	Short to battery.
• B2320 Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	Open or short to ground.
	Short to battery.

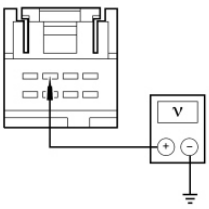
• B2322 Mirror Driver Horizontal Feedback Potentiometer Circuit Short to Battery	
• B2324 Mirror Driver Vertical Feedback Potentiometer Circuit Failure	Open or short to ground.
• B2326 Mirror Driver Vertical Feedback Potentiometer Circuit Short to Battery	Short to battery.

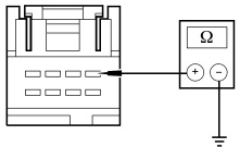
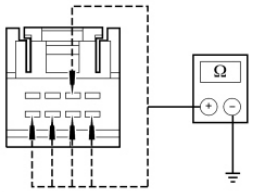
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- DDM
- DSM
- Exterior mirror motor
- Exterior mirror
- Exterior mirror control switch

PINPOINT TEST D: THE MEMORY MIRROR IS INOPERATIVE

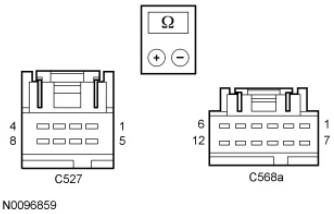
Test Step	Result / Action to Take
D1 RETRIEVE THE DTCs FROM THE DSM AND DDM	
• Use the recorded DSM and DDM DTCs from the continuous and on-demand self tests. • **Are DTCs retrieved?**	**Yes** If DTC B1733, B1737, B1741 or B1745 - CARRY OUT the Exterior Mirror Control Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. If the switch tests OK, GO to D11 . If DTC B1667 or B1668 - If other DTCs are present, DIAGNOSE them first. If no other DTCs are present, INSPECT the LH exterior mirror motor for foreign material, damage or a binding condition. If no condition is found, GO to D12 . If DTC B1669 or B1670 - If other DTCs are present, DIAGNOSE them first. If no other DTCs are present, INSPECT the RH exterior mirror motor for foreign material, damage or a binding condition. If no condition is found, GO to D14 . If DTC B2223, GO to D16 . If DTC B2224, GO to D19 . If DTC B2312, B2316, B2320 or B2324, GO to D22 . If DTC B2314, B2318, B2322 or B2326, GO to D26 . **No** GO to D2 .

D2 CHECK THE OPERATION OF THE EXTERIOR MIRRORS FROM THE EXTERIOR MIRROR CONTROL SWITCH	
• Operate the mirrors using the exterior mirror control switch. • **Do the mirrors operate momentarily using the exterior mirror control switch?**	**Yes** GO to D8 . **No** GO to D3 .
D3 CHECK THE EXTERIOR MIRROR CONTROL SWITCH	
• Ignition OFF. • Disconnect: Exterior Mirror Control Switch C527. • Carry out the Exterior Mirror Control Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the exterior mirror control switch pass the component test?**	**Yes** GO to D4 . **No** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the system for normal operation.
D4 CHECK CIRCUIT SBP12 (GN/RD) FOR VOLTAGE	
• Ignition ON. • Measure the voltage between exterior mirror control switch C527-3, circuit SBP12 (GN/RD), harness side and ground.  N0006111 • **Is the voltage greater than 10 volts?**	**Yes** GO to D5 . **No** VERIFY Smart Junction Box (SJB) fuse 12 (7.5A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
D5 CHECK CIRCUIT GD126 (BK/WH) FOR AN OPEN	
• Ignition OFF. • Measure the resistance between exterior mirror control switch C527-1, circuit GD126 (BK/WH), harness side and ground.	**Yes** GO to D6 . **No** REPAIR the circuit. TEST the system for normal operation.

 N0006112 • **Is the resistance less than 5 ohms?**	
D6 CHECK CIRCUITS CPM16 (BN/BU), CPM17 (BU/GN), CPM20 (BN/WH), CPM21 (YE/VT) AND CPM23 (GY) FOR A SHORT TO GROUND	
• Disconnect: DDM C568B. • Measure the resistance between ground and exterior mirror control switch: ♦ C527-2, circuit CPM21 (YE/VT), harness side. ♦ C527-5, circuit CPM17 (BU/GN), harness side. ♦ C527-6, circuit CPM23 (GY), harness side. ♦ C527-7, circuit CPM20 (BN/WH), harness side. ♦ C527-8, circuit CPM16 (BN/BU), harness side.  N0006283 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to D7 . **No** REPAIR the circuit(s). TEST the system for normal operation.
D7 CHECK CIRCUITS CPM16 (BN/BU), CPM17 (BU/GN), CPM20 (BN/WH), CPM21 (YE/VT) AND CPM23 (GY) FOR AN OPEN	
• Measure the resistance between exterior mirror control switch C527, harness side and DDM C568A, harness side using the following chart:	**Yes** GO to D29 . **No** REPAIR the circuit(s). TEST the system for normal operation.

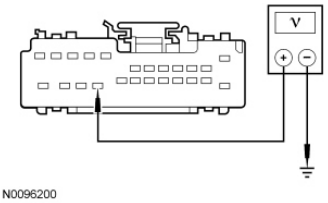
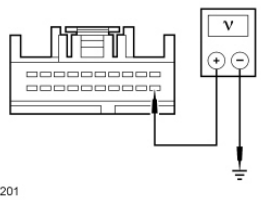
Exterior Mirror Control Switch	Circuit	DDM
C527-2	CPM21 (YE/VT)	C568A-7
C527-5	CPM17 (BU/GN)	C568A-9

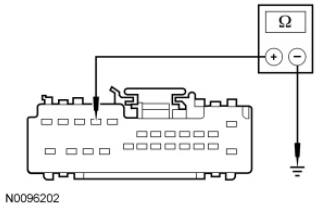
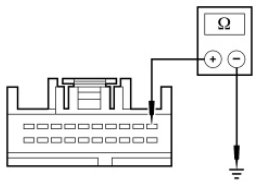
C527-6	CPM23 (GY)	C568A-11
C527-7	CPM20 (BN/WH)	C568A-8
C527-8	CPM16 (BN/BU)	C568A-10

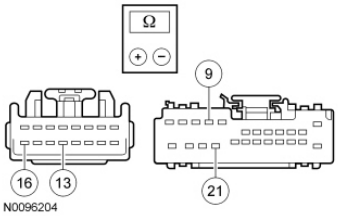


N0096859

- **Are the resistances less than 5 ohms?**

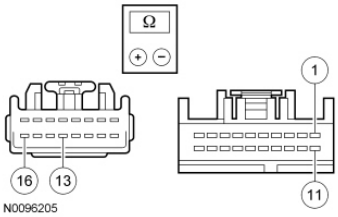
D8 CHECK CIRCUIT RPM30 (YE) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: **Inoperative LH Mirror:** DDM C568A and DDM C568B. • Disconnect: **Inoperative RH Mirror:** DSM C3299C and C3299D. • Ignition ON. • **Inoperative LH mirror:** Measure the voltage between DDM C568B-21, circuit RPM30 (YE), harness side and ground.  N0096200 • **Inoperative RH mirror:** Measure the voltage between DSM C3299D-11, circuit RPM30 (YE), harness side and ground.  N0096201 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to D9 .
D9 CHECK CIRCUIT LPM30 (GY/VT) FOR SHORT TO GROUND	

• Ignition OFF. • Disconnect: Inoperative Exterior Mirror C522 (LH) or C626 (RH). • **Inoperative LH mirror:** Measure the resistance between DDM C568B-9, circuit LPM30 (GY/VT), harness side and ground.  N0096202 • **Inoperative RH mirror:** Measure the resistance between DSM C3299D-1, circuit LPM30 (GY/VT), harness side and ground.  N0096203 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D10 . **No** REPAIR the circuit. TEST the system for normal operation.
D10 CHECK CIRCUITS RPM30 (YE) AND LPM30 (GY/VT) FOR AN OPEN	
• **Inoperative LH mirror:** Measure the resistance between LH exterior mirror C522, harness side, DDM C568A, harness side and DDM C568B, harness side using the following chart: **LH Exterior Mirror** / **Circuit** / **DDM** C522-16 / RPM30 (YE) / C568B-21 C522-13 / LPM30 (GY/VT) / C568B-9	**Yes** CHECK the LH or RH exterior mirror jumper harness between the vehicle harness and the exterior mirror motors for open or shorted circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new LH or RH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new LH or RH exterior mirror motor. REFER to Exterior Mirror Motor in this section. TEST the system for normal operation. **No** REPAIR the circuit(s). TEST the system for normal operation.



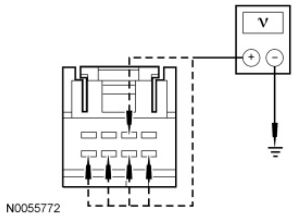
- **Inoperative RH mirror:** Measure the resistance between RH exterior mirror C626, harness side and DSM C3299C, harness side using the following chart:

RH Exterior Mirror	Circuit	DSM
C626-13	LPM30 (GY/VT)	C3299D-1
C626-16	RPM30 (YE)	C3299D-11

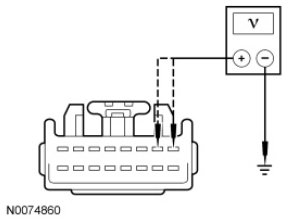
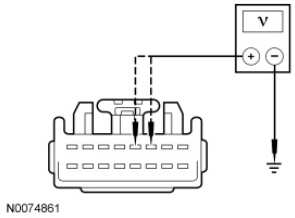


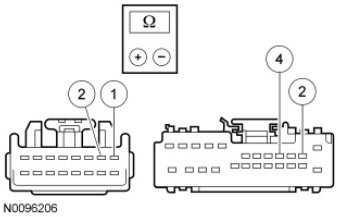
- **Are the resistances less than 5 ohms?**

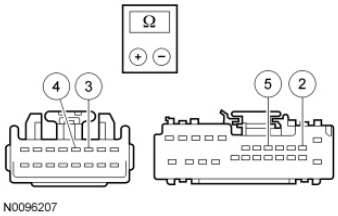
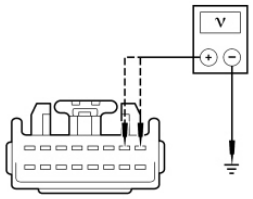
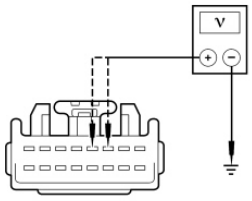
D11 CHECK CIRCUITS CPM16 (BN/BU), CPM17 (BU/GN), CPM20 (BN/WH), CPM21 (YE/VT) AND CPM23 (GY) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Exterior Mirror Control Switch C527. • Disconnect: DDM C568B. • Ignition ON. • Measure the voltage between ground and exterior mirror control switch: ♦ C527-2, circuit CPM21 (YE/VT), harness side. ♦ C527-5, circuit CPM17 (BU/GN), harness side. ♦ C527-6, circuit CPM23 (GY), harness side. ♦ C527-7, circuit CPM20 (BN/WH), harness side. ♦ C527-8, circuit CPM16 (BN/BU), harness side.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. TEST the system for normal operation. **No** GO to D29 .



- **Is any voltage present?**

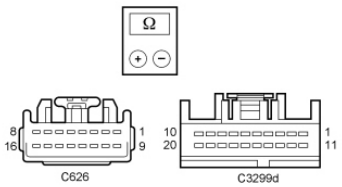
D12 CHECK THE EXTERIOR MIRROR FOR VOLTAGE FROM THE DDM	
• Ignition OFF. • Disconnect: LH Exterior Mirror C522. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DDM DataLogger. • **DTC B1667:** Measure the voltage between LH exterior mirror C522-1, circuit CPM29 (GN), harness side and ground while toggling the LH exterior mirror DDM PID DR_UP to ON; and between LH exterior mirror C522-2, circuit CPM27 (GY/BU), harness side and ground while toggling the LH exterior mirror DDM PID DR_DOWN to ON.  • **DTC B1668:** Measure the voltage between LH exterior mirror C522-3, circuit CPM27 (GY/BU), harness side and ground while toggling the LH exterior mirror DDM PID DR_LEFT to ON; and between LH exterior mirror C522-4, circuit CPM28 (BU/BN), harness side and ground while toggling the LH exterior mirror DDM PID DR_RIGHT to ON.  	**Yes** CHECK the LH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for shorted and open circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new LH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new LH exterior mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs. TEST the system for normal operation. **No** GO to D13 .

• **Do the voltages momentarily change from 0 volt to greater than 10 volts when the active command is toggled ON?**	
D13 CHECK CIRCUITS CPM27 (GY/BU), CPM28 (BU/BN) AND CPM29 (GN) FOR AN OPEN	
• Ignition OFF. • Disconnect: DDM C568B. • **DTC B1667:** Measure the resistance between LH exterior mirror C522, harness side and DDM C568B, harness side using the following chart: **LH Exterior Mirror** / **Circuit** / **DDM** C522-1 / CPM29 (GN) / C568B-4 C522-2 / CPM27 (GY/BU) / C568B-2  N0096206 • **DTC B1668:** Measure the resistance between LH exterior mirror C522, harness side and DDM C568B, harness side using the following chart: **LH Exterior Mirror** / **Circuit** / **DDM** C522-3 / CPM27 (GY/BU) / C568B-2 C522-4 / CPM28 (BU/BN) / C568B-5	**Yes** GO to D29 . **No** REPAIR the circuit(s). CLEAR the DTCs. TEST the system for normal operation.

 N0096207 • **Are the resistances less than 5 ohms?**	
D14 CHECK THE EXTERIOR MIRROR FOR VOLTAGE FROM THE DSM	
• Ignition OFF. • Disconnect: RH Exterior Mirror C626. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DSM DataLogger. • **DTC B1669:** Measure the voltage between RH exterior mirror C626-1, circuit CPM34 (WH/BN), harness side and ground while toggling the RH exterior mirror DSM PID PR_UP to ON; and between RH exterior mirror C626-2, circuit CPM31 (YE/GY), harness side and ground while toggling the RH exterior mirror DSM PID PR_DOWN to ON.  N0074863 • **DTC B1670:** Measure the voltage between RH exterior mirror C626-3, circuit CPM31 (YE/GY), harness side and ground while toggling the RH exterior mirror DSM PID PR_LEFT to ON; and between RH exterior mirror C626-4, circuit CPM33 (WH/VT), harness side and ground while toggling the RH exterior mirror DSM PID PR_RIGHT to ON.  N0074864 • **Do the voltages momentarily change from 0 volt to greater than 10 volts when the active command is toggled ON?**	**Yes** CHECK the RH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for shorted and open circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new RH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new RH exterior mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs. TEST the system for normal operation. **No** GO to D15 .

D15 CHECK CIRCUITS CPM31 (YE/GY), CPM33 (WH/VT) AND CPM34 (WH/BN) FOR AN OPEN	
• Ignition OFF. • Disconnect: DSM C3299D. • **DTC B1669:** Measure the resistance between RH exterior mirror C626, harness side and DSM C3299D, harness side using the following chart:	**Yes** GO to D28 . **No** REPAIR the circuit(s). CLEAR the DTCs. TEST the system for normal operation.

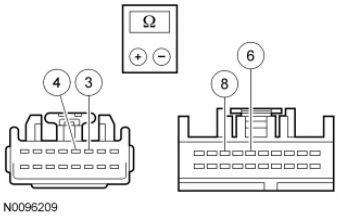
RH Exterior Mirror	Circuit	DSM
C626-1	CPM34 (WH/BN)	C3299D-7
C626-2	CPM31 (YE/GY)	C3299D-8



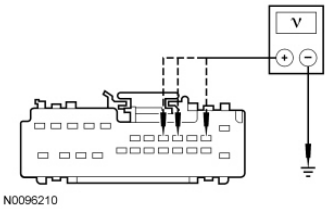
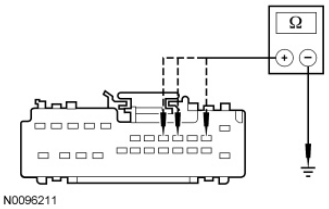
N0096860

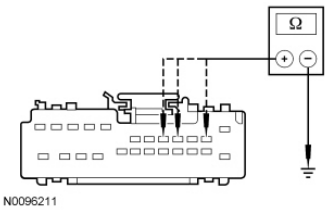
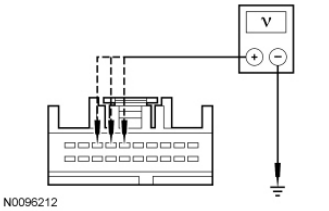
• **DTC B1670:** Measure the resistance between RH exterior mirror C626, harness side and DSM C3299D, harness side using the following chart:

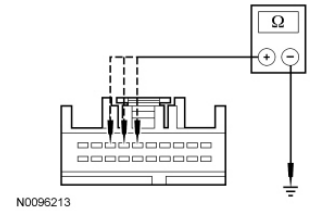
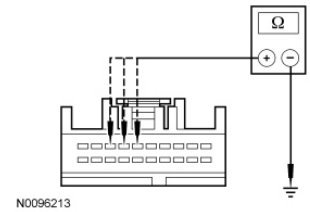
RH Exterior Mirror	Circuit	DSM
C626-3	CPM31 (YE/GY)	C3299D-8
C626-4	CPM33 (WH/VT)	C3299D-6

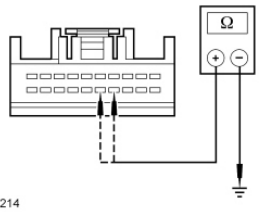
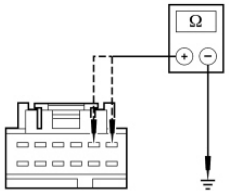
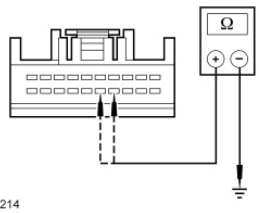


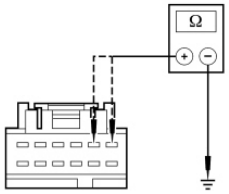
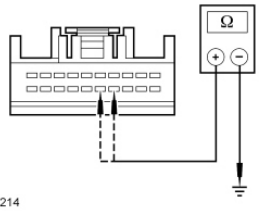
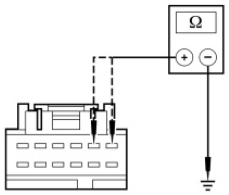
N0096209

• **Are the resistances less than 5 ohms?**	
D16 CHECK CIRCUITS CPM27, CPM28 (BU/BN) AND CPM29 (GN) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: DDM C568B. • Ignition ON. • Measure the voltage between ground and DDM : ♦ C568B-5, circuit CPM28 (BU/BN), harness side. ♦ C568B-4, circuit CPM29 (GN), harness side. ♦ C568B-2, circuit CPM27 (GY/BU), harness side.  N0096210 • **Is any voltage present?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. TEST the system for normal operation. **No** GO to D17 .
D17 CHECK CIRCUITS CPM27 (GY/BU), CPM28 (BU/BN) AND CPM29 (GN) FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between ground and DDM : ♦ C568B-5, circuit CPM28 (BU/BN), harness side. ♦ C568B-4, circuit CPM29 (GN), harness side. ♦ C568B-2, circuit CPM27 (GY/BU), harness side.  N0096211 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to D29 . **No** GO to D18 .
D18 CHECK THE LH EXTERIOR MIRROR FOR A SHORT TO GROUND	

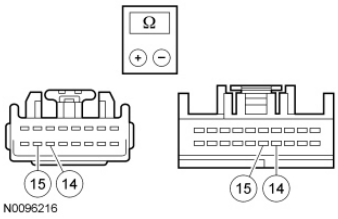
• Disconnect: LH Exterior Mirror C522. • Measure the resistance between ground and DDM : ♦ C568B-5, circuit CPM28 (BU/BN), harness side. ♦ C568B-4, circuit CPM29 (GN), harness side. ♦ C568B-2, circuit CPM27 (GY/BU), harness side.  N0096211 • **Are the resistances greater than 10,000 ohms?**	**Yes** CHECK the LH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for shorted circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new LH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new LH exterior mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR the circuit(s). CLEAR the DTCs. TEST the system for normal operation.
D19 CHECK CIRCUITS CPM31 (YE/GY), CPM33 (WH/VT) AND CPM34 (WH/BN) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: DSM C3299D. • Ignition ON. • Measure the voltage between ground and DSM : ♦ C3299D-7, circuit CPM34 (WH/BN), harness side. ♦ C3299D-8, circuit CPM31 (YE/GY), harness side. ♦ C3299D-6, circuit CPM33 (WH/VT), harness side.  N0096212 • **Is any voltage present?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. TEST the system for normal operation. **No** GO to D20 .
D20 CHECK CIRCUITS CPM31 (YE/GY), CPM33 (WH/VT) AND CPM34 (WH/BN) FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between ground and DSM : ♦ C3299D-7, circuit CPM34 (WH/BN), harness side.	**Yes** GO to D28 . **No** GO to D21 .

♦ C3299D-8, circuit CPM31 (YE/GY), harness side. ♦ C3299D-6, circuit CPM33 (WH/VT), harness side.  N0096213 • **Are the resistances greater than 10,000 ohms?**	
D21 CHECK THE RH EXTERIOR MIRROR FOR A SHORT TO GROUND	
• Disconnect: LH Exterior Mirror C626. • Measure the resistance between ground and DSM : ♦ C3299D-7, circuit CPM34 (WH/BN), harness side. ♦ C3299D-8, circuit CPM31 (YE/GY), harness side. ♦ C3299D-6, circuit CPM33 (WH/VT), harness side.  N0096213 • **Are the resistances greater than 10,000 ohms?**	**Yes** CHECK the RH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for shorted circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new RH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new RH exterior mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR the circuit(s). CLEAR the DTCs. TEST the system for normal operation.
D22 CHECK THE LH AND RH EXTERIOR MIRRORS	
• Ignition OFF. • Disconnect: **DTC B2312 or B2316:** DSM C3299D. • Disconnect: **DTC B2320 or B2324:** DDM C568A. • **DTC B2312 or B2316:** Measure the resistance between ground and DSM : ♦ **DTC B2312:** C3299D-15, circuit VPM37 (BU/OG), harness side. ♦ **DTC B2316:** C3299D-14, circuit VPM38 (BN/GN), harness side.	**Yes** GO to D24 . **No** GO to D23 .

 N0096214 • **DTC B2320 or B2324:** Measure the resistance between ground and DDM : ♦ **DTC B2320:** C568A-2, circuit VPM35 (YE/BU), harness side. ♦ **DTC B2324:** C568A-1, circuit VPM36 (BN/YE), harness side.  N0096215 • **Is the resistance greater than 10,000 ohms?**	
D23 CHECK CIRCUITS VPM35 (YE/BU), VPM36 (BN/YE), VPM37 (BU/OG) AND VPM38 (BN/GN) FOR A SHORT TO GROUND	
• Disconnect: **DTC B2312 or B2316:** RH Exterior Mirror C625. • Disconnect: **DTC B2320 or B2324:** LH Exterior Mirror C522. • **DTC B2312 or B2316:** Measure the resistance between ground and DSM : ♦ **DTC B2312:** C3299D-15, circuit VPM37 (BU/OG), harness side. ♦ **DTC B2316:** C3299D-14, circuit VPM38 (BN/GN), harness side.  N0096214 • **DTC B2320 or B2324:** Measure the resistance between ground and DDM : ♦ **DTC B2320:** C568A-2, circuit VPM35 (YE/BU), harness side. ♦ **DTC B2324:** C568A-1, circuit VPM36 (BN/YE), harness side.	**Yes** CHECK the RH or LH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for shorted circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new RH or LH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new RH or LH exterior mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR the circuit(s). CLEAR the DTCs. TEST the system for normal operation.

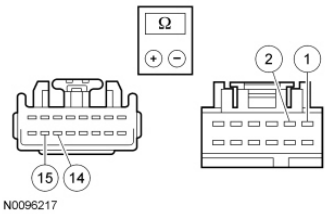
 N0096215 • **Is the resistance greater than 10,000 ohms?**	
D24 CHECK THE RH AND LH EXTERIOR MIRRORS FOR AN INTERNAL OPEN	
• **DTC B2312 or B2316:** Measure the resistance between DSM C3299D-15, circuit VPM37 (BU/OG), harness side and C3299D-14, circuit VPM38 (BN/GN), harness side.  N0096214 • **DTC B2320 or B2324:** Measure the resistance between DDM C568A-2, circuit VPM35 (YE/BU), harness side and C568A-1, circuit VPM36 (BN/YE), harness side.  N0096215 • **Is the resistance less than 5 ohms?**	**Yes** For DTC B2312 or B2316, GO to D28 . For DTC B2320 or B2324, GO to D29 . **No** GO to D25 .
D25 CHECK CIRCUITS VPM35 (YE/BU), VPM36 (BN/YE), VPM37 (BU/OG) AND VPM38 (BN/GN) FOR AN OPEN	
• Disconnect: **DTC B2312 or B2316:** RH Exterior Mirror C626. • Disconnect: **DTC B2320 or B2324:** LH Exterior Mirror C522. • **DTC B2312 or B2316:** Measure the resistance between RH exterior mirror C626, harness side and DSM C3299D, harness side using the following chart:	**Yes** CHECK the RH or LH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for shorted circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new RH or LH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new RH or LH exterior mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs.

DTC	RH Exterior Mirror	Circuit	DSM
B2312	C626-15	VPM37 (BU/OG)	C3299D-15
B2316	C626-14	VPM38 (BN/GN)	C3299D-14



- **DTC B2320 or B2324:** Measure the resistance between LH exterior mirror C522, harness side and DDM C568A, harness side using the following chart:

DTC	RH Exterior Mirror	Circuit	DSM
B2312	C522-15	VPM35 (YE/BU)	C568A-2
B2316	C522-14	VPM36 (BN/YE)	C568A-1



- **Is the resistance less than 5 ohms?**

TEST the system for normal operation.

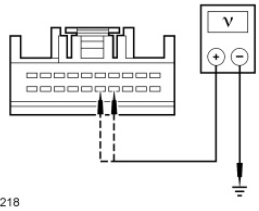
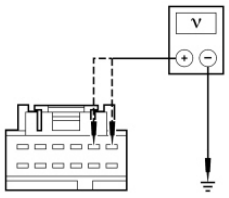
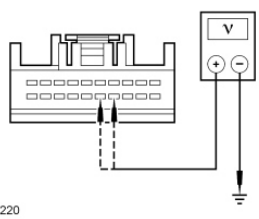
No
REPAIR the circuit(s). CLEAR the DTCs. TEST the system for normal operation.

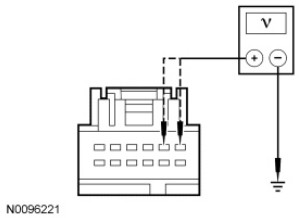
D26 CHECK THE LH AND RH EXTERIOR MIRRORS

- Ignition OFF.
- Disconnect: **DTC B2314 or B2318:** DSM C3299D.
- Disconnect: **DTC B2322 or B2326:** DDM C568A.
- Ignition ON.
- **DTC B2314 or B2318:** Measure the voltage between ground and DSM :

Yes
GO to D27 .

No
For DTC B2314 or B2318, GO to D28 . For DTC B2322 or B2326, GO to D29 .

♦ **DTC B2314:** C3299D-15, circuit VPM37 (BU/OG), harness side. ♦ **DTC B2318:** C3299D-14, circuit VPM38 (BN/GN), harness side.  N0096218 • **DTC B2322 or B2326:** Measure the voltage between ground and DDM : ♦ **DTC B2322:** C568A-2, circuit VPM35 (YE/BU), harness side. ♦ **DTC B2326:** C568A-1, circuit VPM36 (BN/YE), harness side.  N0096219 • **Is any voltage present?**	
D27 CHECK THE LH AND RH EXTERIOR MIRRORS	
• Ignition OFF. • Disconnect: **DTC B2314 or B2318:** RH Exterior Mirror C626. • Disconnect: **DTC B2322 or B2326:** LH Exterior Mirror C522. • **DTC B2314 or B2318:** Measure the voltage between ground and DSM : ♦ **DTC B2314:** C3299D-15, circuit VPM37 (BU/OG), harness side. ♦ **DTC B2318:** C3299D-14, circuit VPM38 (BN/GN), harness side.  N0096220 • **DTC B2322 or B2326:** Measure the voltage between ground and DDM :	**Yes** REPAIR the circuit(s). CLEAR the DTCs. TEST the system for normal operation. **No** CHECK the RH or LH exterior mirror jumper harness between the vehicle harness and the exterior mirror motor for shorted circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new RH or LH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new RH or LH exterior mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs. TEST the system for normal operation.

♦ **DTC B2322:** C568A-2, circuit VPM35 (YE/BU), harness side. ♦ **DTC B2326:** C568A-1, circuit VPM36 (BN/YE), harness side.  • **Is any voltage present?**	
D28 CHECK THE DSM FOR CORRECT OPERATION	
• Disconnect all DSM connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all DSM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DSM . REFER to Section 501-10 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
D29 CHECK THE DDM FOR CORRECT OPERATION	
• Disconnect all DDM connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all DDM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DDM . REFER to Section 501-14 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test E: The Heated Exterior Mirror is Inoperative

Refer to Wiring Diagrams Cell 56 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Heated Windows for schematic and connector information.

Refer to Wiring Diagrams Cell 124 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Mirrors for schematic and connector information.

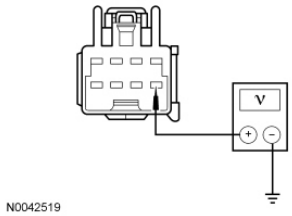
Normal Operation

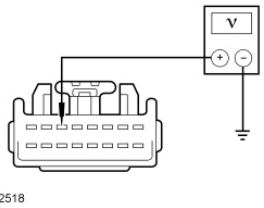
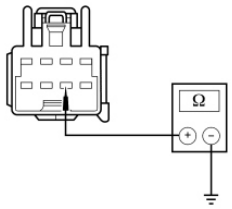
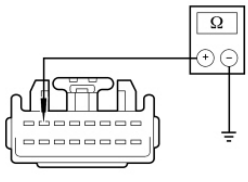
Under normal operation, the LH and RH exterior mirror glass receives power from Power Distribution Box (PDB) fuse 38 (10A) and through circuit CBB38 (GY/BU), when the rear window defrost system is on. Ground is supplied to the LH heated exterior mirror glass through circuit GD126 (BK/WH) and to the RH heated exterior mirror glass through circuit GD139 (BK/YE).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Exterior mirror glass
- Exterior mirror

PINPOINT TEST E: THE HEATED EXTERIOR MIRROR IS INOPERATIVE

Test Step	Result / Action to Take
E1 CHECK THE OPERATION OF THE REAR WINDOW DEFROST SYSTEM	
• Ignition ON. • Press the rear window defrost switch to the ON position. • Place a hand on the rear window to verify that the rear window heats up. • **Does the rear window defrost system operate?**	**Yes** GO to E2 . **No** REFER to Section 501-11 to diagnose the rear window defrost system.
E2 CHECK THE VOLTAGE TO THE EXTERIOR MIRRORS	
• Ignition OFF. • Disconnect: LH Exterior Mirror C517 (without memory mirrors)/C522 (with memory mirrors) or RH Exterior Mirror C625 (without memory mirrors)/C626 (with memory mirrors). • Ignition ON. • Press the rear window defrost switch to the ON position. • **Without memory mirrors:** Measure the voltage between ground and inoperative exterior mirror: ♦ **LH:** C517-5, circuit CBB38 (GY/BU), harness side. ♦ **RH:** C625-5, circuit CBB38 (GY/BU0), harness side.  • **With memory mirrors:** Measure the voltage between ground and inoperative exterior mirror: ♦ **LH:** C522-6, circuit CBB38 (BU/OG), harness side.	**Yes** GO to E3 . **No** VERIFY that PDB fuse 38 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.

♦ **RH:** C626-6, circuit CBB38 (GY/BU), harness side.  N0042518 • **Is the voltage greater than 10 volts?**	
E3 CHECK THE EXTERIOR REAR VIEW MIRROR GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • **Without memory mirrors:** Measure the resistance between ground and inoperative exterior mirror: ♦ **LH:** C517-6, circuit GD126 (BK/WH), harness side. ♦ **RH:** C625-6, circuit GD139 (BK/YE), harness side.  N0042521 • **With memory mirrors:** Measure the resistance between ground and inoperative exterior mirror: ♦ **LH:** C522-7, circuit GD126 (BK/WH), harness side. ♦ **RH:** C626-7, circuit GD139 (BK/YE), harness side.  N0042520 • **Is the resistance less than 5 ohms?**	**Yes** CHECK the LH or RH exterior mirror jumper harness between the vehicle harness and the exterior mirror glass for open circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new LH or RH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new LH or RH exterior mirror glass. REFER to Exterior Mirror Glass in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

Rear View Mirrors - Interior

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent

Principles of Operation

Interior Auto-Dimming Rear View Mirror

The interior auto-dimming rear view mirror automatically reduces the glare caused by headlamps reflecting in the interior rear view mirror. Voltage is supplied to the interior auto-dimming mirror when the ignition is in RUN or ACC. The auto-dimming feature is disabled when the vehicle is in REVERSE.

The interior auto-dimming rear view mirror has 2 photoelectric sensors, forward facing and rearward facing sensors, that detect forward and rearward light conditions. Based on these inputs, the automatic dimming feature adjusts the reflectance level of the interior rear view mirror glass to eliminate unwanted glare. The reflectance level of the mirror glass is variable and depends on the amount of rear glare in relation to ambient light conditions in front of the interior mirror.

When the forward facing sensor detects daytime conditions, the rearward facing sensor is inactive and the mirror stays in a high reflectance mode. When the forward facing sensor detects nighttime conditions, the rearward facing sensor is active and detects glare from the headlights of vehicles approaching from the rear, or other glare producing light sources. To provide increased visibility when backing up, the interior rear view and LH exterior mirror automaticallturns to a high reflectance mode whenever the vehicle is in REVERSE.

If the forward or rearward sensors are blocked, the automatic dimming interior mirror might not work correctly.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Interior rear view mirror	• Smart Junction Box (SJB) fuse 41 (15A) • Circuitry • LH exterior mirror glass • LH exterior mirror

	• Interior auto-dimming rear view mirror • Loose or corroded connections

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

4. If the concern is not visually evident, verify the symptom and GO to Symptom Chart - Interior Mirror or GO to Symptom Chart - NVH .

Symptom Chart - Interior Mirror

Symptom Chart - Interior Mirror

Symptom Chart - NVH

Symptom Chart - NVH

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

ConditionPossible SourcesAction

- The interior mirror loose/vibrates
- Interior mirror mounting loose
- If the mirror is still on the windshield **do not remove.** ATTEMPT to fully seat the mirror first (use Rear View Mirror Installer Tool for non-auto-dimming mirror). If the mirror is still loose or vibrates, REMOVE and REINSTALL the mirror. REFER to Interior Rear View Mirror in this section. If the condition still exists, INSTALL a new mirror.

Pinpoint Tests

Pinpoint Test F: The Auto-Dimming Mirror Does Not Operate Correctly

Refer to Wiring Diagrams Cell 124 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Mirrors for schematic and connector information.

Normal Operation

Under normal operation the interior auto-dimming mirror receives voltage from the Smart Junction Box (SJB). The interior auto-dimming mirror contains 2 photoelectric sensors: one in the front of the interior rear view mirror and one mounted on the glass side of the mirror. If the sensors are blocked, the LH exterior mirror and auto-dimming feature may not operate correctly. Always verify both sensors are not physically blocked before attempting to diagnose auto-dimming mirror concerns. Whenever the gear selector lever is placed in REVERSE, the interior auto-dimming mirror temporarily disables the auto-dimming feature. The auto-dimming feature is enabled again when the gear selector lever is moved out of REVERSE.

This pinpoint test is intended to diagnose the following:

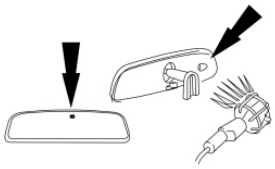
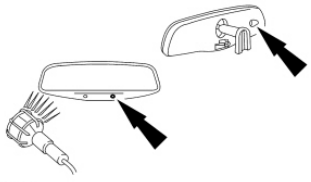
- Fuse
- Wiring, terminals or connectors
- Interior auto-dimming mirror
- LH exterior mirror auto-dimming glass
- LH exterior auto-dimming mirror (if equipped)

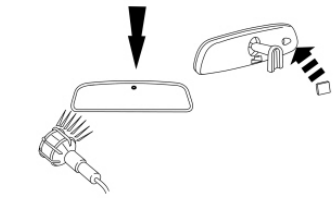
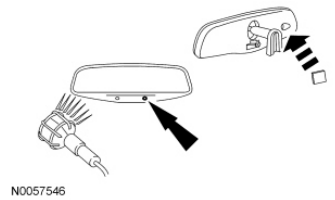
PINPOINT TEST F: THE AUTO-DIMMING MIRROR DOES NOT OPERATE CORRECTLY

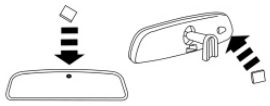
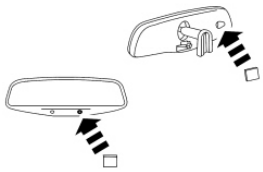
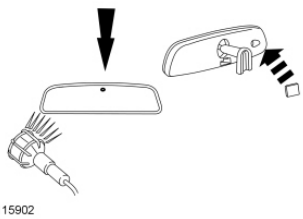
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

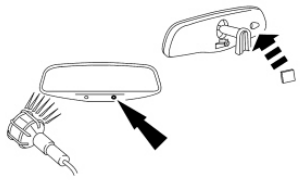
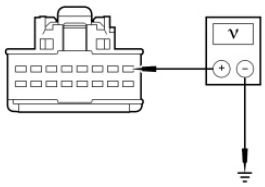
NOTE: If the Transmission Range (TR) sensor is malfunctioning and the backup lamps are on all the time or do not turn on, the auto-dimming interior mirror will not darken or return to normal view.

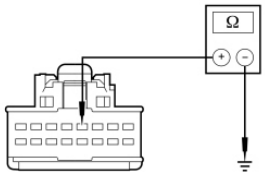
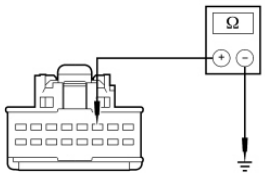
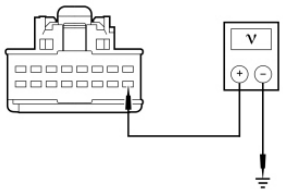
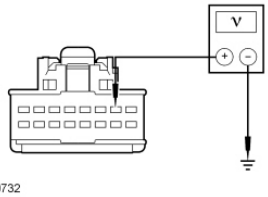
Test Step	Result / Action to Take
F1 CHECK THE OPERATION OF THE BACKUP LAMPS	
• Ignition ON. • Move the selector lever through the entire range. • **Do the backup lamps illuminate and only in REVERSE?**	**Yes** **MKZ only:** If the LH exterior mirror only is always dim, REPAIR circuit LRD12 (BU/GY) for a short to voltage. TEST the system for normal operation. **MKZ only:** If the LH exterior mirror only does not dim correctly, GO to F10 . **MKZ only:** If the interior mirror only does not dim correctly and the LH exterior mirror does dim correctly, INSTALL a new interior mirror, REFER to Interior Rear View Mirror in this section. TEST the system for normal operation. **MKZ only:** If the LH exterior mirror and interior mirror does not dim correctly, GO to F2 . **Fusion only:** If the interior mirror does not operate correctly, GO to F2 . **No** REFER to Section 417-01 to diagnose the backup lamps.
F2 VERIFY THAT THE FORWARD AND REARWARD FACING SENSORS ARE NOT BLOCKED	
• Visually verify that the forward and rearward facing sensors are not blocked.	**Yes** If possible, REMOVE the blockage. TEST the system for normal operation. If the blockage cannot be

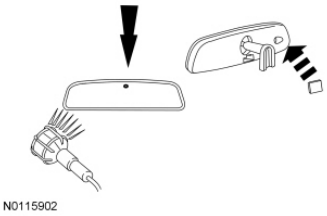
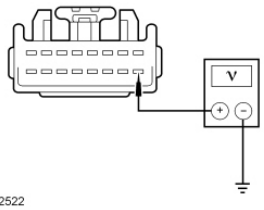
Sources of blockage can include: ♦ stickers, window decals or tags. ♦ fold-down screens for TVs or DVD players. ♦ non-OEM window tinting. • **Were either of the sensors blocked?**	removed, ADVISE the customer of the correct operation of the interior auto-dimming mirror. **No** GO to F3 .
F3 CHECK THE OPERATION OF THE INTERIOR AUTO-DIMMING MIRROR - DAYLIGHT CONDITIONS	
• Ignition ON. • **Without video display:** Use a bright lamp to simultaneously illuminate the forward-facing sensor and the rearward-facing sensor. The mirror should adjust to a high reflectance mode (mirror will be clear).  N0116951 • **With video display:** Use a bright lamp to simultaneously illuminate the forward-facing sensor and the rearward-facing sensor. The mirror should adjust to a high reflectance mode (mirror will be clear).  N0057545 • **Does the mirror adjust to the high reflectance (clear) mode?**	**Yes** GO to F4 . **No** INSTALL a new interior mirror. REFER to Interior Rear View Mirror in this section. TEST the system for normal operation.
F4 CHECK THE OPERATION OF THE INTERIOR AUTO-DIMMING MIRROR - NIGHTTIME CONDITIONS WITH GLARE	
• Ignition ON. • **Without video display:** Simulate nighttime conditions with glare: **NOTE:** Covering the sensor with a finger or hand is not adequate.	**Yes** GO to F5 . **No** GO to F7 .

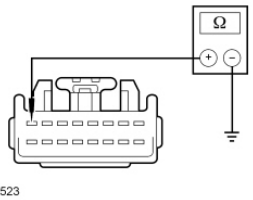
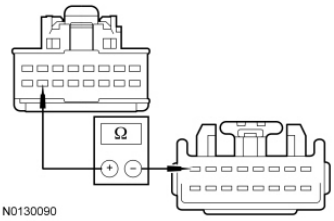
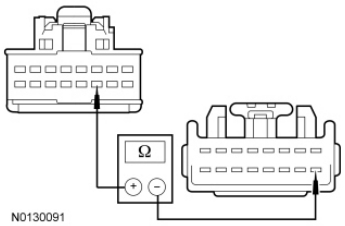
♦ Cover the forward-facing sensor with black electrical tape or other dark material. ♦ Illuminate the rearward-facing sensor. The mirror should darken to a lower reflectance mode.  N0115902 **With video display:** Simulate nighttime conditions with glare: **NOTE:** Covering the sensor with a finger or hand is not adequate. ♦ Cover the forward-facing sensor with black electrical tape or other dark material. ♦ Illuminate the rearward-facing sensor. The mirror should darken to a lower reflectance mode.  N0057546 • **Did the mirror darken to a lower reflectance (darker) mode?**	
F5 CHECK THE OPERATION OF THE INTERIOR AUTO-DIMMING MIRROR - NIGHTTIME CONDITIONS WITHOUT GLARE	
• Ignition ON. • **Without video display:** Simulate nighttime conditions without glare: **NOTE:** Covering the sensor with a finger or hand is not adequate. ♦ Cover the rearward-facing sensor. The mirror should adjust to e high reflectance mode.	**Yes** GO to F6 . **No** GO to F7 .

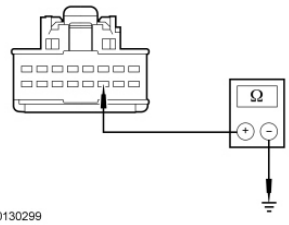
 N0116353 • **With video display:** Simulate nighttime conditions without glare: **NOTE:** Covering the sensor with a finger or hand is not adequate. ♦ Cover the rearward-facing sensor. The mirror should adjust to the high reflectance mode.  N0057547 • **Did the mirror adjust to the high reflectance (clear) mode?**	
F6 CHECK THE OPERATION OF THE INTERIOR AUTO-DIMMING MIRROR - NIGHTTIME CONDITIONS WITH THE VEHICLE IN REVERSE	
Ignition ON. • **Without video display:** Simulate nighttime conditions with glare: **NOTE:** Covering the sensor with a finger or hand is not adequate. ♦ Cover the forward-facing sensor with black electrical tape or other dark material. ♦ Illuminate the rearward-facing sensor.  N0115902 • **With video display:** Simulate nighttime conditions with glare:	**Yes** The system is operating normally at this time. REVIEW operation of the interior auto-dimming mirror feature with the customer. **No** GO to F7 .

NOTE: Covering the sensor with a finger or hand is not adequate. ♦ Cover the forward-facing sensor with black electrical tape or other dark material. ♦ Illuminate the rearward-facing sensor.  N0057546 • Select REVERSE. • **Did the mirror adjust to a high reflectance (clear) mode?**	
F7 CHECK THE VOLTAGE TO THE INTERIOR MIRROR	
• Ignition OFF. • Disconnect: Interior Mirror C911 or C9039 (with video display). • Ignition ON. • Measure the voltage between ground and: ♦ **Without video display** , interior auto-dimming mirror C911-1, circuit CBP41 (BU), harness side. ♦ **With video display** , interior auto-dimming mirror C9039-1, circuit CBP41 (BU), harness side.  N0070730 • **Is the voltage greater than 10 volts?**	**Yes** GO to F8 . **No** VERIFY SJB fuse 41 (15A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
F8 CHECK THE GROUND TO THE INTERIOR MIRROR	
• Ignition OFF. • **Without video display:** Measure the resistance between interior auto-dimming mirror C911-4, circuit GD139 (BK/YE), harness side and ground.	**Yes** GO to F9 . **No** REPAIR the circuit. TEST the system for normal operation.

 N0122756 • **With video display:** Measure the resistance between interior auto-dimming mirror C9039-3, circuit GD139 (BK/YE), harness side and ground.  N0070731 • **Is the resistance less than 5 ohms?**	
F9 CHECK REVERSE INPUT CIRCUIT	
• Ignition ON. • Select REVERSE. • **Without video display:** Measure the voltage between interior auto-dimming mirror C911-3, circuit CLS10 (GN/BN), harness side and ground.  N0122757 • **With video display:** Measure the voltage between interior auto-dimming mirror C9039-2, circuit CLS10 (GN/BN), harness side and ground.  N0070732	**Yes** INSTALL a new interior auto-dimming mirror. REFER to Interior Rear View Mirror in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

• **Is the voltage greater than 10 volts?**	
F10 CHECK CIRCUIT LRD12 (BU/GY) FOR VOLTAGE	
• Ignition OFF. • Disconnect: LH Exterior Mirror C522. • Ignition ON. • Simulate nighttime conditions with glare: **NOTE:** Covering the sensor with a finger or hand is not adequate. ♦ Cover the forward-facing sensor with black electrical tape or other dark material. ♦ Illuminate the rearward-facing sensor. The mirror should darken to a lower reflectance mode.  N0115902 • Measure the voltage between LH exterior mirror C522-9, circuit LRD12 (BU/GY), harness side and ground.  N0042522 • **Is the voltage greater than 1 volt?**	**Yes** GO to F11 . **No** GO to F13 .
F11 CHECK CIRCUIT RRD12 (BN) FOR GROUND	
• Measure the resistance between LH exterior mirror C522-8, circuit RRD12 (BN), harness side and ground.	**Yes** GO to F12 . **No** CHECK the LH exterior mirror jumper harness between the vehicle harness and the exterior mirror glass for shorted or open circuits and damaged or pushed-out pins. If the jumper harness is not OK, REPAIR the jumper harness. If the jumper harness cannot be repaired, INSTALL a new LH exterior mirror. REFER to Exterior Mirror in this section. If the jumper harness is OK, INSTALL a new LH

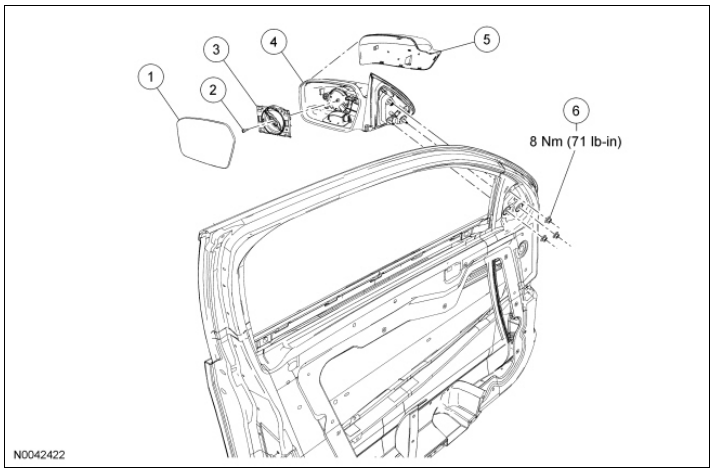
 N0042523 • **Is the resistance greater than 10,000 ohms?**	exterior mirror glass. REFER to Exterior Mirror Glass in this section. TEST the system for normal operation.
F12 CHECK CIRCUIT RRD12 (BN) FOR AN OPEN	
• Ignition OFF. • Disconnect: Interior Mirror C911. • Measure the resistance between LH exterior mirror C522-8, circuit RRD12 (BN), harness side and interior auto-dimming mirror C911-15, circuit RRD12 (BN), harness side.  N0130090 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL new interior mirror. REFER to Interior Rear View Mirror in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
F13 CHECK CIRCUIT LRD12 (BU/GY) FOR AN OPEN	
• Ignition OFF. • Disconnect: Interior Mirror C911. • Measure the resistance between LH exterior mirror C522-9, circuit LRD12 (BU/GY), harness side and interior auto-dimming mirror C911-11, circuit LRD12 (BU/GY), harness side.  N0130091 • **Is the resistance less than 5 ohms?**	**Yes** GO to F14 . **No** REPAIR the circuit. TEST the system for normal operation.
F14 CHECK CIRCUIT LRD12 (BU/GY) FOR A SHORT TO GROUND	

• Measure the resistance between ground and interior auto-dimming mirror C911-11, circuit LRD12 (BU/GY), harness side.  N0130299 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL new interior mirror. REFER to Interior Rear View Mirror in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

Exterior Mirrors - Exploded View

Exterior mirror with Blind Spot Information System (BLIS®)

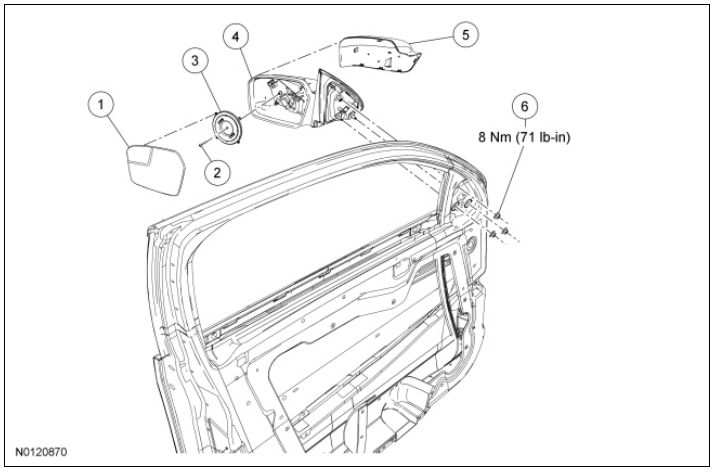
NOTE: LH exterior mirror shown, RH exterior mirror similar.



Item	Part Number	Description
1	17K707	Exterior mirror glass
2	-	Exterior mirror motor screw (part of 17D696)
3	17D696	Exterior mirror motor
4	17682 RH/ 17683 LH	Exterior mirror
5	17D742 RH/ 17D743 LH	Exterior mirror cover
6	N621906	Exterior mirror nut (3 required)

Exterior mirror with integrated spotter mirror

NOTE: LH exterior mirror shown, RH exterior mirror similar.



Item	Part Number	Description
1	17K707	Exterior mirror glass>
2	-	Exterior mirror motor screw (part of 17D696)
3	17D696	Exterior mirror motor
4	17682 RH/ 17683 LH	Exterior mirror housing
5	17D743 LH/ 17D742 RH	Exterior mirror cover
6	N621906	Exterior mirror nut (3 required)

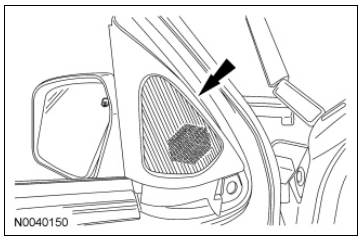
1. For additional information, refer to the procedures in this section.

Exterior Mirror

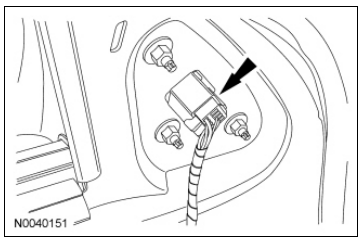
Removal and Installation

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .

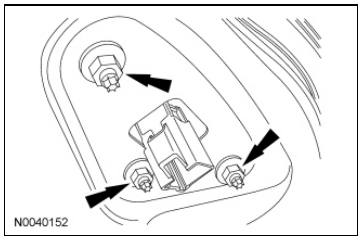
2. Remove the front door sail panel.
   - If equipped, disconnect the speaker electrical connector.



3. Disconnect the exterior mirror electrical connector.



4. Remove the 3 exterior mirror nuts and the exterior mirror.
   - To install, tighten to 8 Nm (71 lb-in).



5. To install, reverse the removal procedure.

Exterior Mirror Glass

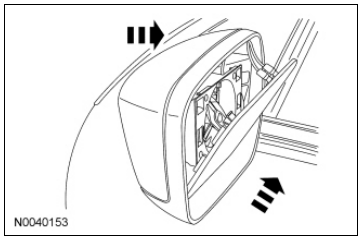
Removal

Vehicles with Blind Spot Information System (BLIS®)

1. Position the exterior mirror glass in the full down position.

2. WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.

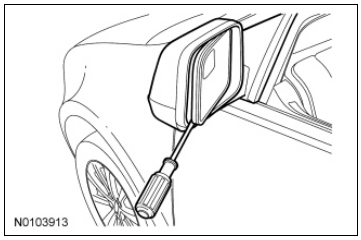
   Pull the upper edge of the exterior mirror glass outward and then upward to release the locking tabs from the exterior mirror motor.



3. Disconnect the electrical connectors from the exterior mirror glass.

Vehicles with integrated spotter mirror

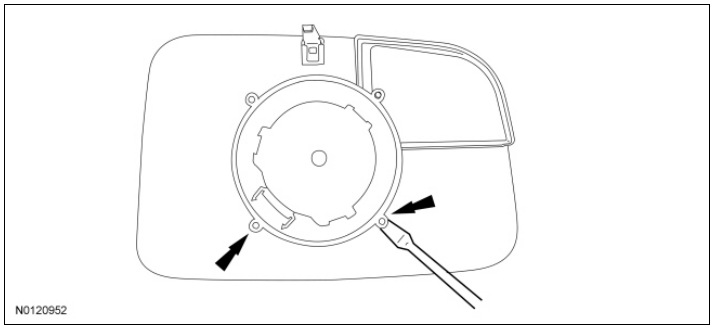
4. Position the exterior mirror glass to the full upward and inboard position and insert a thin, flat-blade screwdriver.



5. ⚠ **WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.**

   NOTE: LH mirror and motor removed from the housing and viewed from the back to show location of clips and placement of screwdriver.

   Using the thin, flat-blade screwdriver, remove the exterior mirror glass by releasing the tabs. Starting at the lower outboard side of the mirror and continuing to the lower inboard side.

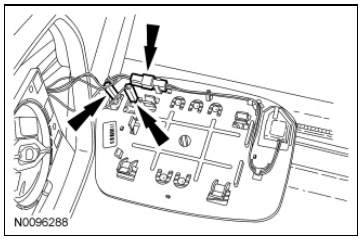


6. If equipped, disconnect the electrical connectors and remove the exterior mirror glass.

Installation

Vehicles with Blind Spot Information System (BLIS®)

1. If equipped, connect the electrical connectors to the exterior mirror glass.



2. Install the lower exterior mirror glass onto the exterior mirror motor.

3. Position the exterior glass upward.

4. ⚠ **WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.**

   NOTE: An audible click will be heard during installation.

   Place a hand against the back of the exterior mirror and a hand flat against the upper exterior mirror glass and press the exterior mirror glass into the upper exterior mirror motor retainers.

Vehicles with integrated spotter mirror

5. If equipped, connect the electrical connectors.

6. ⚠ **WARNING: Place a shop towel between the hands and the exterior mirror glass for protection in case of glass breakage during mirror service. Failure to follow this instruction may result in serious personal injury.**

   Position the exterior mirror glass onto the exterior mirror motor.

7. **NOTE:** An audible click will be heard during installation.

   Firmly press the exterior mirror glass until it snaps onto the exterior mirror motor.

8. Rotate the exterior mirror glass in all directions after the installation to make sure that all of the exterior mirror glass retaining clips are completely fastened.

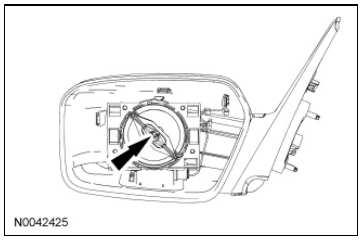
Exterior Mirror Motor

Removal and Installation

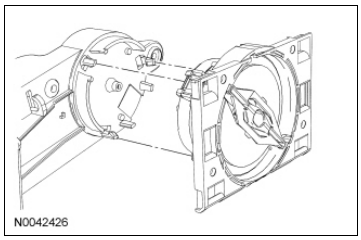
NOTE: Exterior mirror with Blind Spot Information System (BLIS®) shown, exterior mirror with integrated spotter mirror similar.

1. Removethe exterior mirror glass. For additional information, refer to Exterior Mirror Glass in this section.

2. Remove the exterior mirror motor screw.



3. Use a flat-blade screwdriver and remove the exterior mirror motor from the 3 mounting clips.
   - Disconnect the electrical connector(s).



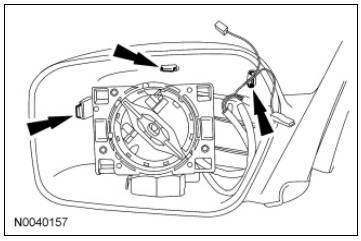
4. To install, reverse the removal procedure.

Exterior Mirror Cover

1. Remove the exterior mirror glass. For additional information, refer to Exterior Mirror Glass in this section.

2. **NOTE:** Exterior mirror with Blind Spot Information System (BLIS®) shown, exterior mirror without BLIS® similar.

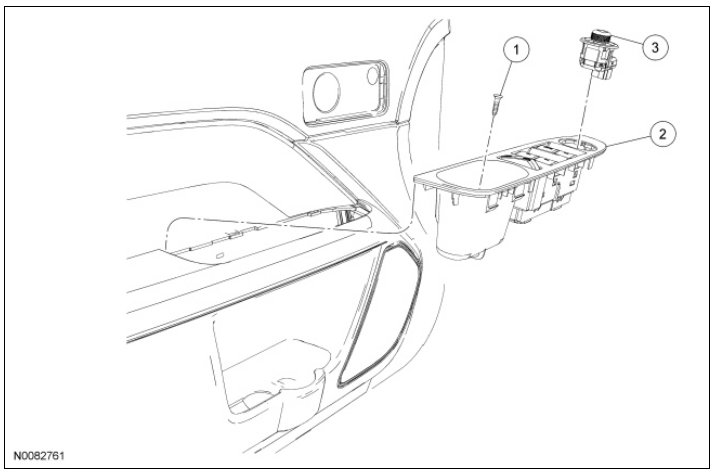
   Depress the 3 tabs and remove the exterior mirror cover.



3. To install, reverse the removal procedure.

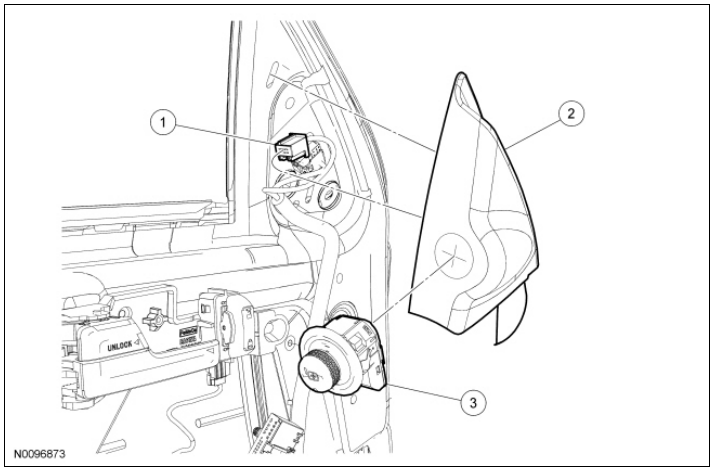
Exterior Mirror Control Switch

Fusion



Item	Part Number	Description
1	W505153	Window control switch screw
2	22635	Window control switch bezel
3	17B676	Exterior mirror control switch

MKZ



Item	Part Number	Description
1	14631	Exterior mirror electrical connector
2	17K709	Front door trim sail panel
3	17B676	Exterior mirror control switch

Removal and Installation

Fusion

1. Remove the window control switch bezel in the following sequence.
    1. Remove the window control switch screw.
    2. Pull upward and remove the control switch bezel.
    3. Disconnect the electrical connectors.

MKZ

2. Remove the front door trim panel. For additional information, refer to Section 501-05 .

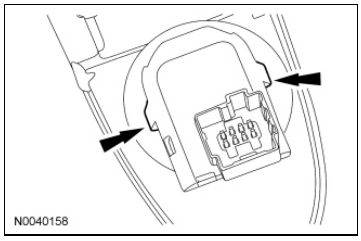
3. Pull outward to remove the front door trim sail panel and disconnect the electrical connector.

All vehicles

4. **NOTE:** Fusion shown, MKZ similar.

   Remove the exterior mirror control switch.

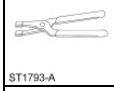
   - Depress the 2 locking tabs.



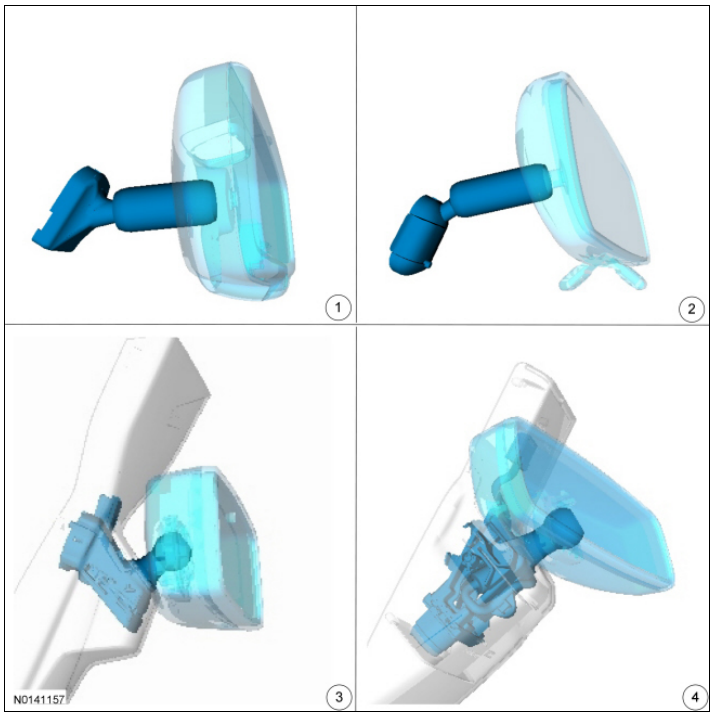
5. To install, reverse the removal procedure.

Interior Rear View Mirror

Special Tool(s)

 ST1793-A	Installer, Rear View Mirror 501-025 (T94P-17700-AH)
 ST3250-A	Mirror Remover 501-D118A
 ST3311-A	Installer, Rear View Mirror 501-191
 ST3310-A	Mirror Remover 501-190

Mirror Identification



Item	Part Number	Description
1	-	Mirror type 1
2	-	Mirror type 2
3	-	Mirror type 3
4	-	Mirror type 4

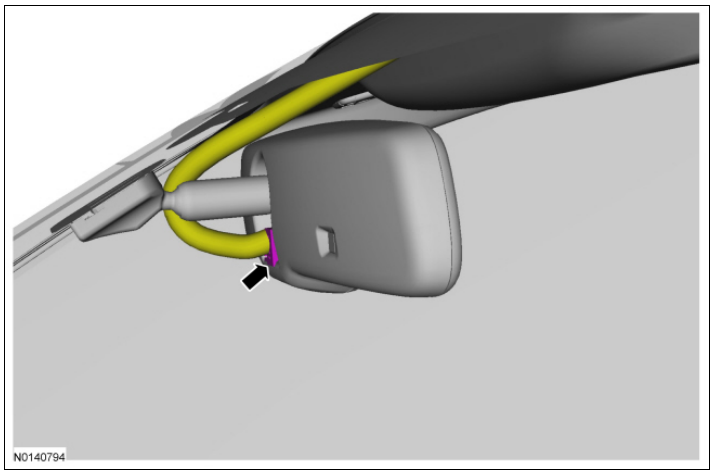
Removal

Mirror Type 1

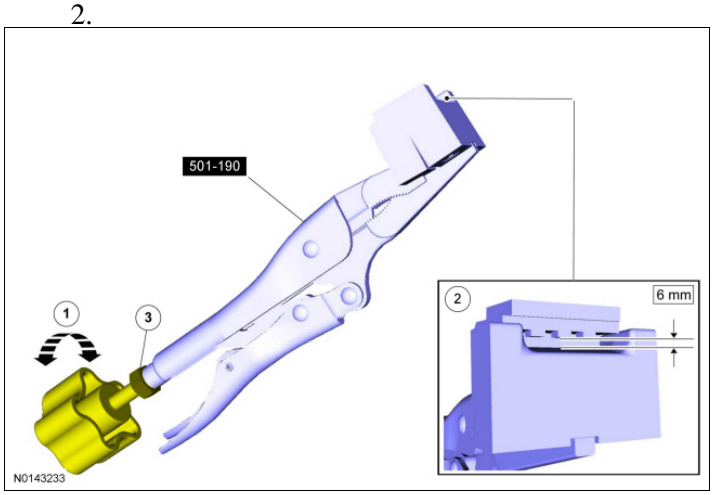
NOTICE: **The windshield must be at room temperature. Otherwise, damage to the windshield glass may occur.**

NOTE: Click here to view a video version of this procedure.

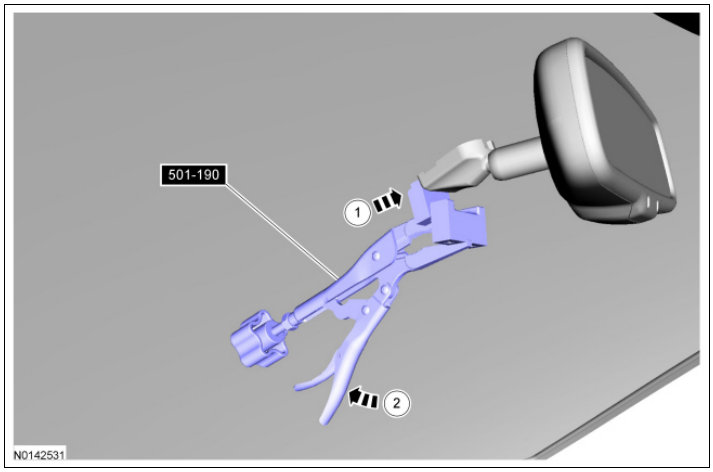
1. If equipped.



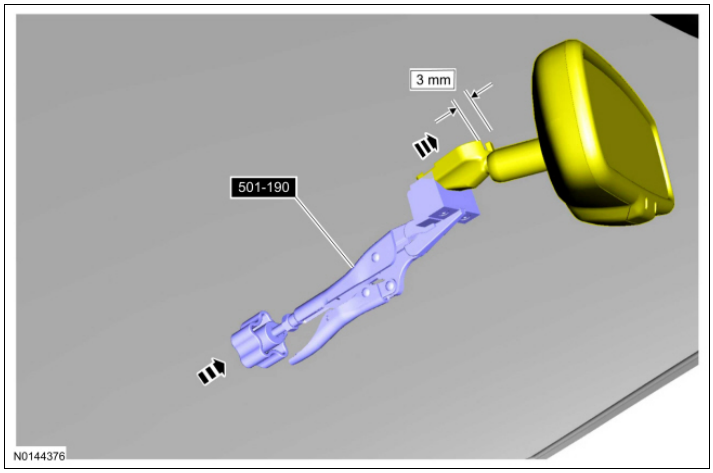
2.



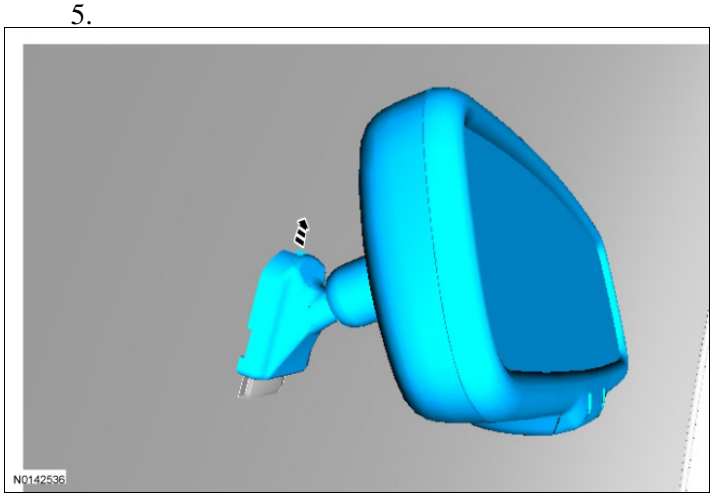
3. ***NOTICE:*** **Make sure the Mirror Remover is fully insertthe interior rear view mirror mount access hole. Otherwise, damage to the windshield glass may occur.**



4. Using a closed hand, bump the adjustment handle of the Mirror Remover to slide the mirror upward on the mirror mount.

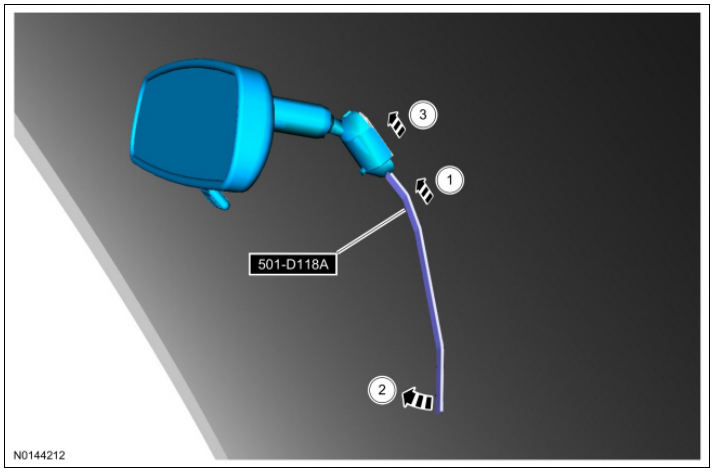


5.



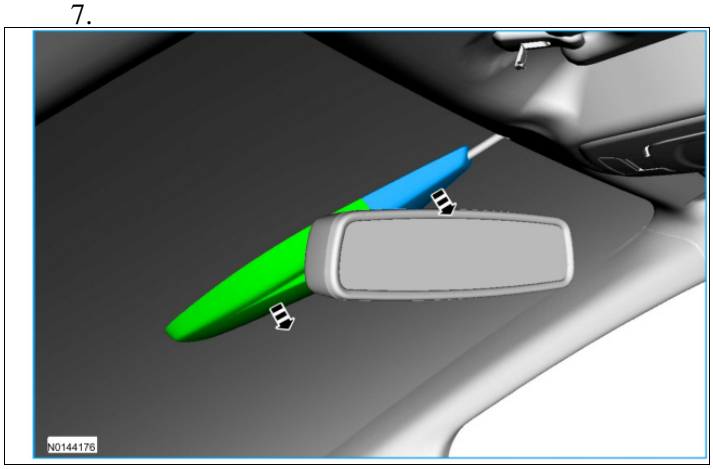
Mirror Type 2

6.

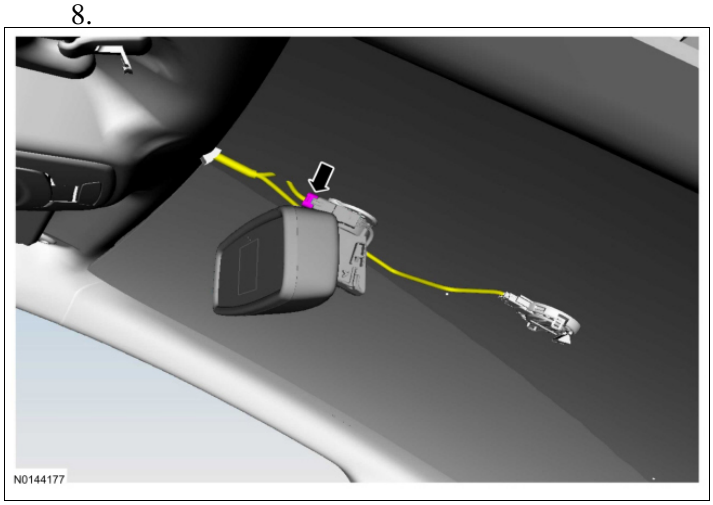


Mirror Type 3

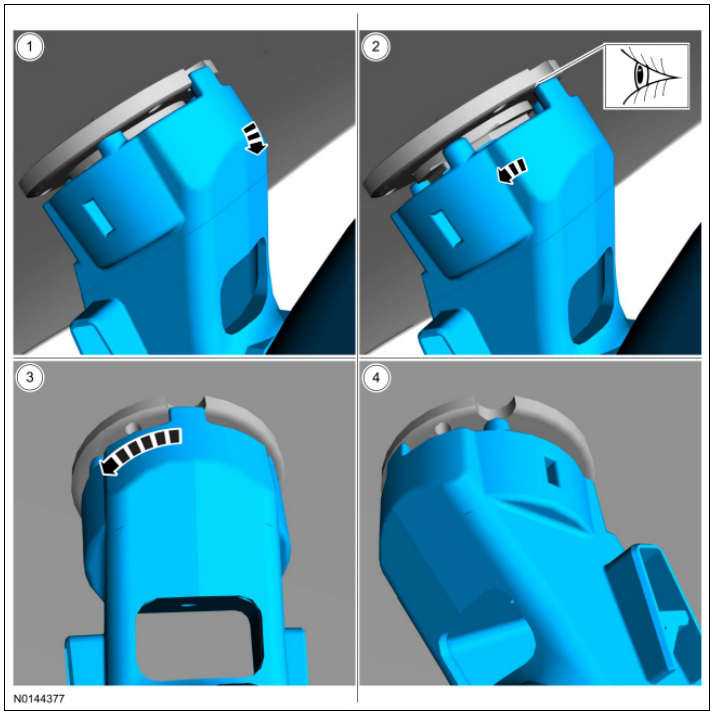
7.



8.

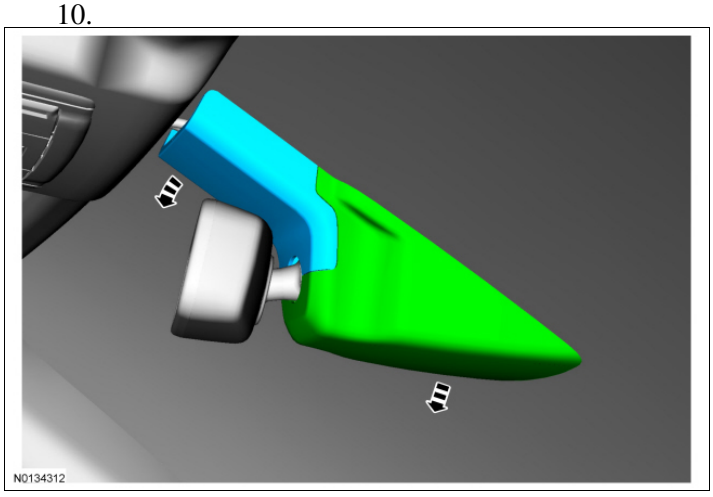


9.

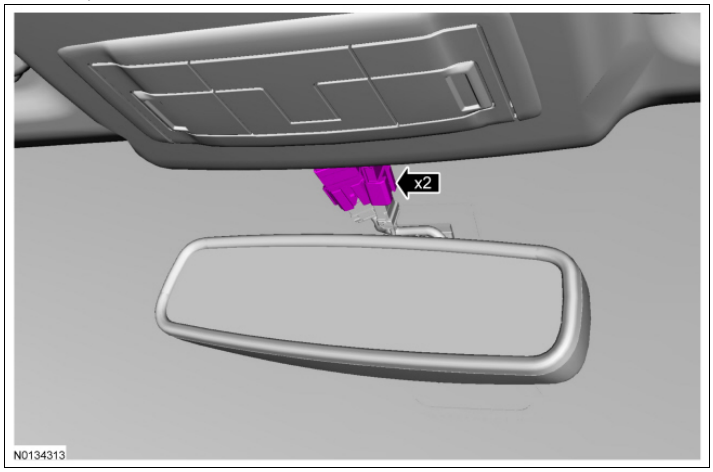


Mirror Type 4

10.

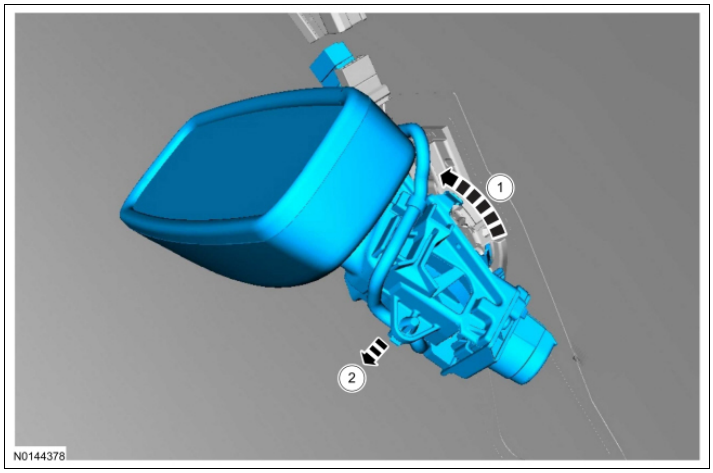


11.



12. ***NOTICE:*** **To prevent damage to the mirror or base, rotate the mirror base with hands only do not use tools.**

    NOTICE: **To prevent damage to the mirror wiring, do not rotate the mirror head beyond 180 degrees.**

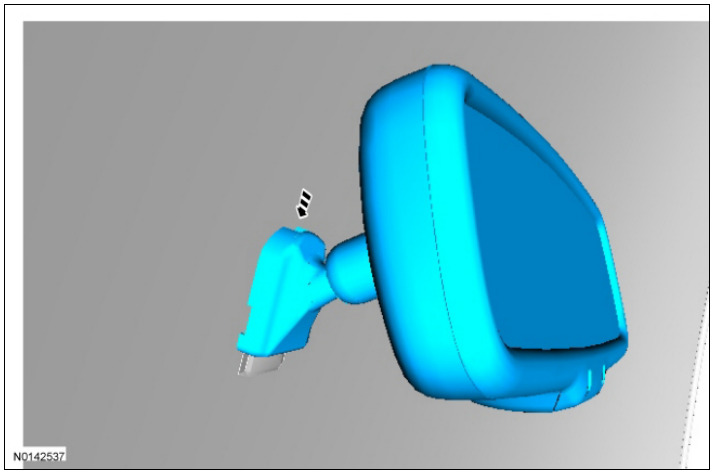


Installation

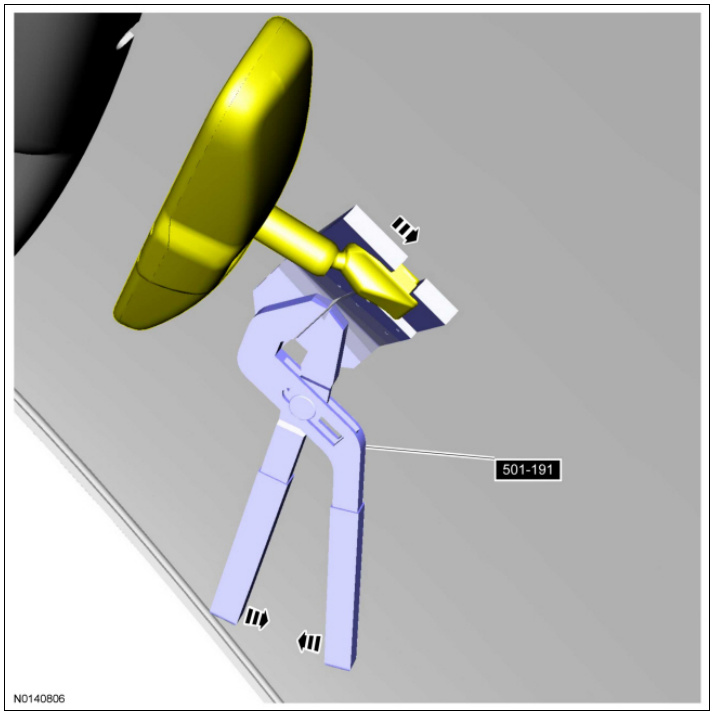
Mirror Type 1

NOTE: Click here to view a video version of this procedure.

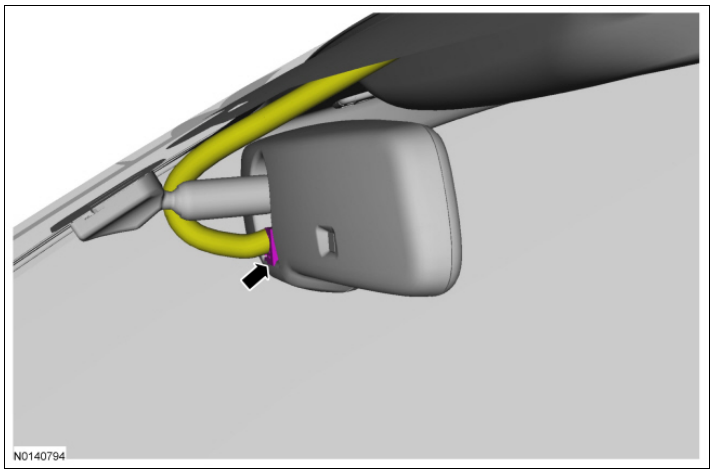
1. Slide the interior rear view mirror mount over the windshield bracket from the top.



2. **NOTE:** An audible click will be heard as the mirror fully seats.



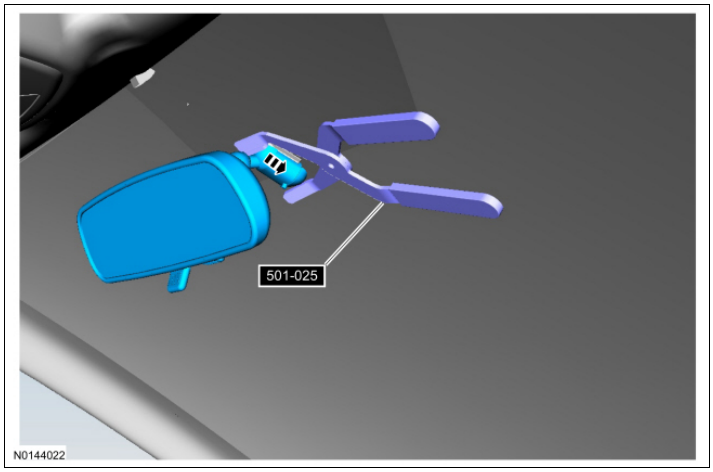
3. If equipped.



4. If equipped with compass module, check the compass zone and calibration. Refer to General Procedures in Section 413-01 or Section 419-11.

Mirror Type 2

5.



6. If equipped with a compass module which requires calibration, check the compass zone adjustment and calibration. Refer to General Procedures in Section 413-01 or Section 419-11.

Mirror Type 3

7. To install, reverse the removal procedure.

Mirror Type 4

8. To install, reverse the removal procedure.
    - If a new mirror has been installed, download the IPM-A configuration information from the scan tool to the new IPM-A .
    - If a new mirror has been installed, perform camera alignment using a scan tool.

Torque Specifications

Description	Nm	lb-ft	lb-in
Front Seat			
Cushion Thermo-Electric Device (TED) assembly nuts	6	-	53
Occupant Classification System (OCS) rail-to-seat track bolts	25	18	-
Power recliner motor bolt	6	-	53
Power seat track horizontal drive unit bolts	28	21	-
Recliner-to-backrest frame bolts	55	41	-
Recliner-to-cushion frame bolts	55	41	-
Safety belt anchor bracket nuts	36	27	-
Safety belt buckle bolt	40	30	-
Safety belt buckle bracket nuts	36	27	-
Safety belt retractor belt anchor bolt	40	30	-
Seat position sensor bolt	6	- 53	
Seat riser bolts	25	18	-
Seat-to-floor bolts [a]	-	-	-
Seat track-to-cushion frame nuts	36	27	-
Side air bag-to-backrest frame nuts	8	-	71
Rear Seat			
Armrest pivot bolts	10	-	89
Armrest bracket-to-backrest bolts	10	-	89
Backrest latch release handle bracket nuts	9	-	80
Backrest latch nuts	48	35	-
Backrest-to-floor bolts	47	35	-
Side bolster bolt	11	-	

Seats

Front Seats

Each front seat can be equipped with the following serviceable items and systems:

- Power or manual seat track
- Backrest recliners
- Heated or climate controlled seat system
- Driver memory seat
- Power or manual lumbar
- Seat side air bags
- Occupant Classification System (OCS) system on front passenger seat

For a detailed list of front seat serviceable parts, refer to Seat - Exploded View, Front in this section.

Driver Memory Seat

When equipped with the memory option, the seat is controlled by the Driver Seat Module (DSM).

The system contains the following serviceable components:

- DSM , mounted to the seat track
- Memory SET switch, located on the driver door
- Power seat track
- Seat control switch

Heated Seat System

The system contains the following serviceable components:

- Seat heater mats located in the seat cushion and backrest
- Heated seat module, mounted to the bottom of the front passenger seat track
- Heated seat buttons, located on the HVAC module (without navigation) or on the Front Controls Interface Module (FCIM) (with navigation)
- Heated seat indicators, located on the heated seat button
- HVAC module (with navigation)

The FCIM and HVAC module operate the heated seat system independently from other systems. Upon pressing a heated seat button, the heated seat module will cycle off, high, low and off. Both indicators illuminate in high, the lower indicator illuminates in low and neither will be illuminated when off.

If the ignition source is turned off, the heated seat module will enter an off state and will not return to on until the heated seat control button is once again pressed with the ignition in RUN. The heated seat module does not time out.

Climate Controlled Seat System

The system contains the following serviceable components:

- Thermo-Electric Device (TED) and blower assembly within each front seat cushion and backrest

  TED and blower assembly (for cushion TED filter, turn to the left to remove) (backrest TED filter is not serviceable but can be removed)
- Cushion and backrest manifolds
- Cushion and backrest foam pads
- Cushion and backrest trim covers
- Climate controlled seat buttons, located on the FCIM
- Dual Climate Controlled Seat Module (DCSM), mounted to the bottom of the front passenger seat cushion
- HVAC module

Backrest Recliners

All backrest recliners are serviced with the backrest frame.

Seat Side Air Bags

The driver and front passenger seat side air bags are standard equipment attached to the front seat backrest frame. If a seat side air bag deployment has occurred, or for more information, refer to Section 501-20B .

Occupant Classification System (OCS) System

The OCS system is standard equipment on all front passenger seats. For diagnosing or servicing the OCS system, refer to Section 501-20B .

Rear Seats

The rear seats contain the following serviceable parts and systems:

- 60/40 split folding backrest
- Fold-down armrest that may be equipped with cup holders
- A latch attached to the package tray sheet metal for each backrest
- Backrest latch release handles, located in the luggage compartment (non-hybrid vehicles only)

For a detailed list of rear seat serviceable parts, refer to Seat - Exploded View, Rear in this section.

Non-Hybrid Vehicle

The center tunnel is higher on an All-Wheel Drive (AWD) vehicle, creating the need for a shorter cushion foam pad. Make sure when installing a new cushion foam pad, the correct part is being installed.

Hybrid Vehicle

The cushion has a 2-piece foam pad to allow for traction battery ventilation. Make sure when installing a new cushion the correct hard and soft foam pads are being installed.

/body>

Seats

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Medium Speed Controller Area Network (MS-CAN)

This vehicle utilizes a communication system called a Medium Speed Controller Area Network (MS-CAN). When diagnosing the memory seat, heated seats or climate controlled seats, use a Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool with the latest software update with the capability of communicating over the MS-CAN bus.

Principles of Operation

Driver and Passenger Power Seats Without Memory

The 10-way power seat control feature moves the seat in 10 possible directions: the seat can be moved forward or backward and the front and back of the cushion can be moved up and down independently. The backrest of the seat can be moved forward and backward, and the lumbar can be moved in and out. All 10 positions are controlled by one switch. The power seat feature operates independent of the ignition position.

The 8-way power seat control feature moves the seat in 8 possible directions. It is like the 10-way power seat, less power lumbar.

The 4-way power seat control feature moves the seat in 4 possible directions: the seat can be moved forward or backward and the backrest of the seat can be moved forward and backward.

The power seat motors are hardwired to the seat control switch. The circuits are normally at ground through the seat control switch. An individual circuit is switched to voltage when a specific adjustment position is selected.

Power Driver Seat With Memory

NOTE: Verify good battery condition before diagnosing the memory seat system. Poor battery condition may interfere with memory seat operation, even if vehicle starting is possible.

NOTE: A memory recall in progress does not prohibit the initiation of another memory recall; the most recently requested memory recall will be executed.

The driver power memory seat is controlled by the Driver Seat Module (DSM). The memory seat feature allows the driver to program a personalized seat position that can be recalled using the memory switch or a Remote Keyless Entry (RKE) transmitter. There are 2 memory settings possible. The 2 settings consist of 8 possible directions: the seat can be moved forward or backward and the front and back of the cushion can be moved up and down independently. The backrest of the seat can be moved forward and backward. Adjustable lumbar is not a memory option. The power seat feature operates independent of the ignition position.

The driver seat control switch provides voltage to the DSM when activated. The NEUTRAL position of the driver seat control switch position is a ground state through the seat control switch contacts. A voltage input causes the DSM to power the appropriate motor until the input is removed. Ground is the normal state of the motor circuits through the DSM and is not switched to control the motors. The DSM internally switches the appropriate circuit from ground to voltage for operating the motors.

As the seat is adjusted, the DSM constantly monitors the motor position sensors to record the current seat position. The DSM will remove voltage from the motor upon termination of the seat control switch input or if the DSM does not see movement from the motor by monitoring the position sensor.

The DSM communicates DTCs and other information using the MS-CAN communication bus. It should be noted for diagnostics that because Controller Area Network (CAN) bus communication is more robust and reliable than other methods, it may be possible to have limited module communication with one of the CAN bus circuits disconnected or shorted to ground. Refer to Section 418-00 for information concerning MS-CAN bus communication.

For information on programming memory positions or recalling a stored memory position, refer to Memory Position Programming in this section. For information on RKE transmitter programming, refer to Section 501-14 .

The DSM is located under the driver seat. To install a new DSM , refer to Driver Seat Module (DSM) in this section. Programmable Module Installation (PMI) must be carried out when installing a new DSM . Refer to Section 418-01 .

This section only diagnoses concerns specific to the memory seat. To diagnose a memory exterior mirror concern, refer to Section 501-09 .

Easy Exit/Easy Entry

The easy entry/easy exit feature is a function of the DSM that moves the driver seat backwards about 50.8 mm (2 in) when the ignition key is removed from the ignition. The DSM receives a key out command over the MS-CAN communication network and powers the driver seat rearward. This function will not operate if the seat is less than the 50.8 mm (2 in) travel distance to the end of the track or the function has been disabled. The DSM will also cancel this operation if a valid input command is received from the driver seat control switch, memory SET switch or exterior mirror control switch.

The DSM will record the current seat position before powering the seat for an easy exit function. This recorded position will be used to return the seat to this position on the easy entry operation. During easy entry operation, the seat is returned to the position previous to the easy exit operation. Easy entry operation will be cancelled if a valid input command from the seat control switch, memory SET switch or exterior mirror control switch is received by the DSM .

The easy entry/easy exit feature can be enabled/disabled using a scan tool. When enabled, the feature becomes

a user accessible item on the message center allowing the user to turn the feature on and off. Refer to the Owner's Literature or Section 413-01 for information on the message center.

Heated Seats

When equipped with navigation, heated seat request and indicator messages are communicated between the Front Controls Interface Module (FCIM) and HVAC module over the Controller Area Network (CAN), otherwise, heated seat request and indicator messages are always communicated between the HVAC module and heated seat module.

The engine must be running for the heated seat system to operate and it does not time out. The heated seat module supplies voltage to the heater mats. The heated seat module regulates seat temperature by monitoring a thermostat located in the cushion heater mat.

The heated seat module does not report DTCs and does not communicate on the communication network. If a fault is detected, the module will disable the affected seat(s) and indicator(s). After the fault is corrected, the heated seat module needs to be reset by cycling the ignition.

The heated seat module control circuits are monitored by the HVAC module and will set a DTC if a circuit fault is detected. Refer to the HVAC Module DTC Chart.

Climate Controlled Seat System

NOTICE: **Avoid applying voltage directly to a Thermo-Electric Device (TED) for testing its operation. Doing so may cause damage to the TED .**

NOTE: When installing a new Dual Climate Controlled Seat Module (DCSM), it is necessary to carry out Programmable Module Installation (PMI). Refer to Section 418-01 .

The driver and front passenger climate controlled seats are independently controlled by the DCSM . The climate controlled seat system only operates with the engine running, however, if using a scan tool to command the DCSM , diagnostic testing can be carried out with the ignition ON and engine OFF. The DCSM receives voltage from the Battery Junction Box (BJB) on DCSM C3265A pins E and F. If one pin does not receive voltage, both seats will remain operational because the voltage supply circuits are internally connected in the DCSM .

If a fault is detected, only the affected seat will be disabled. If the system shuts down, cycling the ignition OFF and then ON again will reset the DCSM to function until the DTC resets.

The 4 buttons (identified with seat icons), located on the FCIM , activate each seat system setting and illuminate indicators on each button to indicate the operating mode, 3 indicators for HIGH, 2 indicators for MED or 1 indicator for LOW. The push-buttons with the blue seat icon operate the seat cooling mode and the push-buttons with the red seat icon operate the seat heating mode.

The climate controlled seat button commands are communicated from the FCIM over the MS-CAN to the HVAC module and then to the DCSM . Upon receiving a command, the DCSM then communicates indicator illumination commands back to the HVAC module which then commands the FCIM to turn the indicators on or off. The climate controlled seat system can only operate if all 3 modules are communicating correctly on the CAN .

Each cushion and backrest is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Applying voltage polarity to the TED in one

direction, causes it to heat. Applying voltage polarity in the opposite direction causes the TED to cool. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the incoming air depending on the control switch settings. The air is then directed into the manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM controls the heating/cooling modes and the blower speed dependant on the settings.

The temperature differences between the individual heated and cooled settings is minimal. For example, it is difficult to distinguish between LOW COOL and MEDIUM COOL settings. Measuring seat temperature at different settings is possible by monitoring the DCSM PIDs using the scan tool.

The climate controlled seats can be commanded using the scan tool to verify both module communication on the MS-CAN bus and operation of the DCSM . This method may be useful for isolating a control switch concern. It should also be noted that because CAN bus communication is more robust and reliable than other methods, it may be possible to have limited module communication with one of the CAN bus circuits disconnected or shorted to ground. Refer to Section 418-00 for information concerning CAN bus communication.

Heating Characteristics

NOTE: The presence of overtemperature faults (DTCs B2729, B2730, B272A and B272B) can be induced by incorrect operation of the climate controlled seat system after an initial heat setting has been attained. If a heat setting is repeatedly turned OFF and ON in an attempt to increase the seat temperature, an overtemperature condition can result and the DTCs will be set.

- In the LOW setting, the DCSM is set to maintain TED temperature at approximately 46°C (115°F).
- In the MEDIUM setting, the DCSM is set to maintain TED temperature at approximately 60°C (140°F).
- In the HIGH setting, the DCSM is set to maintain TED temperature at approximately 65°C (149°F).
- When heating, the DCSM will vary the speed of the fans and the TED duty cycle in order to reach and maintain the temperature determined by the switch setting.
- Engine must be running over 3 and seat heating does not time out.

Cooling Characteristics

- In cool mode, the TED circuits of a given seat are wired in series internally in the DCSM .
- In cool mode, the TED can remove up to 8°C (14°F) from the ambient air temperature entering the system.
- When cooling, the DCSM maintains constant speed of the fans and constant TED supply voltage (duty cycle) in open loop cool mode.
- Engine must be running over 350 rpm and seat cooling does not time out.

The climate controlled seat system is deactivated by one of the following actions:

- Selecting the HVAC module setting to manual OFF.
- Turning the vehicle OFF.

Climate Controlled Seat System Recovery Mode

NOTE: The presence of overtemperature faults (DTCs B2729, B2730, B272A and B272B) can be induced by incorrect operation of the climate controlled seat system after an initial heat setting has been attained. If a heat

setting is repeatedly turned OFF and ON in an attempt to increase the seat temperature or repeatedly toggled between heat and cool modesan overtemperature condition can result and the DTCs will be set.

If the temperature at one of the TEDs falls below 5°C (41°F), the DCSM will shut down the TEDs and initiate system recovery mode. If the temperature continues to drop below 2°C (36°F), the DCSM will shut down the affected seat operation.

If the temperature at one of the TEDs rises above 110°C (230°F) in the heat mode or 65°C (149°F) in the cool mode for more than 4 seconds, the DCSM will record an overtemperature DTC, remove voltage from the TEDs and go into recovery mode (blower only) for 30 seconds to cool down the TEDs . The same will occur if a temperature difference of 60°C (108°F) or greater is seen between the backrest and cushion TEDs on either front seat. The DCSM will continue to monitor the TEDs while in recovery mode. If the temperature of the TEDs does not drop to 105°C (221°F) in the heat mode or 60°C (140°F) in the cool mode after 30 seconds, the system will continue to cool the TEDs in recovery mode for up to 5 minutes. If the TEDs cool down at any time after 30 seconds, but before 5 minutes (checked at 4-second intervals), the system will operate as normal. An overtemperature DTC will still be recorded even if the system recovers and is operating normally. Recovery mode is more likely to occur during extreme cabin temperatures with significant seat back sunload. If the system does not recover within 30 seconds in heat mode or within 5 minutes in cool mode, the DCSM will disable that seat (fault mode) and remain off until the ignition is cycled. Also, if the DCSM detects temperature differentfault twice during the same ignition cycle, it will shutdown. When a fault causes a shutdown, the climate controlled seat indicators will turn off for the affected seat and that seat will not be operational until the next key cycle.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Switch(es) • Seat tracks obstructed or damaged • Lumbar assembly damaged • Recliner assembly damaged (backrest frame) • Thermo-Electric Device (TED) assembly filter dirty (cushion or backrest)	• Battery Junction Box (BJB) fuse(s): ♦ 12 (30A MKZ) (climate controlled seats) ♦ 31 (30A) (passenger power seat) ♦ 32 (30A) (driver power seat or driver memory seat) • Smart Junction Box (SJB) fuse(s): ♦ 12 (7.5A) (driver memory seat) ♦ 18 (20A Fusion) (heated seat module) ♦ 35 (10A Fusion) (heated seat module) • Wiring harness • Loose or corroded connections • Seat control switch(es)

	• Power seat motor (seat track) • Memory SET switch • Seat cushion heater • Seat backrest heater • Lumbar control switch • Power lumbar motor • TED assembly (cushion or backrest) • Power recliner motor • Driver Door Module (DDM) • Driver Seat Module (DSM) • Dual Climate Controlled Seat Module (DCSM) • Front Controls Interface Module (FCIM) • Heated seat module • HVAC module

NOTE: The Smart Junction Box (SJB) may also be identified as the Generic Electronic Module (GEM).

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

4. If the concern is with the power seat (non-memory seat) or heated seat and the cause is not visually evident, verify the symptom and GO to Symptom Chart .

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

   If the concern is with the memory seat or climate controlled seat and the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

6. **NOTE:** The VCM LED prove out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

7. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

8. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record CMDTCs .

9. Clear the continuous DTCs and carry out the self-test diagnostics for the Driver Seat Module (DSM), Driver Door Module (DDM), DCSM , FCIM and HVAC module.

10. If the DTCs retrieved are related to the concern, go to Driver Seat Module (DSM) DTC Chart, Dual Climate Controlled Seat Module (DCSM) DTC Chart, HVAC Module DTC Chart or Driver Door Module (DDM) DTC Chart. For all other DTCs, refer to Section 419-10 .

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

DTC Charts

Driver Door Module (DDM) DTC Chart

DTC	Description	Action
B1534	Memory 1 Switch Circuit Short To Ground	GO to Pinpoint Test M .
B1538	Memory 2 Switch Circuit Short To Ground	GO to Pinpoint Test M .
All Other DTCs	-	REFER to the DTC Chart in Section 501-14 .

Driver Seat Module (DSM) DTC Chart

DTC	Description	Action
B106E	Solid State Driver Disabled due to Short Circuit	GO to Pinpoint Test B .
B106F	Module Disabled Due to External Fault	GO to Pinpoint Test B .
B1317	Battery Voltage High	GO to Pinpoint Test AV .
B1318	Battery Voltage Low	GO to Pinpoint Test AW .
B1663	Seat Driver Front Up/Down Motor Stalled	If the motor does not operate, GO to Pinpoint Test L . If the motor operates, GO to Pinpoint Test M .
B1664	Seat Driver Rear Up/Down Motor Stalled	If the motor does not operate, GO to Pinpoint Test L . If the motor operates, GO to Pinpoint Test M .
B1665	Seat Driver Forward/Backward Motor Stalled	If the motor does not operate, GO to Pinpoint Test L . If the motor operates, GO to Pinpoint Test M .
B1666	Seat Driver Recline Motor Stalled	If the motor does not operate, GO to Pinpoint Test L . If the motor operates, GO to Pinpoint Test M .
B1669	Mirror Passenger Up/Down Motor Stalled	Section 501-09 .
B1670	Mirror Passenger Right/Left Motor Stalled	Section 501-09 .
B1703	Seat Driver Recline Forward Switch Circuit Short To Battery	GO to Pinpoint Test L .
B1707	Seat Driver Recline Rearward Switch Circuit Short To Battery	GO to Pinpoint Test L .
B1711	Seat Driver Front Up Switch Circuit Short To Battery	GO to Pinpoint Test L .
B1715	Seat Driver Front Down Switch Circuit Short To Battery	GO to Pinpoint Test L .

B1719	Seat Driver Forward Switch Circuit Short To Battery	GO to Pinpoint Test L .
B1723	Seat Driver Rearward Switch Circuit Short To Battery	GO to Pinpoint Test L .
B1727	Seat Driver Rear Up Switch Circuit Short To Battery	GO to Pinpoint Test L .
B1731	Seat Driver Rear Down Switch Circuit Short To Battery	GO to Pinpoint Test L .
B1952	Seat Rear Up/Down Position Feedback Circuit Short To Battery	GO to Pinpoint Test M .
B1953	Seat Rear Up/Down Position Feedback Circuit Short To Ground	GO to Pinpoint Test M .
B1956	Seat Front Up/Down Position Feedback Circuit Short To Battery	GO to Pinpoint Test M .
B1957	Seat Front Up/Down Position Feedback Circuit Short To Ground	GO to Pinpoint Test M .
B1960	Seat Recline Forward/Backward Position Feedback Circuit Short To Battery	GO to Pinpoint Test M .
B1961	Seat Recline Forward/Backward Position Feedback Circuit Short To Ground	GO to Pinpoint Test M .
B1964	Seat Horizontal Forward/Rearward Position Feedback Circuit Short To Battery	GO to Pinpoint Test M .
B1965	Seat Horizontal Forward/Rearward Position Feedback Circuit Short To Ground	GO to Pinpoint Test M .
B2143	NVM (Non Volatile Memory) Failure	CARRY OUT Programmable Module Installation (PMI) on the DSM . REFER to Section 418-01 . CLEAR DTCs. CYCLE the ignition and RETEST the system. If DTC B2143 is retrieved again, INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section.
B2224	Passenger Mirror Drive Circuit Failure	Section 501-09 .
B2312	Passenger Mirror Horizontal Feedback Potentiometer Circuit Failure	Section 501-09 .
B2314	Passenger Mirror Horizontal Feedback Potentiometer Circuit Short to Battery	Section 501-09 .
B2316		Section 501-09 .

	Passenger Mirror Vertical Feedback Potentiometer Circuit Failure	
B2318	Passenger Mirror Vertical Feedback Potentiometer Circuit Short to Battery	Section 501-09 .
B2477	Module Configuration Failure	REFER to Section 418-01 .
U0140	Lost Communication With Body Control Module (GEM)	GO to Pinpoint Test AX .
U0155	Lost Communication With Instrument Panel Cluster (IC) Control Module	GO to Pinpoint Test AY .
U2050	No Application Present	REFER to Section 418-01 .

Dual Climate Controlled Seat Module (DCSM) DTC Chart

DTC	Description	Action
B103B	Thermoelectric Driver Overcurrent Low	GO to Pinpoint Test W .
B103C	Thermoelectric Driver Open Load	GO to Pinpoint Test X .
B103D	Blower Driver Overtemperature	GO to Pinpoint Test Y .
B1111	Driver Thermal Electric Device Control Overtemperature Fault	GO to Pinpoint Test W .
B1113	Passenger Thermal Electric Device Control Overtemperature Fault	GO to Pinpoint Test Z .
B111B	Passenger Thermoelectric Driver Overcurrent Low	GO to Pinpoint Test Z .
B111C	Passenger Thermoelectric Driver Open Load	GO to Pinpoint Test AA .
B111D	Passenger Blower Driver Overtemperature	GO to Pinpoint Test AB .
B1342	ECU is Faulted	INSTALL a new Dual Climate Controlled Seat Module (DCSM). REFER to Dual Climate Controlled Seat Module (DCSM) in this section.
B19A1	Passenger Seat Cushion Blower Speed Short to Battery	GO to Pinpoint Test AC .
B19A2	Passenger Seat Back Blower Speed Short to Battery	GO to Pinpoint Test AD .
B19A3	Driver Seat Cushion Blower Speed Short to Battery	GO to Pinpoint Test AE .
B19A4	Driver Seat Back Blower Speed Short to Battery	GO to Pinpoint Test AF .
B19A5	Passenger Seat Cushion Blower	GO to Pinpoint Test AG .

	Speed Short to Ground	
B19A6	Passenger Seat Back Blower Speed Short to Ground	GO to Pinpoint Test AH .
B19A7	Driver Seat Cushion Blower Speed Short to Ground	GO to Pinpoint Test AI .
B19A8	Driver Seat Back Blower Speed Short to Ground	GO to Pinpoint Test AJ .
B2477	Module Configuration Failure	**NOTE:** This DTC indicates PMI has not been done to a newly installed module or configuration data has been lost. CARRY OUT Programmable Module Installation (PMI) on the DCSM . REFER to Section 418-01 . REPEAT the self-test. If PMI is successful, the DTC will not be present.
B2486	Climate Control Seat Module Voltage Out of Range	GO to Pinpoint Test AK .
B2729	Cushion Over-Temp Detected (Driver)	GO to Pinpoint Test AL .
B272A	Passenger Cushion Over-Temp Detected	GO to Pinpoint Test AM .
B272B	Passenger Back Over-Temp Detected	GO to Pinpoint Test AN .
B272C	Driver Differential Temperature Fault	GO to Pinpoint Test AO .
B272D	Passenger Differential Temperature Fault	GO to Pinpoint Test AP .
B272E	Driver Ignition Run/Blower Circuit Short to Ground (this DTC sets for an open or short to voltage)	GO to Pinpoint Test AQ .
B272F	Passenger Ignition Run/Blower Circuit Short to Ground (this DTC sets for an open or short to voltage)	GO to Pinpoint Test AR .
B2730	Back Over-Temp Detected (Driver)	GO to Pinpoint Test AS .
U2050	No Application Present	INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test.

HVAC Module DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

NOTE: Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

DTC	Description	Action to Take
B1030:12	Left Front Seat Heater: Circuit Short To Battery	GO to Pinpoint Test R .
B1030:14	Left Front Seat Heater: Circuit Short To Ground Or Open	GO to Pinpoint Test R .
B1032:12	Right Front Seat Heater: Circuit Short To Battery	GO to Pinpoint Test S .
B1032:14	Right Front Seat Heater: Circuit Short To Ground Or Open	GO to Pinpoint Test S .
All Other DTCs	-	REFER to the DTC Chart in Section 412-00A or Section 412-00B .

Symptom Chart

Symptom Chart

Pinpoint Tests

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

Refer to Inspection and Verification, Driver Seat Module (DSM) DTC Chart, Driver Door Module (DDM) DTC Chart, Dual Climate Controlled Seat Module (DCSM) DTC Chart, HVAC Module DTC Chart and the Symptom Chart for direction to the appropriate pinpoint test.

Pinpoint Test A: The Power Seat is Inoperative - Driver, Without Memory

Refer to Wiring Diagrams Cell 120 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Seats for schematic and connector information.

Normal Operation

The driver seat control switch is supplied voltage and ground. When the driver seat control switch is activated, voltage and ground is supplied to the applicable seat track motor to move the seat to the desired position. There are 3 seat track motors that combine to move the seat cushion horizontally (forward/rearward) and vertically (front up/down and rear up/down). If a new motor on the seat track needs to be installed, it is necessary to install an entire seat track assembly. There is an additional motor in the seat recliner mechanism to move the seat backrest forward and rearward.

This pinpoint test is intended to diagnose the following:

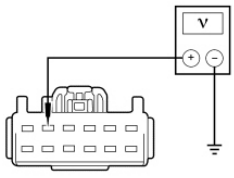
- Fuse
- Wiring, terminals or connectors
- Seat control switch

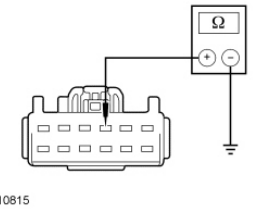
PINPOINT TEST A: THE POWER SEAT IS INOPERATIVE - DRIVER, WITHOUT MEMORY

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
A1 CHECK FOR VOLTAGE TO THE SEAT CONTROL SWITCH	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Driver Seat Control Switch C360. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between driver seat control switch C360-5, circuit SBB32 (VT/RD), harness side and ground.  N0010816 • **Is the voltage greater than 10 volts?**	**Yes** GO to A2 . **No** VERIFY Battery Junction Box (BJB) fuse 32 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
A2 CHECK FOR GROUND TO THE SEAT CONTROL SWITCH	
• Measure the resistance between driver seat control switch C360-3, circuit GD126 (BK/WH), harness side and ground.	**Yes** INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

 • **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test B: DTCs B106E and B106F

Refer to Wiring Diagrams Cell 120 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Seats for schematic and connector information.

Normal Operation

The Driver Seat Module (DSM) controls the output of several vehicle systems by means of solid state drivers. When an overload occurs on any of these drivers, a DTC is set. The module also tracks the number of repetitive faults on each of these circuits. The module compares this number of overloads to 3 progressive thresholds established for each circuit. If the 3 thresholds have not been exceeded, then the DTC of the affected circuit can be cleared by eliminating the fault, then clearing the DTCs and running the self-test. At the point that each of the first 2 thresholds are exceeded, B106E is set along with the DTC relating to the affected circuit. Once the final threshold has been exceeded, the affected output is permanently disabled, and B106F is set along with B1342, at which time the DSM must be replaced.

- DTC B106E (Solid State Driver Disabled Due To Short Circuit) - sets when the DSM has disabled a circuit due to a repetitive fault causing a circuit overload. A corresponding DTC for the circuit in question is also set.
- DTC B106F (Module Disabled Due to External Fault) - sets when one or more output functions are permanently disabled due to a repetitive circuit overload fault. DTC B106F is set with DTC B1342. When DTC B106F is present, a new DSM must be installed after the fault condition has been corrected.

This pinpoint test is intended to diagnose the following:

- Output circuit short to ground or voltage
- DSM

PINPOINT TEST B: DTCs B106E, B106F

NOTICE: **If DTC B106F is present, the fault condition mbe corrected prior to installing a new DSM . Failure to correct the fault condition first may cause damage to the new DSM , resulting in a repeat repair.**

Test Step	Result / Action to Take
B1 REVIEW THE DTCs	
• Review the DTCs from the DSM self-test.	**Yes** CORRECT the cause of any other DTCs present. When the other DTCs are corrected, INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. TEST the system for normal

• **Are DTCs B106F and B1342 present?**	operation. **No** GO to B2 .
B2 REPAIR OTHER DTCs	
• Repair the cause of any DTCs present, other than DTC B106E. Refer to DTC Charts in this section. • Clear the DTCs. • Carry out the DSM self-test. • **Is DTC B106E still present?**	**Yes** The fault causing the output state to be disabled is still present. REPAIR the cause of the concern. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern was caused by a fault in one of the output circuits.

Pinpoint Test C: The Power Seat is Inoperative - MKZ, Passenger

Refer to Wiring Diagrams Cell 120 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Seats for schematic and connector information.

Normal Operation

The passengeseat control switch is supplied voltage and ground. When the passenger seat control switch is activated, voltage and ground is supplied to the applicable seat track motor to move the seat to the desired position. There are 3 seat track motors that combine to move the seat cushion horizontally (forward/rearward) and vertically (front up/down and rear up/down). If a new motor on the seat track needs to be installed, it is necessary to install an entire seat track assembly. There is an additional motor in the seat recliner mechanism to move the seat backrest forward and rearward.

This pinpoint test is intended to diagnose the following:
- Fuse
- Wiring, terminals or connectors
- Seat control switch

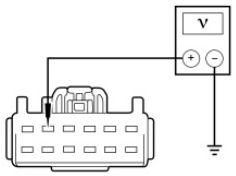
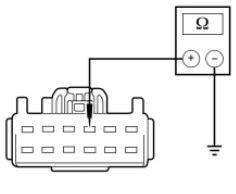
PINPOINT TEST C: THE POWER SEAT IS INOPERATIVE - MKZ, PASSENGER

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
C1 CHECK FOR VOLTAGE TO THE SEAT CONTROL SWITCH	

• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Passenger Seat Control Switch C3190. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between passenger seat control switch C3190-5, circuit SBB31 (WH/RD), harness side and ground.  N0010819 • **Is the voltage greater than 10 volts?**	**Yes** GO to C2 . **No** VERIFY Battery Junction Box (BJB) fuse 31 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
C2 CHECK FOR GROUND TO THE SEAT CONTROL SWITCH	
• Measure the resistance between passenger seat control switch C3190-3, circuit GD126 (BK/WH), harness side and ground.  N0010825 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test D: The Power Seat is Inoperative - Fusion, Passenger

Refer to Wiring Diagrams Cell 120 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Seats for schematic and connector information.

Normal Operation

The passenger seat control switch is supplied voltage and ground. When the passenger seat control switch is activated, voltage and ground is supplied to the seat track motor to move the seat to the desired position. The seat track motor moves the seat cushion horizontally (forward/rearward). If a new motor on the seat track needs to be installed, it is necessary to install an entire seat track assembly. There is an additional motor in the seat recliner mechanism to move the seat backrest forward and rearward.

This pinpoint test is intended to dgnose the following:

- Fuse
- Wiring, terminals or connectors
- Seat control switch

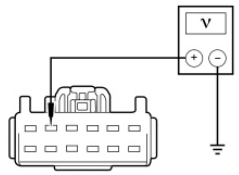
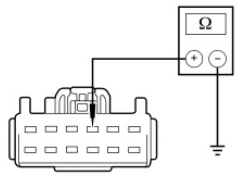
PINPOINT TEST D: THE POWER SEAT IS INOPERATIVE - FUSION, PASSENGER

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
D1 CHECK FOR VOLTAGE AT THE SEAT CONTROL SWITCH	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: Passenger Seat Control Switch C330. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between passenger seat control switch C330-5, circuit SBB31 (WH/RD), harness side and ground.	**Yes** GO to D2 . **No** VERIFY Battery Junction Box (BJB) fuse 31 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 N0010819 • **Is the voltage greater than 10 volts?**	
D2 CHECK FOR GROUND TO THE SEAT CONTROL SWITCH	
• Measure the resistance between passenger seat control switch C330-3, circuit GD139 (BK/YE), harness side and ground.  N0010825 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test E: The Power Seat Moves But is Loose

Normal Operation

Power seat movement should be smooth and the seat cushion should not rock during or after operation.

This pinpoint test is intended to diagnose the following:
- Loose fastening hardware
- Seat track

PINPOINT TEST E: THE POWER SEAT MOVES BUT IS LOOSE

Test Step	Result / Action to Take
E1 CHECK THE FASTENING HARDWARE	
• Inspect for loose mounting hardware on the seat. • **Are the seat fasteners tight?**	**Yes** IDENTIFY the cause and REPAIR as necessary. TEST the system for normal operation. **No** TIGHTEN all fastening hardware to specification. TEST

	the system for normal operation.

Pinpoint Test F: The Power Seat Moves But is Noisy

Normal Operation

The power seat should move quietly during operation. Some noise is acceptable.

This pinpoint test is intended to diagnose the following:

- Seat track
- Seat track component
- Object obstructing seat movement

PINPOINT TEST F: THE POWER SEAT MOVES BUT IS NOISY

Test Step	Result / Action to Take
F1 CHECK THE TRACK ALIGNMENT	
• Check the alignment of the track to the floor and the track to the seat. • **Is the seat track aligned correctly?**	**Yes** IDENTIFY the cause and REPAIR as necessary. TEST the system for normal operation. **No** ALIGN the track to the seat and the floor. TEST the system for normal operation.

Pinpoint Test G: The Power Seat Does Not Make Full Travel

Normal Operation

The power seat should travel fully horizontal (forward/rearward) and vertical (front up/down and rear up/down).

This pinpoint test is intended to diagnose the following:

- Obstruction
- Seat track

PINPOINT TEST G: THE POWER SEAT DOES NOT MAKE FULL TRAVEL

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take

G1 CHECK FOR AN OBSTRUCTION IN THE SEAT TRACK	
• Ignition OFF. • Remove the seat. Refer to Seat - Front in this section. • Check the seat track for any obstructions. • **Is the seat track clear of obstructions?**	**Yes** IDENTIFY the cause and REPAIR as necessary. REPOWER the SRS . REFER to Section 501-20B . TEST the system for normal operation. **No** REMOVE the obstruction(s). INSTALL the seat. REPOWER the SRS . REFER to Section 501-20B . TEST the system for normal operation.

Pinpoint Test H: The Power Seat Does Not Move Horizontally/Vertically/Recline - Driver

Refer to Wiring Diagrams Cell 120 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Seats for schematic and connector information.

Normal Operation

The driver seat control switch is supplied voltage and ground. When the driver seat control switch is activated, voltage and ground is supplied to the applicable seat track motor to move the seat to the desired position. There are 3 seat track motors that combine to move the seat cushion horizontally (forward/rearward) and vertically (front up/down and rear up/down). If a new motor on the seat track needs to be installed, it is necessary to install an entire seat track assembly. There is an additional motor in the seat recliner mechanism to move the seat backrest forward and rearward.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Seat control switch
- Seat track
- Seat recliner motor

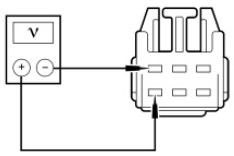
PINPOINT TEST H: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY/RECLINE - DRIVER

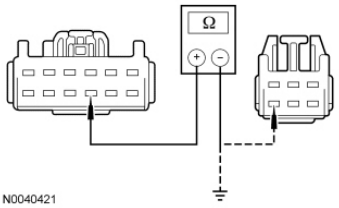
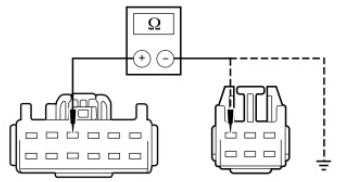
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

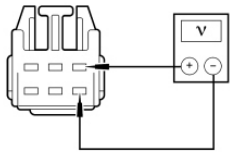
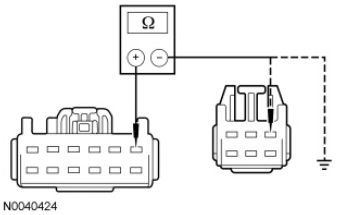
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

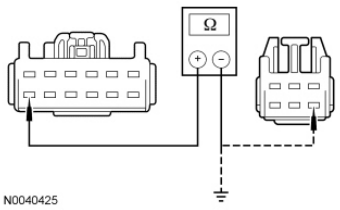
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

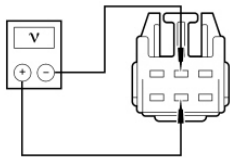
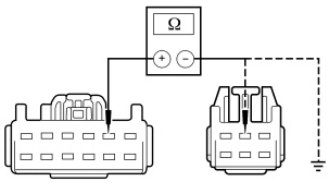
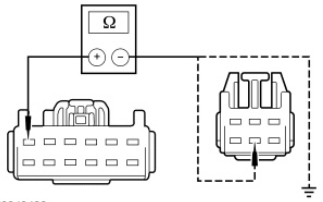
Test Step	Result / Action to Take
H1 CHECK THE HORIZONTAL MOTOR FOR CORRECT OPERATION	
• Operate the driver power seat forward and rearward. • **Does the seat move horizontally?**	**Yes** GO to H2 . **No**

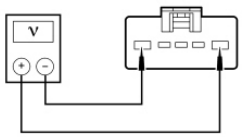
	GO to H3 .
H2 CHECK THE RECLINER MOTOR FOR CORRECT OPERATION	
• Recline the driver backrest forward and rearward. • **Does the seat backrest recline forward and rearward?**	**Yes** GO to H6 . **No** GO to H13 .
H3 CHECK VOLTAGE TO THE DRIVER SEAT HORIZONTAL MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Driver Seat Motor C357. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between driver seat motor C357-6, circuit CPS23 (GN/VT), harness side and C357-3, circuit CPS22 (BN), harness side, while operating the seat control switch horizontal adjust forward and rearward.  N0040420 • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to H4 .
H4 CHECK HORIZONTAL MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Driver Seat Control Switch C360. • Measure the resistance between: ♦ driver seat control switch C360-9, circuit CPS23 (GN/VT), harness side and driver seat motor C357-6, circuit CPS23 (GN/VT), harness side. ♦ driver seat control switch C360-9, circuit CPS23 (GN/VT), harness side and ground.	**Yes** GO to H5 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side

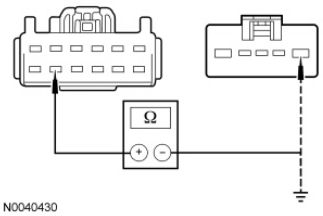
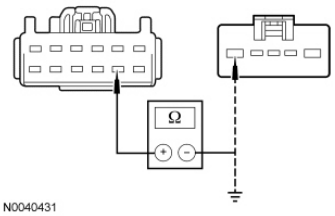
 N0040421 • **Is the resistance less than 5 ohms between the driver seat motor and the driver seat control switch; and greater than 10,000 ohms between the driver seat control switch and ground?**	air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
H5 CHECK HORIZONTAL MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ♦ driver seat control switch C360-4, circuit CPS22 (BN), harness side and driver seat motor C357-3, circuit CPS23 (GN/VT), harness side. ♦ driver seat control switch C360-4, circuit CPS22 (BN), harness side and ground.  N0040422 • **Is the resistance less than 5 ohms between the driver seat motor and the driver seat control switch; and greater than 10,000 ohms between the driver seat control switch and ground?**	**Yes** INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
H6 DETERMINE THE SEAT HEIGHT ADJUST FAILURE	
• Operate the front and rear seat height adjustments. • **Does the seat front and rear height adjust up and down?**	**Yes** If only front height adjust operates, GO to H7 . If only rear height adjust operates, GO to H10 . **No** INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section

	501-20B .
H7 CHECK VOLTAGE TO THE DRIVER SEAT REAR HEIGHT MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Driver Seat Motor C357. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between driver seat motor C357-1, circuit CPS27 (BU/BN), harness side and C357-4, circuit CPS26 (YE/BU), harness side, while operating the seat control switch rear height adjust up and down.  N0040423 • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to H8 .
H8 CHECK REAR HEIGHT MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Driver Seat Control Switch C360. • Measure the resistance between: ♦ driver seat control switch C360-1, circuit CPS27 (BU/BN), harness side and driver seat motor C357-1, circuit CPS27 (BU/BN), harness side. ♦ driver seat control switch C360-1, circuit CPS27 (BU/BN), harness side and ground.  N0040424	**Yes** GO to H9 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

• **Is the resistance less than 5 ohms between the driver seat motor and the driver seat control switch; and greater than 10,000 ohms between the driver seat control switch and ground?**	
H9 CHECK REAR HEIGHT MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ♦ driver seat control switch C360-12, circuit CPS26 (YE/BU), harness side and driver seat motor C357-4, circuit CPS26 (YE/BU), harness side. ♦ driver seat control switch C360-12, circuit CPS26 (YE/BU), harness side and ground.  • **Is the resistance less than 5 ohms between the driver seat motor and the driver seat control switch; and greater than 10,000 ohms between the driver seat control switch and ground?**	**Yes** INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
H10 CHECK VOLTAGE TO THE DRIVER SEAT FRONT HEIGHT MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Driver Seat Motor C357 . • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between driver seat motor C357-2, circuit CPS25 (WH/VT), harness side and C357-5, circuit CPS24 (GY), harness side, while operating the seat control switch front height adjust up and down.	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to H11 .

 N0040426 • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	
H11 CHECK FRONT HEIGHT MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Driver Seat Control Switch C360. • Measure the resistance between: ♦ driver seat control switch C360-2, circuit CPS25 (WH/VT), harness side and driver seat motor C357-2, circuit CPS25 (WH/VT), harness side. ♦ driver seat control switch C360-2, circuit CPS25 (WH/VT), harness side and ground.  N0040427 • **Is the resistance less than 5 ohms between the driver seat motor and the driver seat control switch; and greater than 10,000 ohms between the driver seat control switch and ground?**	**Yes** GO to H12 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
H12 CHECK FRONT HEIGHT MOTOR CIRCUIT FOR AN OPEN AND A SHORT TO GROUND	
• Measure the resistance between: ♦ driver seat control switch C360-6, circuit CPS24 (GY) harness side, and driver seat motor C357-5, circuit CPS24 (GY), harness side. ♦ driver seat control switch C360-6, circuit CPS24 (GY), harness side and ground.  N0040428 • **Is the resistance less than 5 ohms between the driver seat motor and the driver seat control switch; and greater than 10,000 ohms between the driver seat control switch and ground?**	**Yes** INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section

	501-20B .
H13 CHECK VOLTAGE TO THE DRIVER SEAT RECLINER MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Driver Seat Recliner Motor C3187. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between driver seat recliner motor C3187-1, circuit CPS29 (WH/BN), harness side and C3187-5, circuit CPS30 (VT/BN), harness side, while operating the seat control switch recline adjust forward and rearward.  N0040429 • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	**Yes** INSTALL a new driver seat recliner motor. REFER to Seat Recliner Motor in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to H14 .
H14 CHECK RECLINER MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Driver Seat Control Switch C360. • Measure the resistance between: ♦ driver seat control switch C360-11, circuit CPS29 (WH/BN), harness side and driver seat recliner motor C3187-1, circuit CPS29 (WH/BN), harness side. ♦ driver seat control switch C360-11, circuit CPS29 (WH/BN), harness side and ground.	**Yes** GO to H15 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

 N0040430 • **Is the resistance less than 5 ohms between the driver seat recliner motor and the driver seat control switch; and greater than 10,000 ohms between the driver seat control switch and ground?**	
H15 CHECK RECLINER MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ♦ driver seat control switch C360-8, circuit CPS30 (VT/BN) harness side, and driver seat recliner motor C3187-5, circuit CPS30 (VT/BN), harness side. ♦ driver seat control switch C360-8, circuit CPS30 (VT/BN), harness side and ground.  N0040431 • **Is the resistance less than 5 ohms between the driver seat recliner motor and the driver seat control switch; and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** INSTALL a new driver seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test J: The Power Seat Does Not Move Horizontally/Vertically/Recline - MKZ, Passenger

Refer to Wiring Diagrams Cell 120 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Seats for schematic and connector information.

Normal Operation

The passenger seat control switch is supplied voltage and ground. When the passenger seat control switch is activated, voltage and ground is supplied to the applicable seat track motor to move the seat to the desired position. There are 3 seat track motors that combine to move the seat cushion horizontally (forward/rearward) and vertically (front up/down and rear up/down). If a new motor on the seat track needs to be installed, it is necessary to install an entire seat track assembly. There is an additional motor in the seat recliner mechanism to move the seat backrest forward and rearward.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Seat control switch
- Seat track

- Seat recliner motor

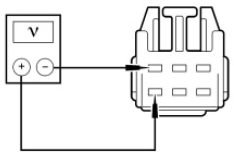
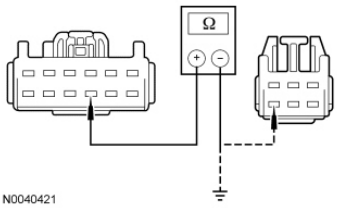
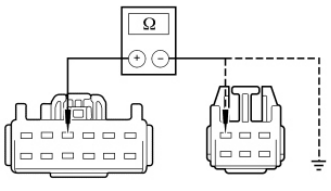
PINPOINT TEST J: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY/RECLINE - MKZ, PASSENGER

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

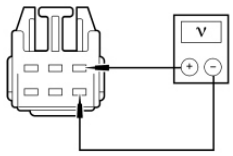
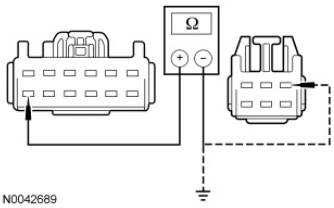
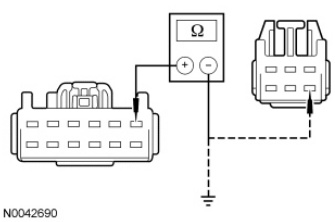
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

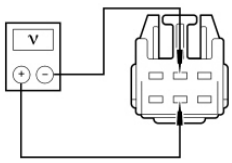
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

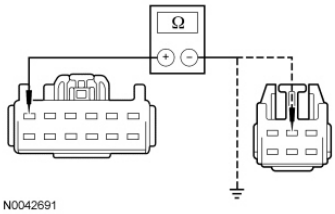
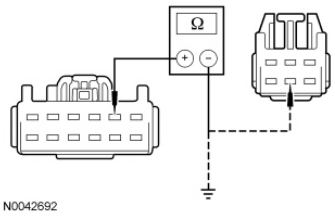
Test Step	Result / Action to Take
J1 CHECK THE HORIZONTAL MOTOR FOR CORRECT OPERATION	
• Operate the passenger power seat forward and rearward. • **Does the seat move horizontally?**	**Yes** GO to J2 . **No** GO to J3 .
J2 CHECK THE RECLINER MOTOR FOR CORRECT OPERATION	
• Recline the passenger backrest forward and rearward. • **Does the seat backrest recline forward and rearward?**	**Yes** GO to J6 . **No** GO to J13 .
J3 CHECK VOLTAGE TO THE PASSENGER SEAT HORIZONTAL MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Passenger Seat Motor C3015. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between passenger seat motor C3015-6, circuit CPS38 (GN/BU), harness side and C3015-3, circuit CPS33 (WH), harness side, while operating the seat control switch horizontal adjust forward and rearward.	**Yes** INSTALL a new passenger seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to J4 .

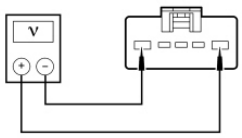
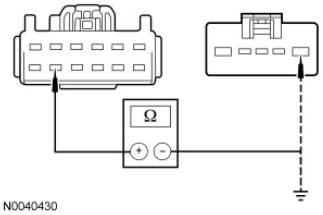
 N0040420 • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	
J4 CHECK HORIZONTAL MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Passenger Seat Control Switch C3190. • Measure the resistance between: ♦ passenger seat control switch C3190-9, circuit CPS38 (GN/BU), harness side and passenger seat motor C3015-6, circuit CPS38 (GN/BU), harness side. ♦ passenger seat control switch C3190-9, circuit CPS38 (GN/BU), harness side and ground.  N0040421 • **Is the resistance less than 5 ohms between the passenger seat motor and the passenger seat control switch; and greater than 10,000 ohms between the passenger seat control switch and ground?**	**Yes** GO to J5 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
J5 CHECK HORIZONTAL MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ♦ passenger seat control switch C3190-4, circuit CPS33 (WH), harness side and passenger seat motor C3015-3, circuit CPS33 (WH), harness side. ♦ passenger seat control switch C3190-4, circuit CPS33 (WH), harness side and ground.  N0040422 • **Is the resistance less than 5 ohms between the passenger seat motor and the passenger seat control switch; and greater than 10,000 ohms between the passenger seat control switch and**	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal

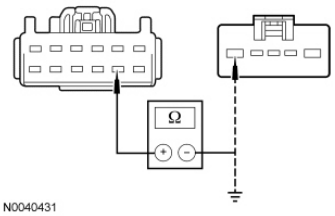
ground?	operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
J6 DETERMINE THE SEAT HEIGHT ADJUST FAILURE	
• Operate the front and rear seat height adjustments. • **Does the seat front and rear height adjust up and down?**	**Yes** If only front height adjust operates, GO to J7 . If only rear height adjust operates, GO to J10 . **No** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
J7 CHECK VOLTAGE TO THE PASSENGER SEAT REAR HEIGHT MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Passenger Seat Motor C3015. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between passenger seat motor C3015-1, circuit CPS37 (WH/BU), harness side and C3015-4, circuit CPS36 (YE/GY), harness side, while operating the seat control switch rear height adjust up and down.	**Yes** INSTALL a new passenger seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to J8 .

 N0040423 • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	
J8 CHECK REAR HEIGHT MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Passenger Seat Control Switch C3190. • Measure the resistance between: ♦ passenger seat control switch C3190-12, circuit CPS37 (WH/BU), harness side and passenger seat motor C3015-1, circuit CPS37 (WH/BU), harness side. ♦ passenger seat control switch C3190-12, circuit CPS37 (WH/BU), harness side and ground.  N0042689 • **Is the resistance less than 5 ohms between the passenger seat motor and the passenger seat control switch; and greater than 10,000 ohms between the passenger seat control switch and ground?**	**Yes** GO to J9 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
J9 CHECK REAR HEIGHT MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ♦ passenger seat control switch C3190-1, circuit CPS36 (YE/GY), harness side and passenger seat motor C3015-4, circuit CPS36 (YE/GY), harness side. ♦ passenger seat control switch C3190-4, circuit CPS36 (YE/GY), harness side and ground.  N0042690 • **Is the resistance less than 5 ohms between the passenger seat motor and the passenger seat control switch; and greater than 10,000 ohms between the passenger seat control switch and**	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal

ground?	operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
J10 CHECK VOLTAGE TO THE PASSENGER SEAT FRONT HEIGHT MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Passenger Seat Motor C3015. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between passenger seat motor C3015-2, circuit CPS35 (VT/GN), harness side and C3015-5, circuit CPS34 (GY/BU), while operating the seat control switch front height adjust up and down.  N0040426 • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	**Yes** INSTALL a new passenger seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to J11 .
J11 CHECK FRONT HEIGHT MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Passenger Seat Control Switch C3190. • Measure the resistance between: ♦ passenger seat control switch C3190-6, circuit CPS35 (VT/GN), harness side and passenger seat motor C3015-2, circuit CPS35 (VT/GN), harness side. ♦ passenger seat control switch C3190-6, circuit CPS35 (VT/GN), harness side and ground.	**Yes** GO to J12 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT

 N0042691 • **Is the resistance less than 5 ohms between the passenger seat motor and the passenger seat control switch; and greater than 10,000 ohms between the passenger seat control switch and ground?**	passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
J12 CHECK FRONT HEIGHT MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ♦ passenger seat control switch C3190-2, circuit CPS34 (GY/BU) harness side, and passenger seat motor C3015-5, circuit CPS34 (GY/BU), harness side. ♦ passenger seat control switch C3190-2, circuit CPS34 (GY/BU), harness side and ground.  N0042692 • **Is the resistance less than 5 ohms between the passenger seat motor and the passenger seat control switch; and greater than 10,000 ohms between the passenger seat control switch and ground?**	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
J13 CHECK VOLTAGE TO THE PASSENGER SEAT RECLINER MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Passenger Seat Recliner Motor C3189. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 .	**Yes** INSTALL a new passenger seat recliner motor. REFER to Seat Recliner Motor in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to

• **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between passenger seat recliner motor C3189-1, circuit CPS39 (GY/YE), harness side and C3189-5, circuit CPS40 (VT/GY), harness side, while operating the seat control switch recline adjust forward and rearward.  N0040429 • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	Section 501-20B . **No** GO to J14 .
J14 CHECK RECLINER MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Passenger Seat Control Switch C3190. • Measure the resistance between: ♦ passenger seat control switch C3190-11, circuit CPS39 (GY/YE), harness side and passenger seat recliner motor C3189-1, circuit CPS39 (GY/YE), harness side. ♦ passenger seat control switch C3190-11, circuit CPS39 (GY/YE), harness side and ground.  N0040430 • **Is the resistance less than 5 ohms between the passenger seat recliner motor and the passenger seat control switch; and greater than 10,000 ohms between the passenger seat control switch and ground?**	**Yes** GO to J15 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
J15 CHECK RECLINER MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ♦ passenger seat control switch C3190-8, circuit CPS40 (VT/GY) harness side, and passenger seat recliner motor C3189-5, circuit CPS40 (VT/GY), harness side. ♦ passenger seat control switch C3190-8, circuit CPS40 (VT/GY), harness side and ground.	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT

 • **Is the resistance less than 5 ohms between the passenger seat recliner motor and the passenger seat control switch; and greater than 10,000 ohms between the seat control switch and ground?**	passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test K: The Power Seat Does Not Move Horizontally/Recline - Fusion, Passenger

Refer to Wiring Diagrams Cell 120 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Seats for schematic and connector information.

Normal Operation

The passenger seat control switch is supplied voltage and ground. When the passenger seat control switch is activated, voltage and ground is supplied to the seat track motor to move the seat to the desired position. The seat track motor moves the seat cushion horizontally (forward/rearward). If a new motor on the seat track needs to be installed, it is necessary to install an entire seat track assembly. There is an additional motor in the seat recliner mechanism to move the seat backrest forward and rearward.

This pinpoint test is intended to diagnose the following:
- Wing, terminals or connectors
- Seat control switch
- Seat track

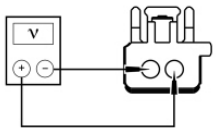
PINPOINT TEST K: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/RECLINE - FUSION, PASSENGER

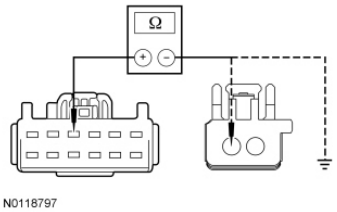
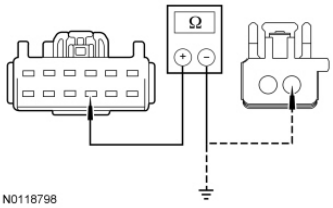
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

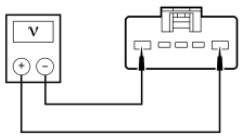
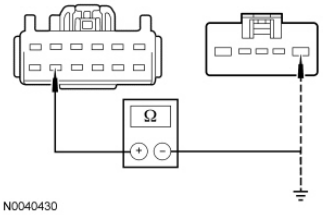
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

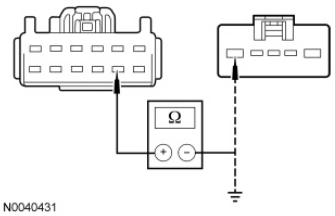
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
K1 CHECK THE HORIZONTAL MOTOR FOR CORRECT OPERATION	
• Operate the passenger power seat forward and rearward. • **Does the seat move horizontally?**	**Yes** GO to K5 .

	No GO to K2 .
K2 CHECK VOLTAGE TO THE PASSENGER SEAT HORIZONTAL MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: Passenger Seat Horizontal Motor C332. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between passenger seat motor C332-1, circuit CPS38 (GN/BU), harness side and C332-2, circuit CPS33 (WH), harness side, while operating the seat control switch horizontal adjust forward and rearward.  N0118796 • **Is the voltage greater than 10 volts when the seat control switch is toggled in both directions and 0 volt in the rest position?**	**Yes** INSTALL a new passenger seat track assembly. REFER to Seat Track in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to K3 .
K3 CHECK THE HORIZONTAL MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Passenger Seat Control Switch C330. • Measure the resistance between: ♦ passenger seat control switch C330-4, circuit CPS33 (WH), harness side and passenger seat horizontal motor C332-2, circuit CPS33 (WH), harness side. ♦ passenger seat control switch C330-4, circuit CPS33 (WH), harness side and ground.	**Yes** GO to K4 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 N0118797 • **Is the resistance less than 5 ohms between the passenger seat horizontal motor and the passenger seat control switch; and greater than 10,000 ohms between the passenger seat control switch and ground?**	
K4 CHECK THE HORIZONTAL MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ♦ passenger seat control switch C330-9, circuit CPS38 (GN/BU), harness side and passenger seat horizontal motor C332-1, circuit CPS38 (GN/BU), harness side. ♦ passenger seat control switch C330-9, circuit CPS38 (GN/BU), harness side and ground.  N0118798 • **Is the resistance less than 5 ohms between the passenger seat horizontal motor and the passenger seat control switch; and greater than 10,000 ohms between the passenger seat control switch and ground?**	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
K5 CHECK VOLTAGE TO THE PASSENGER SEAT RECLINER MOTOR	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Passenger Seat Recliner Motor C3189. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 .	**Yes** INSTALL a new passenger seat recliner motor. REFER to Seat Recliner Motor in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to

• **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between passenger seat recliner motor C3189-1, circuit CPS39 (GY/YE), harness side and C3189-5, circuit CPS40 (VT/GY), harness side, while operating the seat control switch recline adjust forward and rearward.  N0040429 • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	Section 501-20B . **No** GO to K6 .
K6 CHECK RECLINER MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Passenger Seat Control Switch C330. • Measure the resistance between: ♦ passenger seat control switch C330-11, circuit CPS39 (GY/YE), harness side and passenger seat recliner motor C3189-1, circuit CPS39 (GY/YE), harness side. ♦ passenger seat control switch C330-11, circuit CPS39 (GY/YE), harness side and ground.  N0040430 • **Is the resistance less than 5 ohms between the passenger seat recliner motor and the passenger seat control switch; and greater than 10,000 ohms between the passenger seat control switch and ground?**	**Yes** GO to K7 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
K7 CHECK RECLINER MOTOR CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Measure the resistance between: ♦ passenger seat control switch C330-8, circuit CPS40 (VT/GY) harness side, and passenger seat recliner motor C3189-5, circuit CPS40 (VT/GY), harness side. ♦ passenger seat control switch C330-8, circuit CPS40 (VT/GY), harness side and ground.	**Yes** INSTALL a new passenger seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT

 • **Is the resistance less than 5 ohms between the passenger seat recliner motor and the passenger seat control switch; and greater than 10,000 ohms between the seat control switch and ground?**	passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test L: The Memory Seat is Inoperative/Does Not Operate Correctly - Does Not Operate Horizontally/Vertically/Recline

Refer to Wiring Diagrams Cell 123 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Memory Seats for schematic and connector information.

Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Component Testing for component testing.

Normal Operation

When activated, the seat control switch supplies voltage and ground to the applicable Driver Seat Module (DSM) inputs. The DSM then supplies voltage and ground to the appropriate seat track motor or seat recliner motor to move the seat in the desired direction. There are 3 seat track motors that combine to move the seat horizontally (forward/backward) and vertically (front up/down and rear up/down). The seat recliner mechanism uses a single motor to pivot the seat backrest forward and backward.

Each motor in the memory power seat track and power recliner contains a Hall-effect position sensor. The DSM supplies a signal supply circuit to each position sensor and a shared reference signal return circuit. Each position sensor sends a signal voltage back to the DSM used to monitor the position of the power seat and seat backrest. The DSM uses this information to return the seat to a stored pre-programmed position when pressing the memory SET switch or a Remote Keyless Entry (RKE) transmitter. Refer to Principles of Operation in this section or the Owner's Literature for information on programming the DSM for storing memory seat positions.

The following pinpoint test diagnoses a memory seat that does not operate in one or more directions when using the seat control switch. If the memory seat moves in all directions using the seat control switch, GO to Pinpoint Test M .

DTC Description	Fault Trigger Conditions
• B1342 - ECU is Faulted	If a programming error is detected, the DTC is set.

• B1663 - Seat Driver Front Up/Down Motor Stalled • B1664 - Seat Driver Rear Up/Down Motor Stalled • B1665 - Seat Driver Forward/Backward Motor Stalled	During self-test, the DSM attempts to operate the appropriate seat track motor and uses the motor's position sensor to monitor movement. If no motor movement is sensed, the DTC is set. The DSM will retry motor operation on the next activation of the seat control switch. If no movement continues to be monitored after 250 milliseconds, the DSM disables the output.
• B1666 - Seat Driver Recline Motor Stalled	During self-test, the DSM attempts to operate the recliner motor and uses the recliner motor position sensor to monitor movement. If no motor movement is sensed, the DTC is set. The DSM will retry motor operation on the next activation of the seat control switch. If no motor movement is still monitored after 250 millisthe DSM disables the output.
• B1703 - Seat Driver Recline Forward Switch Circuit Short to Battery • B1707 - Seat Driver Recline Rearward Switch Circuit Short to Battery	If voltage is sensed on the switch input circuit during the DSM Self Test, the DTC is set. If voltage is sensed on the input circuit for greater than 2 minutes, the DTC is set as continuous. With the DTC set, any input signal on the circuit is ignored.
• B1711 - Seat Driver Front Up Switch Circuit Short to Battery • B1715 - Seat Driver Front Down Switch Circuit Short to Battery	If voltage is sensed on the switch input circuit during the DSM Self Test, the DTC is set. If voltage is sensed on the input circuit for greater than 2 minutes, the DTC is set as continuous. With the DTC set, any input signal on the circuit is ignored.
• B1719 - Seat Driver Forward Switch Circuit Short to Battery • B1723 - Seat Driver Rearward Switch Circuit Short to Battery	If voltage is sensed on the switch input circuit during the DSM Self Test, the DTC is set. If voltage is sensed on the input circuit for greater than 2 minutes, the DTC is nuous. With the DTC set, any input signal on the circuit is ignored.
• B1727 - Seat Driver Rear Up Switch Circuit Short to Battery • B1731 - Seat Driver Rear Down Switch Circuit Short to Battery	If voltage is sensed on the switch input circuit during the DSM Self Test, the DTC is set. If voltage is sensed on the input circuit for greater than 2 minutes, the DTC is set as continuous. With the DTC set, any input signal on the circuit is ignored.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Seat control switch
- Seat track
- Seat recliner motor
- DSM

PINPOINT TEST L: THE MEMORY SEAT IS INOPERATIVE/DOES NOT OPERATE CORRECTLY - DOES NOT OPERATE HORIZONTALLY/VERTICALLY/RECLINE

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

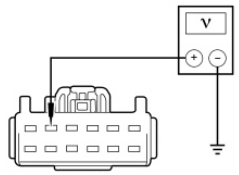
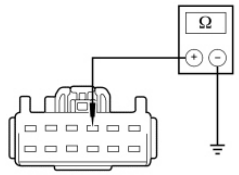
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Verify good battery condition before diagnosing the memory seat system. Poor battery condition may interfere with memory seat operation, even if vehicle starting is possible.

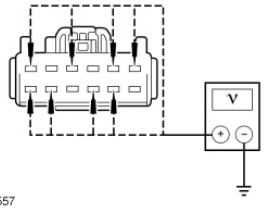
Test Step	Result / Action to Take
L1 CHECK THE TCM TRANSMISSION RANGE (TR) PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - TCM - PID: TR. • Operate the transmission gear selector in all positions while monitoring the TCM PID TR states. • **Do the PID states agree with the selected positions?**	**Yes** GO to L2 . **No** To diagna transmission gear selector (PRNDL) status concern, REFER to Section 307-01A , Section 307-01B or Section 307-01C .
L2 CHECK THE DSM IGNITION SWITCH STATUS (IGN_SW) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - DSM - PID: IGN_SW. • Cycle the ignition in all positions while monitoring the DSM PID states. • **Do the PID states agree with the selected positions?**	**Yes** GO to L3 . **No** To diagnose an ignition status concern, REFER to Section 211-05 .
L3 RETRIEVE THE DSM DTCs	
• Operate the memory seat and memory exterior mirrors in all	**Yes** If DTCs B1663, B1664, B1665 and B1666 are all retrieved, GO to L12 .

directions through the full range of travel. • Place the memory seat and memory exterior mirrors in central travel positions. • Enter the following diagnostic mode on the scan tool: Self Test - DSM . • **Are any DTCs retrieved?**	If DTC B1663, GO to L22 . If DTC B1664, GO to L25 . If DTC B1665, GO to L28 . If DTC B1666, GO to L31 . If DTC B1703, GO to L5 . If DTC B1707, GO to L5 . If DTC B1711, GO to L5 . If DTC B1715, GO to L5 . If DTC B1719, GO to L5 . If DTC B1723, GO to L5 . If DTC B1727, GO to L5 . If DTC B1731, GO to L5 . If DTC B1342, INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs. For any other DSM DTCs, REFER to the Driver Seat Module (DSM) DTC Chart. **No** GO to L4 .
L4 CHECK THE DSM SEAT CONTROL SWITCH PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger - DSM - PIDs. ♦ Driver Power Seat Front Up/Down Switch (SFNT_SW) ♦ Driver Power Seat Forward/Backward Switch (SFWD_SW) ♦ Driver Power Seat Rear Up/Down Switch (SREARSW) ♦ Driver Power Seat Recline Switch Status (SRCL_SW) • Operate the seat control switch in all positions and monitor the	**Yes** GO to L11 . **No** VERIFY Smart Junction Box (SJB) fuse 12 (7.5A) is OK. If SJB fuse 12 (7.5A) fails while operating the seat control switch, DISCONNECT the seat control switch C3297 and GO to L9 . If SJB fuse 12 (7.5A) is OK, GO to L5 .

DSM seat control switch PIDs. • **Do the PID states agree with the switch positions?**	
L5 CHECK THE SEAT CONTROL SWITCH	
• Remove the seat control switch. Refer to Seat Control Switch in this section. • Check the seat control switch. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Component Testing for component testing. • **Is the seat control switch OK?**	**Yes** GO to L6 . **No** INSTALL a new seat control switch. REFER to Seat Control Switch in this section. REPEAT the self-test. CLEAR the DTCs.
L6 CHECK FOR VOLTAGE TO THE SEAT CONTROL SWITCH	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between seat control switch C3297-5, circuit SBP12 (GN/RD), harness side and ground.	**Yes** GO to L7 . **No** VERIFY SJB fuse 12 (7.5A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPEAT the self-test. CLEAR the DTCs. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

 N0010816 • **Is the voltage greater than 10 volts?**	
L7 CHECK FOR GROUND TO THE SEAT CONTROL SWITCH	
• Measure the resistance between seat control switch C3297-3, circuit GD126 (BK/WH), harness side and ground.  N0010815 • **Is the resistance less than 5 ohms?**	**Yes** GO to L8 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
L8 CHECK CIRCUITS BETWEEN THE SEAT CONTROL SWITCH AND DSM FOR A SHORT TO VOLTAGE	
• Disconnect: DSM C3299B. • Ignition ON. • Measure the voltage between seat control switch C3297, harness side and ground using the following chart: **Connector** / **Circuit** C3297-9 — CPS06 (GN/WH) C3297-4 — CPS01 (GN/BU) C3297-2 — CPS03 (VT/GY) C3297-6 — CPS02 (GY/YE) C3297-11 — CPS07 (GY/BN) C3297-8 — CPS08 (VT/OG) C3297-12 — CPS04 (YE/OG)	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to L9 .

C3297-1	CPS05 (BU/WH)

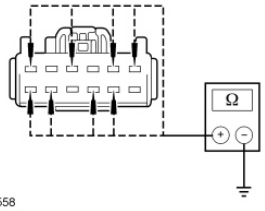


- **Is voltage present on any circuits?**

L9 CHECK CIRCUITS BETWEEN THE SEAT CONTROL SWITCH AND DSM FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: DSM C3299B. • Disconnect: Driver Seat Control Switch C3297. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between seat control switch C3297 pins, harness side and ground using the following chart:	**Yes** GO to L10 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

Connector	Circuit
C3297-9	CPS06 (GN/WH)

C3297-4	CPS01 (GN/BU)
C3297-2	CPS03 (VT/GY)
C3297-6	CPS02 (GY/YE)
C3297-11	CPS07 (GY/BN)
C3297-8	CPS08 (VT/OG)
C3297-12	CPS04 (YE/OG)
C3297-1	CPS05 (BU/WH)



- **Are the resistances greater than 10,000 ohms?**

L10 CHECK CIRCUITS BETWEEN THE SEAT CONTROL SWITCH AND DSM FOR AN OPEN

- Measure the resistance between seat control switch C3297, harness side and DSM C3299B pins, harness side using the following chart:

Seat Control Switch Connector	Circuit	DSM Connector
C3297-9	CPS06 (GN/WH)	C3299B-15
C3297-4	CPS01 (GN/BU)	C3299B-16
C3297-2	CPS03 (VT/GY)	C3299B-18
C3297-6	CPS02 (GY/YE)	C3299B-6
C3297-11	CPS07 (GY/BN)	C3299B-19
C3297-8	CPS08 (VT/OG)	C3299B-7
C3297-12	CPS04 (YE/OG)	C3299B-5

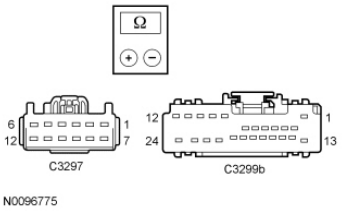
Yes
INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

No
REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.

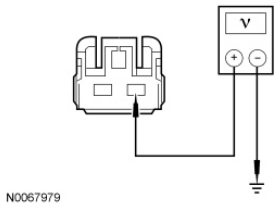
DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

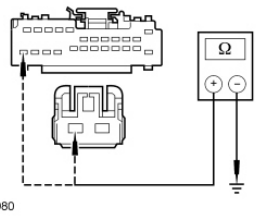
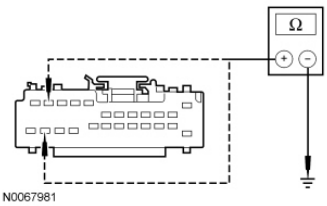
C3297-1	CPS05 (BU/WH)	C3299b-17	

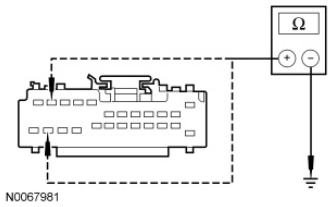
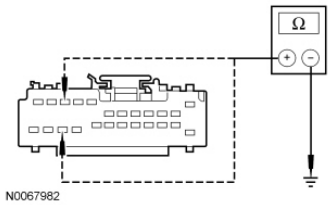


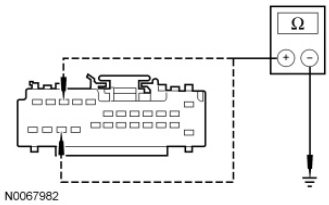
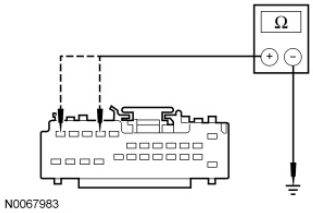
- **Are the resistances less than 5 ohms?**

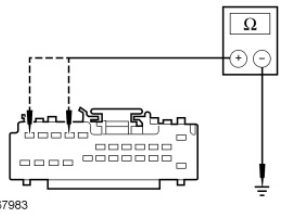
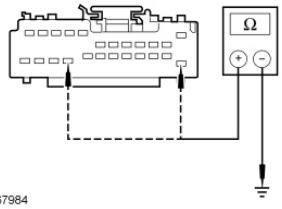
L11 CHECK SEAT TRACK OPERATION USING DSM SEAT TRACK MOTOR PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger - DSM - PIDs. ♦ Front Motor Up (FRONT_UP) ♦ Front Motor Down (FRONT_DWN) ♦ Rear Motor Up (REAR_UP) ♦ Rear Motor Down (REAR_DWN) ♦ Horizontal Motor Forward (HORZ_FWD) ♦ Horizontal Motor Backward (HORZ_BWD) ♦ Recline Motor Backward (RECL_BWD) ♦ Recline Motor Forward (RECL_FWD) • Toggle the DSM active commands ON and OFF while monitoring the seat movement. • **Does the driver seat operate correctly?**	**Yes** The condition may be intermittent. CHECK for causes of an intermittent concern, particularly the pins and terminals of electrical connectors that were disconnected. **Do not install any new components at this time. Components should only be installed when directed to do so in the pinpoint test.** REPAIR any intermittent wiring, terminal or connector concerns found. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** If no seat movement, GO to L12 . If no front vertical seat movement, GO to L22 . If no rear vertical seat movement, GO to L25 . If no horizontal seat movement, GO to L28 . If no recline seat movement, GO to L31 .
L12 CHECK FOR VOLTAGE TO THE DSM	

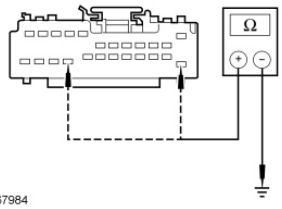
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: DSM C3299A . • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between DSM C3299A-1, circuit SBB32 (VT/RD), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to L13 . **No** VERIFY Battery Junction Box (BJB) fuse 32 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
L13 CHECK FOR GROUND TO THE DSM	
• Disconnect: DSM C3299B. • Measure the resistance between: ♦ DSM C3299A-2, circuit GD126 (BK/WH), harness side and ground. ♦ DSM C3299B-24, circuit GD126 (BK/WH), harness side and ground.	**Yes** GO to L14 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

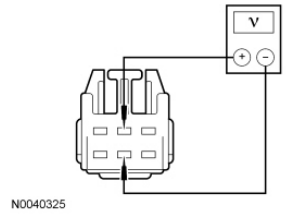
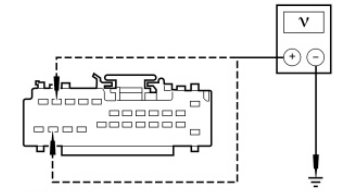
 N0067980 • **Is the resistance less than 5 ohms?**	
L14 CHECK THE FRONT HEIGHT MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: DSM C3299B. • Measure the resistance between: ♦ DSM C3299B-23, circuit CPS25 (WH/VT), harness side and ground. ♦ DSM C3299B-11, circuit CPS24 (GY), harness side and ground.  N0067981 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to L16 . **No** GO to L15 .
L15 CHECK THE FRONT HEIGHT MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Power Seat Motor C357. • Measure the resistance between: ♦ DSM C3299B-23, circuit CPS25 (WH/VT), harness side and ground. ♦ DSM C3299B-11, circuit CPS24 (GY), harness side and ground.	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to

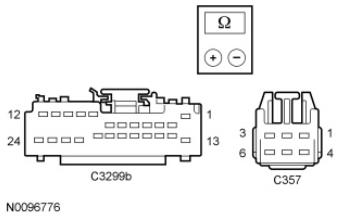
	Section 501-20B .
 N0067981 • **Are the resistances greater than 10,000 ohms?**	
L16 CHECK THE REAR HEIGHT MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between: ♦ DSM C3299B-22, circuit CPS27 (BU/BN), harness side and ground. ♦ DSM C3299B-10, circuit CPS26 (YE/BU), harness side and ground.  N0067982 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to L18 . **No** GO to L17 .
L17 CHECK THE REAR HEIGHT MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Power Seat Motor C357. • Measure the resistance between: ♦ DSM C3299B-22, circuit CPS27 (BU/BN), harness side and ground. ♦ DSM C3299B-10, circuit CPS26 (YE/BU), harness side and ground.	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

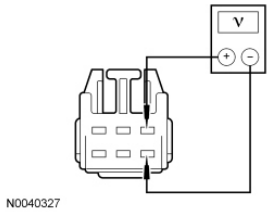
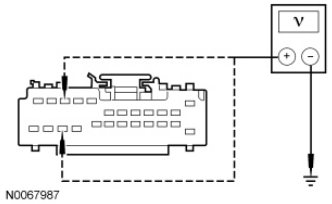
 N0067982 • **Are the resistances greater than 10,000 ohms?**	
L18 CHECK THE HORIZONTAL MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between: ♦ DSM C3299B-9, circuit CPS23 (GN/VT), harness side and ground. ♦ DSM C3299B-12, circuit CPS22 (BN), harness side and ground.  N0067983 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to L20 . **No** GO to L19 .
L19 CHECK THE HORIZONTAL MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Power Seat Motor C357. • Measure the resistance between: ♦ DSM C3299B-9, circuit CPS23 (GN/VT), harness side and ground. ♦ DSM C3299B-12, circuit CPS22 (BN), harness side and ground.	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

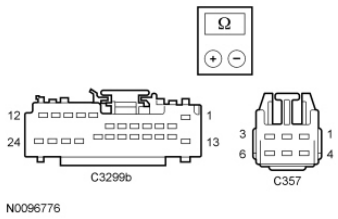
 N0067983 • **Are the resistances greater than 10,000 ohms?**	
L20 CHECK THE RECLINER MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between: ♦ DSM C3299B-13, circuit CPS29 (WH/BN), harness side and ground. ♦ DSM C3299B-21, circuit CPS30 (VT/BN), harness side and ground.  N0067984 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to L21 .
L21 CHECK THE RECLINER MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Driver Power Seat Recliner Motor C3187. • Measure the resistance between: ♦ DSM C3299B-13, circuit CPS29 (WH/BN), harness side and ground. ♦ DSM C3299B-21, circuit CPS30 (VT/BN), harness side and ground.	**Yes** INSTALL a new driver seat recliner motor. REFER to Seat Recliner Motor in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

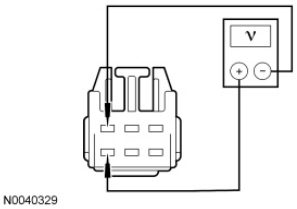
 • **Are the resistances greater than 10,000 ohms?**	
L22 CHECK FOR VOLTAGE AT THE FRONT HEIGHT MOTOR USING DSM SEAT TRACK MOTOR PIDs	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Power Seat Motor C357. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - DSM - PIDs. ♦ Front Motor Up (FRONT_UP) ♦ Front Motor Down (FRONT_DWN) • Measure the voltage between power seat motor C357-2, circuit CPS25 (WH/VT) and C357-5, circuit CPS24 (GY), harness side while toggling DSM active commands FRONT_UP and FRONT_DWN, ON and OFF.	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to L23 .

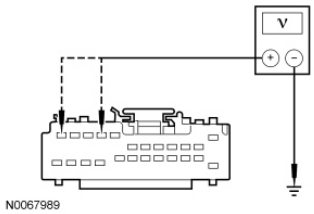
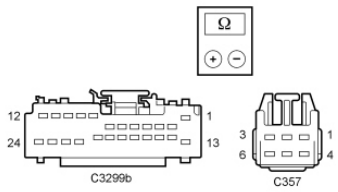
 N0040325 • **Is the voltage greater than 10 volts when command ON in both directions and 0 volt when commanded OFF?**	
L23 CHECK THE FRONT HEIGHT MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: DSM C3299B. • Ignition ON. • Measure the voltage between: ♦ DSM C3299B-23, circuit CPS25 (WH/VT), harness side and ground. ♦ DSM C3299B-11, circuit CPS24 (GY), harness side and ground.  N0067985 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to L24 .
L24 CHECK THE FRONT HEIGHT MOTOR CIRCUITS FOR AN OPEN	
• Measure the resistance between: ♦ DSM C3299B-23, circuit CPS25 (WH/VT), harness side and power seat motor C357-2, circuit CPS25 (WH/VT), harness side. ♦ DSM C3299B-11, circuit CPS24 (GY),	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.

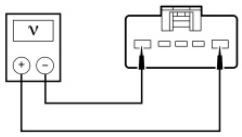
harness side and power seat motor C357-5, circuit CPS24 (GY), harness side.  • **Are the resistances less than 5 ohms?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
L25 CHECK VOLTAGE AT THE REAR HEIGHT MOTOR USING DSM SEAT TRACK MOTOR PIDs	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Power Seat Motor C357. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - DSM - PIDs. ♦ Rear Motor Up (REAR_UP) ♦ Rear Motor Down (REAR_DWN) • Measure the voltage between power seat motor C357-1, circuit CPS27 (BU/BN),	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to L26 .

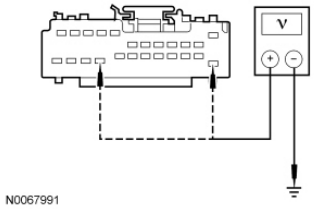
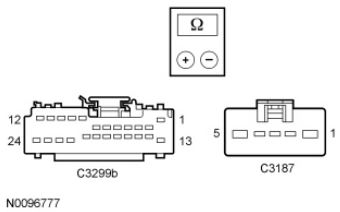
harness side and C357-4, circuit CPS26 (YE/BU), harness side while toggling DSM active commands REAR_UP and REAR_DWN, ON and OFF.  N0040327 • **Is the voltage greater than 10 volts when command ON in both directions and 0 volt when commanded OFF?**	
L26 CHECK THE REAR HEIGHT MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: DSM C3299B. • Ignition ON. • Measure the voltage between: ♦ DSM C3299B-22, circuit CPS27 (BU/BN), harness side and ground. ♦ DSM C3299B-10, circuit CPS26 (YE/BU), harness side and ground.  N0067987 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to L27 .
L27 CHECK THE REAR HEIGHT MOTOR CIRCUITS FOR AN OPEN	

• Ignition OFF. • Measure the resistance between: ♦ DSM C3299B-22, circuit CPS27 (BU/BN), harness side and power seat motor C357-1, circuit CPS27 (BU/BN), harness side. ♦ DSM C3299B-10, circuit CPS26 (YE/BU), harness side and rear height power seat motor C357-4, circuit CPS26 (YE/BU), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
L28 CHECK VOLTAGE AT THE HORIZONTAL MOTOR USING DSM SEAT TRACK MOTOR PIDs	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Power Seat Motor C357. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to L29 .

. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - DSM - PIDs. ♦ Horizontal Motor Forward (HORZ_FWD) ♦ Horizontal Motor Backward (HORZ_BWD) • Measure the voltage between power seat motor C357-3, circuit CPS22 (BN) and C357-6, circuit CPS23 (GN/VT), harness side while toggling DSM active commands HORZ_FWD and HORZ_BWD, ON and OFF.  N0040329 • **Is the voltage greater than 10 volts when command ON in both directions and 0 volt when commanded OFF?**	
L29 CHECK THE HORZONTAL MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: DSM C3299B. • Ignition ON. • Measure the voltage between: ♦ DSM C3299B-9, circuit CPS23 (GN/VT), harness side and ground. ♦ DSM C3299B-12, circuit CPS22 (BN), harness side and ground.	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to L30 .

 N0067989 • **Is voltage present on either circuit?**	
L30 CHECK THE HORIZONTAL MOTOR CIRCUITS FOR AN OPEN	
• Ignition OFF. • Measure the resistance between: ♦ DSM C3299B-9, circuit CPS23 (GN/VT), harness side and power seat motor C357-6, circuit CPS23 (GN/VT), harness side. ♦ DSM C3299B-12, circuit CPS22 (BN), harness side and horizontal power seat motor C357-3, circuit CPS22 (BN), harness side.  N0096776 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
L31 CHECK VOLTAGE AT THE RECLINER MOTOR USING DSM RECLINER MOTOR PIDs	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327.	**Yes** INSTALL a new driver seat recliner motor. REFER to ref="SCS~us~en~file=SCS1A014.HTM~gen~ref.HTM" >Seat Recliner Motor in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No**

• Disconnect: Driver Seat Power Recliner Motor C3187. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - DSM - PIDs . ♦ Recline Motor Forward (RECL_FWD) ♦ Recline Motor Backward (RECL_BWD) • Measure the voltage between driver seat power recliner motor C3187-1, circuit CPS29 (WH/BN) and C3187-5, circuit CPS30 (VT/BN), harness side while toggling the DSM commands ON and OFF.  N0040377 • **Is the voltage greater than 10 volts when commanded ON in both directions and 0 volt when commanded OFF?**	GO to L32 .
L32 CHECK RECLINER MOTOR CIRCUITS FOR A SHORT TO VOLTAGE	

• Disconnect: DSM C3299B. • Ignition ON. • Measure the voltage between: ♦ DSM C3299B-13, circuit CPS29 (WH/BN), harness side and ground. ♦ DSM C3299B-21, circuit CPS30 (VT/BN), harness side and ground.  N0067991 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to L33 .
L33 CHECK THE RECLINER MOTOR CIRCUITS FOR AN OPEN	
• Ignition OFF. • Measure the resistance between: ♦ DSM C3299B-13, circuit CPS29 (WH/BN), harness side and recliner power seat motor C3187-1, circuit CPS29 (WH/BN), harness side. ♦ DSM C3229B-21, circuit CPS30 (VT/BN), harness side and recliner power seat motor C3187-5, circuit CPS30 (VT/BN), harness side.  N0096777 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test M: The Memory Seat Does Not Operate Correctly - Does Not Operate Using the Memory SET Switch

Refer to Wiring Diagrams Cell 123 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Memory Seats for schematic and connector information. /p>

Normal Operation

Each motor in the memory seat track and recliner mechanism contains a Hall-effect position sensor. The Driver Seat Module (DSM) supplies a shared signal return feed circuit to each sensor. Each position sensor sends a signal pulse back to the DSM on the sensor feed circuit to monitor the position of the power seat and seat backrest. The DSM stores the sensor position data when a SET command is received and uses this information to return the seat to the stored position when a recall command is received.

When the memory SET switch button 1 or 2 is pressed, a ground signal is supplied to the Driver Door Module (DDM). The DDM communicates a memory SET command to the DSM on the Medium Speed Controller Area Network (MS-CAN). The DSM then supplies voltage and ground to the power seat track motors and power recliner motor to move the seat to the stored position. For information on programming memory positions or recalling a stored memory position, refer to Memory Position Programming in this section.

The following pinpoint test diagnoses a memory seat that does not operate correctly using the memory SET switch. If the memory seat does not move in all directions using the seat control switch, GO to Pinpoint Test L .

DTC Description	Fault Trigger Conditions
• B1342 - ECU is Faulted	If a programming error is detected, the DTC is set.
• B1534 - Memory 1 Switch Circuit Short to Ground • B1538 - Memory 2 Switch Circuit Short to Ground	If a short to ground is sensed on the switch input circuit during the DDM Self Test, the DTC is set. If activity is sensed on the input circuit for greater than 2 minutes, the DTC is set as continuous. With the DTC set, any input signal on the circuit is ignored.
• B1663 - Seat Driver Front Up/Down Motor Stalled • B1664 - Seat Driver Rear Up/Down Motor Stalled • B1665 - Seat Driver Forward/Backward Motor Stalled	During self-test the DSM attempts to operate the appropriate seat track motor and uses the motor's position sensor to monitor movement. If no motor movement is sensed, the DTC is set. The DSM will retry motor operation on the next activation of the seat control switch. If no movement continues to be monitored after 250 milliseconds, the DSM disables the output.
• B1666 - Seat Driver Recline Motor Stalled	During self-test the DSM attempts to operate the recliner motor and uses the recliner motor position sensor to monitor movement. If no motor movement is sensed, the DTC is set. The DSM will retry motor operation on the next activation of the seat control switch. If no motor movement is still monitored after 250 milliseconds, the DSM disables the output.

• B1952 - Seat Rear Up/Down Position Feedback Circuit Short to Battery • B1956 - Seat Front Up/Down Position Feedback Circuit Short to Battery • B1960 - Seat Recline Forward/Backward Position Feedback Circuit Short to Battery • B1964 - Seat Horizontal Forard Position Feedback Circuit Short to Battery	If a short to voltage or an open condition is present on the affected motor's position sensor (Hall effect) feedback circuit, the DTC is set. After a DTC is set, a memory recall is not possible but the seat control switch can operate the associated motor in 1-second increments.
• B1953 - Seat Rear Up/Down Position Feedback Circuit Short to Ground • B1957 - Seat Front Up/Down Position Feedback Circuit Short to Ground • B1961 - Seat Recline Forward/Backward Position Feedback Circuit Short to Ground • B1965 - Seat Horizontal Forward/Rearward Position Feedback Circuit Short to Ground	If a short to ground condition is present on the affected motor's position sensor (Hall effect) feedback circuit, the DTC is set. After a DTC is set, a memory recall is not possible but the seat control switch can operate the associated motor in 1-second increments.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Memory SET switch
- Missing status information - MS-CAN communication bus messages:
  - ♦ ignition switch status
  - ♦ gear selector position
- Memory power seat track
- Seat recliner motor
- DDM
- DSM

PINPOINT TEST M: THE MEMORY SEAT DOES NOCORRECTLY - DOES NOT OPERATE USING THE MEMORY SET SWITCH

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

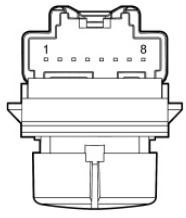
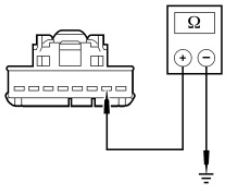
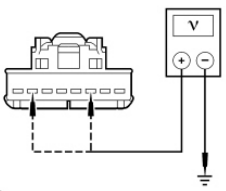
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

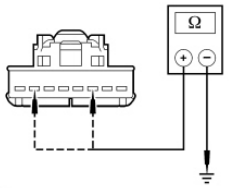
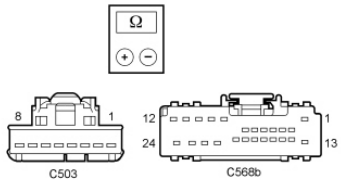
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

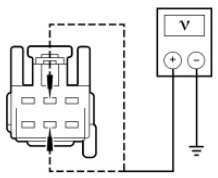
NOTE: Verify good battery condition before diagnosing the memory seat system. Poor battery condition may interfere with memory seat operation, even if vehicle starting is possible.

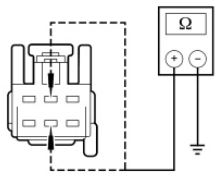
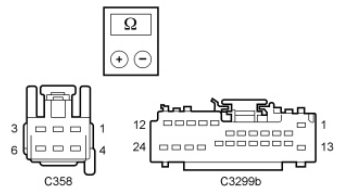
Test Step	Result / Action to Take
M1 CHECK TCM TRANSMISSION RANGE (TR) PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - TCM - PIDs: TR. • Operate the transmission gear selector in all positions while monitoring the TCM PID TR states. • **Do the PID states agree with the selected positions?**	**Yes** GO to M2 . **No** To diagnose a transmission gear selector (PRNDL) status concern, REFER to Section 307-01A , Section 307-01B or Section 307-01C .
M2 CHECK DSM IGNITION SWITCH STATUS (IGN_SW) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - DSM - PID: IGN_SW. • Cycle the ignition in all positions while monitoring the DSM PID states. • **Do the PID states agree with the selected positions?**	**Yes** GO to M3 . **No** To diagnose an ignition status concern, REFER to Section 211-05 .
M3 RETRIEVE THE DTCs	
• Operate the memory seat and memory exterior mirrors in all directions through the full range of travel. • Place the memory seat and memory exterior mirrors in central travel positions. • Enter the following diagnostic mode on the scan tool: Self Test - DSM . • Enter the following diagnostic mode on the scan tool: Self Test - DDM . • **Are any DTCs retrieved during the DDM Self Tests?**	**Yes** If one or both of the following DDM DTCs are retrieved; B1534 or B1538, GO to M5 . If DTCs B1952, B1956, B1960 and B1964 are all retrieved, GO to M10 . If DTCs B1953, B1957, B1961 and B1965 are all retrieved, GO to M10 . If DTC B1663, GO to M11 . If DTC B1664, GO to M14 . If DTC B1665, GO to M17 . If DTC B1666, GO to M20 . If DTC B1952, GO to M14 . If DTC B1953, GO to M15 .

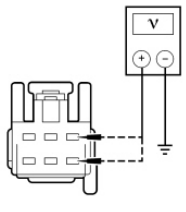
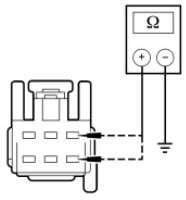
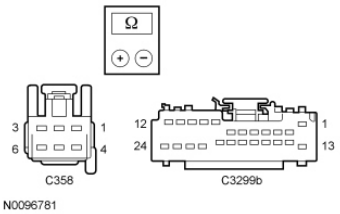
	If DTC B1956, GO to M11 . If DTC B1957, GO to M12 . If DTC B1960, GO to M20 . If DTC B1961, GO to M21 . If DTC B1964, GO to M17 . If DTC B1965, GO to M18 . If DTC B1342, INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs. **No** GO to M4 .
M4 CHECK THE DSM MEMORY SET SWITCH PID STATES	
• Enter the following diagnostic mode on the scan tool: DataLogger - DSM - PIDs. ♦ Memory 1 recall switch status ♦ Memory 2 recall switch status • While activating the memory switch recall 1 and recall 2 buttons, monitor the DDM memory SET switch PID states. • **Do the PID states agree with the switch button positions?**	**Yes** GO to M10 . **No** GO to M5 .
M5 CHECK THE MEMORY SET SWITCH	
• Ignition OFF. • Disconnect: Memory SET Switch C503. • Measure the resistance between memory SET switch pins, component side, while pressing the indicated buttons using the following chart and illustration: **Switch Button** / **Pins** / **Ohms** Memory Switch 1 / 7 and 2 / Less than 20 Memory Switch 2 / 3 and 2 / Less than 20	**Yes** GO to M6 . **No** INSTALL a new memory SET switch. REFER to Memory Set Switch in this section. REPEAT the self-test. CLEAR the DTCs.

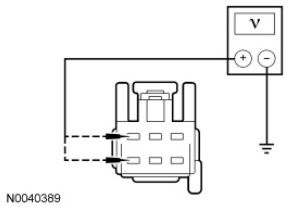
 N0054920 • **Is the memory SET switch OK?**	
M6 CHECK MEMORY SET GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between memory SET switch C503-2, circuit GD126 (BK/WH), harness side and ground.  N0091010 • **Is the resistance less than 5 ohms?**	**Yes** GO to M7 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.
M7 CHECK MEMORY SET CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: DDM C568B. • Ignition ON. • Measure the voltage between memory SET switch C503, harness side and ground using the following chart: **Connector** / **Circuit** C503-7 — CPS15 (VT/WH) C503-3 — CPS16 (YE)  N0091011 • **Is voltage present on any circuits?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. **No** GO to M8 .
M8 CHECK MEMORY SET CIRCUITS FOR A SHORT TO GROUND	

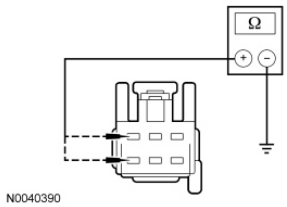
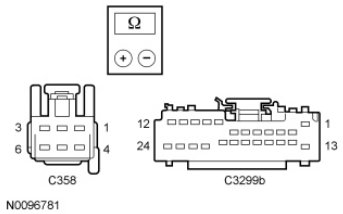
• Ignition OFF. • Measure the resistance between memory SET switch C503, harness side and ground using the following chart: **Connector** / **Circuit** C503-7 — CPS15 (VT/WH) C503-3 — CPS16 (YE)  N0091012 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to M9 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.
M9 CHECK MEMORY SET CIRCUITS FOR AN OPEN	
• Measure the resistance between memory SET switch C503 pins and DDM C568B pins using the following chart: **Memory SET switch connector** / **Circuit** / **DDM connector** C503-7 — CPS15 (VT/WH) — C568B-16 C503-3 — CPS16 (YE) — C568B-17  N0096778 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DDM . REFER to Section 501-14 . REPEAT the self-test. CLEAR the DTCs. **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.
M10 CHECK DSM SENSOR PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger - DSM - PIDs. ♦ Driver Power Seat Front Up/Down Sense (SFNT_MT) ♦ Driver Power Seat Forward/Backward Sense (SFWD_MT)	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs. **No**

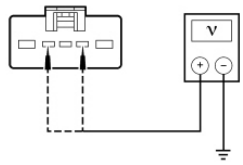
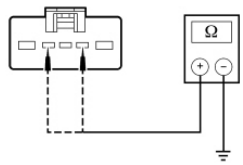
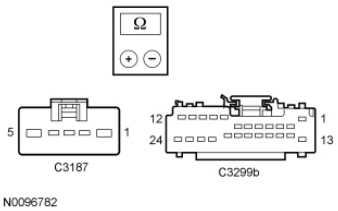
♦ Driver Power Seat Rear Up/Down Sense (SREARMT) ♦ Driver Power Seat Recline Sense (SRCL_MT) • **NOTE:** If the DSM detects a fault while carrying out this step, the associated motor may operate in one-second intervals. • Using the switch, operate the memory seat in all directions through the full range of travel while monitoring the DSM PIDs. • **Does each PID indicate the sensor is operational throughout each motor's full range of travel?**	If the PID indicates driver seat front vertical position sensor is not present, GO to M11 . If the PID indicates driver seat rear vertical position sensor is not present, GO to M14 . If the PID indicates driver seat horizontal position sensor is not present, GO to M17 . If the PID indicates driver seat recline position sensor is not present, GO to M20 .
M11 CHECK THE FRONT HEIGHT SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: DSM C3299B . • Disconnect: Memory Seat Position Sensor C358. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between: ♦ memory seat position sensor C358-2, circuit VPS10 (BU/GN), harness side and ground. ♦ memory seat position sensor 358-5, circuit RPS13 (GN/OG), harness side and ground.  N0040383 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to M12 .
M12 CHECK THE FRONT HEIGHT SENSOR CIRCUITS FOR A SHORT TO GROUND	

• Ignition OFF. • Measure the resistance between: ♦ memory seat position sensor C358-2, circuit VPS10 (BU/GN), harness side and ground. ♦ memory seat position sensor 358-5, circuit RPS13 (GN/OG), harness side and ground.  N0040384 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to M13 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
M13 CHECK THE FRONT HEIGHT SENSOR CIRCUITS FOR AN OPEN	
• Measure the resistance between: ♦ memory seat position sensor C358-2, circuit VPS10 (BU/GN), harness side and DSM C3299B-4, circuit VPS10 (BU/GN), harness side. ♦ memory seat position sensor 358-5, circuit RPS13 (GN/OG), harness side and DSM C3299B-8, circuit RPS13 (GN/OG), harness side.  N0096781 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
M14 CHECK THE REAR HEIGHT SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: DSM C3299B. • Disconnect: Memory Seat Position Sensor C358. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to M15 .

• Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between: ♦ memory seat position sensor C358-1, circuit VPS11 (GN/BN), harness side and ground. ♦ driver seat position sensor C358-4, circuit RPS13 (GN/OG), harness side and ground.  N0040386 • **Is voltage present on either circuit?**	
M15 CHECK THE REAR HEIGHT SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ memory seat position sensor C358-1, circuit VPS11 (GN/BN), harness side and ground. ♦ memory seat position sensor C358-4, circuit RPS13 (GN/OG), harness side and ground.  N0040387 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to M16 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
M16 CHECK THE REAR HEIGHT SENSOR CIRCUITS FOR AN OPEN	
• Measure the resistance between: ♦ memory position sensor C358-1, circuit VPS11 (GN/BN), harness side and DSM C3299B-3, circuit VPS11 (GN/BN), harness side. ♦ memory seat position sensor C358-4, circuit RPS13 (GN/OG), harness side and DSM C3299B-8, circuit RPS13 (GN/OG), harness side.  N0096781 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s) in question. REPEAT the self-test. CLEAR the DTCs.

	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
M17 CHECK THE HORIZONTAL SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: DSM C3299B. • Disconnect: Memory Seat Position Sensor C358 . • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between: ♦ memory seat position sensor C358-3, circuit VPS09 (BN/BU), harness side and ground. ♦ memory seat position sensor C358-6, circuit RPS13 (GN/OG), harness side and ground.  N0040389 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to M18 .
M18 CHECK THE HORIZONTAL SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ memory seat position sensor C358-3, circuit VPS09 (BN/BU), harness side and ground. ♦ memory seat position sensor C358-6, circuit RPS13 (GN/OG), harness side and ground.	**Yes** GO to M19 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

 N0040390 • **Are the resistances greater than 10,000 ohms?**	
M19 CHECK THE HORIZONTAL SENSOR CIRCUITS FOR AN OPEN	
• Measure the resistance between: ♦ memory seat position sensor C358-3, circuit VPS09 (BN/BU), harness side and DSM C3299B-14, circuit VPS09 (BN/BU), harness side. ♦ memory seat position sensor C358-6, circuit RPS13 (GN/OG), harness side and DSM C3299B-8, circuit RPS13 (GN/OG), harness side.  C358 C3299b N0096781 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new driver seat track assembly. REFER to Seat Track in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
M20 CHECK THE RECLINER SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: DSM C3299B. • Disconnect: Driver Seat Recliner Motor C3187. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between: ♦ driver seat recliner motor C3187-2, circuit RPS13 (GN/OG), harness side and ground. ♦ driver seat recliner motor C3187-4, circuit VPS12 (GY/OG), harness side and ground.	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to M21 .

 N0040392 • **Is voltage present on either circuit?**	
M21 CHECK THE RECLINER SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ driver seat recliner motor C3187-2, circuit RPS13 (GN/OG), harness side and ground. ♦ driver seat recliner motor C3187-4, circuit VPS12 (GY/OG), harness side and ground.  N0040393 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to M22 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
M22 CHECK THE RECLINER SENSOR CIRCUITS FOR AN OPEN	
• Measure the resistance between: ♦ driver seat recliner motor C3187-2, circuit RPS13 (GN/OG), harness side and DSM C3299B-8, circuit RPS13 (GN/OG), harness side. ♦ driver seat recliner motor C3187-4, circuit VPS12 (GY/OG), harness side and DSM C3299B-20, circuit VPS12 (GY/OG), harness side.  N0096782 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new driver seat recliner motor. REFER to Seat Recliner Motor in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test N: Easy Exit/Easy Entry is Inoperative/Does Not Operate Correctly

Normal Operation

The Driver Seat Module (DSM) receives a key out command over the Medium Speed Controller Area Network (MS-CAN) and powers the driver seat rearward about 50.8 mm (2 in).

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Key-in-ignition warning switch
- Instrument Panel Cluster (IPC) module
- DSM

PINPOINT TEST N: EASY EXIT/EASY ENTRY IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

NOTE: The Smart Junction Box (SJB) may also be identified as the Generic Electronic Module (GEM).

Test Step	Result / Action to Take
N1 CHECK POWER SEAT OPERATION	
• Ignition ON. • Check the message center to verify the easy entry/easy exit feature is enabled. ♦ The easy entry/easy exit feature can be enabled/disabled using a scan tool in module programming. When enabled, the feature becomes a user accessible item on the message center allowing the user to turn the feature on and off. Refer to the Owner's Literature or Section 413-01 for information on the message center. • Operate the seat fully forward and rearward with the switch to verify the power seat track is OK. • **Does the power seat operate forward and rearward correctly?**	**Yes** GO to N2 . **No** REFER to the Symptom Chart for diagnosis of inoperative driver power seat horizontal movement.
N2 CHECK EASY EXIT OPERATION	
• Position the driver seat at least 50.8 mm (2 in) from the rear stop point. • Ignition OFF. • Remove the key from the ignition. • **Does the seat move rearward approximately 50.8 mm (2 in)?**	**Yes** GO to N5 . **No** GO to N3 .
N3 CHECK THE GEM / SJB IGNITION SWITCH POSITION (IGN_SW) PID STATES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - GEM - PID: IGN_SW. • Monitor the GEM PID states with the ignition key in and with the key removed. • **Do the PID states agree with the key positions?**	**Yes** GO to N4 . **No** To diagnose the key-in-ignition warning switch fault, REFER to Section 413-01 .
N4 CHECK DSM DTCs	

• Enter the following diagnostic mode on the scan tool: Self Test - DSM . • **Are any DSM DTCs present?**	**Yes** REFER to the Driver Seat Module (DSM) DTC Chart for DSM DTC diagnosis. **No** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs.
N5 CHECK THE EASY ENTRY OPERATION	
• Insert the ignition key. • **Does the driver power seat move forward approximately 50.8 mm (2 in)?**	**Yes** The system is operating correctly at this time. RETEST the system for intermittent operation. If no fault is found, INSTRUCT the customer on the correct operation of the system. **No** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. REPEAT the self-test. CLEAR the DTCs.

Pinpoint Test O: The Power Lumbar is Inoperative - Driver

Refer to Wiring Diagrams Cell 123 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Memory Seats for schematic and connector information.

Normal Operation

The seat control switch is supplied battery voltage and ground. When the lumbar button (part of seat control switch) is pressed, voltage and ground are supplied to the power lumbar motor to move the lumbar mechanism in or out.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Seat control switch
- Power lumbar motor assembly

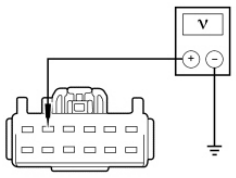
PINPOINT TEST O: THE POWER LUMBAR IS INOPERATIVE - DRIVER

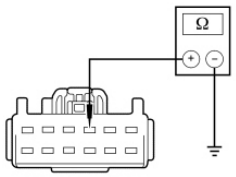
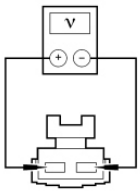
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

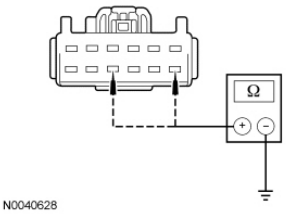
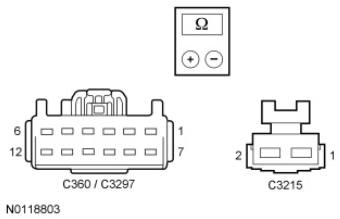
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take

O1 CHECK FOR VOLTAGE TO THE SEAT CONTROL SWITCH	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Seat Control Switch C3297 (MKZ) or C360 (Fusion). • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between seat control switch and ground. ♦ For Fusion, measure the voltage between seat control switch C360-5, circuit SBB32 (VT/RD), harness side and ground. ♦ For MKZ, measure the voltage between seat control switch C3297-5, circuit SBP12 (GN/RD), harness side and ground.  N0010816 • **Is the voltage greater than 10 volts?**	**Yes** GO to O2 . **No** VERIFY Smart Junction Box (SJB) fuse 12 (7.5A) (MKZ) or Battery Junction Box (BJB) fuse 32 (30A) (Fusion) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .
O2 CHECK FOR GROUND AT THE SEAT CONTROL SWITCH	
• Measure the resistance between seat control switch and ground. ♦ For Fusion, measure the resistance between seat control switch C360-3, circuit GD126 (BK/WH), harness side and ground. ♦ For MKZ, measure the resistance between seat control switch C3297-3, circuit GD126 (BK/WH), harness side and ground.	**Yes** GO to O3 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

 N0010815 • **Is the resistance less than 5 ohms?**	
O3 CHECK VOLTAGE TO THE LUMBAR MOTOR	
• Connect: Seat Control Switch C3297 (MKZ) or C360 (Fusion). • Disconnect: Power Lumbar Motor C3215. • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between power lumbar motor C3215-1, circuit CPS18 (BN/GN), harness side and power lumbar motor C3215-2, circuit CPS19 (GY/VT), harness side.  N0040627 • Operate the seat control switch in both directions. • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	**Yes** INSTALL a new power lumbar assembly. REFER to Lumbar Assembly in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** GO to O4 .
O4 CHECK THE LUMBAR MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Seat Control Switch C3297 (MKZ) or C360 (Fusion). • Measure the resistance between: ♦ seat control switch C3297-7 (MKZ) or C360-7 (Fusion), circuit CPS18 (BN/GN), harness side and ground. ♦ seat control switch C3297-10 (MKZ) or C360-10 (Fusion), circuit CPS19 (GY/VT), harness side and ground.	**Yes** GO to O5 . **No** REPAIR the circuit(s). TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

 • **Are the resistances greater than 10,000 ohms.**	
O5 CHECK THE LUMBAR MOTOR CIRCUITS FOR AN OPEN	
• Measure the resistance between: ♦ seat control switch C3297-7 (MKZ) or C360-7 (Fusion), circuit CPS18 (BN/GN), harness side and power lumbar motor C3215-1, circuit CPS18 (BN/GN), harness side. ♦ seat control switch C3297-10 (MKZ) or C360-10 (Fusion), circuit CPS19 (GY/VT), harness side and power lumbar motor C3215-2, circuit CPS19 (GY/VT), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test P: The Power Lumbar is Inoperative - Passenger

Refer to Wiring Diagrams Cell 120 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Seats for schematic and connector information.

Normal Operation

The seat control switch is supplied battery voltage and ground. When the lumbar button (part of seat control switch) is pressed, voltage and ground are supplied to the power lumbar motor to move the lumbar mechanism in or out.

This pinpoint test is intended to diagnose the following:

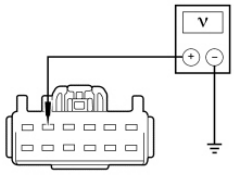
- Wiring, terminals or connectors
- Seat control switch
- Power lumbar motor assembly

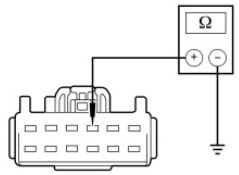
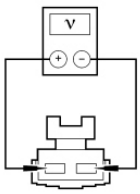
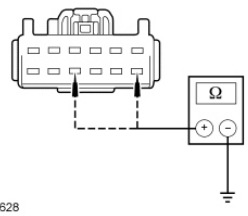
PINPOINT TEST P: THE POWER LUMBAR IS INOPERATIVE - PASSENGER

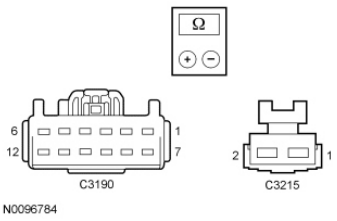
b>NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
P1 CHECK FOR VOLTAGE TO THE SEAT CONTROL SWITCH	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Seat Control Switch C3190. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between seat control switch C3190-5, circuit SBB31 (WH/RD), harness side and ground.  N0010816 • **Is the voltage greater than 10 volts?**	**Yes** GO to P2 . **No** VERIFY Battery Junction Box (BJB) fuse 31 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
P2 CHECK FOR GROUND TO THE SEAT CONTROL SWITCH	
• Measure the resistance between seat control switch C3190-3, circuit GD126 (BK/WH), harness side and ground.	**Yes** GO to P3 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag

 N0010815 • **Is the resistance less than 5 ohms?**	module C313. REPOWER the SRS . REFER to Section 501-20B .
P3 CHECK FOR VOLTAGE TO THE LUMBAR MOTOR	
• Connect: Seat Control Switch C3190. • Disconnect: Power Lumbar Motor C3216. • **NOTE:** During the following step, the voltage being measured changes polarity dependent upon which direction the seat control switch is activated. • Measure the voltage between power lumbar motor C3216-1, circuit CPS20 (VT), harness side and power lumbar motor C3216-2, circuit CPS21 (WH/OG), harness side.  N0040627 • Operate the seat control switch in both directions. • **Is the voltage greater than 10 volts when the seat control switch is operated and 0 volt in the rest position?**	**Yes** INSTALL a new power lumbar assembly. REFER to Lumbar Assembly in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to P4 .
P4 CHECK THE LUMBAR MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Seat Control Switch C3190. • Measure the resistance between: ♦ seat control switch C3190-7, circuit CPS20 (VT), harness side and ground. ♦ seat control switch C3190-10, circuit CPS21 (WH/OG), harness side and ground.  N0040628 • **Are the resistances greater than 10,000 ohms.**	**Yes** GO to P5 . **No** REPAIR the circuit(s). TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
P5 CHECK THE LUMBAR MOTOR CIRCUITS FOR AN OPEN	

• Measure the resistance between: ♦ seat control switch C3190-7, circuit CPS20 (VT), harness side and power lumbar motor C3215-1, circuit CPS20 (VT), harness side. ♦ seat control switch C3190-10, circuit CPS21 (WH/OG), harness side and power lumbar motor C3215-2, circuit CPS21 (WH/OG), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test Q: The Heated Seats are Inoperative - Driver and Front Passenger

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The engine must be running for the heated seat system to operate. When the driver or passenger heated seat button is pressed, a momentary ground signal is sent on the driver or passenger request circuit to turn the heated seat system on or off. The heated seat module monitors temperature sensors contained within the cushion heater mats. The temperature sensors share the same return circuit to the heated seat module. If the temperature sensor return circuit opens (resistance greater than 300,000 ohms), the heated seat module will disable the outputs to both seats.

The Front Controls Interface Module (FCIM) (with navigation), HVAC module and heated seat module must be communicating correctly for the system to operate correctly. PIDs are available to check heated seat switch operation in the FCIM (with navigation) and HVAC module (with and without navigation).

Normal heat cycle may require several minutes to initially warm the seat. The seat should be occupied to correctly test for normal operation. Temperature measuring devices do not provide an accurate method for testing heated seat operation as surface temperatures are subject to human and environmental characteristics. Correct testing requires heater mat resistance measurements which have tight tolerances affecting the length of time for the heater mats to reach maximum operating temperature.

The heated seat module does not report DTCs. If a fault is detected, the module will disable the affected seat(s) and indicator(s). After the fault is corrected, the heated seat module needs to be reset by cycling the ignition.

This pinpoint test is intended to diagnose the following:

- Fuse(s)
- Wiring, terminals or connectors
- Medium Speed Controller Area Network (MS-CAN) fault
- FCIM (if equipped)

- Heated seat module
- HVAC module

PINPOINT TEST Q: THE HEATED SEATS ARE INOPERATIVE - DRIVER AND FRONT PASSENGER

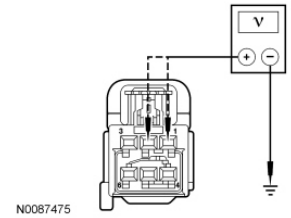
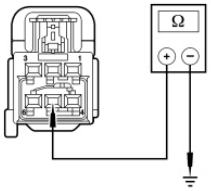
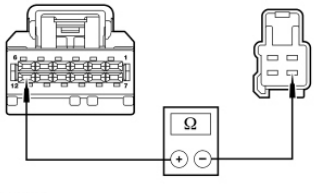
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation andoes not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
Q1 CHECK HEATED SEAT OPERATION	
• Ignition OFF. • Start the engine. • Verify both heated seats do not heat. • **Does either heated seat operate?**	**Yes** GO to Symptom Chart to diagnose the heated seat is inoperative/does not operate correctly - driver or the heated seat is inoperative/does not operate correctly - passenger. **No** GO to Q2 .
Q2 CHECK HEATED SEAT INDICATOR ILLUMINATION	
• Ignition OFF. • Start the engine. • Verify system indicator illumion. • **When pressing and releasing each heated seat button individually, does any heated seat indicator illuminate or flash and then turn off?**	**Yes** GO to Q7 . **No** For vehicles with navigation, GO to Q3 . For vehicles without navigation, GO to Q4 .
Q3 RETRIEVE THE FCIM DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - FCIM . • **Are any FCIM DTCs retrieved?**	
Q4 RETRIEVE THE HVAC MODULE DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - HVAC Module. • **Are any HVAC module DTCs retrieved?**	**Yes** For any HVAC module DTCs, REFER to the HVAC Module DTC Chart in this section. **No** For vehicles with navigation, GO to Q5 . For vehicles without navigation, GO to Q6 .
Q5 MONITOR THE FCIM PIDs AND CHECK INPUTS	

• Enter the following diagnostic mode on the scan tool: DataLogger - FCIM - PIDs. ♦ Driver Heated Seat (CC_SW_D_HSEATS) ♦ Passenger Heated Seat (CC_SW_P_HSEATS) • Monitor the FCIM PIDs while individually pushing the driver and passenger heated seat buttons. • **Do the PID values agree with the switch button positions?**	**Yes** GO to Q6 . **No** INSTALL a new FCIM . REFER to Section 415-00 < TEST the system for normal operation.
Q6 MONITOR THE HVAC MODULE PIDs AND CHECK INPUTS	
• Enter the following diagnostic mode on the scan tool: DataLogger - HVAC Module - PIDs. ♦ Driver Heated Seat (CC_SW_D_HSEATS) ♦ Passenger Heated Seat (CC_SW_P_HSEATS) • Monitor HVAC module PIDs while individually pushing the driver and passenger heated seat buttons. • **Do the PID values agree with the switch button positions?**	**Yes** The fault is intermittent, CHECK for causes of the intermittent fault. INSPECT the connectors, terminals and wiring. ATTEMPT to recreate the fault by flexing the wire harness and operating the system. CHECK the electrical connectors for corrosion, poor pin contact or pushed-out pins. REPAIR any intermittent concerns found and TIGHTEN any loose connector pins. REPEAT the self-test. CLEAR the DTCs. CHECK the system for normal operation. **No** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.
Q7 CHECK VOLTAGE TO THE HEATED SEAT MODULE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedurestion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Heated Seat Module C3304B. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between:	**Yes** GO to Q8 . **No** VERIFY Smart Junction Box (SJB) fuses 18 (20A) and 35 (10A) are OK. If OK, REPAIR the affected circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

♦ heated seat module C3304B-1, circuit SBP18 (YE/RD), harness side and ground. ♦ heated seat module C3304B-2, circuit CBP35 (YE/GY), harness side and ground.  N0087475 • **Are the voltages greater than 10 volts?**	
Q8 CHECK THE HEATED SEAT MODULE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between heated seat module C3304B-5, circuit GD139 (BK/YE), harness side and ground.  N0087476 • **Is the resistance less than 5 ohms?**	**Yes** GO to Q9 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
Q9 CHECK HEATED SEAT MODULE SENSOR RETURN CIRCUIT FOR AN OPEN	
• Disconnect: Heated Seat Module C3304A. • Disconnect: Passenger Seat Cushion Heater C334. • Measure the resistance between heated seat module C3304A-12, circuit RHS05 (YE/VT), harness side and passenger seat cushion heater C334-4, circuit RHS05 (YE/VT), harness side.  N0090927 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable.

	CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test R: The Heated Seat is Inoperative - Driver

Refer to Wiring Dgrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The heated seat module receives battery voltage. The HVAC module supplies a momentary ground signal to the heated seat module to request the system on/off. The heated seat module supplies voltage to the heater mats. The heated seat module monitors the heater mat temperature sensor. If the temperature sensor circuits open, the heated seat module will disable output voltage to the heater mat. The heated seat module control circuits are monitored by the HVAC module and will set a DTC if a circuit fault is detected.

The Front Controls Interface Module (FCIM) (with navigation), HVAC module and heated seat module must be communicating correctly for the system to operate correctly. PIDs are available to check heated seat switch operation in the FCIM (with navigation) and HVAC module (with and without navigation).

Normal heat cycle may require several minutes to initially warm the seat. The seat should be occupied to correctly test for normal operation. Temperature measuring devices do not provide an accurate method for testing heated seat operation as surface temperatures are subject to human and environmental characteristics. Correct testing requires heater mat resistance measurements which have tight tolerances affecting the length of time for the heater mats to reach maximum operating temperature.

- DTC B1030:12 (Left Front Seat Heater: Circuit Short To Battery) - If the driver seat control circuit from the HVAC module to the heated seat module is shorted to voltage, the DTC is set in the HVAC module.
- DTC B1030:14 (Left Front Seat Heater: Circuit Short To Ground or Open) - If the driver seat control circuit from the HVAC module to the heated seat module is shorted to ground or open, the DTC is set in the HVAC module.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Heater feed circuit short to battery, ground or open
- Sensor circuit short to battery, ground or open
- Heated seat switch stuck closed to ground
- Heater mat
- Heated seat module
- HVAC module
- FCIM (if equipped)

PINPOINT TEST R: THE HEATED SEAT IS INOPERATIVE - DRIVER

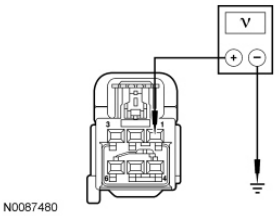
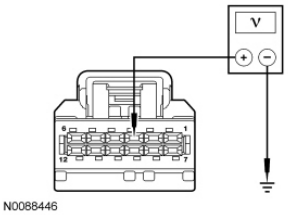
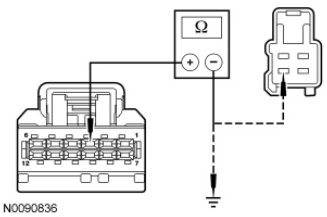
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

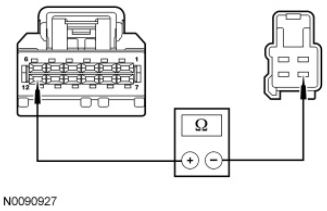
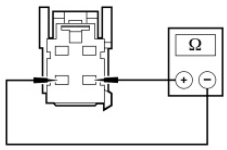
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

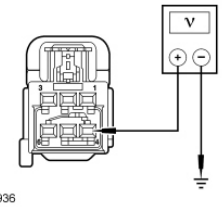
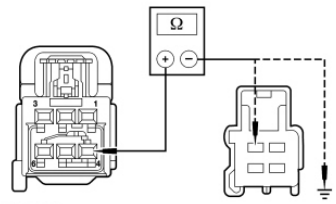
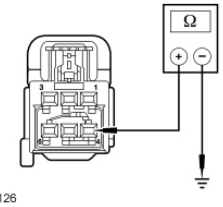
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

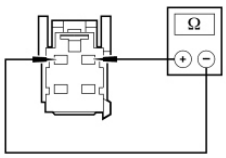
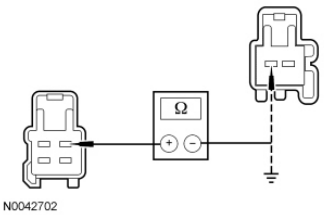
Test Step	Result / Action to Take
R1 CHECK HEATED SEAT OPERATION	
• Start the engine. • Verify the passenger heated seat is operational. • **Is the passenger heated seat operational?**	**Yes** GO to R2 . **No** GO to Symptom Chart to diagnose the heated seats are inoperative - driver and front passenger or the heated seat is inoperative/ds not operate correctly - passenger.
R2 CHECK HEATED SEAT INDICATOR ILLUMINATION	
• Verify system indicator illumination. • **Do the driver heated seat indicators illuminate or flash and then turn off?**	**Yes** GO to R7 . **No** Vehicles with navigation, GO to R3 . Vehicles without navigation, GO to R4 .
R3 RETRIEVE THE FCIM DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - FCIM . • **Are any FCIM DTCs retrieved?**	**Yes** For all FCIM DTCs, REFER to the Master DTC Chart in Section 415-00 . **No** GO to R4 .
R4 RETRIEVE THE HVAC MODULE DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - HVAC Module. • **Are any HVAC module DTCs retrieved?**	**Yes** If DTC B1030:12, GO to R18 . If DTC B1030:14, GO to R19 . For any other HVAC module DTCs, REFER to the HVAC Module DTC Chart in this section. **No** For vehicles with navigation, GO to R5 . For vehicles without navigation, GO to R6 .
R5 MONITOR THE DRIVER HEATED SEAT (CC_SW_D_HSEATS) PID AND CHECK INPUTS	
• Enter the following diagnostic mode on the scan tool: DataLogger - FCIM - PIDs: CC_SW_D_HSEATS.	**Yes** GO to R6 . **No** INSTALL a new FCIM . REFER to Section 415-00 .

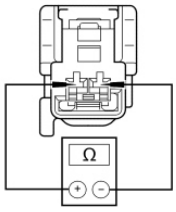
• Monitor the FCIM PID while pushing the driver heated seat button. • **Do the PID states agree with the switch button positions?**	TEST the system for normal operation.
R6 MONITOR THE DRIVER HEATED SEAT (CC_SW_D_HSEATS) PID AND CHECK INPUTS	
• Enter the following diagnostic mode on the scan tool: DataLogger - HVAC Module - PIDs: CC_SW_D_HSEATS. • Monitor the HVAC module PID while pushing the driver heated seat button. • **Do the PID values agree with the switch button positions?**	**Yes** The fault is intermittent, CHECK for causes of the intermittent fault. INSPECT the connectors, terminals and wiring. ATTEMPT to recreate the fault by flexing the wire harness and operating the system. CHECK the electrical connectors for corrosion, poor pin contact or pushed-out pins. REPAIR any intermittent concerns found and TIGHTEN any loose connector pins. REPEAT the self-test. CLEAR the DTCs. CHECK the system for normal operation. **No** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.
R7 CHECK FOR VOLTAGE TO THE HEATED SEAT MODULE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C327. • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Heated Seat Module C3304B. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between heated seat module C3304B-1, circuit SBP18 (YE/RD) harness side and ground.	**Yes** GO to R8 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

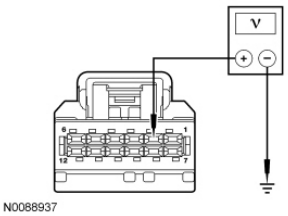
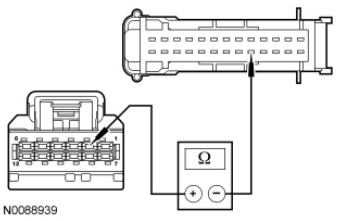
 N0087480 • **Is the voltage greater than 10 volts?**	
R8 CHECK THE TEMPERATURE SENSOR OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Heated Seat Module C3304A. • Disconnect: Driver Seat Cushion Heater Mat C364. • Ignition ON. • Measure the voltage between heated seat module C3304A-3, circuit VHS26 (VT), harness side and ground.  N0088446 • **Is any voltage present?**	**Yes** REPAIR the circuit. GO to R11 to check the temperature sensor for damage. If OK, TEST the system for normal operation. If not OK, INSTALL a new driver seat cushion heater mat. REFER to Seat Cushion Cover - Front in this section. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO t R9 .
R9 CHECK THE TEMPERATURE SENSOR OUTPUT CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ heated seat module C3304A-3, circuit VHS26 (VT), harness side and rear seat cushion heater mat C364-3, circuit VHS26 (VT), harness side. ♦ heated seat module C3304A-3, circuit VHS26 (VT), harness side and ground.  N0090836 • **Is the resistance less than 5 ohms between C3304A-3 and C364-3, and**	**Yes** GO to R10 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

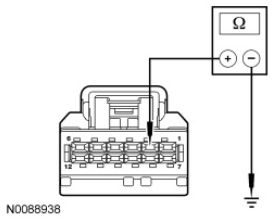
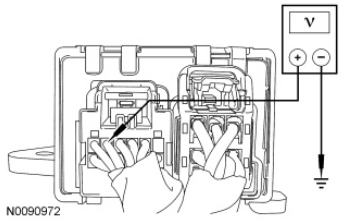
greater than 10,000 ohms between C3304A-3 and ground?	
R10 CHECK THE TEMPERATURE SENSOR RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between heated seat module C3304A-12, circuit RHS05 (YE/VT), harness side and driver seat cushion heater mat C364-4, circuit RHS05 (YE/VT), harness side.  N0090927 • **Is the resistance less than 5 ohms?**	**Yes** GO to R11 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
R11 CHECK THE TEMPERATURE SENSOR FOR AN OPEN	
• Measure the resistance between rear heated seat cushion C364 pin 3 and pin 4, component side.  N0090831 • **Is the resistance between 300 ohms and 300,000 ohms?**	**Yes** GO to R12 . **No** INSTALL a new cushion heater mat. REFER to Seat Cushion Cover - Front in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
R12 CHECK THE HEATER MAT OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between heated seat module C3304B-4, circuit CHS02 (YE/BU), harness side and ground.	**Yes** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to R13 .

 N0096936 • **Is any voltage present?**	
R13 CHECK THE HEATER MAT OUTPUT CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ heated seat module C3304B-4, circuit CHS02 (YE/BU), harness side and cushion heater mat C364-1, circuit CHS02 (YE/BU), harness side. ♦ heated seat module C3304B-4, circuit CHS02 (YE/BU), harness side and ground.  N0091127 • **Is the resistance less than 5 ohms between C3304B-4 and C364-1, and greater than 10,000 ohms between C3304B-4 and ground?**	**Yes** GO to R14 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
R14 CHECK THE HEATER MAT RESISTANCE	
• Connect: Driver Seat Backrest Heater Mat C365. • Connect: Driver Seat Cushion Heater Mat C364. • Measure the resistance between heated seat module C3304B-4, circuit CHS02 (YE/BU), harness side and ground.  N0091126	**Yes** GO to R21 . **No** GO to R15 .

• **Is the resistance between 1.2 and 4.0 ohms?**	
R15 CHECK THE CUSHION HEATER MAT FOR AN OPEN	
• Disconnect: Driver Seat Cushion Heater Mat C364. • Measure the resistance between driver seat cushion heater mat C364 pins 1 and 2, component side.  N0090832 • **Is the resistance between 0.6 and 2.0 ohms?**	**Yes** GO to R16 . **No** INSTALL a new driver seat cushion heater mat. REFER to Seat Cushion Cover - Front in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
R16 CHECK THE CIRCUIT BETWEEN THE CUSHION HEATER MAT AND BACKREST HEATER MAT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Driver Seat Backrest Heater Mat C365. • Measure the resistance between: ♦ seat cushion heater mat C364-2, circuit CHS11 (VT/GN), harness side and seat backrest heater mat C365-1, circuit CHS11 (VT/GN), harness side. ♦ seat cushion heater mat C364-2, circuit CHS11 (VT/GN), harness side and ground.  N0042702 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to R17 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
R17 CHECK THE BACKREST HEATER MAT FOR AN OPEN	

• Measure the resistance between driver seat backrest heater mat C365 pins 1 and 2, component side.  N0042705 • **Is the resistance between 0.6 and 2.0 ohms?**	**Yes** REPAIR circuit GD126 (BK/WH) for an open. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new driver seat backrest heater mat. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
R18 CHECK HEATED SEAT MODULE SWITCH INPUT CIRCUIT FOR SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Heated Seat Module C3304A. • Disconnect: HVAC Module C2356A. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between heated seat module C3304A-2, circuit CHS29 (WH/BU), harness side and ground.	**Yes** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 • **Is any voltage present?**	
R19 CHECK THE HEATED SEAT MODULE SWITCH INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Heated Seat Module C3304A. • Disconnect: HVAC Module C2356A. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between heated seat module C3304A-2, circuit CHS29 (WH/BU), harness side and HVAC module C2356A-5, circuit CHS29 (WH/BU), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to R20 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
R20 CHECK THE HEATED SEAT MODULE SWITCH INPUT CIRCUIT FOR A SHORT TO GROUND	

• Measure the resistance between heated seat module C3304A-2, circuit CHS29 (WH/BU), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
R21 CHECK THE HVAC MODULE OUTPUT	
• Connect: Heated Seat Module C3304A and C3304B. • Ignition ON. • **NOTE:** The following measurement must be taken by back-probing heated seat module C3304A. • **NOTE:** Voltage on circuit CHS29 (WH/BU) should drop momentarily when the driver heated seat control button is pressed. • Measure the voltage between heated seat module C3304A-2, circuit CHS29 (WH/BU), harness side and ground by back-probing heated seat module connector. Press the driver heated seat button on the HVAC module and note the voltage.  • **Is the voltage greater than 10 volts before pressing the driver heated seat control button, then momentarily drops when the heated seat control button is pressed?**	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** If voltage is greater than 10 volts but did not drop when the driver heated seat button was pressed, INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. If voltage is less than 10 volts, INSTALL a new heated seat module. REFER to Heated Seat Module in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test S: The Heated Seat is Inoperative - Passenger

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

Theeated seat module receives battery voltage. The HVAC module supplies a momentary ground signal to the heated seat module to request the system on/off. The heated seat module supplies voltage to the heater mats. The heated seat module monitors the heater mat temperature sensor. If the temperature sensor circuits open, the heated seat module will disable output voltage to the heater mat. The heated seat module control circuits are monitored by the HVAC module and will set a DTC if a circuit fault is detected.

The Front Controls Interface Module (FCIM) (with navigation), HVAC module and heated seat module must be communicating correctly for the system to operate correctly. PIDs are available to check heated seat switch operation in the FCIM (with navigation) and HVAC module (with and without navigation).

Normal heat cycle may require several minutes to initially warm the seat. The seat should be occupied to correctly test for normal operation. Temperature measuring devices do not provide an accurate method for testing heated seat operation as surface temperatures are subject to human and environmental characteristics. Correct testing requires heater mat resistance measurements which have tight tolerances affecting the length of time for the heater mats to reach maximum operating temperature.

- DTC B1032:12 (Right Front Seat Heater: Circuit Short To Battery) - If the passenger seat control circuit from the HVAC module to the heated seat module is shorted to voltage, the DTC is set in the HVAC module.
- DTC B1032:14 (Right Front Seat Heater: Circuit Short To Ground or Open) - If the passenger seat control circuit from the HVAC module to the heated seat module is shorted to ground or open, the DTC is set in the HVAC module.

This pinpoint test is intended to diagnose the follo:
- Wiring, terminals or connectors
- Heater feed circuit short to battery, ground or open
- Sensor circuit short to battery, ground or open
- Heated seat switch stuck closed to ground
- Heater mat
- Heated seat module
- HVAC module
- FCIM (if equipped)

PINPOINT TEST S: THE HEATED SEAT IS INOPERATIVE - PASSENGER

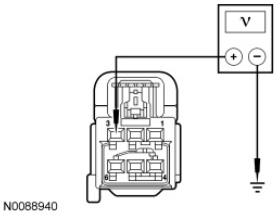
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

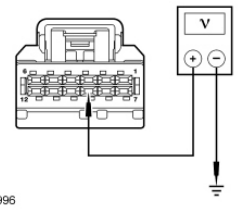
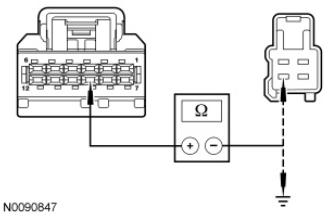
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

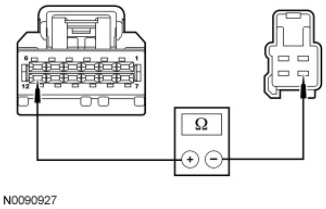
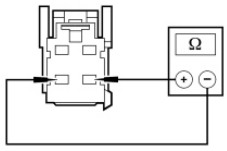
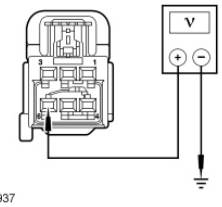
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

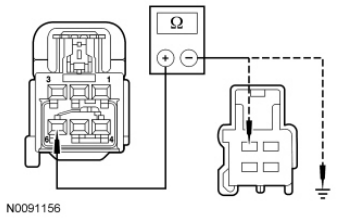
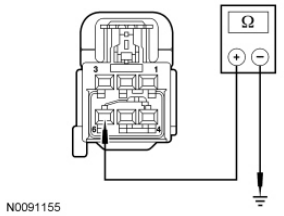
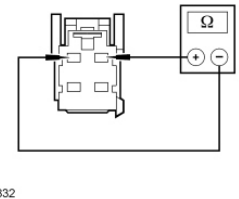
Test Step	Result / Action to Take
S1 CHECK HEATED SEAT OPERATION	

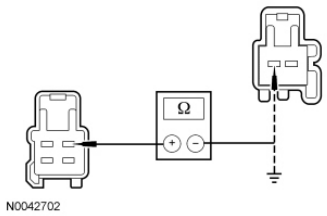
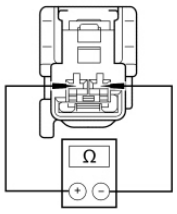
• Ignition OFF. Start the engine. • Verify the driver heated seat is operational. • **Is the driver heated seat operational?**	**Yes** GO to S2 . **No** GO to Symptom Chart to diagnose the heated seats are inoperative - driver and front passenger or the heated seat is inoperative/does not operate correctly - driver.
S2 CHECK HEATED SEAT INDICATOR ILLUMINATION	
• Verify system indicator illumination. • **Do the passenger heated seat indicators illuminate or flash and then turn off?**	**Yes** GO to S7 . **No** Vehicles with navigation, GO to S3 . Vehicles without navigation, GO to S4 .
S3 RETRIEVE THE FCIM DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - FCIM . • **Are any FCIM DTCs retrieved?**	**Yes** For all FCIM DTCs, REFER to the Master DTC Chart in Section 415-00 . **No** GO to S4 .
S4 RETRIEVE THE HVAC MODULE DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - HVAC Module. • **Are any HVAC module DTCs retrieved?**	**Yes** If DTC B1032:12, GO to S18 . If DTC B1032:14, GO to S19 . For any other HVAC module DTCs, REFER to the HVAC Module DTC Chart in this section. **No** For vehicles with navigation, GO to S5 . For vehicles without navigation, GO to S6 .
S5 MONITOR THE PASSENGER HEATED SEAT (CC_SW_P_HSEATS)ID AND CHECK INPUTS	
• Enter the following diagnostic mode on the scan tool: DataLogger - FCIM - PIDs: CC_SW_P_HSEATS. • Monitor the FCIM PID while pushing the passenger heated seat button. • **Do the PID states agree with the switch button positions?**	**Yes** GO to S6 . **No** INSTALL a new FCIM . REFER to Section 415-00 . TEST the system for normal operation.
S6 MONITOR THE PASSENGER HEATED SEAT (CC_SW_P_HSEATS) PID AND CHECK INPUTS	

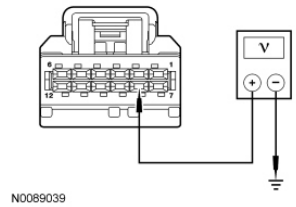
• Enter the following diagnostic mode on the scan tool: DataLogger - HVAC Module - PIDs: CC_SW_P_HSEATS. • Monitor the HVAC module PID while pushing the passenger heatedtton. • **Do the PID values agree with the switch button positions?**	**Yes** The fault is intermittent, CHECK for causes of the intermittent fault. INSPECT the connectors, terminals and wiring. ATTEMPT to recreate the fault by flexing the wire harness and operating the system. CHECK the electrical connectors for corrosion, poor pin contact or pushed-out pins. REPAIR any intermittent concerns found and TIGHTEN any loose connector pins. REPEAT the self-test. CLEAR the DTCs. CHECK the system for normal operation. **No** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.
S7 CHECK FOR VOLTAGE TO THE HEATED SEAT MODULE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Heated Seat Module C3304B. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the voltage between heated seat module C3304B-3, circuit SBP18 (YE/RD), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to S8 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
S8 CHECK THE TEMPERATURE SENSOR OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	

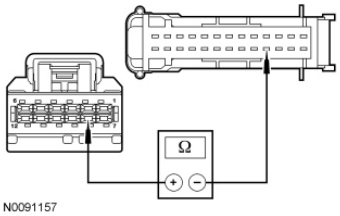
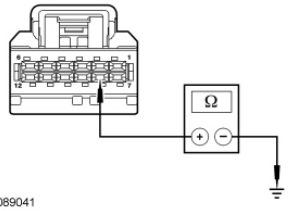
• Disconnect: Heated Seat Module C3304A. • Disconnect: Passenger Seat Cushion Heater Mat C334. • Ignition ON. • Measure the voltage between heated seat module C3304A-9, circuit VHS27 (WH/OG), harness side and ground.  N0088996 • **Is any voltage present?**	**Yes** REPAIR the circuit. GO to S11 to check the temperature sensor for damage. If OK, TEST the system for normal operation. If not OK, INSTALL a new driver seat cushion heater mat. REFER to Seat Cushion Cover - Front in this section. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to S9 .
S9 CHECK THE TEMPERATURE SENSOR OUTPUT CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ heated seat module C3304A-9, circuit VHS27 (WH/OG), harness side and seat cushion heater mat C334-3, circuit VHS27 (WH/OG), harness side. ♦ heated seat module C3304A-9, circuit VHS27 (WH/OG), harness side and ground.  N0090847 • **Is the resistance less than 5 ohms between C3304A-9 and C334-3, and greater than 10,000 ohms between C3304A-9 and ground?**	**Yes** GO to S10 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
S10 CHECK THE TEMPERATURE SENSOR RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between heated seat module C3304A-12, circuit RHS05 (YE/VT), harness side and passenger seat cushion heater mat C334-4, circuit RHS05 (YE/VT), harness side.	**Yes** GO to S11 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag

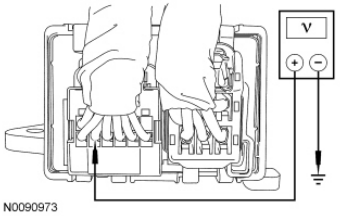
 N0090927 • **Is the resistance less than 5 ohms?**	module C313. REPOWER the SRS . REFER to Section 501-20B .
S11 CHECK TEMPERATURE SENSOR FOR AN OPEN	
• Measure the resistance between rear heated seat cushion C334 pin 3 and pin 4, component side.  N0090831 • **Is the resistance between 300 ohms and 300,000 ohms?**	**Yes** GO to S12 . **No** INSTALL a new cushion heater mat. REFER to Seat Cushion Cover - Front in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
S12 CHECK THE HEATER MAT OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between heated seat module C3304B-6, circuit CHS07 (GY/BU), harness side and ground.  N0096937 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. COECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to S13 .
S13 CHECK CUSHION HEATER MAT OUTPUT CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ heated seat module C3304B-6, circuit CHS07 (GY/BU), harness side and passenger seat cushion heater mat C334-1, circuit CHS07 (GY/BU), harness side.	**Yes** GO to S14 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable.

♦ heated seat module C3304B-6, circuit CHS07 (GY/BU), harness side and ground.  N0091156 • **Is the resistance less than 5 ohms between C3304B-6 and C334-1, and greater than 10,000 ohms between C3304B-6 and ground?**	CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
S14 CHECK THE HEATER MAT RESISTANCE	
• Connect: Passenger Seat Backrest Heater Mat C335. • Connect: Passenger Seat Cushion Heater Mat C334. • Measure the resistance between heated seat module C3304B-6, circuit CHS07 (GY/BU), harness side and ground.  N0091155 • **Is the resistance between 1.2 and 4.0 ohms?**	**Yes** GO to S21 . **No** GO to S15 .
S15 CHECK THE CUSHION HEATER MAT FOR AN OPEN	
• Disconnect: Passenger Seat Cushion Heater Mat C334. • Measure the resistance between passenger seat cushion heater mat C334 pins 1 and 2, component side.  N0090832 • **Is the resistance between 0.6 and 2.0 ohms?**	**Yes** GO to S16 . **No** INSTALL a new driver seat cushion heater mat. REFER to Seat Cushion Cover - Front n this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

S16 CHECK THE CIRCUIT BETWEEN THE CUSHION HEATER MAT AND BACKREST HEATER MAT FOR AN OPEN AND SHORT TO GROUND	
• Disconnect: Passenger Seat Backrest Heater Mat C335. • Measure the resistance between: ♦ seat cushion heater mat C334-2, circuit CHS12 (YE/GN), harness side and seat backrest heater mat C335-1, circuit CHS12 (YE/GN), harness side. ♦ seat cushion heater mat C334-2, circuit CHS12 (YE/GN), harness side and ground.  N0042702 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to S17 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
S17 CHECK BACKREST HEATER MAT FOR AN OPEN	
• Measure the resistance between passenger seat backrest heater mat C335 pins 1 and 2, component side.  N0042705 • **Is the resistance between 0.6 and 2.0 ohms?**	**Yes** REPAIR circuit GD139 (BK/YE) for an open. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new passenger seat backrest heater mat. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
S18 CHECK HEATED SEAT MODULE SWITCH INPUT CIRCUIT FOR SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .	**Yes** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS .

• Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Heated Seat Module C3304A. • Disconnect: HVAC Module C2365A. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between heated seat module C3304A-8, circuit CHS30 (GY/YE), harness side and ground.  N0089039 • **Is any voltage present?**	REFER to Section 501-20B . **No** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
S19 CHECK THE HEATED SEAT MODULE SWITCH INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: Heated Seat Module C3304A. • Disconnect: HVAC Module C2356A. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between heated seat module C3304A-8, circuit CHS30 (GY/YE), harness side and HVAC module C2356A-4, circuit CHS30 (GY/YE), harness side.	**Yes** GO to S20 . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 N0091157 • **Is the resistance less than 5 ohms?**	
S20 CHECK THE HEATED SEAT MODULE SWITCH INPUT CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between heated seat module C3304A-8, circuit CHS30 (GY/YE), harness side and ground.  N0089041 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
S21 CHECK THE HVAC MODULE OUTPUT	
• Connect: Heated Seat Module C3304A and C3304B. • Ignition ON. • **NOTE:** The following measurement must be taken by back-probing heated seat module C3304A. • **NOTE:** Voltage on circuit CHS30 (GY/YE) should drop momentarily when the passenger heated seat control button is pressed. • Measure the voltage between passenger heated seat module C3304A-8, circuit CHS30 (GY/YE), harness side and ground by back-probing the heated seat module connector. Press the passenger heated seat button on the HVAC module and note the voltage.	**Yes** INSTALL a new heated seat module. REFER to Heated Seat Module in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** If voltage is greater than 10 volts but did not drop when the passenger heated seat button was pressed, INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 • **Is the voltage greater than 10 volts before pressing the passenger heated seat control button, then momentarily drops when the heated seat control button is pressed?**	If voltage is less than 10 volts, INSTALL a new heated seat module. REFER to Heated Seat Module in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test T: The Heated Seat Does Not Operate Correctly - Seat Does Heat But the Heated Seat Indicator Does Not Illuminate When Pressed

Rer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

When the heated seat module is commanded ON, voltage is supplied from the heated seat module to the HVAC module on the low/high heat mode indicator circuits. When voltage is not supplied from the heated seat module, none of the indicators illuminate.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Heated seat module
- HVAC module
- Front Controls Interface Module (FCIM)

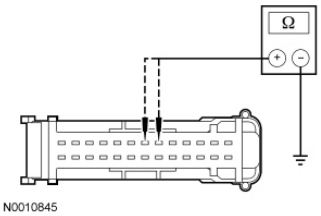
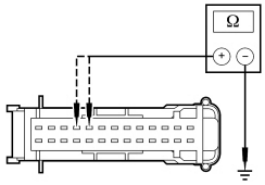
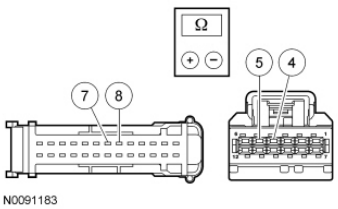
PINPOINT TEST T: THE HEATED SEAT DOES NOT OPERATE CORRECTLY - SEAT DOES HEAT BUT THE HEATED SEAT INDICATOR DOES NOT ILLUMINATE WHEN PRESSED

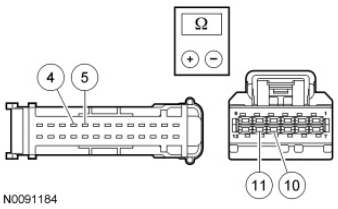
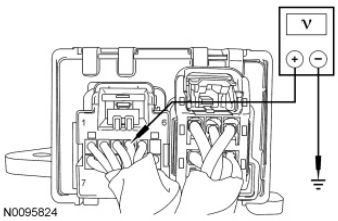
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

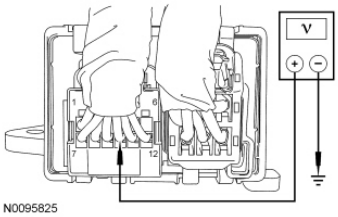
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
T1 CHECK INDICATOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: HVAC Module C2356B. • Disconnect: Heated Seat Module C3304A.	**Yes** GO to T2 . **No** REPAIR the circuit(s). TEST the system for normal operation. DISCONNECT the battery ground

• For driver seat, measure the resistance between: ♦ HVAC module C2356B-7, circuit CHS04 (YE/GY), harness side and ground. ♦ HVAC module C2356B-8, circuit CHS13 (VT/BN), harness side and ground.  N0010845 • For passenger seat, measure the resistance between: ♦ HVAC module C2356B-4, circuit CHS09 (GY), harness side and ground. ♦ HVAC module C2356B-5, circuit CHS14 (GN), harness side and ground.  N0067896 • **Are the resistances greater than 10,000 ohms?**	cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
T2 CHECK INDICATOR CIRCUITS FOR AN OPEN	
• For driver seat, measure the resistance between: ♦ HVAC module C2356B-7, circuit CHS04 (YE/GY), harness side and heated seat module C3304A-4, circuit CHS04 (YE/GY), harness side. ♦ HVAC module C2356B-8, circuit CHS13 (VT/BN), harness side and heated seat module C3304A-5, circuit CHS13 (VT/BN), harness side.  N0091183 • For passenger seat, measure the resistance between: ♦ HVAC module C2356B-4, circuit CHS09 (GY), harness side and heated seat module C3304A-10, circuit CHS09 (GY), harness side. ♦ HVAC module C2356B-5, circuit CHS14 (GN), harness side and heated seat module C3304A-11, circuit CHS14 (GN), harness side.	**Yes** For driver seat, GO to T3 . For passenger seat, GO to T4 . **No** REPAIR the circuit(s). TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 • **Are the resistances less than 5 ohms?**	
T3 CHECK THE HEATED SEAT MODULE INDICATOR CIRCUIT OUTPUT	
• Connect: HVAC Module C2356B. • Connect: Heated Seat Module C3304A. • Start the engine. • **NOTE:** The following measurement must be taken by back-probing heated seat module C3304A. • **NOTE:** There should be no voltage on circuit CHS04 (YE/GY) when the driver seat side of the heated seat module is off. When the heated seat module is commanded on, voltage on circuit CHS04 (YE/GY) should drop momentarily each time the driver heated seat control button is pressed. • Measure the voltage between heated seat module C3304A-4, circuit CHS04 (YE/GY), harness side and ground by back-probing heated seat module C3304A-4. Press the driver heated seat control button and note the voltage.  • **Is there less than 1 volt when the heated seat module is off and greater than 10 volts when the driver heated seat module is in low or high mode?**	**Yes** For vehicles without navigation, INSTALL a new HVAC module. REFER to Section 412-01 . For vehicles with navigation, INSTALL a new FCIM . REFER to Section 415-00 . TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new heated seat module. REFER to Heated Seat Module in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
T4 CHECK THE HEATED SEAT MODULE INDICATOR CIRCUIT OUTPUT	

• Connect: HVAC Module C2356B. • Connect: Heated Seat Module C3304A. • Start the engine. • **NOTE:** The following measurement must be taken by back-probing heated seat module C3304A. • **NOTE:** There should be no voltage on circuit CHS09 (GY) when the passenger seat side of the heated seat module is off. When the heated seat module is commanded on, voltage on circuit CHS09 (GY) should drop momentarily each time the passenger heated seat control button is pressed. • Measure the voltage between heated seat module C3304A-10, circuit CHS09 (GY), harness side and ground by back-probing heated seat module C3304A-10. Press the passenger heated seat control button and note the voltage.  • **Is there less than 1 volt when the heated seat module is off and greater than 10 volts when the driver heated seat module is in low or high mode?**	**Yes** For vehicles without navigation, INSTALL a new HVAC module. REFER to Section 412-01 . For vehicles with navigation, INSTALL a new FCIM . REFER to Section 415-00 . TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new heated seat module. REFER to Heated Seat Module in this section. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test U: All Climate Controlled Seats Are Inoperative - Switch Indicators May or May Not Illuminate

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied voltage at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, it only operates in 15-second intervals. Both voltage supply circuits are spliced together internal to the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat is disabled by the DCSM .

Climate controlled seat button commands are communicated from the Front Controls Interface Module (FCIM) over the Medium Speed Controller Area Network (MS-CAN) to the HVAC module and then to the DCSM . Upon receiving a command, the DCSM then communicates indicator illumination commands back to the HVAC module which then commands the FCIM to turn the indicators on or off. No direct connection exists between the FCIM , HVAC module and DCSM . The climate controlled seat system can only operate if all 3 modules are communicating correctly on the Controller Area Network (CAN).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- MS-CAN
- FCIM
- HVAC module
- DCSM

PINPOINT TEST U: ALL CLIMATE CONTROLLED SEATS ARE INOPERATIVE - SWITCH INDICATORS MAY OR MAY NOT ILLUMINATE

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

Test Step	Result / Action to Take
U1 VERIFY CLIMATE CONTROLLED SEAT BLOWER OPERATION	
• Ignition OFF. • Remove the driver and front passenger cushion Thermo-Electric Device (TED) filters to verify blower operation. ♦ Turn the filters to the left (counterclockwise) and remove. • Start the engine. • Operate climate controlled seat buttons while verifying both blowers operate. • **Does either blower operate?**	**Yes** If only one blower operates, GO to Symptom Chart to diagnose a single climate controlled seat is inoperative. If both blowers operate, GO to U5 . **No** GO to U2 .
U2 VERIFY CLIMATE CONTROLLED SEAT INDICATOR ILLUMINATION	
• Ignition OFF.	**Yes** GO to U5 .

• Start the engine. • Verify system indicator illumination. • **Does any climate controlled seat indicator illuminate or flash and then turn off?**	**No** GO to U3 .
U3 CHECK THE FCIM FOR DTCs	
• Ignition In ACC. • Enter the following diagnostic mode on the scan tool: Self Test - FCIM . • **Are any DTCs retrieved?**	**Yes** REFER to the Master DTC Chart in Section 415-00 . **No** GO to U4 .
U4 CHECK THE HVAC MODULE FOR DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - HVAC module. • **Are any DTCs retrieved?**	**Yes** REFER to the Master DTC Chart in Section 412-00A or Section 412-00B . **No** GO to U6 .
U5 CHECK THE DCSM FOR DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - DCSM . • **Are any DTCs present?**	**Yes** GO to the Dual Climate Controlled Seat Module (DCSM) DTC Chart in this section. **No** CHECK for causes of the intermittent fault. INSPECT the connectors, terminals and wiring. ATTEMPT to recreate the fault by flexing the wire harness and operating the system. CHECK the electrical connectors for corrosion, poor pin contact or pushed-out pins. REPAIR any intermittent concerns found and TIGHTEN any loose DCSM connector pins. REPEAT the self-test.

	If no intermittent concerns are found, CARRY OUT the Component Test - Thermo-Electric Device (TED) Cooling Performance in this section for both seats.		
U6 MONITOR THE FCIM PIDs AND CHECK INPUTS		• Enter the following diagnostic mode on the scan tool: DataLogger - FCIM - PIDs. ♦ Driver Cooled Seat (CC_SW_D_CL_S) ♦ Driver Heated Seat (CC_SW_D_HSEATS) ♦ Passenger Cooled Seat (CC_SW_P_CL_S) ♦ Passenger Heated Seat (CC_SW_P_HSEATS) • Monitor the FCIM PIDs while individually pushing driver and passenger climate controlled seat switch buttons. • **Do the PID values agree with the switch positions?**	**Yes** GO to U7 . **No** INSTALL a new FCIM . REFER to Section 415-00 . TEST the system for normal operation.
U7 MONITOR THE HVAC MODULE PIDs AND CHECK INPUTS			
	Yes GO to U8 . **No** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.	• Enter the following diagnostic mode he scan tool: DataLogger - HVAC module - PIDs. ♦ Driver Cooled Seat (CC_SW_D_CL_S) ♦ Driver Heated Seat (CC_SW_D_HSEATS)	

♦ Passenger Cooled Seat (CC_SW_P_CL_S) ♦ Passenger Heated Seat (CC_SW_P_HSEATS) • Monitor the HVAC module PIDs while individually pushing driver and passenger climate controlled seat switch buttons. • **Do the PID values agree with the switch positions?**	
U8 CHECK DCSM USING ACTIVE COMMANDS	
• Enter the following diagnostic mode on the scan tool: DataLogger - DCSM - PIDs. ♦ Seat Cushion Thermal Electric Device Temperature (CSHTEMP) ♦ Seat Back Thermal Electric Device Temperature (BK_TEMP) ♦ Climate-conSeat Heat Command (TED_HEAT_D) ♦ Passenger Cushion Thermal Electric Device (TED) Temperature (PCSHTMP) ♦ Passenger Back TED Temperature (PBKTMP) ♦ Passenger TED Heat Mode (TED_HEAT_P) • **NOTE:** The DCSM active commands TED_HEAT_D (driver seat) and TED_HEAT_P	**Yes** CHECK for causes of the intermittent fault. INSPECT the connectors, terminals and wiring. ATTEMPT to recreate the fault by flexing the wire harness and operating the system. CHECK the electrical connectors for corrosion, poor pin contact or pushed-out pins. REPAIR any intermittent concerns found and TIGHTEN any loose HVAC module connector pins. REPEAT the self-test. CHECK the system for normal operation. **No** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs.

(passenger seat) are limited to 15 seconds in the ON state, then turn OFF. • Operate the climate controlled seats using active commands while monitoring the appropriate PIDs. ♦ When the command is in process, the TED temperature PIDs on the seat being commanded should momentarily increase. If no temperature increase is noted, remove the cushion blower filter and repeat the active command while physically monitoring the cushion blower for fan movement. • **Do the PID states or cushion blower movement indicate climate controlled seat operation?**	

Pinpoint Test V: A Single Climate Controlled Seat is Inoperative - Switch Indicators May or May Not Illuminate

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied voltage at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, it only operates in 15-second intervals. Both voltage supply circuits are spliced together internal to the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only

the affected seat is disabled by the DCSM .

Climate controlled seat button commands are communicated from the Front Controls Interface Module (FCIM) over the Medium Speed Controller Area Network (MS-CAN) to the HVAC module and then to the DCSM . Upon receiving a command, the DCSM then communicates indicator illumination commands back to the HVAC module which then commands the FCIM to turn the indicators on or off. No direct connection exists between the FCIM , HVAC module and DCSM . The climate controlled seat system can only operate if all 3 modules are communicating correctly on the Controller Area Network (CAN).

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- MS-CAN
- FCIM
- HVAC module
- DCSM

PINPOINT TEST V: A SINGLE CLIMATE CONTROLLED SEAT IS INOPERATIVE - SWITCH INDICATORS MAY OR MAY NOT ILLUMINATE

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

Test Step	Result / Action to Take
V1 VERIFY CLIMATE CONTROLLED SEAT BLOWER OPERATION	
• Ignition OFF. • Remove the driver and front passenger cushion TED filters to verify blower operation. ♦ Turn the filter to the left (counterclockwise) and remove. • Start the engine. • Operate climate controlled seat buttons while verifying both blowers operate. • **Are all climate controlled seats inoperative?**	**Yes** GO to Symptom Chart to diagnose all climate controlled seats are inoperative. **No** If both blowers operate, GO to V3 . If only one blower operates, GO to V2 .
V2 VERIFY CLIMATE CONTROLLED SEAT INDICATOR ILLUMINATION	
• Ignition OFF. • Start the engine. • Verify system indicator illumination. • **Does any climate controlled seat indicator illuminate or flash and then turn off?**	**Yes** GO to V3 . **No** GO to V4 .
V3 CHECK THE DCSM FOR DTCs	

• Ignition In ACC. • Enter the following diagnostic mode on the scan tool: Self Test - DCSM . • **Are any DTCs present?**	**Yes** GO to the Dual Climate Controlled Seat Module (DCSM) DTC Chart in this section. **No** GO to V8 .
V4 CHECK THE FCIM FOR DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - FCIM . • **Are any DTCs retrieved?**	**Yes** REFER to the Master DTC Chart in Section 415-00 . **No** GO to V5 .
V5 CHECK THE HVAC MODULE FOR DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - HVAC module. • **Are any DTCs retrieved?**	**Yes** REFER to the Master DTC Chart in Section 412-00A or Section 412-00B . **No** GO to V6 .
V6 MONITOR THE FCIM PIDs AND CHECK INPUTS	
• Enter the following diagnostic mode on the scan tool: DataLogger - FCIM - PIDs. ♦ Driver Cooled Seat (CC_SW_D_CL_S) ♦ Driver Heated Seat (CC_SW_D_HSEATS) ♦ Passenger Cooled Seat (CC_SW_P_CL_S) ♦ Passenger Heated Seat (CC_SW_P_HSEATS) • Monitor the FCIM PIDs while individually pushing the affected driver or passenger climate controlled seat switch buttons. • **Do the PID values agree with the switch positions?**	**Yes** GO to V7 . **No** INSTALL a new FCIM . REFER to Section 41 . TEST the system for normal operation.
V7 MONITOR THE HVAC MODULE PIDs AND CHECK INPUTS	
• Enter the following diagnostic mode on the scan tool: DataLogger - HVAC module - PIDs. ♦ Driver Cooled Seat (CC_SW_D_CL_S) ♦ Driver Heated Seat (CC_SW_D_HSEATS) ♦ Passenger Cooled Seat (CC_SW_P_CL_S)	**Yes** GO to V8 . **No** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.

♦ Passenger Heated Seat (CC_SW_P_HSEATS) • Monitor the HVAC module PIDs while individually pushing the affected driver or passenger climate controlled seat switch buttons. • **Do the PID values agree with the switch positions?**	
V8 CHECK DCSM USING ACTIVE COMMANDS	
• Enter the following diagnostic mode on the scan tool: DataLogger - DCSM - PIDs. ♦ Seat Cushion Thermal Electric Device Temperature (CSHTEMP) ♦ Seat Back Thermal Electric Device Temperature (BK_TEMP) ♦ Climate-controlled Seat Heat Command (TED_HEAT_D) ♦ Passenger Cushion Thermal Electric Device (TED) Temperature (PCSHTMP) ♦ Passenger Back TED Temperature (PBKTMP) ♦ Passenger TED Heat Mode (TED_HEAT_P) • **NOTE:** The DCSM active commands TED_HEAT_D (driver seat) and TED_HEAT_P (passenger seat) are limited to 15 seconds in the ON state, then turn OFF. • Operate the affected climate controlled seat using active commands while monitoring the appropriate PIDs. ♦ When the command is in process, the TED temperature PIDs on the affected seat being commanded should momentarily increase. If no temperature increase is noted, remove the cushion blower filter and repeat the active command while physically monitoring the cushion blower for fan movement. • **Do the PID states or cushion blower movement indicate climate controlled seat operation?**	**Yes** CHECK for causes of the intermittent fault. INSPECT the connectors, terminals and wiring. ATTEMPT to recreate the fault by flexing the wire harness and operating the system. CHECK the electrical connectors for corrosion, poor pin contact or pushed-out pins. REPAIR any intermittent concerns found and TIGHTEN any loose HVAC module connector pins. REPEAT the self-test. CHECK the system for normal operation. If no intermittent concerns are found, CARRY T the Component Test - Thermo-Electric Device (TED) Cooling Performance in this section for both seats. REPEAT the self-test. **No** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs.

Pinpoint Test W: DTCs B103B and B1111

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied volta at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, it only operates in 15-second intervals. Both voltage supply circuits are spliced together internal to the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat is disabled by the DCSM .

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the HVAC module seat switch settings.

- DTC B103B (Thermo-Electric Driver Overcurrent Low) - If DCSM outputs to the driver seat backrest or cushion TED (circuit pin G, H, J or K at the DCSM connector) or any components within these circuit loops are shorted to ground or a TED resistance of less than 0.9 ohm is sensed, the DCSM will shut down the driver seat system and set this DTC.
- DTC B1111 (Driver Thermo-Electric Device Control Overtemperature Fault) - If the DCSM TED driver integrated circuit temperature exceeds 175°C (347°F), the DCSM will shut down the driver seat system and set this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED assembly
- DCSM

PINPOINT TEST W: DTCs B103B AND B1111

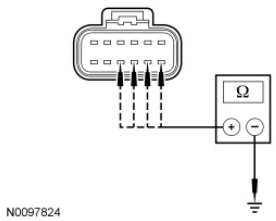
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

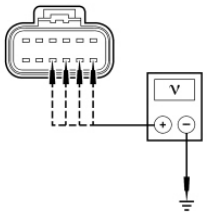
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
W1 CHECK TED CIRCUITS FOR A SHORT TO	

GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: DCSM C3305A. • Measure the resistance between DCSM C3305A, harness side and ground using the following chart: **Connector** / **Circuit** C3305A-G — CHS02 (YE/BU) C3305A-H — RHS02 (BU/OG) C3305A-J — CHS01 (GY/VT) C3305A-K — RHS01 (WH/VT)  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to W2 . **No** If the resistance of C3305A-G, circuit CHS02 (YE/BU) and/or C3305A-H, circuit RHS02 (BU/OG) to ground is **not** greater than 10,000 ohms, GO to W6 . If the resistance of C3305A-J, circuit CHS01 (GY/VT) and/or C3305A-K, circuit RHS01 (WH/VT) to ground is **not** greater than 10,000 ohms, GO to W7 .
W2 CHECK TED CIRCUITS FOR A SHORT TO VOLTAGE	
• ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3305A, harness side and ground using the following chart: **Connector** / **Circuit** C3305A-G — CHS02 (YE/BU)	**Yes** If voltage is present at C3305A-G and/or C3305A-H, GO to W8 . If voltage is present at C3305A-J and/or C3305A-K, GO to W9 . **No** GO to W3 .

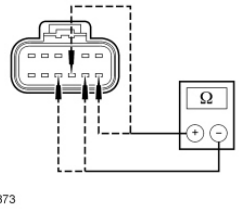
C3305A-H	RHS02 (BU/OG)
C3305A-J	CHS01 (GY/VT)
C3305A-K	RHS01 (WH/VT)



- **Is voltage present on any circuits?**

W3 CHECK THE RESISTANCE OF THE TED AND WIRING

- Ignition OFF.
- Measure the resistance between:
  - DCSM C3305A-G, circuit CHS02 (YE/BU), harness side and DCSM C3305A-H, circuit RHS02 (BU/OG), harness side.
  - DCSM C3305A-J, circuit CHS01 (GY/VT), harness side and C3305A-K, circuit RHS01 (WH/VT), harness side.



- **Are the resistances between 0.9 and 10 ohms?**

Yes
INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs.

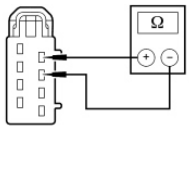
DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

No
If the resistance between DCSM C3305A-G and C3305A-H is **not** between 0.9 and 10 ohms, GO to W5 .

If the resistance between DCSM C3305A-J and C3305A-K is **not** between 0.9 and 10 ohms, GO to W4 .

W4 CHECK THE BACKREST TED RESISTANCE

- Disconnect: Backrest TED C3310.
- Measure the resistance between backrest TED C3310 pin 1 and pin 3, component side.

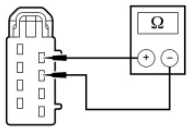
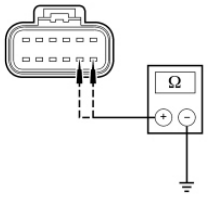


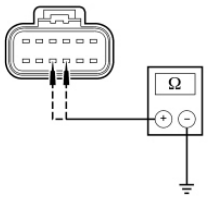
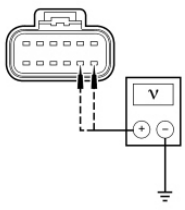
- **Is the resistance between 0.9 and 10 ohms?**

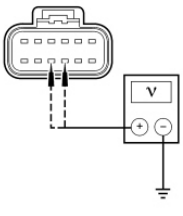
Yes
REPAIR circuit CHS01 (GY/VT) or RHS01 (WH/VT) for an open. REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

No
INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric

	Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
W5 CHECK THE CUSHION TED RESISTANCE	
• Disconnect: Cushion TED C3300. • Measure the resistance between cushion TED C3300 pin 1 and pin 3, component side.  N0042874 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR circuit CHS02 (YE/BU) or RHS02 (BU/OG) for an open. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
W6 CHECK CUSHION TED CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Cushion TED C3300. • Measure the resistance between: ♦ DCSM C3305A-G, circuit CHS02 (YE/BU), harness side and ground. ♦ DCSM C3305A-H, circuit RHS02 (BU/OG), harness side and ground.  N0042875 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.

	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
W7 CHECK BACKREST TED CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Backrest TED C3310. • Measure the resistance between: ♦ DCSM C3305A-J, circuit CHS01 (GY/VT), harness side and ground. ♦ DCSM C3305A-K, circuit RHS01 (WH/VT), harness side and ground.  N0042876 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
W8 CHECK CUSHION TED CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: Cushion TED C3300. • Ignition ON. • Measure the voltage between: ♦ DCSM C3305A-G, circuit CHS02 (YE/BU), harness side and ground. ♦ DCSM C3305A-H, circuit RHS02 (BU/OG), harness side and ground.  N0042877 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT

	passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
W9 CHECK BACKREST TED CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: Backrest TED C3310. • Ignition ON. • Measure the voltage between: ♦ DCSM C3305A-J, circuit CHS01 (GY/VT), harness side and ground. ♦ DCSM C3305A-K, circuit RHS01 (WH/VT), harness side and ground.  N0042878 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test X: DTC B103C

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied voltage at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, it only operates in 15-second intervals. Both voltage supply circuits are spliced together internal to the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat is disabled by the DCSM .

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the HVAC module seat switch settings.

- DTC B103C (Thermo-Electric Driver Open Load) - If DCSM outputs to the driver seat backrest or cushion TED (circuit pins G, H, J or K at the DCSM connector) or any components within these circuit loops are open, disconnected or a TED resistance greater than 90 kohms is sensed, the DCSM continues normal operation and sets this DTC.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- TED assembly
- DCSM

PINPOINT TEST X: DTC B103C

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

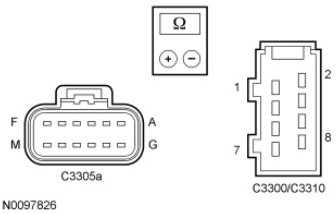
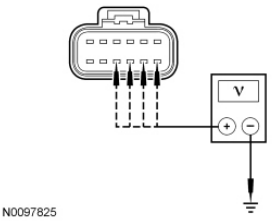
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

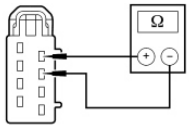
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
X1 CHECK TED CIRCUITS FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: DCSM C3305A. • Disconnect: Cushion TED C3300. • Disconnect: Backrest TED C3310. • Measure the resistance between DCSM C3305A, harness side and cushion TED C3300, harness side; and between DCSM C3305A, harness side and backrest TED C3310, harness side using the following chart:	**Yes** GO to X2 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

DCSM Connector	Circuit	TED Connector
C3305A-G	CHS02 (YE/BU)	C3300-1
C3305A-H	RHS02 (BU/OG)	C3300-3
C3305A-J	CHS01 (GY/VT)	C3310-1
C3305A-K	RHS01 (WH/VT)	C3310-3

 • **Are the resistances less than 5 ohms?**	
X2 CHECK TED CIRCUITS FOR A SHORT TO VOLTAGE	
• ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3305A, harness side and ground using the following chart: **Connector** / **Circuit** C3305A-G — CHS02 (YE/BU) C3305A-H — RHS02 (BU/OG) C3305A-J — CHS01 (GY/VT) C3305A-K — RHS01 (WH/VT)  • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to X3 .
X3 CHECK THE BACKREST AND CUSHION TED RESISTANCE	
• Ignition OFF. • Measure the resistance between: ♦ backrest TED C3310 pin 1 and pin 3, component side. ♦ cushion TED C3310 pin 1 and pin 3, component side.	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery

 N0042874 • **Are the resistances between 0.9 and 10 ohms?**	ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** If backrest TED resistance is **not** between 0.9 and 10 ohms, INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. If cushion TED resistance is **not** between 0.9 and 10 ohms, INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test Y: DTC B103D

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied voltage at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, it only operates in 15-second intervals. Both voltage supply circuits are spliced together internal to the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat is disabled by the DCSM .

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once

the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the HVAC module seat switch settings.

- DTC B103D (Blower Driver Overtemperature) - If the DCSM outputs to the driver seat blower or any components within these circuit loops are shorted to ground or cause an excessive current draw, the DCSM will overheat, shut down the driver seat system and set this DTC.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- TED assembly
- DCSM

PINPOINT TEST Y: DTC B103D

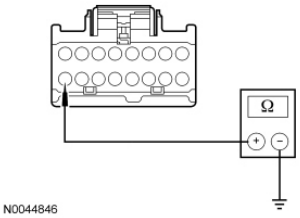
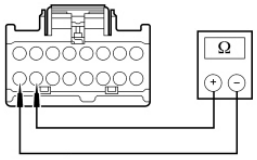
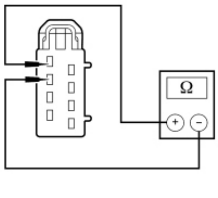
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
Y1 CHECK THE BLOWER MOTOR FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C327. • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: DCSM C3305C. • Disconnect: Cushion TED C3300. • Disconnect: Backrest TED C3310. • Measure the resistance between DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and ground.	**Yes** GO to Y2 . **No** REPAIR the circuit. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 N0044846 • **Is the resistance greater than 10,000 ohms?**	
Y2 CHECK FOR A SHORT BETWEEN THE BLOWER MOTOR FEED AND GROUND CIRCUITS	
• Measure the resistance between DCSM C3305C-15, circuit RHS03 (GY/OG), harness side and C3305C-16, circuit CHS03 (GN/BN), harness side.  N0044847 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to Y3 . **No** REPAIR the circuits. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
Y3 CHECK THE BACKREST AND CUSHION BLOWER MOTOR RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between: ♦ backrest TED C3310 pin 2 and pin 4, component side. ♦ cushion TED C3300 pin 2 and pin 4, component side.  N0042881 • **Are the resistances between 4,000 and 10,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** If cushion TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. If backrest TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module

	C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test Z: DTCs B1113 and B111B

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied voltage at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, it only operates in 15-second intervals. Both voltage supply circuits are spliced together internal to the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat is disabled by the DCSM .

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the HVAC module seat switch settings.

- DTC B1113 (Passenger Thermo-Electric Device Control Overtemperature Fault) - If the DCSM TED driver integrated circuit temperature exceeds 175°C (347°F), the DCSM will shut down the passenger seat system and set this DTC.
- DTC B111B (Passenger Thermo-Electric Driver Overcurrent Low) - If DCSM outputs to the passenger seat backrest or cus TED (circuit pins A, B, C or D at the DCSM connector) or any components within these circuit loops are shorted to ground or a TED resistance of less than 0.9 ohm is sensed, the DCSM will shut down the passenger seat system and set this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED assembly
- DCSM

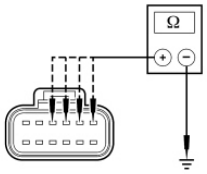
PINPOINT TEST Z: DTCs B1113 AND B111B

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>Z1 CHECK THE TED CIRCUITS FOR A SHORT TO GROUND</td><td></td></tr>
<tr><td>
• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .
• Disconnect: Passenger Seat Side Air Bag Module C313.
• Disconnect: DCSM C3305A.
• Measure the resistance between DCSM C3305A, harness side and ground using the following chart:
<table>
<tr><th>Connector</th><th>Circuit</th></tr>
<tr><td>C3305A-A</td><td>CHS07 (GY/BU)</td></tr>
<tr><td>C3305A-B</td><td>RHS07 (BU)</td></tr>
<tr><td>C3305A-C</td><td>CHS06 (BU/BN)</td></tr>
<tr><td>C3305A-D</td><td>RHS06 (WH)</td></tr>
</table>

N0097827
• Are the resistances greater than 10,000 ohms?
</td><td>
Yes
GO to Z2 .

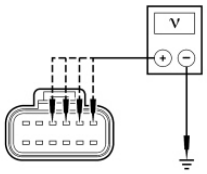
No
If the resistance between C3305A-A and/or C3305A-B to ground is not greater than 10,000 ohms, GO to Z6 .

If the resistance between C3305A-C and/or C3305A-D to ground is not greater than 10,000 ohms, GO to Z7 .
</td></tr>
<tr><td>Z2 CHECK THE TED CIRCUITS FOR A SHORT TO VOLTAGE</td><td></td></tr>
<tr><td>
• ⚠ WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.
• Connect the battery ground cable. Refer to Section 414-01 .
• Ignition ON.
• Measure the voltage between DCSM C3305A, harness side and ground using the following chart:
<table>
<tr><th>Connector</th><th>Circuit</th></tr>
</table>
</td><td>
Yes
If voltage is present at C3305A-A and/or C3305A-B, GO to Z8 .

If voltage is present at C3305A-C and/or C3305A-D, GO to Z9 .

No
GO to Z3 .
</td></tr>
</table>

C3305A-A	CHS07 (GY/BU)
C3305A-B	RHS07 (BU)
C3305A-C	CHS06 (BU/BN)
C3305A-D	RHS06 (WH)

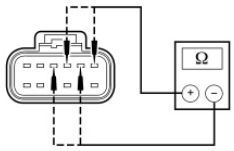


N0097828

- **Is voltage present on either circuit?**

Z3 CHECK THE RESISTANCE OF THE TED AND WIRING

- Ignition OFF.
- Measure the resistance between:
  - DCSM C3305A-A, circuit CHS07 (GY/BU), harness side and DCSM C3305A-B, circuit RHS07 (BU), harness side.
  - DCSM C3305A-C, circuit CHS06 (BU/BN), harness side and C3305A-D, circuit RHS06 (WH), harness side.



N0042882

- **Are the resistances between 0.9 and 10 ohms?**

Yes
INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

No
If the resistance between DCSM C3305A-A and C3305A-B is **not** between 0.9 and 10 ohms, GO to Z5 .

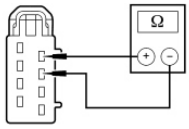
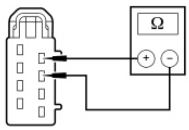
If the resistance between DCSM C3305A-C and C3305A-D is **not** between 0.9 and 10 ohms, GO to Z4 .

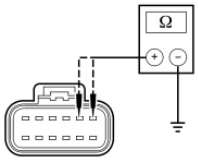
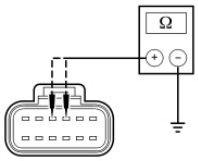
Z4 CHECK THE BACKREST TED RESISTANCE

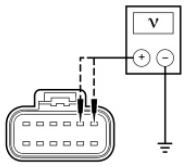
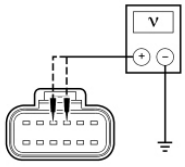
- Disconnect: Backrest TED C3311.
- Measure the resistance between backrest TED C3311 pin 1 and pin 3, component side.

Yes
REPAIR circuit CHS06 (BU/BN) or RHS06 (WH) for an open. REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT

 N0042874 • **Is the resistance between 0.9 and 10 ohms?**	passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
Z5 CHECK THE CUSHION TED RESISTANCE	
• Disconnect: Cushion TED C3303. • Measure the resistance between cushion TED C3303 pin 1 and pin 3, component side.  N0042874 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR circuit CHS07 (GY/BU) or RHS07 (BU) for an open. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
Z6 CHECK THE CUSHION TED CIRCUITS FOR A SHORT TO GROUND	

• Disconnect: Cushion TED C3303. • Measure the resistance between: ♦ DCSM C3305A-A, circuit CHS07 (GY/BU), harness side and ground. ♦ DCSM C3305A-B, circuit RHS07 (BU), harness side and ground.  N0042883 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
Z7 CHECK THE BACKREST TED CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Backrest TED C3311. • Measure the resistance between: ♦ DCSM C3305A-C, circuit CHS06 (BU/BN), harness side and ground. ♦ DCSM C3305A-D, circuit RHS06 (WH), harness side and ground.  N0042884 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Z8 CHECK THE CUSHION TED CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: Cushion TED C3303. • Ignition ON. • Measure the voltage between: ♦ DCSM C3305A-A, circuit CHS07 (GY/BU), harness side and ground. ♦ DCSM C3305A-B, circuit RHS07 (BU), harness side and ground.  N0042885 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
Z9 CHECK THE BACKREST TED CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: Backrest TED C3311. • Ignition ON. • Measure the voltage between: ♦ DCSM C3305A-C, circuit CHS06 (BU/BN), harness side and ground. ♦ DCSM C3305A-D, circuit RHS06 (WH), harness side and ground.  N0042886 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER

	the SRS . REFER to Section 501-20B .

Pinpoint Test AA: DTC B111C

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied voltage at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, it only operates in 15-second intervals. Both voltage supply circuits are spliced together internal to the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat is disabled by the DCSM .

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the HVAC module seat switch settings.

- DTC B111C (Passenger Thermo-Electric Driver Open Load) - If DCSM outputs to the passenger seat backrest or cushion TED (circuit pins A, B, C or D at the DCSM connector) or any components within these circuit loops are open, disconnected or a TED resistance greater than 90 kohms is sensed, the DCSM continues normal operation and sets this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED assembly
- DCSM

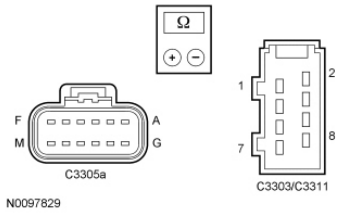
PINPOINT TEST AA: DTC B111C

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>AA1 CHECK THE TED CIRCUITS FOR AN OPEN</td><td></td></tr>
<tr><td>
• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .
• Disconnect: Passenger Seat Side Air Bag Module C313.
• Disconnect: DCSM C3305A.
• Disconnect: Cushion TED C3303.
• Disconnect: Backrest TED C3311.
• Measure the resistance between DCSM C3305A, harness side and cushion TED C3303, harness side; and between DCSM C3305A, harness side and backrest TED C3311, harness side using the following chart:
<table>
<tr><th>DCSM Connector</th><th>Circuit</th><th>TED Connector</th></tr>
<tr><td>C3305A-A</td><td>CHS07 (GY/BU)</td><td>C3303-1</td></tr>
<tr><td>C3305A-B</td><td>RHS07 (BU)</td><td>C3303-3</td></tr>
<tr><td>C3305A-C</td><td>CHS06 (BU/BN)</td><td>C3311-1</td></tr>
<tr><td>C3305A-D</td><td>RHS06 (WH)</td><td>C3311-3</td></tr>
</table>


• Are the resistances less than 5 ohms?
</td><td>Yes
GO to AA2 .

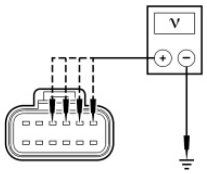
No
REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .</td></tr>
<tr><td>AA2 CHECK THE TED CIRCUITS FOR A SHORT TO VOLTAGE</td><td></td></tr>
<tr><td>
• ⚠ WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.
• Connect the battery ground cable. Refer to Section 414-01 .
• Ignition ON.
• Measure the voltage between DCSM C3305A, harness side and ground using the following chart:
<table>
<tr><th>Connector</th><th>Circuit</th></tr>
</table>
</td><td>Yes
REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

No
GO to AA3 .</td></tr>
</table>

C3305A-A	CHS07 (GY/BU)
C3305A-B	RHS07 (BU)
C3305A-C	CHS06 (BU/BN)
C3305A-D	RHS06 (WH)

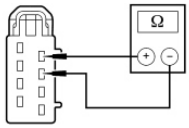


N0097828

- **Is voltage present on any circuits?**

AA3 CHECK THE BACKREST AND CUSHION TED RESISTANCE

- Ignition OFF.
- Measure the resistance between:
  - ♦ backrest TED C3311 pin 1 and pin 3, component side.
  - ♦ cushion TED C3311 pin 1 and pin 3, component side.



N0042874

- **Are the resistances between 0.9 and 10 ohms?**

Yes
INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

No
If backrest TED resistance is **not** between 0.9 and 10 ohms, INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs.

If cushion TED resistance is **not** between 0.9 and 10 ohms, INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag

	module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AB: DTC B111D

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied voltage at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, it only operates in 15-second intervals. Both voltage supply circuits are spliced together internal to the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat is disabled by the DCSM .

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the HVAC module seat switch settings.

- DTC B111D (Passenger Blower Driver Overtemperature) - If the DCSM outputs to the passenger seat blower or any components within these circuit loops are shorted to ground or cause an excessive current draw, the DCSM will overheat, shut down the passenger seat system and set this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED assembly
- DCSM

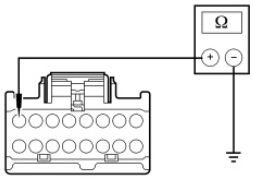
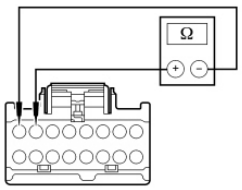
PINPOINT TEST AB: DTC B111D

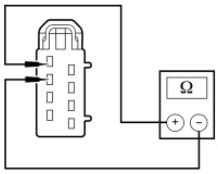
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AB1 CHECK THE BLOWER MOTOR FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • Disconnect: Cushion TED C3303. • Disconnect: Backrest TED C3311. • Measure the resistance between DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and ground.  N0044848 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AB2 . **No** REPAIR the circuit. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AB2 CHECK FOR A SHORT BETWEEN THE BLOWER MOTOR FEED AND GROUND CIRCUITS	
• Measure the resistance between DCSM C3305C-7, circuit RHS08 (VT/WH), harness side and C3305C-8, circuit CHS08 (BN/YE), harness side.  N0044849 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AB3 . **No** REPAIR the circuits. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AB3 CHECK THE BACKREST CUSHION BLOWER MOTOR RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between: ♦ cushion TED C3303 pin 2 and pin 4, component side.	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

♦ backrest TED C3311 pin 2 and pin 4, component side.  N0042881 • **Are the resistances between 4,000 and 10,000 ohms?**	**No** If cushion TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. If backrest TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AC: DTC B19A1

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the passenger seat cushion Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A1 (Passenger Seat Cushion Blower Speed Short to Battery) - If the passenger seat cushion blower speed circuit is shorted to voltage, the DCSM will shut down the passenger seat system and set this DTC.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

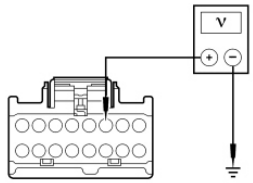
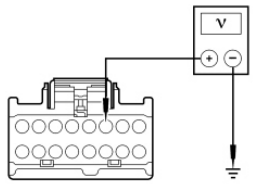
PINPOINT TEST AC: DTC B19A1

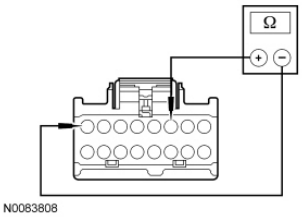
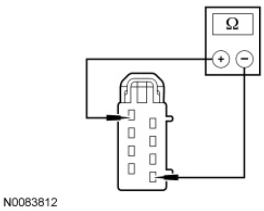
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being rviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AC1 CHECK THE CUSHION TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between C3305C-3, circuit VHS23 (BN/BU), harness side and ground.  N0083372 • **Is any voltage present?**	**Yes** GO to AC2 . **No** GO to AC3 .
AC2 CHECK THE CUSHION TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Cushion TED C3303. • Measure the voltage between DCSM C3305C-3, circuit VHS23 (BN/BU), harness side and ground.  N0083372 • **Is any voltage present?**	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AC3 .
AC3 CHECK THE CUSHION TED BLOWER MOTOR SPEED CONTROL AND BLOWER MOTOR FEED CIRCUITS FOR A SHORT TOGETHER	

• Ignition OFF. • Disconnect: Cushion TED C3303. • Measure the resistance between DCSM C3305C-3, circuit VHS23 (BN/BU), harness side and C3305C-8, circuit CHS08 (BN/YE), harness side.  N0083808 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AC4 . **No** REPAIR the circuits. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AC4 CHECK THE CUSHION TED RESISTANCE FOR AN INTERNAL SHORT	
• Measure the resistance between cushion TED C3303 pin 2 and pin 7, component side.  N0083812 • **Is the resistance greater than 2,000,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AD: DTC B19A2

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the passenger seat backrest Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A2 (Passenger Seat Back Blower Speed Short to Battery) - If the passenger seat backrest blower speed circuit is shorted to voltage, the DCSM will shut down the passenger seat system and set this DTC.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

PINPOINT TEST AD: DTC B19A2

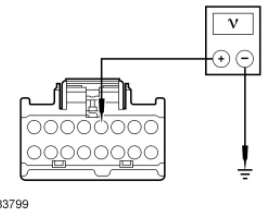
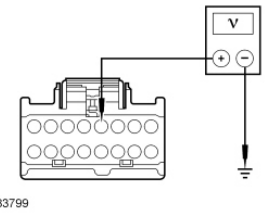
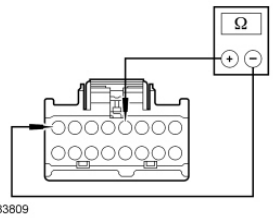
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

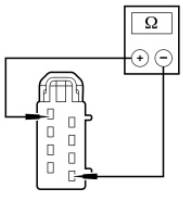
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AD1 CHECK THE BACKREST TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between C3305C-4, circuit VHS21 (BU/WH), harness side and ground.	**Yes** GO to AD2 . **No** GO to AD3 .

 N0083799 • **Is any voltage present?**	
AD2 CHECK THE BACKREST TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Backrest TED C3311. • Measure the voltage between DCSM C3305C-4, circuit VHS21 (BU/WH), harness side and ground.  N0083799 • **Is any voltage present?**	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AD3 .
AD3 CHECK THE BACKREST TED BLOWER MOTOR SPEED CONTROL AND BLOWER MOTOR FEED CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Disconnect: Backrest TED C3311. • Measure the resistance between DCSM C3305C-4, circuit VHS21 (BU/WH), harness side and C3305C-8, circuit CHS08 (BN/YE), harness side.  N0083809 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AD4 . **No** REPAIR the circuits. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AD4 CHECK THE BACKREST TED RESISTANCE FOR AN INTERNAL SHORT	

• Measure the resistance between backrest TED C3311 pin 2 and pin 7, component side.  N0083812 • **Is the resistance greater than 2,000,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AE: DTC B19A3

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the driver seat cushion Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A3 (Driver Seat Cushion Blower Speed Short to Battery) - If the driver seat cushion blower speed circuit is shorted to voltage, the DCSM will shut down the driver seat system and set this DTC.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

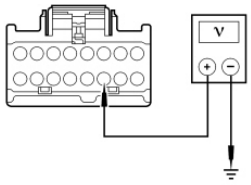
PINPOINT TEST AE: DTC B19A3

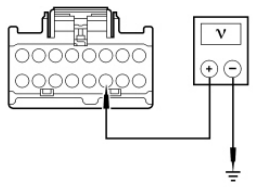
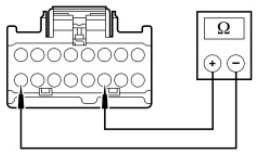
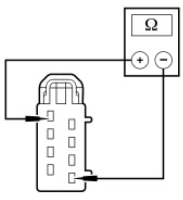
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AE1 CHECK THE CUSHION TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • **⚠ WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between C3305C-11, circuit VHS18 (BN/GN), harness side and ground.  N0083800 • **Is any voltage present?**	**Yes** GO to AE2 . **No** GO to AE3 .
AE2 CHECK THE CUSHION TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	

• Disconnect: Cushion TED C3300. • Measure the voltage between C3305C-11, circuit VHS18 (BN/GN), harness side and ground.  N0083800 • **Is any voltage present?**	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AE3 .
AE3 CHECK THE CUSHION TED BLOWER MOTOR SPEED CONTROL AND BLOWER MOTOR FEED CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Disconnect: Cushion TED C3300. • Measure the resistance between DCSM C3305C-11, circuit VHS18 (BN/GN), harness side and C3305C-16, circuit CHS03 (GN/BN), harness side.  N0083810 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AE4 . **No** REPAIR the circuits. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AE4 CHECK THE CUSHION TED RESISTANCE FOR AN INTERNAL SHORT	
• Measure the resistance between cushion TED C3300 pin 2 and pin 7, component side.  N0083812 • **Is the resistance greater than 2,000,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

	No INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AF: DTC B19A4

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the driver seat backrest Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A4 (Driver Seat Back Blower Speed Short to Battery) - If the driver seat backrest blower speed circuit is shorted to voltage, the DCSM will shut down the driver seat system and set this DTC.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

PINPOINT TEST AF: DTC B19A4

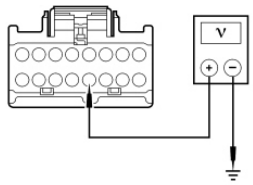
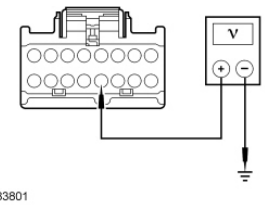
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

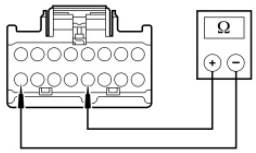
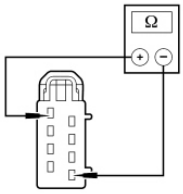
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignitn switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take

AF1 CHECK THE BACKREST TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between C3305C-12, circuit VHS16 (BU/GN), harness side and ground.  • **Is any voltage present?**	**Yes** GO to AF2 . **No** GO to AF3 .
AF2 CHECK THE BACKREST TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Backrest TED C3310. • Measure the voltage between C3305C-12, circuit VHS16 (BU/GN), harness side and ground.  • **Is any voltage present?**	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AF3 .
AF3 CHECK THE BACKREST TED BLOWER MOTOR SPEED CONTROL AND BLOWER MOTOR FEED CIRCUITS FOR A SHORT TOGETHER	

• Ignition OFF. • Disconnect: Backrest TED C3310. • Measure the resistance between DCSM C3305C-12, circuit VHS16 (BU/GN), harness side and C3305c-16, circuit CHS03 (GN/BN), harness side.  N0083811 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AF4 . **No** REPAIR the circuits. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AF4 CHECK THE BACKREST TED RESISTANCE FOR AN INTERNAL SHORT	
• Measure the resistance between backrest TED C3310 pin 2 and pin 7, component side.  N0083812 • **Is the resistance greater than 2,000,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AG: DTC B19A5

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the passenger seat cushion Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A5 (Passenger Seat Cushion Blower Speed Short to Ground) - If the passenger seat cushion blower speed circuit is shted to ground, the DCSM will shut down the passenger seat system and set this DTC.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

PINPOINT TEST AG: DTC B19A5

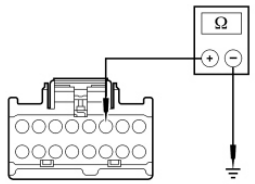
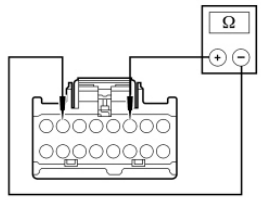
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AG1 CHECK THE CUSHION TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • Disconnect: Cushion TED C3303. • Measure the resistance between DCSM C3305C-3, circuit VHS23 (BN/BU), harness side and ground.	**Yes** GO to AG2 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 N0083842 • **Is the resistance greater than 10,000 ohms?**	
AG2 CHECK THE CUSHION TED BLOWER MOTOR SPEED CONTROL AND BLOWER MOTOR GROUND CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between DCSM C3305C-3, circuit VHS23 (BN/BU), harness side and C3305C-7, circuit RHS08 (VT/WH), harness side.  N0083843 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuits. REPEAT the self-test. CLEAR the DTCs. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AH: DTC B19A6

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the passenger seat backrest Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A6 (Passenger Seat Back Blower Speed Short to Ground) - If the passenger seat backrest blower speed circuit is shorted to ground, the DCSM will shut down the passenger seat system and set this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED and blower assembly

- DCSM

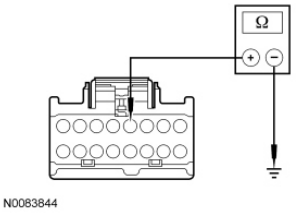
PINPOINT TEST AH: DTC B19A6

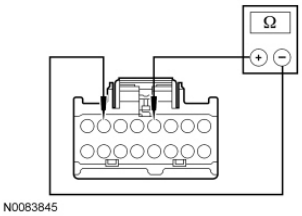
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AH1 CHECK THE BACKREST TED BLOWER SPEED CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • Disconnect: Backrest TED C3311. • Measure the resistance between DCSM C3305C-4, circuit VHS21 (BU/WH), harness side and ground.  N0083844 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AH2 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AH2 CHECK THE BACKREST TED BLOWER MOTOR SPEED CONTROL AND BLOWER MOTOR GROUND CIRCUITS FOR A SHORT TOGETHER	

• Measure the resistance between DCSM C3305C-4, circuit VHS21 (BU/WH), harness side and C3305C-7, circuit RHS08 (VT/WH), harness side.  N0083845 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuits. REPEAT the self-test. CLEAR the DTCs. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AI: DTC B19A7

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the driver seat cushion Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A7 (Driver Seat Cushion Blower Speed Short to Ground) - If the driver seat cushion blower speed circuit is shorted to ground, the DCSM will shut down the driver seat system and set this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

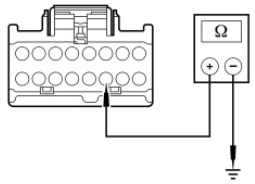
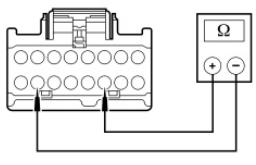
PINPOINT TEST AI: DTC B19A7

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCsand system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AI1 CHECK THE CUSHION TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • Disconnect: Cushion TED C3300. • Measure the resistance between DCSM C3305C-11, circuit VHS18 (BN/GN), harness side and ground.  N0083846 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AI2 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AI2 CHECK THE CUSHION TED BLOWER MOTOR SPEED CONTROL AND BLOWER MOTOR GROUND CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between DCSM C3305C-11, circuit VHS18 (BN/GN), harness side and C3305C-15, circuit RHS03 (GY/OG), harness side.  N0083847 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

	No REPAIR the circuits. REPEAT the self-test. CLEAR the DTCs. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AJ: DTC B19A8

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to the driver seat backrest Thermo-Electric Device (TED). The DCSM also sends a speed control voltage signal to the TED to control blower speed.

- DTC B19A8 (Driver Seat Back Blower Speed Short to Ground) - If the driver seat backrest blower speed circuit is shorted to ground, the DCSM will shut down the driver seat system and set this DTC.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- TED and blower assembly
- DCSM

PINPOINT TEST AJ: DTC B19A8

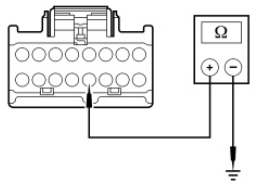
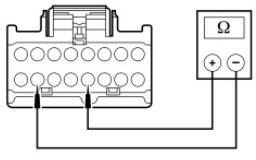
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take

AJ1 CHECK THE BACKREST TED BLOWER MOTOR SPEED CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • Disconnect: Backrest TED C3310. • Measure the resistance between DCSM C3305C-12, circuit VHS16 (BU/GN), harness side and ground.  N0083848 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AJ2 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AJ2 CHECK THE BACKREST TED BLOWER MOTOR SPEED CONTROL AND BLOWER MOTOR GROUND CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between DCSM C3305C-12, circuit VHS16 (BU/GN), harness side and C3305C-15, circuit RHS03 (GY/OG), harness side.  N0083849 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** REPAIR the circuits. REPEAT the self-test. CLEAR the DTCs. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag

	module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AK: DTC B2486

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) monitors the input voltage for correct operation. If the DCSM detects input voltage below 10 volts or above 15 volts, it will store DTC B2486 in memory. If DTC B2486 is set, the DCSM enters a standby mode and suspends the system outputs for the operation of both seats until system voltage between 10 and 15 volts is restored and a climate controlled seat switch button is selected on.

- DTC B2486 (Climate Control Seat Module Voltage Out of Range) - If the DCSM detects voltage below 10 volts or greater than 15 volts, the DTC is set.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- DCSM

PINPOINT TEST AK: DTC B2486

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

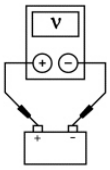
NOTE: DTC B1676 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

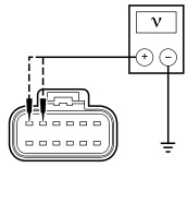
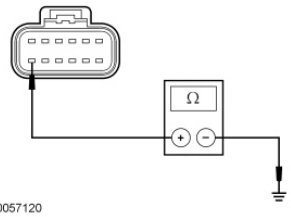
NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
AK1 RETRIEVE ALL CMDTCs IN ALL MODULES	
• Ignition ON.	**Yes** REFER to Section 414-00 to diagnose the charging system.

• Enter the following diagnostic mode on the scan tool: Self Test - ALL CMDTCs . • **Is DTC B2486 or B1676 present in one or more modules AND P0563, P0620, P0625, P0626 or P065B retrieved from the PCM?**	**No** GO to AK2 .
AK2 CHECK THE BATTERY CONDITION	
NOTE: DTC B1676 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on. • Ignition OFF. • Carry out the Battery Condition Test. Refer to Section 414-01 . • **Did the battery pass the condition test?**	**Yes** If the battery passed the condition test, but required a recharge, REFER to Section 414-00 to diagnose the charging system. CLEAR all Continuous Memory Diagnostic Trouble Codes (CMDTCs). TEST the system for normal operation. If the battery passed the condition test and did not require a recharge, GO to AK3 . **No** INSTALL a new battery. CLEAR all CMDTCs . TEST the system for normal operation.
AK3 CHECK THE CHARGING SYSTEM VOLTAGE	
NOTE: Do not allow the engine speed to increase above 2,000 rpm while performing this step or the generator may self excite and result in default charging system output voltage. If engine speed goes above 2,000 rpm, shut the vehicle OFF and restart the engine before performing this step. • Start the engine. • Measure voltage of the battery with and without a load on the charging system as follows: ♦ Turn off all accessories and run the engine at 1,500 rpm for a minimum of 2 minutes while measuring battery voltage. ♦ Turn on headlights and HVAC fan on high and run engine at 1,500 rpm for a minimum of 2 minutes while measuring battery voltage.  AJ0210-A • **Are the voltages between 13 and 15.2 volts?**	**Yes** GO to AK4 . **No** REFER to Section 414-00 to diagnose the charging system. CLEAR all CMDTCs . TEST the system for normal operation.
AK4 CHECK VOLTAGE TO THE DCSM	

• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305A. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between: ♦ DCSM C3305A-E, circuit SBB12 (GN/RD), harness side and ground. ♦ DCSM C3305A-F, circuit SBB12 (GN/RD), harness side and ground.  N0042997 • **Are the voltages greater than 10 volts?**	**Yes** GO to AK5 . **No** VERIFY BJB fuse 12 (30A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR all CMDTCs . REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AK5 CHECK THE DCSM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between DCSM C3305A-M, circuit GD139 (BK/YE), harness side and ground.  N0057120 • Repeat this measurement while wiggling the harness. • **Is the resistance less than 5 ohms?**	**Yes** GO to AK6 . **No** REPAIR the circuit. CLEAR all CMDTCs . REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AK6 CHECK FOR CORRECT DCSM OPERATION	
• Check the harness and component side connectors for the following: ♦ corrosion. ♦ damaged pins.	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. CLEAR all CMDTCs . REPEAT the self-test.

♦ pushed-out pins. • Connect: DCSM C3305A. • Make sure the DCSM connector is seated correctly. • Start the engine. • Operate the climate controlled seats and verify system operation. • Enter the following diagnostic mode on the scan tool: Self Test - DCSM . • **Is DTC B1317 or B1318 still present?**	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all CMDTCs . REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AL: DTC B2729

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) monitors seat cushion temperature while it supplies voltage and ground to both blower motors. The DCSM also supplies a variable voltage signal to control the blower speed. Cabin air enters the blower through a filter attached to the Thermo-Electric Device (TED) housing. Conditioned air exits the TED and flows through a manifold attached to the foam pad.

- DTC B2729 (Cushion Over-Temp Detected) - In the heating mode, if the driver seat cushion TED temperature exceeds 85°C (185°F) for more than 34 seconds, the TED is disconnected or the duct is blocked, the DCSM will shut down the driver seat system and set this DTC.
- DTC B2729 (Cushion Over-Temp Detected) - In the cooling mode, if the driver seat cushion TED temperature exceeds 70°C (158°F) for more than 34 seconds, the TED is disconnected or the duct is blocked, the DCSM will shut down the driver seat system and set this DTC.

This pinpoint test is intended to diagnose the following:

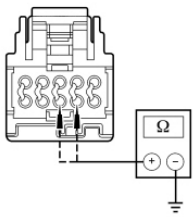
- Wiring, terminals or connectors
- Restricted cushion TED filter
- Crushed or restricted climate controlled seat manifold
- Cushion TED assembly

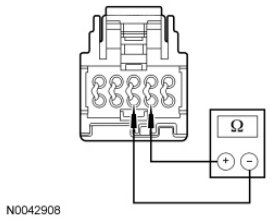
PINPOINT TEST AL: DTC B2729

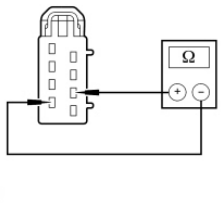
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and systeilure. Touching the tip of these connector pins is recommended instead.**

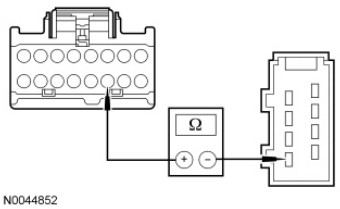
NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

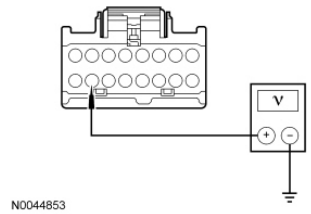
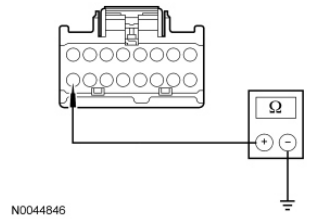
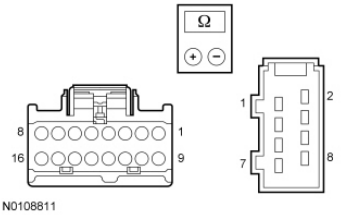
NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

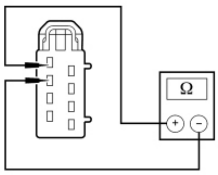
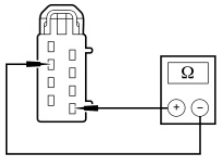
Test Step	Result / Action to Take
AL1 CHECK THE DCSM FOR ON-DEMAND DTCs	
• Start the vehicle and set the driver seat to HIGH heat. • Enter the following diagnostic mode on the scan tool: Self Test - DCSM . • **Was DTC B2729 retrieved on-demand during the self-test?**	**Yes** GO to AL2 . **No** GO to AL5 .
AL2 CHECK THE DRIVER SEAT CUSHION TED THERMISTOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327 and Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305B. • Disconnect: Driver Seat Cushion TED C3300. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between: ♦ DCSM C3305B-7, circuit VHS26 (VT), harness side and ground. ♦ DCSM C3305B-8, circuit RHS05 (YE/VT), harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AL3 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AL3 CHECK THE DRIVER SEAT CUSHION TED THERMISTOR AND WIRING	

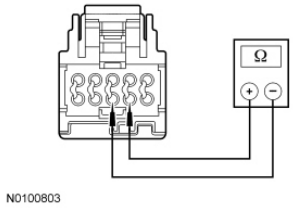
• Connect: Driver Seat Cushion TED C3300. • Measure the resistance between DCSM C3305B-7, circuit VHS26 (VT), harness side and DCSM C3305B-8, circuit RHS05 (YE/VT), harness side. Note the ambient temperature and refer to the following table. **Temperature / Resistance** 0-10°C (32-50°F) — 2,782-1,663 ohms 10-20°C (50-68°F) — 1,837-1,140 ohms 20-30°C (68-86°F) — 1,260-806 ohms 893-570 ohms 40-50°C (104-122°F) — 630-428 ohms  N0042908 • **Is the resistance within the limits indicated?**	**Yes** GO to AL18 . **No** GO to AL4 .
AL4 CHECK THE DRIVER SEAT CUSHION TED THERMISTOR	
• Disconnect: Driver Seat Cushion TED C3300. • Measure the resistance between driver seat cushion TED C3300 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table. **Temperature / Resistance** 0-10°C (32-50°F) — 2,782-1,663 ohms 10-20°C (50-68°F) — 1,837-1,140 ohms 20-30°C (68-86°F) — 1,260-806 ohms 30-40°C (86-104°F) — 893-570 ohms 40-50°C (104-122°F) — 630-428 ohms	**Yes** REPAIR circuit VHS26 (VT) or RHS05 (YE/VT) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new driver seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313.

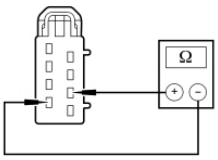
 N0042890 • **Is the resistance within the limits indicated?**	REPOWER the SRS . REFER to Section 501-20B .
AL5 CONFIRM THE FAULT WHILE MONITORING THE DCSM SEAT BACK THERMAL ELECTRIC DEVICE TEMPERATURE (BK_TEMP) AND SEAT CUSHION THERMAL ELECTRIC DEVICE TEMPERATURE (CSHTEMP) PIDs	
• Set the driver seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Enter the following diagnostic mode on the scan tool: DataLogger - DCSM . • Monitor the DCSM PIDs BK_TEMP and CSHTEMP. • **NOTE:** A crushed seat cushion foam pad or a crushed climate controlled seat manifold may be the cause of the fault making it necessary to occupy the seat to recreate and identify the fault. • Attempt to recreate the fault. Start the vehicle and set the driver seat to HIGH heat for at least 15 minutes while occupying the seat. • **Do the PIDs increase incrementally (gradually) and stay within 15°C (27°F) of each other?**	**Yes** Fault not present at this time. Fault may have been set due to a past failure, incorrect use of the climate controlled seat system by repeated switching between heat and cool modes or due to excessive passenger compartment temperature. CLEAR the DTCs. REPEAT the self-test. **No** If the CSHTEMP PID increases incrementally and is greater than 15°C (27°F) of the BK_TEMP PID, GO to AL6 . If the CSHTEMP PID increases quickly (temperature "jumps" and does not increase incrementally) and is greater than 15°C (27°F) of the BK_TEMP PID, GO to AL16 .
AL6 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS	
• With the engine running, set both front seats to HIGH cool. • Note the airflow exhausting from the driver seat cushion TED and compare it to the airflow exhausting from the passenger seat cushion TED . • Carry out a wiggle test of the wire harnesses between the DCSM and the driver seat cushion TED while monitoring blower operation of the TED . The blower should operate consistently and not change speeds • **Is the airflow exhausting from the driver seat cushion TED comparable to the airflow exhausting from the passenger seat cushion TED with no change in operation when carrying out the wiggle test?**	**Yes** GO to AL7 . **No** If the airflow exhausting from the driver seat cushion TED is not comparable to the airflow exhausting from the passenger seat cushion TED , GO to AL8 . If the driver seat cushion TED blower operation changed while carrying out the wiggle test, IDENTIFY and REPAIR the wiring fault. CLEAR the DTCs. REPEAT the self-test.
AL7 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS WHILE OCCUPIED	

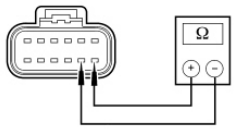
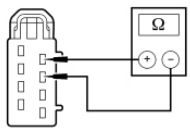
• Note the airflow exhausting from the driver seat cushion TED with the driver seat occupied and compare it to the airflow exhausting from the passenger seat cushion TED with the passenger seat occupied. • **Is the airflow exhausting from the driver seat cushion TED comparable to the airflow exhausting from the passenger seat cushion TED ?**	**Yes** GO to AL16 . **No** INSTALL a new driver seat cushion foam pad and/or climate controlled seat manifold. CLEAR the DTCs. REPEAT the self-test.
AL8 CHECK THE DRIVER SEAT CUSHION BLOWER FOR AN OBSTRUCTION OR RESTRICTED FILTER	
• Ignition OFF. • Inspect the blower of the driver seat cushion TED assembly for an obstruction or for a restricted filter. • **Is the blower obstructed or the filter restricted?**	**Yes** REMOVE the obstruction or INSTALL a new filter. CLEAR the DTCs. REPEAT the self-test. **No** GO to AL9 .
AL9 CHECK THE DRIVER SEAT CUSHION BLOWER SPEED CONTROL CIRCUIT FOR AN OPEN	
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327 and Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • Disconnect: Driver Seat Cushion TED C3300. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3305C-11, circuit VHS18 (BN/GN), harness side and driver seat cushion TED C3300-7, circuit VHS18 (BN/GN), harness side.  N0044852 • **Is the resistance less than 5 ohms?**	**Yes** GO to AL10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AL10 CHECK THE DRIVER SEAT CUSHION BLOWER CIRCUIT FOR A SHORT TO VOLTAGE	

• Ignition ON. • Measure the voltage between DCSM C3305C-15, circuit RHS03 (GY/OG), harness side and ground.  N0044853 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AL11 .
AL11 CHECK THE DRIVER SEAT CUSHION BLOWER CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and ground.  N0044846 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AL12 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AL12 CHECK THE DRIVER SEAT CUSHION BLOWER CIRCUITS FOR AN OPEN	
• Measure the resistance between: ♦ DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and driver seat cushion TED C3300-2, circuit CHS03 (GN/BN), harness side. ♦ DCSM C3305C-15, circuit RHS03 (GY/OG), harness side and driver seat cushion TED C3300-4, circuit RHS03 (GY/OG), harness side.  N0108811 • **Are the resistances less than 5 ohms?**	**Yes** GO to AL13 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AL13 CHECK THE DRIVER SEAT CUSHION BLOWER RESISTANCE	

• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between driver seat cushion TED C3300 pin 2 and pin 4, component side.  N0042881 • **Is the resistance between 4,000 ohms and 10,000 ohms?**	**Yes** GO to AL14 . **No** INSTALL a new driver seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AL14 CHECK THE DRIVER SEAT CUSHION BLOWER SPEED CONTROL RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between driver seat cushion TED C3300 pin 7 and pin 4, component side.  N0042893 • **Is the resistance between 240K ohms and 400K ohms?**	**Yes** GO to AL15 . **No** INSTALL a new driver seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AL15 CHECK THE DRIVER SEAT CUSHION TED INSTALLATION AND FOR CRUSHED SEAT CUSHION	
• Ignition OFF. • Remove the driver seat. Refer to Seat - Front in this section. • Remove the driver seat cushion cover. Refer to Seat Cushion Cover - Front in this section. • Inspect the driver seat cushion for the following: ♦ Is the driver seat cushion TED correctly installed?	**Yes** INSTALL the driver seat cushion cover and seat and GO to AL18 . **No** CORRECTLY install the driver seat cushion TED or INSTALL a new driver seat cushion foam pad and/or climate controlled seat manifold.

♦ Is the driver seat cushion seat cushion foam pad crushed or restricted? ♦ Is the driver seat cushion climate controlled seat manifold crushed or restricted? • **Is the driver seat cushion TED correctly installed and are there no signs of damage to the foam pad and manifold?**	CONNECT the battery ground cable. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AL16 CHECK THE DRIVER SEAT CUSHION TED THERMISTOR AND WIRING	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327 and Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305B. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3305B-7, circuit VHS26 (VT), harness side and C3305B-8 circuit RHS05 (YE/VT), harness side. Note the ambient temperature and refer to the following table. **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms  	**Yes** GO to AL18 . **No** GO to AL17 .

• **Is the resistance within the limits indicated?**	
AL17 CHECK THE DRIVER SEAT CUSHION TED THERMISTOR	
• Measure the resistance between driver seat cushion TED C3300 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table. **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms  N0042890 • **Is the resistance within the limits indicated?**	**Yes** REPAIR circuit VHS26 (VT) or RHS05 (YE/VT) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. AT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AL18 CHECK THE DRIVER SEAT CUSHION TED HEATING/COOLING CIRCUITRY CURRENT DRAW	
• Connect: All DCSM , TED and body harness-to-seat harness connectors. • ***NOTICE:*** **It may be necessary to open the seat wire harness conduit to allow placing the inductive current probe around the circuit as described in the following step. Care must be taken when opening up the wire harness so as not to damage any wiring or connectors. Do not damage any wiring or induce stress on any wiring or connectors. Close up the wire harness once repairs to the seat are complete.** • **NOTE:** Use a commercially available inductive current probe (such as Electronic Specialties Current Probe/Multimeter 685 or a Fluke I410 [used with a digital multimeter]) or the low current probe from the Vehicle Measurement Module available for use with Integrated Diagnostic System (IDS). If these are unavailable, the inductive current probe feature from a battery tester may be substituted. • Place an inductive current probe around circuit CHS02 (YE/BU) near DCSM C3305A-G and monitor the	**Yes** GO to AL19 . **No** INSTALL a new driver seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

current draw. • Start the vehicle and set the driver seat to HIGH heat. • **Is the current draw less than 11 amps?**	
AL19 CHECK RESISTANCE OF THE DRIVER SEAT CUSHION TED AND WIRING	
• Ignition OFF. • Disconnect: DCSM C3305A. • Measure the resistance between DCSM C3305A-G circuit CHS02 (YE/BU), harness side and C3305A-H, circuit RHS02 (BU/OG), harness side.  N0042194 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AL21 . **No** GO to AL20 .
AL20 CHECK THE RESISTANCE OF THE DRIVER SEAT CUSHION TED	
• Disconnect: Driver Seat Cushion TED C3300. • Measure the resistance between driver seat cushion TED C3300 pin 1 and pin 3, component side.  N0042874 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR circuit CHS02 (YE/BU) or RHS02 (BU/OG) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new driver seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AL21 CHECK FOR CORRECT DCSM OPERATION	

• Inspect the DCSM and driver seat cushion TED harness and component side connectors and the body harness-to-seat harness connectors for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect: All DCSM , TED and Body Harness-to-Seat Harness Connectors. • Make sure the connectors are seated correctly. • Start the engine. • Set the driver seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Attempt to recreate the fault. With the engine still running set the driver seat to HIGH heat for at least 15 minutes. • **Is the concern still present?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AM: DTC B272A

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) monitors seat cushion temperature while it supplies voltage and ground to both blower motors. The DCSM also supplies a variable voltage signal to control the blower speed. Cabin air enters the blower through a filter attached to the Thermo-Electric Device (TED) housing. Conditioned air exits the TED and flows through a manifold attached to the foam pad.

- DTC B272A (Passenger Cushion Over-Temp Detected) - In the cooling mode, if the passenger seat cushion TED temperature exceeds 70°C (158°F) for more than 34 seconds, the TED is disconnected or the duct is blocked, the DCSM will shut down the passenger seat system and set this DTC.
- DTC B272A (Passenger Cushion Over-Temp Detected) - In the heating mode, if the passenger seat cushion TED temperature exceeds 85°C (185°F) for more than 34 seconds, the TED is disconnected or the duct is blocked, the DCSM will shut down the passenger seat system and set this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Restricted cushion TED filter
- Crushed or restricted climate controlled seat manifold
- Cushion TED assembly

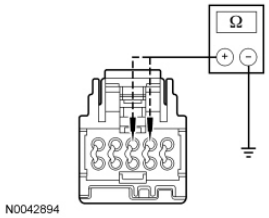
PINPOINT TEST AM: DTC B272A

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and tgnition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

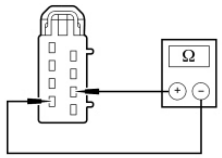
Test Step	Result / Action to Take
AM1 CHECK THE DCSM FOR ON-DEMAND DTCs	
• Start the vehicle and set the passenger seat to HIGH heat. • Enter the following diagnostic mode on the scan tool: Self Test - DCSM . • **Was DTC B272A retrieved on-demand during the self-test?**	**Yes** GO to AM2 . **No** GO to AM5 .
AM2 CHECK THE PASSENGER SEAT CUSHION TED THERMISTOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305B. • Disconnect: Passenger Seat Cushion TED C3303. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between: ♦ DCSM C3305B-2, circuit VHS27 (WH/OG), harness side and ground. ♦ DCSM C3305B-3, circuit RHS10 (BU/OG), harness side and ground.	**Yes** GO to AM3 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .



- **Are the resistances greater than 10,000 ohms?**

AM3 CHECK THE PASSENGER SEAT CUSHION TED THERMISTOR AND WIRING	
• Connect: Passenger Seat Cushion TED C3303. • Measure the resistance between DCSM C3305B-2, circuit VHS27 (WH/OG), harness side and DCSM C3305B-3, circuit RHS10 (BU/OG), harness side. Note the ambient temperature and refer to the following table. **Temperature / Resistance** 0-10°C (32-50°F) — 2,782-1,663 ohms 10-20°C (50-68°F) — 1,837-1,140 ohms 20-30°C (68-86°F) — 1,260-806 ohms 30-40°C (86-104°F) — 893-570 ohms 40-50°C (104-122°F) — 630-428 ohms • **Is the resistance within the limits indicated?**	**Yes** GO to AM18 . **No** GO to AM4 .
AM4 CHECK THE PASSENGER SEAT CUSHION TED THERMISTOR	
• Disconnect: Passenger Seat Cushion TED C3303. • Measure the resistance between passenger seat cushion TED C3303 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table. **Temperature / Resistance** 0-10°C (32-50°F) — 2,782-1,663 ohms 10-20°C (50-68°F) — 1,837-1,140 ohms 20-30°C (68-86°F) — 1,260-806 ohms	**Yes** REPAIR circuit VHS27 (WH/OG) or RHS10 (BU/OG) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No**

30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



N0042890

- **Is the resistance within the limits indicated?**

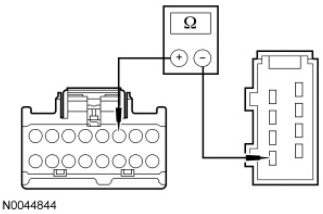
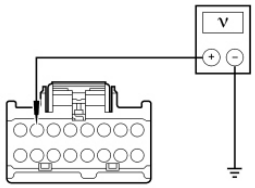
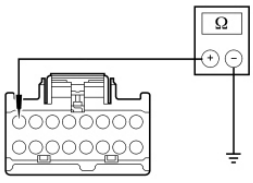
INSTALL a new passenger seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

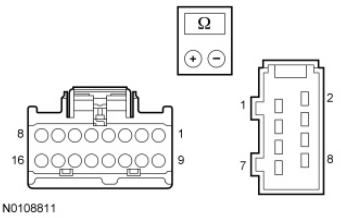
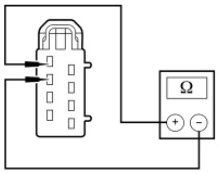
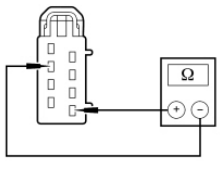
DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B .

AM5 CONFIRM THE FAULT WHILE MONITORING THE DCSM SEAT BACK THERMAL ELECTRIC DEVICE TEMPERATURE (PBKTEMP) AND SEAT CUSHION THERMAL ELECTRIC DEVICE TEMPERATURE (PCSHTEMP) PIDs	
• Set the passenger seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Enter the following diagnostic mode on the scan tool: DataLogger - DCSM . • Monitor the DCSM PIDs PBKTEMP and PCSHTEMP. • **NOTE:** A crushed seat cushion foam pad or a crushed climate controlled seat manifold may be the cause of the fault making it necessary to occupy the seat to recreate and identify the fault. • Attempt to recreate the fault. Start the vehicle and set the passenger seat to HIGH heat for at least 15 minutes while occupying the seat. • **Do the PIDs increase incrementally (gradually) and stay within 15°C (27°F) of each other?**	**Yes** Fault not present at this time. Fault may have been set due to a past failure, incorrect use of the climate controlled seat system by repeated switching between heat and cool modes or due to excessive passenger compartment temperature. CLEAR the DTCs. REPEAT the self-test. **No** If the PCSHTEMP PID increases incrementally and is greater than 15°C (27°F) of the PBKTEMP PID, GO to AM6 . If the PCSHTEMP PID increases quickly (temperature "jumps" and does not increase incrementally) and is greater than 15°C (27°F) of the PBKTEMP PID, GO to AM16 .
• With the engine running, set both front seats to HIGH cool. • Note the airflow exhausting from the passenger seat cushion TED and compare it to the airflow exhausting from the driver seat cushion TED . • Carry out a wiggle test of the wire harnesses between the DCSM and the passenger seat cushion TED while monitoring blower operation of the TED . The blower should operate consistently and not change speeds • **Is the airflow exhausting from the passenger seat cushion TED comparable to the airflow exhausting from the driver seat cushion TED with no change in**	**Yes** GO to AM7 . **No** If the airflow exhausting from the passenger seat cushion TED is not comparable to the airflow exhausting from the driver seat cushion TED , GO to AM8 . If the passenger seat cushion TED blower operation changed while carrying out the wiggle test,

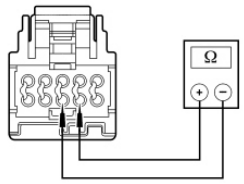
operation when carrying out the wiggle test?	IDENTIFY and REPAIR the wiring fault. CLEAR the DTCs. REPEAT the self-test.
AM7 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS WHILE OCCUPIED	
• Note the airflow exhausting from the passenger seat cushion TED with the passenger seat occupied and compare it to the airflow exhausting from the driver seat cushion TED with the driver seat occupied. • **Is the airflow exhausting from the passenger seat cushion TED comparable to the airflow exhausting from the driver seat cushion TED ?**	**Yes** GO to AM16 . **No** INSTALL a new passenger seat cushion foam pad and/or climate controlled seat manifold. CLEAR the DTCs. REPEAT the self-test.
AM8 CHECK THE PASSENGER SEAT CUSHION BLOWER FOR AN OBSTRUCTION OR RESTRICTED FILTER	
• Ignition OFF. • Inspect the blower of the passenger seat cushion TED assembly for an obstruction or for a restricted filter. • **Is the blower obstructed or the filter restricted?**	**Yes** REMOVE the obstruction or INSTALL a new filter. CLEAR the DTCs. REPEAT the self-test. **No** GO to AM9 .
AM9 CHECK THE PASSENGER SEAT CUSHION BLOWER SPEED CONTROL CIRCUIT FOR AN OPEN	
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM 3305C. • Disconnect: Passenger Seat Cushion TED C3303. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3305C-3, circuit VHS23 (BN/BU), harness side and passenger seat cushion TED C3303-7, circuit VHS23 (BN/BU), harness side.	**Yes** GO to AM10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 N0044844 • **Is the resistance less than 5 ohms?**	
AM10 CHECK THE PASSENGER SEAT CUSHION BLOWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between DCSM C3305C-7, circuit RHS08 (VT/WH), harness side and ground.  N0044855 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AM11 .
AM11 CHECK THE PASSENGER SEAT CUSHION BLOWER CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and ground.  N0044848 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AM12 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AM12 CHECK THE PASSENGER SEAT CUSHION BLOWER CIRCUITS FOR AN OPEN	
• Measure the resistance between: ♦ DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and passenger seat cushion TED C3303-2, circuit CHS08 (BN/YE), harness side. ♦ DCSM C3305C-7, circuit RHS08 (VT/WH), harness side and passenger seat cushion TED C3303-4, circuit RHS08 (VT/WH), harness side.	**Yes** GO to AM13 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

 N0108811 • **Are the resistances less than 5 ohms?**	REPOWER the SRS . REFER to Section 501-20B .
AM13 CHECK THE PASSENGER SEAT CUSHION BLOWER RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between passenger seat cushion TED C3303 pin 2 and pin 4, component side.  N0042881 • **Is the resistance between 4,000 ohms and 10,000 ohms?**	**Yes** GO to AM14 . **No** INSTALL a new passenger seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AM14 CHECK THE PASSENGER SEAT CUSHION BLOWER SPEED CONTROL RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between passenger seat cushion TED C3303 pin 7 and pin 4, component side.  N0042893	**Yes** GO to AM15 . **No** INSTALL a new passenger seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

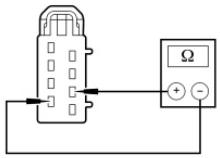
• **Is the resistance between 240K ohms and 400K ohms?**	
AM15 CHECK THE PASSENGER SEAT CUSHION TED INSTALLATION AND FOR CRUSHED SEAT CUSHION	
• Ignition OFF. • Remove the passenger seat. Refer to Seat - Front in this section. • Remove the passenger seat cushion cover. Refer to Seat Cushion Cover - Front in this section. • Inspect the passenger seat cushion for the following: ♦ Is the passenger seat cushion TED correctly installed? ♦ Is the passenger seat cushion seat cushion foam pad crushed or restricted? ♦ Is the passenger seat cushion climate controlled seat manifold crushed or restricted? • **Is the passenger seat cushion TED correctly installed and are there no signs of damage to foam pad and manifold?**	**Yes** INSTALL the passenger seat cushion cover and seat and GO to AM18 . **No** CORRECTLY install the passenger seat cushion TED or INSTALL a new passenger seat cushion foam pad and/or climate controlled seat manifold. CONNECT the battery ground cable. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AM16 CHECK THE PASSENGER SEAT CUSHION TED THERMISTOR AND WIRING	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305B. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3305B-2, circuit VHS27 (WH/OG), harness side and C3305B-3 circuit RHS10 (BU/OG), harness side. Note the ambient temperature and refer to the following table. **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms	**Yes** GO to AM18 . **No** GO to AM17 .

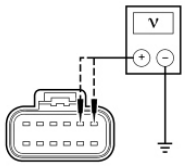
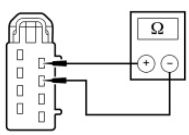
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



N0100803

- **Is the resistance within the limits indicated?**

AM17 CHECK THE PASSENGER SEAT CUSHION TED THERMISTOR	
• Measure the resistance between passenger seat cushion TED C3303 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table. **Temperature / Resistance** 0-10°C (32-50°F): 2,782-1,663 ohms 10-20°C (50-68°F): 1,837-1,140 ohms 20-30°C (68-86°F): 1,260-806 ohms 30-40°C (86-104°F): 893-570 ohms 40-50°C (104-122°F): 630-428 ohms  N0042890 • **Is the resisin the limits indicated?**	**Yes** REPAIR circuit VHS27 (WH/OG) or RHS10 (BU/OG) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AM18 CHECK THE PASSENGER SEAT CUSHION TED HEATING/COOLING CIRCUITRY CURRENT DRAW	
• Connect: All DCSM , TED and Body Harness-to-Seat Harness Connectors. • ***NOTICE:*** **It may be necessary to open the seat wire harness conduit to allow placing the inductive current probe around the circuit as described in the following step. Care must be taken when opening up the wire harness so as not to damage any wiring or connectors. Do not damage any wiring or induce**	**Yes** GO to AM19 . **No** INSTALL a new passenger seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

stress on any wiring or connectors. Close up the wire harness once repairs to the seat are complete. • **NOTE:** Use a commercially available inductive current probe (such as Electronic Specialties Current Probe/Multimeter 685 or a Fluke I410 [used with a digital multimeter]) or the low current probe from the Vehicle Measurement Module available for use with Integrated Diagnostic System (IDS). If these are unavailable, the inductive current probe feature from a battery tester may be substituted. • Place an inductive current probe around circuit CHS07 (GY/BU) near DCSM C3305A-A and monitor the current draw. • Start the vehicle and set the passenger seat to HIGH heat. • **Is the current draw less than 11 amps?**	DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AM19 CHECK RESISTANCE OF THE PASSENGER SEAT CUSHION TED AND WIRING	
• Ignition OFF. • Disconnect: DCSM 3305A. • Measure the resistance between DCSM C3305A-A circuit CHS07 (GY/BU), harness side and C3305A-B, circuit RHS07 (BU), harness side.  N0042885 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AM21 . **No** GO to AM20 .
AM20 CHECK THE RESISTANCE OF THE PASSENGER SEAT CUSHION TED	
• Disconnect: Passenger Seat Cushion TED C3303. • Measure the resistance between passenger seat cushion TED C3303 pin 1 and pin 3, component side.  N0042874 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR circuit CHS07 (GY/BU) or RHS07 (BU) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new passenger seat cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section.

	CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AM21 CHECK FOR CORRECT DCSM OPERATION	
• Inspect the DCSM and passenger seat cushion TED harness and component side connectors and the body harness-to-seat harness connectors for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect: All DCSM , TED and Body Harness-to-Seat Harness Connectors. • Make sure the connectors are seated correctly. • Start the engine. • Set the passenger seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Attempt to recreate the fault. With the engine still running set the passenger seat to HIGH heat for at least 15 minutes. • **Is the concern still present?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. TEST the system for normal operation. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AN: DTC B272B

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) monitors seat backrest temperature while it supplies voltage and ground to both blower motors. The DCSM also supplies a variable voltage signal to control the blower speed. Cabin air enters the blower through a filter attached to the Thermo-Electric Device (TED) housing. Conditioned air exits the TED and flows through a manifold attached to the foam pad.

- DTC B272B (Passenger Back Over-Temp Detected) - In the cooling mode, if the passenger seat backrest TED temperature exceeds 70°C (158°F) for more than 34 seconds, the TED is disconnected or the duct is blocked, the DCSM will shut down the passenger seat system and set this DTC.

- DTC B272B (Passenger Back Over-Temp Detected) - In the heating mode, if the passenger seat backrest TED temperature exceeds 85°C (185°F) for more than 34 seconds, the TED is disconnected or the duct is blocked, the DCSM will shut down the passenger seat system and set this DTC. **This pinpoint test is intended to diagnose the following:**
- Wiring, terminals or connectors
- Restricted backrest TED filter
- Crushed or restricted climate controlled seat manifold
- Backrest TED assembly

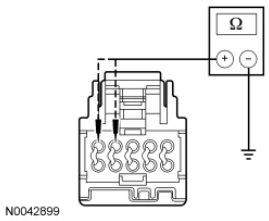
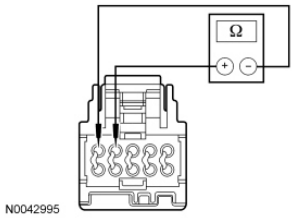
PINPOINT TEST AN: DTC B272B

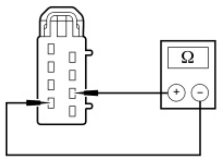
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

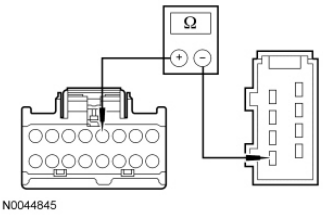
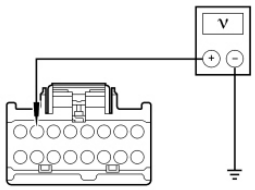
NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

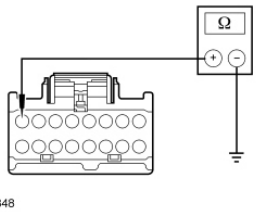
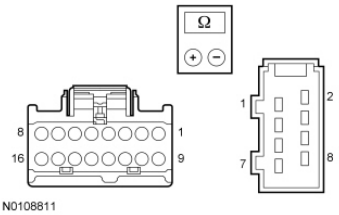
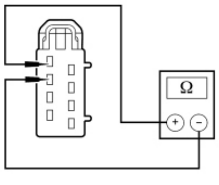
Test Step	Result / Action to Take
AN1 CHECK THE DCSM FOR ON-DEMAND DTCs	
• Start the vehicle and set the passenger seat to HIGH heat. • Enter the following diagnostic mode on the scan tool: Self Test - DCSM . • **Was DTC B272B retrieved on-demand during the self-test?**	**Yes** GO to AN2 . **No** GO to AN5 .
AN2 CHECK THE PASSENGER SEAT BACKREST TED THERMISTOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305B. • Disconnect: Passenger Seat Backrest TED C3311. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental**	**Yes** GO to AN3 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

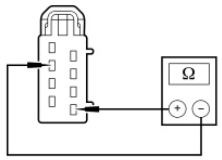
deployment. • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between: ♦ DCSM C3305B-4, circuit VHS36 (YE/BU), harness side and ground. ♦ DCSM C3305B-5, circuit RHS20 (GN/BU), harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	
AN3 CHECK THE PASSENGER SEAT BACKREST TED THERMISTOR AND WIRING	
• Connect: Passenger Seat Backrest TED C3311. • Measure the resistance between DCSM C3305B-4, circuit VHS36 (YE/BU), harness side and DCSM C3305B-5, circuit RHS20 (GN/BU), harness side. Note the ambient temperature and refer to the following table. **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms  • **Is the resistance within the limits indicated?**	**Yes** GO to AN18 . **No** GO to AN4 .
AN4 CHECK THE PASSENGER SEAT BACKREST TED THERMISTOR	

• Disconnect: Passenger Seat Backrest TED C3311. • Measure the resistance between passenger seat backrest TED C3311 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table. **Temperature / Resistance** 0-10°C (32-50°F) — 2,782-1,663 ohms 10-20°C (50-68°F) — 1,837-1,140 ohms 20-30°C (68-86°F) — 1,260-806 ohms 30-40°C (86-104°F) — 893-570 ohms 40-50°C (104-122°F) — 630-428 ohms  N0042890 • **Is the resistance within the limits indicated?**	**Yes** REPAIR circuit VHS36 (YE/BU) or RHS20 (GN/BU) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new passenger seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AN5 CONFIRM THE FAULT WHILE MONITORING THE DCSM SEAT BACK THERMAL ELECTRIC DEVICE TEMPERATURE (PBKTEMP) AND SEAT CUSHION THERMAL ELECTRIC DEVICE TEMPERATURE (PCSHTEMP) PIDs	
• Set the passenger seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Enter the following diagnostic mode on the scan tool: DataLogger - DCSM . • Monitor the DCSM PIDs PBKTEMP and PCSHTEMP. • **NOTE:** A crushed seat backrest foam pad or a crushed climate controlled seat manifold may be the cause of the fault making it necessary to occupy the seat to recreate and identify the fault. • Attempt to recreate the fault. Start the vehicle and set the passenger seat to HIGH heat for at least 15 minutes while occupying the seat. • **Do the PIDs increase incrementally (gradually) and stay within 15°C (27°F) of each other?**	**Yes** Fault not present at this time. Fault mahave been set due to a past failure, incorrect use of the climate controlled seat system by repeated switching between heat and cool modes or due to excessive passenger compartment temperature. CLEAR the DTCs. REPEAT the self-test. **No** If the PBKTEMP PID increases incrementally and is greater than 15°C (27°F) of the PCSHTEMP PID, GO to AN6 . If the PBKTEMP PID increases quickly (temperature "jumps" and does not increase incrementally) and is greater than 15°C (27°F) of the PCSHTEMP PID, GO to AN16 .
AN6 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS	

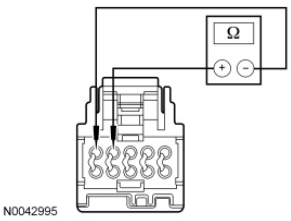
• With the engine running, set both front seats to HIGH cool. • Note the airflow exhausting from the passenger seat backrest TED and compare it to the airflow exhausting from the driver seat backrest TED . • Carry out a wiggle test of the wire harnesses between the DCSM and the passenger seat backrest TED while monitoring blower operation of the TED . The blower should operate consistently and not change speeds • **Is the airflow exhausting from the passenger seat backrest TED comparable to the airflow exhausting from the driver seat backrest TED with no change in operation when carrying out the wiggle test?**	**Yes** GO to AN7 . **No** If the airflow exhausting from the passenger seat backrest TED is not comparable to the airflow exhausting from the driver seat backrest TED , GO to AN8 . If the passenger seat backrest TED blower operation changed while carrying out the wiggle test, IDENTIFY and REPAIR the wiring fault. CLEAR the DTCs. REPEAT the self-test.
AN7 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS WHILE OCCUPIED	
• Note the airflow exhausting from the passenger seat backrest TED with the passenger seat occupied and compare it to the airflow exhausting from the driver seat backrest TED with the driver seat occupied. • **Is the airflow exhausting from the passenger seat backrest TED comparable to the airflow exhausting from the driver seat backrest TED ?**	**Yes** GO to AN16 . **No** INSTALL a new passenger seat backrest foam pad and/or climate controlled seat manifold. CLEAR the DTCs. REPEAT the self-test.
AN8 CHECK THE PASSENGER SEAT BACKREST BLOWER FOR AN OBSTRUCTION OR RESTRICTED FILTER	
• Ignition OFF. • Inspect the blower of the passenger seat backrest TED assembly for an obstruction or for a restricted filter. • **Is the blower obstructed or the filter restricted?**	**Yes** REMOVE the obstruction or INSTALL a new filter. CLEAR the DTCs. REPEAT the self-test. **No** GO to AN9 .
AN9 CHECK THE PASSENGER SEAT BACKREST BLOWER SPEED CONTROL CIRCUIT FOR AN OPEN	
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • Disconnect: Passenger Seat Backrest TED C3311. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal**	**Yes** GO to AN10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

injury in the event of an accidental deployment. • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3305C-4, circuit VHS21 (BU/WH), harness side and passenger seat backrest TED C3311-7, circuit VHS21 (BU/WH), harness side.  N0044845 • **Is the resistance less than 5 ohms?**	
AN10 CHECK THE PASSENGER SEAT BACKREST BLOWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between DCSM C3305C-7, circuit RHS08 (VT/WH), harness side and ground.  N0044855 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AN11 .
AN11 CHECK THE PASSENGER SEAT BACKREST BLOWER CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and ground.	**Yes** GO to AN12 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 N0044848 • **Is the resistance greater than 10,000 ohms?**	
AN12 CHECK THE PASSENGER SEAT BACKREST BLOWER CIRCUITS FOR AN OPEN	
• Measure the resistance between: ♦ DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and passenger seat backrest TED C3311-2, circuit CHS08 (BN/YE), harness side. ♦ DCSM C3305C-7, circuit RHS08 (VT/WH), harness side and passenger seat backrest TED C3311-4, circuit RHS08 (VT/WH), harness side.  N0108811 • **Are the resistances less than 5 ohms?**	**Yes** GO to AN13 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AN13 CHECK THE PASSENGER SEAT BACKREST BLOWER RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between passenger seat backrest TED C3311 pin 2 and pin 4, component side.  N0042881 • **Is the resistance between 4,000 ohms and 10,000 ohms?**	**Yes** GO to AN14 . **No** INSTALL a new passenger seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

AN14 CHECK THE PASSENGER SEAT BACKREST BLOWER SPEED CONTROL RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between passenger seat backrest TED C3311 pin 7 and pin 4, component side.  N0042893 • **Is the resistance between 240K ohms and 400K ohms?**	**Yes** GO to AN15 . **No** INSTALL a new passenger seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AN15 CHECK THE PASSENGER SEAT BACKREST TED INSTALLATION AND FOR CRUSHED SEAT BACKREST	
• Ignition OFF. • Remove the passenger seat. Refer to Seat - Front in this section. • Remove the passenger seat backrest cover. Refer to Seat Backrest Cover - Front in this section. • Inspect the passenger seat backrest for the following: ♦ Is the passenger seat backrest TED correctly installed? ♦ Is the passenger seat backrest foam pad crushed or restricted? ♦ Is the passenger seat backrest climate controlled seat manifold crushed or restricted? • **Is the passenger seat backrest TED correctly installed and are there no signs of damage to the foam pad and manifold?**	**Yes** INSTALL the passenger seat backrest cover and seat and GO to AN18 . **No** CORRECTLY install the passenger seat backrest TED or INSTALL a new passenger seat backrest foam pad and/or climate controlled seat manifold. CONNECT the battery nd cable. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AN16 CHECK THE PASSENGER SEAT BACKREST TED THERMISTOR AND WIRING	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .	1,260-806 ohms

<table>
<tr><td>
• Disconnect: Passenger Seat Side Air Bag C313.
• Disconnect: DCSM C3305B.
• ⚠ WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.
• Connect the battery ground cable. Refer to Section 414-01 .
• Measure the resistance between DCSM C3305B-4, circuit VHS36 (YE/BU), harness side and C3305B-5 circuit RHS20 (GN/BU), harness side. Note the ambient temperature and refer to the following table.
<table>
<tr><th>Temperature</th><th>Resistance</th></tr>
<tr><td>0-10°C (32-50°F)</td><td>2,782-1,663 ohms</td></tr>
<tr><td>10-20°C (50-68°F)</td><td>1,837-1,140 ohms</td></tr>
</table>
</td><td></td></tr>
<tr><td>30-40°C (86-104°F)</td><td>893-570 ohms</td></tr>
<tr><td>40-50°C (104-122°F)</td><td>630-428 ohms</td></tr>
</table>



• **Is the resistance within the limits indicated?**

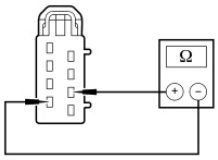
Yes
GO to AN18 .

No
GO to AN17 . **AN17 CHECK THE PASSENGER SEAT BACKREST TED THERMISTOR**

• Measure the resistance between passenger seat backrest TED C3315 and pin 8, component side. Note the ambient temperature and refer to the following table.

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms

10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



N0042890

- **Is the resistance within the limits indicated?**

Yes
REPAIR circuit VHS36 (YE/BU) or RHS20 (GN/BU) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B .

No
INSTALL a new TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B . **AN18 CHECK THE PASSENGER SEAT BACKREST TED HEATING/COOLING CIRCUITRY CURRENT DRAW**

- Connect: All DCSM , TED and Body Harness-to-Seat Harness Connectors.
- ***NOTICE:*** **It may be necessary to open the seat wire harness conduit to allow placing the inductive current probe around the circuit as described in the following step. Care must be taken when opening up the wire harness so as not to damage any wiring or connectors. Do not damage any wiring or induce stress on any wiring or connectors. Close up the wire harness once repairs to the seat are complete.**
- **NOTE:** Use a commercially available inductive current probe (such as Electronic Specialties Current Probe/Multimeter 685 or a Fluke I410 [used with a digital multimeter]) or the low current probe from the Vehicle Measurement Module available for use with Integrated Diagnostic System (IDS). If these are unavailable, the inductive current probe feature from a battery tester may be substituted.
- Place an inductive current probe around circuit CHS06 (BU/BN) near DCSM C3305A-C and monitor the current draw.
- Start the vehicle and set the passenger seat to HIGH heat.
- **Is the current draw less than 11 amps?**

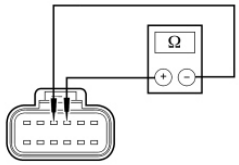
Yes
GO to AN19 .

No
INSTALL a new passenger seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B . **AN19 CHECK RESISTANCE OF THE PASSENGER SEAT BACKREST TED AND WIRING**

- Ignition OFF.
- Disconnect: DCSM C3305A.
- Measure the resistance between DCSM C3305A-C circuit CHS06 (BU/BN), harness side and C3305A-D, circuit RHS06 (WH), harness side.



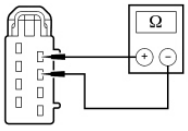
N0042989

- **Is the resistance between 0.9 and 10 ohms?**

Yes
GO to AN21 .

No
GO to AN20 . **AN20 CHECK THE RESISTANCE OF THE PASSENGER SEAT BACKREST TED**

- Disconnect: Passenger Seat Backrest TED C3311.
- Measure the resistance between passenger seat backrest TED C3311 pin 1 and pin 3, component side.



N0042874

- **Is the resistance between 0.9 and 10 ohms?**

Yes
REPAIR circuit CHS06 (BU/BN) or RHS06 (WH) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B .

No
INSTALL a new passenger seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B . **AN21 CHECK FOR CORRECT DCSM OPERATION**

- Inspect the DCSM and passenger seat backrest TED harness and component side connectors and the body harness-to-seat harness connectors for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect: All DCSM , TED and Body Harness-to-Seat Harness Connectors.
- Make sure the connectors are seated correctly.
- Start the engine.
- Set the passenger seat to OFF.
- Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM .
- Attempt to recreate the fault. With the engine still running set the passenger seat to HIGH heat for at least 15 minutes.
- **Is the concern still present?**

Yes
INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. TEST the system for normal operation.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B .

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AO: DTC B272C

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied voltage at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, the climate controlled seat system only operates in 15-second intervals. Both voltage supply circuits are spliced together internal to the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat is disabled by the DCSM .

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and the blower speed dependant on the HVAC module seat switch settings.

A differential fault occurs when the cushion and backrest TEDs on an affected seat are reporting very different temperatures to the DCSM . This may result from an airflow restriction or a circuit fault of either TED area. If a TED and manifold is clear of obstruction and is operational, the other TED and circuitry on the seat should be checked. It is important to note that a TED with a higher temperature may be operating correctly and not the area of concern. The other TED may be indicating a much lower temperature, causing the DTC to set.

- DTC B272C (Driver Differential Temperature Fault) - If there is a temperature differential between the driver backrest and cushion TED of 60°C (108°F) or more for more than 4 seconds, the TED is disconnected or the duct is blocked, this DTC will set. When this happens the first time in a key cycle, the DCSM puts the driver seat system into recovery mode (see principles of operation). If the system is able to recover, it will function nory. If the system is able to recover and it occurs a second time in the same key cycle, the DCSM will shut down the driver seat system.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Restricted cushion or backrest TED filter
- Crushed or restricted cushion or backrest foam pad
- Crushed or restricted cushion or backrest climate controlled seat manifold
- Cushion or backrest TED assembly
- DCSM

PINPOINT TEST AO: DTC B272C

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

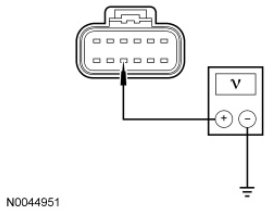
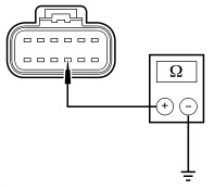
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

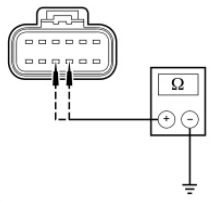
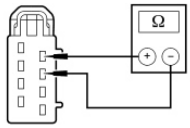
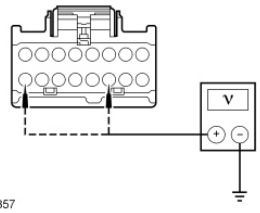
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

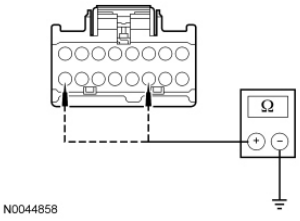
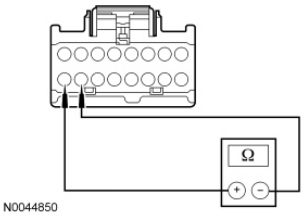
Test Step	Result / Action to Take
AO1 CHECK FOR DCSM DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - DCSM . • **Was DTC B2729 or B2730 retrieved?**	**Yes** For DTC B2729, GO to Pinpoint Test AL . For DTC B2730, GO to Pinpoint Test AS . **No** GO to AO2 .
AO2 MONITOR THE TED TEMPERATURE PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger - DCSM - PIDs.	**Yes** GO to AO3 .

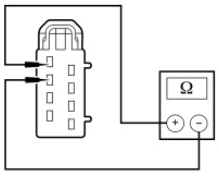
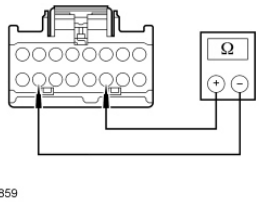
♦ Passenger Cushion Thermal Electric Device (TED) Temperature (PCSHTMP) ♦ Passenger Back TED Temperature (PBKTMP) ♦ Seat cushion thermal electric device temperature (CSHTEMP) ♦ Seat back thermal electric device temperature (BK_TEMP) • **NOTE:** Make sure the temperature of the climate controlled seats has stabilized before monitoring the PIDs. Not allowing stabilization can cause incorrect readings and lead to incorrect identification of components that are not faulty. • Monitor TED temperature PIDs with the climate controlled seats OFF. Compare the PID values of the driver seat to those of the front passenger seat, this can help identify if there is a concern with the driver seat cushir backrest PID value readings. • **Are both driver seat TED temperature PIDs within 10°C (18°F) of the ambient temperature?**	**No** If the driver seat cushion PID varies 10°C (18°F) or more from ambient temperature, GO to AO16 . If the driver seat backrest PID varies 10°C (18°F) or more from ambient temperature, GO to AO32 .
AO3 CONFIRM THE FAULT IS IN THE SEAT CUSHION OR THE BACKREST	
• Ignition OFF. • Ignition ON. • **NOTE:** A crushed seat cushion foam pad or a crushed climate controlled seat manifold may be the cause of the fault. It may be necessary to sit on the seat or place something of reasonable size and weight on the seat to recreate the fault. • **NOTE:** If at shuts down before a 15-minute heat cycle has timed-out, carry out the DCSM self-test and go to the Dual Climate Controlled Seat Module (DCSM) DTC Chart to continue diagnostics. • After cycling the ignition and with the engine running, set the driver seat to high heat (3 indicators illuminated on HVAC module). Allow the seat to heat for at least 15 minutes while monitoring the TED temperature PIDs of the driver seat. If necessary, when the seat times-out after 15 minutes, set the driver seat to high heat once again. • **Do the driver seat cushion TED and backrest TED PIDs vary more than 60°C (108°F) from each other?**	**Yes** If the driver seat cushion PID is 60°C (108°F) hotter than the backrest PID, GO to AO5 . If the driver seat backrest PID is 60°C (108°F) hotter than the cushion PID, GO to AO20 . **No** GO to AO4 .
AO4 CHECK THE TEDs COOLING PERFORMANCE	

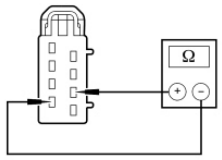
• Check the TEDs cooling performance on the affected seat. Refer to Component Test - Thermo-Electric Device (TED) Cooling Performance in this section. • **Did the TEDs pass the component test?**	**Yes** The DTC may have been set by extreme cabin temperatures or excessive sunload on the seat causing the system to enter recovery mode. Occupant size and weight characteristics can also be a factor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If a concern cannot be found or duplicated, RETURN the vehicle to the customer. **No** CHECK the affected seat cushion or backrest for correct installation of the climate controlled seat components (TED , manifold, plenum, air ducts and foam pad). CHECK for airflow restrictions (TED inlets and outlets, TED -to-manifold or plenum connections, filters and ducts) and REPAIR as needed. CHECK for an intermittent wiring fault. REPAIR as needed. REPEAT the self-test. CLEAR the DTCs.
AO5 CHECK FOR CORRECT TED INSTALLATION AND FOR CRUSHED FOAM	
• Ignition OFF. • Remove the seat. Refer to Seat - Front in this section. • Remove the seat cushion trim cover. Refer to Seat Cushion Cover - Front in this section. • Inspect the seat cushion for the following: ♦ Is the cushion blower obstructed? ♦ Is the blower filter restricted or plugged? ♦ Is the TED correctly installed? • Is the seat cushion foam pad crushed or restricted? ♦ Is the climate controlled seat manifold crushed or restricted? • **Is the TED correctly installed and the foam pad and manifold OK?**	**Yes** GO to AO6 . **No** CORRECTLY install the cushion TED or INSTALL a new seat cushion foam pad and/or climate controlled seat manifold. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. REPOWER the SRS . REFER to Section 501-20B .
AO6 CHECK THE BACKREST TED GROUND CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Position the driver seat in the vehicle and connect the seat-to-floor connectors. • Disconnect: Driver Seat Side Air Bag Module C327. • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: DCSM C3305A.	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

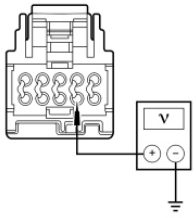
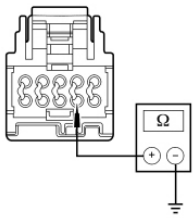
• **⚠ WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3305A-K, circuit RHS01 (WH/VT), harness side and ground.  N0044951 • **Is any voltage present?**	**No** GO to AO7 .
AO7 CHECK THE BACKREST TED FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3305A-J, circuit CHS01 (GY/VT), harness side and ground.  N0042910 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AO8 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO8 CHECK THE RESISTANCE OF THE BACKREST TED AND WIRING	
• Measure the resistance between DCSM C3305A-J, circuit CHS01 (GY/VT), harness side and DCSM C3305A-K, circuit RHS01 (WH/VT), harness side.	**Yes** GO to AO10 . **No** GO to AO9 .

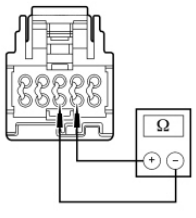
 N0042876 • **Is the resistance between 0.9 and 10 ohms?**	
AO9 CHECK THE RESISTANCE OF THE BACKREST TED	
• Disconnect: Backrest TED C3310. • Measure the resistance between backrest TED C3310 pin 1 and pin 3, component side.  N0042874 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR circuit CHS01 (GY/VT) or RHS01 (WH/VT) for an open. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO10 CHECK THE BLOWER MOTOR FEED AND SPEED CONTROL CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: DCSM C3305C. • Ignition ON. • Measure the voltage between: ♦ DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and ground. ♦ DCSM C3305C-11, circuit VHS18 (BN/GN), harness side and ground.  N0044857 • **Is voltage present on either circuit?**	**Yes** GO to AO11 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

AO11 CHECK THE BLOWER MOTOR FEED AND SPEED CONTROL CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and ground. ♦ DCSM C3305C-11, circuit VHS18 (BN/GN), harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AO12 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO12 CHECK THE BLOWER MOTOR AND WIRING	
• **NOTE:** The ohmmeter must be connected with the positive lead to DCSM C3305C-16, circuit CHS03 (GN/BN) and the negative lead to DCSM C3305C-15, circuit RHS03 (GY/OG) when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and DCSM C3305C-15, circuit RHS03 (GY/OG), harness side.  • **Is the resistance between 4,000 and 10,000 ohms?**	**Yes** GO to AO14 . **No** GO to AO13 .
AO13 CHECK THE BLOWER MOTOR RESISTANCE	

• Disconnect: Cushion TED C3300. • **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between cushion TED C3300 pin 2 and pin 4, component side.  N0042881 • **Is the resistance between 4,000 and 10,000 ohms?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO14 CHECK THE BLOWER MOTOR SPEED CONTROL AND CIRCUIT RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to C3305C-11, circuit VHS18 (BN/GN), harness side and the negative lead to C3305C-15, circuit RHS03 (GY/OG), harness side when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3305C-11, circuit VHS18 (BN/GN), harness side and DCSM C3305C-15, circuit RHS03 (GY/OG), harness side.  N0044859 • **Is the resistance between 240 kohms and 4 megohms?**	**Yes** GO to AO16 . **No** GO to AO15 .
AO15 CHECK THE BLOWER MOTOR SPEED CONTROL RESISTANCE	

• Disconnect: Cushion TED C3300. • **NOTE:** The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between cushion TED C3300 pin 7 and pin 4, component side.  N0042890 • **Is the resistance between 240 kohms and 4 megohms?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO16 CHECK THE THERMISTOR FEED CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C327. • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: DCSM C3305B. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3305B-7, circuit VHS26 (VT), harness side and ground.	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AO17 .

 N0042906 • **Is any voltage present?**	
AO17 CHECK THE THERMISTOR FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3305B-7, circuit VHS26 (VT), harness side and ground.  N0042907 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AO18 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO18 CHECK THE TED THERMISTOR AND WIRING RESISTANCE AT THE DCSM	
• Measure the resistance between DCSM C3305B-7, circuit VHS26 (VT), harness side and DCSM C3305B-8, circuit RHS05 (YE/VT), harness side. Note the ambient temperature and compare result to the following table: **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AO19 .

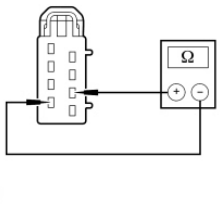


- **Is the resistance within the limits indicated?**

AO19 CHECK THE TED THERMISTOR RESISTANCE

- Disconnect: Cushion TED C3300.
- Measure the resistance between cushion TED pin 5 and pin 8, component side. Note the ambient temperature and compare result to the following table:

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



- **Is the resistance within the limits indicated?**

Yes
REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.
SRS . REFER to Section 501-20B .

No
INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

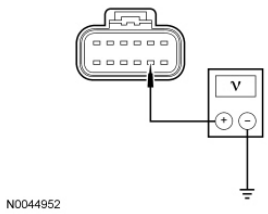
AO20 CHECK FOR CORRECT TED INSTALLATION AND FOR CRUSHED FOAM

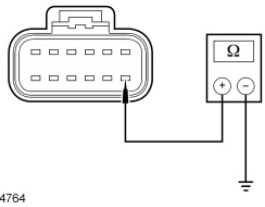
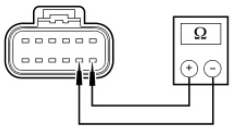
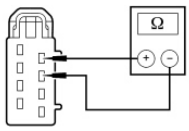
- Ignition OFF.
- Remove the seat. Refer to Seat - Front in this section.
- Remove the seat backrest trim cover. Refer to Seat Backrest - Front in this section.
- Inspect the seat backrest for the following:
  - Is the backrest blower obstructed?
  - Is the blower filter restricted or plugged?
  - Is the TED correctly installed?
  - Is the seat backrest foam pad crushed or restricted?

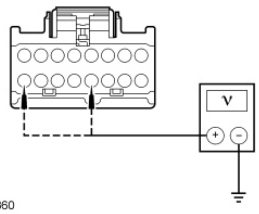
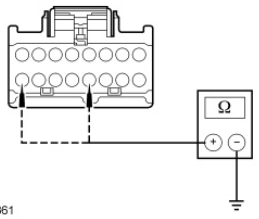
Yes
GO to AO21 .

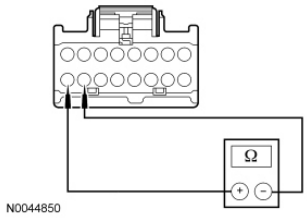
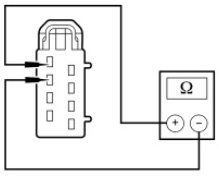
No
CORRECTLY install the backrest TED or INSTALL a new seat backrest foam pad and/or climate controlled seat manifold. REPEAT the self-test. CLEAR the DTCs.

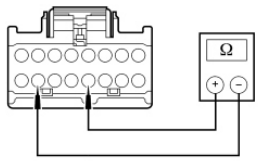
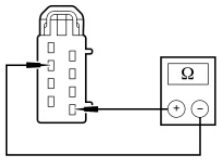
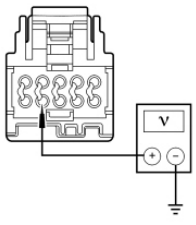
DISCONNECT the battery ground cable. REPOWER the SRS . REFER to Section 501-20B .

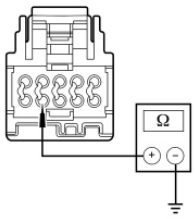
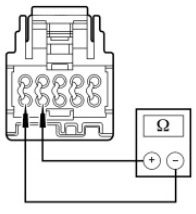
♦ Is the climate controlled seat manifold crushed or restricted? • **Is the TED correctly installed and the foam pad and manifold OK?**	
AO21 CHECK THE CUSHION TED GROUND CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Position the driver seat in the vehicle and connect the seat-to-floor connectors. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327. • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: DCSM C3305A. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3305A-H, circuit RHS02 (BU/OG), harness side and ground.  • **Is any voltage present?**	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AO22 .
AO22 CHECK THE CUSHION TED FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3305A-G, circuit CHS02 (YE/BU), harness side and ground.	**Yes** GO to AO23 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag

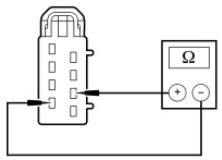
 N0044764 • **Is the resistance greater than 10,000 ohms?**	module C313. REPOWER the SRS . REFER to Section 501-20B .
AO23 CHECK THE RESISTANCE OF THE CUSHION TED AND WIRING	
• Measure the resistance between DCSM C3305A-G circuit CHS02 (YE/BU), harness side and DCSM C3305A-H, circuit RHS02 (BU/OG), harness side.  N0042194 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AO25 . **No** GO to AO24 .
AO24 CHECK THE CUSHION TED RESISTANCE	
• Disconnect: Cushion TED C3300. • Measure the resistance between cushion TED C3300 pin 1 and pin 3, component side.  N0042874 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR circuit CHS02 (YE/BU) or RHS02 (BU/OG) for an open. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO25 CHECK THE BLOWER MOTOR FEED AND SPEED CONTROL CIRCUITS FOR A SHORT TO VOLTAGE	

• Disconnect: DCSM C3305C. • Ignition ON. • Measure the voltage between: ♦ DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and ground. ♦ DCSM C3305C-12, circuit VHS16 (BU/GN), harness side and ground.  N0044860 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AO26 .
AO26 CHECK THE BLOWER MOTOR AND SPEED CONTROL FEED CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and ground. ♦ DCSM C3305C-12, circuit VHS16 (BU/GN), harness side and ground.  N0044861 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AO27 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO27 CHECK THE BLOWER MOTOR AND WIRING RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to DCSM C3305C-16, circuit CHS03 (GN/BN) and the negative lead to DCSM C3305C-15, circuit RHS03 (GY/OG) when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and DCSM C3305C-15, circuit RHS03 (GY/OG), harness side.	**Yes** GO to AO29 . **No** GO to AO28 .

 N0044850 • **Is the resistance between 4,000 and 10,000 ohms?**	
AO28 CHECK THE BLOWER MOTOR RESISTANCE	
• Disconnect: Backrest TED C3310. • **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between backrest TED C3310 pin 2 and pin 4, component side.  N0042881 • **Is the resistance between 4,000 and 10,000 ohms?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO29 CHECK THE BLOWER MOTOR SPEED CONTROL AND CIRCUIT RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to C3305C-12, circuit VHS16 (BU/GN), harness side and the negative lead to C3305C-15, circuit RHS03 (GY/OG), harness side when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3305C-12, circuit VHS16 (BU/GN), harness side and DCSM C3305C-15, circuit RHS03 (GY/OG), harness side.	**Yes** GO to AO31 . **No** GO to AO30 .

 N0044862 • **Is the resistance between 240 kohms and 4 megohms?**	
AO30 CHECK THE BLOWER MOTOR SPEED CONTROL RESISTANCE	
• Disconnect: Backrest TED C3310. • **NOTE:** The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between backrest TED C3310 pin 7 and pin 4, component side.  N0042893 • **Is the resistance between 240 kohms and 4 megohms?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO31 CHECK THE THERMISTOR FEED CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: DCSM C3305B. • Ignition ON. • Measure the voltage between DCSM C3305B-9, circuit VHS35 (VT/OG), harness side and ground.  N0042974 • **Is any voltage present?**	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AO32 .
AO32 CHECK THE THERMISTOR FEED CIRCUIT FOR A SHORT TO GROUND	

• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag Module C327. • Disconnect: Passenger Seat Side Air Bag Module C313. • Disconnect: DCSM C3305B. • Measure the resistance between DCSM C3305B-9, circuit VHS35 (VT/OG), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AO33 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AO33 CHECK THE TED THERMISTOR AND WIRING RESISTANCE	
• Measure the resistance between DCSM C3305B-9, circuit VHS35 (VT/OG), harness side and DCSM C3305B-10, circuit RHS15 (GY/BN), harness side. Note the ambient temperature and compare result to the following table: **Temperature** / **Resistance** 0-10°C (32-50°F) — 2,782-1,663 ohms 10-20°C (50-68°F) — 1,837-1,140 ohms 20-30°C (68-86°F) — 1,260-806 ohms 30-40°C (86-104°F) — 893-570 ohms 40-50°C (104-122°F) — 630-428 ohms  	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AO34 .

• **Is the resistance within the limits indicated?**	
AO34 CHECK THE TED THERMISTOR RESISTANCE	
• Disconnect: Backrest TED C3310. • Measure the resistance between backrest TED pin 5 and pin 8, component side. Note the ambient temperature and compare result to the following table: **Temperature / Resistance** 0-10°C (32-50°F) — 2,782-1,663 ohms 10-20°C (50-68°F) — 1,837-1,140 ohms 20-30°C (68-86°F) — 1,260-806 ohms 30-40°C (86-104°F) — 893-570 ohms 40-50°C (104-122°F) — 630-428 ohms  N0042890 • **Is the resistance within the limits indicated?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to SRS . REFER to Section 501-20B .

Pinpoint Test AP: DTC B272D

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) is supplied voltage at all times, but the climate controlled seat system only operates with the engine running. The system can be operated with the ignition ON engine OFF by using a scan tool to bypass the climate controlled seat buttons on the touchscreen interface. When commanding a heat or cool mode operation in this manner, the climate controlled seat system only operates in 15-second intervals. Both voltage supply circuits are spliced together internal to the DCSM , so if one circuit becomes open, both seats can still be operated. However, if a fault occurs setting a DTC specific to either climate controlled seat, only the affected seat is disabled by the DCSM .

The seat cushion is equipped with a Thermo-Electric Device (TED) assembly that includes a seat blower (fan motor, serviced as an assembly with the TED). Similarly, the seat backrest is also equipped with its own TED assembly with blower. Cabin air is drawn through the blower and distributed to each of the TED modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad and manifold where it is distributed along the surface of the cushion and backrest of the seat. Once the system is activated, the DCSM uses a set of flexible algorithms to control the heating/cooling modes and

the blower speed dependant on the HVAC module seat switch settings.

A differential fault occurs when the cushion and backrest TEDs on an affected seat are reporting very different temperatures to the DCSM . This may result from an airflow restriction or a circuit fault of either TED area. If a TED and manifold is clear of obstruction and is operational, the other TED and circuitry on the seat should be checked. It is important to note that a TED with a higher temperature may be operating correctly and not the area of concern. The other TED may be indicating a much lower temperature, causing the DTC to set.

- DTC B272D (Passenger Differential Temperature Fault) - If there is a temperature differential between the passenger backrest and cushion TED of 60°C (108°F) or more for more than 4 seconds, the TED is disconnected or the duct is blocked, this DTC will set. When this happens the first time in a key cycle, the DCSM puts the passenger seat system into recovery mode (see Principles of Operation). If the system is able to recover, it will function normally. If the system is able to recover and it occurs a second time in the same key cycle, the DCSM will shut down the passenger seat system.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Restricted cushion or backrest TED filter
- Crushed or restricted cushion or backrest foam pad
- Crushed or restricted cushion or backrest climate controlled seat manifold
- Cushion or backrest TED assembly
- DCSM

PINPOINT TEST AP: DTC B272D

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

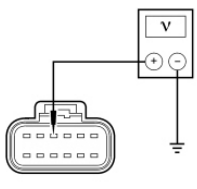
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

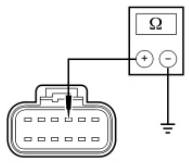
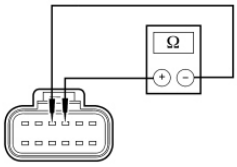
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

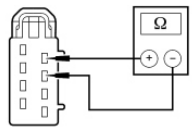
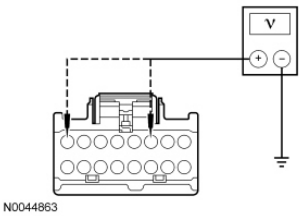
Test Step	Result / Action to Take
AP1 CHECK THE DCSM FOR DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - DCSM . • **Was DTC B272A or B272B retrieved?**	**Yes** For DTC B272A, GO to Pinpoint Test AM . For DTC B272B, GO to Pinpoint Test AN . **No** GO to AP2 .
AP2 MONITOR THE TED TEMPERATURE PIDs	

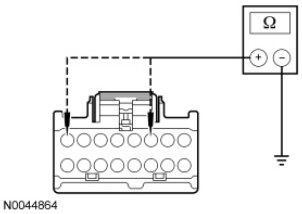
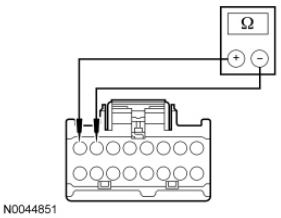
l> • Enter the following diagnostic mode on the scan tool: DataLogger - DCSM - PIDs. ♦ Passenger cushion thermal electric device (TED) temperature (PCSHTMP) ♦ Passenger back TED temperature (PBKTMP) ♦ Seat cushion thermal electric device temperature (CSHTEMP) ♦ Seat back thermal electric device temperature (BK_TEMP) • **NOTE:** Make sure the temperature of the climate controlled seats has stabilized before monitoring the PIDs. Not allowing stabilization can cause incorrect readings and lead to incorrect identification of components that are not faulty. • Monitor the TED temperature PIDs with the climate controlled seats OFF. Compare the PIDs of the front passenger seat to those of the driver seat, this can help identify if there is a concern with the front passenger seat cushion or backrest PID readings. • **Are both front passenger seat TED temperature PIDs within 10°C (18°F) of the ambient temperature?**	**Yes** GO to AP3 . **No** If the front passenger seat cushion PID varies 10°C (18°F) or more from ambient temperature, GO to AP16 . If the front passenger seat backrest PID varies 10°C (18°F) or more from ambient temperature, GO to AP32 .
AP3 CONFIRM THE FAULT IS IN THE SEAT CUSHION OR BACKREST TED	
• Ignition OFF. • Ignition ON. • **NOTE:** A crushed seat cushion foam pad or a crushed climate controlled seat manifold may be the cause of the fault. It may be necessary to sit on the seat or place something of reasonable size and weight on the seat to recreate the fault. • **NOTE:** If the seat shuts down before a 15-minute heat cycle has timed-out, carry out the DCSM self-test and go to the Dual Climate Controlled Seat Module (DCSM) DTC Chart to continue diagnostics.	**Yes** If the front passenger seat cushion PID is 60°C (108°F) hotter than the backrest PID, GO to AP5 . If the front passenger seat backrest PID is 60°C (108°F) hotter than the cushion PID, GO to AP20 . **No** GO to AP4 .

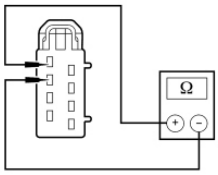
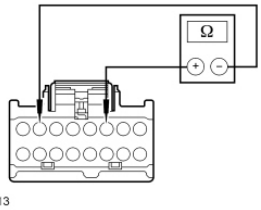
• After cycling the ignition and with the engine running, set the driver seat to high heat (3 indicators illuminated on HVAC module). Allow the seat to heat for at least 15 minutes while monitoring the TED temperature PIDs of the driver seat. If necessary, when the seat times-out after 15 minutes, set the driver seat to high heat once again. • **Do the driver seat cushion TED and backrest TED PIDs vary more than 60°C (108°F) from each other?**	
AP4 CHECK THE TEDs COOLING PERFORMANCE	
• Check TEDs cooling performance on the affected seat. Refer to Component Test - Thermo-Electric Device (TED) Cooling Performance in this section. • **Did the TEDs pass the component test?**	**Yes** The DTC may have been set by extreme cabin temperatures or excessive sunload on the seat causing the system to enter recovery mode. Occupant size and weight characteristics can also be a factor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If a concern cannot be found or duplicated, RETURN the vehicle to the customer. **No** CHECK the affected seat cushion or backrest for correct installation of the climate controlled seat components (TED , manifold, plenum, air ducts and foam pad). CHECK for airflow restrictions (TED inlets and outlets, TED -to-manifold or plenum connections, filters and ducts) and REPAIR as needed. CHECK for an intermittent wiring fault. REPAIR as needed. REPEAT the self-test. CLEAR the DTCs.
AP5 CHECK FOR CORRECT TED INSTALLATION AND FOR CRUSHED FOAM	
• Ignition OFF. • Remove the seat. Refer to Seat - Front in this section. • Remove the seat cushion trim cover. Refer to Seat Cushion Cover - Front in this section. • Inspect the seat cushion for the following: ♦ Is the cushion blower obstructed? ♦ Is the blower filter restricted or plugged? ♦ Is the TED correctly installed?	**Yes** GO to AP6 . **No** Correctly INSTALL the cushion TED or INSTALL a new seat cushion foam pad and/or climate controlled seat manifold. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. REPOWER the SRS . REFER to Section 501-20B .

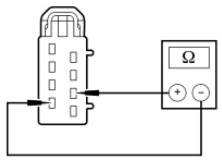
♦ Is the seat cushion foam pad crushed or restricted? ♦ Is the climate controlled seat manifold crushed or restricted? • **Is the TED correctly installed and the foam pad and manifold OK?**	
AP6 CHECK THE BACKREST TED GROUND CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Position the front passenger seat in the vehicle and connect the seat-to-floor connectors. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305A. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3305A-D, circuit RHS06 (WH), harness side and ground.  N0044950 • **Is any voltage present?**	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP7 .

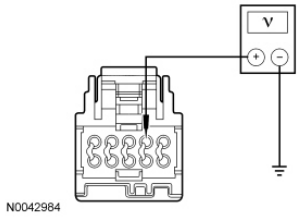
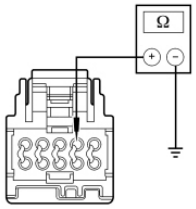
AP7 CHECK THE BACKREST TED FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3305A-C, circuit CHS06 (BU/BN), harness side and ground.  N0042988 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AP8 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP8 CHECK THE RESISTANCE OF THE BACKREST TED AND WIRING	
• Measure the resistance between DCSM C3305A-C, circuit CHS06 (BU/BN), harness side and DCSM C3305A-D, circuit RHS06 (WH), harness side.  N0042989 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AP10 . **No** GO to AP9 .
AP9 CHECK THE RESISTANCE OF THE BACKREST TED	
• Disconnect: Backrest TED C3311. • Measure the resistance between backrest TED C3311 pin 1 and pin 3, component side.	**Yes** REPAIR circuit CHS06 (BU/BN) or RHS06 (WH) for an open. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest

 N0042874 • **Is the resistance between 0.9 and 10 ohms?**	Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP10 CHECK THE BLOWER MOTOR FEED AND SPEED CONTROL CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: DCSM C3305C. • Ignition ON. • Measure the voltage between: ♦ DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and ground. ♦ DCSM C3305C-3, circuit VHS23 (BN/BU), harness side and ground.  N0044863 • **Is voltage present on either circuit?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP11 .
AP11 CHECK THE BLOWER MOTOR FEED AND SPEED CONTROL CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and ground. ♦ DCSM C3305C-3, circuit VHS23 (BN/BU), harness side and ground.	**Yes** GO to AP12 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

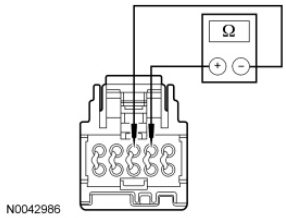
 • **Are the resistances greater than 10,000 ohms?**	
AP12 CHECK THE BLOWER MOTOR AND WIRING RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to DCSM C3305C-8, circuit CHS08 (BN/YE) and the negative lead to DCSM C3305C-7, circuit RHS08 (VT/WH) when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and DCSM C3305C-7, circuit RHS08 (VT/WH), harness side.  • **Is the resistance between 4,000 and 10,000 ohms?**	**Yes** GO to AP14 . **No** GO to AP13 .
AP13 CHECK THE BLOWER MOTOR RESISTANCE	
• Disconnect: Cushion TED C3303. • **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion

identification of components that are not faulty. • Measure the resistance between cushion TED C3303 pin 2 and pin 4, component side.  N0042881 • **Is the resistance between 4,000 and 10,000 ohms?**	Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP14 CHECK THE BLOWER MOTOR SPEED CONTROL AND CIRCUIT RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to C3305C-3, circuit VHS23 (BN/BU), harness side and the negative lead to C3305C-7, circuit RHS08 (VT/WH), harness side when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3305C-3, circuit VHS23 (BN/BU), harness side and DCSM C3305C-7, circuit RHS08 (VT/WH), harness side.  N0047113 • **Is the resistance between 240 kohms and 4 megohms?**	**Yes** GO to AP16 . **No** GO to AP15 .
AP15 CHECK THE BLOWER MOTOR SPEED CONTROL RESISTANCE	

• Disconnect: Cushion TED C3303. • **NOTE:** The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between cushion TED C3303 pin 7 and pin 4, component side.  N0042890 • **Is the resistance between 240 kohms and 4 megohms?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP16 CHECK THE THERMISTOR FEED CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305B. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON.	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP17 .

• Measure the voltage between DCSM C3305B-2, circuit VHS27 (WH/OG), harness side and ground.  N0042984 • **Is any voltage present?**	
AP17 CHECK THE THERMISTOR FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3305B-2, circuit VHS27 (WH/OG), harness side and ground.  N0042985 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AP18 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP18 CHECK THE THERMISTOR AND WIRING RESISTANCE	
• Measure the resistance between DCSM C3305B-2, circuit VHS27 (WH/OG), harness side and DCSM C3305B-3, circuit RHS10 (BU/OG), harness side. Note the ambient temperature and compare result to the following table: **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER theitle="Supplemental Restraint System" class="popup" onmouseover="this.className='popupnounderline';" onmouseout="this.className='popup';">SRS . REFER to Section 501-20B . **No** GO to AP19 .

10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



- **Is the resistance within the limits indicated?**

AP19 CHECK THE THERMISTOR RESISTANCE

- Disconnect: Cushion TED C3303.
- Measure the resistance between cushion TED pin 5 and pin 8, component side. Note the ambient temperature and compare result to the following table:

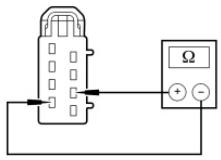
Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms

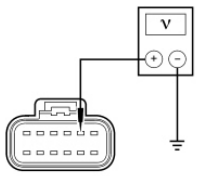
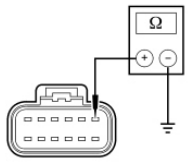
Yes
REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.

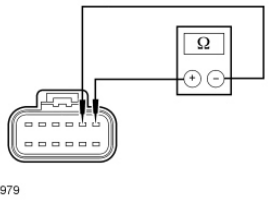
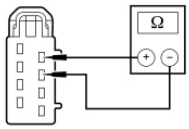
DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

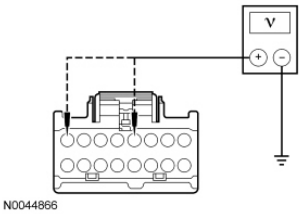
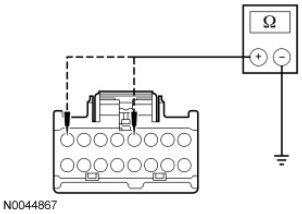
No
INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs.

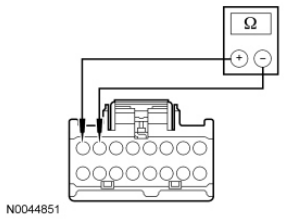
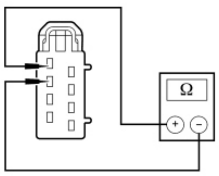
DISCONNthe battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

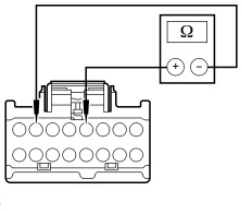
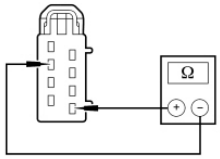
 N0042890 • **Is the resistance within the limits indicated?**	
AP20 CHECK FOR CORRECT TED INSTALLATION AND FOR CRUSHED FOAM	
• Ignition OFF. • Remove the seat. Refer to Seat - Front in this section. • Remove the seat backrest trim cover. Refer to Seat Backrest - Front in this section. • Inspect the seat backrest for the following: ♦ Is the backrest blower obstructed? ♦ Is the blower filter restricted or plugged? ♦ Is the TED correctly installed? ♦ Is the seat backrest foam pad crushed or restricted? ♦ Is the climate controlled seat manifold crushed or restricted? • **Is the TED correctly installed and the foam pad and manifold OK?**	**Yes** GO to AP21 . **No** Correctly INSTALL the backrest TED or INSTALL a new seat backrest foam pad and/or climate controlled seat manifold. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. REPOWER the SRS . REFER to Section 501-20B .
AP21 CHECK THE CUSHION TED GROUND CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Position the front passenger seat in the vehicle and connect the seat-to-floor connectors. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305A.	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP22 .

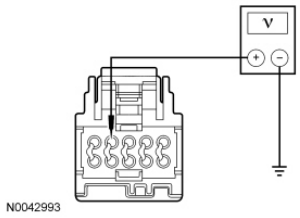
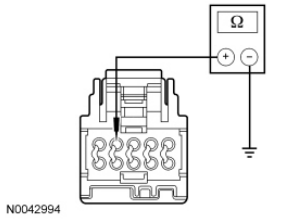
• **⚠ WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between DCSM C3305A-B, circuit RHS07 (BU), harness side and ground.  N0044870 • **Is any voltage present?**	
AP22 CHECK THE CUSHION TED FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between DCSM C3305A-A, circuit CHS07 (GY/BU), harness side and ground.  N0042978 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AP23 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP23 CHECK THE CUSHION TED AND WIRING RESISTANCE	

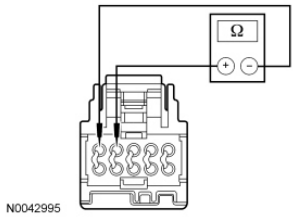
• Measure the resistance between DCSM C3305A-A circuit CHS07 (GY/BU), harness side and DCSM C3305A-B, circuit RHS07 (BU), harness side.  N0042979 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AP25 . **No** GO to AP24 .
AP24 CHECK THE CUSHION TED RESISTANCE	
• Disconnect: Cushion TED C3303. • Measure the resistance between cushion TED C3303 pin 1 and pin 3, component side.  N0042874 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR circuit CHS07 (GY/BU) or RHS07 (BU) for an open. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP25 CHECK THE BLOWER MOTOR FEED AND SPEED CONTROL CIRCUITS FOR A SHORT TO VOLTAGE	
• Disconnect: DCSM C3305C. • Ignition ON. • Measure the voltage between: ♦ DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and ground. ♦ DCSM C3305C-4, circuit VHS21 (BU/WH), harness side and ground.	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP26 .

 N0044866 • **Is voltage present on either circuit?**	
AP26 CHECK THE BLOWER MOTOR FEED AND SPEED CONTROL CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and ground. ♦ DCSM C3305C-4, circuit VHS21 (BU/WH), harness side and ground.  N0044867 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AP27 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP27 CHECK THE BLOWER MOTOR AND WIRING RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to DCSM C3305C-8, circuit CHS08 (BN/YE) and the negative lead to DCSM C3305C-7, circuit RHS08 (VT/WH) when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3305C-8, circuit CHS08 (BN/YE), harness side and DCSM C3305C-7, circuit	**Yes** GO to AP29 . **No** GO to AP28 .

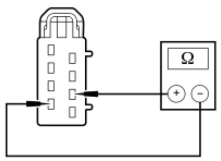
RHS08 (VT/WH), harness side.  N0044851 • **Is the resistance between 4,000 and 10,000 ohms?**	
AP28 CHECK THE BLOWER MOTOR RESISTANCE	
• Disconnect: Backrest TED C3311. • **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between backrest TED C3311 pin 2 and pin 4, component side.  N0042881 • **Is the resistance between 4,000 and 10,000 ohms?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP29 CHECK THE BLOWER MOTOR GROUND CIRCUIT TO BLOWER MOTOR SPEED CONTROL CIRCUIT RESISTANCE	
• **NOTE:** The ohmmeter must be connected with the positive lead to C3305C-4, circuit VHS21 (BU/WH), harness side and the negative lead to C3305C-7, circuit RHS08 (VT/WH), harness side when measuring.	**Yes** GO to AP31 . **No** GO to AP30 .

Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between DCSM C3305C-4, circuit VHS21 (BU/WH), harness side and DCSM C3305C-7, circuit RHS08 (VT/WH), harness side.  N0044868 • **Is the resistance between 240 kohms and 4 megohms?**	
AP30 CHECK THE BLOWER MOTOR SPEED CONTROL RESISTANCE	
• Disconnect: Backrest TED C3311. • **NOTE:** The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between backrest TED C3311 pin 7 and pin 4, component side.  N0042893 • **Is the resistance between 240 kohms and 4 megohms?**	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP31 CHECK THE THERMISTOR FEED CIRCUIT FOR A SHORT TO VOLTAGE	

• Disconnect: DCSM C3305B. • Ignition ON. • Measure the voltage between DCSM C3305B-4, circuit VHS36 (YE/BU), harness side and ground.  • **Is any voltage present?**	**Yes** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP32 .
AP32 CHECK THE THERMISTOR FEED CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Passenger Seat Side Air Bag Module C313. • Measure the resistance between DCSM C3305B-4, circuit VHS36 (YE/BU), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AP33 . **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AP33 CHECK THE THERMISTOR AND WIRING RESISTANCE AT THE DCSM	

• Measure the resistance between DCSM C3305B-4, circuit VHS36 (YE/BU), harness side and DCSM C3305B-5, circuit RHS20 (GN/BU), harness side. Note the ambient temperature and compare result to the following table: **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms  • **Is the resistance within the limits indicated?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AP34 .
AP34 CHECK THE TED THERMISTOR RESISTANCE	
• Disconnect: Backrest TED C3311. • Measure the resistance between backrest TED pin 5 and pin 8, component side. Note the ambient temperature and compare result to the following table: **Temperature** / **Resistance** 	**Yes** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

0-10°C (32-50°F)	2,782-1,663 ohms		
10-20°C (50-68°F)	20-30°C (68-86°F)	1,260-806 ohms	
30-40°C (86-104°F)	893-570 ohms		
40-50°C (104-122°F)	630-428 ohms		



N0042890

- **Is the resistance within the limits indicated?**

Pinpoint Test AQ: DTC B272E

NOTE: This DTC sets for an open or short to voltage. See DTC setting description below.

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The driver climate controlled seat blowers are located within the backrest and cushion Thermo-Electric Devices (TEDs). The Dual Climate Controlled Seat Module (DCSM) supplies voltage and ground to both blowers. The blowers are independently controlled by separate speed control circuits from the DCSM .

- DTC B272E (Driver Ignition Run/Blower Circuit Short to Ground [this DTC sets for an open or short to voltage]) - If either the blower voltage supply or return circuits are open (to both cushion and backrest blowers) or shorted to voltage, the DTC is set and after 4-6 seconds the DCSM disables outputs to the driver seat. The DTC will also set if the blower voltage supply or return circuit is open to only one blower when DCSM supply voltage is less than 12 volts.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- HVAC module
- Backrest or cushion TED
- DCSM

PINPOINT TEST AQ: DTC B272E

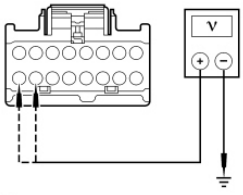
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the male connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in**

Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

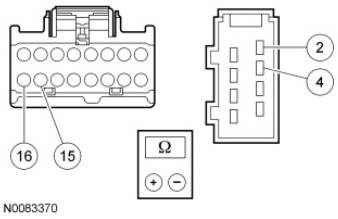
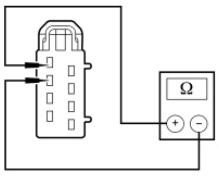
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>AQ1 CHECK THE TED BLOWER MOTOR CIRCUITS FOR A SHORT TO VOLTAGE</td><td></td></tr>
<tr><td>
• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .
• Disconnect: Driver Seat Side Air Bag C327 and Passenger Seat Side Air Bag C313.
• Disconnect: DCSM C3305C.
• Disconnect: Cushion TED C3300.
• Disconnect: Backrest TED C3310.
• ⚠ WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.
• Connect the battery ground cable. Refer to Section 414-01 .
• Ignition ON.
• Measure the voltage between DCSM C3305C, harness side and ground using the following chart.
<table>
<tr><th>DCSM Connector</th><th>Circuit</th></tr>
<tr><td>C3305C-16</td><td>CHS03 (GN/BN)</td></tr>
<tr><td>C3305C-15</td><td>RHS03 (GY/OG)</td></tr>
</table>


N0100444
• Is voltage present on either circuit?
</td><td>Yes
REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B .

No
GO to AQ2 .</td></tr>
<tr><td>AQ2 CHECK THE TED BLOWER MOTOR CIRCUITS FOR AN OPEN</td><td></td></tr>
</table>

• Ignition OFF. • Measure the resistance between DCSM C3305C, harness side and cushion TED C3300, harness side using the following chart. **DCSM Connector** / **Circuit** / **Cushion TED Connector** C3305C-16 / CHS03 (GN/BN) / C3300-2 C3305C-15 / RHS03 (GY/OG) / C3300-4  N0083370 • **Are the resistances less than 5 ohms?**	**Yes** GO to AQ3 . **No** REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313 REPOWER the SRS . REFER to Section 501-20B .
AQ3 CHECK THE RESISTANCE OF THE CUSHION AND BACKREST TED BLOWER MOTORS	
• **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty. • Measure the resistance between: ♦ cushion TED C3300 pins 2 and 4, component side. ♦ backrest TED C3310 pins 2 and 4, component side.  N0042881 • **Are the resistances between 4,000 and 10,000 ohms?**	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** If the cushion TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. If backrest the TED resistance

	is **not** between 4,000 and 10,000 ohms, INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AR: DTC B272F

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The passenger climate controlled seat blowers are located within the backrest and cushion Thermo-Electric Devices (TEDs). The Dual Climate Controlled Seat Module (DCSM) supplies voltage to both blowers on circuit CHS08 (BN/YE) and ground to both blowers on circuit RHS08 (VT/WH). The blowers are independently controlled by separate speed control circuits from the DCSM .

- DTC B272F (Passenger Ignition Run/Blower Circuit Short to Ground [this DTC sets for an open or short to voltage]) - If either the blower voltage supply or return circuits are open (to both cushion and backrest blowers) or shorted to voltage, the DTC is set and after 4-6 seconds the DCSM disables outputs to the passenger seat. The DTC will also set if the blower voltage supply or return circuit is open to only one blower when DCSM supply voltage is less than 12 volts.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- HVAC module
- Backrest or cushion TED
- DCSM

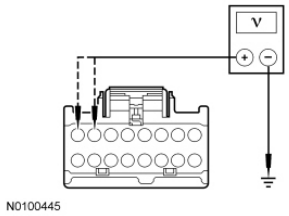
PINPOINT TEST AR: DTC B272F

NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can causintermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: If a seat equipped with a seat mounted side air bag is being serviced, the Supplemental Restraint System (SRS) must be depowered. Refer to Section 501-20B .

NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>AR1 CHECK THE TED BLOWER MOTOR CIRCUITS FOR A SHORT TO VOLTAGE</td><td></td></tr>
<tr><td>
• Ignition OFF.
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .
• Disconnect: Passenger Seat Side Air Bag C313.
• Disconnect: DCSM C3305C.
• Disconnect: Cushion TED C3303.
• Disconnect: Backrest TED C3311.
• ⚠ WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.
• Connect the battery ground cable. Refer to Section 414-01 .
• Ignition ON.
• Measure the voltage between DCSM C3305C, harness side and ground using the following chart.
<table>
<tr><th>DCSM Connector</th><th>Circuit</th></tr>
<tr><td>C3305C-8</td><td>CHS08 (BN/YE)</td></tr>
<tr><td>C3305C-7</td><td>RHS08 (VT/WH)</td></tr>
</table>


N0100445
• Is voltage present on either circuit?
</td><td>
Yes
REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.

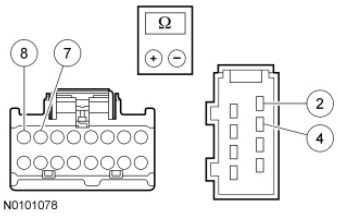
DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B .

No
GO to AR2 .
</td></tr>
<tr><td>AR2 CHECK THE TED BLOWER MOTOR CIRCUITS FOR AN OPEN</td><td></td></tr>
<tr><td>
• Ignition OFF.
• Measure the resistance between DCSM C3305C, harness side and cushion TED C3300, harness side using the following chart.
</td><td>
Yes
GO to AR3 .

No
REPAIR the circuit(s). REPEAT the self-test. CLEAR the DTCs.
</td></tr>
</table>

DCSM Connector	Circuit	Cushion TED Connector
C3305C-8	CHS08 (BN/YE)	C3303-2
C3305C-7	RHS08 (VT/WH)	C3303-4



N0101078

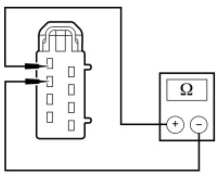
- **Are the resistances less than 5 ohms?**

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B .

AR3 CHECK THE RESISTANCE OF THE CUSHION AND BACKREST TED BLOWER MOTORS

- **NOTE:** The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected will result in false readings and lead to incorrect identification of components that are not faulty.
- Measure the resistance between:
  - ♦ cushion TED C3303 pins 2 and 4, component side.
  - ♦ backrest TED C3311 pins 2 and 4, component side.



N0042881

- **Are the resistances between 4,000 and 10,000 ohms?**

Yes
INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery ground cable. CONNECT passenger seat side air bag module C313.

REPOWER the SRS . REFER to Section 501-20B .

No
If the cushion TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new cushion TED . REFER to Seat Cushion Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs.

If backrest the TED resistance is **not** between 4,000 and 10,000 ohms, INSTALL a new backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. REPEAT the self-test. CLEAR the DTCs.

DISCONNECT the battery

	ground cable. CONNECT passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AS: DTC B2730

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) monitors seat backrest temperature while it supplies voltage and ground to both blower motors. The DCSM also supplies a variable voltage signal to control the blower speed. Cabin air enters the blower through a filter attached to the Thermo-Electric Device (TED) housing. Conditioned air exits the TED and flows through a manifold attached to the foam pad.

- DTC B2730 (Back Over-Temp Detected) - If the driver seat backrest TED temperature exceeds 85°C (185°F) in cool mode or 70°C (158°F) in heat mode for more than 34 seconds the DCSM will shut down the driver seat system and set.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Restricted backrest TED filter
- Crushed or restricted climate controlled seat manifold
- Backrest TED assembly

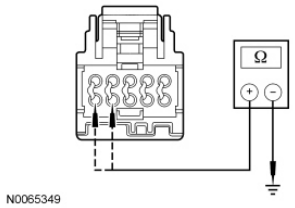
PINPOINT TEST AS: DTC B2730

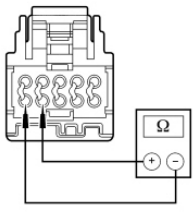
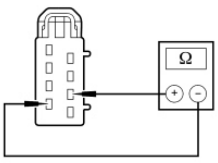
NOTICE: **When taking measurements at Dual Climate Controlled Seat Module (DCSM) harness connectors, do not insert the electrical probes into the female connector pins. Inserting the probes into connector pins can cause intermittent or open electrical connections after reassembly resulting in Diagnostic Trouble Codes (DTCs) and system failure. Touching the tip of these connector pins is recommended instead.**

NOTE: The air bag warning indicator illuminates when the correct Restraintsol Module (RCM) fuse is removed and the ignition is ON.

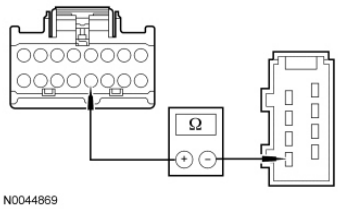
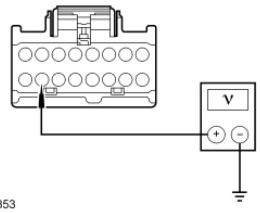
NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

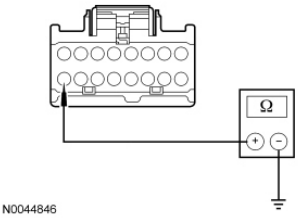
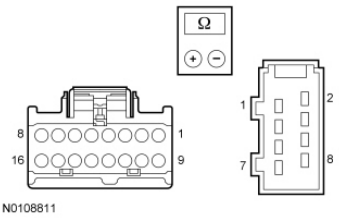
Test Step	Result / Action to Take
AS1 CHECK THE DCSM FOR ON-DEMAND DTCs	
• Start the vehicle and set the driver seat to HIGH heat. • Enter the following diagnostic mode on the scan tool: Self Test - DCSM . • **Was DTC B2730 retrieved on-demand during the self-test?**	**Yes** GO to AS2 . **No** GO to AS5 .

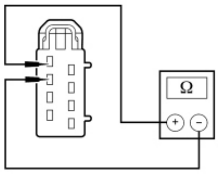
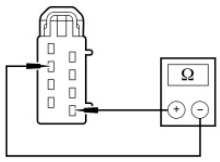
AS2 CHECK THE DRIVER SEAT BACKREST TED THERMISTOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327 and Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305B. • Disconnect: Driver Seat Backrest TED C3310. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between: ♦ DCSM C3305B-9, circuit VHS35 (VT/OG), harness side and ground. ♦ DCSM C3305B-10, circuit RHS15 (GY/BN), harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AS3 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AS3 CHECK THE DRIVER SEAT BACKREST TED THERMISTOR AND WIRING	
• Connect: Driver Seat Backrest TED C3310. • Measure the resistance between DCSM C3305B-9, circuit VHS35 (VT/OG), harness side and DCSM C3305B-10, circuit RHS15 (GY/BN), harness side. Note the ambient temperature and refer to the following table. **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms	**Yes** GO to AS18 . **No** GO to AS4 .

 N0042976 • **Is the resistance within the limits indicated?**	
AS4 CHECK THE DRIVER SEAT BACKREST TED THERMISTOR	
• Disconnect: Driver Seat Backrest TED C3310. • Measure the resistance between driver seat backrest TED C3310 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table. **Temperature** / **Resistance** 0-10°C (32-50°F) / 2,782-1,663 ohms 10-20°C (50-68°F) / 1,837-1,140 ohms 20-30°C (68-86°F) / 1,260-806 ohms 30-40°C (86-104°F) / 893-570 ohms 40-50°C (104-122°F) / 630-428 ohms  N0042890 • **Is the resistance within the limits indicated?**	**Yes** REPAIR circuit VHS35 (VT/OG) or RHS15 (GY/BN) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . INSTALL a new driver seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AS5 CONFIRM THE FAULT WHILE MONITORING THE DCSM SEAT BACK THERMAL ELECTRIC DEVICE TEMPERATURE (BK_TEMP) AND SEAT CUSHION THERMAL ELECTRIC DEVICE TEMPERATURE (CSHTEMP) PIDs	
• Set the driver seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Enter the following diagnostic mode on the scan tool: DataLogger - DCSM . • Monitor the DCSM PIDs BK_TEMP and CSHTEMP. • **NOTE:** A crushed seat backrest foam pad or a crushed climate controlled seat manifold may be the cause of the	**Yes** Fault not present at this time. Fault may have been set due to a past failure, incorrect use of the climate controlled seat system by repeated switching between heat and cool modes or due to excessive driver compartment temperature. CLEAR the DTCs. REPEAT the self-test.

fault making it necessary to occupy the seat to recreate and identify the fault. • Attempt to recreate the fault. Start the vehicle and set the driver seat to HIGH heat for at least 15 minutes while occupying the seat. • **Do the PIDs increase incrementally (gradually) and stay within 15°C (27°F) of each other?**	**No** If the BK_TEMP PID increases incrementally and is greater than 15°C (27°F) of the CSHTEMP PID, GO to AS6 . If the BK_TEMP PID increases quickly (temperature "jumps" and does not increase incrementally) and is greater than 15°C (27°F) of the CSHTEMP PID, GO to AS16 .
AS6 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS	
• With the engine running, set both front seats to HIGH cool. • Note the airflow exhausting from the driver seat backrest TED and compare it to the airflow exhausting from the passenger seat backrest TED . • Carry out a wiggle test of the wire harnesses between the DCSM and the driver seat backrest TED while monitoring blower operation of the TED . The blower should operate consistently and not change speeds • **Is the airflow exhausting from the driver seat backrest TED comparable to the airflow exhausting from the passenger seat backrest TED with no change in operation when carrying out the wiggle test?**	**Yes** GO to AS7 . **No** If the airflow exhausting from the driver seat backrest TED is not comparable to the airflow exhausting from the driver seat backrest TED , GO to AS8 . If the passenger seat backrest TED blower operation changed while carrying out the wiggle test, IDENTIFY and REPAIR the wiring fault. CLEAR the DTCs. REPEAT the self-test.
AS7 COMPARE OPERATION OF THE DRIVER AND PASSENGER SEATS WHILE OCCUPIED	
• Note the airflow exhausting from the passenger seat backrest TED with the driver seat occupied and compare it to the airflow exhausting from the passenger seat backrest TED with the passenger seat occupied. • **Is the airflow exhausting from the driver seat backrest TED comparable to the airflow exhausting from the passenger seat backrest TED ?**	**Yes** GO to AS16 . **No** INSTALL a new driver seat backrest foam pad and/or climate controlled seat manifold. CLEAR the DTCs. REPEAT the self-test.
AS8 CHECK THE DRIVER SEAT BACKREST BLOWER FOR AN OBSTRUCTION OR RESTRICTED FILTER	
• Ignition OFF. • Inspect the blower of the driver seat backrest TED assembly for an obstruction or for a restricted filter. • **Is the blower obstructed or the filter restricted?**	**Yes** REMOVE the obstruction or INSTALL a new filter. CLEAR the DTCs. REPEAT the self-test. **No** GO to AS9 .
AS9 CHECK THE DRIVER SEAT BACKREST BLOWER SPEED CONTROL CIRCUIT FOR AN OPEN	

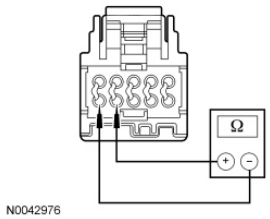
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327 and Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305C. • Disconnect: Driver Seat Backrest TED C3310. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3305C-12, circuit VHS16 (BU/GN), harness side and driver seat backrest TED C3310-7, circuit VHS16 (BU/GN), harness side.  N0044869 • **Is the resistance less than 5 ohms?**	**Yes** GO to AS10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AS10 CHECK THE DRIVER SEAT BACKREST BLOWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between DCSM C3305C-15, circuit RHS03 (GY/OG), harness side and ground.  N0044853 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** GO to AS11 .
AS11 CHECK THE DRIVER SEAT BACKREST BLOWER CIRCUIT FOR A SHORT TO GROUND	

• Ignition OFF. • Measure the resistance between DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AS12 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AS12 CHECK THE DRIVER SEAT BACKREST BLOWER CIRCUITS FOR AN OPEN	
• Measure the resistance between: ♦ DCSM C3305C-16, circuit CHS03 (GN/BN), harness side and driver seat backrest TED C3310-2, circuit CHS03 (GN/BN), harness side. ♦ DCSM C3305C-15, circuit RHS03 (GY/OG), harness side and driver seat backrest TED C3310-4, circuit RHS03 (GY/OG), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** GO to AS13 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AS13 CHECK THE DRIVER SEAT BACKREST BLOWER RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 2 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between driver seat backrest TED C3310 pin 2 and pin 4, component side.	**Yes** GO to AS14 . **No** INSTALL a new driver seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

 N0042881 • **Is the resistance between 4,000 ohms and 10,000 ohms?**	
AS14 CHECK THE DRIVER SEAT BACKREST BLOWER SPEED CONTROL RESISTANCE	
• ***NOTICE:*** **The ohmmeter must be connected with the positive lead to pin 7 and the negative lead to pin 4 when measuring. Ohmmeter leads incorrectly connected results in false readings and leads to incorrect identification of components that are not damaged.** • Measure the resistance between driver seat backrest TED C3310 pin 7 and pin 4, component side.  N0042893 • **Is the resistance between 240K ohms and 400K ohms?**	**Yes** GO to AS15 . **No** INSTALL a new driver seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AS15 CHECK THE DRIVER SEAT BACKREST TED INSTALLATION AND FOR CRUSHED SEAT BACKREST	
• Ignition OFF. • Remove the driver seat. Refer to Seat - Front in this section. • Remove the driver seat backrest cover. Refer to Seat Backrest Cover - Front in this section. • Inspect the driver seat backrest for the following: ♦ Is the driver seat backrest TED correctly installed? ♦ Is the driver seat backresam pad crushed or restricted? ♦ Is the driver seat backrest climate controlled seat manifold crushed or restricted? • **Is the driver seat backrest TED correctly installed and are there no signs of damage to the foam pad and manifold?**	**Yes** INSTALL the driver seat backrest cover and seat and GO to AS18 . **No** CORRECTLY install the driver seat backrest TED or INSTALL a new driver seat backrest foam pad and/or climate controlled seat manifold. CONNECT the battery ground cable. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to

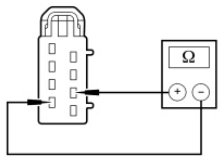
	Section 501-20B .
AS16 CHECK THE DRIVER SEAT BACKREST TED THERMISTOR AND WIRING	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B . • Disconnect: Driver Seat Side Air Bag C327 and Passenger Seat Side Air Bag C313. • Disconnect: DCSM C3305B. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Connect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between DCSM C3305B-9, circuit VHS35 (VT/OG), harness side and C3305B-10 circuit RHS15 (GY/BN), harness side. Note the ambient temperature and refer to the following table. • **Is the resistance within the limits indicated?**	**Yes** GO to AS18 . **No** GO to AS17 .
AS17 CHECK THE DRIVER SEAT BACKREST TED THERMISTOR	
• Measure the resistance between driver seat backrest TED C3310 pin 5 and pin 8, component side. Note the ambient temperature and refer to the following table.	**Yes** REPAIR circuit VHS35 (VT/OG) or RHS15 (GY/BN) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test.

Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
40-50°C (104-122°F)	630-428 ohms



	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C7 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

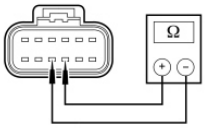
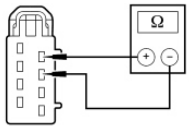
Temperature	Resistance
0-10°C (32-50°F)	2,782-1,663 ohms
10-20°C (50-68°F)	1,837-1,140 ohms
20-30°C (68-86°F)	1,260-806 ohms
30-40°C (86-104°F)	893-570 ohms
630-428 ohms	



N0042890

- **Is the resistance within the limits indicated?**

AS18 CHECK THE DRIVER SEAT BACKREST TED HEATING/COOLING CIRCUITRY CURRENT DRAW	
• Connect: All DCSM , TED and Body Harness-to-Seat Harness Connectors. • ***NOTICE:*** **It may be necessary to open the seat wire harness conduit to allow placing the inductive current probe around the circuit as described in the following step. Care must be taken when opening up the wire harness so as not to damage any wiring or connectors. Do not damage any wiring or induce stress on any wiring or connectors. Close up the wire harness once repairs to the seat are complete.** • **NOTE:** Use a commercially available inductive current probe (such as Electronic Specialties Current Probe/Multimeter 685 or a Fluke I410 [used with a digital multimeter]) or the low current probe from the Vehicle Measurement Module available for use with Integrated Diagnostic System (IDS). If these are unavailable, the inductive current probe feature from a battery tester may be substituted. • Place an inductive current probe around circuit CHS01 (GY/VT) near DCSM C3305A-J and monitor the current draw. • Start the vehicle and set the driver seat to HIGH heat. • **Is the current draw less than 11 amps?**	**Yes** GO to AS19 . **No** INSTALL a new driver seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AS19 CHECK RESISTANCE OF THE DRIVER SEAT BACKREST TED AND WIRING	

• Ignition OFF. • Disconnect: DCSM C3305A. • Measure the resistance between DCSM C3305A-J circuit CHS01 (GY/VT), harness side and C3305A-K, circuit RHS01 (WH/VT), harness side.  N0132223 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** GO to AS21 . **No** GO to AS20 .
AS20 CHECK THE RESISTANCE OF THE DRIVER SEAT BACKREST TED	
• Disconnect: Driver Seat Backrest TED C3310. • Measure the resistance between driver seat backrest TED C3310 pin 1 and pin 3, component side.  N0042874 • **Is the resistance between 0.9 and 10 ohms?**	**Yes** REPAIR circuit CHS01 (GY/VT) or RHS01 (WH/VT) for an open or high resistance. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** INSTALL a new driver seat backrest TED . REFER to Seat Backrest Thermo-Electric Device in this section. CLEAR the DTCs. REPEAT the self-test. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .
AS21 CHECK FOR CORRECT DCSM OPERATION	
• Inspect the DCSM and driver seat backrest TED harness and component side connectors and the body harness-to-seat harness connectors for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new DCSM . REFER to Dual Climate Controlled Seat Module (DCSM) in this section. REPEAT the self-test. TEST the system for normal operation.

• Connect: All DCSM , TED and Body Harness-to-Seat Harness Connectors. • Make sure the connectors are seated correctly. • Start the engine. • Set the driver seat to OFF. • Enter the following diagnostic mode on the scan tool: Clear DTCs - DCSM . • Attempt to recreate the fault. With the engine still running set the driver seat to HIGH heat for at least 15 minutes. • **Is the concern still present?**	DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C327 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. DISCONNECT the battery ground cable. CONNECT driver seat side air bag module C3051 and passenger seat side air bag module C313. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test AT: DTC U0140

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

The Driver Seat Module (DSM) and the Smart Junction Box (SJB) communicate using the Medium Speed Controller Area Network (MS-CAN). Messages are exchanged between the modules on the MS-CAN for the purposes of determining what functions are being carried out.

- DTC U0140 (Lost Communication With Body Control Module (GEM)) - set by the DSM whenever it has lost communication to the SJB for 15 seconds or longer as long as the module voltage is between 10 and 15 volts.

This pinpoint test is intended to diagnose the following:

- Module communication
- DSM
- SJB

PINPOINT TEST AT: DTC U0140

Test Step	Result / Action to Take
AT1 VERIFY CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AT2 . **No**

	The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AT2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the SJB pass the network test?**	**Yes** GO to AT3 . **No** REFER to Section 418-00 .
AT3 RETRIEVE THE RECORDED DTCs FROM THE SELF-TEST	
• Check for recorded DSM DTCs from the self-test. • **Is DTC B1317 or DTC B1318 recorded?**	**Yes** GO to Pinpoint Test AK . **No** GO to AT4 .
AT4 RECHECK THE DSM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the DSM self-test. • **Is DTC U0140 still present?**	**Yes** GO to AT5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AT5 CHECK FOR DTC U0140/U0140:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0140/U0140:00 set in other modules?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . **No** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section.

Pinpoint Test AU: DTC U0155

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

The Driver Seat Module (DSM) and the Instrument Panel Cluster (IPC) communicate using the Medium Speed Controller Area Network (MS-CAN). Messages are exchanged between the modules on the MS-CAN for the purposes of determining what functions are being carried out.

- DTC U0155 (Lost Communication with Instrument Panel Cluster (IC) Control Module) - set by the DSM if ignition status message is present, the DSM supply voltage is greater than 10.5 volts, the

ignition must be in the on position for a minimum of 5 seconds and if messages are missing for 15 seconds or longer from the IPC over the MS-CAN .

This pinpoint test is intended to diagnose the following:

- Module communication
- DSM
- IPC

PINPOINT TEST AU: DTC U0155

Test Step	Result / Action to Take
AU1 VERIFY CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AU2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AU2 CHECK THE COMMUNICATION NETWORK	
• Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the IPC pass the network test?**	**Yes** GO to AU3 . **No** REFER to Section 418-00 .
AU3 RETRIEVE THE RECORDED DTCs FROM THE SELF-TEST	
• Check for recorded DSM DTCs from the self-test. • **Is DTC B1317 or B1318 recorded?**	**Yes** GO to Pinpoint Test AK . **No** GO to AU4 .
AU4 RECHECK THE DSM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the DSM self-test. • **Is DTC U0155 still present?**	**Yes** GO to AU5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AU5 CHECK FOR DTC U0155/U0155:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF.	**Yes** INSTALL a new IPC . REFER to Section 413-01 .

• Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0155/U0155:00 set in other modules?**	**No** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section.

Pinpoint Test AV: DTC B1317

Refer to Wiring Diagrams Cell 123 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Memory Seats for schematic and connector information.

Normal Operation

The Driver Seat Module (DSM) monitors the voltage from the battery to determine if it goes above or below specific thresholds.

- DTC B1317 (Battery Voltage High) - a continuous memory or on-demand DTC that sets when the DSM detects battery voltage above 15.5 volts on circuit SBB32.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- DSM

PINPOINT TEST AV: DTC B1317

NOTE: DTC B1317 may be stored in the module memory due to previous battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
AV1 CHECK FOR DTC B1317, B1676 OR P0563 SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Retrieve All CMDTCs Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC B1317, B1676 or P0563 (PCM) set in more than one module?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AV2 .
AV2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No**

minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	GO to AV3 .
AV3 RECHECK FOR DTC B1317	
• Turn the engine off. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DSM Self-Test. • Clear the continuous memory DTCs. • Carry out the DSM self-test. • **Is DTC B1317 present?**	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. TEST the system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test AW: DTC B1318

Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

Normal Operation

The Driver Seat Module (DSM) monitors the voltage from the battery to determine if it goes above or below specific thresholds.

- DTC B1318 (Battery Voltage Low) - a continuous memory or on-demand DTC that sets when the DSM detects battery voltage below 10 volts on circuit SBB32.

This pinpoint test is intended to diagnose the following:

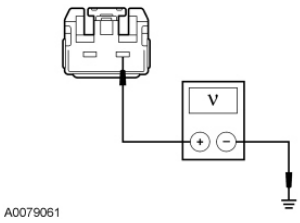
- Wiring, terminals or connectors
- High circuit resistance
- DSM

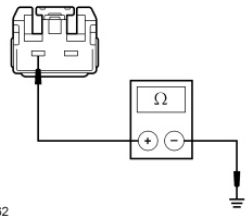
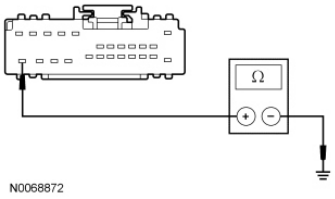
PINPOINT TEST AW: DTC B1318

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistce readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AW1 RECHECK THE DSM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DSM Self-Test. • Clear the DTCs. Repeat the DSM self-test. • **Is DTC B1318 still present?**	**Yes** GO to AW2 . **No** The system is operating normally at this time. The DTC may have been set previously during battery

	charging or while jump starting the vehicle.
AW2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Enter the following diagnostic mode on the scan tool: PCM Self-Test. • Retrieve the continuous memory DTCs from the PCM. • **Is DTC P0620, P0625, P0626 or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to AW3 .
AW3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Ignition OFF. • Check the battery condition and verify the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AW4 . **No** REFER to Section 414-00 .
AW4 CHECK THE DSM VOLTAGE SUPPLY	
• Measure and record the voltage at the battery. • Disconnect: DSM C3299a. • Ignition ON. • Measure the voltage between the DSM C3299a-1, circuit SBB32 (VT/RD), harness side and ground.  • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to AW5 . **No** REPAIR the circuit for high resistance. CLEAR the DTCs. REPEAT the self-test.
AW5 CHECK THE DSM GROUND CIRCUITS	
• Ignition OFF. • Disconnect: Negative Battery Cable. • Disconnect: DSM C3299b. • Measure the resistance between the DSM C3299a-2, circuit GD126 (BK/WH), harness side and ground.	**Yes** CONNECT the negative battery cable. GO to AW6 . **No** REPAIR the circuit for high resistance. CONNECT the negative battery cable. TEST the system for normal operation.

 A0079062 • Measure the resistance between the DSM C3299b-24, circuit GD126 (BK/WH), harness side and ground.  N0068872 • **Are the resistances less than 5 ohms?**	
AW6 CHECK FOR CORRECT DSM OPERATION	
• Disconnect the DSM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the DSM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AX: DTC U0140

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

The Driver Seat Module (DSM) and the Smart Junction Box (SJB) communicate using the Medium Speed Controller Area Network (MS-CAN). Messages are exchanged between the modules on the MS-CAN for the purposes of determining what functions are being carried out.

- DTC U0140 (Lost Communication With Body Control Module (GEM)) - set by the DSM whenever it has lost communication to the SJB for 15 seconds or longer as long as the module voltage is between 10 and 15 volts.

This pinpoint test is intended to diagnose the following:

- Module communication
- DSM

- SJB

PINPOINT TEST AX: DTC U0140

Test Step	Result / Action to Take
AX1 VERIFY CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AX2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AX2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the SJB pass the network test?**	**Yes** GO to AX3 . **No** REFER to Section 418-00 .
AX3 RETRIEVE THE RECORDED DTCs FROM THE SELF-TEST	
• Check for recorded DSM DTCs from the self-test. • **Is DTC B1317 or DTC B1318 recorded?**	**Yes** For DTC B1317, GO to Pinpoint Test AV . For DTC B1318, GO to Pinpoint Test AW . **No** GO to AX4 .
AX4 RECHECK THE DSM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the DSM self-test. • **Is DTC U0140 still present?**	**Yes** GO to AX5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AX5 CHECK FOR DTC U0140/U0140:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds.	**Yes** INSTALL a new SJB . REFER to Section 419-10 . **No**

• Enter the following diagnostic mode on the scan tool: Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0140/U0140:00 set in other modules?**	INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section.

Pinpoint Test AY: DTC U0155

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

The Driver Seat Module (DSM) and the Instrument Panel Cluster (IPC) communicate using the Medium Speed Controller Area Network (MS-CAN). Messages are exchanged between the modules on the MS-CAN for the purposes of determining what functions are being carried out.

- DTC U0155 (Lost Communication with Instrument Panel Cluster (IC) Control Module) - set by the DSM if ignition status message is present, the DSM supply voltage is greater than 10.5 volts, the ignition must be in the on position for a minimum of 5 seconds and if messages are missing for 15 seconds or longer from the IPC over the MS-CAN .

This pinpoint test is intended to diagnose the following:

- Modu communication
- DSM
- IPC

PINPOINT TEST AY: DTC U0155

Test Step	Result / Action to Take
AY1 VERIFY CUSTOMER CONCERN	
• Ignition ON. • Verify there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AY2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AY2 CHECK THE COMMUNICATION NETWORK	
• Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the IPC pass the network test?**	**Yes** GO to AY3 . **No** REFER to Section 418-00 .
AY3 RETRIEVE THE RECORDED DTCs FROM THE SELF-TEST	
• Check for recorded DSM DTCs from the self-test.	**Yes** For DTC B1317, GO to Pinpoint

• **Is DTC B1317 or B1318 recorded?**	Test AV . For DTC B1318, GO to Pinpoint Test AW . **No** GO to AY4 .
AY4 RECHECK THE DSM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the DSM self-test. • **Is DTC U0155 still present?**	**Yes** GO to AY5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AY5 CHECK FOR DTC U0155/U0155:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0155/U0155:00 set in other modules?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . **No** INSTALL a new DSM . REFER to Driver Seat Module (DSM) in this section.

Component Test

Component Testing - Thermo-Electric Device (TED) Cooling Performance

NOTE: This test is intended to check the cooling mode performance of an operational climate controlled seat backrest or cushion Thermo-Electric Device (TED) and verify it is cooling inlet air at the TED (ambient cabin air) between 6-8°C (10-14°F).

NOTE: Make sure the vehicle is out of direct sunlight and is in an area with a stable air temperature when testing the climate controlled seat system.

NOTE: For correct temperature measurements, the seat being tested should be occupied.

1. EntataLogger and monitor the following Dual Climate Controlled Seat Module (DCSM) PIDs:
   - CSHTEMP (Seat cushion thermal electric device temperature)
   - BK_TEMP (Seat back thermal electric device temperature)
   - PCSHTMP (Passenger Cushion Thermal Electric Device [TED] Temperature)
   - PBKTMP (Passenger Back TED Temperature)
   - DCCSMOD (Driver State Seat Mode)
   - PCCSMOD (Passenger State Seat Mode)

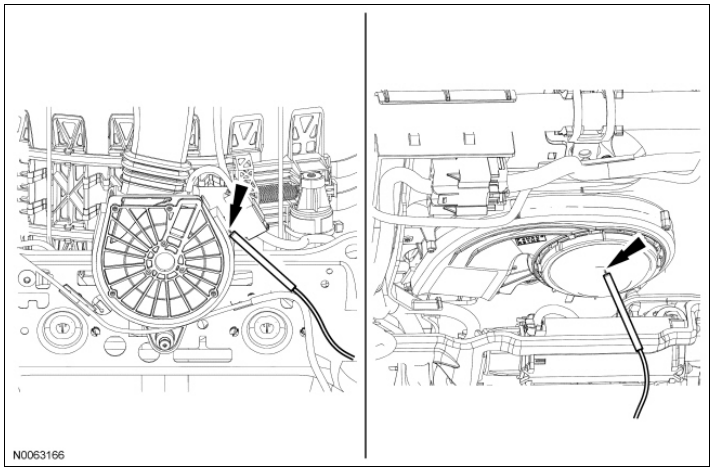
2. Any initial PID value of greater than 205°C (401°F) or less than 2°C (36°F) indicates a system hardware failure. Do not proceed with this test. GO to Symptom Chart or Dual Climate Controlled

Seat Module (DCSM) DTC Chart for diagnosis.

3. **NOTE:** Typical backrest and cushion TED shown, others similar.

   Gain access to the seat backrest and cushion TEDs and use a suitable thermo-couple temperature measuring device to monitor the air inlet temperature.

   - Access the backrest TED .
     - ♦ Release the backrest trim cover J-clips at the sides and bottom.
     - ♦ Pull out at the bottod detach the 2 lower hard back panel pin-type retainers.
     - ♦ Position the backrest trim cover aside.
   - Place the temperature probe near each TEDs air filter.



4. **NOTE:** The engine must be running to operate the climate controlled seat system and carry out this test.

   Operate system in high cool mode and measure the temperature at the cushion TED filter using the thermo-couple device.

   - Obtain and record the air inlet temperature at the TED .

5. Use a scan tool to measure the cushion TED PID temperature and record the value.
   - Monitor the MODE PID and verify the system is operating. If during testing the PID value changes to Blower Only state, the system has entered into recovery mode and voltage to the TEDs is disabled. If this occurs, the seat has failed the test. Do not continue. Return to the diagnostic routine.

6. Subtract the cushion TED PID temperature from the cushion air inlet temperature and record the temperature difference value.

7. Continue to operate the system in high cool mode and use the thermo-couple device to measure the temperature at the backrest TED filter.
   - Obtain and record the air inlet temperature at the TED .
     - ♦ Secure the temperature probe at the backrest TED air filter and close the backrest trim cover before measuring.

8. Use a scan tool to measure the backrest TED PID temperature and record the value.
   - Monitor the MODE PID and verify the system is operating. If during testing the PID value changes to Blower Only state, the system has entered into recovery mode and voltage to the TEDs is disabled. If this occurs, the seat has failed the test. Do not continue. Return to the

diagnostic routine.

9. Subtract the backrest TED PID temperature from the backrest air inlet temperature and record the value.

10. Compare the cushion and backrest calculated temperature values. Both values should be between 6°-8°C (10.8°-14.4°F) and approximately equal (±1°C [±1.8°F]).

11. If the calculated temperature values are not within these specifications, check the climate controlled seat components for air duct or filter restrictions, blockages, duct or electrical disconnections and for incorrect assembly. Repair as needed. If OK, carry out the DCSM self-test and if any DTC is retrieved, go to Dual Climate Controlled Seat Module (DCSM) DTC Chart for diagnostic direction. Return to the diagnostic routine.

Heated Seat Module Reset

NOTE: This heated seat module is used on 2 different systems. These systems use 2 different on/off switches, the single momentary switch and the dual momentary switch. A new heated seat module is programmed to function for a single momentary switch.

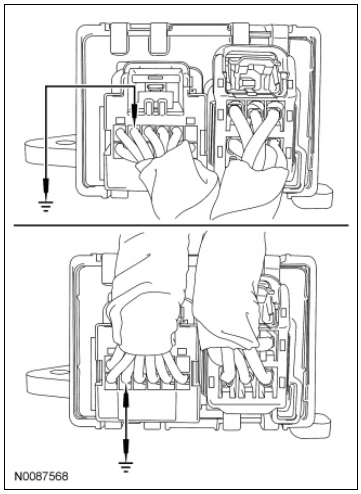
The single momentary switch provides a ground signal to the heated seat module on one circuit. This cycles the system high, low and off.

The dual momentary switch provides a ground to the heated seat module on 2 different circuits. Toggling the dual momentary switch to one side cycles the system low and off. Toggling the switch to the other side cycles the system high and off.

When a new heated seat module is installed on a system with a dual momentary switch and the module receives a ground signal from the low circuit of that switch, the module is then programmed to function for a dual momentary switch. Now the heated seat module will expect to see ground signals on 2 different circuits to cycle the system high/off and low/off.

Once the heated seat module is programmed for use with dual momentary switches, the heated seat module cannot be used with a single momentary switch heated seat system until the following reset procedure is carried out.

1. Back probe and short both high switch inputs to ground.



2. Turn the ignition ON.

3. Wait for heated seat switch LEDs to start flashing.

4. Disconnect both grounds as soon as the heated seat switch LEDs start flashing.

5. The LEDs will flash a total of 5 times when the module is reset.
   - Wait for the LEDs to stop flashing and the system should work correctly.

6. If the system does not work correctly, carry out the Heated Seat Module Reset steps again. Otherwise, refer to the Symptom Chart in the Seats portion of this section.

Memory Position Programming

Programming Memory Positions

NOTE: Memory positions can be stored at any time.

NOTE: Verify good battery condition before diagnosing the memory seat system. Poor battery condition may interfere with memory seat operation, even if vehicle starting is possible.

1. Place the vehicle ignition to ON.
2. **NOTE:** To program the Remote Keyless Entry (RKE) transmitter, refer to Section 501-14 .

   To set memory position(s), move the memory driver seat, memory exterior mirrors (if equipped), memory adjustable pedals (if equipped) and memory steering column (if equipped) to the preferred position using the appropriate switch(es).
3. **NOTE:** Input from the driver seat control switch, exterior mirror control switch (if equipped), steering column control switch (if equipped) and adjustable pedal control switch (if equipped) during memory programming will abort the operation.

   NOTE: If other tones or chimes are being produced, the memory save tone will not be heard because it is one of the lowest priorities.

   Press and hold a memory button (1 or 2) until a tone is heard (1.5 seconds). When the tone is heard, the memory programming is complete.
4. Repeat the previous steps to program another memory position.

Recalling a Stored Memory Position

NOTE: A memory recall can be initiated only if the vehicle is in PARK or NEUTRAL gear and the ignition is not in START. A memory recall in progress will not be affected by placing the ignition in START or by moving the gearshift lever out of PARK or NEUTRAL.

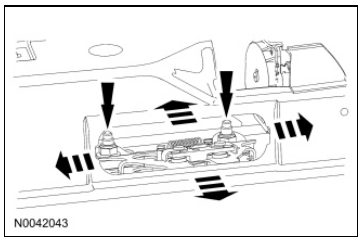
NOTE: Input from the driver seat control switch, memory SET switch, adjustable pedal control switch (if equipped), exterior mirror control switch (if equipped) or steering column control switch (if equipped) during a memory recall will abort the memory recall.

1. The driver can recall the desired memory driver seat, memory exterior mirror (if equipped), memory adjustable pedal (if equipped) and memory steering column (if equipped) positions by depressing either memory SET switch button 1 or 2. Depressing memory SET switch button 1 will initiate a recall of the positions stored for Memory 1. Depressing memory SET switch button 2 will initiate a recall of the positions stored for Memory 2.

Seat Latch Adjustment - Rear

1. Remove the parcel shelf. For additional information, refer to Section 501-05 .

2. Loosen the 2 rear seat backrest latch nuts. Adjust the latch position as necessary for good backrest fit and latch closure when upright.
   - Tighten to 48 Nm (35 lb-ft).



3. Install the parcel shelf. For additional information, refer to Section 501-05 .

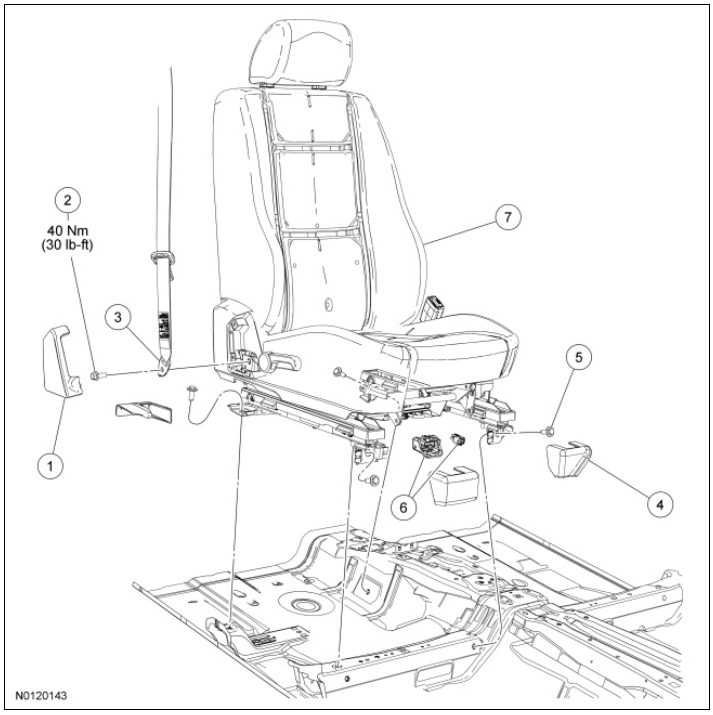
Seat - Front

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: Passenger seat shown, driver seat similar.

NOTE: The seat track-to-floor bolts must be tightened in the sequence described in this procedure.



Item	Part Number	Description
1	621A44	Safety belt retractor belt anchor bolt cover (part of 62184) (passenger only)
2	W505274	Safety belt retractor belt anchor bolt (passenger only)
3	-	Safety belt retractor belt anchor (part of 611B08) (passenger only)
4	61748 (passenger)/ 61749 (driver)	Seat-to-floor bolt cover (4 required)

5	W707858	Seat-to-floor bolt (4 required)
6	/td>	Electrical connectors (part of 14A698)
7	-	Front seat assembly

Removal

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition switch is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

Passenger seat

1. Remove the safety belt retractor belt anchor bolt cover from the cushion side shield to access the safety belt anchor bolt.
   - If equipped with power seats, position the seat track downward to access the safety belt retractor anchor bolt.

2. Remove the bolt and separate the safety belt anchor from the seat.

All seats

3. Push the release buttons on the head restraint guides and remove the head restraint.

4. Position the seat to gain access to all 4 seat-to-floor bolts.
   - If equipped with power seats, fully raise the seat to aid seat service.

5. Depower the S . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .

6. Remove the 4 seat track-to-floor bolt covers and bolts.

7. Lift the seat to disengage 2 locator pins from the floor and tip the seat to access the electrical connectors.

8. **⚠ WARNING: Use care when handling the front passenger seat and track assembly. Dropping the assembly, placing excessive weight on or sitting on a front passenger seat that is not secured in the vehicle may result in damaged seat components. Failure to follow these instructions may result in incorrect operation of the occupant classification system (OCS) and increases the risk of serious personal injury or death in a crash.**

   Disconnect the seat harness electrical connectors and remove the seat.

   - Slide and disengage the side air bag module electrical connector locking clip, release the tab and disconnect the side air bag module electrical connector.
   - ***NOTICE:*** **Use care when disconnecting the seat harness electrical connector. Excessive force on the assurance lever can break the connector mounting.**

     Disconnect the seat harness electrical connector.

- Release the locking tab and rotate the assurance lever fully to disengage the seat harness electrical connector.
- Slightly tip the connector away and disconnect.

Installation

⚠ WARNING: Make sure the front passenger seat is correctly installed and fastened to the vehicle. Do not force the alignment to the floorpan mounting holes. If the seat does not align to the floorpan mounting holes, repair the seat or floorpan as needed. Failure to follow these instructions may result in incorrect operation of the occupant classification system (OCS) and increase the risk of serious personal injury or death in a crash.

⚠ WARNING: After any crash, inspect the front passenger seat-to-floorpan mounting area for deformation and restore to its original condition, if deformed. Correct alignment of the occupant classification system (OCS) sensor rails to the seat and floorpan is critical for correct OCS operation. Incorrect operation of the OCS increases the risk of serious personal injury or death in a crash.

Manual seats

1. Align both seat track rails to be flush with the rear edge of the seat track base to synchronize.

All seats

2. Position the seat in the vehicle.

3. Tip the seat and connect the electrical connectors.
   - Connect the seat harness electrical connector.
     - Make sure the electrical connector assurance lever is in the fully released position.
     - Tip the body harness connector into the seat connector and partially insert.
     - Rotate the assurance lever while pushing the connectors together until the handle is locked.
   - Connect the side air bag module electrical connector, then slide and engage the side air bag electrical connector locking clip.

4. Align the 2 forward seat mounting locators to the guide holes in the floor and position the seat in place.

5. **NOTE:** Make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   Install the seat-to-floor bolts by hand and tighten in the following sequence.

   1. Tighten to 47 Nm (35 lb-ft).
   2. Tighten to 47 Nm (35 lb-ft).
   3. Tighten to 47 Nm (35 lb-ft).
   4. Tighten to 47 Nm (35 lb-ft).



6. Install the 4 seat-to-floor bolt covers.

7. Repower the SRS . **If a passenger seat has been serviced, do not prove out the SRS at this time.** For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .

8. Install the head restraint.

Passenger seat

9. **NOTE:** Make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   NOTE: If equipped with power seats, position the passenger seat track downward for safety belt retractor belt anchor and bolt installation.

   Position the safety belt retractor belt anchor to the seat and install the bolt.

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

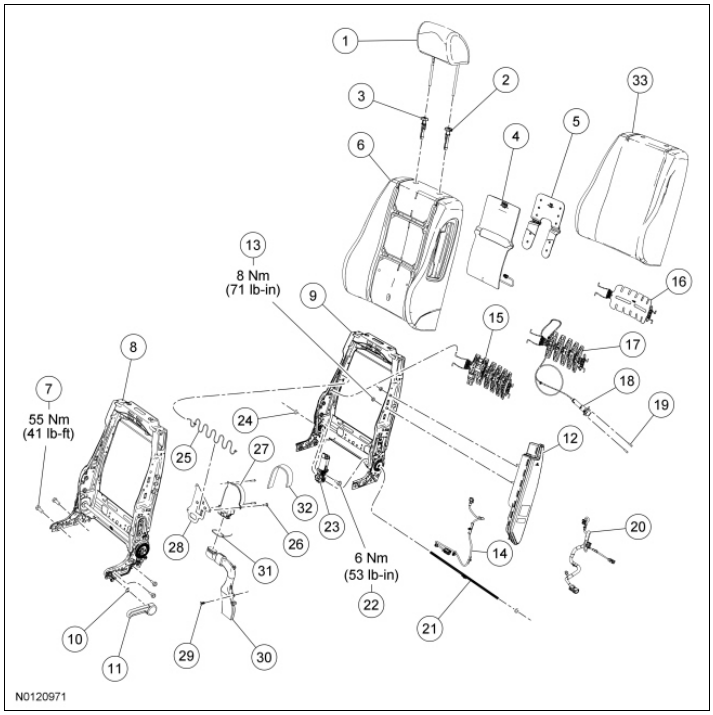
10. Install the safety belt retractor belt anchor bolt cover.

11. Carry out the Occupant Classification System (OCS) System Reset. For additional information, refer to the General Procedures portion of Section 501-20B .

Seat - Exploded View, Front

Front Seat Backrest

NOTE: Driver backrest shown, passenger backrest similar.

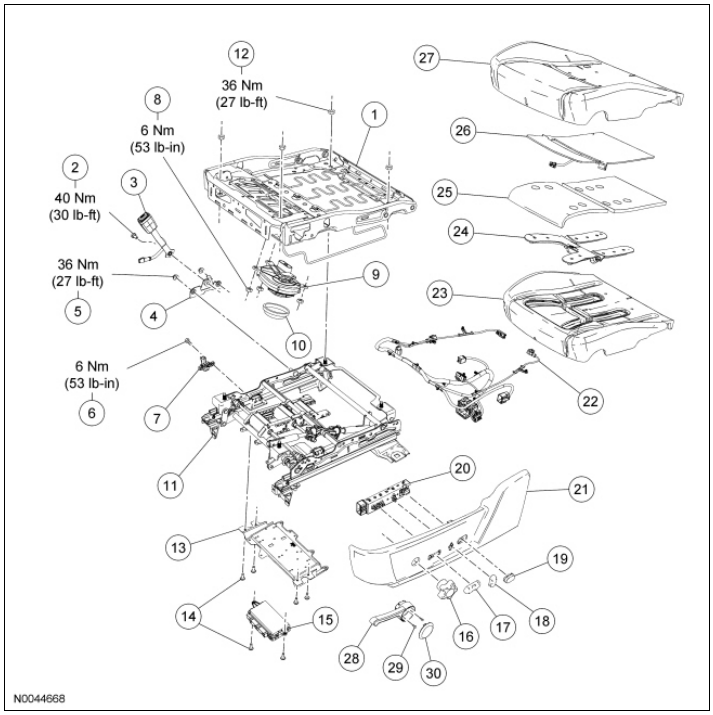


Item	Part Number	Description
1	611A08	Head restraint
2	610A16	Head restraint guide (master)
3	610A18	Head restraint guide (slave)
4	14D696	Backrest heater mat (if equipped)
5	19N550	Backrest manifold, climate controlled seat (if equipped)
6	64811	Backrest foam pad
7	W500632	Recliner-to-cushion frame bolt (4 required)
8	61018	Backrest frame (with manual recliner) (if equipped)
9	608A15	Backrest frame (with power recliner) (if equipped)
10	-	Spring clip, recliner handle (part of 61199) (if equipped)
11	61199	Handle, recliner (if equipped)
12	611D11	Side air bag module
13	N620480	Nut, side air bag (2 required)
14		

	14K155 td>Wiring harness, side air bag (if equipped)	
15	65500	Lumbar assembly, power (if equipped)
16	64842	Lumbar assembly, static (if equipped)
17	65500	Lumbar assembly, manual (if equipped)
18	610C01	Manual lumbar control (if equipped)
19	W715704	Rivet, manual lumbar control (2 required) (if equipped)
20	14C693	Wiring harness, power seat backrest (if equipped)
21	613A68	Recliner torque shaft
22	W790022	Bolt, recliner motor (if equipped)
23	14547	Recliner motor (if equipped)
24	-	Pal nut, recliner torque shaft (2 required)
25	64646	Upper support spring
26	W712476	Rivet, climate controlled seat Thermo-Electric Device (TED) (3 required) (if equipped)
27	19N550	TED assembly (if equipped)
28	18D583	Bracket, TED assembly (if equipped)
29	W790002	Pin-type retainer
30	18D507	Exhaust duct, climate controlled seat TED assembly (if equipped)
31	-	Tie strap
32	-	Filter, climate controlled seat TED assembly (part of 19N550) (if equipped)
33	64417	Backrest trim cover

Driver Seat Cushion

NOTE: Power seat track shown, manual seat track similar.

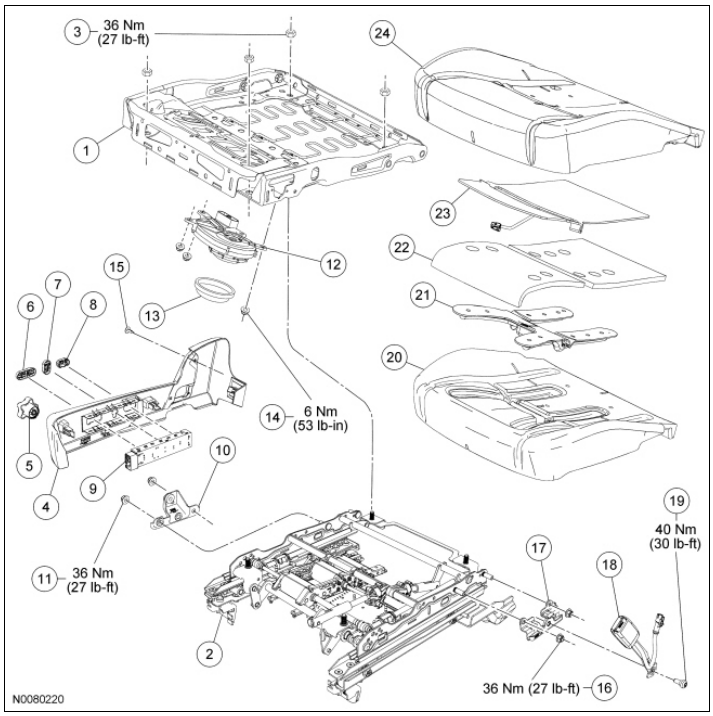


Item	Part Number	Description
1	63101	Cushion frame
2	-	Bolt, safety belt buckle (part of 61203)
3	61203	Safety belt buckle
4	610D09	Safety belt buckle bracket
5	W520113	Nut, safety belt buckle bracket-to-seat track (2 required)
6	W505256	Bolt, seat position sensor (part of 61203) (driver only)
7	14B416	Seat position sensor (driver only)
8	N620480	Nut, cushion Thermo-Electric Device (TED) (3 required) (if equipped)
9	19N550	
10	19E880	Cushion TED filter (if equipped)
11	61711	Seat track
12	W520113	Seat track-to-cushion frame nut (4 required)
13	610E34	Electrical bracket
14	-	Pop rivets (4 required)
15	14C708	Driver Seat Module (DSM) (if equipped)
16	62622	Manual lumbar control knob (if equipped)
17	14711	Seat control switch knob (if equipped)
18	14711	Power recline switch knob (if equipped)
19	14711	Power lumbar switch knob (if equipped)
20	14A701	Seat control switch (if equipped)
21	62187	Cushion side shield
22	14A699	Driver seat wire harness
23	632A23	Cushion foam pad
24	-	

		Cushion manifold, climate controlled seat (part of 632A23) (if equipped)
25	-	Cushion insert (part of 632A23) (if equipped)
26	14D696	Cushion heater mat (if equipped)
27	62900	Cushion trim co
28	61753	Manual height adjust handle (if equipped)
29	W711217	Screw, manual height adjust handle (if equipped)
30	62768	Cover, manual height adjust handle (if equipped)

Passenger Seat Cushion

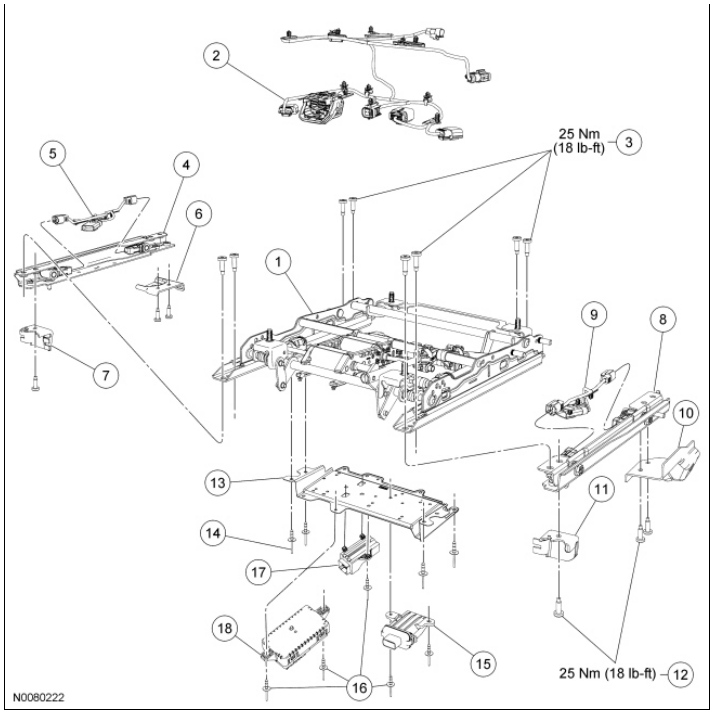
NOTE: Power seat track shown, manual seat track similar.



Item	Part Number	Description
1	63100	Cushion frame
2	61710	Seat track
3	W520113	Seat track-to-cushion frame nut (4 required)
4	62186	Cushion side shield
5	62622	Manual lumbar control knob (if equipped)
6	14711	Seat control switch knob (if equipped)
7	14711	Power recline switch knob (if equipped)
8	14711	Power lumbar switch knob (if equipped)
9	14A701	Seat control switch (if equipped)
10	610D08	Safety belt anchor bracket
11	W520113	Nut, safety belt anchor bracket (2 required)
12	19N550	Cushion Thermo-Electric Device (TED) (if equipped)

13	19E880	Cushion TED filter (if equipped)
14	N620480	Nut, cushion TED (3 required) (if equipped)
15	W790002	Scrivet
16	W520113	Nut, safety belt buckle bracket (2 required)
17	610D08	Safety belt buckle bracket
18	61202	Safety belt buckle
19	-	Bolt, safety belt buckle (part of 61202)
20	632A22	Cushion foam pad
21	-	Cushion manifold, climate controlled seat (part of 632A22) (if equipped)
22	-	Cushion insert (part of 632A22) (if equipped)
23	14D698	Cushion heater mat (if equipped)
24	62900	Cushion trim cover

Power Seat Track - Passenger



Item	Description	
1	61710	Seat track
2	14A698	Passenger seat wire harness
3	W712479	Occupant Classification System (OCS) rail-to-seat track bolts (8 required)
4	61708	Outboard OCS weight sensor assembly
5	14A577	Outboard OCS wire harness
6	61912	Rear outboard seat riser
7	61912	Front outboard seat riser
8	61709	Inboard OCS weight sensor assembly

9	14A578	Inboard OCS wire harness
10	61913	Rear inboard seat riser
11	61913	Front inboard seat riser
12	W712479	Seat riser-to-seat track bolts (6 required)
13	610E34	Electrical bracket
14	31134/31147	Pop rivet (4 required)
15	14B422	Occupant Classification System Module (OCSM)
16	31134/31147	Pop rivets (quantity varies with seat option)
17	14C724	Heated seat module (if equipped)
18	14C724	Dual Climate Controlled Seat Module (DCSM) (if equipped)

1. For additional information, refer to the procedures in this section.

Head Restraint Guide Sleeve

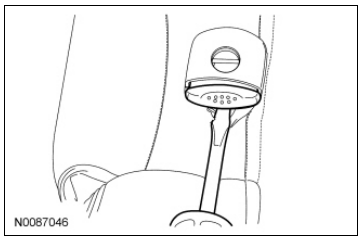
Removal

NOTE: Typical head restraint guide sleeve shown, others similar.

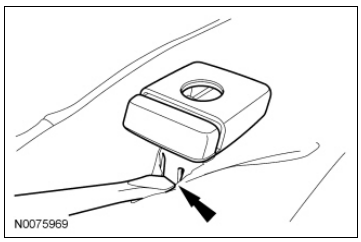
1. Push in on the 2 head restraint guide sleeve release buttons and remove the head restraint.

2. Obtain a flat-head screwdriver with a width of 4 mm (0.157 in) to 7 mm (0.275 in) and a thickness of approximately 1 mm (0.039 in).

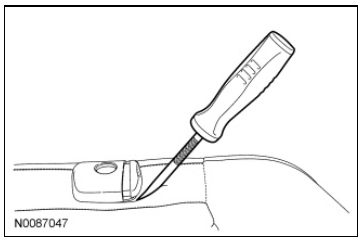
3. Align the screwdriver to the middle of the head restraint guide sleeve release button.



4. Position the screwdriver between the head restraint guide sleeve neck and backrest trim cover and foam pad.

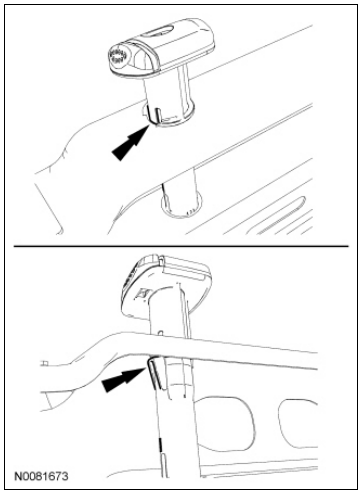


5. Position the screwdriver at a 45-degree angle.

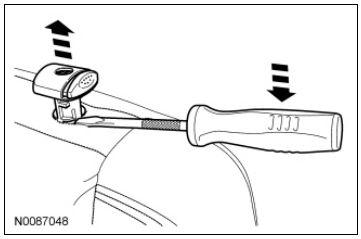


6. **NOTE:** For retainer clarity, backrest trim cover and foam pad are removed.

   Push the screwdriver in, bending the lock feature on the head restraint guide sleeve in.



7. While bending the lock feature in, push down on the screwdriver handle, prying the head restraint guide sleeve up and disengaging it from the backrest frame crossmember.



8. Remove the head restraint guide sleeve.
    - Discard the head restraint guide sleeve.

9. Repeat these steps for the head restraint guide sleeve on the opposite side.

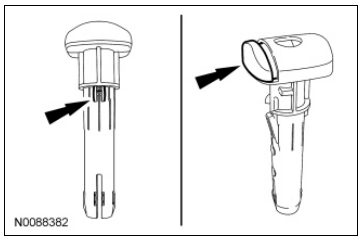
Installation

NOTICE: **Always install new head restraint guide sleeves. Difficult adjustment of the head restraint may occur. Failure to follow these instructions may result in component failure.**

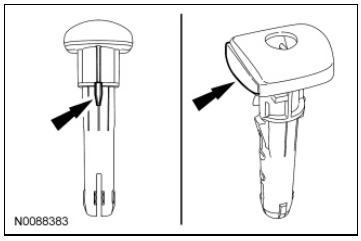
NOTICE: **The head restraint guide sleeves are not interchangeable. Failure to install the correct head restraint guide sleeve at the correct position may result in component failure.**

1. Make sure the holes in the backrest foam pad and backrest trim cover are aligned to the holes in the backrest frame.

2. Install the head restraint guide sleeve with the large button and wide key on the LH side of the seat.

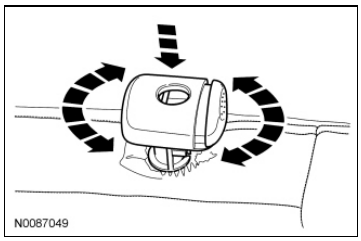


3. Install the head restraint guide sleeve with the small button and thin key on the RH side of the seat.



4. ***NOTICE:*** **Do not attempt to seat the head restraint guide sleeve by hand. This may result in excessive head restraint adjustment efforts and permanent damage to the head restraint guide sleeve.**

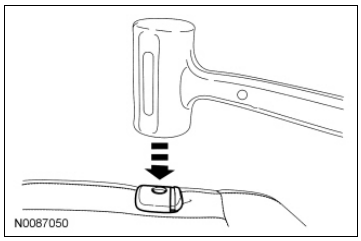
   To allow the head restraint guide sleeve to slide freely through the backrest foam pad and backrest trim cover, twist the head restraint guide sleeve while pushing it into the backrest frame hole as far as it will go with hand pressure.



5. ***NOTICE:*** **Striking effort should not result in any type of damage or distortion to the head restraint guide sleeve. If a head restraint guide sleeve is damaged, install a new one.**

   Using a non-marring mallet, strike the top of the head restraint guide sleeve with moderate force, seating it in the backrest frame.

   - Striking effort must be hard enough to snap the head restraint guide sleeve retainer in place in the backrest frame.



6. Inspect the head restraint guide sleeve.
   - Pull the head restraint guide sleeve out by hand, making sure it is locked in place. If the head restraint guide sleeve can be removed by hand, repeat the installation procedure. If the head restraint guide sleeve can be removed again after installing a second time, install a new head restraint guide sleeve.

7. Repeat these steps for the head restraint guide sleeve on the opposite side.

8. After installation of 2 new head restraint guide sleeves, install the head restraint in the following sequence.
   1. Position the head restraint rods to the head restraint guide sleeve holes.
   2. Push the head restraint down, guiding the rods into the head restraint guide sleeve holes.
   3. Make sure the head restraint adjusts without excessive effort and locks in place.

Seat Backrest - Front

Removal and Installation

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

NOTICE: **Do not reinstall the cushion side shield or side shield retainers after removal. These are one-time-use items that become damaged during removal and may not remain attached if reinstalled. Install a new side shield during seat assembly (includes new retainers attached).**

All seats

1. Remove the front seat. For additional information, refer to Seat - Front in this section.

2. Remove the manual height adjust handle, if equipped.
   - Remove the height adjust handle cover.
   - Remove the 2 screws and height adjust handle.

3. Remove the spring clip and manual recliner handle, if equipped.

4. Remove the manual lumbar control knob, if equipped.
   - Adjust the manual lumbar to the full relaxed position.
   - Pull outward and remove the manual lumbar knob.

Seat Backrest Cover - Front

Removal and Installation

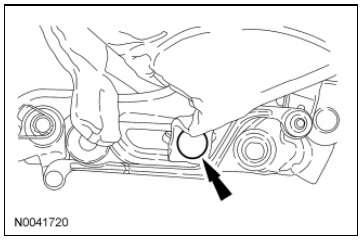
⚠ WARNING: Front seat backrest trim covers installed on seats equipped with seat side air bags cannot be repaired. A new trim cover must be installed. Cleaning is permissible. Failure to follow these instructions may result in the seat side air bag module deploying incorrectly and increase the risk of serious personal injury or death in a crash.

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

1. Remove the front seat backrest. For additional information, refer to Seat Backrest - Front in this section.

2. Remove the 2 head restraint guide sleeves. For additional information, refer to Head Restraint Guide Sleeve in this section.

3. Detach the 2 pin-type retainers and trim cover flaps from the recliners.



4. Disengage the backrest cover lower J-strips.

5. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the backrest foam pad.**

   Invert the backrest cover up the backrest, remove all rows of hog rings (if equipped) from the front of the backrest trim cover and separate the hook-and-loop strips.

6. Remove the backrest cover rear upper hog rings.
   - To install, make sure the climate controlled seat backrest manifold is correctly aligned to the foam pad, if equipped.

7. Separate any remaining hook-and-loop strips, invert up and remove the backrest cover.

8. To install, reverse the removal procedure.

Seat Cushion Cover - Front

Removal and Installation

1. Remove the front seat backrest. For additional information, refer to Seat Backrest - Front in this section.

2. **NOTE:** Trim cover J-clip configurations vary with seat option.

   Release all the remaining J-clips attaching the trim cover to the cushion frame.

3. ***NOTICE:*** **Use care when separating the seat cushion trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the cushion foam pad.**

   Release the hook-and-loop strips, remove the hog rings (if equipped), separate the cushion trim cover from the cushion foam pad and remove.

4. To install, reverse the removal procedure.

Seat Track

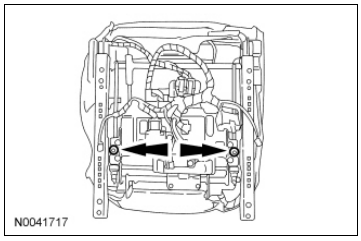
Removal and Installation

All seats

1. Remove the front seat backrest. For additional information, refer to Seat Backrest - Front in this section.

Passenger seat with failed horizontal motor

2. To remove the Occupant Classification System (OCS) weight sensor assemblies, remove the 2 seat track horizontal drive unit bolts. This will allow the power seat tracks to move manually for access to the 8 OCS weight sensor assembly bolts.



Passenger seat receiving a new seat track

3. Remove the inboard and outboard OCS weight sensor assemblies. For additional information, refer to Occupant Classification System (OCS) in Section 501-20B .

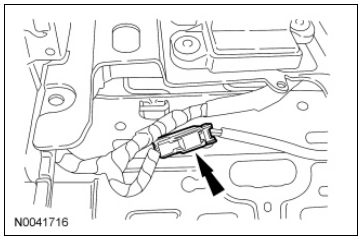
Power seat

4. If equipped, disconnect the seat control switch and remove the cushion side shield.

Heated seat

5. **NOTE:** Passenger seat shown, driver seat similar.

   Disconnect the cushion heater mat electrical connector.



All seats

6. Detach the hook-and-loop strips from around the safety belt buckle assembly.

7. Detach all wiring harness pin-type retainers from the cushion frame.

8. Release the cushion trim cover J-clips and remove the seat cushion foam pad and cushion trim cover.

Climate controlled seat

9. ***NOTICE:*** **Inspect the climate controlled seat cushion manifold and foam pad for crush or obstruction. Before installation, repair as needed.**

   NOTE: Covering the Thermo-Electric Device (TED) openings is recommended to prevent foreign material from entering the TED .

   Disconnect the TED assembly electrical connector.

All seats

10. Remove the 4 cushion frame-to-seat track nuts and separate the cushion frame and seat track.
    - To install, tighten to 36 Nm (27 lb-ft).

11. Detach any remaining wiring harness retainers attached to the cushion frame and remove the seat track.

12. To install, reverse the removal procedure.

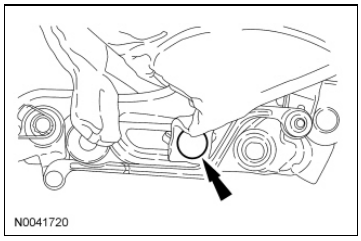
Seat Recliner Motor

Removal

NOTE: The manual recliners and power recliners are serviced as part of the backrest frame.

1. Remove the front seat backrest. For additional information, refer to Seat Backrest - Front in this section.

2. Detach the 2 pin-type retainers and trim cover flaps from the recliners.



3. Disengage the backrest cover lower J-strips.

4. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the backrest foam pad.**

   Invert the backrest cover up the backrest, remove all rows of hog rings (if equipped) from the front of the backrest trim cover and separate the hook-and-loop strips.

5. Remove the one-way push clip on the RH side of the power recliner. Slide the recliner shaft out from the LH side of the seat enough to clear the RH recliner and power recline motor.

6. Disconnect the electrical connector, remove the screw and the power recline motor.

Installation

1. ***NOTICE:*** **Avoid rotating the recliner shaft until the recliner is fully installed or the recliners will not be synchronized.**

   Install the recliner motor in the following sequence:

   1. Position the recliner shaft through the recliner motor and RH recliner.
   2. Install a new one-way push clip onto the recliner shaft at the RH recliner.
   3. Slightly turn the recliner motor to align the bolt hole with the hole in the RH recliner and install the recliner motor bolt.
      - Tighten to 6 Nm (53 lb-in).
   4. Connect the recliner motor electrical connecto

2. Roll the backrest trim cover down, attach the hook-and-loop strips, install new hog rings (if equipped) and attach the backrest cover lower J-strips.

3. Attach the 2 pin-type retainers and trim cover flaps to the recliners.

4. Install the front seat backrest. For additional information, refer to Seat Backrest - Front in this section.

Lumbar Assembly

Removal and Installation

All vehicles

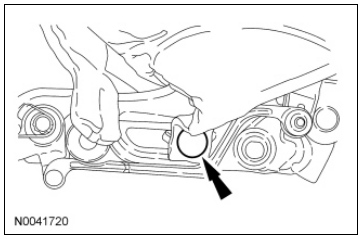
1. Remove the front seat backrest. For additional information, refer to Seat Backrest - Front in this section.

Vehicles with climate controlled seats

2. Remove the 2 head restraint guide sleeves. For additional information, refer to Head Restraint Guide Sleeve in this section.

All vehicles

3. Detach the 2 pin-type retainers and trim cover flaps from the recliners.



4. Disengage the backrest cover lower J-strips.

5. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the backrest foam pad.**

   Invert the backrest cover up the backrest, remove all rows of hog rings (if equipped) from the front of the backrest trim cover and separate the hook-and-loop strips.

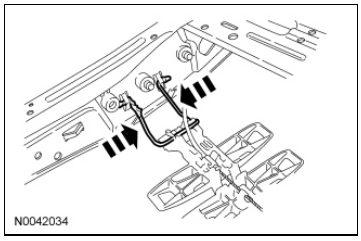
Vehicles with climate controlled seats

6. Remove the rear upper hog rings attaching the trim cover to the backrest frame and remove the trim cover.

7. Remove the foam pad from the backrest frame.
   - If equipped with climate controlled seats, remove the hog rings from the upper support spring.
   - If equipped with heated seats, detach the pin-type retainer and backrest heater mat wiring harness from the backrest frame.

All vehicles

8. Release the 2 lumbar spring clips from the backrest frame and remove the lumbar.
   - Route out the manual lumbar cable, if equipped.
     - ♦ Note the routing of the lumbar cable for installation.
   - Disconnect the electrical connector from the power lumbar motor, if equipped.



9. To install, reverse the removal procedure.

Seat Backrest Thermo-Electric Device

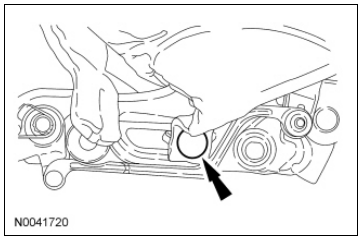
Removal and Installation

NOTE: The backrest Thermo-Electric Device (TED) filter is detachable from the TED assembly housing and can be replaced without TED removal.

1. Remove the front seat backrest. For additional information, refer to Seat Backrest - Front in this section.

2. Remove the 2 head restraint guide sleeves. For additional information, refer to Head Restraint Guide Sleeve in this section.

3. Detach the 2 pin-type retainers and trim cover flaps from the recliners.



4. Disengage the backrest cover lower J-strips.

5. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the backrest foam pad.**

   Invert the backrest cover up the backrest, remove all rows of hog rings (if equipped) from the front of the backrest trim cover and separate the hook-and-loop strips.

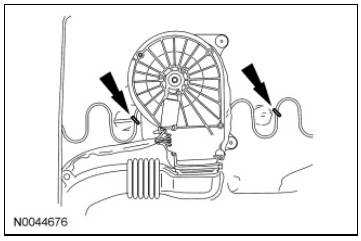
6. Remove the rear upper hog rings and trim cover.

7. ***NOTICE:*** **Inspect the climate controlled seat backrest manifold for crush and obstruction before installation. If damaged, install a new backrest manifold.**

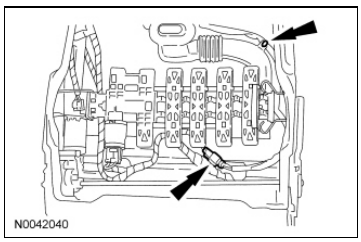
   If necessary, remove the climate controlled seat backrest manifold from the foam pad.

   - To install, align the backrest manifold and insert into the valleys of the foam pad.
     - ♦ Check for correct fit between the manifold, foam pad and TED assembly, to make sure there is no air flow obstruction or cushion crush.

8. Remove the hog rings from the upper support spring and remove the foam pad.



9. Disconnect the backrest TED assembly electrical connector and detach the wiring harness retainers.



10. Remove the TED exhaust duct.
    - Cut and remove the tie strap.
        - ♦ During installation, install a new tie strap.
    - Remove the pin-type retainer and separate the exhaust duct from the TED .

11. Disconnect the backrest upper support spring from the backrest frame and remove the spring support with the TED attached.

12. If necessary, detach the backrest TED filter from the TED .

13. **NOTE:** Note the TED position on the support spring for installation.

    Separate the TED from the upper backrest support spring.

14. ***NOTICE:*** **Cover the Thermo-Electric Device (TED) openings before removing any rivets to prevent foreign material from entering the TED .**

    Remove the 3 rivets and bracket from the TED .

15. To install, reverse the removal procedure.

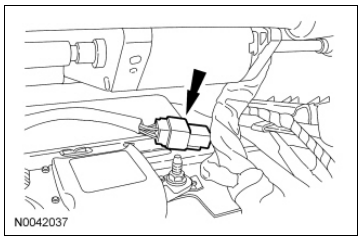
Seat Cushion Thermo-Electric Device

Removal and Installation

NOTE: The cushion Thermo-Electric Device (TED) filter is detachable from the TED assembly housing from underneath the seat cushion.

1. Remove the front seat. For additional information, refer to Seat - Front in this section.
   - Fully raise the seat before depowering the Supplemental Restraint System (SRS) to aid cushion TED assembly access.

2. Disconnect the TED electrical connector.



3. ***NOTICE:*** **Inspect the climate controlled seat cushion manifold and foam pad for crush or obstruction. Before installation, repair as needed. Failure to do so may cause the climate control to work inefficiently.**

   Remove the 3 nuts and TED assembly from the cushion frame.

   - To install, tighten to 6 Nm (53 lb-in).
   - To install, check for correct fit between the cushion manifold, foam pad and TED assembly, to make sure there is no airflow obstruction, cushion crush or foreign material.

4. To install, reverse the removal procedure.

Dual Climate Controlled Seat Module (DCSM)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Removal

NOTE: When installing a new Dual Climate Controlled Seat Module (DCSM), it is necessary to carry out the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

1. Before removing the DCSM , carry out the appropriate steps in the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

2. Remove the front passenger seat. For additional information, refer to Seat - Front in this section.

3. Remove the DCSM from the cushion electrical bracket.
   - Release the locking wedges and disconnect the 3 DCSM electrical connectors.
   - Remove the 2 rivets and DCSM .

Installation

1. Install the DCSM to the seat.
   - Position the DCSM to the electrical bracket and install 2 new rivets.
   - Connect the 3 DCSM electrical connectors and locking wedges.

2. Install the front seat. For additional information, refer to Seat - Front in this section.

3. After installing the DCSM , carry out the appropriate steps in the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

Heated Seat Module

Removal and Installation

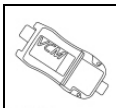
1. Remove the front passenger seat. For additional information, refer to Seat - Front in this section.

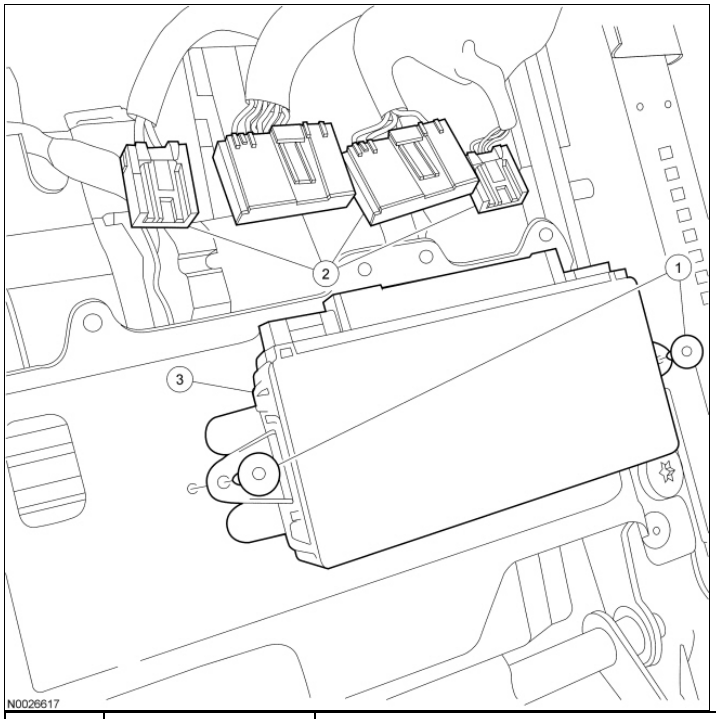
2. Remove the heated seat module from the cushion electrical bracket.
   - Disconnect the 2 heated seat module electrical connectors.
   - Remove the rivet and heated seat module.

3. To install, reverse the removal procedure.

Driver Seat Module (DSM)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool



Item	Part Number	Description
1	-	Driver Seat Module (DSM) rivets (2 required)
2	-	DSM electrical connectors (part of 14A699)
3	13C789	DSM

Removal and Installation

NOTICE: **Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.**

NOTE: Prior to the removal of the module, it is necessary to upload the module configuration information to the appropriate scan tool. This information needs to be downloaded into the new module once installed. For additional information, refer to Section 418-01 .

1. **NOTE:** This step is necessary only if the Driver Seat Module (DSM) is being replaced.

   Upload the module configuration information from the DSM into the scan tool. For additional information, refer to Section 41 .

2. Remove the driver seat. For additional information, refer to Section 501-10 .

3. Drill out the 2 rivets.

4. Disconnect the 4 electrical connectors and remove the DSM .

5. To install, reverse the removal procedure.
   - **NOTE:** If the DSM was not replaced, this substep is not necessary.

     Download the DSM configuration from the scan tool into the new DSM . For additional information, refer to Section 418-01 .

Seat Control Switch

Removal and Installation

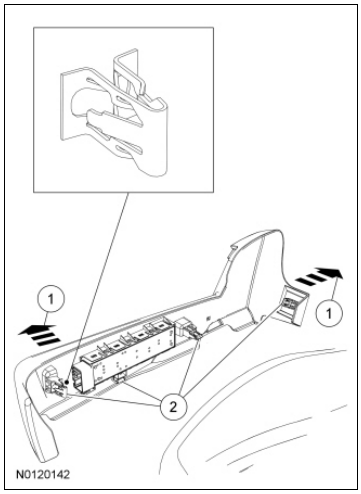
NOTICE: **Do not reinstall the cushion side shield or side shield retainers after removal. These are one-time-use items that become damaged during removal and may not remain attached if reinstalled. Install a new side shield during seat assembly (includes new retainers attached).**

1. Remove the front seat. For additional information, refer to Seat - Front in this section.

2. Remove the spring clip and manual recliner handle, if equipped.

3. Pull and remove the manual lumbar control knob and seat control switch button(s), if equipped.

4. Remove and discard the cushion side shield and one-time-use retainers.
    1. Pull out on the side and rear of the cushion side shield and release the retainers.
        - Separate the wire harness from the cushion side shield.
    2. Remove the side shield and any remaining side shield retainers from the seat and discard.
        - For installation, install a new cushion side shield (includes new retainers attached).



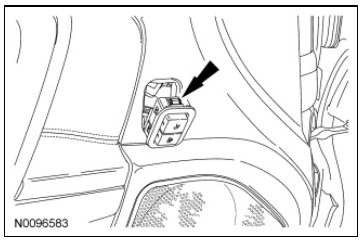
5. Disconnect the seat control switch, release the cushion side shield retainers and remove the seat control switch.

6. To install, reverse the removal procedure.

Memory Set Switch

Removal and Installation

1. Release the memory SET switch bezel tab at the top and separate from the door panel.

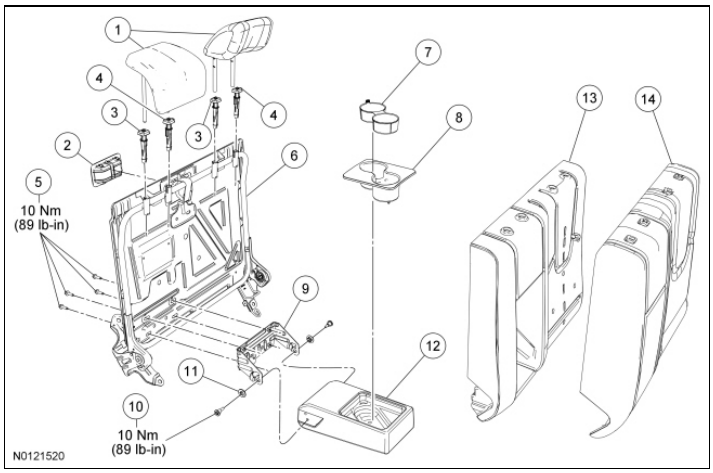


2. Disconnect the electrical connector, release the 4 tabs and remove the memory SET switch.

3. To install, reverse the removal procedure.

Seat - Exploded View, Rear

Rear Seat Backrest, 60 Percent



Item	Part Number	Description
1	611A08	Head restraints (1 each required)
2	66716	Striker cover
3	610A18	Head restraint guide sleeves (without button) (2 required)
4	610A16	Head restraint guide sleeves (with button) (2 required)
5	-	Armrest bracket-to-backrest bolts (4 required)
6	613A39	Backrest frame
7	047A74	Rubber insert, armrest cup holder
8	13562	Armrest cup holder
9	67210	Armrest bracket
10	W790023	Armrest pivot bolt (2 required)
11	613B44	Armrest pivot bushing (2 required)
12	67112	Armrest assembly
13	66801	Backrest foam pad
14	66601	Backrest trim cover

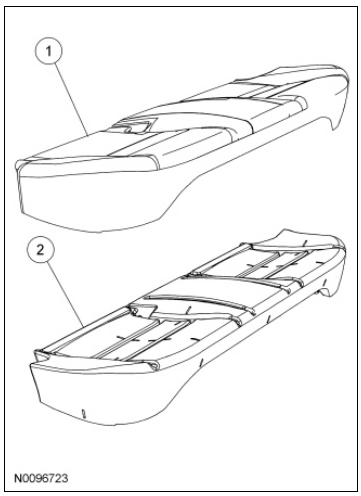
Rear Seat Backrest, 40 Percent

.

Item	Part Number	Description
1	611A08	Head restraint
2	66716	Striker cover
3	610A18	Head restraint guide sleeve (without button)

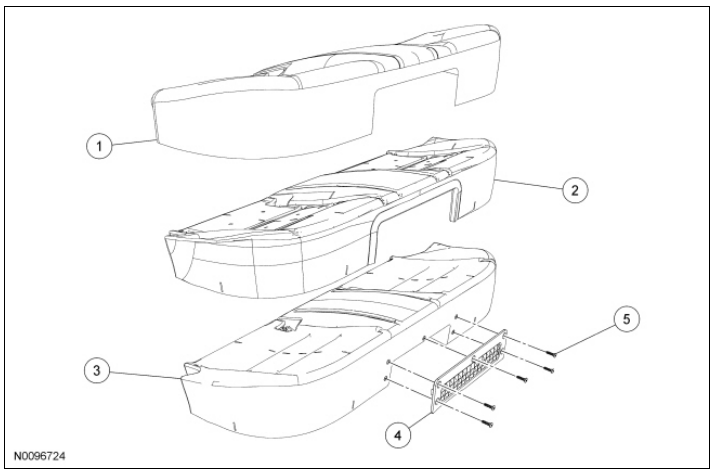
4	610A16	Head restraint guide sleeve (with button)
5	613A38	Backrest frame
6	66800	Backrest foam pad
7	66600	Backrest trim cover

Rear Seat Cushion, Non-Hybrid



Item	Part Number	Description
1	63804	Cushion cover
2	600A88	Cushion foam pad

Rear Seat Cushion, Hybrid

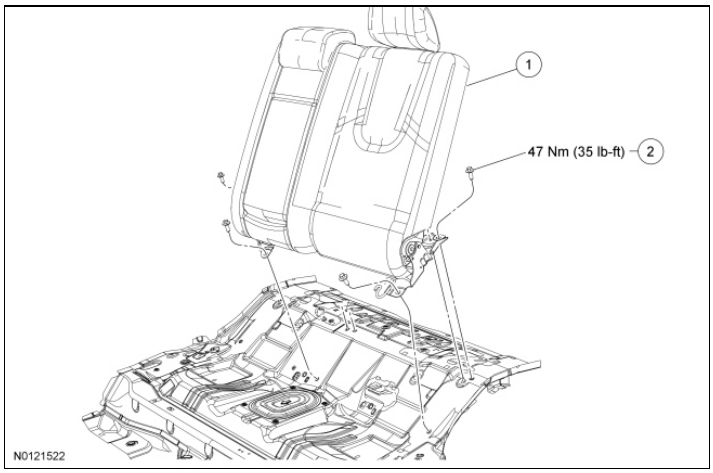


Item	Part Number	Description
1	63804	Cushion cover
2	600A88	Cushion foam pad
3	63160	Hard foam
4	638A52	Grille
5	-	Screw (5 required) (part of 638A52)

1. For additional information, refer to the procedures in this section.

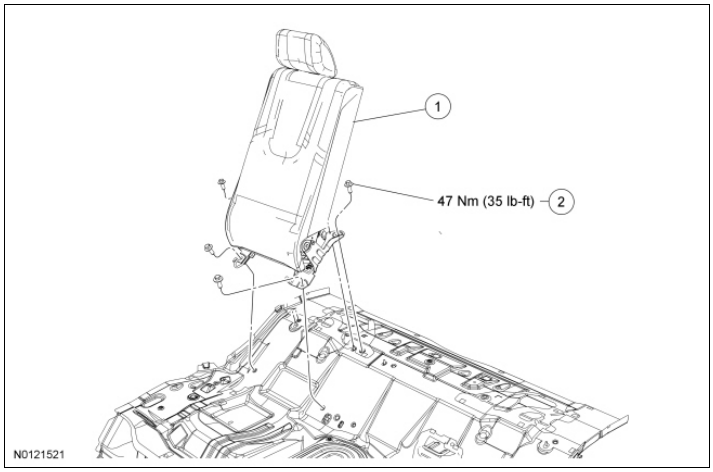
Seat Backrest - Rear

Rear Seat Backrest, 60 Percent



Item	Part Number	Description
1	-	Backrest assembly
2	W707858	Backrest-to-floor bolt (4 required)

Rear Seat Backrest, 40 Percent



Item	Part Number	Description
1	-	Backrest assembly
2	W707858	Backrest-to-floor bolt (4 required)

Removal

NOTE: If the center safety belt retractor locks and the safety belt webbing prevents the 60 percent backrest from lowering, raise the backrest upward to release the safety belt retractor and belt webbing.

All vehicles

1. Remove the rear seat cushion. For additional information, refer to Seat Cushion - Rear in this section.

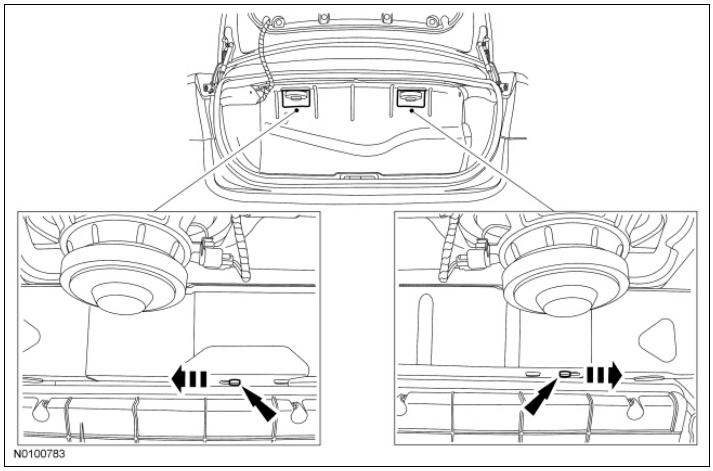
2. Remove the 2 forward backrest-to-floor bolts from the affected rear seat backrest.

Non-Hybrid vehicles

3. Open the trunk, pull the release handle under the quarter panel and fold the affected backrest down.

Hybrid vehicles

4. Fold the affected backrest down.
   - Between the High Voltage Traction Battery (HVTB) and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.



All vehicles

5. Remove the 2 rearward backrest-to-floor bolts from the affected rear seat backrest.
   - Position aside the floor trim cover behind the backrest to gain access to the rearward backrest-to-floor bolts.

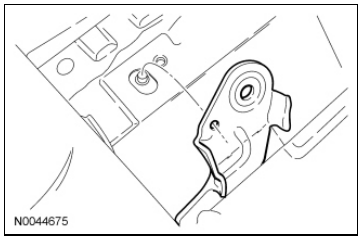
6. Raise the rear seat backrest and hinge assembly above the 2 locator pins on the floor and remove the backrest.

Installation

1. **NOTE:** Make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   Position the rear seat backrest pivot assembly to the 2 locator pins on the floor.

   - Make sure the rear seat safety belt webbing is positioned in front of the backst assembly for installation and is not positioned underneath the backrest pivot assembly.



2. Install the 2 rearward backrest-to-floor bolts.
    - Tighten to 47 Nm (35 lb-ft).

3. Position the backrest upright and install the 2 forward backrest-to-floor bolts.
    - Tighten to 47 Nm (35 lb-ft).

4. Check backrest latch and latch release operation.
    - Raise the backrest and check for good backrest fit and latch closure when upright.
    - If necessary, adjust the rear seat latch. For additional information, refer to Seat Latch Adjustment - Rear in the General Procedures portion of this section.

Seat Backrest Cover - Rear, 40 Percent

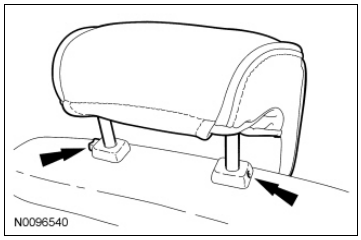
Removal and Installation

All vehicles

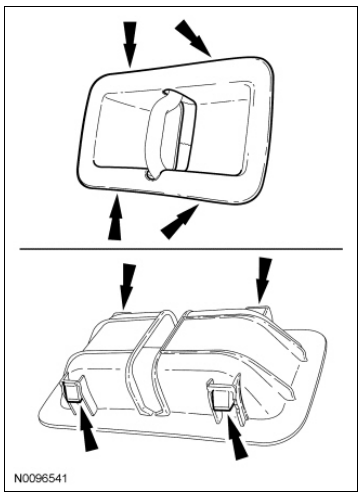
1. Remove the 40 percent rear seat backrest. For additional information, refer to Seat Backrest - Rear in this section.

2. **NOTE:** Typical head restraint shown.

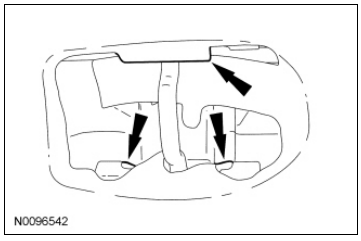
   While lifting up on the head restraint, push in the hole, push in the button and remove the head restraint.



3. Release 4 tabs (2 shown) and remove the striker cover.



4. Release the backrest cover from around the striker opening.

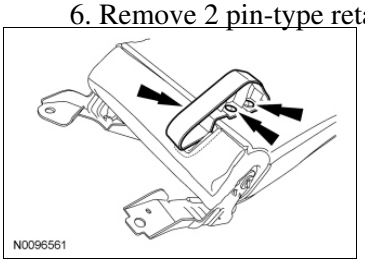


- **NOTE:** The head restraint guide sleeves are keyed and will not interchange. Install the head restraint guide sleeve with the button on the LH side.

Squeeze the ends of the head restraint guide sleeves together and remove.

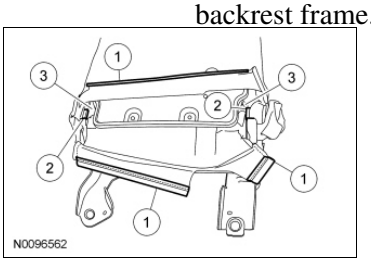
Hybrid vehicle

6. Remove 2 pin-type retainers and the duct end seal.



All vehicles

7. Separate the backrest cover.
    1. Disengage the lower J-strips.
        - Slide the heat deflector out from between the backrest frame and backrest cover, if equipped.
    2. Disengage the 2 J-clips.
    3. Disengage the backrest cover clip and unwrap the backrest cover from around the backrest frame.



8. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the backrest foam pad.**

    Remove the backrest cover.

    - Invert the backrest cover, separate the hook-and-loop strips and remove all rows of hog rings working up the backrest.
9. To install, reverse the removal procedure.

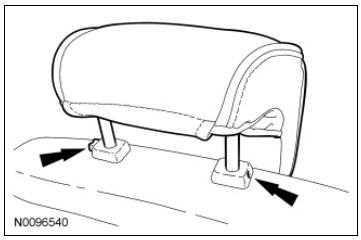
Seat Backrest Cover - Rear, 60 Percent

Removal and Installation

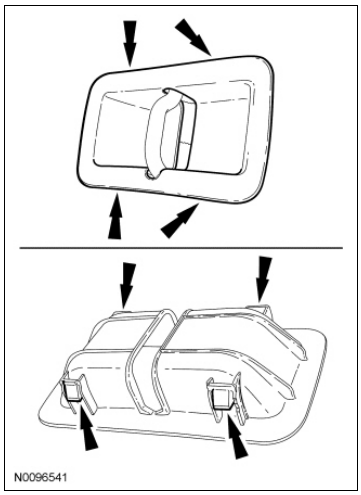
All vehicles

1. Remove the 60 percent rear seat backrest. For additional information, refer to Seat Backrest - Rear in this section.

2. While lifting up on the head restraint, push in the hole, push in the button and remove the head restraint.
    - Repeat for the other head restraint.



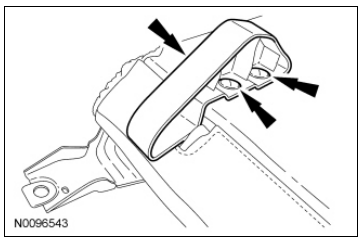
3. Release 4 tabs (2 shown) and remove the striker cover.



4. Release the backrest cover from around the striker opening.

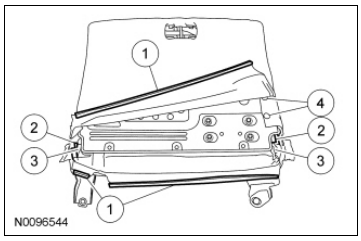
Hybrid vehicle

5. Remove 2 pin-type retainers and the duct end seal.

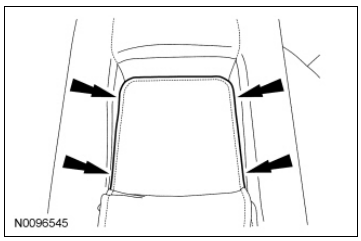


All vehicles

6. Separate the backrest cover.
    1. Disengage the lower J-strips.
        - ♦ Slide the heat deflector out from between the backrest frame and backrest cover, if equipped.
    2. Disengage the 2 J-clips.
    3. Disengage the backrest cover clip and unwrap the backrest cover from around the backrest frame.
    4. Remove 2 pin-type retainers.

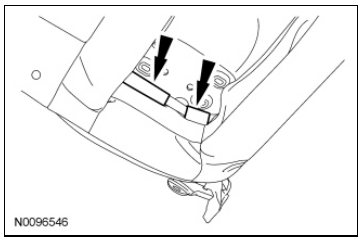


7. Separate 4 pin-type retainers attaching the armrest pocket cover to the backrest frame.



8. Remove the 4 armrest-to-backrest bolts and armrest assembly.
    - For installation, adjust the armrest horizontally as needed for good fit.
    - To install, tighten to 10 Nm (89 lb-in).

9. Disengage 2 clips in the armrest pocket.



10. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the backrest foam pad.**

Invert the backrest cover up as far as it will go.

- Separate the hook-and-loop strips and remove all rows of hog rings working up the backrest.

11. **NOTE:** The head restraint guide sleeves are keyed and will not interchange. Install the head restraint guide sleeve with the button on the LH side.

    Under the backrest foam pad, squeeze the ends of the head restraint guide sleeves together and remove.

12. Remove the backrest cover.

13. To install, reverse the removal procedure.

Seat Armrest - Rear

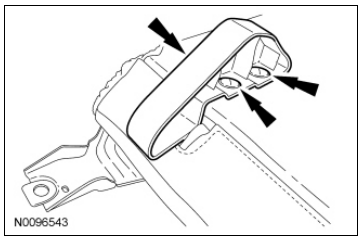
Removal and Installation

All vehicles

1. Remove the 60 percent rear seat backrest. For additional information, refer to Seat Backrest - Rear in this section.

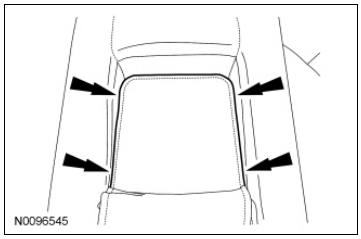
Hybrid vehicle

2. Remove the 2 pin-type retainers and the duct end seal.



All vehicles

3. Separate the 4 pin-type retainers attaching the armrest pocket cover to the backrest frame.



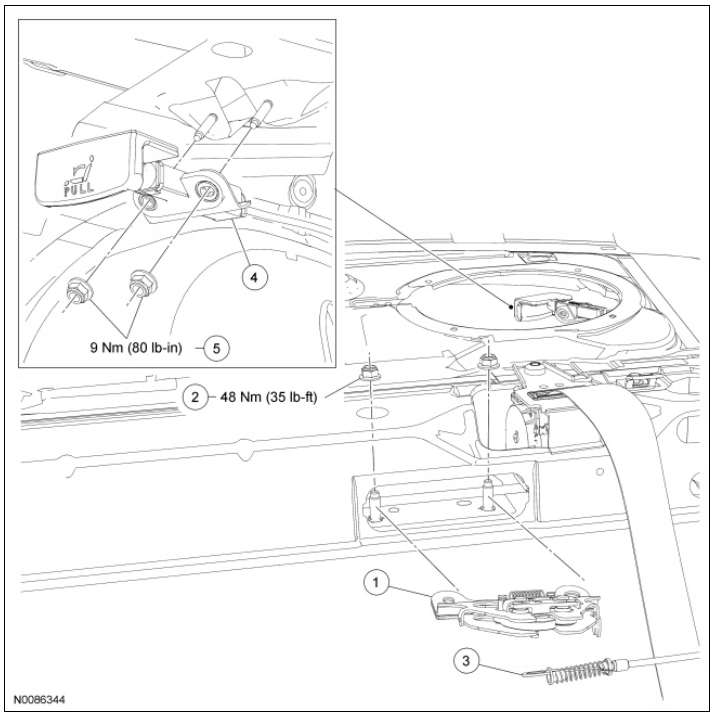
4. Remove the armrest assembly.
    1. Disengage the backrest cover lower J-strips.
    2. Remove the 4 armrest-to-backrest bolts and armrest assembly.
        - For installation, adjust the armrest horizontally as needed for good fit.
        - To install, tighten to 10 Nm (89 lb-in).

5. Disassemble the armrest assembly in the following sequence.
    1. Remove the cup holder rubber insert.
    2. Remove 2 pin-type retainers and the cup holder.
    3. Remove 2 armrest pivot bolts and armrest bracket.
        - To install, tighten to 10 Nm (89 lb-in).
    4. Release the armrest cover clip, invert and remove.

6. To install, reverse the removal procedure.

Seat Backrest Latch - Rear

NOTE: LH side shown, RH side similar.



Item	Part Number	Description
1	613D61	Backrest latch assembly
2	W520103	Backrest latch nut (2 required)
3	601L60	Latch release cable assembly
4	624A94	Latch release handle bracket (non-hybrid vehicles)
5	W520101	Latch release handle bracket nuts (2 required) (non-hybrid vehicles)

Removal

NOTE: LH side shown, RH side similar.

All vehicles

1. Remove the parcel shelf from the rear of the vehicle to access the rear backrest latch nuts. For additional information, refer to Section 501-05 .

2. **NOTE:** Make sure the affected backrest is released.

   Access the luggage compartment, detach the trim pin-type retainer and position the trim aside.

Non-hybrid vehicles

3. Re the 2 nuts and detach the latch release handle bracket.

4. Detach the 2 pin-type retainers and latch cable assembly.
    - Note the cable routing for installation.

5. Detach the release cable from the latch and remove.

All vehicles

6. Remove the backrest latch.
    - Remove the 2 nuts and backrest latch.

Installation

Non-hybrid vehicles

1. Attach the release cable to the latch.

2. Route the release cable, position the release handle and bracket to the 2 studs and install the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).
    - Install the 2 release cable pin-type retainers.
    - Position the trim and install the pin-type retainer.

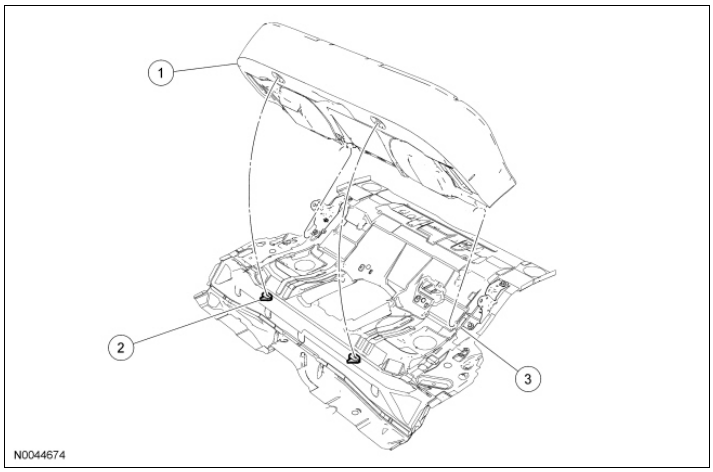
All vehicles

3. Position the latch and install the nuts.
    - Adjust the latch. For additional information, refer to Seat Latch Adjustment - Rear in the General Procedures portion of this section.
    - Tighten to 48 Nm (35 lb-ft).

4. Install the parcel shelf. For additional information, refer to Section 501- .

Seat Cushion - Rear

NOTE: Backrest pad and frame removed for clarity.



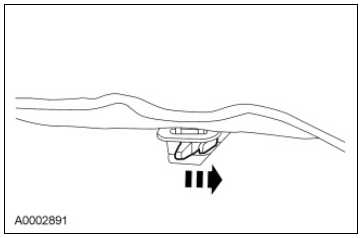
Item	Part Number	Description
1	-	Cushion assembly
2	624A14	Cushion latch (2 required)
3	-	Cushion rear retainer (2 required, part of rear seat backrest)

Removal and Installation

1. ***NOTICE:*** **Do not force the latches or cushion to release. Applying excessive force to release the rear seat cushion latches can damage them.**

   NOTICE: **Make sure the 2 rear cushion latches are fully disengaged before raising the seat cushion to avoid damaging the latches.**

   From under the front of the cushion assembly, push each of the 2 seat cushion latch release levers to the left of the vehicle. Lift up at the front and release the front of the cushion assembly.



2. ***NOTICE:*** **The Hybrid Electric Vehicle (HEV) seat cushion can be easily damaged if not removed correctly. Do not attempt to removet cushion without disengaging the wires in the hard foam from the backrest frame hooks. Failure to follow this instruction can pull the wires out of the hard foam.**

Release the rear of the seat cushion in the following sequence.

1. Push the cushion assembly back as far as possible.
2. Lift up at the rear outboard ends of the cushion assembly, disengaging the wires in the cushion from the wire retainer hooks of the backrest assembly.
3. Pull the cushion assembly forward and remove.

3. **NOTE:** Make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   To install, reverse the removal procedure.

   - Make sure the wires in the cushion are engaged to the wire retainer hooks of the backrest assembly on each side.

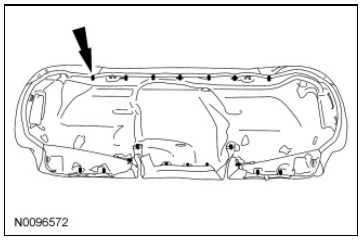
Seat Cushion Cover - Rear

Removal and Installation

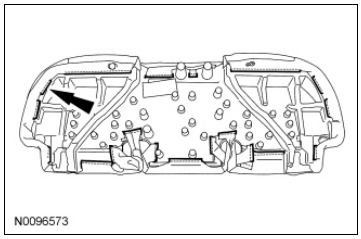
1. Remove the rear seat cushion. For additional information, refer to Seat Cushion - Rear in this section.

2. If equipped, remove 5 screws and the grille.

3. If equipped, remove the hog rings retaining the cushion cover wire to the cushion foam pad wire and the draw strings to the cover wires.



4. If equipped, separate the cushion cover retainers attached to the hard foam.



5. Invert the cushion cover.

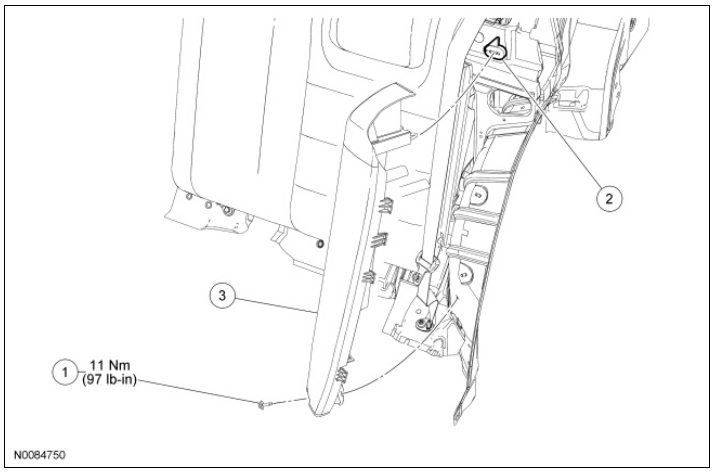
6. ***NOTICE:*** **Use care when separating the cushion cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the cushion foam pad.**

   Remove the hog rings (if equipped), separate the hook-and-loop strips and remove the cushion cover.

7. To install, reverse the removal proced

Seat Bolster - Rear

NOTE: LH side shown, RH side similar.



Item	Part Number	Description
1	W710330	Bolster bolt
2	-	Bolster latch
3	66893	Rear seat side bolster

Removal

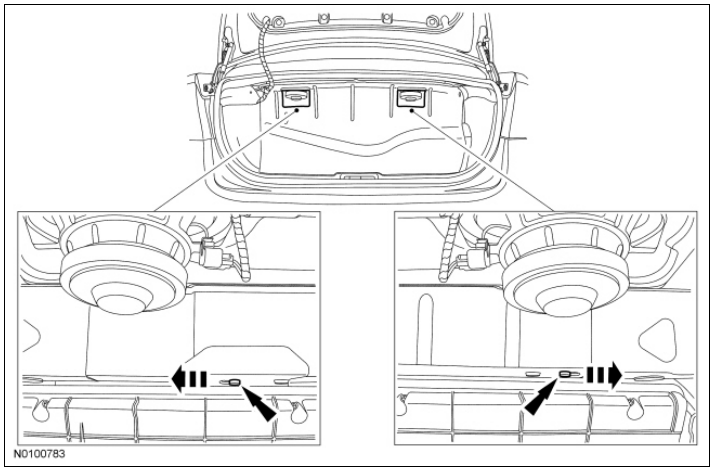
NOTICE: **Do not apply excessive forward force to the side bolsters or damage may occur.**

1. Remove the rear seat cushion. For additional information, refer to Seat Cushion - Rear in this section.

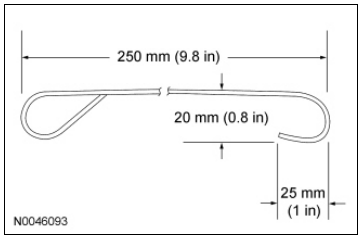
2. Remove the bolt from the affected side bolster.

3. For non-hybrid vehicles, open the trunk, pull the release handle under the quarter panel and fold the affected seat backrest down.

4. For hybrid vehicle, fold the affected backrest down.
   - Between the High Voltage Traction Battery (HVTB) and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down



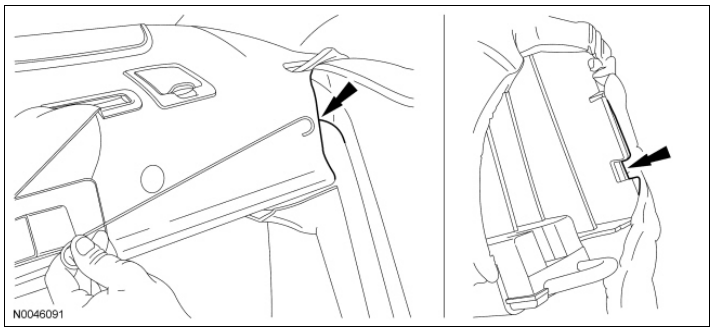
5. If removing the LH side bolster, fashion a tool for releasing the LH side bolster as shown.



6. **NOTE:** LH side shown, RH side similar.

   NOTE: The latch release tabs are accessible through a small service notch located on the rear inboard edge of each side bolster (behind the bolster trim cover sew seam).

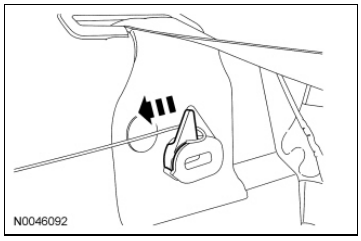
   Locate the service notch behind the rear inboard edge of the affected side bolster to access the latch release tab.



7. ***NOTICE:*** **Do not force the latch or side bolster to release. Applying excessive force can damage the latch.**

   NOTE: Latch shown with bolster removed for clarity.

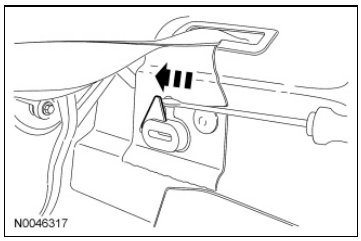
   To remove the LH side bolster, use a hooked pick or fashion a hooked tool to pull the latch release toward the RH side of the vehicle and release the side bolster.



8. *NOTICE:* **Do not force the latch or side bolster to release. Applying excessive force can damage the latch.**

   NOTE: Latch shown with bolster removed for clarity.

   To remove the RH side bolster, use a flat-blade screwdriver to push the latch release toward the RH side of the vehicle and release the side bolster.



9. With the affected bolster latch released, pull the side bolster forward and remove.

Installation

1. **NOTE:** Make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   Position the side bolster, align and insert to the latch.

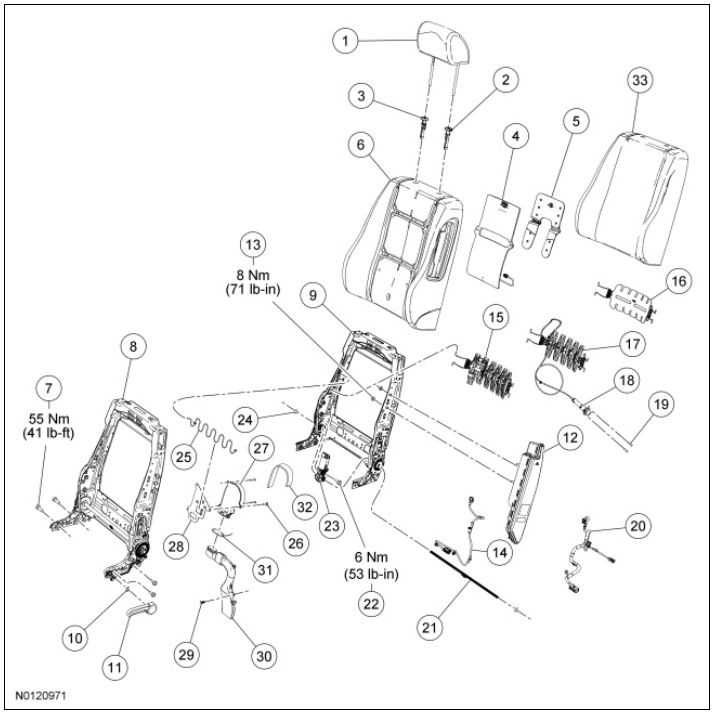
2. Align the bolt holes and install the side bolster bolt.
   - Tighten to 11 Nm (97 lb-in).

3. Install the rear seat cushion. Refer to Seat Cushion - Rear in this section.

>

Seat Backrest - Front

NOTE: Driver backrest shown, passenger backrest similar.



Item	Part Number	Description
1	611A08	Head restraint
2	610A16	Head restraint guide (master)
3	610A18	Head restraint guide (slave)
4	14D696	Backrest heater mat (if equipped)
5	19N550	Backrest manifold, climate controlled seat (if equipped)
6	64811	Backrest foam pad
7	W500632	Recliner-to-cushion frame bolt (4 required)
8	61018	Backrest frame (with manual recliner) (if equipped)
9	608A15	Backrest frame (with power recliner) (if equipped)
10	-	Spring clip, recliner handle (part of 61199) (if equipped)
11	61199	Handle, recliner (if equipped)
12	611D11	Side air bag module (if equipped)
13	N620480	Nut, side air bag bracket (2 required) (if equipped)
14	14K155	Wiringss, side air bag (if equipped)
15	65500	Lumbar assembly, power (if equipped)
16	64842	Lumbar assembly, static (if equipped)
17	65500	Lumbar assembly, manual (if equipped)
18	610C01	Manual lumbar control (if equipped)

19	W715704	Rivet, manual lumbar control (2 required) (if equipped)
20	14C693	Wiring harness, power seat backrest (if equipped)
21	613A68	Recliner torque shaft
22	W790022	Bolt, recliner motor (if equipped)
23	14547	Recliner motor (if equipped)
24	-	Pal nut, recliner torque shaft (2 required)
25	64646	Upper support spring
26	W712476	Rivet, climate controlled seat Thermo-Electric Device (TED) (3 required) (if equipped)
27	19N550	TED assembly (if equipped)
28	18D583	Bracket, TED assembly (if equipped)
29	W790002	Pin-type retainer
30	18D507	Exhaust duct, climate controlled seat TED assembly (if equipped)
31	-	Tie strap
32	-	Filter, climate controlled seat TED assembly (part of 19N550) (if equipped)
33	64417	Backrest trim cover

Disassembly

⚠ WARNING: Always carry or place a live air bag module with the air bag and deployment door/trim cover/tear seam pointed away from the body. Do not set a live air bag module down with the deployment door/trim cover/tear seam face down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

⚠ WARNING: If the seat side air bag cover has been damaged or separated from its mounting, or if the air bag material has been exposed, install a new seat side air bag module. Never try to repair the seat side air bag module. Failure to follow these instructions may result in the seat side air bag deploying incorrectly, which increases the risk of serious personal injury or death in a crash.

⚠ WARNING: Front seat backrest trim covers installed on seats equipped with seat side air bags cannot be repaired. A new trim cover must be installed. Cleaning is permissible. Failure to follow these instructions may result in the seat side air bag module deploying incorrectly and increase the risk of serious personal injury or death in a crash.

NOTE: If a side air bag deployment took place, a new seat backrest foam pad, backrest trim cover and side air bag module and nuts must be installed. A new seat backrest frame should be installed if necessary.

NOTE: The manual recliners and power recliners are serviced as part of the backrest frame.

All seats

1. Remove the front seat backrest. For additional information, refer to Seat Backrest - Front in this section.

2. Remove and discard th2 head restraint guide sleeves. For additional information, refer to Head Restraint Guide Sleeve in this section.

3. Detach the 2 pin-type retainers and trim cover flaps from the recliners, if equipped.

4. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the backrest foam pad.**

   Disengage the backrest cover lower J-strips, separate the hook-and-loop strips and invert the trim cover up as far as it will go.

5. If equipped, remove all rows of hog rings from the backrest trim cover and separate the hook-and-loop strips while inverting the trim cover up the backrest.

6. Remove the backrest cover rear upper hog rings.

7. Remove the backrest cover.

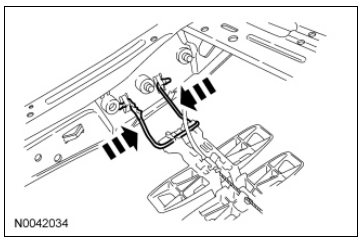
8. If equipped, detach the pin-type retainer and backrest heater mat wiring harness from the backrest frame.

9. Separate the backrest foam pad from the backrest frame.
   - If equipped with climate controlled seats, remove the hog rings from the upper support spring.
   - Remove the backrest heater mat (if equipped) or the backrest climate controlled seat manifold (if equipped) from the foam pad.

10. Remove the backrest climate controlled seat manifold from the foam pad.

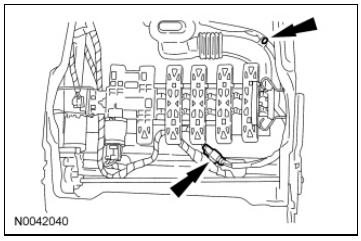
11. If a new heater mat is needed, carefully peel and remove the backrest heater mat from the backrest foam pad.
    - It is acceptable for a thin layer of foam to peel away with the old heater mat. The new heater mat will adhere to the foam pad, but if foam tearing occurs or if any pieces of foam are removed, install a new foam pad.

12. Release the 2 lumbar spring clips from the backrest frame and remove the lumbar assembly.
    - Route out the lumbar cable from the backrest frame, if equipped.
      - ♦ Note the routing of the lumbar cable for installation.
    - Disconnect the electrical connector from the power lumbar motor, if equipped.



Climate controlled seat

13. Disconnect the Thermo-Electric Device (TED) assembly electrical connector and detach the wiring harness retainers.



14. Remove the TED exhaust duct.
    - Cut and remove the tie strap.
    - Remove the retainer and separate the exhaust duct from the TED .

15. Disconnect the backrest upper support spring from the backrest frame and remove the spring support with the TED attached.
    - Use an appropriate tool and separate the TED from the upper backrest support spring.
        - ♦ Note the TED position on the support spring for installation.

Seat with power recliner

16. Remove the one-way push clip on the RH side of the power recliner. Slide the recliner shaft out from the LH side of the seat enough to clear the RH recliner and power recline motor.

17. Disconnect the electrical connector, remove the bolt and the power recline motor.

All seats

18. **NOTE:** Note the side air bag module wire harness routing for assembly.

    Release the side air bag module wire harness pin-type retainers and remove the side air bag module wiring harness from the backrest frame.

19. Remove and discard the 2 side air bag module nuts.
    - Pull outward on the side air bag module until the studs clear the backrest frame.

20. Detach any pin-type retainers, route out and remove the backrest wiring harness, if equipped.

Assembly

All seats

1. Route and install the backrest wiring harness, if removed.

2. ⚠ **WARNING: If the seat side air bag cover has been damaged or separated from its mounting, or if the air bag material has been exposed, install a new seat side air bag module. Never try to repair the seat side air bag module. Failure to follow these instructions may result in the seat side air bag deploying incorrectly, which increases the risk of serious personal injury or death in a crash.**

   ⚠ **WARNING: Inspect the seat side air bag module and mounting surfaces for any damage or foreign material before installing the seat side air bag module. If any damage is found, install new components. If any foreign material is found, remove it. Failure to follow these instructions may result in the seat side air bag module deploying incorrectly and increase the risk of serious personal injury or death in a crash.**

   Position the side air bag module to the backrest frame and install 2 new nuts.

- Tighten to 8 Nm (71 lb-in).

3. Install the side air bag wiring harness.
   - Route the side air bag wiring harness to the backrest frame as noted in disassembly and install the pushpin-type retainers.

4. Connect the side air bag module electrical connector and then slide and engage the side air bag electrical connector locking clip.

Seat with power recliner

5. **NOTE:** The recliners are synchronized. Do not rotate the recliner shaft until fully installed.

   Install the recliner motor in the following sequence.

   1. Position the recliner shaft through the recliner motor and RH recliner.
   2. Install a new one-way push clip onto the recliner shaft at the RH recliner.
   3. Slightly turn the recliner motor to align the bolt hole with the hole in the RH recliner and install the recliner motor bolt.
      - Tighten to 6 Nm (53 lb-in).
   4. Connect the recliner motor electrical connector.

Climate controlled seat

6. ***NOTICE:*** **Before assembly, inspect the climate controlled seat components for damage, crush, obstruction and foreign material and repair as needed.**

   Install the upper support spring and TED assembly to the backrest frame.

   - Attach the TED and bracket to the backrest upper support spring as noted in disassembly.

7. Connect the exhaust duct to the TED and install a new tie strap.

8. Connect the TED electrical connector.

All seats

9. Attach the lumbar assembly spring clips and install the lumbar assembly to the backrest frame.
   - If manual lumbar, route the lumbar cable to the backrest as noted in disassembly.
   - If power lumbar, connect the power lumbar motor electrical connector.

10. Position the backrest foam pad to the backrest frame.

11. ***NOTICE:*** **Do not install a used heater mat to any foam pad. It will not adhere correctly causing it to bunch up and may cause system failure.**

    If installing a new heater mat, attach the backrest heater mat to the backrest foam pad.

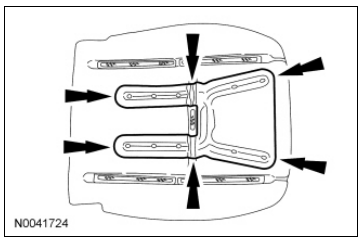
    - Remove the paper backing from the adhesive strips.
    - Align the heater mat to the foam pad and apply it to the foam making sure it lays flat, without wrinkles and is tucked into the valleys of the foam pad.

Climate controlled seat

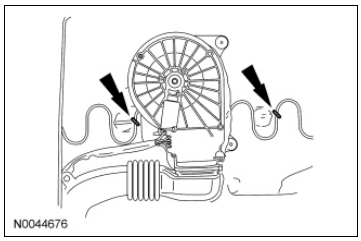
12. ***NOTICE:*** **Before assembly, inspect the climate controlled seat components for damage, crush, obstruction and foreign material and repair as needed.**

    Align the backrest manifold and insert into the valleys of the foam pad.

    - Check for correct fit between the manifold, foam pad and TED assembly, to make sure there is no air flow obstruction or cushion crush.



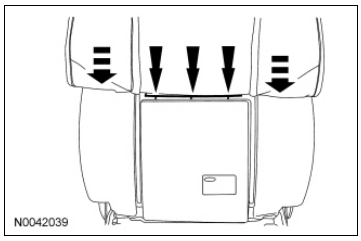
13. Install new hog rings to the upper support spring and foam pad.



All seats

14. Position the backrest trim cover to the backrest frame and foam pad and install new rear upper hog rings to the backrest frame.

15. Roll the backrest trim cover downward and attach the hook-and-loop strips.
    - If removed, install new hog rings as noted during disassembly.



16. Attach the backrest cover lower J-strips.

17. Install 2 new head restraint guide sleeves. For additional information, refer to Head Restraint Guide Sleeve in this section.

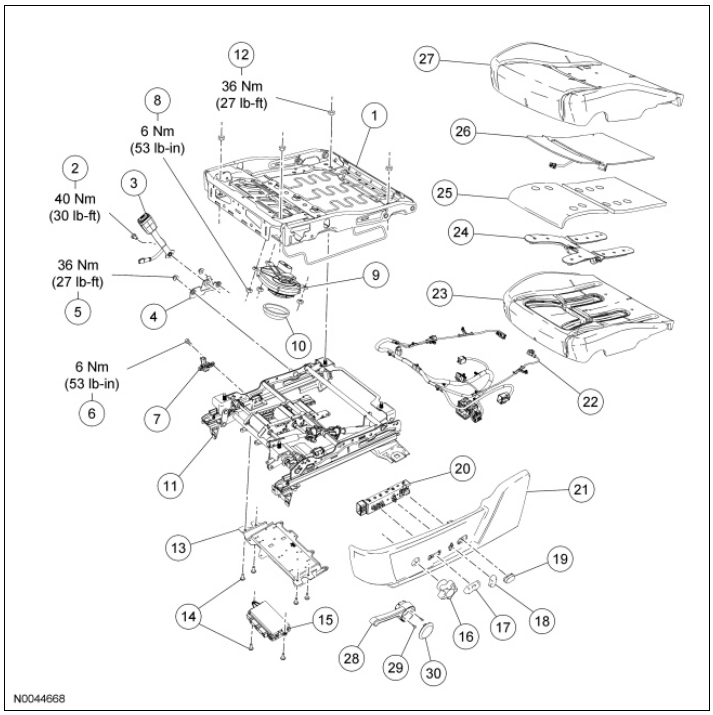
18. Install the 2 pin-type retainers and trim cover flaps to the recliners, if equipped.

19. Install the front seat backrest. For additional information, refer to Seat Backrest - Front in this section.

Seat Cushion - Front

Driver Seat Cushion

NOTE: Power seat track shown, manual seat track similar.



Item	Part Number	Description
1	63101	Cushion frame
2	-	Bolt, safety belt buckle (part of 61203)
3	61203	Safety belt buckle
4	610D09	Safety belt buckle bracket
5	W520113	Nut, safety belt buckle bracket-to-seat track (2 required)
6	W505256	Bolt, seat position sensor (part of 61203) (driver only)
7	14B416	Seat position sensor (driver only)
8	N620480	Nut, cushion Thermo-Electric Device (TED) (3 required) (if equipped)
9	19N550	Cushion TED , climate controlled seat (if equipped)
10	19E880	Cushion TED filter (if equipped)
11	61711	
12	W520113	Seat track-to-cushion frame nut (4 required)
13	610E34	Electrical bracket
14	-	Pop rivets (4 required)
15	14C708	Driver Seat Module (DSM) (if equipped)
16	62622	Manual lumbar control knob (if equipped)

17	14711	Seat control switch knob (if equipped)
18	14711	Power recline switch knob (if equipped)
19	14711	Power lumbar switch knob (if equipped)
20	14A701	Seat control switch (if equipped)
21	62187	Cushion side shield
22	14A699	Driver seat wire harness
23	632A23	Cushion foam pad
24	-	Cushion manifold, climate controlled seat (part of 632A23) (if equipped)
25	-	Cushion insert (part of 632A23) (if equipped)
26	14D696	Cushion heater mat (if equipped)
27	62900	Cushion trim cover
28	61753	Manual height adjust handle (if equipped)
29	W711217	Screw, manual height adjust handle (if equipped)
30	62768	Cover, manual height adjust handle (if equipped)

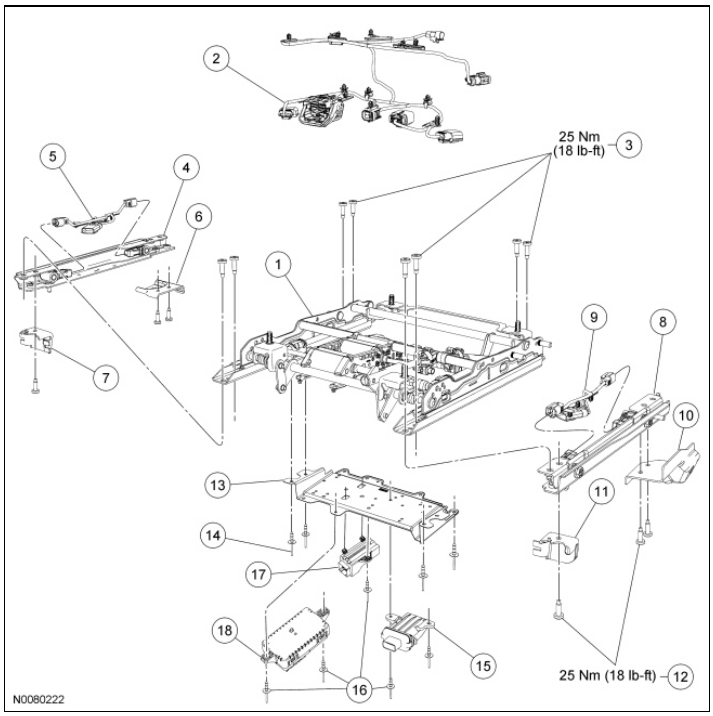
Passenger Seat Cushion

NOTE: Power seat track shown, manual seat track similar.

Item	Part Number	Description
1	63100	Cushion frame
2	61710	Seat track
3	W520113	Seat track-to-cushion frame nut (4 required)
4	62186	Cushion side shield
5	62622	Manual lumbar control knob (if equipped)
6	14711	Seat control switch knob (if equipped)
7	14711	Power recline switch knob (if equipped)
8	14711	Power lumbar switch knob (if equipped)
9	14A701	Seat control switch (if equipped)
10	610D08	Safety belt anchor bracket
11	W520113	Nut, safety belt anchor bracket (2 required)
12	19N550	Cushion Thermo-Electric Device (TED) (if equipped)
13	19E880	Cushion TED filter (if equipped)
14	N620480	Nut, cushion TED (3 required) (if equipped)
15	W790002	Scrivet
16	W520113	Nut, safety belt buckle bracket (2 required)
17	610D08	Safety belt buckle bracket
18	61202	Safety belt buckle
19	-	Bolt, safety belt buckle (part of 61202)
20	632A22	Cushion foam pad

21	-	Cushion manifold, climate controlled seat (part of 632A22) (if equipped)
22	-	Cushion insert (part of 632A22) (if equipped)
23	14D698	Cushion heater mat (if equipped)
24	62900	Cushion trim cover

Power Seat Track - Passenger



Item	Part Number	Description
1	61710	Seat track
2	14A698	Passenger seat wire harness
3	W712479	Occupant Classification System (OCS) rail-to-seat track bolts (8 required)
4	61708	Outboard OCS> weight sensor assembly
5	14A577	Outboard OCS wire harness
6	61912	Rear outboard seat riser
7	61912	Front outboard seat riser
8	61709	Inboard OCS weight sensor assembly
9	14A578	Inboard OCS wire harness
10	61913	Rear inboard seat riser
11	61913	Front inboard seat riser
12	W712479	Seat riser-to-seat track bolts (6 required)
13	610E34	Electrical bracket
14	31134/31147	Pop rivet (4 required)
15	14B422	Occupant Classification System Module (OCSM)
16	31134/31147	Pop rivets (quantity varies with seat option)

17	14C724	Heated seat module (if equipped)
18	14C724	Dual Climate Controlled Seat Module (DCSM) (if equipped)

Disassembly and Assembly

All seats

1. Remove the seat. For additional information, refer to Seat - Front in this section.

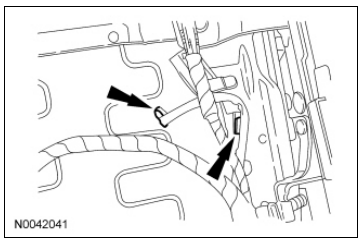
2. Remove the seat track. For additional information, refer to Seat Track in this section.

3. ***NOTICE:*** **Use care when separating the seat cushion trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the cushion foam pad.**

   Release the hook-and-loop strips, remove the hog rings, if equipped and separate the cushion trim cover from the cushion foam pad.

Heated seat

4. If a new heater mat is needed, carefully peel and remove the cushion heater mat from the cushion foam pad and route the wire harness through the cushion foam pad opening.
   - It is acceptable for a thin layer of foam to peel away with the old heater mat. The new heater mat will adhere to the foam pad, but if foam tearing occurs or if any pieces of foam are removed, install a new foam pad.
   - For installation, peel away the paper from the adhesive strips, align and apply the new heater mat to the cushion foam pad being sure to tuck the heater mat into the foam pad creases.
     - The heater mat must lay flat on the foam pad with no wrinkles.

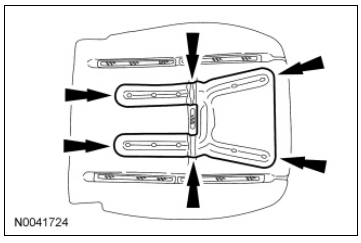


Climate controlled seat

5. ***NOTICE:*** **Before assembly, inspect the climate controlled seat components for damage, crush, obstruction and foreign material. Repair as needed.**

   If necessary, remove the cushion manifold from the foam pad.

   - For installation, align the cushion manifold and insert into the valleys of the foam pad.
     - Check for correct fit between the manifold, foam pad and cushion Thermo-Electric Device (TED) assembly, to make sure there is no airflow obstruction or cushion crush.



6. **NOTE:** Covering the TED openings is recommended to prevent foreign material from entering the TED .

   Remove the 3 nuts and cushion TED assembly from the cushion frame.

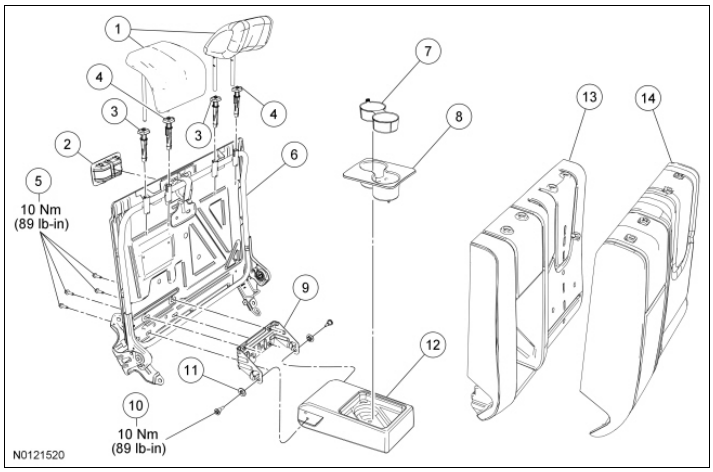
   - To install, tighten to 6 Nm (53 lb-in).
   - For installation, check for correct fit between the cushion manifold, foam pad and cushion TED assembly, to make sure there is no air flow obstruction, cushion crush or foreign material.

All seats

7. Remove the recliner cable, if equipped.

8. To assemble, reverse the disassembly procedure.

Seat Backrest - Rear, 60 Percent



Item	Part Number	Description
1	611A08	Head restraints (1 each required)
2	66716	Striker cover
3	610A18	Head restraint guide sleeves (without button) (2 required)
4	610A16	Head restraint guide sleeves (with button) (2 required)
5	-	Armrest bracket-to-backrest bolts (4 required)
6	613A39	Backrest frame
7	047A74	Rubber insert, armrest cup holder
8	13562	Armrest cup holder
9	67210	Armrest bracket
10	W790023	Armrest pivot bolt (2 required)
11	613B44	Armrest pivot bushing (2 required)
12	67112	Armrest assembly
13	66801	Backrest foam pad
14	66601	Backrest trim cover

Disassembly and Assembly

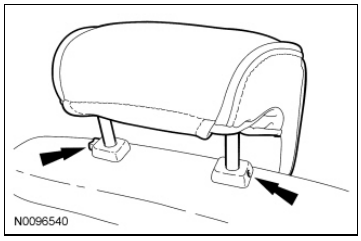
All vehicles

1. Remove the 60 percent rear seat backrest. ditional information, refer to Seat Backrest - Rear in this section.

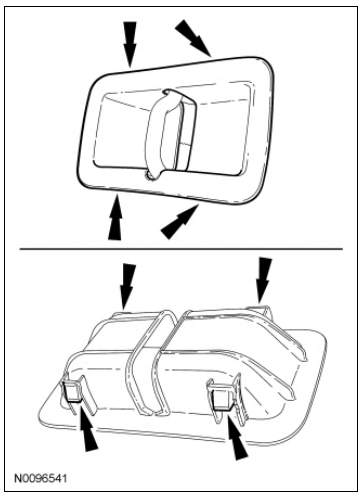
2. **NOTE:** Typical head restraint shown.

   While lifting up on the head restraint, push in the hole, push in the button and remove the head restraint.

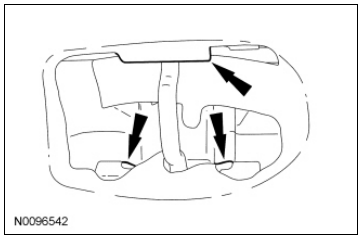
   - Repeat for the other head restraint.



3. Release the 4 tabs (2 shown) and remove the striker cover.

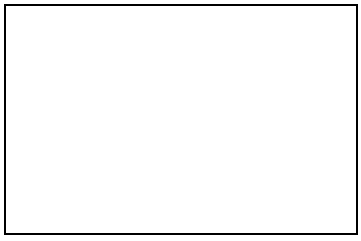


4. Release the backrest cover from around the striker opening.



Hybrid vehicle

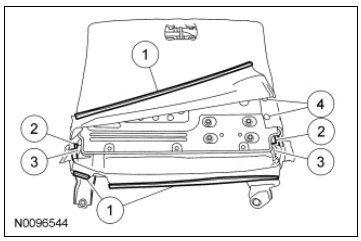
5. Remove 2 pin-type retainers and the duct end seal.



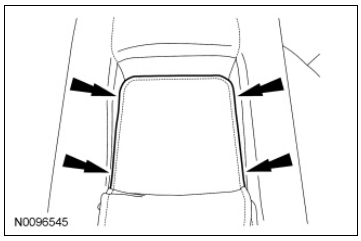
All vehicles

6. Separate the backrest cover.
    1. Disengage the lower J-strips.
        - Slide the heat deflector out from between the backrest frame and backrest cover, if equipped.
    2. Disengage the 2 J-clips.
    3. From in the opening, disengage the backrest cover clip and unwrap the backrest cover from around the backrest frame.

4. Remove the 2 pin-type retainers.



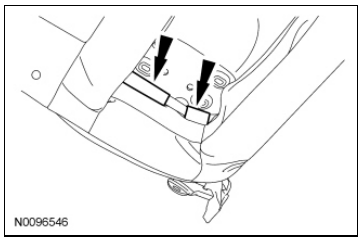
7. Separate the 4 pin-type retainers attaching the armrest pocket cover to the backrest frame.



8. Remove the 4 armrest-to-backrest bolts and armrest assembly.
    - For installation, adjust the armrest horizontally as needed for good fit.
    - To install, tighten to 10 Nm (89 lb-in).

9. Disassemble the armrest assembly in the following sequence.
    1. Remove the cup holder rubber insert.
    2. Remove the 2 pin-type retainers and cup holder.
    3. Remove 2 armrest pivot bolts and armrest bracket.
        - To install, tighten to 10 Nm (89 lb-in).

10. Disengage 2 backrest cover clips in the armrest pocket.



11. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the backrest foam pad.**

    Invert the backrest cover up as far as it will go.

    - Separate the hook-and-loop strips and remove all rows of hog rings working up the backrest.

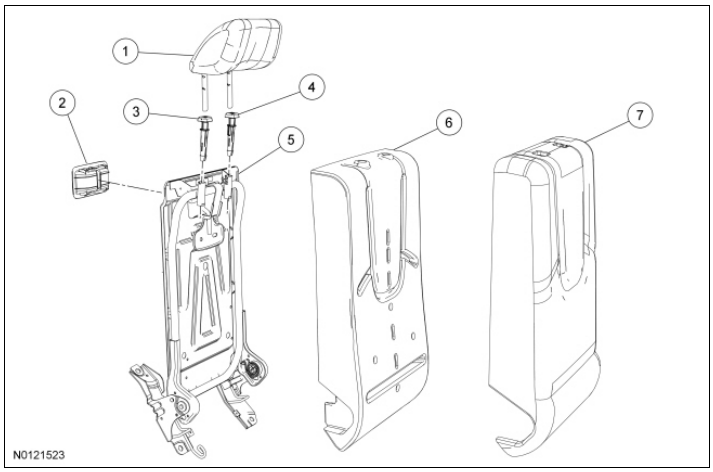
12. **NOTE:** The head restraint guide sleeves are keyed and will not interchange. To assemble, install the head restraint guide sleeve with the button on the LH side.

    Under the backrest foam pad, squeeze the ends of the head restraint guide sleeves together and remove.

13. Remove the backrest cover and foam pad from the backrest frame.

14. To assemble, reverse the disassembly procedure.

Seat Backrest - Rear, 40 Percent



Item	Part Number	Description
1	611A08	Head restraint
2	66716	Striker cover
3	610A18	Head restraint guide sleeve (without button)
4	610A16	Head restraint guide sleeve (with button)
5	613A38	Backrest frame
6	66800	Backrest foam pad
7	66600	Backrest trim cover

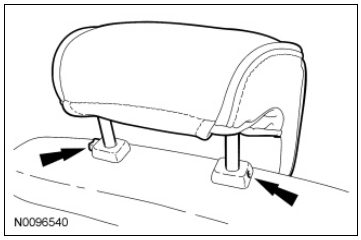
Disassembly and Assembly

All vehicles

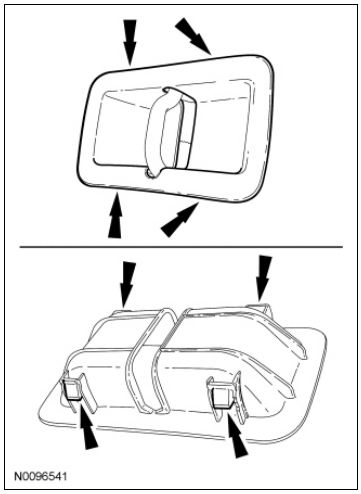
1. Remove the 40 percent rear seat backrest. For additional information, refer to Seat Backrest - Rear in this section.

2. **NOTE:** Typical head restraint shown.

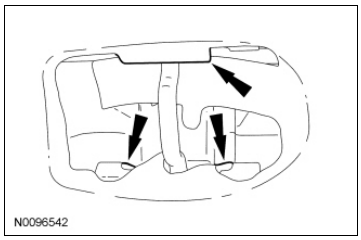
   While lifting up on the head restraint, push in the hole, push in the button and remove the head restraint.



3. Release the 4 tabs (2 shown) and remove the striker cover.

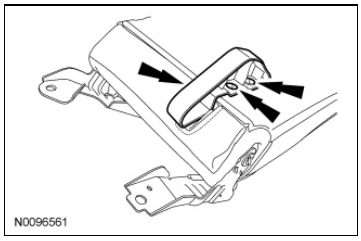


4. Release the backrest cover from around the striker opening.



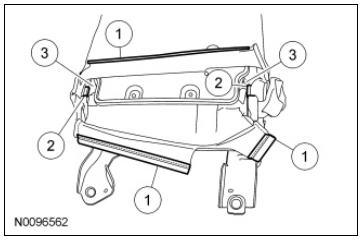
Hybrid vehicle

5. Remove the 2 pin-type retainers and duct end seal.



All vehicles

6. Separate the backrest cover.
    1. Disengage the lower J-strips.
        - Slide the heat deflector out from between the backrest frame and backrest cover, if equipped.
    2. Disengage the 2 J-clips.
    3. From in the opening, disengage the backrest cover clip and unwrap the backrest cover from around the backrest frame.



7. **NOTE:** The head restraint guide sleeves are keyed and will not interchange. To assemble, install the head restraint guide sleeve with the button on the LH side.

   Squeeze the ends of the head restraint guide sleeves together and remove.

8. ***NOTICE:*** **Use care when separating the backrest cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the backrest foam pad.**

   Remove the backrest cover.

   - Invert the backrest cover, separate the hook-and-loop strips and remove all rows of hog rings working up the backrest.

9. Remove the foam pad from the backrest frame.

10. To assemble, reverse the disassembly procedure.

Material

Item	Specification	Fill Capacity
Dow Urethane Adhesive BetasealTM Express	-	-
Dow Urethane One Step Glass Primer BetaprimeTM 5500 / 5500A / 5500SA	-	-
Motorcraft® Lacquer Touch-Up Paint (match color to exterior grid wire) PMP-19500-XXXXX	ESR-M2P100-C	-
Permatex® Quick GridTM Rear Window Defogger Repair Kit 15067	-	-
Sika Urethane Adhesive Sika Tack ASAP	-	-
Sika Urethane Metal and Glass Primer Sika 206 G+P	-	-
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A	-

General Specifications

Item	Specification
Terminal Kit - Back Glass 4F1Z-14421-AA	-

Torque Specifications

Description	Nm	lb-in
Front and rear interior door handle bolt	8	71
Front door module bolts	11	97
Front window glass clamp bolts	6	53 gn="left">Rear door module bolts 11 97
Rear window glass clamp bolt	6	53

Glass, Frames and Mechanisms

NOTE: The Smart Junction Box (SJB) may also be identified as the Generic Electronic Module (GEM).

The glass, frames and mechanisms consist of:

- accessory delay relay.
- door window regulator motors.
- Front Controls Interface Module (FCIM).
- front door glass top run.
- front door window glass.
- HVAC module.
- rear door window glass.
- rear window defrost grid.
- rear window defrost relay.
- rear window glass.
- rear fixed window glass.
- rear window regulator and motor - run and brackets.
- SJB .
- window control switches.
- window regulators.
- windshield glass.

The glass, frames and mechanisms include:

- standard plastic and laminate safety glass.
- windshield glass which is bonded to the opening flange with a urethane adhesive.

NOTE: All vehicles are equipped with one-touch up/down feature on the LH front window. All MKZ and some Fusion vehicles are equipped with one-touch up/down feature for both LH and RH front windows.

The window regulator control switch:

- is located on each door trim panel.
- may be used to manually raise or lower all windows from the left front window control switch or the individual side window from the corresponding individual door switch.
- can lock out rear window control switches when the lock-out switch on the left front window control switch is turned on.

The accessory delay relay, located in the SJB , provides power for the operation of the power windows. The accessory delay feature is active when the ignition switch is in the RUN or the ACC position, or when the ignition switch is changed from RUN or ACC to the OFF/LOCK position and the LF and RF doors are closed.

Global Open (If Equipped)

NOTE: All MKZ and some Fusion are equipped with the global open feature. Only Fusion vehicles equipped with RH front one-touch up/down have the global open feature.

NOTE: The global open feature may be enabled/disabled via scan tool or in some cases modified by the customer following a procedure listed in the vehicle Oer's Literature. For a complete list of available programmable parameters, refer to the Module Configuration and Parameter Chart in Section 418-01 .

The SJB sends a signal on the global open circuit, to both front door window motors and the roof opening panel motor, to open or close the windows based on a signal received from the Remote Keyless Entry (RKE) transmitter. If the accessory delay relay is active, the global open feature will not operate.

Rear Window Defrost

For MKZ, the rear window defrost switch is integral to the FCIM . For Fusion, the rear window defrost switch is integral to the HVAC module or FCIM if equipped with navigation system. When the rear window defrost switch is pressed, the HVAC module will activate the rear window defrost relay. When the rear window defrost relay is activated, the rear window defrost grid will be energized.

Glass, Frames and Mechanisms

Special Tool(s)

 ST1138-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3094-A	Test Light SGT27000 or equivalent 250-300 mA incandescent bulb test lamp
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Front Power Window Control - One-Touch Up/Down

NOTE: All vehicles are equipped with one-touch up/down feature on the LH front window. All MKZ and some Fusion vehicles are equipped with one-touch up/down feature for both LH and RH front windows. LH and RH one-touch up/down functionality is identical.

NOTE: The front window motor must be de-initialized, then initialized whenever:

- the front window motor is removed from the window regulator drum housing.
- a new window regulator is installed.
- a new window glass is installed.
- a new top run is installed.
- grease or lubricants are applied to the window regulator or glass run.

Each door window motor is a 6-pin motor with integral electronics and must be initialized whenever a new window motor has been installed. Initialization is required to learn the full UP position and the profile of the glass as it travels through the glass channel. Once initialized, obstacle detection is enabled. When mechanical repairs have been carried out on the window regulator or glass run, the window motor must be de-initialized, and then initialized. The window control switch sends 2 separate signals to the window motor: up and down. When the window control switch is pressed to the first detent position, a 12-volt signal is sent to the window motor to request an up or down operation. When auto up or auto down is requested (switch pressed to the second detent position), the window control switch provides a 12-volt signal on both the up and down line simultaneously. During an auto up or auto down request, the window motor determines intended window direction by the signal first received. If the window control switch is pressed too quickly to the second detent position (less than 5 milliseconds of time between first detent signal and second detent signal), the window motor will not be able to determine the intended direction request and will not operate until the window control switch is relsed and pressed again. The up and down contacts are floating within the window control

switch when the switch is in the neutral position. The up and down feeds to the window motor are all low current.

When the window motor is operating in auto up or auto down mode, movement of the window can be stopped by pressing the switch to any position (up, down, auto up, auto down). The window control switch must be released before the window will move again.

If there is an open in the window control switch or the associated wiring, the related function will become inoperative. If the up contact of the switch or the associated wiring develops an open circuit, the window will only operate in the down direction. If the down contact of the switch or the associated wiring develops an open circuit, the window will only operate in the up direction.

A new window motor will not operate in one-touch up mode, and the bounce-back feature will be disabled prior to initialization. If the switch is actuated to the AUTO UP or AUTO DOWN position and released, window movement will stop when the up or down contact in the window control switch is released. If the window motor is removed from the window regulator drum housing, or if a new window motor is installed, it must be initialized. Refer to Window Motor Initialization in this section.

The window motor will automatically adjust to system changes throughout its life: changes in seal drag and slight changes in the full OPEN position will occur and will be automatically compensated for. Once initialized, the window motor will soft stall into the upper and lower positions contributing to extended durability of the system. If the window does not seal completely in the full UP position (very small gaps/non bounce-back events only), the window switch can be actuated to the UP position and the window will be energized for a fraction of a second to fully seal and this new position will be learned.

Passenger windows may be raised or lowered using the LH front window control switch or the corresponding passenger window control switch. Rear passenger window control switches receive power when the accessory delay relay is active and the LH front window lock switch is in the UNLOCK position. When the LH front window lock switch is in the LOCK position, the rear passenger windows will not operate.

Bounce-Back

The window motor has a bounce-back feature. If an obstacle has been detected in the window opening as the window glass is moving upward, the window motor will automatically reverse direction and move the glass toward the bounce-back position (in both up and one-touch up modes). If an obstruction occurs between 4 mm (0.15 in) and 200 mm (7.87 in) of window opening, the bounce-back position will be 250 mm (9.84 in) of window opening. If an obstruction occurs at a position greater than 200 mm (7.87 in) of window opening, the bounce-back position will be 50 mm (1.96 in) below where the obstruction occurred.

Security Override

To override a bounce-back condition (to overcome the resistance of ice on the window or seals for example), within 2 seconds after the window reaches the bounce-back position, pull and hold the window control switch. The window will travel up with no bounce-back or pinch protection. If the window control switch is released before the window is fully closed, the window will stop. If the ignition switch is turned to OFF or START (without delayed accessory power), the window motor will stop.

Global Open (if equipped)

NOTE: The global open feature may be enabled/disabled via scan tool or in some cases modified by the customer following a procedure listed in the vehicle Owner's Literature. For a complete list of available programmable parameters, refer to the Module Configuration and Parameter Chart in Section 418-01 .

NOTE: The Smart Junction Box (SJB) may also be identified as the Generic Electronic Module (GEM).

If equipped, when the unlock button of the Remote Keyless Entry (RKE) transmitter is held for 2 seconds, the global open feature activates. The SJB sends a signal to activate the one-touch down operation of both front windows. The global open feature does not operate if the delay accessory is active.

Delayed Accessory Power

The SJB activates the accessory delay relay whenever the ignition switch is in the RUN or the ACC position, or when the ignition switch is changed from RUN or ACC to the off/lock position and the LH and RH front doors are closed. When energized, the accessory delay relay supplies voltage to the power window system.

The SJB will deactivate the delayed accessory feature when:

- the LF door is ajar and the ignition switch is in the off/lock or key-out position.
- the RF door is ajar and the ignition switch is in the off/lock or key-out position.
- ten minutes have elapsed since the ignition switch was changed from ACC or RUN to the off/lock position.

Rear Window Defrost

For MKZ the rear window defrost switch is integral to the Front Controls Interface Module (FCIM). For Fusion, the rear window defrost switch is integral to the HVAC module or the FCIM if equipped with navigation system. When the rear window defrost switch is pressed, the HVAC module will activate the rear window defrost relay located in the Battery Junction Box (BJB). When the rear window defrost relay is active, the rear window defrost grid will be energized.

The HVAC module will deactivate the rear window defrost relay when one of the following conditions is met:

- The rear window defrost switch is pressed when the feature is active
- Ignition switch state is changed from RUN to OFF/LOCK
- The 10-minute timer completes

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Door window regulator and motor • Door glass run • Door window glass	• Loose, corroded connectors • Circuitry • Window control switch • Battery Junction Box (BJB) fuse 6 (40A) • Smart Junction Box (SJB) circuit breaker 47 (30A) • SJB fuse(s): ♦ 1 (30A) ♦ 4 (30A) ♦ 17 (20A) ♦ 41 (15A)

	♦ 45 (5A) • Accessory delay relay • Rear window defrost relay • Circuit breaker • Rear window defrost grid

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the SJB or HVAC module.

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

8. Clear the CMDTCs and carry out the self-test diagnostics for the SJB .

9. If the DTCs retrieved are related to the concern, go to Smart Junction Box (SJB) DTC Chart or HVAC Module DTC Chart. For all other DTCs, refer to Section 419-10 .

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

DTC Charts

Smart Junction Box (SJB) DTC Chart

DTC	Description	Action
B1302	Accessory Delay Relay Coil Circuit Failure	If the accessory delay is always on, GO to Pinpoint Test Q . If the accessory delay is inoperative, GO to Pinpoint Test P .
B1304	Accessory Delay Relay Coil Circuit Short to Battery	GO to Pinpoint Test P .

B2947	Global Opening/Closing Circuit Open	GO to Pinpoint Test K .
B2949	Global Opening/Closing Circuit Short to Battery	GO to Pinpoint Test K .
All Other DTCs	-	REFER to the Master DTC Chart in Section 419-10 .

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. CMDTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

HVAC Module DTC Chart

DTC	Description	Action
B1C83:12	Rear Defog Relay: Circuit Short to Battery	For MKZ, GO to Pinpoint Test L . For Fusion, GO to Pinpoint Test N .
B1C83:14	Rear Defog Relay: Circuit Short to Ground or Open	If the rear window does not defrost, GO to Pinpoint Test L (MKZ) or GO to Pinpoint Test N (Fusion). If the rear window defrost does not turn off, GO to Pinpoint Test M (MKZ) or GO to Pinpoint Test O (Fusion).
All other DTCs	-	REFER to the Master DTC Chart in Section 412-00A or Section 412-00B .

Symptom Chart

Symptom Chart

• All power windows are inoperative - Fusion	• Accessory delay relay • Circuit breaker • Wiring, terminals or connectors • Window control switch	• GO to Pinpoint Test B .
• All passenger power windows are inoperative - Fusion, LH and RH rear	• Wiring, terminals or connectors • Window control switch	• GO to Pinpoint Test C .
• A single power window is inoperative - MKZ, LH front	• Fuse(s)	• GO to

	• Wiring, terminals or connectors • Window control switch • Power window motor • SJB	Pinpoint .
• A single power window is inoperative - Fusion, LH front	• Wiring, terminals or connectors • Window control switch • Power window motor • SJB	• GO to Pinpoint Test E .
• A single power window is inoperative - MKZ, RH front	• Fuse • Wiring, terminals or connectors • Window control switch • Power window motor	• GO to Pinpoint Test F .
• A Single Power Window is Inoperative - Fusion, RH Front (RH Front Window is Equipped With One-Touch Up/Down)	• Fuse • Wiring, terminals or connectors • Window control switch • Power window motor	• GO to Pinpoint Test G .
• A single power window is inoperative - MKZ, LH or RH rear	• Fuse • Wiring, terminals or connectors • Window control switch • Power window motor	• GO to Pinpoint Test H .
• A single power window is inoperative - Fusion, RH front, LH or RH rear	• Wiring, terminals or connectors • Window control switch • Power window motor	• GO to Pinpoint Test I .
• The one-touch up/down feature is inoperative	• Wiring, terminals or connectors • Power window motor • Window control switch • Power window motor not initialized • Battery power was lost while LH or RH front power window motor was operating	• GO to Pinpoint Test J .
• The global open function is inoperative/does not operate correctly - if equipped	• Remote Keyless Entry (RKE) transmitters • Wiring, terminals or connectors • SJB	• GO to Pinpoint Test K .

	• Power window motor(s) not initialized	
• The defrost system is inoperative - MKZ	• Fuse(s) • Rear window defrost relay • Wiring, terminals or connectors • Rear window defrost grid • Antenna module • HVAC module • Front Controls Interface Module (FCIM)	• GO to Pinpoint Test L .
• The defrost system will not shut off automatically - MKZ	• Rear window defrost relay • Wiring, terminals or connectors • HVAC module /td>	• GO to Pinpoint Test M .
• The defrost system is inoperative - Fusion	• Fuse(s) • Rear window defrost relay • Wiring, terminals or connectors • Rear window defrost grid • HVAC module • FCIM (if equipped with navigation system)	• GO to Pinpoint Test N .
• The defrost system will not shut off automatically - Fusion	• Rear window defrost relay • Wiring, terminals or connectors • HVAC module	• GO to Pinpoint Test O .
• The delayed accessory is inoperative	SJB	• GO to Pinpoint Test P .
• The delayed accessory does not turn off	• Accessory delay relay • Wiring, terminals or connectors • SJB	• GO to Pinpoint Test Q .

Pinpoint Tests

Pinpoint Test A: All Passenger Power Windows are Inoperative - MKZ, LH and RH Rear

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

Normal Operation

Under normal operation, the accessory delay relay supplies voltage to the master window control switch. When the master window lockout control switch is in the UNLOCK position, voltage is supplied to the LH and RH rear window control switches. The master window control switch supplies the ground circuit for passenger rear window operation.

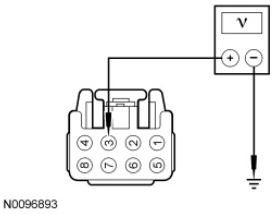
This pinpoint test is intended to diagnose the following:

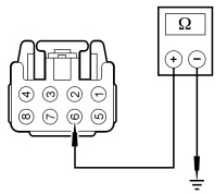
- Circuit breaker
- Wiring, terminals or connectors
- Window control switch

PINPOINT TEST A: ALL PASSENGER POWER WINDOWS ARE INOPERATIVE - MKZ, LH AND RH REAR

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Before performing this pinpoint test, make sure the master window lockout control switch is in the UNLOCK position.

Test Step	Result / Action to Take
A1 CHECK FOR VOLTAGE TO MASTER WINDOW CONTROL SWITCH	
• Disconnect: Master Window Control Switch C535B. • Ignition ON. • Measurthe voltage between master window control switch C535B-3, circuit CBP47 (GN/BU), harness side and ground.  N0096893 • **Is the voltage greater than 10 volts?**	**Yes** GO to A2 . **No** VERIFY SJB circuit breaker 47 (30A) is OK. If OK, REPAIR the circuit. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
A2 CHECK THE MASTER WINDOW CONTROL SWITCH GROUND CIRCUIT	

• Ignition OFF. • Measure the resistance between master window control switch C535B-6, circuit GD126 (BK/WH), harness side and ground.  N0096894 • **Is the resistance less than 5 ohms?**	**Yes** GO to A3 . **No** REPAIR the circuit. TEST the system for normal operation.
A3 CHECK THE MASTER WINDOW CONTROL SWITCH	
• Carry out the master window control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the master window control switch pass the component test?**	**Yes** REPAIR circuit CPW14 (VT/WH) for an open. TEST the system for normal operation. **No** INSTALL a new master window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation.

Pinpoint Test B: All Power Windows are Inoperative - Fusion

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

Normal Operation

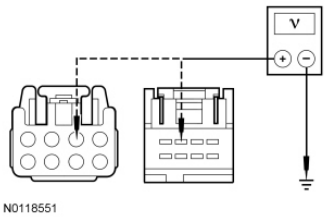
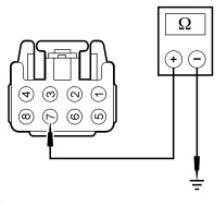
Under normal operation, the accessory delay relay supplies voltage to the master window control switch. The master window control switch supplies the ground circuit for passenger rear window operation. On vehicles not equipped with RH front window one-touch up/down feature, this ground circuit is shared with the LH front window motor.

This pinpoint test is intended to diagnose the following:

- Accessory lay relay
- Circuit breaker
- Wiring, terminals or connectors
- Window control switch

PINPOINT TEST B: ALL POWER WINDOWS ARE INOPERATIVE - FUSION

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK FOR VOLTAGE TO MASTER WINDOW CONTROL SWITCH	
• Disconnect: Master Window Control Switch C535A (if RH front window is equipped with one-touch up/down) or C537A (if RH front window is not equipped with one-touch up/down). • Ignition ON. • Measure the voltage between master window control switch C535A-3 or C537A-2, circuit CBP47 (GN/BU), harness side and ground.  N0118551 • **Is the voltage greater than 10 volts?**	**Yes** For vehicles not equipped with RH front window one-touch up/down feature, GO to B2 . For vehicles equipped with RH front window one-touch up/down feature, INSTALL a new master window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation. **No** VERIFY SJB circuit breaker 47 (30A) is OK. If OK, GO to Pinpoint Test O to diagnose the accessory delay relay circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
B2 CHECK THE MASTER WINDOW CONTROL SWITCH GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Master Window Control Switch C537B. • Measure the resistance between master window control switch C537B-7, circuit GD126 (BK/WH), harness side and ground.  N0094076 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new master window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

Pinpoint Test C: All Passenger Power Windows are Inoperative - Fusion, LH and RH Rear

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

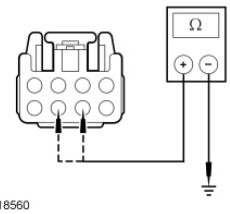
Normal Operation

Under normal operation, the accessory delay relay supplies voltage to the master window control switch. When the master window lockout control switch is in the UNLOCK position, voltage is supplied to the LH and RH rear window control switches. The master window control switch supplies the ground circuit for passenger rear window operation.

l type="disc">**This pinpoint test is intended to diagnose the following:**
- Wiring, terminals or connectors
- Window control switch

PINPOINT TEST C: ALL PASSENGER POWER WINDOWS ARE INOPERATIVE - FUSION, LH AND RH REAR

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 CHECK THE REAR PASSENGER WINDOW OPERATION FROM THE MASTER WINDOW CONTROL SWITCH	
• Ignition ON. • Attempt to operate the rear passenger windows from the master window control switch. • **Do the rear passenger windows operate from the master window control switch?**	**Yes** GO to C3 . **No** GO to C2 .
C2 CHECK THE MASTER WINDOW CONTROL SWITCH GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Master Window Control Switch C535B (if RH front window is equippedith one-touch up/down) or C537B (if RH front window is not equipped with one-touch up/down). • Measure the resistance between master window control switch C535B-6 or C537B-7, circuit GD126 (BK/WH), harness side and ground.  N0118560 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new master window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
C3 CHECK THE MASTER WINDOW CONTROL SWITCH	
	Yes REPAIR circuit CPW14 (VT/WH) for

• Carry out the master window control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the master window control switch pass the component test?**	an open. TEST the system for normal operation. **No** INSTALL a new master window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation.

Pinpoint Test D: A Single Power Window is Inoperative - MKZ, LH Front

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

NOTE: A new LH front power window motor will not operate in one-touch up mode until initialized. Refer to Window Motor Initialization in this section.

Normal Operation

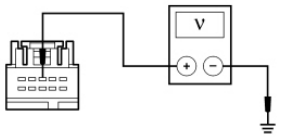
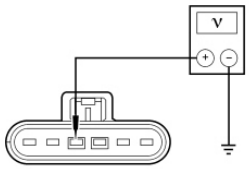
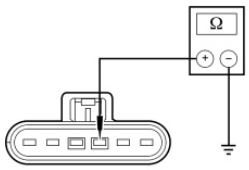
Under normal operation, voltage is supplied to the master window control switch from the accessory delay relay. The LH front power window motor has dedicated high current power and ground circuits. When the master window control switch is activated, a low current voltage signal is supplied to the LH front power window motor which causes the window to move upward or downward.

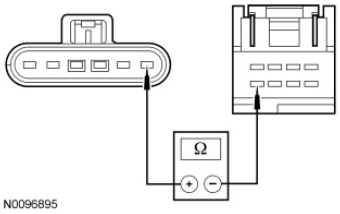
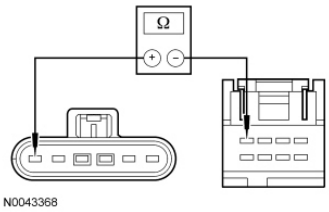
This pinpoint test is intended to diagnose the following:
- Fuse(s)
- Wiring, terminals or connectors
- Power window motor
- Window control switch

PINPOINT TEST D: A SINGLE POWER WINDOW IS INOPERATIVE - MKZ, LH FRONT

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 CHECK THE POWER TO THE MASTER WINDOW CONTROL SWITCH	
• Disconnect: Master Window Control Switch C535A. • Igtion ON. • Measure the voltage between master window control switch C535A-3, circuit CBP41 (BU), harness side and ground.	**Yes** GO to D2 . **No** VERIFY Smart Junction Box (SJB) fuse 41 (15A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. DE-INITIALIZE then INITIALIZE the front window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

 N0012607 • **Is the voltage greater than 10 volts?**	
D2 CHECK THE VOLTAGE TO THE POWER WINDOW MOTOR	
• Ignition OFF. • Disconnect: LH Front Power Window Motor C540. • Measure the voltage between LH front power window motor C540-4, circuit SBP01 (RD), harness side and ground.  N0043364 • **Is the voltage greater than 10 volts?**	**Yes** GO to D3 . **No** VERIFY SJB fuse 1 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. DE-INITIALIZE, then INITIALIZE the LH front window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
D3 CHECK THE LH FRONT POWER WINDOW MOTOR GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between LH front power window motor C540-3, circuit GD126 (BK/WH), harness side and ground.  N0043365 • **Is the resistance less than 5 ohms?**	**Yes** GO to D4 . **No** REPAIR the circuit. DE-INITIALIZE then INITIALIZE the LH front window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
D4 CHECK THE MASTER WINDOW CONTROL SWITCH-TO-LH FRONT POWER WINDOW MOTOR CIRCUITS FOR AN OPEN	
• Measure the resistance between LH front power window motor C540-1, circuit CPW10 (YE/VT), harness side and master window control switch C535A-8, circuit CPW10 (YE/VT), harness side.	**Yes** GO to D5 . **No** REPAIR circuit CPW10 (YE/VT) or CPW11 (BU/GY) for an open. DE-INITIALIZE then INITIALIZE the LH front window motor.

 • Measure the resistance between LH front power window motor C540-6, circuit CPW11 (BU/GY), harness side and master window control switch C535A-4, circuit CPW11 (BU/GY), harness side.  • **Are the resistances less than 5 ohms?**	REFER to Window Motor Initialization in this section. TEST the system for normal operation.
D5 CHECK THE MASTER WINDOW CONTROL SWITCH	
• Carry out the master window control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the master window control switch pass the component test?**	**Yes** INSTALL a new LH front power window motor. REFER to Window Regulator and Motor - Front Door in this section. INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation. **No** INSTALL a new master window control switch. REFER to Window Control Switch in this section. DE-INITIALIZE, then INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

Pinpoint Test E: A Single Power Window is Inoperative - Fusion, LH Front

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

NOTE: A new LH front power window motor will not operate in one-touch up mode until initialized. Refer to Window Motor Initialization in this section.

Normal Operation

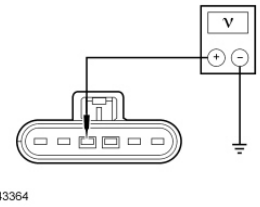
Under normal operation, voltage is supied to the master window control switch from the accessory delay relay. The LH front power window motor has dedicated high current power and ground circuits. When the master window control switch is activated, a low current voltage signal is supplied to the LH front power window motor which causes the window to move upward or downward.

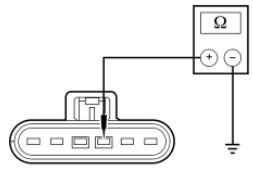
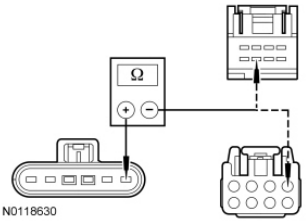
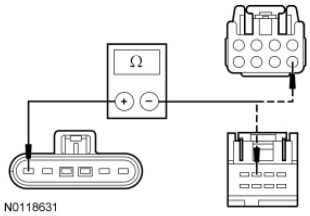
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Power window motor
- Window control switch

PINPOINT TEST E: A SINGLE POWER WINDOW IS INOPERATIVE - FUSION, LH FRONT

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 CHECK THE VOLTAGE TO THE POWER WINDOW MOTOR	
• Ignition OFF. • Disconnect: LH Front Power Window Motor C540. • Measure the voltage between LH front power window motor C540-4, circuit SBP01 (RD), harness side and ground.  N0043364 • **Is the voltage greater than 10 volts?**	**Yes** GO to E2 . **No** VERIFY Smart Junction Box (SJB) fuse 1 (30A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. DE-INITIALIZE, then INITIALIZE the LH front window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
E2 CHECK THE LH FRONT POWER WINDOW MOTOR GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between LH front power window motor C540-3, circuit GD126 (BK/WH), harness side and ground.	**Yes** GO to E3 . **No** REPAIR the circuit. DE-INITIALIZE then INITIALIZE the LH front window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

 N0043365 • **Is the resistance less than 5 ohms?**	
E3 CHECK THE MASTER WINDOW CONTROL SWITCH-TO-LH FRONT POWER WINDOW MOTOR CIRCUITS FOR AN OPEN	
• Disconnect: LH Front Window Control Switch C535A (if RH front window is equipped with one-touch up/down) or C537A (if RH front window is not equipped with one-touch up/down). • Measure the resistance between LH front power window motor C540-1, circuit CPW10 (YE/VT), harness side and master window control switch C535A-7 or C537A-1, circuit CPW10 (YE/VT), harness side.  N0118630 • Measure the resistance between LH front power window motor C540-6, circuit CPW11 (BU/GY), harness side and master window control switch C535A-3 or C537A-5, circuit CPW11 (BU/GY), harness side.  N0118631 • **Are the resistances less than 5 ohms?**	**Yes** GO to E4 . **No** REPAIR the circuit. DE-INITIALIZE then INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
E4 CHECK THE MASTER WINDOW CONTROL SWITCH	
• Carry out the master window control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component	**Yes** INSTALL a new LH front power window motor. REFER to Window Regulator and Motor - Front Door in this section. INITIALIZE the LH front power window motor. REFER to Window Motor

testing. • **Did the master window control switch pass the component test?**	Initialization in this section. TEST the system for normal operation. **No** INSTALL a new master window control switch. REFER to Window Control Switch in this section. DE-INITIALIZE, then INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

Pinpoint Test F: A Single Power Window is Inoperative - MKZ, RH Front

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

NOTE: A new RH front power window motor will not operate in one-touch up mode until initialized. Refer to Window Motor Initialization in this section.

Normal Operation

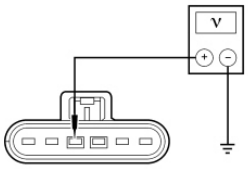
Under normal operation, the accessory delay relay supplies voltage to the master window control switch and the RH front window control switch. The RH front power window motor has dedicated high current power and ground circuits. When the master window control switch or RH front window control switch is activated, a low current voltage signal is supplied to the RH front power window motor which causes the window to move upward or downward.

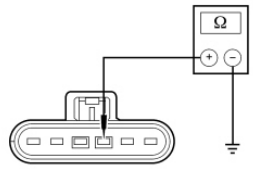
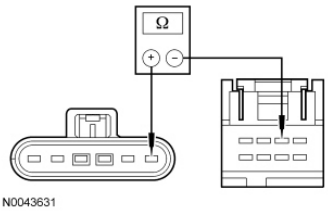
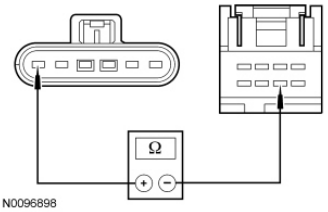
This pinpoint test is intended to diagnose the following:
- Fuse(s)
- Wiring, terminals or connectors
- Power window motor
- Window control switch

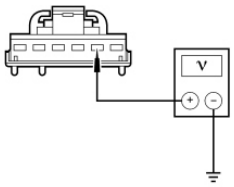
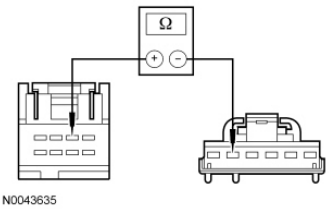
PINPOINT TEST F: A SINGLE POWER WINDOW IS INOPERATIVE - MKZ, RH FRONT

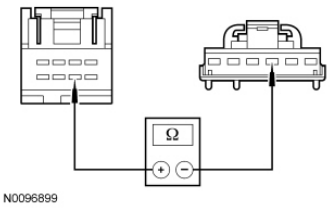
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 CHECK THE RH FRONT POWER WINDOW OPERATION FROM THE MASTER WINDOW CONTROL SWITCH	
• Attempt to operate the RH front window using the master window control switch. • **Does the RH window operate when using the master window control switch?**	**Yes** GO to F7 . **No** GO to F2 .
F2 CHECK THE POWER TO THE MASTER WINDOW CONTROL SWITCH	

• Disconnect: Master Window Control Switch C535A. • Ignition ON. • Measure the voltage between master window control switch C535A-3, circuit CBP41 (BU), harness side and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to F3 . **No** VERIFY Smart Junction Box (SJB) fuse 41 (15A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. DE-INITIALIZE, then INITIALIZE the front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
F3 CHECK THE VOLTAGE TO THE POWER WINDOW MOTOR	
• Ignition OFF. • Disconnect: RH Front Power Window Motor C623. • Measure the voltage between RH front power window motor C623-4, circuit SBP04 (GN/RD), harness side and ground.  N0043364 • **Is the voltage greater than 10 volts?**	**Yes** GO to F4 . **No** VERIFY SJB fuse 4 (30A) is OK. If OK, REPAIR the circuit. DE-INITIALIZE then INITIALIZE the RH front power window motor. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
F4 CHECK THE RH FRONT POWER WINDOW MOTOR GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between RH front power window motor C623-3, circuit GD139 (BK/YE), harness side and ground.	**Yes** GO to F5 . **No** REPAIR the circuit. DE-INITIALIZE then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

 N0043365 • **Is the resistance less than 5 ohms?**	
F5 CHECK THE MASTER WINDOW CONTROL SWITCH-TO-RH FRONT POWER WINDOW MOTOR CIRCUITS FOR AN OPEN	
• Measure the resistance between RH front window power window motor C623-1, circuit CPW12 (GN/OG), harness side and master window control switch C535A-2, circuit CPW12 (GN/OG), harness side.  N0043631 • Measure the resistance between RH front power window motor C623-6, circuit CPW13 (BN/YE), harness side and master window control switch C535A-6, circuit CPW13 (BN/YE), harness side.  N0096898 • **Are the resistances less than 5 ohms?**	**Yes** GO to F6 . **No** REPAIR the circuit. DE-INITIALIZE then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
F6 CHECK THE MASTER WINDOW CONTROL SWITCH	
• Carry out the master window control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing.	**Yes** INSTALL a new RH front power window motor. REFER to Window Regulator and Motor - Front Door in this section. INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

• **Did the master window control switch pass the component test?**	**No** INSTALL a new master window control switch. REFER to Window Control Switch in this section. INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
F7 CHECK FOR VOLTAGE TO THE RH FRONT WINDOW CONTROL SWITCH	
• Disconnect: RH Front Window Control Switch C624. • Ignition ON. • Measure the voltage between RH front window control switch C624-2, circuit CBP41 (BU), harness side and ground.  N0043634 • **Is the voltage greater than 10 volts?**	**Yes** GO to F8 . **No** REPAIR the circuit. TEST the system for normal operation.
F8 CHECK THE MASTER WINDOW CONTROL SWITCH-TO-RH FRONT WINDOW CONTROL SWITCH CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Master Window Control Switch C535A. • Measure the resistance between master window control switch C535A-2, circuit CPW12 (GN/OG), harness side and RH front window control switch C624-5, circuit CPW12 (GN/OG), harness side.  N0043635 • Measure the resistance between master window control switch C535A-6, circuit CPW13 (BN/YE), harness side and RH front window control switch C624-3,	**Yes** INSTALL a new RH front window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

circuit CPW13 (BN/YE), harness side.  • **Are the resistances less than 5 ohms?**	

Pinpoint Test G: A Single Power Window is Inoperative - Fusion, RH Front (RH Front Window is Equipped With One-Touch Up/Down)

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

NOTE: A new RH front power window motor will not operate in one-touch up mode until initialized. Refer to Window Motor Initialization in this section.

Normal Operation

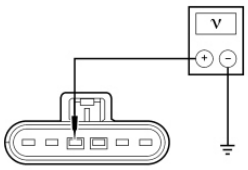
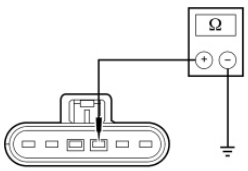
Under normal operation, the accessory delay relay supplies voltage to the master window control switch and the RH front window control switch. The RH front power window motor has dedicated high current power and ground circuits. When the master window control switch or RH front window control switch is activated, a low current voltage signal is supplied to the RH front power window motor which causes the window to move upward or downward.

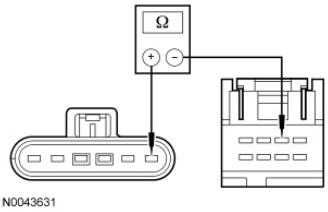
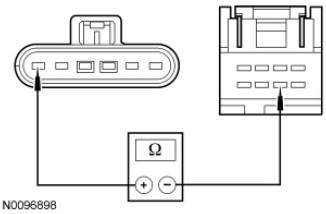
This pinpoint test is intended to diagnose the following:
- Fuse(s)
- Wiring, terminals or connectors
- Power window motor
- Window control switch

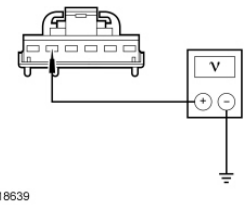
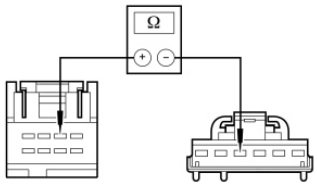
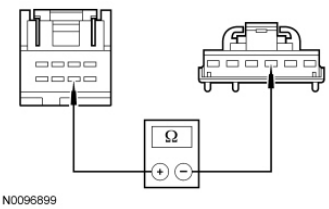
PINPOINT TEST G: A SINGLE POWER WINDOW IS INOPERATIVE - FUSION, RH FRONT (RH FRONT WINDOW IS EQUIPPED WITH ONE-TOUCH UP/DOWN)

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage e connector.**

Test Step	Result / Action to Take
G1 CHECK THE RH FRONT POWER WINDOW OPERATION FROM THE MASTER WINDOW CONTROL SWITCH	
• Attempt to operate the RH front window using the master window control switch. • **Does the RH window operate when using the master window control switch?**	**Yes** GO to G6 . **No** GO to G2 .

G2 CHECK THE VOLTAGE TO THE POWER WINDOW MOTOR	
• Ignition OFF. • Disconnect: RH Front Power Window Motor C623. • Measure the voltage between RH front power window motor C623-4, circuit SBP04 (GN/RD), harness side and ground.  N0043364 • **Is the voltage greater than 10 volts?**	**Yes** GO to G3 . **No** VERIFY SJB fuse 4 (30A) is OK. If OK, REPAIR the circuit. DE-INITIALIZE then INITIALIZE the RH front power window motor. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
G3 CHECK THE RH FRONT POWER WINDOW MOTOR GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between RH front power window motor C623-3, circuit GD139 (BK/YE), harness side and ground.  N0043365 • **Is the resistance less than 5 ohms?**	**Yes** GO to G4 . **No** REPAIR the circuit. DE-INITIALIZE then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.
G4 CHECK THE MASTER WINDOW CONTROL SWITCH-TO-RH FRONT POWER WINDOW MOTOR CIRCUITS FOR AN OPEN	
• Disconnect: Master Window Control Switch C535A. • Measure the resistance between RH front window power window motor C623-1, circuit CPW12 (GN/OG), harness side and master window control switch C535A-2, circuit CPW12 (GN/OG), harness side.	**Yes** GO to G5 . **No** REPAIR the circuit. DE-INITIALIZE then INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation.

 N0043631 • Measure the resistance between RH front power window motor C623-6, circuit CPW13 (BN/YE), harness side and master window control switch C535A-6, circuit CPW13 (BN/YE), harness side.  N0096898 • **Are the resistances less than 5 ohms?**	
G5 CHECK THE MASTER WINDOW CONTROL SWITCH	
• Carry out the master window control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the master window control switch pass the component test?**	**Yes** INSTALL a new RH front power window motor. REFER to Window Regulator and Motor - Front Door in this section. INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal operation. **No** INSTALL a new master window control switch. REFER to Window Control Switch in this section. INITIALIZE the RH front power window motor. REFER to Window Motor Initialization in this section. TEST the system for normal opation.
G6 CHECK FOR VOLTAGE TO THE RH FRONT WINDOW CONTROL SWITCH	
• Disconnect: RH Front Window Control Switch C624. • Ignition ON. • Measure the voltage between RH front window control switch C624-5, circuit CBP41 (BU), harness side and ground.	**Yes** GO to G7 . **No** VERIFY Smart Junction Box (SJB) fuse 41 (15A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. DE-INITIALIZE, then INITIALIZE the front power window motor. REFER to Window Motor Initialization in this section. TEST

 N0118639 • **Is the voltage greater than 10 volts?**	the system for normal operation.
G7 CHECK THE MASTER WINDOW CONTROL SWITCH-TO-RH FRONT WINDOW CONTROL SWITCH CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Master Window Control Switch C535A. • Measure the resistance between master window control switch C535A-2, circuit CPW12 (GN/OG), harness side and RH front window control switch C624-4, circuit CPW12 (GN/OG), harness side.  N0118640 • Measure the resistance between master window control switch C535A-6, circuit CPW13 (BN/YE), harness side and RH front window control switch C624-3, circuit CPW13 (BN/YE), harness side.  N0096899 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new RH front window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

Pinpoint Test H: A Single Power Window is Inoperative - MKZ, LH or RH Rear

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

Normal Operation

The LH and RH rear window control switches receive voltage from the master window control switch when the window lockout switch is set to the UNLOCK position. Ground is also provided to the LH and RH rear window control switches from the master window control switch. The LH and RH rear window control switches transfer power and ground to their respective rear window motors. Window direction is controlled by reversing polarity of the voltage and ground circuits being supplied to the window motor.

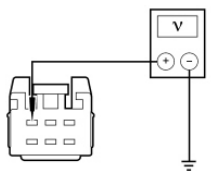
When operating the LH or RH rear window from the master window control switch, voltage and ground is sent from the LH front window control switch through the normally closed contacts within the LH or RH rear window control switch to operate the LH or RH rear window. Window direction is controlled by reversing polarity of the voltage and ground circuits being supplied to the window motor.

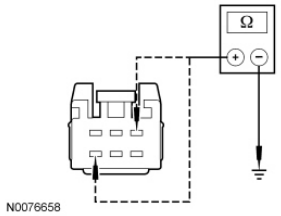
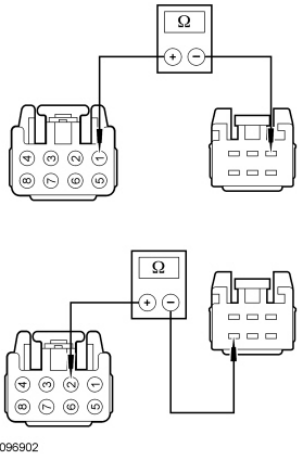
This pinpoint test is intended to diagnose the following:

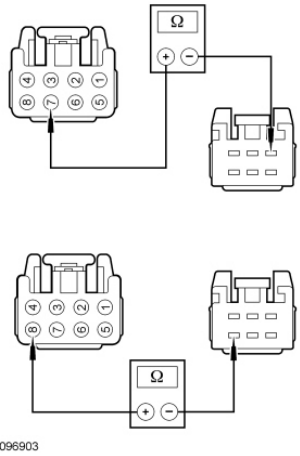
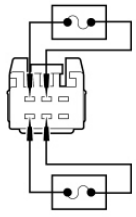
- Wiring, terminals or connectors
- Window control switch
- Power window motor

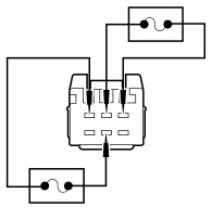
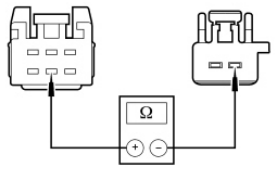
PINPOINT TEST H: A SINGLE POWER WINDOW IS INOPERATIVE - MKZ, LH OR RH REAR

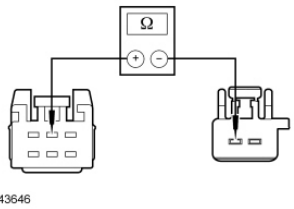
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
H1 CHECK THE VOLTAGE TO THE LH OR RH REAR WINDOW CONTROL SWITCH	
• Disconnect: Inoperative Rear Window Control Switch C701 (LH) or C819 (RH). • Ignition ON. • **NOTE:** Set the master window control lockout switch to the UNLOCK position. • Measure the voltage between the inoperative rear window connector and ground: ♦ for the RH rear window control switch, measure the voltage between RH rear window control switch C819-3, circuit CPW14 (VT/WH), harness side and ground. ♦ for the LH rear window control switch, measure the voltage between C701-3, circuit CPW14 (VT/WH), harness side and ground.  N0043638 • **Is the voltage greater than 10 volts?**	**Yes** GO to H2 . **No** REPAIR the circuit. TEST the system for normal operation.
H2 CHECK THE GROUNDS TO THE INOPERATIVE REAR WINDOW CONTROL SWITCH	

• Ignition OFF. • Measure the resistance between the inoperative window control switch and ground: ♦ for the RH rear window control switch, measure the resistance between RH rear window control switch C819-1, circuit CPW17 (BN/GN), harness side and ground; and between RH rear window control switch C819-6, circuit CPW18 (GY/VT), harness side and ground. ♦ for the LH rear window control switch, measure the resistance between LH rear window control switch C701-1, circuit CPW15 (YE), harness side and ground; and between LH rear window control switch C701-6, circuit CPW16 (BU/OG), harness side and ground.  N0076658 • **Are the resistances less than 5 ohms?**	**Yes** GO to H4 . **No** GO to H3 .
H3 CHECK THE CIRCUITS TO THE INOPERATIVE REAR WINDOW CONTROL SWITCH FOR AN OPEN	
• Ignition OFF. • Disconnect: LH Front Window Control Switch C535B. • For an inoperative LH rear power window, measure the resistance between master window control switch C535B-1, circuit CPW15 (YE) and LH rear window control switch C701-1, circuit CPW15 (YE), harness side; and between master window control switch C535B-2, circuit CPW16 (BU/OG) and LH rear window control switch C701-6, circuit CPW16 (BU/OG), harness side.  N0096902 • For an inoperative RH rear power window, measure the resistance between master window control switch C535B-7, circuit CPW17 (BN/GN) and RH window control switch C819-1, circuit CPW17 (BN/GN), harness side; and between master window control switch	**Yes** INSTALL a new master window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit(s) for an open. TEST the system for normal operation.

C535B-8, circuit CPW18 (GY/VT) and RH rear window control switch C819-6, circuit CPW18 (GY/VT), harness side.  N0096903 • **Are the resistances less than 5 ohms?**	
H4 CHECK THE INOPERATIVE WINDOW CONTROL SWITCH	
• Connect: Master Window Control Switch C535B. • Ignition ON. • For an inoperative LH rear window, connect a fused jumper wire between LH rear window control switch C701-2, circuit CPW21 (BN), harness side and LH rear window control switch C701-3, circuit CPW14 (VT/WH), harness side; and between LH rear window control switch C701-5, circuit CPW22 (GN/VT), harness side and LH rear window control switch C701-6, circuit CPW16 (BU/OG), harness side. The LH rear window should operate in the downward direction. • For an inoperative RH rear window, connect a fused jumper wire between RH rear window control switch C819-2, circuit CPW23 (GY), harness side and RH rear window control switch C819-3, circuit CPW14 (VT/WH), harness side; and between RH rear window control switch C819-5, circuit CPW24 (WH/VT), harness side and RH rear window control switch C819-6, circuit CPW18 (GY/VT), harness side. The RH rear window should operate in the downward direction.  N0043644 • For an inoperative LH rear window, connect a fused jumper wire between LH rear window control switch C701-2, circuit CPW21 (BN), harness side and LH rear window control switch C701-1, circuit CPW15 (YE), harness side; and between LH rear window control switch C701-5, circuit CPW22 (GN/VT), harness side and	**Yes** INSTALL a new master window control switch or RH rear window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation. **No** GO to H5 .

LH rear window control switch C701-3, circuit CPW14 (VT/WH), harness side. The LH rear window should operate in the upward direction. • For an inoperative RH rear window, connect a fused jumper wire between RH rear window control switch C819-2, circuit CPW23 (GY), harness side and RH rear window control switch C819-1, circuit CPW17 (BN/GN), harness side; and between RH rear window control switch C819-5, circuit CPW24 (WH/VT), harness side and RH rear window control switch C819-3, circuit CPW14 (VT/WH), harness side. The RH rear window should operate in the upward direction.  N0043645 • **Did the inoperative window operate correctly?**	
H5 CHECK THE POWER WINDOW MOTOR CIRCUITS	
• Ignition OFF. • Disconnect: Inoperative Rear Window Motor C703 (LH) or C803 (RH). • For an inoperative LH rear window, measure the resistance between LH rear window control switch C701-5, circuit CPW22 (GN/VT), harness side and LH rear window motor C703-1, circuit CPW22 (GN/VT), harness side. • For an inoperative RH rear window, measure the resistance between RH rear window control switch C819-5, circuit CPW24 (WH/VT), harness side and RH rear window motor C803-1, circuit CPW24 (WH/VT), harness side.  N0043647 • For an inoperative LH rear window, measure the resistance between LH rear window control switch C701-2, circuit CPW21 (BN), harness side and LH rear window motor C703-2, circuit CPW21 (BN), harness side. • For an inoperative RH rear window, measure the resistance between RH rear window control switch C819-2, circuit CPW23 (GY), harness side and RH rear window motor C803-2, circuit CPW23 (GY), harness side.	**Yes** INSTALL a new LH or RH rear window motor. REFER to Window Regulator Motor in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

 N0043646 • **Is the resistance less than 5 ohms?**	

Pinpoint Test I: A Single Power Window is Inoperative - Fusion, RH Front, LH or RH Rear

NOTE: To diagnose an inoperative RH front window that is equipped with one-touch up/down feature, GO to Pinpoint Test G .

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid),ower Windows for schematic and connector information.

Normal Operation

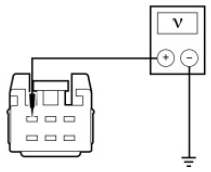
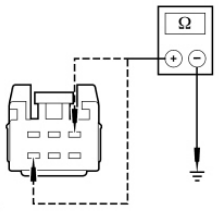
The RH front window control switch receives voltage from the accessory delay relay. The LH and RH rear window control switches receive voltage from the LH front window control switch when the window lock switch is set to the UNLOCK position. Ground is provided to the RH front, LH rear and RH rear window control switches from the LH front window control switch. Each window control switch transfers voltage and ground to their respective window motors. Window direction is controlled by reversing polarity of the voltage and ground circuits being supplied to the window motor.

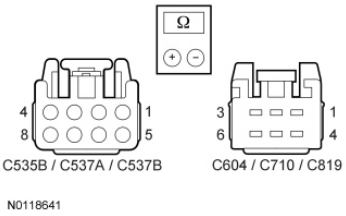
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Window control switch
- Power window motor

PINPOINT TEST I: A SINGLE POWER WINDOW IS INOPERATIVE - FUSION, RH FRONT, LH OR RH REAR

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

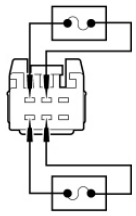
Test Step	Result / Action to Take
I1 CHECK THE VOLTAGE TO THE RH FRONT, LH REAR OR RH REAR WINDOW CONTROL SWITCH	
• Disconnect: Inoperative Rear Window Control Switch C604 (RH front), C701 (LH rear) or C819 (RH rear). • Ignition ON. • **NOTE:** Set the master window control lockout switch to the UNLOCK position. • Measure the voltage between the inoperative window connector and ground: ♦ for the RH front window control switch, measure the voltage between RH front window control switch C604-3, circuit	**Yes** GO to I2 . **No** For RH front window, REPAIR circuit CBP47 (GN/BU) for an open. TEST the system for normal operation.

CBP47 (GN/BU), harness side and ground. ♦ for t RH rear window control switch, measure the voltage between RH rear window control switch C819-3, circuit CPW14 (VT/WH), harness side and ground. ♦ for the LH rear window control switch, measure the voltage between C701-3, circuit CPW14 (VT/WH), harness side and ground.  N0043638 • **Is the voltage greater than 10 volts?**	For LH or RH rear window, REPAIR circuit CPW14 (VT/WH) for an open. TEST the system for normal operation.
I2 CHECK THE GROUNDS TO THE INOPERATIVE REAR WINDOW CONTROL SWITCH	
• Ignition OFF. • Measure the resistance between the inoperative window control switch and ground: ♦ for the RH front window control switch, measure the resistance between RH front window control switch C604-1, circuit CPW12 (GN/OG), harness side and ground; and between RH front window control switch C604-6, circuit CPW13 (GY/RD), harness side and ground. ♦ for the RH rear window control switch, measure the resistance between RH rear window control switch C819-1, circuit CPW17 (BN/GN), harness side and ground; and between RH rear window control switch C819-6, circuit CPW18 (GY/VT), harness side and ground. ♦ for the LH rear window control switch, measure the resistance between LH rear window control switch C701-1, circuit CPW15 (YE), harness side and ground; and between LH rear window control switch C701-6, circuit CPW16 (BU/OG), harness side and ground.  N0076658 • **Are the resistances less than 5 ohms?**	**Yes** GO to I4 . **No** GO to I3 .
I3 CHECK THE CIRCUITS TO THE INOPERATIVE REAR WINDOW CONTROL SWITCH FOR AN OPEN	

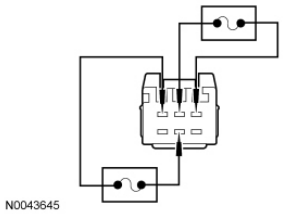
• Ignition OFF. • Disconnect: LH Front Window Control Switch C537A, C535B (if RH front window is equipped with one-touch up/down) or C537B (if RH front window is not equipped with one-touch up/down). • Measure the resistance between the master window control switch and the inoperative window control switch: ♦ For an inoperative RH front power window, measure the resistance between master window control switch C537A-4, circuit CPW12 (GN/OG) and RH front window control switch C604-1, circuit CPW12 (GN/OG), harness side; and between master window control switch C537A-8, circuit CPW13 (GY/RD) and RH front window control switch C604-6, circuit CPW13 (GY/RD), harness side. ♦ For an inoperative LH rear power window, measure the resistance between master window control switch C535B-1 or C537B-1, circuit CPW15 (YE) and LH rear window control switch C701-1, circuit CPW15 (YE), harness side; and between master window control switch C535B-2 or C537B-5, circuit CPW16 (BU/OG) and LH rear window control switch C701-6, circuit CPW16 (BU/OG), harness side. ♦ For an inoperative RH rear power window, measure the resistance between master window control switch C535B-7 or C537B-4, circuit CPW17 (BN/GN) and RH window control switch C819-1, circuit CPW17 (BN/GN), harness side; and between master window control switch C535B-8 or C537B-8, circuit CPW18 (GY/VT) and RH rear window control switch C819-6, circuit CPW18 (GY/VT), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new master window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit(s) for an open. TEST the system for normal operation.
I4 CHECK THE INOPERATIVE WINDOW CONTROL SWITCH	
• Ignition ON. • For an inoperative RH front window, connect a fused jumper wire between RH front window control switch C604-2, circuit CPW19 (VT), harness side and RH front window control switch C604-3, circuit CBP47 (GN/BU), harness side; and between RH front window control switch C604-5, circuit CPW20 (YE/BK), harness side and RH front window control switch C604-6, circuit CPW13 (GY/RD), harness side. The RH front window should operate in the downward direction. • For an inoperative LH rear window, connect a fused jumper wire between LH rear window control switch C701-2, circuit CPW21 (BN), harness side and LH rear window control switch C701-3, circuit CPW14 (VT/WH), harness side; and between LH rear	**Yes** INSTALL a new RH front, LH or RH rear window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation. **No** GO to I5 .

window control switch C701-5, circuit CPW22 (GN/VT), harness side and LH rear window control switch C701-6, circuit CPW16 (BU/OG), harness side. The LH rear window should operate in the downward direction.

- For an inoperative RH rear window, connect a fused jumper wire between RH rear window control switch C819-2, circuit CPW23 (GY), harness side and RH rear window control switch C819-3, circuit CPW14 (VT/WH), harness side; and between RH rear window control switch C819-5, circuit CPW24 (WH/VT), harness side and RH rear window control switch C819-6, circuit CPW18 (GY/VT), harness side. The RH rear window should operate in the downward direction.


N0043644

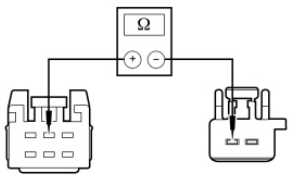
- For an inoperative RH front window, connect a fused jumper wire between RH front window control switch C604-2, circuit CPW19 (VT), harness side and RH front window control switch C604-1, circuit CPW12 (GN/OG), harness side; and between RH front window control switch C604-5, circuit CPW20 (YE/BK), harness side and RH front window control switch C604-3, circuit CBP47 (GN/BU), harness side. The RH front window should operate in the upward direction.
- For an inoperative LH rear window, connect a fused jumper wire between LH rear window control switch C701-2, circuit CPW21 (BN), harness side and LH rear window control switch C701-1, circuit CPW15 (YE), harness side; and between LH rear window control switch C701-5, circuit CPW22 (GN/VT), harness side and LH rear window control switch C701-3, circuit CPW14 (VT/WH), harness side. The LH rear window should operate in the upward direction.
- For an inoperative RH rear window, connect a fused jumper wire between RH rear window control switch C819-2, circuit CPW23 (GY), harness side and RH rear window control switch C819-1, circuit CPW17 (BN/GN), harness side; and between RH rear window control switch C819-5, circuit CPW24 (WH/VT), harness side and RH rear window control switch C819-3, circuit CPW14 (VT/WH), harness side. The RH rear window should operate in the upward direction.



- **Did the inoperative window operate correctly?**

I5 CHECK THE POWER WINDOW MOTOR CIRCUITS

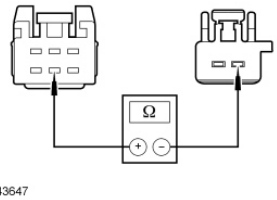
- Ignition OFF.
- Disconnect: Inoperative Power Window Motor C608 (RH front), C703 (LH rear) or C803 (RH rear).
- For an inoperative RH front window, measure the resistance between RH front window control switch C604-2, circuit CPW19 (VT), harness side and RH front power window motor C608-2, circuit CPW19 (VT), harness side.
- For an inoperative LH rear window, measure the resistance between LH rear window control switch C701-2, circuit CPW21 (BN), harness side and LH rear power window motor C703-2, circuit CPW21 (BN), harness side.
- For an inoperative RH rear window, measure the resistance between RH rear window control switch C819-2, circuit CPW23 (GY), harness side and RH rear power window motor C803-2, circuit CPW23 (GY), harness side.



- For an inoperative RH front window, measure the resistance between RH front window control switch C604-5, circuit CPW20 (YE/BK), harness side and RH front power window motor C608-1, circuit CPW20 (YE/BK), harness side.
- For an inoperative LH rear window, measure the resistance between LH rear window control switch C701-5, circuit CPW22 (GN/VT), harness side and LH rear power window motor C703-1, circuit CPW22 (GN/VT), harness side.
- For an inoperative RH rear window, measure the resistance between RH rear window control switch C819-5, circuit CPW24 (WH/VT), harness side and RH rear power window motor C803-2, circuit CPW24 (WH/VT), harness side.

Yes
INSTALL a new RH front, LH or RH rear power window motor. REFER to Window Regulator Motor in this section. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

 • **Are the resistances less than 5 ohms?**	

Pinpoint Test J: The One-Touch Up/Down Feature is Inoperative

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

NOTE: All vehicles are equipped with one-touch up/down feature on the LH front window. All MKZ and some Fusion vehicles are equipped with one-touch up/down feature for both LH and RH front windows.

NOTE: A new LH or RH front power window motor will not operate in one-touch up or one-touch down mode until initialized. Refer to Window Motor Initialization in this section.

Normal Operation

During normal operation, when the window control switch is pressed to the second detent position to request an auto up or auto down operation, the window control switch provides a 12-volt signal on both the up and down line simultaneously. During an auto up or auto down request, the window motor determines intended window direction by the signal first received (first detent position). If the window control switch is pressed too quickly to the second detent position (less than 5 milliseconds of time between first detent signal and second detent signal), the window motor will not be able to determine the intended direction request and will not operate until the window control switch is released and pressed again.

This pinpoint test is intended to diagnose the following:
- B(+) power lost during LH or RH front window operation
- Power window motor not initialized
- Power window motor
- Window control switch

PINPOINT TEST J: THE ONE-TOUCH UP/DOWN FEATURE IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
J1 CHECK FOR POWER (B+) LOSS DURING LH OR RH FRONT POWER WINDOW OPERATION	
• Verify if power (B+) was lost during LH or RH front window operation. • **Was power (B+) lost while the LH or RH front window was in operation?**	**Yes** RAISE the LH or RH front window to the fully CLOSED position. VERIFY the window glass stalls into the upper header seal. The front window should function normally. TEST the system for normal operation.

	No GO to J2 .
J2 DE-INITIALIZE, THEN INITIALIZE THE FRONT POWER WINDOW MOTOR	
• De-initialize the front power window motor, then carry out the front power window motor initialization procedure. Refer to Window Motor Initialization in this section. • **Is the one-touch up/down feature operating correctly?**	**Yes** The system is operating normally at this time. The front power window motor lost initialization. **No** For LH window, GO to J3 . For RH window, GO to J4 .
J3 CHECK THE MASTER WINDOW CONTROL SWITCH	
• Ignition OFF. • Disconnect: Master Window Control Switch C535A and C535B (MKZ or Fusion if RH front window is equipped with one-touch up/down) or C537A and C537B (Fusion if RH front window is not equipped with one-touch up/down). • Carry out the master window control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the master window switch pass the component test?**	**Yes** INSTALL a new LH front power window motor. REFER to Window Regulator Motor in this section. TEST the system for normal operation. **No** INSTALL a new master window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation.
J4 CHECK THE LH AND RH FRONT WINDOW CONTROL SWITCH	
• Ignition OFF. • Disconnect: Master Window Control Switch C535A and C535B. • Disconnect: RH Front Window Control Switch C624. • Carry out the master window control switch component test and the RH front window control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did both the master window control switch and RH front window switch pass the component tests?**	**Yes** INSTALL a new RH front power window motor. REFER to Window Regulator Motor in this section. TEST the system for normal operation. **No** INSTALL a new master window control switch or RH front window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation.

Pinpoint Test K: The Global Open Function is Inoperative/Does Not Operate Correctly - If Equipped

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

NOTE: The global open feature may be enabled/disabled via scan tool or in some cases modified by the customer following a procedure listed in the vehicle Owner's Literature. For a complete list of available programmable parameters, refer to the Module Configuration and Parameter Chart in Section 418-01 .

Normal Operation

When the unlock button of the Remote Keyless Entry (RKE) transmitter is held for 2 seconds, the global open activates. The Smart Junction Box (SJB) sends a signal to the LH and RH front power window motors to activate the one-touch down operation of both front windows.

The global open feature does not operate if the accessory delay relay is active.

- DTC B2947 (Global Opening/Closing Circuit Open) - sets when the SJB detects the global open circuit is open or shorted to ground.
- DTC B2949 (Global Opening/Closing Circuit Short to Battery) - sets when the SJB detects the global open circuit is shorted to voltage.

This pinpoint test is intended to diagnose the following:

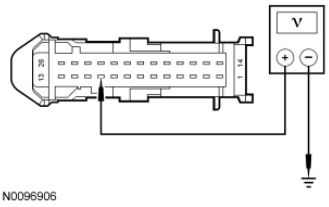
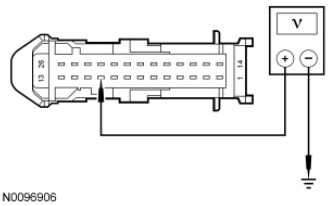
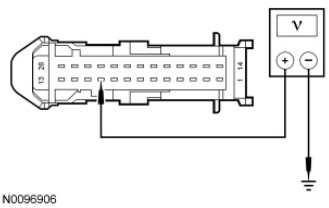
- RKE transmitters
- Wiring, terminals or connectors
- SJB
- Power window motors not initialized

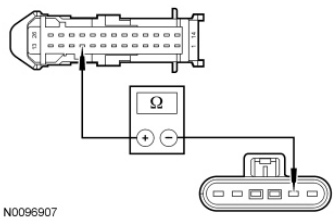
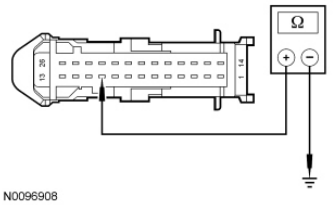
PINPOINT TEST K: THE GLOBAL OPEN FUNCTION IS INOPERATIVE/DOES NOT OPERATE CORRECTLY - IF EQUIPPED

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failuuse the correct probe adapter(s) may damage the connector.**

NOTE: The global open feature must be enabled and one-touch up/down must be operational for the global open function to operate correctly. Make sure the global open feature is enabled and one-touch up/down is operational before proceeding with this diagnostic.

Test Step	Result / Action to Take
K1 CHECK THE DTCs	
• Refer to the results from the previous SJB self-test. • **Was DTC B2947 or B2949 retrieved?**	**Yes** For B2949, GO to K2 . For B2947, GO to K5 . **No** GO to K7 .
K2 CHECK THE GLOBAL OPEN CIRCUIT FOR A SHORT TO VOLTAGE	

• Ignition OFF. • Disconnect: SJB C2280C. • Ignition ON. • Measure the voltage between SJB C2280C-10, circuit CPW01 (BN/BU), harness side and ground.  N0096906 • **Is the voltage greater than 10 volts?**	**Yes** GO to K3 . **No** GO to K9 .
K3 CHECK THE GLOBAL OPEN CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: LH Front Power Window Motor C540. • Measure the voltage between SJB C2280C-10, circuit CPW01 (BN/BU), harness side and ground.  N0096906 • **Is the voltage greater than 10 volts?**	**Yes** GO to K4 . **No** INSTALL a new LH front power window motor. REFER to Window Regulator and Motor - Front Door in this section. INITIALIZE the LH front power window motor. REFER to Window Motor Initialization in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
K4 CHECK THE GLOBAL OPEN CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: RH Front Power Window Motor C62 • Measure the voltage between SJB C2280C-10, circuit CPW01 (BN/BU), harness side and ground.  N0096906 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit. DE-INITIALIZE then INITIALIZE the LH and RH front window motors. REFER to Window Motor Initialization in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new RH front power window motor. REFER to Window Regulator and Motor - Front Door in this section. INITIALIZE the RH front power window motor. REFER to Window Motor Initializaon in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal

	operation.
K5 CHECK THE GLOBAL OPEN CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: SJB C2280C. • Disconnect: LH Front Power Window Motor C540. • Disconnect: RH Front Power Window Motor C623. • Measure the resistance between SJB C2280C-10, circuit CPW01 (BN/BU), harness side and LH front power window motor C540-2, circuit CPW01 (BN/BU), harness side; and between SJB C2280C-10, circuit CPW01 (BN/BU), harness side and RH front power window motor C623-2, circuit CPW01 (BN/BU), harness side.  N0096907 • **Are the resistances less than 5 ohms?**	**Yes** GO to K6 . **No** REPAIR the circuit. DE-INITIALIZE then INITIALIZE the LH and RH front power window motors. REFER to Window Motor Initialization in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
K6 CHECK THE GLOBAL OPEN CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between SJB C2280C-10, circuit CPW01 (BN/BU), harness side and ground.  N0096908 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K9 . **No** REPAIR the circuit. DE-INITIALIZE then INITIALIZE the LH and RH front power window motors. REFER to Window Motor Initialization in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
K7 CHECK THE RKE TRANSMITTER OPERATION	
• Operate the RKE lock/unlock function using all of the RKE transmitters. • **Does the RKE lock/unlock function operate correctly with at least one of the RKE transmitters?**	**Yes** GO to K8 . **No** REFER to Section 501-14 to continue diagnosis of the RKE system. CLEAR the DTCs. REPEAT the self-test. TEST the

	system for normal operation.
K8 CHECK THE RKE TRANSMITTERS GLOBAL OPEN OPERATION	
• Operate the global open function using all of the RKE transmitters. • **Does the global open function operate correctly with at least one of the RKE transmitters?**	**Yes** PROVIDE new RKE transmitters. REFER to Section 501-14 . TEST the system for normal operation. **No** GO to K9 .
K9 CHECK THE SJB FOR CORRECT OPERATION	
• Disconnect all of the SJB connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all of the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test L: The Defrost System is Inoperative - MKZ

Refer to Wiring Diagrams Cell 56 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Heated Window for schematic and connector information.

Normal Operation

When the engine is running and the defrost switch (integral to the Front Controls Interface Module (FCIM)) is pressed, the FCIM sends the defrost request message to the HVAC module over the Controller Area Network (CAN). When the request is received, the HVAC module activates the rear window defrost relay which supplies voltage through the antenna module to the rear window defrost grid.

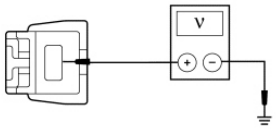
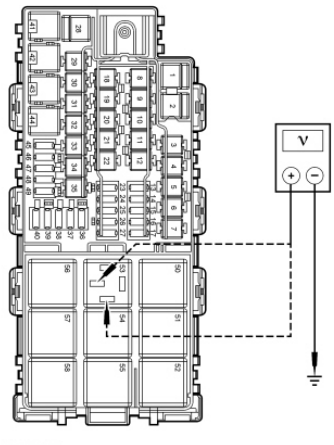
- DTC B1C83:12 (Rear Defog Relay: Circuit Short to Battery) - sets when the HVAC module detects a short to voltage on the rear window defrost relay control circuit.
- DTC B1C83:14 (Rear Defog Relay: Circuit Short to Ground or Open) - sets when the HVAC module detects an open or short to ground on the rear window defrost relay control circuit.

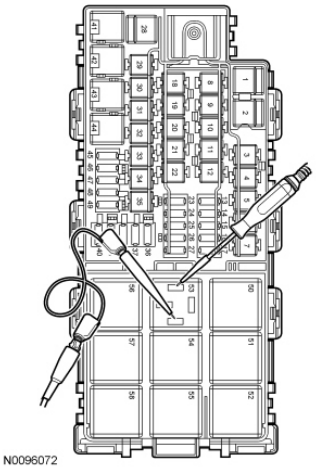
This pinpoint test is intended to diagnose the following:

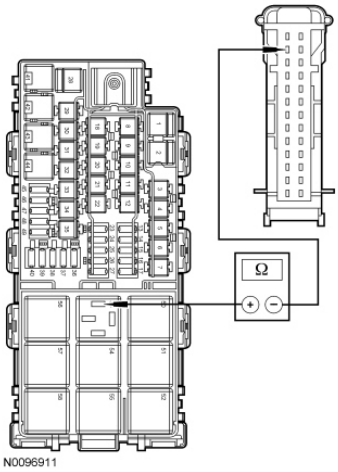
- Fuse(s)
- Rear wi defrost relay
- Wiring, terminals or connectors
- HVAC module
- FCIM
- Antenna module
- Rear window defrost grid

PINPOINT TEST L: THE DEFROST SYSTEM IS INOPERATIVE - MKZ

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
L1 CHECK FOR VOLTAGE TO THE REAR WINDOW DEFROST GRID	
• Disconnect: Antenna Module C4194B. • Start the engine. • Activate the rear defrost switch and measure the voltage between antenna module C4194B-1, circuit CRD06 (BN/YE), harness side and ground.  A0010641 • **Is the voltage greater than 10 volts?**	**Yes** INSPECT antenna module jumper harness and rear window defrost grid ground circuit for damage and REPAIR as necessary. If jumper harness and defrost grid ground wire are OK, INSTALL a new antenna module. TEST the system for normal operation. **No** GO to L2 .
L2 CHECK FOR VOLTAGE TO THE REAR WINDOW DEFROST RELAY	
• Ignition OFF. • Disconnect: Rear Window Defrost Relay. • Ignition ON. • Measure the voltage between rear window defrost relay socket pin 86 and ground; and between rear window defrost relay socket pin 30 and ground.  N0096910 • **Is the voltage greater than 10 volts for both measurements?**	**Yes** GO to L3 . **No** VERIFY Battery Junction Box (BJB) fuse 6 (40A) and Smart Junction Box (SJB) fuse 45 (5A) are OK. If OK, REPAIR the circuit. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. TEST the system for normal operation.
L3 CHECK THE HVAC MODULE	

NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section or equivalent. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Start the engine. • Activate the rear window defrost switch. • Connect a 12-volt incandescent test light between rear window defrost relay socket pin 85, circuit CH122 (WH/OG) and rear window defrost relay socket pin 86.  N0096072 • **Does the test light illuminate?**	**Yes** GO to L4 . **No** GO to L5 .
L4 CHECK THE REAR WINDOW DEFROST RELAY	
• Carry out the rear window defrost relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the rear window defrost relay pass the component test?**	**Yes** REPAIR open in circuit CRD06 (BN/YE). CLEAR the DTCs. TEST the system for normal operation. **No** INSTALL a new rear window defrost relay. CLEAR the DTCs. TEST the system for normal operation.
L5 CHECK THE REAR WINDOW DEFROST SWITCH (CC_SW_R_DEF) PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - FCIM . • Monitor the FCIM CC_SW_R_DEF PID while pressing and releasing the rear window defrost switch. • **Does the PID agree with the rear window defrost switch status?**	**Yes** GO to L6 . **No** INSTALL a new FCIM . REFER to Section 415-00 . CLEAR the DTCs. TEST the system for normal operation.

L6 CHECK THE REAR WINDOW DEFROST RELAY CONTROL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module C2356A. • Measure the resistance between rear window defrost relay socket pin 85, circuit CH122 (WH/OG), harness side and HVAC module C2356A-12, circuit CH122 (WH/OG), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to L7 . **No** REPAIR the circuit. TEST the system for normal operation.
L7 CHECK FOR CORRECT HVAC MODULE OPERATION	
• Disconnect all HVAC module electrical connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all HVAC module electrical connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test M: The Defrost System Will Not Shut Off Automatically - MKZ

Refer to Wiring Diagrams Cell 56 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Heated Window for schematic and connector information.

Normal Operation

When the engine is running and the defrost switch (integral to the Front Controls Interface Module (FCIM)) is pressed, the FCIM sends the defrost request message to the HVAC module over the Controller Area Network (CAN). When the request is received, the HVAC module activates the rear window defrost relay which supplies voltage through the antenna module to the rear window defrost grid.

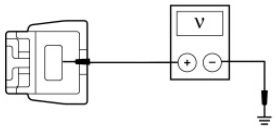
- DTC B1C83:14 (Rear Defog Relay: Circuit Short to Ground or Open) - sets when the HVAC module detects an open or short to ground on the rear window defrost relay control circuit.

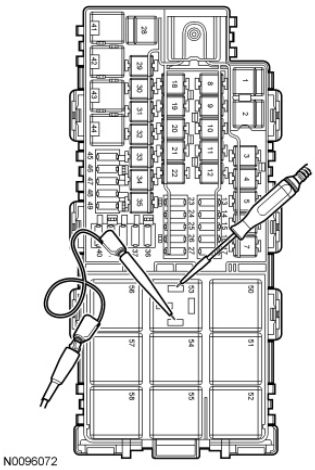
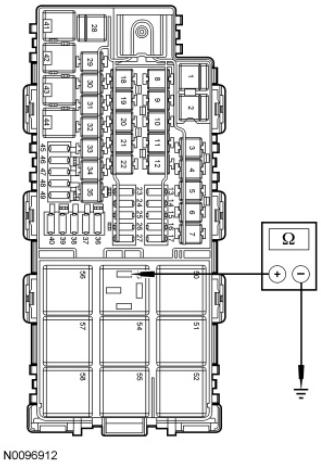
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Rear window defrost relay
- HVAC module

PINPOINT TEST M: THE DEFROST SYSTEM WILL NOT SHUT OFF AUTOMATICALLY - MKZ

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
M1 CHECK THE REAR WINDOW DEFROST GRID POWER CIRCUIT FOR A SHORT TO VOLTA	
• Disconnect: Rear Window Defrost Relay. • Disconnect: Antenna Module C4194B. • Ignition ON. • Measure the voltage between antenna module C4194B-1, circuit CRD06 (BN/YE), harness side and ground.  A0010641 • **Is any voltage present?**	**Yes** REPAIR circuit CRD06 (BN/YE) for a short to voltage. TEST the system for normal operation. **No** GO to M2 .
M2 CHECK THE HVAC MODULE OUTPUT	
• Start the engine. • ***NOTICE:*** **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section or equivalent. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Connect a 12-volt incandescent test light between rear window defrost relay socket pin 85, circuit CH122 (WH/OG) and rear window defrost relay socket pin 86.	**Yes** GO to M3 . **No** INSTALL a new rear window defrost relay. TEST the system for normal operation.

 N0096072 • **Does the test light illuminate?**	
M3 CHECK THE REAR WINDOW DEFROST RELAY CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module C2356A. • Measure the resistance between rear window defrost relay socket pin 85, circuit CH122 (WH/OG) and ground.  N0096912 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to M4 . **No** REPAIR short to ground in circuit CH122 (WH/OG). TEST the system for normal operation.
M4 CHECK FOR CORRECT HVAC MODULE OPERATION	
• Disconnect all HVAC module connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all HVAC module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test N: The Defrost System is Inoperative - Fusion

Refer to Wiring Diagrams Cell 56 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Heated Window for schematic and connector information.

Normal Operation

When the engine is running and the defrost switch (integral to the HVAC module or Front Controls Interface Module (FCIM), if equipped with navigation system) is pressed, the HVAC module activates the rear window defrost relay by grounding the relay coil. For vehicles equipped with navigation system, the FCIM sends the defrost request message to the HVAC module over the Controller Area Network (CAN). When the defrost relay is activated, voltage is supplied from the relay to the rear window defrost grid.

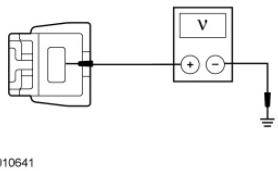
- DTC B1C83:12 (Rear Defog Relay: Circuit Short to Battery) - sets when the HVAC module detects a short to voltage on the rear window defrost relay control circuit.
- DTC B1C83:14 (Rear Defog Relay: Circuit Short to Ground or Open) - sets when the HVAC module detects an open or short to ground on the rear window defrost relay control circuit.

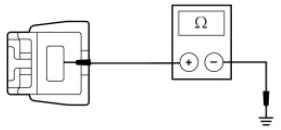
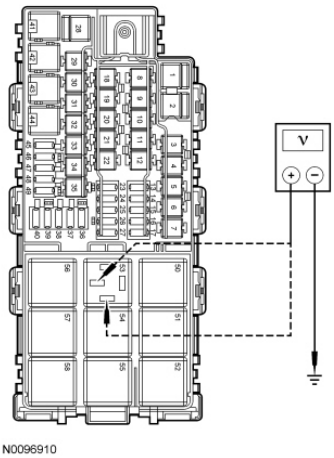
This pinpoint test is intended to diagnose the following:

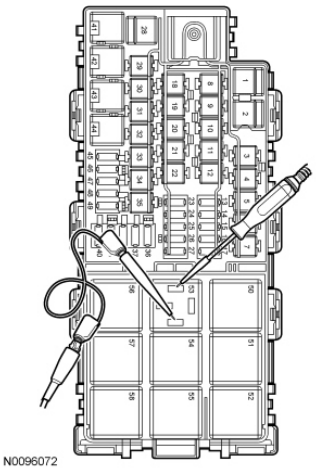
- Fuse
- Rear window defrost relay
- Wiring, terminals or connectors
- HVAC module
- FCIM
- Rear window defrost grid

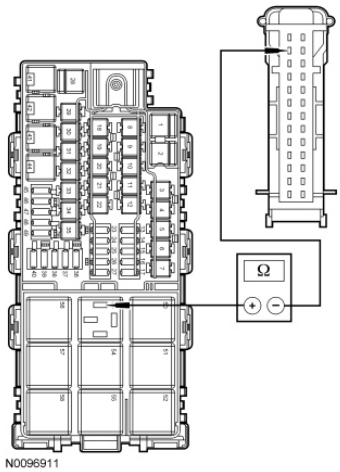
PINPOINT TEST N: THE DEFROST SYSTEM IS INOPERATIVE - FUSION

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. F to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
N1 CHECK FOR VOLTAGE TO THE REAR WINDOW DEFROST GRID	
• Disconnect: Rear Window Defrost Grid Power. • Start the engine. • Activate the rear defrost switch and measure the voltage between rear window defrost grid power C402A-1, circuit CRD06 (BN/YE), harness side and ground.  A0010641 • **Is the voltage greater than 10 volts?**	**Yes** GO to N2 . **No** GO to N3 .

N2 CHECK THE REAR WINDOW DEFROST GRID GROUND	
• Ignition OFF. • Disconnect: Rear Window Defrost Grid Ground C402B. • Measure the resistance between rear window defrost grid ground C402B-1, circuit GD147 (BK/VT) and ground.  A0010644 • **Is the resistance less than 5 ohms?**	**Yes** CARRY OUT the Grid Wire Test in this section. REPAIR the rear window defrost grid or INSTALL a new rear window glass. REFER to Window Grid Wire Repair in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
N3 CHECK THE VOLTAGE SUPPLY TO THE REAR WINDOW DEFROST RELAY	
• Ignition OFF. • Disconnect: Rear Window Defrost Relay. • Ignition ON. • Measure the voltage between rear window defrost relay socket pin 86 and ground; and between rear window defrost relay socket pin 30 and ground.  N0096910 • **Is the voltage greater than 10 volts for both measurements?**	**Yes** GO to N4 . **No** VERIFY Battery Junction Box (BJB) fuse 6 (40A) and Smart Junction Box (SJB) fuse 45 (5A) are OK. If OK, REPAIR the circuit. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the circuit. TEST the system for normal operation.
N4 CHECK THE HVAC MODULE	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section or equivalent. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Start the engine.	**Yes** GO to N5 . **No** If equipped with navigation system, GO to N6 . If not equipped with navigation system, GO to N7 .

• Activate the rear window defrost switch. • Connect a 12-volt incandescent test light between rear window defrost relay socket pin 85, circuit CH122 (WH/OG) and rear window defrost relay socket pin 86.  N0096072 • **Does the test light illuminate?**	
N5 CHECK THE REAR WINDOW DEFROST RELAY	
• Carry out the rear window defrost relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the rear window defrost relay pass the component test?**	**Yes** REPAIR open in circuit CRD06 (BN/YE). CLEAR the DTCs. TEST the system for normal operation. **No** INSTALL a new rear window defrost relay. CLEAR the DTCs. TEST the system for normal operation.
N6 CHECK THE REAR WINDOW DEFROST SWITCH (CC_SW_R_DEF) PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - FCIM . • Monitor the FCIM CC_SW_R_DEF PID while pressing and releasing the rear window defrost switch. • **Does the PID agree with the rear window defrost switch status?**	**Yes** GO to N7 . **No** INSTALL a new FCIM . REFER to Section 415-00 . CLEAR the DTCs. TEST the system for normal operation.
N7 CHECK THE REAR WINDOW DEFROST RELAY CONTROL CIRCUIT FOR AN OPEN	

• Ignition OFF. • Disconnect: HVAC Module - Electronic Manual Temperature Control (EMTC) C2357A or HVAC Module - Dual Automatic Temperature Control (DATC) C2356A. • Measure the resistance between rear window defrost relay socket pin 85, circuit CH122 (WH/OG), harness side and HVAC module - EMTC C2357A-12 or HVAC Module - DATC C2356A-12, circuit CH122 (WH/OG), harness side.  N0096911 • **Is the resistance less than 5 ohms?**	**Yes** GO to N8 . **No** REPAIR the circuit. TEST the system for normal operation.
• Disconnect all HVAC module electrical connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all HVAC module electrical connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test O: The Defrost System Will Not Shut Off Automatically - Fusion

Refer to Wiring Diagrams Cell 56 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Heated Window for schematic and connector information.

Normal Operation

When the engine is running and the defrost switch (integral to the HVAC module or Front Controls Interface Module (FCIM), if equipped with navigation system) is pressed, the HVAC module activates the rear window defrost relay by grounding the relay coil. For vehicles equipped with navigation system, the FCIM sends the defrost request message to the HVAC module over the Controller Area Network (CAN). When the defrost

relay is activated, voltage is supplied from the relay to the rear window defrost grid.

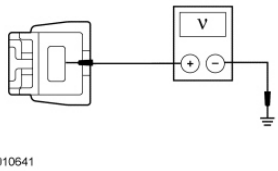
- DTC B1C83:14 (Rear Defog Relay: Circuit Short to Ground or Open) - sets when the HVAC module detects an open or short to ground on the rear window defrost relay control circuit.

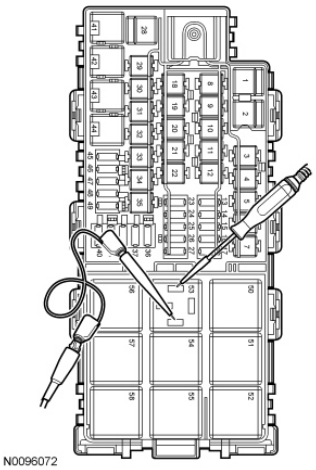
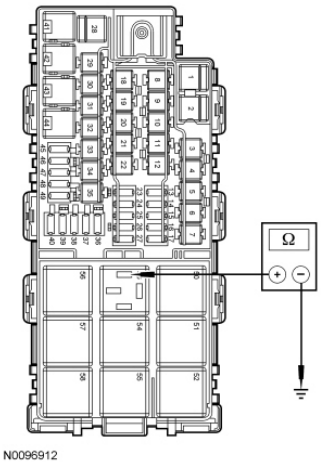
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Rear window defrost relay
- HVAC module

PINPOINT TEST O: THE DEFROST SYSTEM WILL NOT SHUT OFF AUTOMATICALLY - FUSION

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
O1 CHECK THE REAR WINDOW DEFROST GRID POWER CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Rear Window Defrost Relay. • Disconnect: Rear Window Defrost Grid Power C402A. • Ignition ON. • Measure the voltage between rear window defrost grid power C402A-1, circuit CRD06 (BN/YE), harness side and ground.  A0010641 • **Is any voltage present?**	**Yes** REPAIR circuit CRD06 (BN/YE) for a short to voltage. TEST the system for normal operation. **No** GO to O2 .
O2 CHECK THE REAR WINDOW DEFROST RELAY	
• Start the engine. • ***NOTICE:*** **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section or equivalent. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Connect a 12-volt incandescent test light between rear window defrost relay socket pin 85, circuit CH122 (WH/OG) and rear window defrost relay socket pin 86.	**Yes** GO to O3 . **No** INSTALL a new rear window defrost relay. TEST the system for normal operation.

 N0096072 • **Does the test light illuminate?**	
O3 CHECK THE REAR WINDOW DEFROST RELAY CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module - Electronic Manual Temperature Control (EMTC) C2357A or HVAC Module - Dual Automatic Temperature Control (DATC) C2356A. • Start the engine. • Measure the resistance between rear window defrost relay socket pin 85, circuit CH122 (WH/OG), harness side and ground.  N0096912 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to O4 . **No** REPAIR short to ground in circuit CH122 (WH/OG). TEST the system for normal operation.
O4 CHECK FOR CORRECT HVAC MODULE OPERATION	
• Disconnect all HVAC module connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all HVAC module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been

	caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test P: The Delayed Accessory is Inoperative

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

Normal Operation

The accessory delay relay is located in the Smart Junction Box (SJB). When the ignition is turned ON, the SJB activates the accessory delay relay, which provides power to the master window control switch. The delayed accessory feature remains active for 10 minutes after the ignition is turned OFF or until either front door is opened.

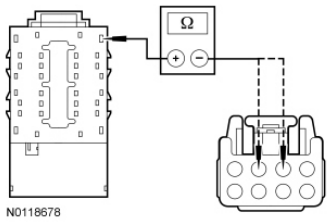
- DTC B1302 (Accessory Delay Relay Coil Circuit Failure) - sets when the SJB detects an open or short to ground on the accessory delay relay control circuit.
- DTC B1304 (Accessory Delay Relay Coil Circuit Short to Battery) - Sets when the SJB detects a short to voltage on the accessory delay relay control circuit.

This pinpoint test is intended to diagnose the following:
- Circuit breaker
- Accessory delay relay
- Wiring, terminals or connectors
- SJB

PINPOINT TEST P: THE DELAYED ASORY IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
P1 CHECK THE DOOR AJAR SWITCH OPERATION	
• Open and close the front doors. Verify the interior lights turn on when the doors are open, and off when the doors are closed. • **Do the interior lights operate normally?**	**Yes** GO to P2 . **No** REFER to Section 417-02 to diagnose the interior lighting and door ajar switches.
P2 CHECK THE ACCESSORY DELAY RELAY	
• Disconnect: Accessory Delay Relay. • Carry out the accessory delay relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the delayed accessory relay pass the component test?**	**Yes** VERIFY SJB fuse 41 (15A) (MKZ only) and circuit breaker 47 (30A) are OK. If OK, GO to P3 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. REPAIR the

	circuit. TEST the system for normal operation. **No** INSTALL a new accessory delay relay. TEST the system for normal operation.
P3 CHECK THE MASTER WINDOW CONTROL SWITCH POWER CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: SJB C2280D. • Disconnect: Master Window Control Switch C537A (Fusion, if RH front window is not equipped with one-touch up/down) or C535B (MKZ and/or Fusion if RH front window is equipped with one-touch up/down). • Measure the resistance between master window control switch C537A-2 or C535B-3 , circuit CBP47 (GN/BU), harness side and SJB C2280D-32, circuit CBP47 (GN/BU), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to P4 . **No** REPAIR the circuit. TEST the system for normal operation.
P4 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all SJB connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test Q: The Delayed Accessory Does Not Turn Off

Refer to Wiring Diagrams Cell 100 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Windows for schematic and connector information.

Normal Operation

The accessory delay relay is located in the Smart Junction Box (SJB). When the ignition is turned ON, the SJB activates the accessory delay relay, which provides power to the master window control switch. The

delayed accessory feature remains active for 10 minutes after the ignition is turned OFF or until either front door is opened.

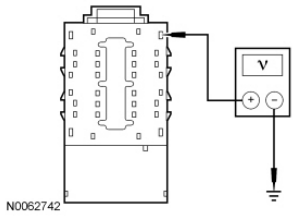
- DTC B1302 (Accessory Delay Relay Coil Circuit Failure) - sets when the SJB detects an open or short to ground on the accessory delay relay control circuit.

This pinpoint test is intended to diagnose the following:
- Accessory delay relay
- Wiring, terminals or connections
- SJB

PINPOINT TEST Q: THE DELAYED ACCESSORY DOES NOT TURN OFF

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take	
Q1 CHECK FOR STUCK/STICKING ACCESSORY DELAY RELAY		• Disconnect: Delayed Accessory Relay. • **Do the power windows still operate?** **Yes** GO to Q3 . **No** GO to Q2 .
Q2 CHECK THE ACCESSORY DELAY RELAY		
• Carry out the accessory delay relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the accessory delay relay pass the component test?**	**Yes** GO to Q4 . **No** INSTALL a new accessory delay relay. TEST the system for normal operation.	
Q3 CHECK THE MASTER WINDOW CONTROL SWITCH POWER CIRCUIT FOR A SHORT TO VOLTAGE		
• Ignition OFF. • Disconnect: SJB C2280D. • Ignition ON. • Measure the voltage between C2280D-32, circuit CBP47 (GN/BU), harness side and ground.	**Yes** REPAIR circuit CBP47 (GN/BU) for a short to voltage. TEST the system for normal operation. **No** GO to Q4 .	

 • **Is any voltage present?**	
Q4 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all SJB connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Component Test

Grid Wire Test

1. Using a bright lamp inside the vehicle, inspect the wire grid from the outside. A broken grid wire appears as a brown spot.

2. Run the engine at idle. Set the rear window defrost switch to ON. The indicator light should illuminate.

3. Working inside the vehicle with a voltmeter, contact the broad, red-brown stripes of the back glass window grid (positive lead to B+ side and negative lead to ground side). The meter should read 10-13 volts. A lower voltage reading may indicate a loose grid connection.

4. Contact a good ground point with the negative lead of the meter. The voltage reading should not change. If the voltage increases, this indicates a loose ground connection. A voltage reading of less than 10 volts indicates a loose B+ side connection.

5. With the negative lead of the meter grounded, touch each grid line of the rear window defrost glass at its midpoint with the positive lead. A reading of approximately 6 volts indicates the line is good. A reading of 0 volt indicates the line is broken between the midpoint and the B+ side of the grid line. A reading of 12 volts indicates the circuit is broken between the midpoint of the grid line and ground.

6. Pinpointing the exact position of the break can be accomplished (if the voltmeter reads 0 volt when the midpoint of the grid line is touched with the positive lead of the voltmeter) by moving the positive lead of the voltmeter toward the B+ side of the grid line and touching the grid line until the voltmeter reads 12 volts. If the voltmeter reads 12 volts when the midpoint of the grid line is touched with the positive lead of the voltmeter, simply move the positive lead of the voltmeter toward the ground connection of the grid line and touch the grid line until the voltmeter reads 0 volt.

Window Grid Wire Repair

General Equipment

Polypropylene Film Fine Line Tape (Commercially available)

Material

Item	Specification
Motorcraft® Lacquer Touch-Up Paint (match color to exterior grid wire) PMP-19500-XXXXX	ESR-M2P100-C
Permatex® Quick GridTM Rear Window Defogger Repair Kit 15067	-
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A

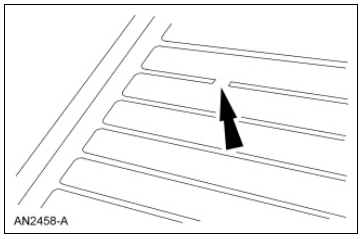
NOTE: The grid line material is not embedded into the glass, but is baked to the glass surface and consequently can be scraped off. An undamaged grid line will have small ridges that project above the surface of the glass and can easily be felt when running a fingernail across them. Grid lines that have been "razor bladed" will feel smooth when a fingernail is dragged across the affected area. Inoperative lines may appear to the eye to be undamaged due to residue remaining on the glass and will require diagnosis with a voltmeter or 12V test lamp. For additional information, refer to Diagnosis and Testing in this section.

1. Bring the vehicle up to a room temperature of at least 16°C (60°F) or above.

2. ***NOTICE:*** **Do not use scrapers, sharp instruments or abrasive window cleaners on the interior surface of the rear window glass as this may cause damage to the grid lines.**

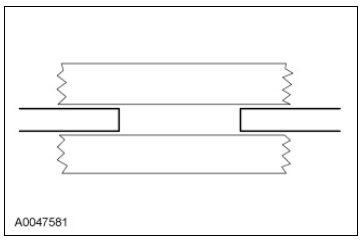
   Clean the entire grid line repair area with glass cleaner and 0000 steel wool to remove all dirt, wax, grease, oil or other foreign material.

3. Mark the location of the grid break on the exterior of the rear window glass.



4. Using a polypropylene film fine line tape, mask the area directly above and below the grid break extending the tape 26 mm (1.02 in) beyond the concern area in both directions. The break area should

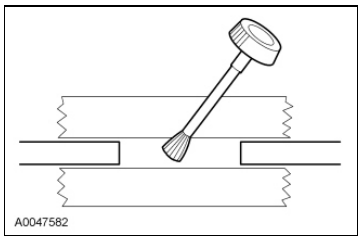
be at the cef the mask.



5. **NOTE:** If the brown layer is not broken or missing, apply only the silver grid repair compound to the break. If both the brown and silver layers of the grid are broken or missing, apply a coating of the lacquer touch up paint across the break in the grid line prior to applying the rear window defroster repair compound. Do not overlap the silver grid line with the paint. Several applications may be necessary to achieve a color match.

   NOTE: Allow at least 5 minutes of drying time between applications for the touch up paint or the silver repair coating. Applying fewer coats or not allowing adequate drying time between coats will produce repaired resistance that is greater than OEM resistance, resulting in poor defrost performance and excessive localized heating.

   Apply the repair coating to the grid break area in several smooth, continuous strokes. Extend the silver repair coating at least 6.35 mm (0.25 in) on both sides of the break area.
   Apply a minimum of 6 applications of the grid repair compound.



6. **NOTE:** The repair coating air-dries in approximately one minute and can be energized after 5 minutes. Optimum adhesion occurs after approximately 24 hours.

   Allow the repair area to dry completely and remove the mask.

7. ***NOTICE:*** **Be careful not to damage the grid line with the razor blade. If this occurs, additional repair may be necessary.**

   Remove any excess repair compound above or below the grid line with a razor blade.

8. **NOTE:** The interior side of the grid lines are not painted, but due to the silver tarnishing will tend to change the grid to a gold or brown color. The repair area will be bright silver and will also tarnish over time to match the rest of the grid.

   Test the system for normal operation.

Lead Terminal Repair

General Equipment

Terminal Kit - Back Glass 4F1Z-14421-AA

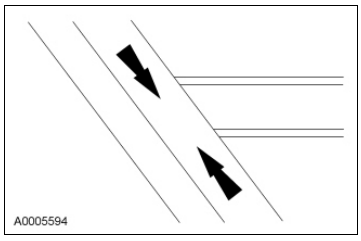
Material

Item	Specification
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A

1. Bring the vehicle up to room temperature of at least 16°C (60°F) or above.

2. **NOTE:** The new terminal will cover the original terminal location, but it must be placed so that the terminal conductive areas will be placed on a good conductive base.

   Clean the bus bar in the area to be repaired with steel wool (000 to 0000 grade), and then with glass cleaner to remove all dirt, wax, grease, oil or other foreign material.



3. ***NOTICE:*** **Do not use any type of flame torch or flame-heated soldering gun for this procedure. Use of these tools provide inadequate heat generation at the tip and the exhaust heat can cause damage to plastic trim parts in the area. Use only an electric soldering gun with 100 watts or more of power. Before using the soldering gun, be sure to melt a small amount of rosin core solder to the tip. The solder will assist in achieving better heat transfer from the soldering gun tip to the new terminal.**

   NOTE: Depending on the original terminal location, and whether the terminal is covered by pillar trim, will determine where to locate the new terminal. Some grid line bus bars may only allow the placement of the terminal above or below the original tab location due to space limitations. Fst vehicle applications, the replacement tab location will cover the original tab location, but still allow the replacement tab to attach to the bus bar on good conductive material.

   Place the replacement terminal type A over the original tab location, making sure the conductive areas of the terminal will be on a good conductive area. Do not place the terminal tab foot on the original location, which does not have conductive material.

4. Hold the terminal in place with an item such as a regular lead pencil at a 90 degree angle from the terminal. (Holding at other than a 90 degree angle may allow the terminal to slip when the solder

liquefies.)

5. **NOTE:** The new terminal has pre-applied solder, flux and temperature-sensitive paint. The paint provides a visual indication when the terminal has reached the correct temperature to melt solder on the terminal. When the correct temperature is achieved, the temperature paint will liquefy and change color.

   Place the soldering gun tip on the top of the terminal, but not on the painted areas of the tab. Energize the soldering gun and watch for the painted area of the terminal to liquefy and change color. The paint should liquefy in approximately 25-45 seconds after heating. As soon as the paint color completely changes on either side of the terminal, de-energize the soldering gun and continue to hold the terminal in place with the soldering gun and pencil for an additional 30 seconds.

6. Remove the soldering gun and pencil from the terminal. The terminal should be allowed to cool for another 2 minutes before the wiring lead is attached to the terminal.

7. Attach the electrical lead connection to this terminal, turn on the heated rear window and verify the operation.

Window Motor Initialization

NOTE: Initialization is required to learn both the full UP and full DOWN positions of the glass as it travels through the glass channel. Once initialized, obstacle detection is enabled.

NOTE: The front window motor must be de-initialized, then initialized whenever:

- the front window motor is removed from the window regulator drum housing.
- a new window regulator is installed.
- a new window glass is installed.
- a new top run is installed.
- grease or lubricants are applied to the window regulator or glass run.

NOTE: Install and tighten all window components to specification before carrying out the initialization procedure.

NOTE: A new (original factory setting) or de-initialized window motor will not operate in one-touch up mode until initialized. If a new front window motor has been installed, proceed to the initialization procedure.

NOTE: Excessive bounce-back (window reverses direction with no obstructions present) may indicate that a de-initialization procedure may need to be performed.

De-Initialization procedure

1. Turn the ignition key ON.

2. Operate the window control switch in one-touch up mode and remove power from the window motor **while the window is moving** by one of the following methods:
    1. Disconnect the vehicle battery cable **while the window is moving** .
    2. Disconnect the window motor connector **while the window is moving** .
    3. Remove the LH or RH front window motor fuse **while the window is moving** .

3. This will de-initialize the window motor and reset the window motor to its original factory settings.

4. Reconnect the battery cable, window motor connector or window motor fuse before proceeding to the initialization procedure.

Initialization procedure

⚠ WARNING: Keep objects and body parts clear of the glass panel when carrying out the initialization procedure. During the initialization procedure, the glass panel closes with high force and cannot detect objects in its path. Failure to follow this instruction may result in serious personal injury.

NOTE: The front window must be in the full OPEN position for this procedure to operate correctly.

NOTE: If the initialization procedure is only partially completed, the front window motor will remain de-initialized and will not operate in one-touch up mode.

5. Turn the ignition key ON.

6. Press and hold the window control switch until the window glass stalls for 2 seconds into the glass top run and release the switch.

7. Pull and hold the window control switch until the window glass stalls for 2 seconds at the bottom of its travel and release the switch.

8. Test for correct window operation by carrying out the one-touch up feature. If the window does not operate correctly, carefully repeat this procedure.

Glass Reseal - Windshield

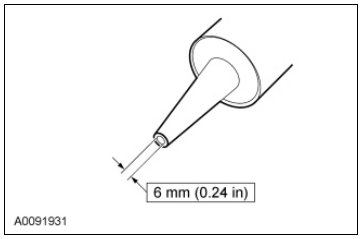
Material

Item	Specification
Dow Urethane Adhesive BetasealTM Express	-
Sika Urethane Adhesive Sika Tack ASAP	-
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A

1. Remove the cowl panel grille. For additional information, refer to Section 501-02 .
2. Remove the LH and RH A-pillar trim panels. For additional information, refer to Section 501-05 .
3. Remove the LH and RH sun visors.
4. If equipped, remove the overhead console.
5. If equipped, disconnect the automatic-dimming rear view mirror electrical connector.
6. If equipped, disconnect the rain sensor electrical connector.
7. Remove the LH and RH assist handles.
8. Lower the front portion of the headliner and block with a suitable material.

- Clean the edge formed by the existing urethane adhesive and the glass on the inside at the top and sides and outside on the bottom of the windshield with glass cleaner.

10. Cut the urethane adhesive applicator tip to specification.



11. **NOTE:** Use either a high-ratio, electric or battery-operated caulk gun that will apply the urethane adhesive with less effort and a continuous bead.

    NOTE: Make sure there are no gaps in the urethane adhesive bead.

    Apply urethane adhesive over the top of the existing urethane adhesive.

- Apply the urethane adhesive to the top and sides of the windshield from the interior of the vehicle.
- Apply the urethane adhesive to the bottom of the windshield from the exterior of the vehicle.

12. **NOTE:** The urethane adhesive must cure for a minimum of one hour before testing for air or water leaks.

    After the urethane adhesive has cured, check the windshield seal for air or water leaks through the urethane adhesive bead and add urethane adhesive as necessary.

13. Position the front portion of the headliner.

14. Install the LH and RH assist handles.

15. If equipped, connect the rain sensor electrical connector.

16. If equipped, connect the automatic-dimming rear view mirror electrical connector.

17. If equipped, install the overhead console.

18. Install the LH and RH sun visors.

19. Install the LH and RH A-pillar trim panels. For additional information, refer to Section 501-05 .

20. Install the cowl panel grille. For additional information, refer to Section 501-02 .

21. Clean the interior and exterior windshield glass with glass cleaner.

Glass Reseal - Rear

Material

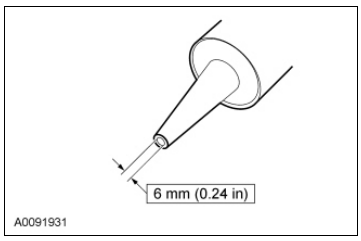
Item	Specification
Dow Urethane Adhesive BetasealTM Express	-
Sika Urethane Adhesive Sika Tack ASAP	-
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A

1. Remove the C-pillar trim panel and parcel shelf, and lower the headliner. For additional information, refer to Section 501-05 .

2. Disconnect the rear window glass electrical connectors.

3. Clean the interior and exterior of the windshield glass surface with glass cleaner.

4. Cut the urethane adhesive applicator tip to specification.



5. **NOTE:** Use either a high ratio, electric or battery-operated caulk gun that applies the urethane adhesive with less effort and continuous bead.

   NOTE: Make sure there are no gaps in the urethane adhesive bead.

   Apply the urethane adhesive over the top of the existing uresive.

   - Apply the urethane adhesive to the top and sides of the rear glass from the interior of the vehicle.
   - Apply the urethane adhesive to the bottom of the rear glass from the exterior of the vehicle.

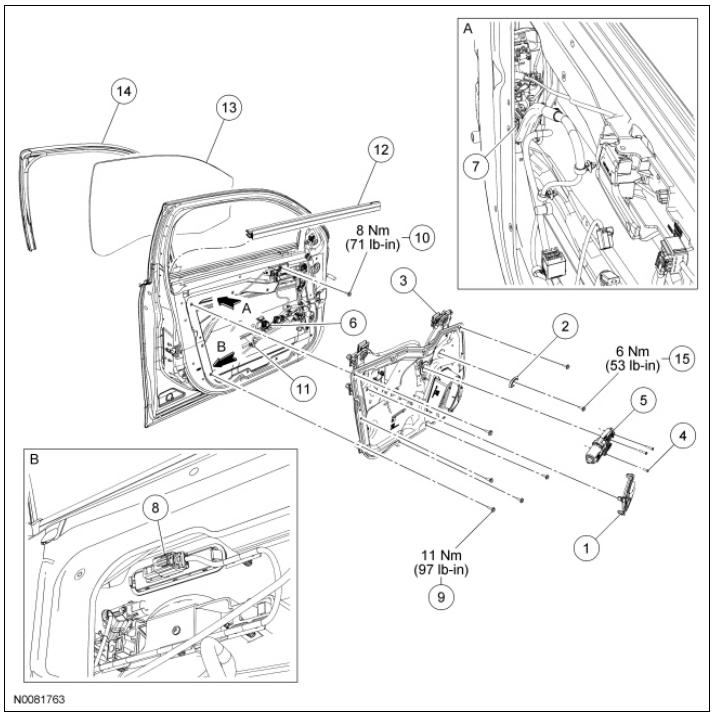
6. **NOTE:** The urethane adhesive must cure for a minimum of one hour before testing for air or water leaks.

   After the urethane adhesive cures, check the rear glass seal for air or water leaks through the urethane adhesive bead and add urethane adhesive as necessary.

7. Connect the rear window glass electrical connectors.

8. Install the headliner, parcel shelf and C-pillar trim panels. For additional information, refer to Section 501-05 .

Glass, Frames and Mechanisms - Exploded View, Front Door



Item	Part Number	Description
1	5402010	Wiring harness cover plate
2	378377-S	Access hole plug
3	5423201 LH/ 5423200 RH	Window regulator
4	W505966-S	Window motor screw (3 required)
5	5423395 LH/ 5423394 RH	Window motor
6	14489	Window motor electrical connector
7	14A464	Door latch electrical connector
8	14A464	Keypad latch electrical connector
9	W505421-S	Door module bolt (10 required)
10	W706476	Interior door handle bolt
11	-	Wiring harness retainer
12	5421457 LH/ 5421456 RH	Interior door window glass belt moulding
13	5421411 LH/ 5425712 RH	Front door window glass
14	5421597 LH/ 5421596 RH	Door window glass top run
15	378377-S	Window glass clamp bolt (2 requir/td>

1. For additional information, refer to the procedures in this section.

Window Glass - Front Door

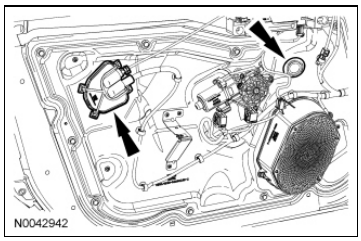
Removal and Installation

NOTE: All vehicles are equipped with a one-touch up/down feature for the LH front window. All MKZ and some Fusion vehicles are equipped with a one-touch up/down feature for the LH and RH front windows. The LH and RH one-touch up/down functionality is identical.

NOTE: The front window motor must be de-initialized, then initialized whenever the LH front or RH front (if equipped with one-touch up/down functionality) window motor is removed from the window regulator drum housing, a new window regulator is installed, a new window glass is installed, a new top run is installed or for any operation in which grease or lubricants are applied to the window regulator or glass run.

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .

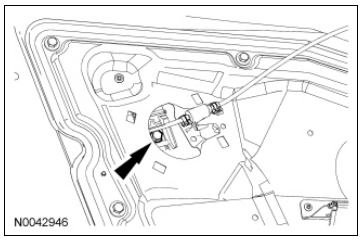
2. Remove the wiring harness cover plate and the access hole plug.



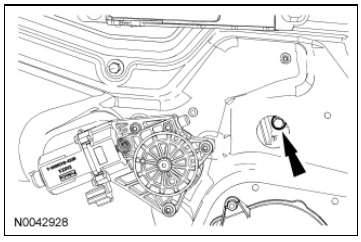
3. **NOTE:** If the window regulator motor is inoperative, remove it. For additional information, refer to Window Regulator Motor in this section.

   Lower the window until the glass clamp bolts can be accessed through the access holes.

4. Loosen the B-pillar front door window glass clamp bolt.
   - To install, tighten to 6 Nm (53 lb-in).



5. Loosen the A-pillar front door window glass clamp bolt.
   - To install, tighten to 6 Nm (53 lb-in).



6. Tape the window in position, then lower the window regulator downward until it reaches the stops at the bottom of the regulator tracks.

7. Lift the window glass out of the door.

8. To install, reverse the removal procedure.
    - If equipped with one-touch up/down functionality, initialize the window motor. For additional information, refer to Window Motor Initialization in this section.

Window Regulator Motor

Removal and Installation

NOTE: All vehicles are equipped with a one-touch up/down feature for the LH front window. All MKZ and some Fusion vehicles are equipped with a one-touch up/down feature for the LH and RH front windows. The LH and RH one-touch up/down functionality is identical.

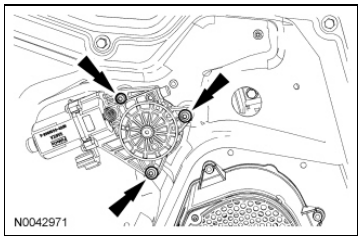
NOTE: The front window motor must be de-initialized, then initialized whenever the LH front or RH front (if equipped with one-touch up/down functionality) window motor is removed from the window regulator drum housing, a new window regulator is installed, a new window glass is installed, a new top run is installed or for any operation in which grease or lubricants are applied to the window regulator or glass run.

1. Remove the door trim panel. For additional information, refer to Section 501-05 .

2. Disconnect the window motor electrical connector.

3. Secure the glass in position with tape.

4. Remove the 3 window motor screws.



5. Remove the window motor.

6. To install, reverse the removal procedure.
    - If equipped with one-touch up/down functionality, initialize the window motor. For additional information, refer to Window Motor Initialization in this section.

Window Regulator and Motor - Front Door

Removal and Installation

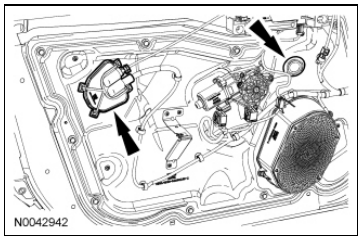
NOTE: All vehicles are equipped with a one-touch up/down feature for the LH front window. All MKZ and some Fusion vehicles are equipped with a one-touch up/down feature for the LH and RH front windows. The LH and RH one-touch up/down functionality is identical.

NOTE: The front window motor must be de-initialized, then initialized whenever the LH front or RH front (if equipped with one-touch up/down functionality) window motor is removed from the window regulator drum housing, a new window regulator is installed, a new window glass is installed, a new top run is installed or for any operation in which grease or lubricants are applied to the window regulator or glass run.

1. **NOTE:** If installing the original front window motor (if equipped with one-touch up/down functionality), it must be de-initialized. For additional information, refer to Window Motor Initialization in this section.

   Remove the door trim panel. For additional information, refer to Section 501-05 .

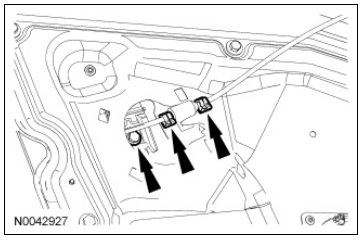
2. Remove the wiring harness cover plate and the access hole plug.



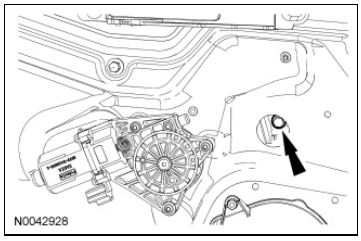
3. **NOTE:** If the window regulator motor is inoperative, remove it. For additional information, refer to Window Regulator Motor in this section.

   Lower the window enough to access the window glass clamp bolts through the access holes.

4. Loosen the B-pillar window glass clamp bolt and disconnect the door latch cable retainers.
   - To install, tighten to 6 Nm (53 lb-in).



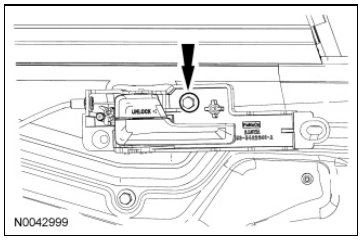
5. Loosen the A-pillar window glass clamp bolt.
   - To install, tighten to 6 Nm (53 lb-in).



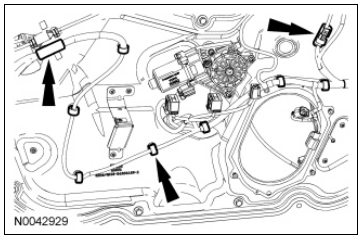
6. Tape the window in position, then lower the window regulator until it is approximately 55 mm (2.165 in) above the bottom of the regulator tracks.

7. Remove the front door speaker. For additional information, refer to Section 415-00 .

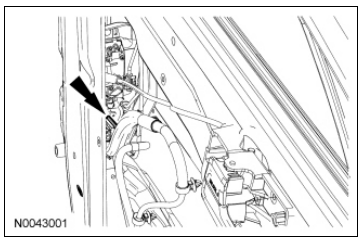
8. Remove the interior door handle bolt and position the door handle aside.



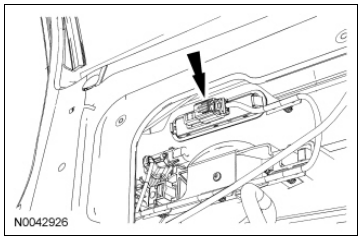
9. Disconnect the wiring harness retainers.



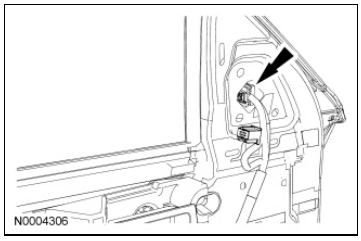
10. Disconnect the door latch electrical connector.



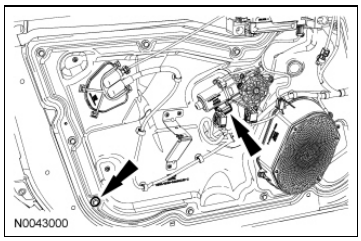
11. If equipped, disconnect the keyless entry keypad and door lock electrical connector and release from the bracket.



12. If equipped, disconnect the power mirror electrical connector.



13. Remove the 10 door module bolts and the window regulator motor electrical connector.
    - To install, tighten to 11 Nm (97 lb-in).



14. Remove the front door module. If installing a new door module, transfer parts as necessary.

15. To install, reverse the removal procedure.
    - If equipped with one-touch up/down functionality, initialize the window motor. For additional information, refer to Window Motor Initialization in this section.

Door Glass Top Run - Front

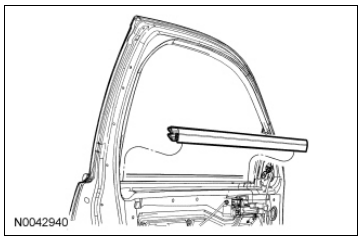
Removal and Installation

NOTE: All vehicles are equipped with a one-touch up/down feature for the LH front window. All MKZ and some Fusion vehicles are equipped with a one-touch up/down feature for the LH and RH front windows. The LH and RH one-touch up/down functionality is identical.

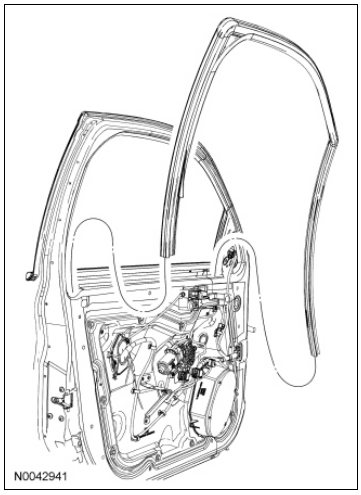
NOTE: The front window motor must be de-initialized, then initialized whenever the LH front or RH front (if equipped with one-touch up/down functionality) window motor is removed from the window regulator drum housing, a new window regulator is installed, a new window glass is installed, a new top run is installed or for any operation in which grease or lubricants are applied to the window regulator or glass run.

1. Remove the front door window glass. For additional information, refer to Window Glass - Front Door in this section.

2. Remove the front door window glass inner weatherstrip.

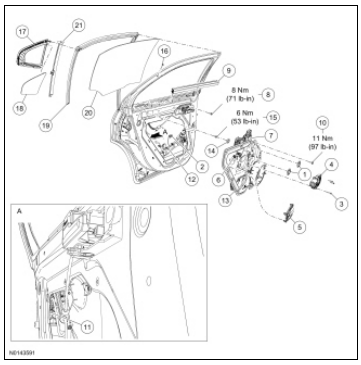


3. Remove the front door glass top run.



4. To install, reverse the removal procedure.
    - If equipped with one-touch up/down functionality, initialize the window motor. For additional information, refer to Window Motor Initialization in this section.

Glass, Frames and Mechanisms - Exploded View, Rear Door



Item	Part Number	Description
1	378377	Access hole plugs
2	14489	Electrical connector
3	W505966-S	Screw (3 required)
4	5423395 LH/ 5423394 RH	Window regulator motor
5	5402010	Wiring harness cover plate
6	-	Clip
7	5427001 LH/ 5427000 RH	Window regulator
8	-	Interior door handle bolt
9	5425861 LH/ 5425860 RH	Interior door window glass belt moulding
10	W505421-S	Door module bolt (10 required)
11	14A464	Rear door latch electrical connector
12	-	Wiring harness retainer
13	54235A89 LH/ 54235A88 RH	Rear door module
14	W651013-S	Access hole plug
15	W506410-S	Window regulator glass clamp bolt (2 required)
	N811106-S	Upper C-pillar rear glass run bolt
17	5429905 LH/ 5429904 RH	Rear door fixed glass weatherstrip
18	5426871 LH/ 5426870 RH	Rear door fixed glass
19	5425767 LH/ 5425766 RH	Rear door glass top run
20	5425713 LH/ 5425712 RH	Rear door window glass
21	5425796	Rear door quarter glass window guide

1. For additional information, refer to the procedures in this section.

Window Glass - Rear Door

Removal and Installation

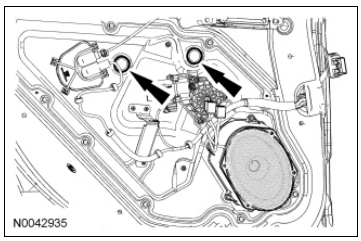
1. Remove the rear door fixed window glass. For additional information, refer to Window Glass - Rear Door, Fixed in this section.
2. Remove the top run.
3. Remove the rear window glass.
4. To install, reverse the removal procedure.

Window Regulator and Motor - Rear Door

Removal and Installation

1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

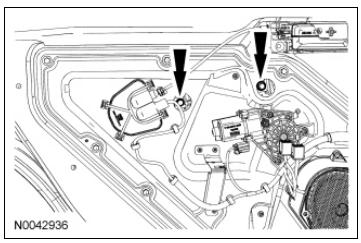
2. Remove the access hole plugs.



3. **NOTE:** If the door window regulator motor is inoperative, remove it. For additional information, refer to Window Regulator Motor in this section.

   Lower the window until the glass clamp bolts are accessible through the access hole plugs, then loosen the glass clamp bolts.

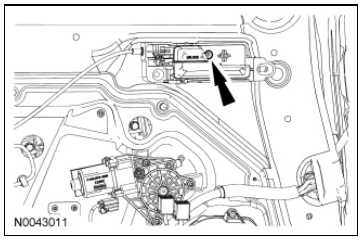
   - To install, tighten to 6 Nm (53 lb-in).



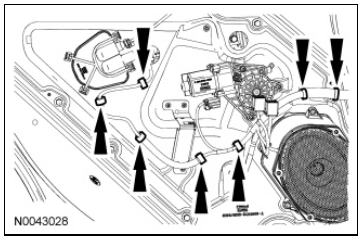
4. Tape the window in position, then lower the window regulator downward until it reaches the stops at the bottom of the regulator tracks.

5. Remove the door speaker. For additional information, refer to Section 415-00 .

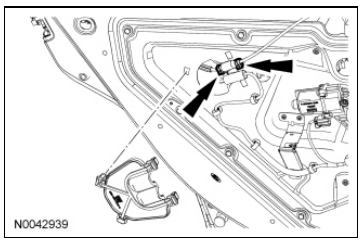
6. Remove the interior door handle screw and position the door handle aside.



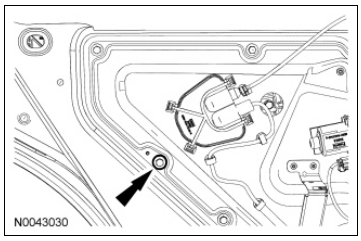
7. Disconnect the wiring harness retainers.



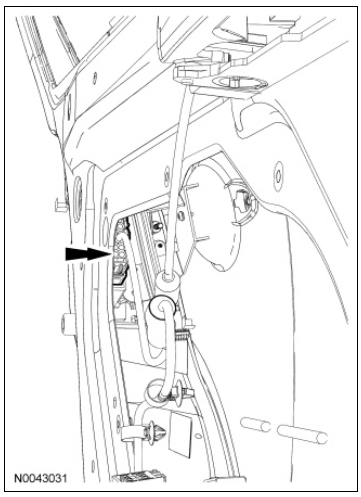
8. Remove the wiring harness cover plate and disconnect the 2 door latch cable retainers.



9. Remove the 10 door module bolts.
    - To install, tighten to 11 Nm (97 lb-in).



10. Disconnect the door latch electrical connector.



11. Remove the rear door module assembly. If installing a new door module, transfer parts as necessary.

12. To install, reverse the removal procedure.

Door Glass Run and Bracket - Rear

Removal and Installation

1. Remove the rear door fixed window glass. For additional information, refer to Window Glass - Rear Door, Fixed in this section.

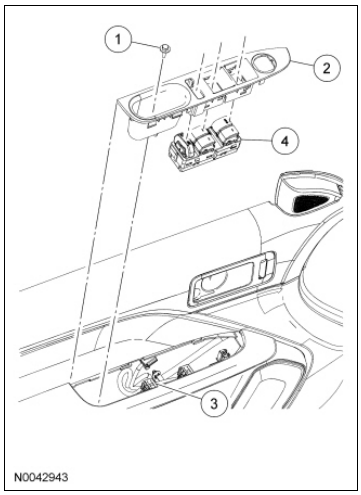
2. Carefully position the glass aside, then remove the rear door glass top run.

3. To install, reverse the removal procedure.

Window Control Switch

Fusion

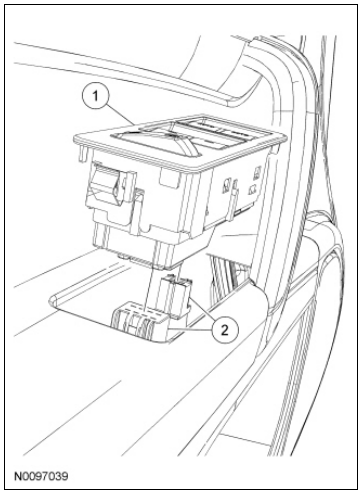
NOTE: LH front shown, all others similar.



Item	Part Number	Description
1	W703268	Screw
2	54266	Window control switch bezel
3	-	Electrical connector (3 required)
4	14529	Window control switch

MKZ - Front Door

NOTE: LH front shown.

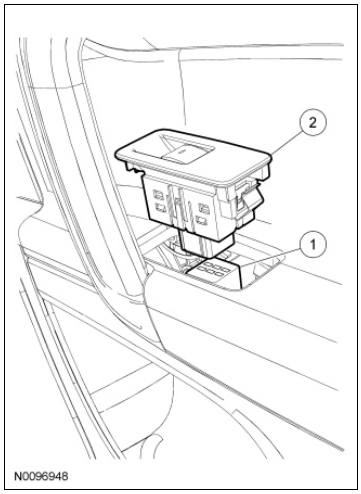


Item	Part Number	Description

1	14529	Window control switch
2	-	Electrical connectors (2 required)

MKZ - Rear Door

NOTE: RH rear shown.



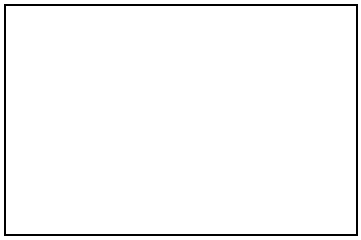
Item	Part Number	Description
1	-	Electrical connector
2	14529	Window control switch

Removal and Installation

Fusion

1. Remove the access cover and the screw.

2. Using an appropriate non-marring trim tool, pry the rear of the switch bezel upward and then shift the switch assembly rearward to disengage the front locking tab.



MKZ

3. **NOTE:** For LH front window control switch assembly only, the rear retaining clip is located off-center towards the outside of the vehicle.

   Using an appropriate non-marring trim tool, pry the rear of the switch bezel upward to disengage the retaining clip, then shift the switch assembly rearward to disengage the front locking tab.

All Vehicles

4. Disconnect the electrical connector(s).

5. Remove the window control switch.

6. To install, reverse the removal procedure.

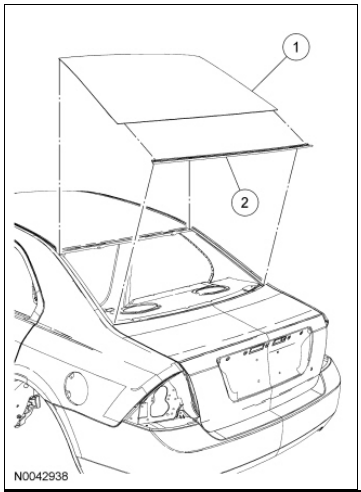
Window Glass - Rear

Special Tool(s)

 ST1320-A	Deluxe Windshield Removal Tool 164-R2450 or equivalent
 ST2085-A	The Pumper 164-R2459 or equivalent

Material

Item	Specification
Dow Urethane Adhesive BetasealTM Express	-
Dow Urethane One Step Glass Primer BetaprimeTM 5500 / 5500A / 5500SA	-
Sika Urethane Adhesive Sika Tack ASAP	-
Sika Urethane Metal and Glass Primer Sika 206 G+P	-
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A



Item	Part Number	Description
1	5442006	Rear window glass
2	-	Moulding

Removal

NOTE: If the rear window glass is being removed to repair a dust/water leak, remove and reinstall the existing rear window glass.

1. Remove the C-pillar trim panel and parcel shelf, and lower the headliner. For additional information, refer to Section 501-05 .

2. Disconnect the 2 rear window defrost electrical connectors.

3. Before cutting the urethane adhesive, remove dirt and other foreign material from the rear window pinchweld area.
   - Use a clean shop towel or oil-free, compressed air.

4. Lubricate the urethane adhesive with water to aid the Deluxe Windshield Removal Tool when cutting.

5. ⚠ **WARNING: Always wear eye protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.**

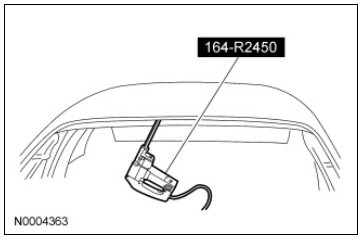
   WARNING: Wear protective gloves when handling components or parts that have pointed or sharp edges. Failure to follow this instruction may result in serious personal injury.

   NOTICE: **To avoid rust formation, use extreme care not to scratch the paint or primer or otherwise damage the pinchweld during glass removal.**

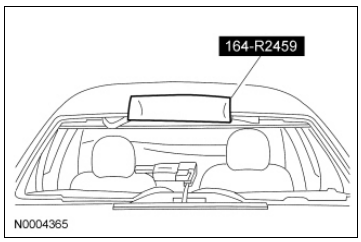
   NOTE: Insert the blade into the Deluxe Windshield Removal Tool so that the flat side is against the glass. This will leave the entire urethane adhesive bead on the pinchweld and allow a dry fit of the replacement rear window glass.

   NOTE: Support the rear window glass to prevent the glass from dropping while cutting the urethane adhesive.

   Insert the Deluxe Windshield Removal Tool at the upper center of the rear window glass and work toward the bottom corners.



6. Using The Pumper, distance the rear window glass from the body.



7. Insert the Deluxe Windshield Removal Tool into the bottom of the urethane adhesive and cut from corner to corner.

8. Carefully remove the rear window glass from the vehicle and place on a stable work surface.

Installation

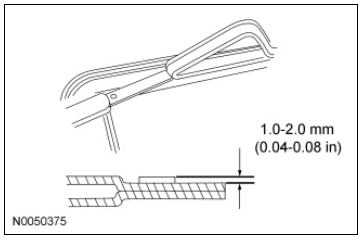
1. Dry-fit the rear window glass on the existing urethane adhesive bead on the pinch weld.
   - Position the glass on the pinch weld.
   - Center the glass in the opening.
   - Make alignment marks with tape or non-staining grease pencil on the rear window glass and the body.

2. After the dry-fit alignment, remove the glass from the body opening and place on a stable work surface with the interior side of the glass facing upward.

3. ⚠ **WARNING: Repair any corrosion found on the pinch weld. The pinch weld is a structural component of the vehicle. Corrosion left unrepaired may reduce the structural integrity of the vehicle. Failure to follow this instruction may result in serious injury to vehicle occupant(s).**

   NOTE: Avoid scratching the pinch weld. Repair all minor scratches or exposed metal on the pinch weld following manufacturer's instructions. Use the same brand pinch weld primer, glass primer and urethane adhesive.

   Using an appropriate tool, trim the urethane adhesive leaving a 1-2 mm (0.04-0.08 in) base of original equipment urethane adhesive on the pinchweld.



4. Using a clean shop towel, brush or oil-free, compressed air, clean the pinch weld area around the existing urethane adhesive. Remove any foreign material or water that may have entered during glass removal.

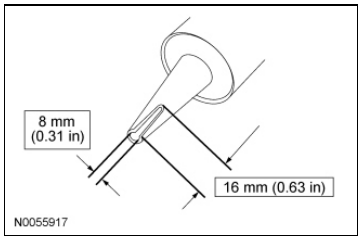
5. If reinstalling the same rear window glass, remove the remaining urethane adhesive from the glass leaving a thin layer to bond with the new urethane adhesive bead.

6. Clean the inside of the new rear window glass surface with glass cleaner.

7. **NOTE:** Be sure to use the same brand and cure-rate products for the urethane adhesive and glass primer. Do not mix different brands of urethane adhesive and glass primer. Refer to the Material Chart in this procedure.

   If installing a new rear window glass, apply glass primer according to manufacturer's instructions. Allow at least 6 minutes to dry.

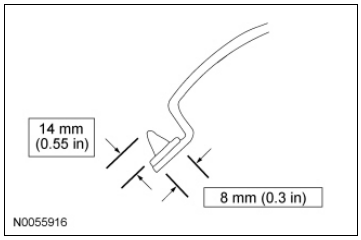
8. Cut the urethane adhesive applicator tip to specification.



9. **NOTE:** Use either a high-ratio, electric or battery-operated caulk gun that will apply the urethane adhesive with less effort and continuous bead.

   NOTE: The rear window glass must be positioned within 10 minutes of applying the urethane adhesive.

   Apply urethane adhesive on top of the existing trimmed urethane adhesive bead on the pinch weld, starting and ending at the bottom of the rear window glass near the center, making sure there are no gaps in the bead.



10. **WARNING: Do not drive vehicle until the urethane adhesive seal has cured. Follow urethane adhesive manufacturer's curing directions. Inadequate or incorrect curing of the urethane adhesive seal will adversely affect glass retention. Failure to follow these instructions may result in serious injury to vehicle occupant(s).**

    NOTICE: **Before positioning the rear window glass, open vehicle windows to prevent the air pressure of closing doors from affecting the urethane adhesive bond.**

    Using the alignment marks made previously, position the rear window glass on the pinch weld.

11. **NOTE:** The urethane adhesive must cure for a minimum of one hour before testing for air or water leaks.

    After the urethane adhesive has cured, check the rear window glass seal for air or water leaks through the urethane adhesive bead and add urethane adhesive as necessary.

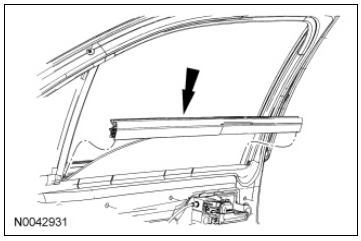
12. Install the headliner, parcel shelf and C-pillar trim panels. For additional information, refer to Section 501-05 .

13. Connect the LH and RH heated rear window electrical connector.

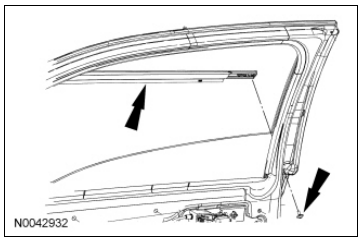
Window Glass - Rear Door, Fixed

Removal and Installation

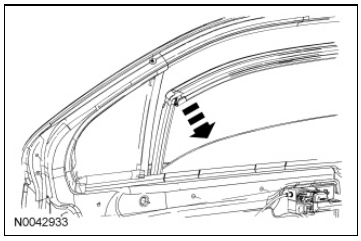
1. Lower the rear window.
2. Remove the rear door inner trim panel. Refer to Section 501-05 .
3. Remove the inner beltline weatherstrip.



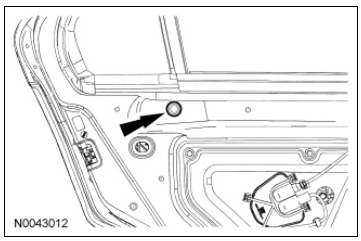
4. Remove the screw and the outer beltline weatherstrip.



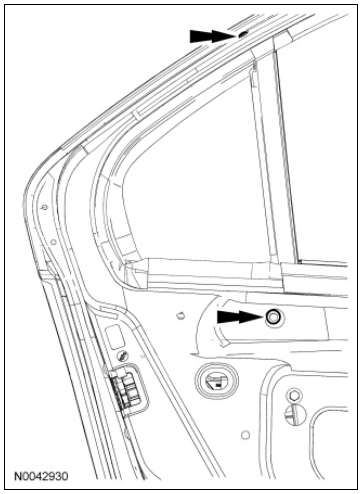
5. Position the rear window glass run aside.



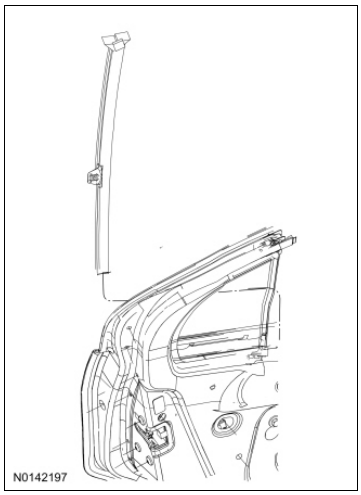
6. Remove the access hole plug.



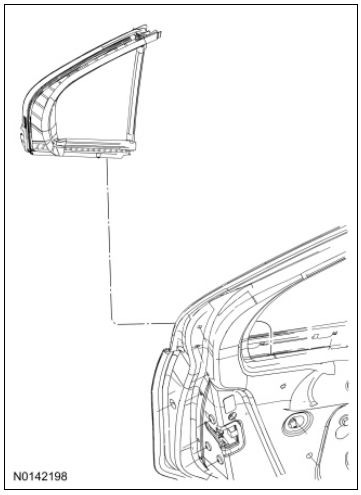
7. Remove the rear quarter glass window guide bolt and screw.



8. Remove the rear quarter glass window guide.



9. Remove the rear door fixed window glass.



10. To install, reverse the removal procedure.

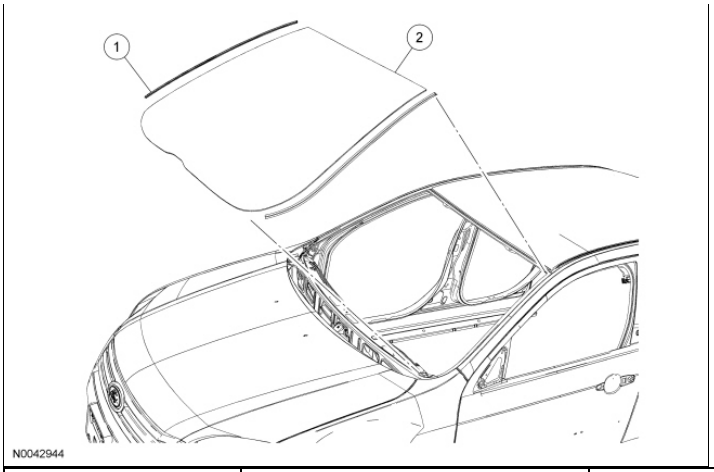
Windshield Glass

Special Tool(s)

 ST1320-A	Deluxe Windshield Removal Tool 164-R2450 or equivalent
 ST2085-A	The Pumper 164-R2459 or equivalent

Material

Item	Specification
Dow Urethane Adhesive BetasealTM Express	-
Dow Urethane One Step Glass Primer BetaprimeTM 5500 / 5500A / 5500SA	-
Sika Urethane Adhesive Sika Tack ASAP	-
Sika Urethane Metal and Glass Primer Sika 206 G+P	-
Motorcraft® Ultra-Clear Spray Glass Cleaner ZC-23	ESR-M14P5-A



Item	Part Number	Description
1	-	Moulding
2	5403100	Windshield

Removal

NOTE: If the windshield glass is being removed to repair a dust/water leak, remove and reinstall the existing windshield glass.

1. Remove the A-pillar trim panels. For additional information, refer to Section 501-05 .

2. Remove the sun visors.

3. Remove the interior mirror. For additional information, refer to Section 501-09 .

4. If equipped, remove the rain sensor. For additional information, refer to Section 501-16 .

5. Partially lower the front portion of the headliner near the windshield header and block with suitable material. For additional information, refer to Section 501-05 .

6. Remove the cowl panel grille. For additional information, refer to Section 501-02 .

7. Before cutting the urethane adhesive, remove dirt and other foreign material from the windshield pinchweld area.
   - Use a clean shop towel or oil-free, compressed air.

8. **NOTE:** Refer to manufacturer's instructions before using the Deluxe Windshield Removal Tool.

   Lubricate the urethane adhesive with water to aid the Deluxe Windshield Removal Tool when cutting.

9. ⚠ **WARNING: Always wear eye protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.**

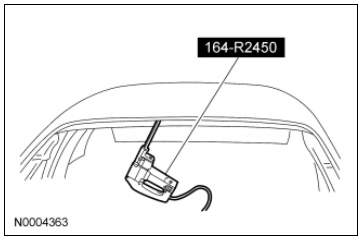
   ⚠ **WARNING: Wear protective gloves when handling components or parts that have pointed or sharp edges. Failure to follow this instruction may result in serious personal injury.**

   NOTICE: **To avoid rust formation, use extreme care not to scratch the paint or primer or otherwise damage the pinchweld during glass removal.**

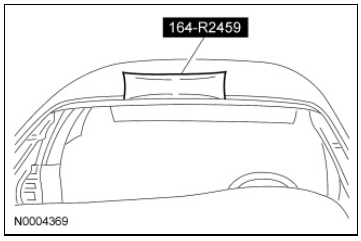
   NOTE: Insert the blade into the Deluxe Windshield Removal Tool so that the flat side is against the glass. This will leave the entire urethane adhesive bead on the pinchweld and allow a dry fit of the replacement windshield glass.

   NOTE: Support the windshield glass to prevent the glass from dropping while cutting the urethane adhesive.

   Insert the Deluxe Windshield Removal Tool at the upper center of the windshield glass and work toward the bottom corners.



10. Using The Pumper, distance the windshield glass from the body.



11. Insert the Deluxe Windshield Removal Tool into the bottom of the urethane adhesive and cut from corner to corner.

12. Carefully remove the windshield glass from the vehicle and place on a stable work surface.

Installation

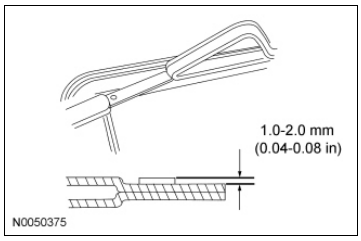
1. Dry-fit the windshield glass on the existing urethane adhesive bead on the pinch weld.
    - Position the windshield glass on the pinch weld.
    - Center the glass in the opening.
    - Adjust the windshield glass stop blocks (if equipped) as needed for best fit.
    - Make alignment marks with tape or non-staining grease pencil (preferably at the windshield glass stop blocks) on the windshield glass and the body.

2. After the dry-fit alignment, remove the glass from the body opening and place on a stable work surface with the interior side of the glass facing upward.

3. ⚠ **WARNING: Repair any corrosion found on the pinch weld. The pinch weld is a structural component of the vehicle. Corrosion left unrepaired may reduce the structural integrity of the vehicle. Failure to follow this instruction may result in serious injury to vehicle occupant(s).**

   NOTE: Avoid scratching the pinch weld. Repair all minor scratches or exposed metal on the pinch weld following manufacturer's instructions. Use the same brand pinch weld primer, glass primer and urethane adhesive.

   Using an appropriate tool, trim the urethane adhesive leaving a 1-2 mm (0.04-0.08 in) base of original equipment urethane adhesive on the pinchweld.



4. Using a clean shop towel, brush or oil-free, compressed air, clean the pinch weld area around the existing urethane adhesive. Remove any foreign material or water that may have entered during glass removal.

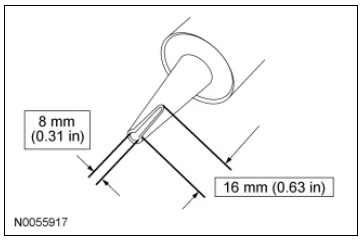
5. If reinstalling the same windshield glass, remove the remaining urethane adhesive from the glass leaving a thin layer to bond with the new urethane adhesive bead.

6. Clean the inside of the windshield glass surface with glass cleaner.
    - Make sure to thoroughly clean the surface of the blackened border area where the urethane adhesive will be applied.

7. **NOTE:** Be sure to use the same brand and cure-rate products for the urethane adhesive and glass primer. Do not mix different brands of urethane adhesive and glass primer. Refer to the Material Chart in this procedure.

   If installing a new windshield glass, apply glass primer according to manufacturer's instructions. Allow at least 6 minutes to dry.

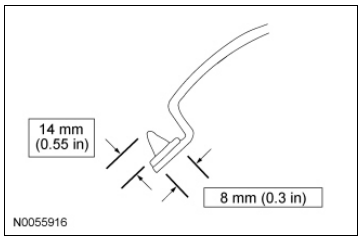
8. Cut the urethane adhesive applicator tip to specification.



9. **NOTE:** Use either a high-ratio, electric or battery-operated caulk gun that will apply the urethane adhesive with less effort and continuous bead.

   NOTE: The windshield glass must be positioned within 10 minutes of applying the urethane adhesive.

   Apply a uniform bead of urethane adhesive on top of the existing trimmed urethane adhesive bead on the pinch weld, starting and ending at the bottom of the windshield glass near the center, making sure there are no gaps in the bead.



10. ⚠ **WARNING: Do not drive vehicle until the urethane adhesive seal has cured. Follow urethane adhesive manufacturer's curing directions. Inadequate or incorrect curing of the urethane adhesive seal will adversely affect glass retention. Failure to follow these instructions may result in serious injury to vehicle occupant(s).**

    NOTICE: **Before positioning the windshield glass, open vehicle windows to prevent the air pressure of closing doors from affecting the urethane adhesive bond.**

    Using the alignment marks made previously, position the windshield glass on the pinch weld.

11. **NOTE:** The urethane adhesive must cure for a minimum of one hour before testing for air or water leaks.

    After the urethane adhesive has cured, check the windshield glass seal for air or water leaks through the urethane adhesive bead and add urethane adhesive as necessary.

12. Install the cowl panel grille. For additional information, refer to Section 501-02 .

13. Install the headliner. For additional information, refer to Section 501-05 .

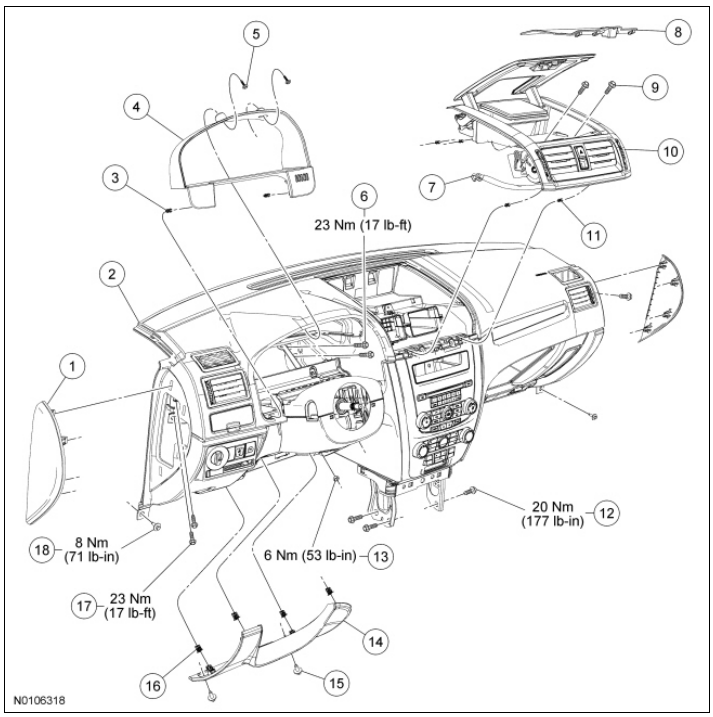
14. If equipped, install the rain sensor. For additional information, refer to Section 501-16 .
15. Install the interior mirror. For additional information, refer to Section 501-09 .
16. Install the sun visors.
17. Install the A-pillar trim panels. For additional information, refer to Section 501-05 .

Torque Specifications

Description	Nm	lb-ft	lb-in
Center instrument panel finish panel screws	3	-	27
Glove compartment dampener screws	2	-	18
Hood release handle screws	3	-	27
Instrument Cluster (IC) opening bolts	23	17	-
Instrument panel center support bolts	20	-	177
Instrument panel lower bolts	8	-	71
Instrument panel side bolts	23	17	-
Steering column shaft bolt	20		177
Upper storage compartment screws	3	-	27
Upper storage compartment tether nut	6	-	53
Wire harness screws	3	-	27

Instrument Panel - Exploded View

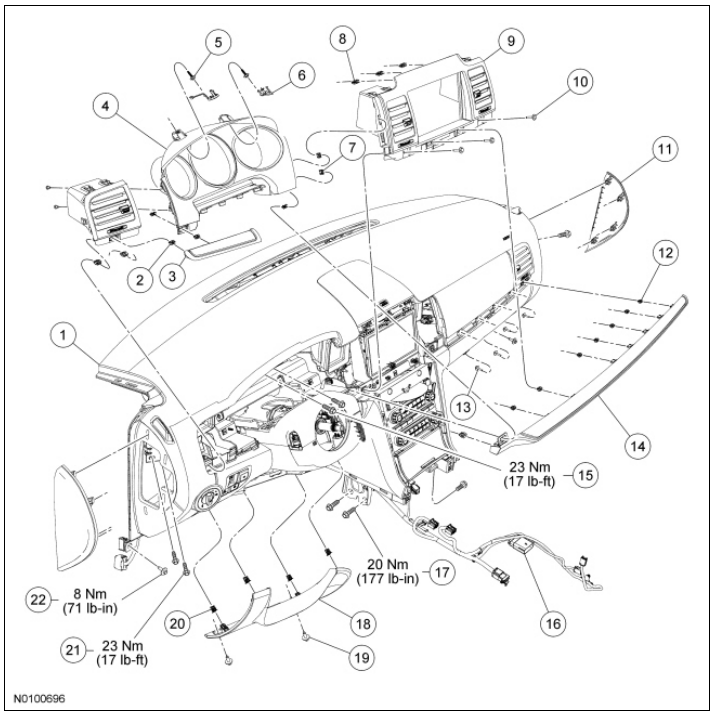
Fusion



Item	Part Number	Description
1	04480 RH/ 04481 LH	Instrument panel side finish panel
2	04320	Instrument panel
3	-	Instrument cluster finish panel retaining clip (part of 044D70) (2 required)
4	044D70	Instrument cluster finish panel
5	W707628	Instrument cluster finish panel screw (2 required)
6	W701834	Instrument Cluster (IC) opening bolt (2 required)
7	-	Upper storage compartment tether (part of 13594)
8	045G34	Upper storage compartment mat
9	W505253	Upper storage compartment screw (2 required)
10	13549	Upper storage compartment
11	-	Upper storage compartment retaining clip (part of 13594) (4 required)
12	N811479	Instrument panel center support bolt (3 required)
13	-	Upper storage compartment tether nut
14		

	Steering column opening trim panel	
15	N808453	Steering column opening trim panel screw (2 required)
16	-	Steering column opening trim panel retaining clip (4 required)
17	W701834	Instrument panel side bolt (3 required)
18	W708268	Instrument panel lower bolt (2 required)

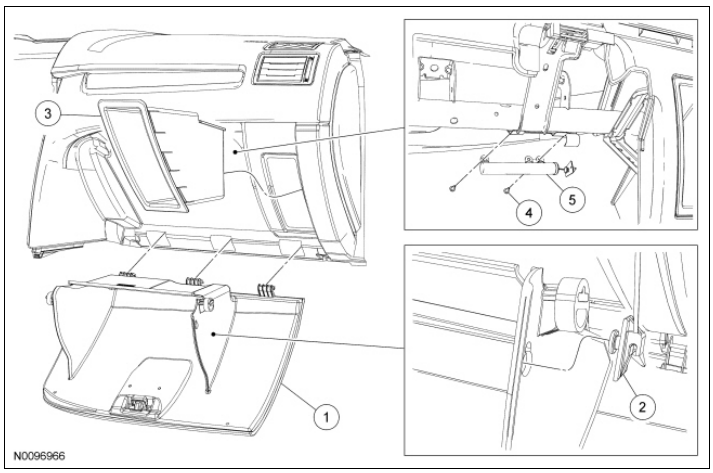
MKZ



Item	Part Number	Description
1	04320	Instrument panel
2	-	LH instrument panel finish panel clip (part of 044A91) (2 required)
3	044A91	LH instrument panel finish panel
4	044D70	Instrument cluster finish panel
5	W707628	Instrument cluster finish panel screw (2 required)
6	-	Instrument cluster finish panel screw cover (part of 044D70) (2 required)
7	-	Instrument cluster finish panel retaining clip (part of 044D70) (3 required)
8	-	Center instrument panel finish panel retaining clip (part of 04302) (3 required)
9	04302	Center instrument panel el
10	W707628	Center instrument panel finish panel screw (3 required)

11	04480 RH/ 04481 LH	Instrument panel side finish panel
12	-	Instrument panel finish moulding retaining clip (part of 044A90) (8 required)
13	W707607	Instrument panel finish moulding screw (4 required)
14	044A90	Instrument panel finish moulding
15	W701834	Instrument Cluster (IC) opening bolt (2 required)
16	14401	Instrument panel harness connector
17	N811479	Instrument panel center support bolt (3 required)
18	011201	Steering column opening trim panel
19	N808453	Steering column opening trim panel screw (2 required)
20	-	Steering column opening trim panel retaining clip (4 required)
21	W701834	Instrument panel side bolt (3 required)
22	W708268	Instrument panel lower bolt (2 required)

Glove Compartment



Item	Part Number	Description
060T10	Glove compartment	
2	-	Glove compartment damper clip (part of 06102)
3	06010	Glove compartment mini-bin (Fusion only)
4	N804693	Glove compartment damper screw (2 required)
5	06102	Glove compartment damper

1. For additional information, refer to the procedures in this section.

Instrument Panel

Removal and Installation

1. Remove the steering wheel. For additional information, refer to Section 211-04 .

2. Remove the floor console. For additional information, refer to Console - Floor, Fusion or Console - Floor, MKZ in this section.

3. Remove the selector lever or the gearshift lever. For additional information, refer to Section 307-05A or Section 307-05B .

4. Remove the LH and RH instrument panel side finish panels.
   - Pull the sides of the instrument panel side finish panels away from the instrument panel to release the retaining tabs.

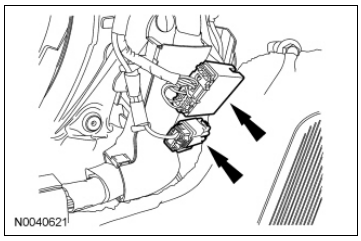
5. Remove the LH and RH weatherstrips from the front door openings near the instrument panel.

6. Remove the LH and RH A-pillar trim panels. For additional information, refer to Section 501-05 .

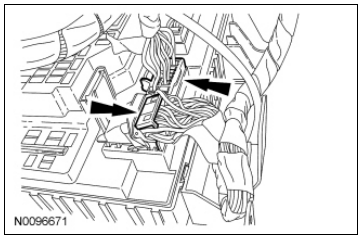
Remove the LH and RH lower cowl panels. For additional information, refer to Interior Trim - Exploded View in Section 501-05 .

8. If equipped, remove the RH lower instrument panel insulator.

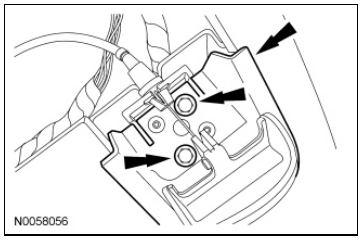
9. Disconnect the 2 electrical connectors located at the LH lower cowl.



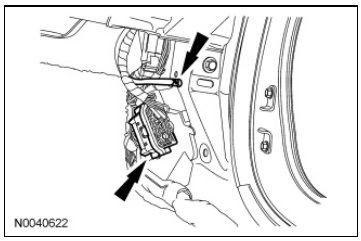
10. Disconnect the small gray and the black electrical connectors from the Smart Junction Box (SJB).



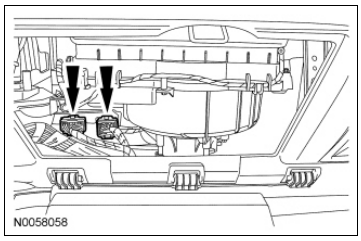
11. Remove the 2 screws and position the hood release handle aside.



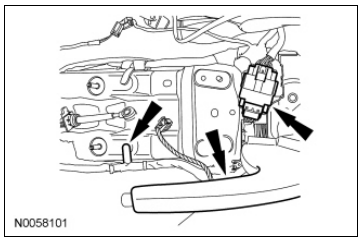
12. Disconnect the bulkhead electrical connector and the antenna cable located at the RH lor cowl. If equipped, disconnect the satellite antenna.



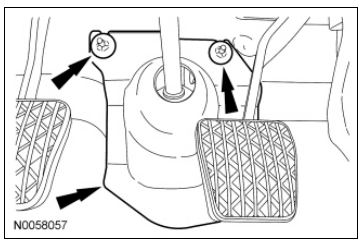
13. Fully lower the glove compartment door and disconnect the 2 A/C electrical connectors.



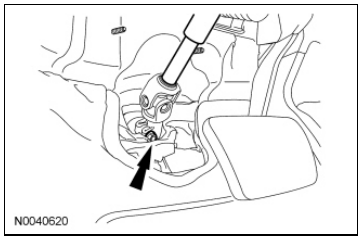
14. Disconnect the electrical connector and the 2 wire harness retainers located on the floor between the front seats.



15. Remove the 2 nuts and position the steering column pinch bolt cover aside.



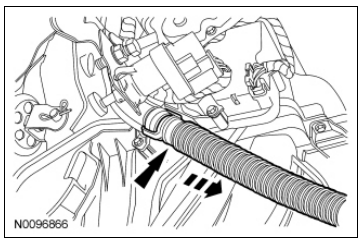
16. Remove and discard the steering column shaft bolt.
    - To install, use a new steering column shaft bolt and tighten to 20 Nm (177 lb-in).



17. **NOTE:** Index-mark the steering column shaft position to the steering gear for reference during installation.

    Detach the upper steering column shaft from the steering column.

18. Disconnect the in-vehicle temperature sensor aspirator hose from the heater core and evaporator core housing, if equipped, in the following sequence.
    1. Separate the aspirator hose retaining clips away from the heater core and evaporator core housing.
    2. Pull the aspirator hose away from the heater core and evaporator core housing.



19. Remove the Instrument Cluster (IC). For additional information, refer to Section 413-01 .

20. Through the IC opening, remove the 2 IC opening bolts.
    - To install, tighten to 23 Nm (17 lb-ft).

21. Remove the 3 instrument panel center support bolts.
    - To install, tighten to 20 Nm (177 lb-in).

22. Remove the LH and RH instrument panel lower bolts from the outer sides of the instrument panel.
    - To install, tighten to 8 Nm (71 lb-in).

23. ***NOTICE:*** **To avoid damaging the instrument panel, the aid of an assistant is required to carry out this step.**

    NOTICE: **Make sure that all electrical connectors and wiring are not hindered before removing the instrument panel or damage to the components may occur.**

    Remove the instrument panel.

    - Through the instrument panel side finish panel openings, remove the 3 instrument panel side bolts.
    - To install, tighten to 23 Nm (17 lb-ft).

24. ***NOTICE:*** **To avoid damaging the instrument panel, the aid of an assistant is required when positioning the instrument panel to the vehicle.**

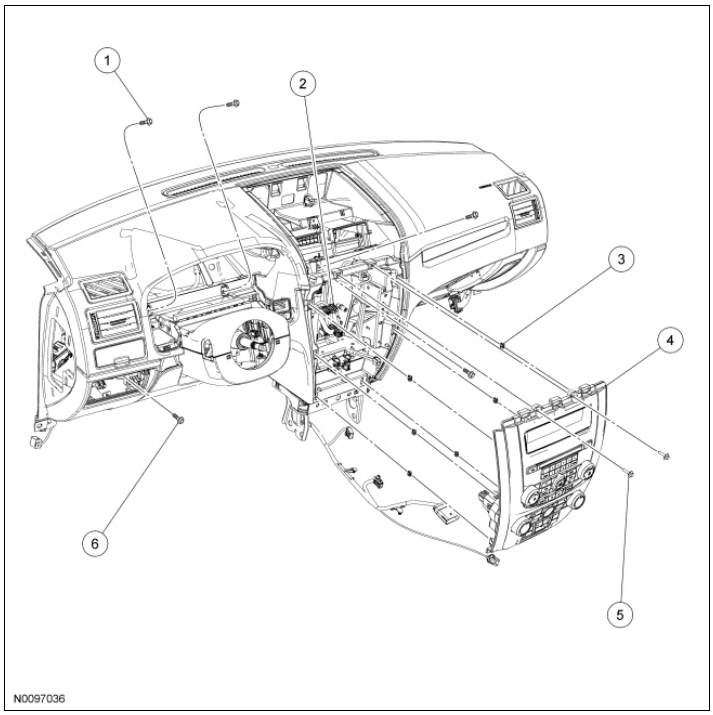
    NOTICE: **Make sure that all electrical connectors and wiring are correctly routed when installing the instrument panel or damage to the components may occur.**

To install, reverse the removal procedure.

Instrument Panel Upper Section

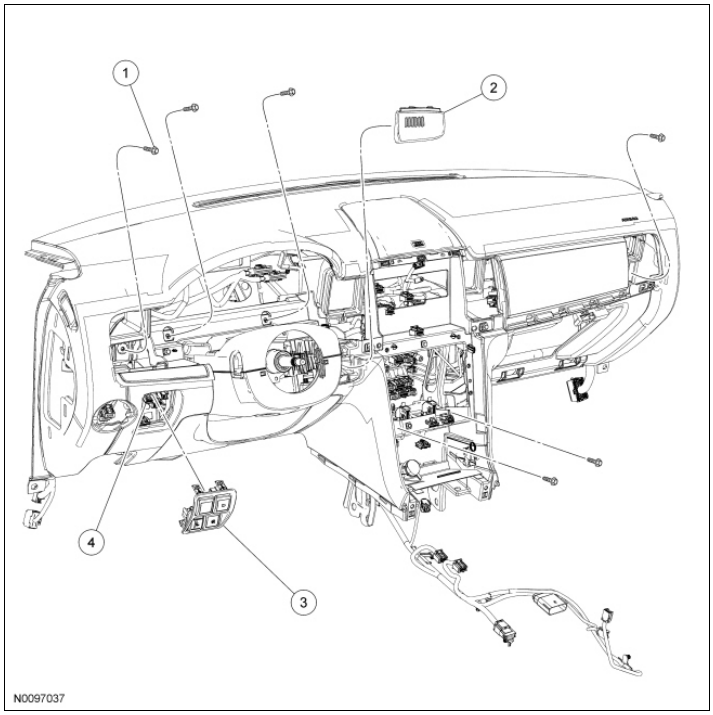
Removal and Installation

Fusion - Front View



Item	Part Number	Description
1	W505253	Instrument panel front screw (3 required)
2	14401	Center instrument panel finish panel electrical connector(s)
3	-	Center instrument panel finish panel retaining clip (part of 011201) (6 required)
4	011201	Center instrument panel finish panel
5	W707628	Center instrument panel finish panel screw (2 required)
6	W505253	LH duct support screw

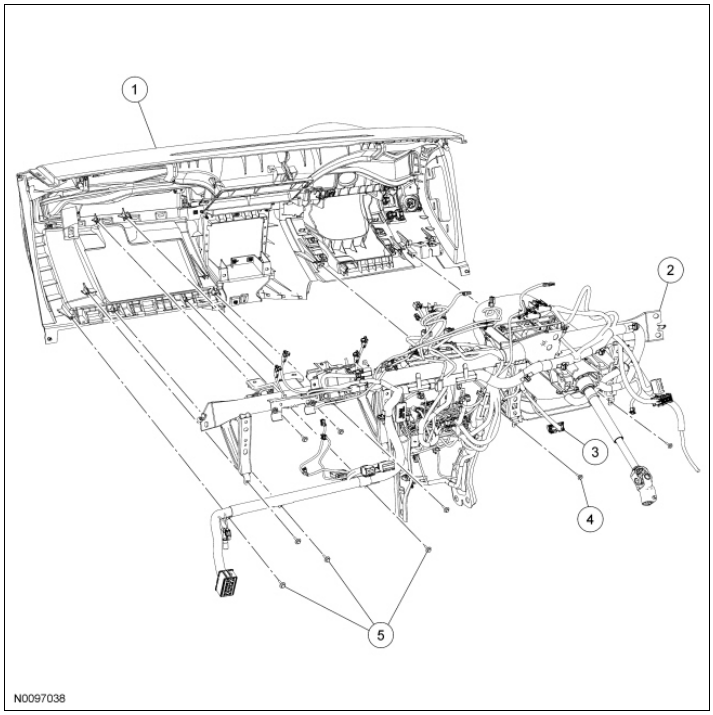
MKZ - Front View



Item	Part Number	Description
1	W505253	Instrument panel front screw (6 required)
2	046A76	In-vehicle temperature sensor
3	04338	LH switch assembly
14401	LH switch assembly electrical connector	

Rear View

NOTE: MKZ shown, Fusion similar.



Item	Part Number	Description
1	04320	Instrument panel upper section
2	04545	In-vehicle cross beam
3	14401	Data Link Connector (DLC)
4	W707607	Instrument panel rear screw (6 required)
5	W707607	Wire harness screws (3 required)

All vehicles

1. Remove the center instrument panel finish panel. For additional information, refer to Instrument Panel Finish Panel - Center in this section.

2. ***NOTICE:*** **To avoid damaging the in-vehicle cross beam or the instrument panel upper section, spread a suitable covering over the bench on which to place the instrument panel when removed from the vehicle.**

   NOTE: Place the instrument panel on the bench upside-down.

   Remove the instrument panel. For additional infortion, refer to Instrument Panel in this section.

3. Remove the passenger air bag. For additional information, refer to Section 501-20B .

4. Remove the audio unit. For additional information, refer to Section 415-00 .

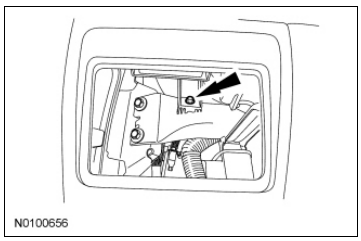
5. Remove the Front Display Interface Module (FDIM), if equipped. For additional information, refer to Section 415-00 .

6. Disconnect the Data Link Connector (DLC) from the lower LH instrument panel.
   - Press the retainer clip toward the center of the connector and push the connector towards the back of the instrument panel.

7. Remove the headlamp switch. For additional information, refer to Section 417-01 .

Fusion

8. Through the headlamp switch opening, remove the LH duct support screw.



9. Through the Instrument Cluster (IC) opening, remove the 2 instrument panel front screws.
10. Remove the HVAC module, if equipped. For additional information, refer to Section 412-01 .
11. Through the audio unit opening, remove the instrument panel front screw.

MKZ

12. Remove LH switch assembly in the following sequence.
    1. Press the 4 switch retainer clips toward the center of the switch and push the switch forward toward the front of the instrument panel upper section.
    2. Disconnect the electrical connectors and remove the switch assembly.
13. Remove the RH register. For additional information, refer to Section 412-01 .
14. Through the LH and RH register openings, remove the 2 instrument panel front screws.
15. Through the IC opening, remove the 2 instrument panel front screws.
16. Through the audio unit opening, remove the 2 instrument panel front screws.
17. Remove the in-vehicle temperature sensor. For additional information, refer to Section 412-01 .

All vehicles

18. Remove the 6 instrument panel rear screws.
19. Remove the 3 wire harness screws from the rear of the instrument panel upper section and disconnect wire harness retainers as necessary.
20. **NOTE:** Position the instrument panel upper section away from the in-vehicle cross beam to access the instrument panel speaker electrical connector.

    If equipped, disconnect the instrument panel speaker.
21. ***NOTICE:*** **To avoid damaging the instrument panel upper section, the aid of an assistant is required to carry out this step.**

    Remove the in-vehicle cross beam from the instrument panel upper section.
22. To install, reverse the removal procedure.
    - Transfer parts from the instrument panel upper section as necessary.

Instrument Cluster Finish Panel - Fusion

Removal and Installation

1. Remove the 2 instrument cluster finish panel screws.

2. Remove the instrument cluster finish panel.
   - Pull the instrument cluster finish panel toward the rear of the vehicle to release the retaining clips.
   - Detach the in-vehicle temperature sensor, if equipped.

3. To install, reverse the removal procedure.

Instrument Cluster Finish Panel - MKZ

Removal and Installation

1. Release the 2 instrument cluster finish panel screws covers and remove the 2 instrument cluster finish panel screws.

2. Remove the steering wheel. For additional information, refer to Section 211-04 .

3. Remove the multifunction switch. For additional information, refer to Section 211-05 .

4. Remove the LH instrument panel finish panel.
   - Pull the LH instrument panel finish panel toward the rear of the vehicle to release the retaining clips.

5. Remove the instrument cluster finish panel.
   - Pull the instrument cluster finish panel toward the rear of the vehicle to release the retaining clips.

6. To install, reverse the removal procedure.
   - If replacing the instrument cluster finish panel, remove the 2 register screws and transfer the register.
   - Make sure to align the LH instrument panel finish panel retaining clips to the retaining clip holes in the instrument panel.

Instrument Panel Finish Panel - Center

Removal and Installation

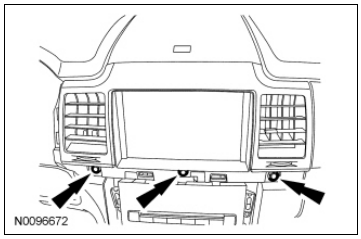
MKZ

1. Remove the instrument cluster finish panel. For additional information, refer to Instrument Cluster Finish Panel - MKZ in this section.

2. Remove the instrument panel finish moulding in the following sequence.
    1. Remove the 4 instrument panel finish moulding screws.
    2. Pull the instrument panel finish moulding toward the rear of the vehicle to release the retaining clips.

3. **NOTE:** Center instrument panel finish panel with navigation shown, center instrument panel finish panel without navigation similar.

   Remove the 3 center instrument panel finish panel screws.



4. Remove the center instrument panel finish panel.
    - Pull the center instrument panel finish panel toward the rear of the vehicle to release the retaining clips.

Fusion

NOTICE: **When prying on a component, a non-marring tool must be used or damage to the component may occur.**

5. Pull the parking brake handle upward.

6. If equipped with anatic transmission, place the selector lever in the NEUTRAL position and remove the selector lever trim ring.
    - Using a non-marring tool, pry upward to release the retaining clips.

7. Remove the floor console finish panel in the following sequence.
    1. Using a non-marring tool, pry upward to release the retaining clips.
    2. Disconnect the electrical connectors, if equipped.

8. Remove the utility tray in the following sequence.
    1. Using a non-marring tool, pry upward to release the retaining clips.
    2. Disconnect the electrical connector.
    3. Disconnect the audio jack connector, if equipped.

9. Remove the upper storage compartment. For additional information, refer to Storage Compartment - Upper in this section.

10. Remove the 2 center instrument panel finish panel screws.

11. Remove the center instrument panel finish panel.
    - Pull the center instrument panel finish panel toward the rear of the vehicle to release the retaining clips.
    - Disconnect the electrical connector(s).

All vehicles

12. To install, reverse the removal procedure.

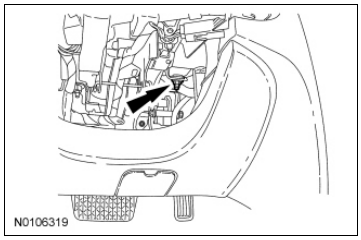
Storage Compartment - Upper

Removal and Installation

1. **NOTE:** Steering column shroud removed to show clarity.

   Remove the upper storage compartment tether nut.

   - To install, tighten to 6 Nm (53 lb-in).

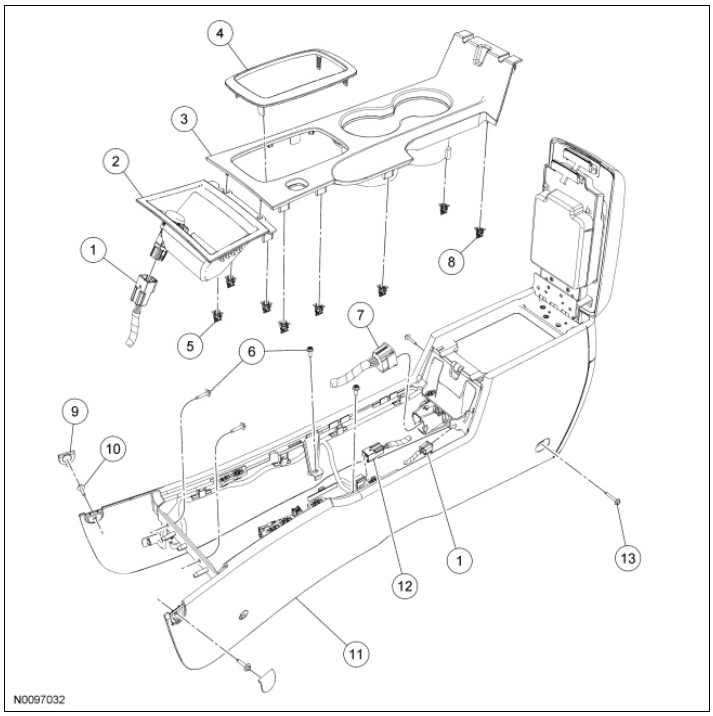


2. Remove the upper storage compartment mat and the 2 upper storage compartment screws.

3. Remove the upper storage compartment in the following sequence.
   1. Pull the upper storage compartment toward the rear of the vehicle to release the 5 retaining clips.
   2. Disconnect the electrical connector, if equipped.

4. To install, reverse the removal procedure.

Console - Floor, Fusion



Item	Part Number	Description
1	14401	Power point connectors
2	-	Utility tray (part of 011202)
3	045A76	Floor console finish panel
4	061A16	Selector lever trim ring
5	-	Utility tray retaining clip (part of 045A76) (2 required)
6	W709955	Floor console screws (4 required)
7	14401	Bulkhead electrical connector
8	-	Floor console finish panel retaining clip (part of 045A76) (6 required)
9	672A40	Floor console screw cover (2 required)
10	W711401	Floor console front screw (2 required)
11	011202	Floor console
12	14401	Ambient light electrical connector
13	W711401	Floor console rear screw (2 required)

Removal and Installation

NOTICE: **When prying on a component, a non-marring tool must be used or damage to the component may occur.**

2. Position the front seats rearward.

3. Pull the parking brake handle upward.

4. If equipped with an automatic transmission, remove the selector lever trim ring.
    - Using a non-marring tool, pry upward to release the retaining clips.

5. If equipped with a manual transmission, remove the gearshift knob by turning in a counterclockwise direction.

6. Open the storage compartment door and remove the floor console finish panel.
    - Using a non-marring tool, pry upward to release the retaining clips.
    - Disconnect the electrical connectors, if equipped.

7. Remove the utility tray.
    - Using a non-marring tool, pry upward to release the retaining clips.
    - Disconnect the electrical connector.
    - Disconnect the audio jack connector, if equipped.

8. Remove the 2 floor console screw covers.

9. Remove the 2 floor console front screws.

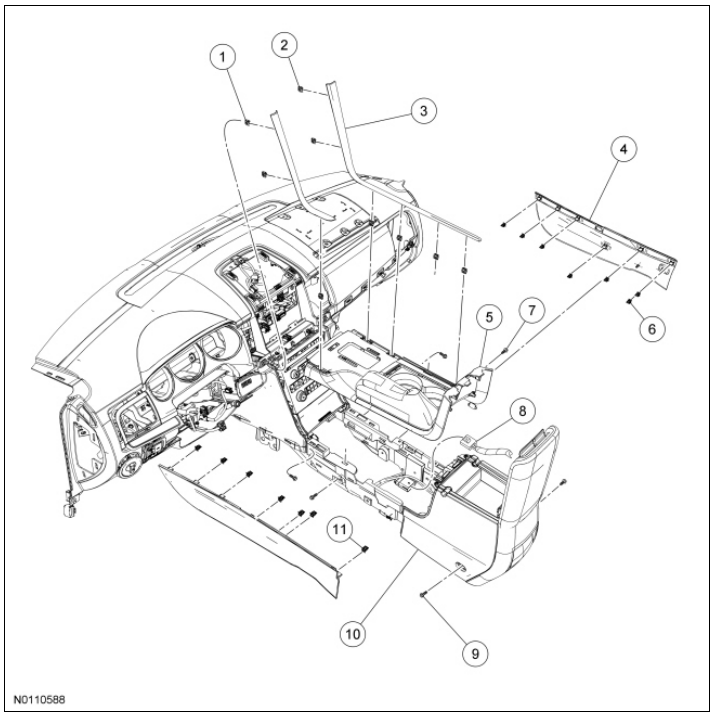
10. Disconnect the power point and bulkhead electrical connectors. Detach the electrical connector pin-type retainer.

11. ***NOTICE:*** **To prevent damage to the instrument panel, place the selector lever in NEUTRAL and pull the console towards the rear of the vehicle when removing the console.**

    Remove the 4 floor console screws, place the selector lever in NEUTRAL, pull the console towards the rear of the vehicle and remove the floor console.

12. To install, reverse the removal procedure.

Console - Floor, MKZ



Item	Part Number	Description
1	-	LH floor console finish moulding retaining clip (part of 061A16) (3 required)
2	-	RH floor console finish moulding retaining clip (part of 061A16) (6 required)
3	061A16	Floor console finish moulding
4	1181081	Floor console lower trim panel
5	045A76	Floor console finish panel
6	-	RH floor console lower trim panel retaining clip (part of 1181081) (7 required)
7	W709955	Floor console front screw (4 required)
8	14401	Bulkhead electrical connector
9	W711401	Floor console rear screw (2 required)
10	04620	Floor console
11	-	LH floor console lower trim panel retaining clip (part of 1181081) (7 required)

Removal and Installation

1. Apply the parking brake.

2. Place the selector lever in the NEUTRAL position.

3. Position the front seats to the full rearward and downwa.

4. Pull the middle and rear of the LH and RH floor console lower trim panels outward to release the retaining clips.

5. ***NOTICE:*** **Damage to the floor console upper trim panels may occur if cardboard is not used to remove the floor console lower trim panels.**

   Position a piece of cardboard between the LH and RH floor console lower trim panels and the floor console.

6. Remove the LH floor console lower trim panel and cardboard simultaneously.

7. Remove the RH floor console lower trim panel and cardboard simultaneously.

8. Position the front seats forward.

9. Remove the 2 floor console rear screws.

10. Position the front seats rearward.

11. Open the storage compartment lid, remove the LH and RH floor console finish mouldings.
    - Lift upward on the floor console finish mouldings to release the retaining clips.

12. Remove the selector lever knob. For additional information, refer to Section 307-05A .

13. ***NOTICE:*** **Use a non-marring tool to pry on the component. Failure to will cause damage to the component.**

    Remove the floor console finish panel in the following sequence:

    1. With a non-marring tool, pry upward on the right rear portion of the floor console finish panel to release the 2 retaining clips.
    2. With a non-marring tool, pry upward on the front sides of the floor console finish panel to release the 4 retaining clips.
    3. If equipped, disconnect the electrical connectors.
    4. Slide the park brake handle boot away from the park brake handle.

14. Remove the 4 floor console front screws.

15. Disconnect the floor console bulkhead and front in-line electrical connectors.

16. Disconnect the floor console power point connector and detach the 2 wire harness pin-type retainers.

17. Remove the floor console.

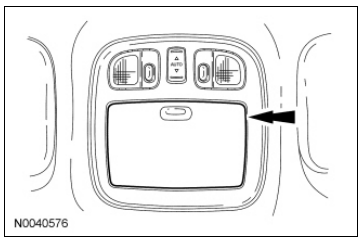
18. To install, reverse the removal procedure.

Console - Overhead

Removal and Installation

NOTE: Fusion shown, MKZ similar.

1. Open the overhead console compartment door.



2. From inside the compartment, remove the 2 screws.

3. Remove the overhead console.
   - Disconnect the electrical connectors.

4. To install, reverse the removal procedure.

Power Point

Special Tool(s)

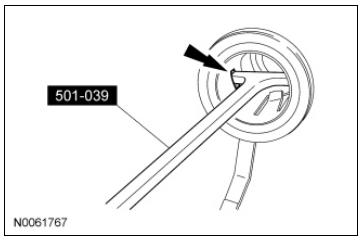
 ST3024-A	Remover, Power Point Socket 501-039 or equivalent

Removal

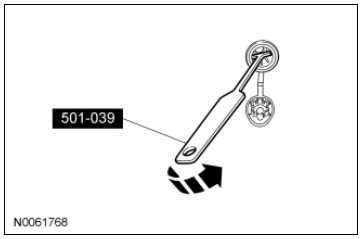
NOTE: Power point cover may differ depending on location.

1. Open the power point cover.

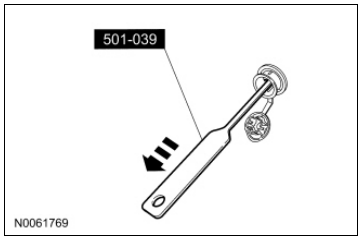
2. Install the Power Point Socket Remover in one of the power point socket slots.



3. Position the Power Point Socket Remover so that it engages in the adjacent slot.



4. Using the Power Point Socket Remover, pull the power point socket out of the retainer.



5. Disconnect the electrical connector.

Installation

1. Connect the electrical connector.

2. Slide the power point socket into the retainer.

Material

Item	Specification	Fill Capacity
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B	-
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-	-

Torque Specifications

Description	Nm	lb-ft	lb-in
Door latch bolts	8	-	71
Door latch striker bolts	25	18	-
Exterior door handle reinforcement bolt	6	53	-
Hood latch bolts	12	-	106
Hood latch striker bolts	12	-	106
Interior door handle bolt	11	-	97
Luggage compartment lid latch nuts	9	-	80
Luggage compartment lid striker bolts	12	- 106	
Secondary hood latch release handle bolt	12	-	106

Handles, Locks, Latches and Entry Systems

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

Hood Latch

The hood latch consists of the following components:

- Hood latch release handle and cable
- Hood latch
- Secondary hood latch release handle and cable (MKZ)

Front Door

The front door consists of the following components:

- Door ajar switch (part of the front door latch)
- Door lock cylinder (driver door only)
- Exterior front door handle
- Exterior front door handle reinforcement
- Front door latch
- Front door lock actuator (part of the front door latch)
- Interior door handle actuating cable
- Interior door handle
- Keyless entry keypad (if equipped)

Rear Door

The rear door consists of the following components:

- Door ajar switch (part of the rear door latch)
- Exterior rear door handle
- Exterior rear door handle reinforcement
- Interior door handle actuating cable (part of the rear door latch)
- Interior door handle
- Rear door latch
- Rear door lock actuator (part of the rear door latch)

Luggage Compartment Lid

The luggage compartment lid consists of the following components:

- Luggage compartment lid latch
- Luggage compartment lid lock cylinder
- Luggage compartment lid release switch (next to headlamp switch)
- Lock cylinder actuating cable (part of the luggage compartment lid latch)
- Mechanical emergency release cable and handle (part of the luggage compartment lid latch)

Power Lock/Unlock

The power lock/unlock feature requests all of the vehicle doors locked or unlocked upon a customer request from either door lock control switch in the vehicle. The power door locking system functions independently of ignition status or vehicle speed.

Autolock

NOTE: The autolock feature is not available on vehicles equipped with a manual transaxle.

The autolock feature locks all the doors when the following conditions are met:

- All the doors are closed
- The ignition switch is in the ON position
- The vehicle is shifted into any gear, putting the vehicle in motion
- The vehicle attains a speed greater than 20 km/h (12 mph)

The autolock feature repeats when:

- any door is opened then closed with the ignition in the ON position.
- the vehicle speed is 15 km/h (9 mph) or slower.
- the vehicle attains a speed greater than 20 km/h (12 mph).

The autolock feature can be enabled/disabled, refer to Autolock and Auto-Unlock Programming in this section for programming information.

Auto-Unlock

NOTE: The doors will not auto-unlock if the vehicle has been electronically locked before the driver door is opened.

NOTE: The auto-unlock feature comes disabled from the factory on vehicles equipped with a manual transaxle, but can be enabled.

The auto-unlock feature unlocks all the doors when the following conditions are met:

- The ignition is in the ON position
- All the doors are closed
- The vehicle has been in motion at a speed greater than 20 km/h (12 mph)
- The vehicle then comes to a stop
- The ignition is switched to the OFF or ACC position
- And the driver door is opened within 10 minutes of the ignition being switched to the LOCK or ACC position

The auto-unlock feature can be enabled/disabled independently of autolock. Refer to Autolock and Auto-Unlock Programming in this section for programming information.

Smart Unlock

The smart unlock feature prevents the doors from locking with the key in the ignition lock cylinder. When the SJB receives a lock command from a door lock control switch (only), and the key is in the ignition lock cylinder with one of the front doors open, the SJB commands the doors to unlock.

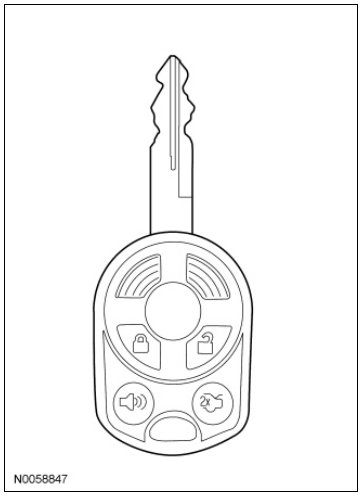
The vehicle can still be locked with the ignition key in the ignition cylinder by locking the doors with the push button rods, the door lock cylinder or a Remote Keyless Entry (RKE) command from an Integrated Keyhead Transmitter (IKT) or the keyless entry keypad (if equipped).

Remote Keyless Entry (RKE)

The RKE system uses an Integrated Keyhead Transmitter (IKT). The IKT incorporates both the Passive Anti-Theft System (PATS) functions and the RKE transmitter functions in a single device.

The RKE transmitter is programmed automatically during PATS key programming. During PATS key programming, the Instrument Panel Cluster (IPC) obtains the Transmitter Identification Code (TIC) from the IKT and sends the TIC data over the Medium Speed Controller Area Network (MS-CAN) to the SJB .

The SJB accepts programming of up to 4 IKTs . In addition to the IKTs , 4 conventional keyfobs can also be programmed to the vehicle if requested by the customer. For information on programming the IKTs , refer to Key Programming Using Two Programmed Keys or Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in Section 419-01B or Section 419-01C . For information on programming the conventional keyfobs, refer to Remote Keyless Entry (RKE) Transmitter Programming in this section.



The IKT carries out the following functions:

- Unlocks the driver door
- Unlocks all doors
- Locks all doors
- Releases the luggage compartment lid latch
- Arms/disarms the perimeter alarm
- Activates/deactivates the panic alarm
- Commands the interior lamps on (when unlocking) and off (when locking)
- Provides a long flash of the turn signals when UNLOCK is pressed (late vehicles only)
- Recalls the memory seat position associated with a particular remote entry device (when enabled) (MKZ)
- Sounds the horn once when LOCK is pressed twice within 3 seconds, and the doors are closed
- Sounds the horn twice when LOCK is pressed twice within 3 seconds, and any door is ajar

The IKT has a normal operating range of 10 m (33 ft).

Remote Keyless Entry (RKE) Lock/Unlock Control - Unlock

The RKE feature provides lock/unlock functions independently of key position, vehicle speed, or transmission position. The RKE feature provides a stepped (if enabled) process for unlocking the doors. Upon receipt of the first request for unlocking the doors, the RKE control feature requests the SJB to unlock the driver door only. If another unlock request is received within 3 seconds of the first, the RKE feature requests the SJB to unlock all the doors. This feature can be configured to one-step unlock, so that all the doors unlock on the first press of the unlock button. Refer to Stepped Unlock Programming in this section for programming information.

Remote Keyless Entry (RKE) Lock/Unlock Control - Lock

The RKE feature requests that all the doors be locked when the lock button is pressed. On any press of the lock button with all doors closed, the SJB provides one flash of the turn signals. If any door is ajar, no flash occurs. As soon as the last door is closed, the SJB provides the flash of the turn signals. If 2 presses of the lock button are received within 3 seconds, the horn chirps once and the turn signals flash twice to indicate that all the doors are closed and locked. If any door is ajar when the second lock request is received within 3 seconds of the first, the RKE transmitter feature requests the SJB chirp the horn twice without flashing the turn signals to indicate it locked all the doors but one or more doors are ajar. When the key is in the ON or START position, the turn signal flashes and horn chirp confirmations do not occur.

Remote Keyless Entry (RKE) Luggage Compartment Lid Release

The RKE feature provides luggage compartment lid release function independently of key position. The luggage compartment lid release button must be pressed twice within 3 seconds for the luggage compartment lid to release.

Panic Alarm

The panic alarm feature provides audible and visual alarms which are evident from the exterior of the vehicle. The panic alarm feature requests that the turn signals are flashed and the horn sounds until deactivation. The flashing of the outputs occurs simultaneously. Activation of the panic alarm is accomplished by pressing the panic button on an Integrated Keyhead Transmitter (IKT) whenever the key is in the OFF position. At all other times this feature is disabled. Deactivation of an active PANIC alarm is accomplished by any of the following actions:

- a second press of the IKT panic button
- the key is switched out of the OFF position
- a period of 2 minutes and 45 seconds has elapsed since the initial activation

Keyless Entry Keypad

The keyless entry keypad carries out the following functions:

- Unlocks the driver door
- Unlocks all the doors
- Locks all doors
- Enables/disables auto-unlocking
- Enables/disables autolocking
- Arms/disarms the perimeter alarm
- Recalls the memory seat position associated with a particular customer key code (when enabled)
- Releases the luggage compartment lid latch
- Programs/erases the customer key code(s)
- Illuminates the keyless entry keypad lamp and issues illuminated entry on/off requests

The keypad feature operates independently of key position status, vehicle speed, or transmission position. When a keypad button is pressed, the keypad buttons illuminate to provide better visibility. If the lock all doors command is entered or 5 seconds have elapsed since the last button press, the illumination is turned off.

Each vehicle equipped with a keypad is programmed with a 5-digit factory set entry code. This code is provided to the customer through a wallet card in the Owner's Literature. In addition, this code is available through a scan tool and is also printed on the SJB label. When entering codes each digit must be entered within 5 seconds of the previous button press. In addition to the factory set code, 3 personal codes can also be programmed. For additional information on programming the personal keypad codes, refer to Keyless Entry

Keypad Code Programming in this section.

Locking the Doors with the Keyless Entry Keypad System

It is not necessary to enter the factory set or personal code prior to locking all doors. To lock all doors, press the 7/8 and 9/0 controls at the same time.

Unlocking the Doors with the Keyless Entry Keypad System

To unlock the driver door (if stepped unlock is disabled), enter either the factory set code or a personal code; each digit must be pressed within 5 seconds of the prior digit. The interior lamps illuminate.

To unlock all doors, enter either the factory set code or a personal code (driver door unlocks) and press the 3/4 button within 5 seconds. This feature can be changed to 1-step unlock, so that all the doors unlock on receipt of the factory set or personal code. Refer to Stepped Unlock Programming in this section for programming information.

To open the luggage compartment, enter the factory set code or a personal code (driver door unlocks) and press the 5/6 button within 5 seconds.

Anti-Scan Feature

To provide added security, the keypad is disabled for 1 minute after 35 button presses without a valid entry code being entered. The keypad flashes during this 1-minute mode with all functionality disabled except for 7/8 and 9/0 still being allowed to lock the vehicle.

Anti-Scan is turned off after 1 minute of keypad inactivity.

Handles, Locks, Latches and Entry Systems

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2574-A	Flex Probe Kit NUD105-R025D

Material

Item	Specification
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The SJB receives inputs and delivers outputs to many of the electronically controlled features of the vehicle. The SJB constantly monitors the system under its control and reports a concern in the form of a DTC.

Power Door Locks - Fusion

Regardless of the key position, the SJB is supplied voltage at all times. When the SJB receives a signal from the Remote Keyless Entry (RKE) transmitter, the keyless entry keypad, or the door lock control switches, the SJB supplies a ground signal to the appropriate lock or unlock relay. The ground signal closes the relay which supplies voltage to the door lock actuators. The door lock actuators then actuate to a lock or unlock position.

Power Door Locks - MKZ

The SJB controls all of the passenger door lock actuators and receives input from the passenger door lock control switch. The Driver Door Module (DDM) controls only the driver door lock actuatoreceives input from the driver door lock control switch. The 2 modules communicate the lock or unlock commands through the Medium Speed Controller Area Network (MS-CAN).

The SJB and the DDM are supplied voltage at all times. When the SJB receives a signal from the Remote Keyless Entry (RKE) transmitter, the keyless entry keypad, or the RH door lock control switch, the SJB sends

a command to the DDM through the MS-CAN , and a ground signal to the lock and unlock relays. When the LH door lock control switch is pressed, the DDM receives the lock or unlock signal. The DDM sends a request through the MS-CAN to the SJB to lock or unlock the passenger doors. The SJB then responds to the DDM request, authorizing a lock or unlock of the driver door by the DDM . The DDM then supplies voltage and ground to the driver door lock actuator based on the lock or unlock request. The ground signal in the SJB closes the relay which supplies voltage to the remaining door lock actuators. The remaining door lock actuators then actuate to a lock or unlock position determined by the relay.

Luggage Compartment Lid Release

NOTE: When using the Integrated Keyhead Transmitter (IKT), 2 presses (within 3 seconds) of the luggage compartment lid release button are required to release the luggage compartment lid.

The luggage compartment lid release system is inhibited when the vehicle speed exceeds 8 km/h (5 mph). The luggage compartment lid latch releases the luggage compartment lid when the customer requests it be opened using either the IKT , the keyless entry keypad, or the luggage compartment lid release switch. When the SJB receives a signal to release the luggage compartment lid, the SJB supplies voltage to the luggage compartment lid latch. The luggage compartment lid latch then actuates to release the luggage compartment lid.

Remote Keyless Entry (RKE)

The SJB interprets radio frequency signals from the Remote Keyless Entry (RKE) transmitters. The SJB requests the illuminated entry feature to turn the interior lamps on when an unlock command is received. If a lock command is received, the illuminated entry feature turns off.

The RKE transmitter supplies a signal to the SJB when any button is pressed. The SJB then supplies voltage to the appropriate door lock actuator(s) to lock or unlock the doors. The RKE transmitter can also be used to release the luggage compartment lid or activate the panic alarm. On MKZ, the RKE transmitter also causes the SJB to send an MS-CAN message to the Driver Seat Module (DSM) to activate all memory features to the positions associated with the RKE transmitter being used.

Keyless Entry Keypad

The keyless entry keypad is hardwired to the SJB . The SJB interprets the inputs from the keyless entry keypad and then controls the associated operation. The keyless entry keypad is illuminated for 5 seconds when any button is pressed. The SJB requests the illuminated entry feature to turn the interior lamps on when a valid entry code is received. If a lock all doors code is entered, the illuminated entry feature turns off.

NOTE: The keyless entry keypad does not lock the doors if the driver door is ajar.

The keyless entry keypad supplies a signal to the SJB when the buttons are pressed. The SJB then supplies voltage to the appropriate door lock actuator(s) to lock or unlock the doors. The keyless entry keypad can also be used to release the luggage compartment lid. On MKZ, the keyless entry keypad also causes the SJB to send an MS-CAN message to the Driver Seat Module (DSM) to activate all memory features to the positions associated with the personal entry code entered on the keypad.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Binding latch mechanisms • Door handles • Door striker adjustment • Hood latch • Luggage compartment lid latch • Misaligned door	• Smart Junction Box (SJB) fuse(s) ♦ 5 (10A) ♦ 17 (20A) • Wiring, terminals or connectors • Door lock control switch • Luggage compartment lid release switch • Keyless entry keypad • Remote Keyless Entry (RKE) transmitter • SJB

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB , Driver Door Module (DDM) and the Instrument Panel Cluster (IPC).

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

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

DTC Charts

Driver Door Module (DDM) DTC Chart

DTC	Description	Action
B106E	Solid State Driver Disabled Due to Short Circuit	GO to Pinpoint Test AA .
B106F	Module Disabled Due to External Fault	GO to Pinpoint Test AA .
B1317	Battery Voltage High	GO to Pinpoint Test AB .
B1318	Battery Voltage Low	GO to Pinpoint Test AC .
B1342	ECU is Faulted	CLEAR the DTCs. REPEAT the self-test. If DTC B1342 is retrieved again, INSTALL a new Driver Door Module (DDM). REFER to Driver Door Module (DDM) in this section. TEST the system for normal operation.
B1534	Memory 1 Switch Circuit Short to Ground	REFER to Section 501-10 .
B1538	Memory 2 Switch Circuit Short to Ground	REFER to Section 501-10 .
B1667	Mirror Driver Up/Down Motor Stalled	REFER to Section 501-09 .
B1668	Mirror Driver Right/Left Motor Stalled	REFER to Section 501-09 .
B1733	Mirror Driver Vertical Switch Circuit Failure	REFER to Section 501-09 .
B1737	Mirror Driver Horizontal Switch Circuit Failure	REFER to Section 501-09 .
B1741	Mirror Passenger Vertical Switch Circuit Failure	REFER to Section 501-09 .
B1745	Mirror Passenger Horizontal Switch Circuit Failure	REFER to Section 501-09 .
B2223	Mirror Driver Drive Circuit Failure	REFER to Section 501-09 .
B2320	Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	REFER to Section 501-09 .
B2322	Mirror Driver Horizontal Feedback Potentiometer Circuit Short To Battery	REFER to Section 501-09 .
B2324	Mirror Driver Vertical Feedback Potentiometer Circuit Failure	REFER to Section 501-09 .
B2326	Mirror Driver Vertical Feedback Potentiometer Circuit Short To Battery	REFER to Section 501-09 .
B2477	Module Configuration Failure	REFER to Section 418-01 .
B2574	Drivers Door LOCK Switch Short to Ground	GO to Pinpoint Test H .
B2575		GO to Pinpoint Test H .

	Drivers Door UNLOCK Switch Short to Ground	
U0140	Lost Communication With Body Control Module (GEM)	GO to Pinpoint Test AD .
U2050	No Application Present	REFER to Section 418-01 .

Instrument Panel Cluster (IPC) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B109E:42	Remote Keyless Entry: General Memory Failure	The Smart Junction Box (SJB) limit of 4 integrated keys is reached. PROGRAM a maximum of 4 integrated keys. REFER to programming keys using diagnostic equipment in Section 419-01B or Section 419-01C . CLEAR the DTCs. REPEAT the self-test.
B109E:51	Remote Keyless Entry: Not Programmed	GO to Pinpoint Test R .
B109E:86	Remote Keyless Entry: Signal Invalid	GO to Pinpoint Test L .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Smart Junction Box (SJB) DTC Chart

DTC	Description	Action
B1138	Memory Full	The SJB limit of 4 integrated keys is reached. PROGRAM a maximum of 4 integrated keys. REFER to programming keys using diagnostic equipment in Section 419-01B or Section 419-01C . CLEAR the DTCs. REPEAT the self-test.
B1139	Invalid Transmitter Identification Code	GO to Pinpoint Test L .
B1624	Lamp Keypad Output Open Circuit	GO to Pinpoint Test K .
B1626	Lamp Keypad Output Short Circuit To Ground	GO to Pinpoint Test K .
B2276	Less Than 2 Transmitters Programmed	PROGRAM all of the customer's Integrated Keyhead Transmitters (IKTs) (minimum of 2). REFER to Section 419-01B or Section 419-01C . TEST the system for normal operation.
B2425	Remote Keyless Entry Out of Synchronization	GO to Pinpoint Test L .

B2667	Liftglass Release Switch Circuit Failure	GO to Pinpoint Test I .
B2A25	Trim Panel Lock Switch Circuit Failure	GO to Pinpoint Test H .
B2A26	Keypad Switch Circuit Failure	GO to Pinpoint Test J .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Symptom Chart

Symptom Chart - Electrical

Symptom Chart - Mechanical

Pinpoint Tests

Pinpoint Test A: All Door Locks Are Inoperative

Refer to Wiring Diagrams Cell 110 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Door Locks for schematic and connector information.

Normal Operation - MKZ

The Smart Junction Box (SJB) supplies voltage and ground to all the passenger door lock actuators by controlling the lock all and unlock all relays. The Driver Door Module (DDM) supplies voltage and ground only to the driver door lock actuator. The SJB receives inputs from the RH door lock control switch, keyless entry keypad, and the Remote Keyless Entry (RKE) transmitter. The DDM only receives input from the LH door lock control switch. Both modules share the information obtained from the inputs over the Medium Speed Controller Area Network (MS-CAN). Upon a lock request, the SJB supplies voltage on the passenger door lock circuit and ground on the passenger door unlock circuit, and the DDM supplies voltage on the driver door lock circuit and ground on the driver door unlock circuit. Upon an unlock request, the voltage and ground are reversed on the previously listed circuits. When the door lock and unlock relays are not energized they are connected to ground. A dedicated SJB ground circuit is provided only for the lock and unlock relays.

Fusion

The SJB supplies voltage to the lock all relay, the unlock driver door relay or unlock all relay based upon input from the door lock control switches, the RKE transmitter, or the keyless entry keypad. Upon a lock request, the SJB supplies voltage on the all door lock circuit and ground on the driver and passenger door lock circuits. Upon an unlock request, the voltage and ground are reversed on the previously listed circuits. When the door lock and unlock relays are not energized they are connected to ground. A dedicated SJB ground circuit is provided only for the lock and unlock relays.

This pinpoint test is intended to diagnose the following:

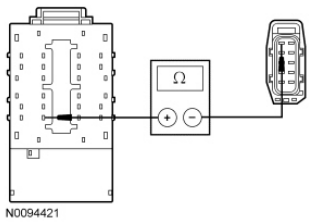
- Fuse
- Wiring, terminals, or connectors
- Luggage compartment lid release solenoid (part of the luggage compartment lid latch)

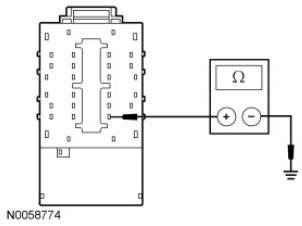
- SJB

PINPOINT TEST A: ALL DOOR LOCKS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
A1 VERIFY THE OPERATION OF BOTH DOOR LOCK CONTROL SWITCHES	
• Press the lock and unlock button on both door lock control switches while observing the door lock operation. • **Are the door locks inoperative from both switches?**	**Yes** For MKZ, multiple failures exist if all locks are inoperative. CHECK the symptom(s) and GO to Symptom Chart - Electrical . For Fusion and Milan, GO to A2 . **No** GO to Pinpoint Test D .
A2 VERIFY ALL DOOR LOCKS ARE INOPERATIVE	
• Press the lock and unlock buttons from a door lock control switch while observing the door locks. • **Are all the door locks inoperative from both switch positions (lock and unlock)?**	**Yes** VERIFY the SJB fuse 17 (20A) is OK. If OK, GO to A3 . If not OK, GO to A5 . **No** GO to Symptom Chart - Electrical .
A3 CHECK THE ALL LOCK CIRCUIT FOR AN OPEN	
• Disconnect: LH Front Door Latch C525 . • Disconnect: SJB C228d . • Measure the resistance between the SJB C2280d-6, circuit CPL11 (GY/BN), harness side and the LH front door latch C525-2, circuit CPL11 (GY/BN), harness side.  	**Yes** GO to A4 . **No** REPAIR circuit CPL11 (GY/BN) for an open. TEST the system for normal operation.

• **Is the resistance less than 5 ohms?**	
A4 CHECK THE POWER DOOR LOCK RELAY GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the SJB C2280d-7, circuit GD126 (BK/WH), harness side and ground.  • **Is the resistance less than 5 ohms?**	**Yes** GO to A8 . **No** REPAIR circuit GD126 (BK/WH) for an open. TEST the system for normal operation.
A5 CHECK THE LUGGAGE COMPARTMENT LID RELEASE OUTPUT CIRCUIT FOR A SHORT TO GROUND	
• Install a new SJB fuse 17 (20A). • Operate the luggage compartment lid release by pressing the luggage compartment lid release switch. • **Is the SJB fuse 17 (20A) OK?**	**Yes** GO to A7 . **No** GO to A6 .
A6 CHECK THE LUGGAGE COMPARTMENT LID RELEASE SOLENOID	
• Install a new SJB fuse 17 (20A). • Disconnect: Luggage Compartment Lid Release Solenoid C429 . • Operate the luggage compartment lid release by pressing the luggage compartment lid release switch. • **Is the SJB fuse 17 (20A) OK?**	**Yes** INSTALL a new luggage compartment lid latch. REFER to Luggage Compartment Lid Latch in this section. **No** REPAIR circuit CPL59 (BN/BU) for a short to ground. TEST the system for normal operation.
A7 CHECK THE ALL LOCK CIRCUIT FOR A SHORT TO GROUND	
• Operate the door lock actuators by pressing LOCK on the door lock control switch. • **Is the SJB fuse 17 (20A) OK?**	**Yes** REPAIR circuit CPL51 (BU/GN) or CPL52 (VT/GY) for a short to ground. TEST the system for normal operation. **No** REPAIR circuit CPL11 (GY/BN) for a short to ground. TEST the system for normal operation.
A8 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors.	**Yes** INSTALL a new SJB . REFER to

• Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: A Single/More Than One Door Lock Is Inoperative - Fusion

Refer to Wiring Diagrams Cell 110 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Door Locks for schematic and connector information.

Normal Operation

The SJB supplies voltage to the lock all relay, the unlock driver door relay or unlock all relay based upon input from the door lock control switches, the RKE transmitter, or the keyless entry keypad. Upon a lock request, the SJB supplies voltage on the all door lock circuit and ground on the driver and passenger door lock circuits. Upon an unlock request, the voltage and ground are reversed on the previously listed circuits. When the door lock and unlock relays are not energized they are connected to ground. A dedicated SJB ground circuit is provided only for the lock and unlock relays.

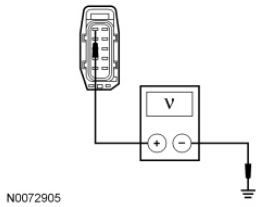
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Door lock actuator (part of the door latch)
- SJB

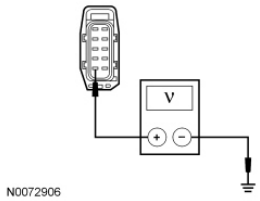
PINPOINT TEST B: A SINGLE/MORE THAN ONE DOOR LOCK IS INOPERATIVE - FUSION

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK THE OPERATION FROM THE INTERIOR DOOR HANDLE	
• Open the door using the interior door handle. • **Does the interior door handle operate normally?**	**Yes** GO to B2 . **No** GO to Pinpoint Test U .
B2 CHECK THE LOCK LEVER OPERATION	
• Operate the door lock lever while observing for any binding. • **Is the door lock lever binding?**	**Yes** INSPECT the interior door handle and door latch for binding. REPAIR as necessary. TEST thsystem for normal operation.

	No GO to B3 .
B3 CHECK THE ALL LOCK CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Disconnect: Inoperative Door Lock Actuator . • **NOTE:** The SJB only supplies voltage to the actuator momentarily. It is important to monitor the meter while pressing the door lock control switch. • While pressing the door lock control switch in the LOCK position, measure the voltage between the inoperative door lock actuator, harness side and ground as follows: **Inoperative Door Lock Actuator** / **Connector-Pin** / **Circuit** LH front / C525-2 / CPL11 (GY/BN) RH front / C603-2 / CPL11 (GY/BN) LH rear / C704-2 / CPL11 (GY/BN) RH rear / C804-2 / CPL11 (GY/BN)  • **Is the voltage momentarily greater than 10 volts?**	**Yes** GO to B4 . **No** REPAIR circuit CPL11 (GY/BN) for an open. TEST the system for normal operation.
B4 CHECK THE UNLOCK CIRCUITS FOR VOLTAGE	
• **NOTE:** The SJB only supplies voltage to the actuator momentarily. It is important to monitor the meter while pressing the door lock control switch. • While pressing the door lock control switch in the UNLOCK position, measure the voltage between the inoperative door lock actuator, harness side and ground as follows: **Connector-Pin** / **Circuit**	**Yes** INSTALL a new door latch for the door lock actuator in question. REFER to Front Door Latch or Rear Door Latch in this section. TEST the system for normal operation. **No** GO to B5 .

Inoperative Door Lock Actuator		
LH front	C525-10	CPL51 (BU/GN)
RH front	C603-10	CPL52 (VT/GY)
LH rear	C704-10	CPL52 (VT/GY)
RH rear	C804-10	CPL52 (VT/GY)



- **Is the voltage momentarily greater than 10 volts?**

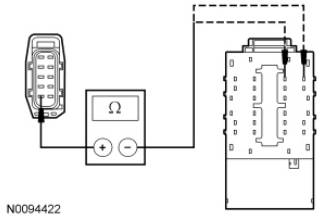
B5 CHECK THE UNLOCK CIRCUITS FOR AN OPEN

- Disconnect: SJB C2280d .
- Measure the resistance between the inoperative door lock actuator, harness side and the SJB , harness side as follows:

Yes
GO to B6 .

No
REPAIR the circuit in question for an open. TEST the system for normal operation.

Inoperative Door Lock Actuator Connector-Pin	SJB Connector-Pin	Circuit
LH front C525-10	C2280d-28	CPL51 (BU/GN)
RH front C603-10	C2280d-27	CPL52 (VT/GY)
LH rear C704-10	C2280d-27	CPL52 (VT/GY)
RH rear C804-10	C2280d-27	CPL52 (VT/GY)



• **Is the resistance less than 5 ohms?**	
B6 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: A Single/More Than One Door Lock Is Inoperative - MKZ

Refer to Wiring Diagrams Cell 110 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Door Locks for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) supplies voltage and ground to all the passenger door lock actuators by controlling the lock all and unlock all relays. The Driver Door Module (DDM) supplies voltage and ground only to the driver door lock actuator. The SJB receives inputs from the RH door lock control switch, keyless entry keypad, and the Remote Keyless Entry (RKE) transmitter. The DDM only receives input from the LH door lock control switch. Both modules share the information obtained from the inputs over the Medium Speed Controller Area Network (MS-CAN). Up a lock request, the SJB supplies voltage on the passenger door lock circuit and ground on the passenger door unlock circuit, and the DDM supplies voltage on the driver door lock circuit and ground on the driver door unlock circuit. Upon an unlock request, the voltage and ground are reversed on the previously listed circuits. When the door lock and unlock relays are not energized they are connected to ground. A dedicated SJB ground circuit is provided only for the lock and unlock relays.

This pinpoint test is intended to diagnose the following:

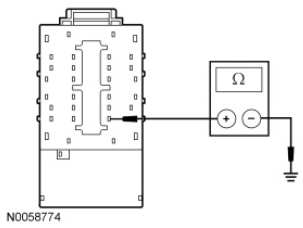
- Fuse
- Wiring, terminals or connectors
- Door lock actuator (part of the door latch)
- Luggage compartment lid release solenoid (part of the luggage compartment latch)
- DDM
- SJB

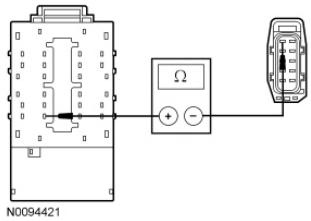
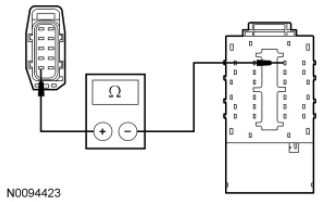
PINPOINT TEST C: A SINGLE/MORE THAN ONE DOOR LOCK IS INOPERATIVE - MKZ

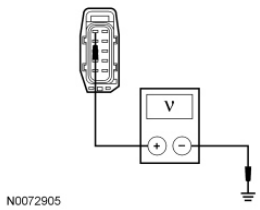
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

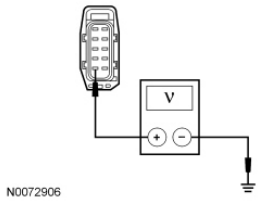
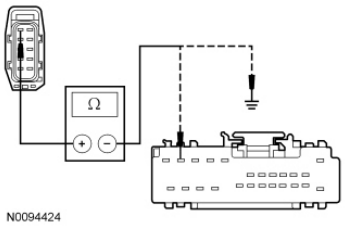
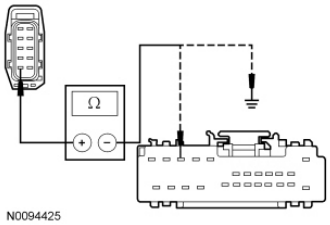
NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

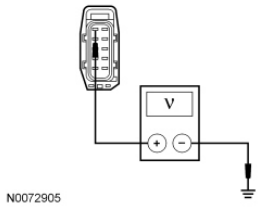
Test Step	Result / Action to Take
C1 CHECK THE OPERATION FROM THE INTERIOR DOOR HANDLE	

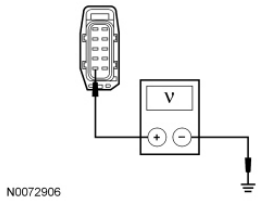
• Open the door using the interior door handle. • **Does the interior door handle operate normally?**	**Yes** GO to C2 . **No** GO to Pinpoint Test U .
C2 CHECK THE LOCK LEVER OPERATION	
• Operate the door lock lever while observing for any binding. • **Is the door lock lever binding?**	**Yes** INSPECT the interior door handle and door latch for binding. REPAIR as necessary. TEST the system for normal operation. **No** GO to C3 .
C3 CHECK FOR COMMUNICATION WITH THE DDM AND SJB	
• Enter the following diagnostic mode on the scan tool: Network Test . • **Does the SJB or DDM fail the network test?**	**Yes** REFER to Section 418-00 . **No** GO to C4 .
C4 CHECK THE PASSENGER DOOR LOCKS	
• Ignition OFF. • Operate the door locks from the passenger door lock control switch. • **Are all of the passenger door locks inoperative?**	**Yes** VERIFY the SJB fuse 17 (20A) is OK. If OK, GO to C5 . If not OK, GO to C8 . **No** GO to C11 .
C5 CHECK THE POWER DOOR LOCK RELAY GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Disconnect: SJB C2280d . • Measure the resistance between the SJB C2280d-7, circuit GD126 (BK/WH), harness side and ground.  • **Is the resistance less than 5 ohms?**	**Yes** GO to C6 . **No** REPAIR circuit GD126 (BK/WH) for an open. TEST the system for normal operation.
C6 CHECK THE LOCK CIRCUIT FOR AN OPEN	

• Disconnect: RH Front Door Latch C603 . • Measure the resistance between the RH front door latch C603-2, circuit CPL11 (GY/BN), harness side and the SJB C2280d-6, circuit CPL11 (GY/BN), harness side.  N0094421 • **Is the resistance less than 5 ohms?**	**Yes** GO to C7 . **No** REPAIR circuit CPL11 (GY/BN) for an open. TEST the system for normal operation.
C7 CHECK THE UNLOCK CIRCUIT FOR AN OPEN	
• Measure the resistance between the RH front door latch C603-10, circuit CPL52 (VT/GY), harness side and the SJB C2280d-27, circuit CPL52 (VT/GY), harness side.  N0094423 • **Is the resistance less than 5 ohms?**	**Yes** GO to C19 . **No** REPAIR circuit CPL52 (VT/GY) for an open. TEST the system for normal operation.
C8 CHECK THE LUGGAGE COMPARTMENT LID RELEASE OUTPUT CIRCUIT FOR A SHORT TO GROUND	
• Install a new SJB fuse 17 (20A). • Operate the luggage compartment lid release by pressing the luggage compartment lid release switch. • **Is the SJB fuse 17 (20A) OK?**	**Yes** GO to C10 . **No** GO to C9 .
C9 CHECK THE LUGGAGE COMPARTMENT LID RELEASE SOLENOID	
• Install a new SJB fuse 17 (20A). • Disconnect: Luggage Compartment Lid Release Solenoid C429 . • Operate the luggage compartment lid release by pressing the luggage compartment lid release switch. • **Is the SJB fuse 17 (20A) OK?**	**Yes** INSTALL a new luggage compartment lid latch. REFER to Luggage Compartment Lid Latch in this section. **No** REPAIR circuit CPL59 (BN/BU) for a short to ground. TEST the system for normal operation.
C10 CHECK THE LOCK CIRCUIT FOR A SHORT TO GROUND	

• Operate the door lock actuators by pressing LOCK on the passenger door lock control switch. • **Is the SJB fuse 17 (20A) OK?**	**Yes** REPAIR circuit CPL52 (VT/GY) for a short to ground. TEST the system for normal operation. **No** REPAIR circuit CPL11 (GY/BN) for a short to ground. TEST the system for normal operation.
C11 CHECK THE DRIVER DOOR LOCK	
• Check to see if the driver door lock is the inoperative lock. • **Is the driver door lock inoperative?**	**Yes** GO to C12 . **No** GO to C16 .
C12 CHECK THE DRIVER DOOR LOCK CIRCUIT FOR VOLTAGE	
• Disconnect: LH Front Door Latch C525 . • **NOTE:** The DDM only supplies voltage to the actuator momentarily. It is important to monitor the meter while pressing the door lock control switch. • While pressing the door lock control switch in the LOCK position, measure the voltage between the LH front door latch C525-2, circuit CPL02 (VT/GN), harness side and ground.  • **Is the voltage momentarily greater than 10 volts?**	**Yes** GO to C13 . **No** GO to C14 .
C13 CHECK THE DRIVER UNLOCK CIRCUIT FOR VOLTAGE	
• **NOTE:** The DDM only supplies voltage to the actuator momentarily. It is important to monitor the meter while pressing the door lock control switch. • While pressing the door lock control switch in the UNLOCK position, measure the voltage between the LH front door latch C525-10, circuit CPL51 (BU/GN), harness side and ground.	**Yes** INSTALL a new driver door latch. REFER to Front Door Latch in this section. TEST the system for normal operation. **No** GO to C15 .

 N0072906 • **Is the voltage momentarily greater than 10 volts?**	
C14 CHECK THE DRIVER LOCK CIRCUIT FOR AN OPEN OR A SHORT TO GROUND	
• Disconnect: DDM C568b . • Measure the resistance between the LH front door latch C525-2, circuit CPL02 (VT/GN), harness side and the DDM C568b-11, circuit CPL02 (VT/GN), harness side; and between the LH front door latch C525-2, circuit CPL02 (VT/GN), harness side and ground.  N0094424 • **Is the resistance less than 5 ohms between the LH front door latch and the DDM , and greater than 10,000 ohms between the LH front door latch and ground?**	**Yes** GO to C15 . **No** REPAIR circuit CPL02 (VT/GN). TEST the system for normal operation.
C15 CHECK THE DRIVER UNLOCK CIRCUIT FOR AN OPEN OR A SHORT TO GROUND	
• Disconnect: DDM C568b . • Measure the resistance between the LH front door latch C525-10, circuit CPL51 (BU/GN), harness side and the DDM C568b-10, circuit CPL51 (BU/GN), harness side; and between the LH front door latch C525-10, circuit CPL51 (BU/GN), harness side and ground.  N0094425 • **Is the resistance less than 5 ohms between the LH front door latch and the DDM , and greater than 10,000 ohms between the LH front door latch and ground?**	**Yes** GO to C18 . **No** REPAIR circuit CPL51 (BU/GN). TEST the system for normal operation.
C16 CHECK THE PASSENGER LOCK CIRCUIT FOR VOLTAGE	

• Disconnect: Suspect Door Latch . • **NOTE:** The SJB only supplies voltage to the actuator momentarily. It is important to monitor the meter while pressing the door lock control switch. • While pressing the door lock control switch in the LOCK position, measure the voltage between the suspect door latch and ground as follows: **Door Latch Connector-Pin** / **Circuit** C603-2 (RH front) — CPL11 (GY/BN) C704-2 (LH rear) — CPL11 (GY/BN) C804-2 (RH rear) — CPL11 (GY/BN)  • **Is the voltage momentarily greater than 10 volts?**	**Yes** GO to C17 . **No** REPAIR circuit CPL11 (GY/BN) for an open. TEST the system for normal operation.
C17 CHECK THE PASSENGER UNLOCK CIRCUIT FOR VOLTAGE	
• **NOTE:** The SJB only supplies voltage to the actuator momentarily. It is important to monitor the meter while pressing the door lock control switch. • While pressing the door lock control switch in the UNLOCK position, measure the voltage between the suspect door latch and ground as follows: **Door Latch Connector-Pin** / **Circuit** C603-10 (RH front) — CPL52 (VT/GY) C704-10 (LH rear) — CPL52 (VT/GY) C804-10 (RH rear) — CPL52 (VT/GY)	**Yes** INSTALL a new door latch for the door lock actuator in question. REFER to Front Door Latch or Rear Door Latch in this section. TEST the system for normal operation. **No** REPAIR circuit CPL52 (VT/GY) for an open. TEST the system for normal operation.

 • **Is the voltage momentarily greater than 10 volts?**	
C18 CHECK FOR CORRECT DDM OPERATION	
• Disconnect all the DDM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the DDM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DDM . REFER to Driver Door Module (DDM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
C19 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: All Door Locks Are Inoperative From One Switch - Fusion

Refer to Wiring Diagrams Cell 110 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Door Locks for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends voltage signals to the door lock control switches through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signalling the SJB to lock or unlock the doors. The door lock control switches have a dedicated ground circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Door lock control switch

PINPOINT TEST D: ALL DOOR LOCKS ARE INOPERATIVE FROM ONE SWITCH - FUSION

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 CHECK THE DOOR LOCK CONTROL SWITCH	
• Disconnect: Inoperative Door Lock Control Switch . • Carry out the door lock control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Is the door lock control switch OK?**	**Yes** REPAIR circuit GD126 (BK/WH) or GD139 (BK/YE) for an open. TEST the system for normal operation. **No** INSTALL a new door lock control switch. REFER to Door Lock Control Switch . TEST the system for normal operation.

Pinpoint Test E: All Door Locks Are Inoperative From One Switch - MKZ

Refer to Wiring Diagrams Cell 110 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Door Locks for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends voltage signals to the passenger door lock control switch through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signalling the SJB to lock or unlock the passenger doors and send a lock or unlock command to the Driver Door Module (DDM) over the Medium Speed Controller Area Network (MS-CAN).

The DDM sends voltage signals to the driver door lock control switch through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signalling the DDM to lock or unlock the driver door and send a lock or unlock command to the SJB over the MS-CAN .

The door lock control switches have a dedicated ground circuit.

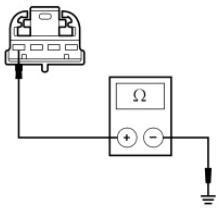
This pinpoint test is intended to diagnose the following:

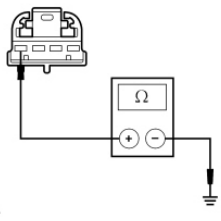
- Wiring, terminals or connectors
- Door lock control switch
- DDM
- SJB

PINPOINT TEST E: ALL DOOR LOCKS ARE INOPERATIVE FROM ONE SWITCH - MKZ

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
E1 CHECK THE RECORDED SJB AND DDM DTCsROM THE SELF-TEST	
• Check the recorded results from the SJB and DDM self-test. • **Are any DTCs present?**	**Yes** REFER to DTC Charts in this section. **No** GO to E2 .
E2 CHECK THE DRIVER DOOR LOCK CONTROL SWITCH	
• Check to see if the driver door lock control switch is the inoperative switch. • **Is the driver door lock control switch inoperative?**	**Yes** GO to E3 . **No** GO to E4 .
E3 CHECK THE DRIVER DOOR SWITCH GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Negative Battery Cable . • Disconnect: Driver Door Lock Control Switch C505 . • Measure the resistance between the driver door lock control switch C505-4, circuit GD126 (BK/WH), harness side and ground.  N0026458 • **Is the resistance less than 5 ohms?**	**Yes** GO to E5 . **No** REPAIR circuit GD126 (BK/WH) for an open. TEST the system for normal operation.
E4 CHECK THE PASSENGER SWITCH GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Negative Battery Cable . • Disconnect: Passenger Door Lock Control Switch C605 . • Measure the resistance between the passenger door lock control switch C605-4, circuit GD139 (BK/YE), harness side and ground.	**Yes** GO to E5 . **No** REPAIR circuit GD139 (BK/YE) for an open. TEST the system for normal operation.

 N0026458 • **Is the resistance less than 5 ohms?**	
E5 CHECK THE SUSPECT DOOR LOCK CONTROL SWITCH FOR CORRECT OPERATION	
• Carry out the door lock control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Is the door lock control switch OK?**	**Yes** For an inoperative driver door lock control switch, GO to E6 . For an inoperative passenger door lock control switch, GO to E7 . **No** INSTALL a new door lock control switch. REFER to Door Lock Control Switch in this section. TEST the system for normal operation.
E6 CHECK THE DDM FOR CORRECT OPERATION	
• Disconnect all the DDM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the DDM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DDM . REFER to Driver Door Module (DDM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
E7 CHECK THE SJB FOR CORRECT OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test F: The Door Lock Switches Operate Only One Way - Fusion

Refer to Wiring Diagrams Cell 110 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Door Locks for

schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends voltage signals to the door lock control switches through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signalling the SJB to lock or unlock the doors. The door lock control switches have a dedicated ground circuit.

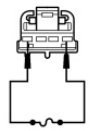
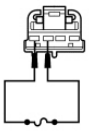
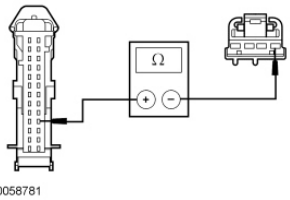
This pinpoint test is intended to diagnose the following:

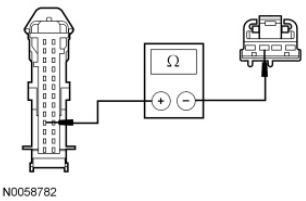
- Wiring, terminals or connectors
- Door lock control switch
- SJB

PINPOINT TEST F: THE DOOR LOCK SWITCHES OPERATE ONLY ONE WAY - FUSION

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 RETRIEVE THE RECORDED SJB DTCs FROM THE SELF-TEST	
• Check for recorded SJB DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** For DTC B2A25, GO to Pinpoint Test H . For all other SJB DTCs, REFER to DTC Charts in this section. **No** GO to F2 .
F2 VERIFY THE OPERATION OF BOTH DOOR LOCK CONTROL SWITCHES	
• Ignition OFF. • Press the lock and unlock button of both door lock control switches while observing the door lock operation. • **Do the door locks operate only one way from both switches?**	**Yes** GO to F4 . **No** GO to F3 .
F3 CHECK THE LOCK INPUT OR UNLOCK INPUT CIRCUIT FOR AN OPEN (SINGLE SWITCH INOPERATIVE)	
• Disconnect: Suspect Door Lock Control Switch . • Unlock the doors from the working door lock control switch. • Observe the door locks while connecting a fused jumper wire between the LH door lock control switch C505-1, circuit CPK19 (BU/GN), harness side and the LH door lock control switch C505-4, circuit GD126 (BK/WH), harness side; or between the RH door lock control switch C605-1, circuit CPK19 (BU/GN), harness side and the RH door lock control switch C605-4, circuit GD139 (BK/YE),	**Yes** INSTALL a new door lock control switch. REFER to Door Lock Control Switch in this section. TEST the system for normal operation. **No**

harness side.  N0062349 • Remove the jumper wire. • Observe the door locks while connecting a fused jumper wire between the LH door lock control switch C505-3, circuit CPK23 (YE/VT), harness side and the LH door lock control switch C505-4, circuit GD126 (BK/WH), harness side; or between the RH door lock control switch C605-3, circuit CPK23 (YE/VT), harness side and the RH door lock control switch C605-4, circuit GD139 (BK/YE), harness side.  N0072908 • **Do the doors lock and unlock with the jumper wire?**	REPAIR the input circuit in question. TEST the system for normal operation.
F4 CHECK THE LOCK INPUT OR THE UNLOCK INPUT CIRCUIT FOR AN OPEN (BOTH SWITCHES INOPERATIVE)	
• Disconnect: LH Door Lock Control Switch C505 . • Disconnect: SJB C2280c . • If the doors do not lock, measure the resistance between the SJB C2280c-17, circuit CPK19 (BU/GN), harness side and the LH door lock control switch C505-1, circuit CPK19 (BU/GN), harness side.  N0058781 • If the doors do not unlock, measure the resistance between the SJB C2280c-4, circuit CPK23 (YE/VT), harness side and the LH door lock control switch C505-3, circuit CPK23 (YE/VT), harness side.	**Yes** GO to F5 . **No** REPAIR the circuit in question. TEST the system for normal operation.

 • **Is the resistance less than 5 ohms?**	
F5 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test G: The Door Lock Switches Operate Only One Way - MKZ

Refer to Wiring Diagrams Cell 110 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Door Locks for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends voltage signals to the passenger door lock control switch through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signalling the SJB to lock or unlock the passenger doors and send a lock or unlock command to the Driver Door Module (DDM) over the Medium Speed Controller Area Network (MS-CAN).

The DDM sends voltage signals to the driver door lockontrol switch through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signalling the DDM to lock or unlock the driver door and send a lock or unlock command to the SJB over the MS-CAN .

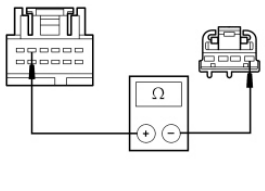
The door lock control switches have a dedicated ground circuit.

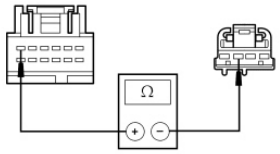
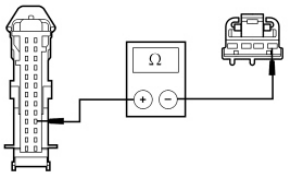
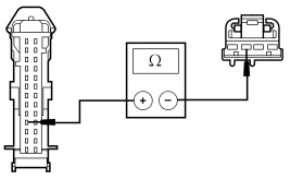
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Door lock control switch
- DDM
- SJB

PINPOINT TEST G: THE DOOR LOCK SWITCHES OPERATE ONLY ONE WAY - MKZ

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
G1 RETRIEVE THE RECORDED DDM AND SJB DTCs FROM BH THE SELF-TESTS	
• Check for recorded DDM and SJB DTCs from the self-tests. • **Are any DTCs recorded?**	**Yes** For DDM DTC B2574 or B2575 and SJB DTC B2A25, GO to Pinpoint Test H . For all other DTCs, REFER to DTC Charts in this section. **No** GO to G2 .
G2 CHECK THE SUSPECT DOOR LOCK CONTROL SWITCH FOR CORRECT OPERATION	
• Disconnect: Inoperative Door Lock Control Switch . • Carry out the door lock control switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Is the door lock control switch OK?**	**Yes** If the driver door lock control switch was the switch tested, GO to G3 . If the passenger door lock control switch was the switch tested, GO to G4 . **No** INSTALL a new door lock control switch. REFER to Door Lock Control Switch in this section. TEST the system for normal operation.
G3 CHECK THE DRIVER LOCK AND UNLOCK INPUT CIRCUITS FOR AN OPEN AT THE DDM	
• Ignition OFF. • Disconnect: DDM C568a . • If the doors do not lock, measure the resistance between the DDM C568a-5, circuit CPL42 (GY/YE), harness side and the LH door lock control switch C505-1, circuit CPL42 (GY/YE), harness side.  N0094426 • If the doors do not unlock, measure the resistance	**Yes** GO to G5 . **No** REPAIR the circuit in question for an open. TEST the system for normal operation.

between the DDM C568a-6, circuit CPL43 (VT/GY), harness side and the LH door lock control switch C505-3, circuit CPL43 (VT/GY), harness side.  N0094427 • **Are the resistances less than 5 ohms?**	
G4 CHECK THE PASSENGER LOCK AND UNLOCK INPUT CIRCUITS FOR AN OPEN AT THE SJB	
• Ignition OFF. • Disconnect: SJB C2280c . • If the doors do not lock, measure the resistance between the SJB C2280c-17, circuit CPK19 (BU/GN), harness side and the RH door lock control switch C605-1, circuit CPK19 (BU/GN), harness side.  N0058781 • If the doors do not unlock, measure the resistance between the SJB C2280c-4, circuit CPK23 (YE/VT), harness side and the RH door lock control switch C605-3, circuit CPK23 (YE/VT), harness side.  N0058782 • **Are the resistances less than 5 ohms?**	**Yes** GO to G6 . **No** REPAIR the circuit in question. TEST the system for normal operation.
G5 CHECK FOR CORRECT DDM OPERATION	
• Disconnect all the DDM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new DDM . REFER to Driver Door Module (DDM) in this section. TEST the system for normal operation.

• Connect all the DDM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
G6 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test H: DTC B2A25, B2574, Or B2575

Refer to Wiring Diagrams Cell 110 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Door Locks for schematic and connector information.

Normal Operation - MKZ

The Smart Junction Box (SJB) sends voltage signals to the passenger door lock control switch through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signalling the SJB to lock or unlock the passenger doors and send a lock or unlock command to the Driver Door Module (DDM) over the Medium Speed Controller Area Network (MS-CAN).

The DDM sends voltage signals to the driver door lock control switch through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signalling the DDM to lock or unlock the driver door and send a lock or unlock command to the SJB over the MS-CAN .

The door lock control switches have a dedicated ground circuit.

Fusion

The SJB sends voltage signals to both door lock control switches through the lock and unlock input circuits. When the lock or unlock switch is pressed, the corresponding voltage signal is routed to ground, signalling the SJB to lock or unlock the doors. The door lock control switches have a dedicated ground circuit.

- DTC B2574 (Drivers Door LOCK Switch Short to Ground) - a continuous and on-demand DTC that sets when the DDM detects a short to ground on the lock input circuit. This code will also set if the driver door lock control switch is pressed for longer than 2 minutes.
- DTC B2575 (Drivers Door UNLOCK Switch Short to Ground) - a continuous and on-demand DTC that sets when the DDM detects a short to ground on the unlock circuit. This code will also set if the driver door lock control switch is pressed for longer than 2 minutes.
- DTC B2A25 (Trim Panel Lock Switch Circuit Failure) - an on-demand DTC that sets when the SJB detects a short to ground from the lock or unlock request input circuits. This DTC may also set if either of the door lock control switches are pressed for longer than 2 minutes.

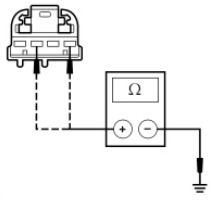
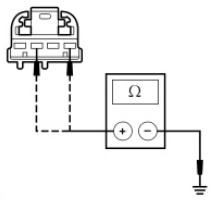
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Door lock control switch
- DDM
- SJB

PINPOINT TEST H: DTC B2A25, B2574, OR B2575

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
H1 CHECK THE RECORDED SJB DTCs FROM THE SELST	
• Check the recorded results from the SJB self-test. • **Is DTC B2A25 present?**	**Yes** GO to H2 . **No** For DTCs B2574 or B2575, GO to H5 .
H2 CHECK THE RH DOOR LOCK CONTROL SWITCH	
• Disconnect: RH Door Lock Control Switch C605 . • Repeat the SJB self-test. • **Is DTC B2A25 retrieved again?**	**Yes** For Fusion and Milan, LEAVE the switch disconnected. GO to H3 . For MKZ, LEAVE the switch disconnected. GO to H4 . **No** INSTALL a new RH door lock control switch. REFER to Door Lock Control Switch in this section. TEST the system for normal operation.
H3 CHECK THE LH DOOR LOCK CONTROL SWITCH - FUSION	
• Disconnect: LH Door Lock Control Switch C505 . • Repeat the SJB self-test. • **Is DTC B2A25 retrieved again?**	**Yes** LEAVE the switch disconnected. GO to H4 . **No** INSTALL a new LH door lock control switch. REFER to Door Lock Control Switch in this section.EST the system for normal operation.
H4 CHECK THE SJB LOCK INPUT CIRCUIT OR THE UNLOCK INPUT CIRCUIT FOR A SHORT TO GROUND	

• Ignition OFF. • Disconnect: SJB C2280c . • Measure the resistance between the RH door lock control switch C605-1, circuit CPK19 (BU/GN), harness side and ground; and between the RH door lock control switch C605-3, circuit CPK23 (YE/VT), harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to H8 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
H5 CHECK THE LH DOOR LOCK CONTROL SWITCH - MKZ	
• Disconnect: LH Door Lock Control Switch C505 . • Repeat the DDM self-test. • **Is DTC B2574 or B2575 retrieved?**	**Yes** LEAVE the switch disconnected. GO to H6 . **No** INSTALL a new LH door lock control switch. REFER to Door Lock Control Switch in this section. TEST the system for normal operation.
H6 CHECK THE DDM LOCK INPUT CIRCUIT OR THE UNLOCK INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: DDM C568a . • Measure the resistance between the LH door lock control switch C505-1, circuit CPL42 (GY/YE), harness side and ground; and between the LH door lock control switch C505-3, circuit CPL43 (VT/GY), harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to H7 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
H7 CHECK FOR CORRECT DDM OPERATION	
• Disconnect all the DDM connectors. • Check for:	**Yes** INSTALL a new DDM . REFER to Driver Door Module (DDM) in this

♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the DDM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
H8 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test I: The Luggage Compartment Lid Release Is Inoperative/Does Not Operate Correctly

Refer to Wiring Diagrams Cell 113 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Luggage Compartment Lid Release for schematic and connector information.

Normal Operation

When the Smart Junction Box (SJB) receives an open request from the luggage compartment lid switch, a Remote Keyless Entry (RKE) transmitter or the keyless entry keypad (if equipped), the SJB supplies voltage to the luggage compartment lid latch which releases the latch. The luggage compartment lid latch has a dedicated ground circuit.

The SJB sends a voltage signal to the luggage compartment lid release switch through the input circuit. When the luggage compartment lid release switch is pressed, the voltage signal is routed to ground, signalling the SJB to release the luggage compartment lid. The luggage compartment lid release switch has a dedicated ground circuit.

- DTC B2667 (Liftglass Release Switch Circuit Failure) - an on-demand DTC that sets if the SJB detects a short to ground on the luggage compartment lid release switch input circuit. This code also sets if the luggage compartment lid release request is detected for longer than 2 minutes.

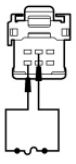
This pinpoint test is intended to diagnose the following:

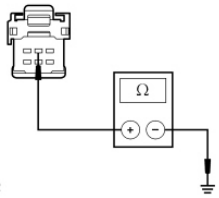
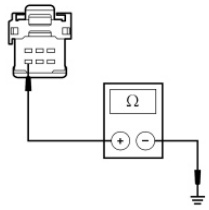
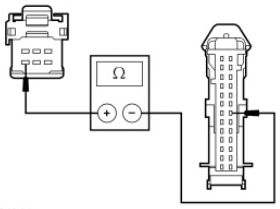
- Wiring, terminals or connectors
- Luggage compartment lid release switch
- Luggage compartment lid latch
- SJB

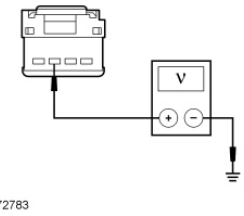
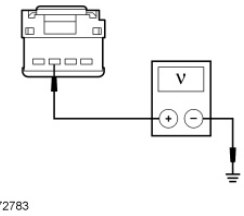
PINPOINT TEST I: THE LUGGAGE COMPARTMENT LID RELEASE IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

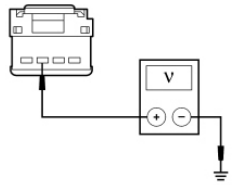
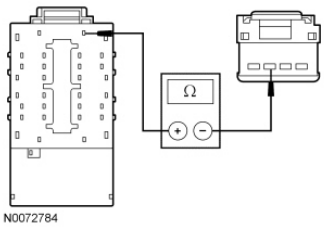
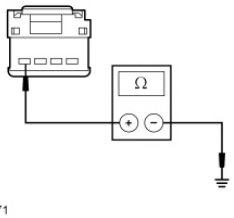
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
I1 CHECK THE DOOR LOCK OPERATION	
• Lock and unlock the doors using a door lock control switch. • **Do the passenger door locks operate?**	**Yes** GO to I2 . **No** For Fusion, GO to Pinpoint Test A . For MKZ, GO to Pinpoint Test C .
I2 CARRY OUT THE SJB LUGGAGE COMPARTMENT LID RELEASE ACTIVE COMMAND USING THE SCAN TOOL	
• Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Select the SJB PID (LIFTGLASS_R) and active command the luggage compartment lid to release. • **Does the luggage compartment lid release?**	**Yes** GO to I3 . **No** GO to I7 .
I3 CHECK THE LUGGAGE COMPARTMENT LID RELEASE SWITCH	
• Disconnect: Luggage Compartment Lid Release Switch C2269 . • Connect a fused jumper wire between the luggage compartment lid release switch C2269-6, circuit CPL60 (BN/YE), harness side and the luggage compartment lid release switch C2269-2, circuit GD116 (BK/VT), harness side.  N0084043 • **Does the luggage compartment lid release?**	**Yes** INSTALL a new luggage compartment lid release switch. REFER to Luggage Compartment Lid Release Switch in this section. TEST the system for normal operation. **No** GO to I4 .
I4 CHECK THE LUGGAGE COMPARTMENT LID RELEASE GROUND CIRCUIT FOR AN OPEN	

• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the luggage compartment lid release switch C2269-2, circuit GD116 (BK/VT), harness side and ground.  N0084042 • **Is the resistance less than 5 ohms?**	**Yes** GO to I5 . **No** REPAIR circuit GD116 (BK/VT) for an open. TEST the system for normal operation.
I5 CHECK THE LUGGAGE COMPARTMENT LID RELEASE SWITCH INPUT CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: SJB C2280c . • Measure the resistance between the luggage compartment lid release switch C2269-6, circuit CPL60 (BN/YE), harness side and ground.  N0084041 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I6 . **No** REPAIR circuit CPL60 (BN/YE) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
I6 CHECK THE LUGGAGE COMPARTMENT LID RELEASE INPUT CIRCUIT FOR AN OPEN	
• Measure the resistance between the luggage compartment lid switch C2269-6, circuit CPL60 (BN/YE), harness side and the SJB C2280c-20, circuit CPL60 (BN/YE), harness side.  N0084044 • **Is the resistance less than 5 ohms?**	**Yes** GO to I12 . **No** REPAIR circuit CPL60 (BN/YE) for an open. TEST the system for normal operation.
I7 CHECK THE LUGGAGE COMPARTMENT LID RELEASE OUTPUT CIRCUIT FOR VOLTAGE	

• Disconnect: Luggage Compartment Lid Latch C429 . • Ignition ON. • **NOTE:** Do not operate the luggage compartment lid release while carrying out this test. • Measure the voltage between the luggage compartment lid latch C429-3, circuit CPL59 (BN/BU), harness side and ground.  N0072783 • **Is any voltage present?**	**Yes** GO to I8 . **No** GO to I9 .
I8 CHECK THE LUGGAGE COMPARTMENT LID RELEASE OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280d . • Ignition ON. • Measure the voltage between the luggage compartment lid latch C429-3, circuit CPL59 (BN/BU), harness side and ground.  N0072783 • **Is any voltage present?**	**Yes** REPAIR circuit CPL59 (BN/BU) for a short to voltage. TEST the system for normal operation. **No** GO to I12 .
I9 CHECK FOR VOLTAGE TO THE LUGGAGE COMPARTMENT LID RELEASE SOLENOID	
• Unlock the doors with a door lock control switch. • **NOTE:** The SJB only supplies voltage to the luggage compartment lid release solenoid momentarily. It is important to monitor the meter while pressing the luggage compartment lid release switch. • While pressing the luggage compartment lid release switch, measure the voltage between the luggage compartment lid latch C429-3, circuit CPL59 (BN/BU), harness side and ground.	**Yes** GO to I11 . **No** GO to I10 .

 N0072783 • **Is the voltage greater than 10 volts?**	
I10 CHECK THE LUGGAGE COMPARTMENT LID RELEASE OUTPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: SJB C2280d . • Measure the resistance between the SJB C2280d-31, circuit CPL59 (BN/BU), harness side and the luggage compartment lid latch C429-3, circuit CPL59 (BN/BU), harness side.  N0072784 • **Is the resistance less than 5 ohms?**	**Yes** GO to I12 . **No** REPAIR circuit CPL59 (BN/BU) for an open. TEST the system for normal operation.
I11 CHECK THE LUGGAGE COMPARTMENT LID LATCH GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the luggage compartment lid latch C429-4, circuit GD171 (BK/GY), harness side and ground.  N0068971 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new luggage compartment lid latch. REFER to Luggage Compartment Lid Latch in this section. TEST the system for normal operation. **No** REPAIR circuit GD171 (BK/GY) for an open. TEST the system for normal operation.
I12 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly

• Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test J: The Doors Do Not Lock/Unlock Using The Keyless Entry Keypad

Refer to Wiring Diagrams Cell 117 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Remote Keyless Entry and Alarm for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) monitors for a ground signal on the keyless entry keypad signal input circuits. When an individual keypad button is pressed, an individual or combination of the input circuits is routed to ground. The SJB then determines which button was pressed based on which circuit(s) are grounded. The keypad has a dedicated ground circuit. Once the SJB determines that the 5-digit personal entry code, or the factory set 5-digit entry code has been entered on the keypad, the SJB then energizes the driver door unlock relay to unlock the driver door.

To unlock all the doors, the 3/4 button must be pressed within 5 seconds of the 5-digit code being entered.

To release the luggage compartment lid, the 5/6 button must be pressed within 5 seconds of the 5-digit code being entered.

To lock all the doors, the 5-digit code does not need to be entered. Press the 7/8 and 9/0 buttons at the same time.

- DTC B2A26 (Keypad Switch Circuit Failure) - an on-demand DTC that sets when the SJB detects a short to ground on any of the keyless entry keypad input circuits.

This pinpoint test is intended to diagnose the following:

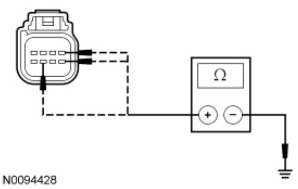
- Wiring, terminals or connectors
- Keyless entry keypad
- SJB

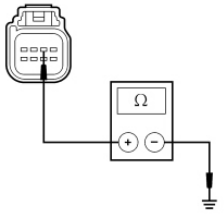
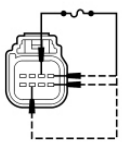
PINPOINT TEST J: THE DOORS DO NOT LOCK/UNLOCK USING THE KEYLESS ENTRY KEYPAD

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
J1 CHECK THE SJB KEYCODE PID	
• Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Observe the SJB PID (KEYCODE). Read and record the 5-digit factory set entry code.	**Yes** The system is operating as designed. INFORM the customer of the correct system operation.

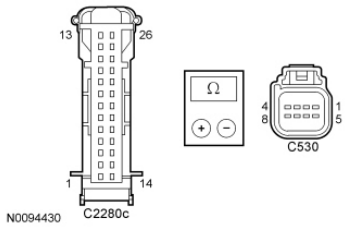
• Enter the 5-digit factory set entry code on the keyless entry keypad, then press the 3/4 button. • **Do the doors unlock?**	**No** GO to J2 .
J2 RETRIEVE THE RECORDED SJB DTCs FROM THE SELF-TEST	
• Check for recorded SJB DTCs from the self-test. • **Is DTC B2A26 recorded?**	**Yes** GO to J3 . **No** GO to J5 .
J3 REPEAT THE SJB SELF-TEST	
• Disconnect: Keyless Entry Keypad C530 . • Clear the DTCs, then repeat the SJB self-test. • **Is DTC B2A26 recorded?**	**Yes** GO to J4 . **No** INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section. CLEAR the DTCs. REPEAT the self-test.
J4 CHECK THE KEYPAD INPUT CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280c . • Measure the resistance between the keypad, harness side and ground as follows: **Keypad Connector-Pin** / **Circuit** C530-7 — CPK29 (GY/BU) C530-5 — CPK30 (VT/GN) C530-1 — CPK31 (YE/GN)  N0094428 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to J10 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
J5 CHECK THE SJB KEY_PAD PID	
• Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Press each keyless entry keypad button while observing the SJB PID (KEY_PAD). • **Does the PID display the correct values?**	**Yes** GO to J10 . **No** GO to J6 .

J6 CHECK THE KEYPAD GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Disconnect: Keyless Entry Keypad C530 . • Measure the resistance between the keyless entry keypad C530-2, circuit GD126 (BK/WH), harness side and ground.  N0026472 • **Is the resistance less than 5 ohms?**	**Yes** GO to J7 . **No** REPAIR the circuit. TEST the system for normal operation.
J7 CHECK THE KEYLESS ENTRY KEYPAD	
• Connect: Negative Battery Cable . • Connect a fused jumper wire between the keyless entry keypad harness side, while monitoring the SJB PID (KEY_PAD) as follows: **Keyless Entry Keypad Connector-Pin/ Circuit** / **Keyless Entry Keypad Connector-Pin/ Circuit** / **SJB PID (KEY_PAD) Value** C530-7 CPK29 (GY/BU) / C530-2 GD126 (BK/WH) / 1/2 C530-5 CPK30 (VT/GN) / C530-2 GD126 (BK/WH) / 7/8 C530-1 CPK31 (YE/GN) / C530-2 GD126 (BK/WH) / 9/0  N0094429 • **Does the PID display the correct values?**	**Yes** INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section. **No** GO to J8 .

J8 CHECK THE KEYPAD INPUT CIRCUITS FOR AN OPEN

- Disconnect: SJB C2280c .
- Measure the resistance between the SJB , harness side and the keyless entry keypad, harness side as follows:

SJB Connector-Pin	Circuit	Keyless Entry Keypad Connector-Pin
C2280c-5	CPK29 (GY/BU)	C530-7
C2280c-18	CPK30 (VT/GN)	C530-5
C2280c-6	CPK31 (YE/GN)	C530-1



- **Are the resistances less than 5 ohms?**

Yes
GO to J9 .

No
REPAIR the circuit in question for an open. TEST the system for normal operation.

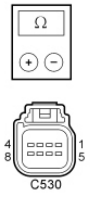
J9 CHECK THE KEYPAD INPUT CIRCUITS FOR A SHORT TO EACH OTHER

- Measure the resistance between the keypad, harness side as follows:

Keypad Connector-Pin	Circuits	Keypad Connector-Pin
C530-7	CPK29 (GY/BU) and CPK30 (VT/GN)	C530-5
C530-7	CPK29 (GY/BU) and CPK31 (YE/GN)	C530-1
C530-5	CPK30 (VT/GN) and CPK31 (YE/GN)	C530-1

Yes
GO to J10 .

No
REPAIR the circuit in question. TEST the system for normal operation.

 • **Are the resistances greater than 10,000 ohms?**	
J10 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test K: The Keyless Entry Keypad Illumination Is Inoperative/Does Not Operate Correctly

Refer to Wiring Diagrams Cell 117 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Remote Keyless Entry and Alarm for schematic and connector information.

Normal Operation

When any keypad button is pressed the Smart Junction Box (SJB) sends voltage to the keyless entry keypad LEDs on the illumination circuit to assist the driver in entering an access code at night. The keyless entry keypad has a separate ground circuit for the LEDs.

- DTC B1624 (Lamp Keypad Output Open Circuit) - a continuous and on-demand DTC that sets when the SJB detects the keyless entry keypad illumination output or ground circuit is open, or the illumination output circuit is shorted to voltage.
- DTC B1626 (Lamp Keypad Output Short Circuit To Ground) - an on-demand DTC that sets when the SJB detects the keyless entry keypad illumination output circuit is shorted to ground.

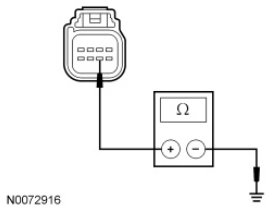
This pinpoint test is intended to diagnose the following:

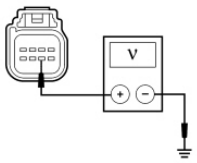
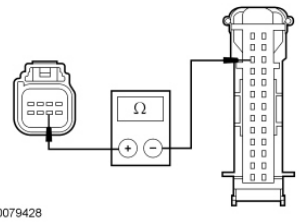
- Wiring, terminals or connectors
- Keyless entry keypad
- SJB

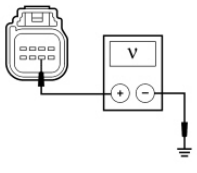
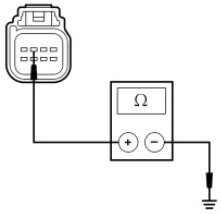
PINPOINT TEST K: THE KEYLESS ENTRY KEYPAD ILLUMINATION IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

NOTICE: **Use the correct probapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
K1 CHECK THE KEYLESS ENTRY KEYPAD OPERATION	
• Press the 7/8 and 9/0 buttons simultaneously on the keyless entry keypad. • **Do all of the doors lock?**	**Yes** GO to K2 . **No** GO to Pinpoint Test J .
K2 CHECK THE RECORDED SJB DTCs FROM THE SELF-TEST	
• Check the recorded results from the SJB self-test. • **Is DTC B1626 present?**	**Yes** GO to K3 . **No** GO to K5 .
K3 CHECK THE KEYLESS ENTRY KEYPAD FOR A SHORT TO GROUND	
• Disconnect: Keyless Entry Keypad C530 . • Clear the DTCs, then repeat the SJB self-test. • **Is DTC B1626 recorded?**	**Yes** GO to K4 . **No** INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section. TEST the system for normal operation.
K4 CHECK THE KEYPAD ILLUMINATION OUTPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280c . • Measure the resistance between the keyless entry keypad C530-6, circuit CPK28 (WH/GN), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K11 . **No** REPAIR circuit CPK28 (WH/GN) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
K5 CHECK THE KEYLESS ENTRY KEYPAD ILLUMINATION	
• Ignition OFF. • Check the keyless entry keypad illumination. • **Is the keyless entry keypad illumination always on?**	**Yes** GO to K6 . **No** GO to K7 .

K6 CHECK THE KEYPAD ILLUMINATION OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: SJB C2280c . • Ignition ON. • Observe the keypad illumination. • **Is the keypad still illuminated?**	**Yes** REPAIR circuit CPK28 (WH/GN) for a short to voltage. TEST the system for normal operation. **No** GO to K11 .
K7 CHECK THE KEYPAD ILLUMINATION OUTPUT CIRCUIT FOR REFERENCE VOLTAGE	
NOTE: The SJB sends out a constant reference voltage on circuit CPK28 (WH/GN) for its own circuit diagnostics. This voltage is 10 volts +/- 1 volt. • Disconnect: Keyless Entry Keypad C530 . • Measure the voltage between the keyless entry keypad C530-6, circuit CPK28 (WH/GN), harness side and ground.  N0062274 • **Are 10 volts (+/- 1 volt) present?**	**Yes** GO to K9 . **No** GO to K8 .
K8 CHECK THE KEYPAD ILLUMINATION OUTPUT CIRCUIT FOR AN OPEN	
• Disconnect: SJB C2280c . • Measure the resistance between the keyless entry keypad C530-6, circuit CPK28 (WH/GN), harness side and the SJB C2280c-11, circuit CPK28 (WH/GN), harness side.  N0079428 • **Is the resistance less than 5 ohms?**	**Yes** GO to K11 . **No** REPAIR circuit CPK28 (WH/GN) for an open. TEST the system for normal operation.
K9 CHECK FOR SJB OUTPUT	

• Measure the voltage between the keyless entry keypad C530-6, circuit CPK28 (WH/GN), harness side and ground while active commanding the SJB PID (KY_PAD_LMP) ON.  N0062274 • **Is the voltage greater than 11 volts?**	**Yes** GO to K10 . **No** GO to K11 .
K10 CHECK THE KEYPAD ILLUMINATION GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Negative Battery Cable . • Measure the resistance between the keyless entry keypad C530-3, circuit GD126 (BK/WH), harness side and ground.  N0026471 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section. TEST the system for normal operation. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
K11 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test L: The Remote Keyless Entry (RKE) Transmitter Is Inoperative

Normal Operation

Remote locking and unlocking of the doors, releasing the luggage compartment lid, and activating the panic alarm is accomplished by the Smart Junction Box (SJB) receiving a command message from the RKE Integrated Keyhead Transmitter (IKT). The IKTs and SJB also utilize a rolling code to prevent the code from being "captured" by a code grabber. The system advances the counter in the RKE transmitter and SJB every

time an IKT button is pressed.

- DTC B1139 (Invalid Transmitter Identification Code) - a continuous DTC that sets when the SJB detects an invalid Transmitter Identification Code (TIC) from an IKT .
- DTC B2425 (Remote Keyless Entry Out of Synchronization) - a continuous DTC that sets when the SJB detects the rolling counter received from an RKE transmitter is 1,024 times greater than the rolling counter stored in the module.
- B109E:86 (Remote Keyless Entry: Signal Invalid) - a continuous DTC that sets when the Instrument Panel Cluster (IPC) detects an invalid TIC from an IKT .

This pinpoint test is intended to diagnose the following:

- IKT
- IKT battery
- IKT button pressed a substantial amount of times while outside the range of the vehicle
- IKT programming
- SJB

PINPOINT TEST L: THE RKE TRANSMITTER IS INOPERATIVE

NOTE: All IKT transmitters mu be present to begin diagnosis of the RKE system.

NOTE: Aftermarket or dealer-installed systems may adversely affect the RKE system operation. These systems should be disconnected before diagnosing any RKE concerns.

Test Step	Result / Action to Take
L1 CHECK FOR THE CORRECT RKE TRANSMITTERS	
• **NOTE:** Make sure the IKTs are those provided with the OEM system and not from an aftermarket system, or a dealer-installed system that may have been installed on the vehicle. • Check that the correct IKTs are used with the vehicle. Compare the IKTs with the one shown in the Description and Operation portion of this section. • **Are all the correct IKTs present?**	**Yes** GO to L2 . **No** The system cannot be tested without the correct IKTs . INFORM the customer that all the correct IKTs must be present to proceed with diagnosis of the system.
L2 CHECK THE RECORDED SJB AND IPC DTCs FROM THE SELF-TEST	
• Check the recorded results from the SJB and IPC self-test. • **Is DTC B2425 or DTC B109E:86 recorded?**	**Yes** For DTC B2425, GO to L3 . For DTC B109E:86, GO to Pinpoint Test R . **No** GO to L4 .
L3 RESYNCHRONIZE THE INOPERATIVE IKT	

• Ignition OFF. • Ignition ON. • Leave the IKT key in the ON position for a minimum of 6 seconds. • Ignition OFF. • Press any button on the IKT . • **Does the IKT operate?**	**Yes** The system is OK. CLEAR the DTCs. REPEAT the self-test. **No** GO to L4 .
L4 MAKE SURE THE RKE TRANSMITTER SIGNAL IS BEING RECEIVED	
• Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Press lock and unlock on the IKT while observing the SJB PIDs (TIC_LAST) and (TNSMT_CMD). • **Does the TIC and RKE command show up on the scan tool screen when a button is pressed?**	**Yes** GO to L5 . **No** GO to L6 .
L5 CHECK IF THE RKE TRANSMITTERS ARE PROGRAMMED	
• Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Press a button on the IKT and compare the SJB PID (TIC_LAST) with the PIDs (TIC_1, 2, 3, 4, 7, 8, 9, or 10). • **Does the TIC displayed match any of the TICs stored in memory?**	**Yes** GO to L8 . **No** PROGRAM the inoperative IKT individually or PROGRAM all the IKTs . REFER to Section 419-01B for the programming procedures. If all the IKTs are to be programmed, INFORM the customer that any IKTs not present need to be programmed. TEST the system for normal operation.
L6 CHECK THE IKT BATTERY	
• Using a thin coin, open the IKT . • Do not clean off any grease from the battery terminals on the back surface of the circuit board. • Verify the correct battery is used (CR2032). • Remove the IKT battery and measure the voltage. • **Is the voltage greater than 2.5 volts?**	**Yes** GO to L7 . **No** INSTALL a new battery (make sure the battery is seated correctly). DO NOT reprogram the IKT (weak or dead batteries do not erase TICs from memory). TEST the system for normal operation.
L7 CHECK FOR NORMAL OPERATION WITH A KNOWN GOOD IKT	
• Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Use the customer's second IKT , or a known good RKE transmitter that is correct for the vehicle, press a button on the IKT while observing the SJB PID (TIC_LAST). • **Does the TIC show up on the scan tool when a button is pressed?**	**Yes** REPLACE the inoperative IKT and PROGRAM the inoperative IKT individually or PROGRAM all the IKTs . REFER to Section 419-01B for the programming procedures. If all the IKTs are to be programmed, INFORM the customer that any IKTs not present need to be programmed. TEST the system for normal operation.

	No GO to L8 .
L8 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test M: An Individual Button/Feature Is Inoperative From The Remote Keyless Entry (RKE) Transmitter

Normal Operation

When any Integrated Keyhead Transmitter (IKT) button is pressed, the SJB receives and processes the command to provide the appropriate output.

This pinpoint test is intended to diagnose the following:

- Door locks
- Horn system
- Luggage compartment lid release
- Turn signal system
- IKT

PINPOINT TEST M: AN INDIVIDUAL BUTTON/FEATURE IS INOPERATIVE FROM THE RKE TRANSMITTER

NOTE: The panic feature will only operate when the key is in the OFF or LOCK positions.

Test Step	Result / Action to Take
M1 VERIFY THE DOOR LOCK OPERATION	
• Press the lock and unlock button on the driver door lock control switch while observing the door lock operation. • **Do the door locks operate correctly?**	**Yes** GO to M2 . **No** GO to Symptom Chart - Electrical .
M2 VERIFY THE HORN OPERATION	

• Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Select the SJB PID (HORN) and active command the horn on. • **Does the horn sound when commanded on?**	**Yes** GO to M3 . **No** REFER to Section 413-06 .
M3 VERIFY THE HAZARD LAMP OPERATION	
• Place the hazard switch in the ON position. • **Do the hazard lamps operate correctly?**	**Yes** GO to M4 . **No** REFER to Section 417-01 .
M4 VERIFY THE LUGGAGE COMPARTMENT LID RELEASE OPERATION	
• Press the luggage compartment lid release button, located next to the headlamp switch. • **Does the luggage compartment lid release?**	**Yes** REPLACE the inoperative IKT and PROGRAM the IKT individually or PROGRAM all the IKTs . REFER to Section 419-01B for the programming procedures. If all the IKTs are to be programmed, INFORM the customer that any IKTs not present need to be programmed. TEST the system for normal operation. **No** GO to Symptom Chart - Electrical .

Pinpoint Test N: The Remote Keyless Entry (RKE) Transmitter Has Poor Range Performance

Normal Operation

The RKE transmitter sends a radio signal to the Smart Junction Box (SJB) based on the user selected RKE transmitter button. The SJB then carries out the selected action.

This pinpoint test is intended to diagnose the following:

- IKT
- IKT battery
- Aftermarket systems
- High power devices
- TV/radio transmission towers
- SJB

PINPOINT TEST N: THE RKE TRANSMITTER HAS POOR RANGE PERFORMANCE

NOTE: All RKE transmitters must be present to begin diagnosis of the RKE system.

NOTE: Aftermarket or dealer-installed systems may adversely affect RKE system operation. These systems should be disconnected before diagnosing any RKE concerns.

Test Step	Result / Action to Take
N1 CHECK FOR THE CORRECT RKE TRANSMITTERS	
• **NOTE:** Make sure the RKE transmitters are those provided with the OEM system and not from an aftermarket system or a dealer-installed system. • Check that the correct RKE transmitters are used with the vehicle. • **Are all the correct RKE transmitters present?**	**Yes** GO to N2 . **No** The system cannot be tested without the correct RKE transmitters. INFORM the customer that all the correct RKE transmitters must be present to proceed with diagnosis of the system.
N2 CHECK ALL THE RKE TRANSMITTERS FOR POOR RANGE PERFORMANCE	
NOTE: The 10 m (33 ft) measurement of range is not the standard but is a guideline that clearly indicates a vehicle is experiencing normal range performance. • Check all the RKE transmitters for poor range performance (less than 10 m [33 ft]). • **Do all RKE transmitters experience poor range?**	**Yes** GO to N4 . **No** GO to N3 .
N3 CHECK THE IKT BATTERY	
• Using a thin coin, open the IKT . • Do not clean off any grease from the battery terminals on the back surface of the circuit board. • Verify the correct battery is used (CR2032). • Remove the IKT battery and measure the voltage. • **Is the voltage greater than 2.5 volts?**	**Yes** REPLACE the inoperative IKT and PROGRAM the IKT individually or PROGRAM all the IKTs . REFER to Section 419-01B for the programming procedures. If all the IKTs are to be programmed, INFORM the customer that any IKTs not present need to be programmed. TEST the system for normal operation. **No** INSTALL a new battery (make sure the battery is seated correctly). DO NOT reprogram the IKT (weak or dead batteries do not erase Transmitter Identification Codes (TICs) from memory). TEST the system for normal operation.
N4 CHECK THE LOCATION OF THE VEHICLE AND THE APPROACH ANGLES AROUND THE VEHICLE	
• Make sure the poor performance is consistent in nature and is not from one approaching angle. • The RKE transmitter range performance may be degraded in certain locations. For	**Yes** GO to N5 . **No** The system is operating correctly at this time. TEST the system for normal operation.

example, if the vehicle is within 0.8 km (0.5 miles) of high-power devices or radio/TV towers, the operating distance of the RKE transmitters may be reduced. • **Is the poor range performance consistent around the vehicle?**	
N5 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test O: The Autolock Does Not Operate Correctly

Normal Operation

The Smart Junction Box (SJB) energizes the lock relay based upon input from the ajar switches, the Transmission Range (TR) sensor, and the vehicle speed signal. The SJB locks the doors when the following conditions are met:

- All the doors are closed
- The ignition switch is in the ON position
- The vehicle is shifted into any gear putting the vehicle in motion
- The vehicle attains a speed greater than 20 km/h (12 mph)

NOTE: The autolock feature is not available on vehicles equipped with a manual transaxle.

This pinpoint test is intended to diagnose the following:

- Ignition switch
- Door ajar switches
- Vehicle speed signal
- TR sensor
- SJB

PINPOINT TEST O: THE AUTOLOCK DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
O1 CHECK THE AUTOLOCKS CONFIGURATION	
• Check to see if the autolocks are enabled. Refer	**Yes** GO to O2 .

to Autolock and Auto-Unlock Programming in this section. • **Are the autolocks enabled?**	**No** ENABLE the autolocks. REFER to Autolock and Auto-Unlock Programming in this section. TEST the system for normal operation.
O2 CHECK THE COURTESY LAMP OPERATION	
• Open and close each door while observing the courtesy lamp operation. • **Do the courtesy lamps operate correctly?**	**Yes** GO to O3 . **No** REFER to Section 417-02 .
O3 CHECK THE SJB IGNITION STATUS PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Monitor the SJB PID (IGN_R_ECU). • **Does the ignition status PID indicate ON?**	**Yes** GO to O4 . **No** REFER to Section 211-05 to continue diagnosis of the ignition switch.
O4 CHECK THE VEHICLE SPEED OPERATION	
• Check the operation of the speedometer. • **Does the speedometer operate correctly?**	**Yes** GO to O5 . **No** REFER to Section 413-01 .
O5 RETRIEVE THE RECORDED SJB DTCs FROM THE CONTINUOUS SELF-TESTS	
• Check for recorded SJB DTCs from the continuous self-tests. • **Is DTC U0155 recorded?**	**Yes** REFER to Section 418-00 . **No** GO to O6 .
O6 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test P: The Auto-Unlock Does Not Operate Correctly

Normal Operation

The Smart Junction Box (SJB) energizes the unlock relay based upon input from the ajar switches and the vehicle speed signal. The SJB unlocks the doors when the following conditions are met:

- The vehicle speed has exceeded 20 km/h (12 mph) then dropped to 0 km/h (0 mph) (vehicle stopped).
- The key is turned to the OFF or ACCY position.
- The LH front door is opened within 10 minutes of the key being turned to the OFF or ACCY position.

This pinpoint test is intended to diagnose the following:

- Door ajar switches
- Ignition switch
- Vehicle speed signal
- SJB

PINPOINT TEST P: THE AUTO-UNLOCK DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
P1 CHECK THE AUTO-UNLOCK CONFIGURATION	
• Check if the auto-unlock is enabled. Refer to Autolock and Auto-Unlock Programming in this section. • **Is auto-unlock enabled?**	**Yes** GO to P2 . **No** ENABLE auto-unlock. REFER to Autolock and Auto-Unlock Programming in this section. TEST the system for normal operation.
P2 CHECK THE COURTESY LAMP OPERATION	
• Open and close each door while observing the courtesy lamp operation. • **Do the courtesy lamps operate correctly?**	**Yes** GO to P3 . **No** REFER to Section 417-02 .
P3 CHECK THE SJB IGNITION STATUS PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Monitor the SJB PID (IGN_R_ECU). • **Does the ignition status PID indicate ON?**	**Yes** GO to P4 . **No** REFER to Section 211-05 to continue diagnosis of the ignition switch.
P4 CHECK THE VEHICLE SPEED OPERATION	
• Check the operation of the speedometer. • **Does the speedometer operate correctly?**	**Yes** GO to P5 . **No** REFER to Section 413-01 .

P5 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test Q: The Smart Unlock Does Not Operate Correctly

Normal Operation

The Smart Junction Box (SJB) commands all doors to unlock based on input from the key-in-ignition switch and door ajar signal. The feature helps prevent the keys from being locked in the vehicle by unlocking the doors if the key is in the ignition and either front door is ajar.

The vehicle can still be locked with the key in the ignition, by using the manual lock rod, a key in the door lock cylinder, keyless entry keypad, or the LOCK button on an Integrated Keyhead Transmitter (IKT).

This pinpoint test is intended to diagnose the following:

- LH front door ajar switch
- RH front door ajar switch
- Key-in-ignition switch
- SJB

PINPOINT TEST Q: THE SMART UNLOCK DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
Q1 CHECK THE COURTESY LAMP OPERATION	
• Open and close each door while checking the courtesy lamp operation. • **Do the courtesy lamps operate correctly?**	**Yes** GO to Q2 . **No** REFER to Section 417-02 .
Q2 CHECK THE KEY-IN-IGNITION CHIME	
• Insert the key in the ignition switch. • Open the driver door. • **Does the key-in-ignition chime operate correctly?**	**Yes** GO to Q3 . **No** REFER to Section 413-01 .

Q3 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test R: B109E:51

Normal Operation

When an Integrated Keyhead Transmitter (IKT) key is programmed, the Remote Keyless Entry (RKE) Transmitter Identification Code (TIC) data from the key is received by the Instrument Panel Cluster (IPC). The IPC then sends the TIC data to the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN). The SJB stores the TIC data in memory and sends an acknowledgement back to the IPC that the TIC data was successfully programmed.

- DTC B109E:51 (Remote Keyless Entry: Not Programmed) - a continuous DTC that sets when the IPC sends the RKE TIC data to the SJB over the MS-CAN , and it does not receive a response from the SJB that the TIC data has been stored.

This pinpoint test is intended to diagnose the following:

- IKT programming
- MS-CAN
- SJB

PINPOINT TEST R: DTC B109E:51

Test Step	Result / Action to Take
R1 CHECK FOR THE CORRECT RKE TRANSMITTERS	
• **NOTE:** Make sure the IKTs are those provided with the OEM system and not from an aftermarket system, or a dealer-installed system that may have been installed on the vehicle. • Check that the correct IKTs are used with the vehicle. • **Are all the correct IKTs present?**	**Yes** GO to R2 . **No** The system cannot be tested without the correct IKTs . INFORM the customer that all the correct IKTs must be present to proceed with diagnosis of the system.
R2 CHECK FOR COMMUNICATION WITH THE IPC AND SJB	

• Enter the following diagnostic mode on the scan tool: Network Test . • **Does the IPC or SJB fail the network test?**	**Yes** REFER to Section 418-00 . **No** GO to R3 .
R3 REPROGRAM THE IKT KEYS	
• Erase and program all of the IKT keys using the scan tool method. Refer to Section 419-01B . • Erase all IPC DTCs. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • **Is DTC B109E:51 retrieved again?**	**Yes** GO to R5 . **No** GO to R4 .
R4 CHECK THE OPERATION OF THE RKE TRANSMITTER	
• Press any button on the suspect IKT key. • **Does the RKE transmitter operate?**	**Yes** The system is operating normally. The concern may have been caused by an improperly programmed IKT key. **No** GO to Pinpoint Test L .
R5 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test S: Hard To Open/Close Door From Either Door Handle

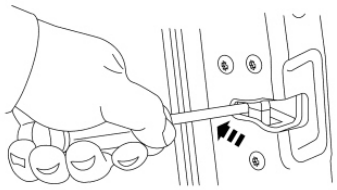
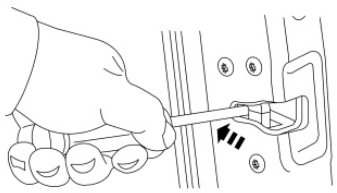
Normal Operation

The door latch can be actuated from the interior or exterior door handle. When actuated, the door latch releases and allows the door to open. If the door latch or the door hinges have insufficient lubrication or if the striker or door are misaligned, it causes extra force to be used when opening or closing the door.

This pinpoint test is intended to diagnose the following:

- Door alignment
- Door hinges
- Striker adjustment
- Door latch

PINPOINT TEST S: HARD TO OPEN/CLOSE DOOR FROM EITHER DOOR HANDLE

Test Step	Result / Action to Take
S1 CHECK THE LATCH OPERATION FROM BOTH DOOR HANDLES	
• Open and close the door using both the interior and exterior door handles. • **Does the door open normally from one of the door handles?**	**Yes** If the door is difficult/does not open from the exterior door handle, GO to Pinpoint Test T . If the door is difficult/does not open from the interior door handle, GO to Pinpoint Test U . **No** If the door does not operate correctly from both door handles, GO to S2 .
S2 CHECK THE LATCH OPERATION	
• Open the door. • Using a screwdriver, fully close the latch (2 clicks).  N0094195 • Verify that the latch releases easily while pulling on the interior/exterior door handle. • **Does the latch release easily?**	**Yes** GO to S4 . **No** GO to S3 .
S3 CHECK THE LATCH OPERATION AFTER LUBRICATION	
• Lubricate the door latch. Refer to Latch Lubrication in this section. • Using a screwdriver, fully close the latch (2 clicks).  N0094195 • Verify that the latch releases easily while pulling on the interior/exterior door handle.	**Yes** The concern was caused by an insufficiently lubricated door latch. **No** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch in this section. TEST the system for normal operation.

• **Does the latch release easily?**	
S4 CHECK THE STRIKER ADJUSTMENT	
• Check the adjustment of the striker. Refer to Section 501-03 . • **Is the striker adjusted correctly?**	**Yes** GO to S5 . **No** ADJUST the striker as necessary. TEST the system for normal operation.
S5 CHECK THE DOOR ALIGNMENT	
• Check the alignment of the door. Refer to Section 501-03 . • **Is the door aligned correctly?**	**Yes** LUBRICATE the door hinges. TEST the system for normal operation. **No** ADJUST the door as necessary. TEST the system for normal operation.

Pinpoint Test T: A Door Is Difficult/Does Not Open From The Exterior Door Handle

Normal Operation

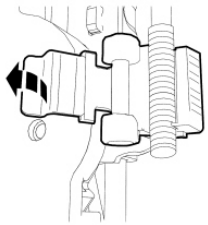
The exterior door handle is connected to the door latch with an actuating rod. When the exterior door handle is pulled it causes the actuating rod to push down on the latch lever. When the latch lever is moved, the door latch releases, allowing the door to open.

This pinpoint test is intended to diagnose the following:

- Broken or binding linkage
- Exterior door handle reinforcement
- Door latch

PINPOINT TEST T: A DOOR IS DIFFICULT/DOES NOT OPEN FROM THE EXTERIOR DOOR HANDLE

Test Step	Result / Action to Take
T1 CHECK THE LATCH OPERATION FROM BOTH DOOR HANDLES	
• Open and close the door using both the interior and exterior door handles. • **Does the door open normally from one of the door handles?**	**Yes** If the door is difficult/does not open from only the exterior door handle, GO to T2 . **No** If the door does not operate correctly from both door handles, GO to Pinpoint Test S .
T2 CHECK THE EXTERIOR DOOR HANDLE REINFORCEMENT	

• Remove the door window regulator and motor assembly. Refer to Section 501-11 . • Open the clip and disconnect the exterior door handle actuating rod.  N0088081 • Pull and release the exterior door handle • **Does the exterior door handle operate correctly?**	**Yes** GO to T3 . **No** INSTALL a new exterior door handle reinforcement. REFER to Door Handle Reinforcement - Exterior, Front or Door Handle Reinforcement - Exterior, Rear in this section. TEST the systor normal operation.
T3 CHECK THE EXTERIOR DOOR HANDLE AND LINKAGE OPERATION	
• Operate the exterior door handle while observing the linkage. • **Are any of the exterior door handle components or linkages binding or broken?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch in this section. TEST the system for normal operation.

Pinpoint Test U: A Door Is Difficult/Does Not Open From The Interior Door Handle

Normal Operation

The interior door handle is connected to the door latch by an actuating cable. When the interior door handle is pulled it causes the cable to pull on the latch lever. When the latch lever is moved, the door latch releases, allowing the door to open.

This pinpoint test is intended to diagnose the following:

- Broken or binding cable/linkage
- Door latch

PINPOINT TEST U: A DOOR IS DIFFICULT/DOES NOT OPEN FROM THE INTERIOR DOOR HANDLE

Test Step	Result / Action to Take
U1 CHECK THE LATCH OPERATION FROM BOTH DOOR HANDLES	
	Yes If the door is difficult/does not open from only the

• For the rear doors, make sure the child lock is in the unlock position. • Open and close the door using both the interior and exterior door handles. • **Does the door open normally from one of the door handles?**	interior door handle, GO to U2 . **No** If the door does not operate correctly from both door handles, GO to Pinpoint Test S .
U2 CHECK THE INTERIOR DOOR HANDLE AND CABLE/LINKAGE OPERATION	
• Remove the door trim panel. Refer to Section 501-05 . • Operate the interior door handle while observing the cable/linkage. • **Are any of the interior door handle components or cable/linkages binding or broken?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch in this section. TEST the system for normal operation.

Pinpoint Test V: Exterior Door Release Handle Sticks

Normal Operation

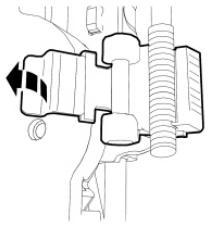
The exterior door handle is connected to the door latch with an actuating rod. When the exterior door handle is pulled it causes the actuating rod to push down on the latch lever. When the latch lever is moved, the door latch releases, allowing the door to open. The handle has a return spring to make sure the handle returns to a closed position.

This pinpoint test is intended to diagnose the following:

- Binding linkage
- Broken handle return spring
- Door latch

PINPOINT TEST V: EXTERIOR DOOR RELEASE HANDLE STICKS

Test Step	Result / Action to Take
V1 CHECK FOR A BROKEN RETURN SPRING	
• Remove the door window regulator and motor assembly. Refer to Section 501-11 . • Open the clip and disconnect the exterior door handle actuating rod.	**Yes** GO to V2 . **No** INSTALL a new exterior door handle reinforcement. REFER to Door Handle Reinforcement - Exterior, Front or Door Handle Reinforcement - Extr, Rear in this section. TEST the system for normal operation.

 N0088081 • Pull and release the exterior door handle • **Does the exterior door handle return to a closed position once released?**	
V2 CHECK THE EXTERIOR DOOR HANDLE AND LINKAGE OPERATION	
• Operate the exterior door handle while observing the linkage. • **Are any of the exterior door handle components or linkages binding?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch in this section. TEST the system for normal operation.

Pinpoint Test W: Interior Door Release Handle Sticks

Normal Operation

The interior door handle is connected to the door latch by an actuating cable. When the interior door handle is pulled it causes the cable to pull on the latch lever. When the latch lever is moved, the door latch releases, allowing the door to open. The handle has a return spring to make sure the handle returns to a closed position.

This pinpoint test is intended to diagnose the following:

- Binding cable
- Broken handle return spring
- Door latch

PINPOINT TEST W: INTERIOR DOOR RELEASE HANDLE STICKS

Test Step	Result / Action to Take
W1 CHECK FOR A BROKEN RETURN SPRING	
• Remove the interior door handle. Refer to Interior Door Handle in this section. • Pull and release the interior door handle • **Does the interior door handle return to a closed position once released?**	**Yes** GO to W2 . **No** INSTALL a new interior door handle. REFER to Interior Door Handle in this section. TEST the system for normal operation.

W2 CHECK THE INTERIOR DOOR HANDLE CABLE OPERATION	
• Remove the door latch release cable. Refer to Door Latch Release Cable in this section. • Observe the door latch release cable for any damage or binding. • **Is the door latch release cable OK?**	**Yes** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch in this section. TEST the system for normal operation. **No** REPAIR as necessary. TEST the system for normal operation.

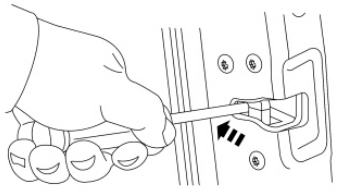
Pinpoint Test X: Squeak/Rattle/Chucking Noise From Door

This pinpoint test is intended to diagnose the following:

- Door alignment
- Striker adjustment
- Door latch

PINPOINT TEST X: SQUEAK/RATTLE/CHUCKING NOISE FROM DOOR

Test Step	Result / Action to Take
X1 CHECK FOR ANY LOOSE COMPONENTS	
• Remove the door trim panel. Refer to Section 501-05 . • Inspect inside the door for any loose components. • **Are there any loose components inside the door?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** GO to X2 .
X2 CHECK THE STRIKER ADJUSTMENT	
• Check the adjustment of the striker. Refer to Section 501-03 . • **Is the striker adjusted correctly?**	**Yes** GO to X3 . **No** ADJUST the striker as necessary. TEST the system for normal operation.
X3 CHECK THE DOOR ALIGNMENT	
• Check the alignment of the door. Refer to Section 501-03 . • **Is the door aligned correctly?**	**Yes** GO to X4 . **No** ADJUST the door as necessary. TEST the system for normal operation.
X4 CHECK THE LATCH OPERATION AFTER LUBRICATION	

• Lubricate the door latch. Refer to Latch Lubrication in this section. • Using a screwdriver, fully close the latch (2 clicks).  N0094195 • Operate the door latch and listen for the noise. • **Is the original noise still present after the latch is lubricated?**	**Yes** INSTALL a new door latch. REFER to Front Door Latch or Rear Door Latch in this section. TEST the system for normal operation. **No** The concern was caused by an insufficiently lubricated door latch.

Pinpoint Test Y: Manual Door Lock Cylinder Inoperative

Normal Operation

The door lock cylinder is connected to the door latch via a lock rod and can be used to manually lock/unlock a door.

This pinpoint test is intended to diagnose the following:

- Bent or binding lock rod and lever
- Door lock cylinder
- Door latch

PINPOINT TEST Y: MANUAL DOOR LOCK CYLINDER INOPERATIVE

Test Step	Result / Action to Take
Y1 CHECK THE LOCK CYLINDER OPERATION AFTER LUBRICATION	
• Spray a lock lubricant such as Motorcraft XL-1 into the lock cylinder opening for a couple seconds. • Operate the door lock cylinder with the key. • **Does the door lock and unlock using the door lock cylinder?**	**Yes** The concern was caused by an insufficiently lubricated lock cylinder. Spray a multi-purpose grease such as Motorcraft XL-5 into the lock cylinder for a couple seconds to provide long term lubrication. **No** GO to Y2 .
Y2 CHECK THE DOOR LOCK CYLINDER	

• Remove the door lock cylinder. Refer to Door Lock Cylinder in this section. • Operate the door lock cylinder with the key. • **Does the door lock cylinder rotate freely to both lock and unlock positions?**	**Yes** GO to Y3 . **No** INSTALL a new door lock cylinder. REFER to Door Lock Cylinder in this section. TEST the system for normal operation.
Y3 CHECK THE DOOR LOCK CYLINDER LINKAGE	
• Operate the door lock cylinder while observing the rod and lever. • **Is the door lock cylinder rod and lever bent or binding?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** INSTALL a new door latch. REFER to Front Door Latch in this section. TEST the system for normal operation.

Pinpoint Test Z: Ignition Key Cannot Be Returned To OFF Position

Refer to Wiring Diagrams Cell 37 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Shift Interlock for schematic and connector information.

Normal Operation

The ignition switch contains a key removal inhibit solenoid. The solenoid prevents the ignition lock cylinder from being turned to lock and the key removed any time the transmission selector lever is in any position except park (automatic transaxle only). The inhibit solenoid receives voltage at all times from the Smart Junction Box (SJB) fuse 27 (20A). When the transmission selector lever is in any gear except park, the selector switch closes, which supplies ground to the solenoid.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Transmission selector lever
- Binding steering column components
- Ignition lock cylinder
- Ignition switch

PINPOINT TEST Z: IGNITION KEY CANNOT BE RETURNED TO OFF POSITION

Test Step	Result / Action to Take
Z1 CHECK FOR AN ENERGIZED KEY REMOVAL INHIBIT SOLENOID	
• Remove the SJB fuse 27 (20A). • Attempt to turn the ignition key to the run position and then back to the lock position and remove the key. • **Does the ignition lock cylinder turn to the lock position and can the key be removed?**	**Yes** REFER to Section 211-05 to continue diagnosis of the key removal inhibit solenoid system. **No** GO to Z2 .

Z2 CHECK THE IGNITION LOCK CYLINDER FOR BINDING	
• Remove the ignition lock cylinder. Refer to Ignition Lock Cylinder in this section. • Rotate the ignition lock cylinder through all positions using the key. • **Does the ignition lock cylinder freely rotate through all positions and can the key be removed from the lock cylinder?**	**Yes** REFER to Section 211-05 to continue diagnosis of the steering column for any binding steering column components or ignition switch. **No** INSTALL a new ignition lock cylinder. REFER to Ignition Lock Cylinder in this section. TEST the system for normal operation.

Pinpoint Test AA: DTCs B106E, B106F

Normal Operation

When a repetitive fault causing a circuit overload is detected on certain output circuits, the Driver Door Module (DDM) disables the circuit by removing voltage, or ground, to the affected circuit. The circuit remains disabled until the fault is corrected and an on-demand self-test is run. When the on-demand self-test has been run after all faults have been corrected, any DTCs related to the fault are cleared.

- DTC B106E (Solid State Driver Disabled Due to Short Circuit) - a continuous DTC that sets when the DDM has disabled a circuit due to a repetitive fault causing a circuit overload. For a complete list of corresponding DTCs, refer to Principles of Operation in this section.
- DTC B106F (Module Disabled Due to External Fault) - a continuous DTC that sets when one or more output functions are permanently disabled due to a repetitive circuit overload fault. DTC B106F is set with DTC B106E. When DTC B106F is present, the DDM must be replaced after the fault condition has been corrected.

This pinpoint test is intended to diagnose the following:

- Output circuit short to ground or voltage
- DDM

PINPOINT TEST AA: DTCs B106E, B106F

NOTICE: **If DTC B106F is present and the DDM is to be replaced, the fault condition must be corrected first. Failure to correct the fault condition first may cause damage to the new DDM , resulting in a repeat repair.**

Test Step	Result / Action to Take
AA1 REVIEW THE DTCs	
• Review the DTCs from the DDM self-test. • **Is only DTC B106F present?**	**Yes** INSTALL a new DDM . REFER to Driver Door Module (DDM) in this section. TEST the system for normal operation. **No** CORRECT any DTCs present other than DTC B106E (DTC B106F may

	also be present). REFER to DTC Charts in this section. After the repair, GO to AA2 .
AA2 CARRY OUT THE DDM SELF-TEST	
• Carry out the DDM self-test. • **Is only DTC B106F present?**	**Yes** INSTALL a new DDM . REFER to Driver Door Module (DDM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern was caused by a fault in one of the output circuits, which is no longer present.

Pinpoint Test AB: DTC B1317

Refer to Wiring Diagrams Cell 123 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Memory Seats for schematic and connector information.

Normal Operation

The Driver Door Module (DDM) monitors the voltage from the battery to determine if it goes above or below specific thresholds and sets DTC B1317 in continuous memory and on-demand if the DDM detects high battery voltage above 15.5 volts on circuit SBP12.

- DTC B1317 (Battery Voltage High) - a continuous memory or on-demand DTC that sets when the DDM detects battery voltage above 15.5 volts on circuit SBP12.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- DDM

PINPOINT TEST AB: DTC B1317

NOTE: DTC B1317 may be stored in the module memory due to previous battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
AB1 CHECK FOR DTC B1317, B1676 OR P0563 SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic me on the scan tool: (All CMDTCs) Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC B1317, B1676 or P0563 (PCM) set in more than one module?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AB2 .

AB2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AB3 .
AB3 RECHECK FOR DTC B1317	
• Turn the engine off. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DDM Self-Test. • Clear the continuous memory DTCs. • Carry out the DDM self-test. • **Is DTC B1317 present?**	**Yes** INSTALL a new DDM . REFER to Driver Door Module (DDM) in this section. TEST the system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test AC: DTC B1318

Refer to Wiring Diagrams Cell 123 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Memory Seats for schematic and connector information.

Normal Operation

The Driver Door Module (DDM) monitors the voltage from the battery to determine if it goes above or below specific thresholds.

- DTC B1318 (Battery Voltage Low) - a continuous memory or on-demand DTC that sets when the DDM detects battery voltage below 10 volts on circuit SBP12.

This pinpoint test is intended to diagnose the following:

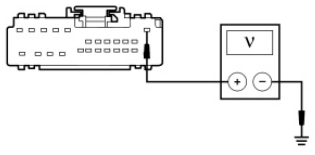
- Wiring, terminals or connectors
- High circuit resistance
- DDM

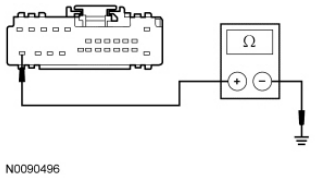
PINPOINT TEST AC: DTC B1318

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take

AC1 RECHECK THE DDM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DDM Self-Test. • Clear the DTCs. Repeat the DDM self-test. • **Is DTC B1318 still present?**	**Yes** GO to AC2 . **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.
AC2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Enter the following diagnostic mode on the scan tool: PCM Self-Test. • Retrieve the continuous memory DTCs from the PCM. • **Is DTC P0620, P0625, P0626 or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to AC3 .
AC3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Ignition OFF. • Check the battery condition and verify the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AC4 . **No** REFER to Section 414-00 .
AC4 CHECK THE DDM VOLTAGE SUPPLY	
• Measure and record the voltage at the battery. • Disconnect: DDM C568b. • Ignition ON. • Measure the voltage between the DDM C568b-1, circuit SBP12 (GN/RD), harness side and ground.  N0090495 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to AC5 . **No** REPAIR the circuit for high resistance. CLEAR the DTCs. REPEAT the self-test.
AC5 CHECK THE DDM GROUND CIRCUIT	
• Ignition OFF. • Disconnect: Negative Battery Cable. • Measure the resistance between the DDM C568b-24, circuit GD126 (BK/WH), harness side and ground.	**Yes** GO to AC6 . **No** REPAIR the circuit for high resistance. TEST the system for normal operation.

 • **Is the resistance less than 5 ohms?**	
AC6 CHECK FOR CORRECT DDM OPERATION	
• Connect: Negative Battery Cable. • Disconnect the DDM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the DDM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DDM . REFER to Driver Door Module (DDM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AD: DTC U0140

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

The Driver Door Module (DDM) and the Smart Junction Box (SJB) communicate using the Medium Speed Controller Area Network (MS-CAN). Messages are exchanged between the modules on the MS-CAN for the purposes of determining what functions are being carried out.

- DTC U0140 (Lost Communication With Body Control Module (GEM)) - set by the DDM whenever it has lost communication to the SJB for 15 seconds or longer as long as the module voltage is between 10 and 15 volts.

This pinpoint test is intended to diagnose the following:

- Module communication
- DDM
- SJB

PINPOINT TEST AD: DTC U0140

Test Step	Result / Action to Take
AD1 VERIFY CUSTOMER CONCERN	
• Ignition ON.	**Yes** GO to AD2 .

• rify there is an observable symptom present. • **Is an observable symptom present?**	**No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the SJB pass the network test?**	**Yes** GO to AD3 . **No** REFER to Section 418-00 .
AD3 RETRIEVE THE RECORDED DTCs FROM THE SELF-TEST	
• Check for recorded DDM DTCs from the self-test. • **Is DTC B1317 or DTC B1318 recorded?**	**Yes** For DTC B1317, GO to Pinpoint Test AB . For DTC B1318, GO to Pinpoint Test AC . **No** GO to AD4 .
AD4 RECHECK THE DDM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the DDM self-test. • **Is DTC U0140 still present?**	**Yes** GO to AD5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD5 CHECK FOR DTC U0140/U0140:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0140/U0140:00 set in other modules?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . **No** INSTALL a new DDM . REFER to Driver Door Module (DDM) in this section.

Remote Keyless Entry (RKE) Transmitter Programming

NOTE: This procedure is for programming conventional keyfobs only. The Remote Keyless Entry (RKE) transmitter of the Integrated Keyhead Transmitter (IKT) is programmed automatically during the Passive Anti-Theft System (PATS) programming. For additional information, refer to Key Programming Using Two Programmed Keys or Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in Section 419-01B to program the IKT .

NOTE: All RKE transmitters must be programmed at the same time.

NOTE: Do not apply the brake pedal during this sequencing, as doing so ends the sequence and the transmitters will not be programmed.

1. Electronically unlock the door locks using the door lock control switch.

2. Cycle the ignition switch from the OFF to the RUN position 8 times in rapid succession (within 10 seconds), with the eighth turn ending in RUN. If the module successfully enters program mode, it locks and then unlocks all the doors.

3. **NOTE:** If no action is taken within 20 seconds after a transmitter has been programmed, the programming sequence ends (the doors lock and unlock to confirm that programming is complete).

   Within 20 seconds, press any button on the RKE transmitter to be programmed. The doors lock and then unlock to confirm that each RKE transmitter is programmed. Repeat this step for each RKE transmitter.

4. Exiting the programming mode is accomplished if one of the following occurs:
   - The key transitions to the OFF position.
   - 20 seconds have passed since entering programming mode or since the last RKE transmitter was programmed.
   - The maximum number (4) of RKE transmitters have been programmed.

5. Check the operation of the RKE transmitter. If the door locks do not respond for the programmed RKE transmitter(s), wait several seconds and press the button again. If the door locks still fail to respond, refer to Handles, Locks, Latches and Entry Systems in this section. (Make sure that no more than the maximum number of RKE transmitters are attempted to be programmed.)

Keyless Entry Keypad Code Programming

Programming a Personal Entry Code and Keypad Association to Memory Features (If Equipped)

NOTE: The system allows 3 personal codes to be programmed.

NOTE: Multiple personal codes can be programmed in one step. When programming multiple codes in one step, each code must be programmed by entering each button within 5 seconds of each other. If 5 seconds elapse between any button press, programming mode is exited.

NOTE: If only a single personal code is desired or unable to program multiple codes in one step, each personal code can be programmed individually by repeating Steps 1-5 for each code desired.

1. Enter the factory set 5-digit keyless entry keypad code.

2. Within 5 seconds, press the 1/2 button on the keypad to activate the programming mode.

3. Enter the new personal 5-digit keyless entry keypad code. Each number must be entered within 5 seconds of each other.

4. After entering the new personal code, press a 6th button to program each new code.
   - Pressing 1/2 stores the first personal code (if equipped with memory, this code is associated with driver 1 settings).
   - Pressing 3/4 stores the second personal code (if equipped with memory, this code is associated with driver 2 settings).
   - Pressing 5/6, 7/8 or 9/0 stores the third personal code, but does not associate the code with a memory setting.

5. The door locks lock and unlock to confirm the new code is programmed.

Erasing a Personal Entry Code

1. Enter the factory set 5-digit keyless entry keypad code.

2. Within 5 seconds, press the 1/2 button on the keypad and release.

3. Within 5 seconds, press and hold the 1/2 button for 2 seconds.

4. All personal codes are now erased and only the factory set 5-digit code works.

Remote Memory Activation

1. Position the driver seat and exterior mirror(s) to the desired positions.
2. Press and hold either memory button (1 or 2) for 5 seconds. A tone will be heard after 1-1/2 seconds when the memory store is done. Continue to hold until a second tone is heard after 5 seconds.
3. Within 3 seconds, press the LOCK button on the Remote Keyless Entry (RKE) transmitter.
4. If a second memory setting is desired, repeat the procedure with the second RKE transmitter.

Remote Memory Deactivation

1. Press and hold either memory button (1 or 2) for 5 seconds. A tone will be heard after 1-1/2 seconds when the memory store is done. Continue to hold until a second tone is heard after 5 seconds.

2. Within 3 seconds, press the UNLOCK button on the Remote Keyless Entry (RKE) transmitter.

3. If a second memory setting is desired to be deactivated, repeat the procedure with the second RKE transmitter.

Autolock and Auto-Unlock Programming

Programming the Autolock Feature Using the Door Lock Control Switch

NOTE: The autolock feature is not available on vehicles equipped with a manual transaxle.

NOTE: The autolock feature can be enabled or disabled independently of the auto-unlock feature.

NOTE: Make sure that the vehicle's perimeter alarm is not armed, the key is in the OFF position and the doors are closed.

NOTE: The following steps must be carried out within 30 seconds or the procedure will need to be repeated. If the procedure needs to be repeated, wait 30 seconds between programming sessions.

1. Turn the ignition key from the OFF to the RUN position.
2. Press the unlock button on the door lock control switch 3 times.
3. Turn the ignition key from the RUN to the OFF position.
4. Press the unlock button on the door lock control switch 3 times.
5. Turn the ignition key to the RUN position. The horn chirps one time to indicate that programming mode is entered.
6. To enable/disable the autolock feature, press the unlock button on the door lock control switch then the lock button. The horn chirps once if the autolocks are disabled or twice (one short chirp followed by a long chirp) if the autolocks are enabled.
7. Turn the ignition key to the OFF position. The horn chirps once to signal that the programming is complete.

Programming the Autolock Feature Using the Keyless Entry Keypad

NOTE: The autolock feature is not available on vehicles equipped with a manual transaxle.

NOTE: The autolock feature can be enabled or disabled independently of the auto-unlock feature.

NOTE: Make sure that the vehicle's perimeter alarm is not armed, the key is in the OFF position and the doors are closed.

NOTE: The following steps must be carried out within 30 seconds or the procedure will need to be repeated. If the procedure needs to be repeated, wait 30 seconds between programming sessions.

1. Turn the ignition key to the OFF position.
2. Close all of the doors.
3. Enter the factory set 5 digit entry code.

4. Press and hold the 3/4 button. While holding the 3/4 button, press the 7/8 button.
5. Release the 7/8 button.
6. Release the 3/4 button. The horn chirps once if the autolocks are disabled, or chirps once followed by a honk if the autolocks are enabled.

Programming the Auto-Unlock Feature Using the Door Lock Control Switch

NOTE: The auto-unlock feature is disabled from the factory on vehicles equipped with a manual transaxle, but can be enabled.

NOTE: The auto-unlock feature can be enabled or disabled independently of the autolock feature.

NOTE: Make sure that the vehicle's perimeter alarm is not armed, the key is in the OFF position and the doors are closed.

NOTE: The following steps must be carried out within 30 seconds or the procedure will need to be repeated. If the procedure needs to be repeated, wait 30 seconds between programming sessions.

1. Turn the ignition key from the OFF to the RUN position.
2. Press the unlock button on the door unlock control switch 3 times.
3. Turn the ignition key from the RUN to the OFF position.
4. Press the unlock button on the door lock control switch 3 times.
5. Turn the ignition key to the RUN position. The horn chirps one time to indicate that programming mode is entered.
6. To enable/disable the auto-unlock feature, press the lock button on the door lock control switch then the unlock button. The horn chirps once if auto-unlock is disabled or twice (one short chirp followed by a long chirp) if auto-unlock is enabled.
7. Turn the ignition key to the OFF position. The horn chirps once to signal that the programming is complete.

Programming the Auto-Unlock Feature Using the Keyless Entry Keypad

NOTE: The auto-unlock feature is disabled from the factory on vehicles equipped with a manual transaxle, but can be enabled.

NOTE: The auto-unlock feature can be enabled or disabled independently of the autolock feature.

NOTE: Make sure that the vehicle's perimeter alarm is not armed, the key is in the OFF position and the doors are closed.

NOTE: The following steps must be carried out within 30 seconds or the procedure will need to be repeated. If the procedure needs to be repeated, wait 30 seconds between programming sessions.

1. Turn the ignition key to the OFF position.
2. Close all of the doors.

3. Enter the factory set 5 digit entry code.

4. Press and hold the 3/4 button. While holding the 3/4 button, press and release the 7/8 button. While still holding the 3/4 button, press and release the 7/8 button a second time.

5. Release the 3/4 button. The horn chirps once if auto-unlock is disabled, or chirps once followed by a honk if auto-unlock is enabled.

Stepped Unlock Programming

1. With the ignition switch in the OFF position, press the LOCK and UNLOCK buttons on the Remote Keyless Entry (RKE) transmitter simultaneously for 4 seconds.
    - The turn signals flash twice to indicate the mode change.

2. Repeat Step 1 to enable/disable the stepped unlocking feature.

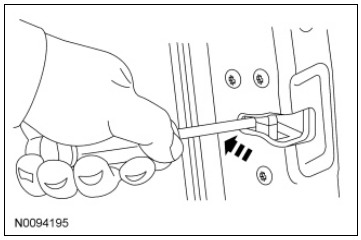
Latch Lubrication

Material

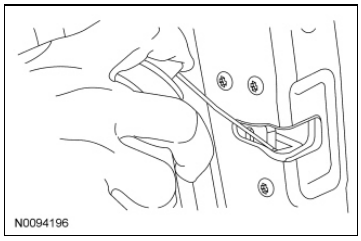
Item	Specification
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B

1. Open the door.

2. Using a screwdriver, fully close the latch (2 clicks).



3. Spray the multi-purpose grease into the opening on the door latch for approximately 5 seconds.



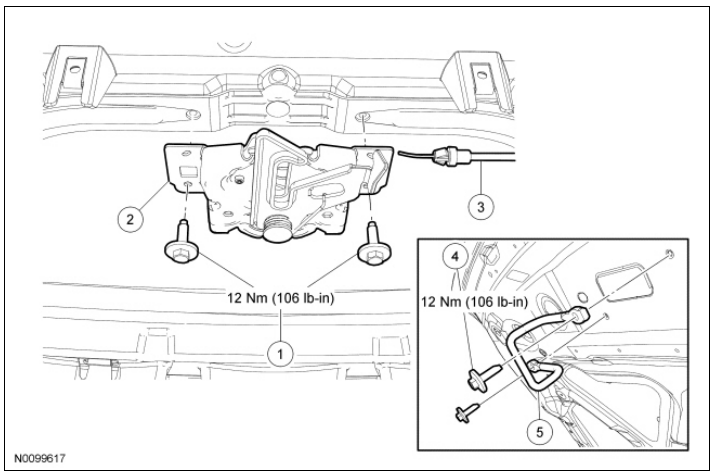
4. Open the latch using either the interior or exterior door handle.

5. Open and close the door several times to circulate the lubricant inside the latch.

6. Wipe off any excess grease.

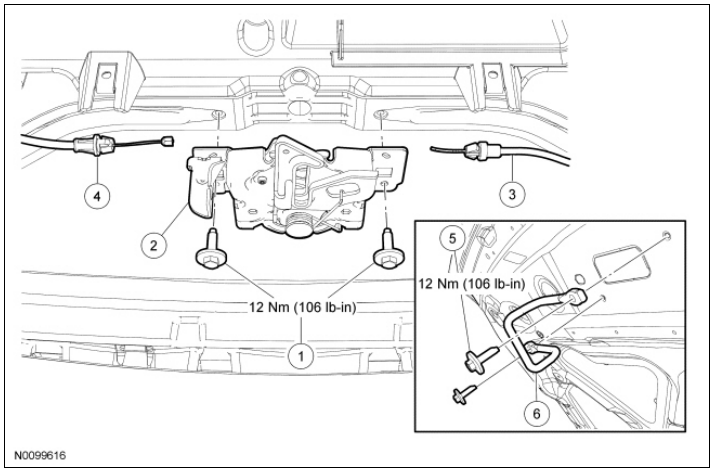
Hood Latch

Fusion



Item	Part Number	Description
1	N808727-S307	Hood latch bolts (2 required)
2	16700	Hood latch
3	16916	Hood latch release cable
4	N807658-S307	Hood latch striker bolts (2 required)
5	16K689	Hood latch striker

MKZ



Item	Part Number	Description
1	N808727-S307	Hood latch bolts (2 required)
2	16700	Hood latch
3	16916	Hood latch release cable

4	16916	Secondary hood latch release cable
5	N807658-S307	Hood latch striker bolts (2 required)
6	16K689	Hood latch striker

Removal and Installation

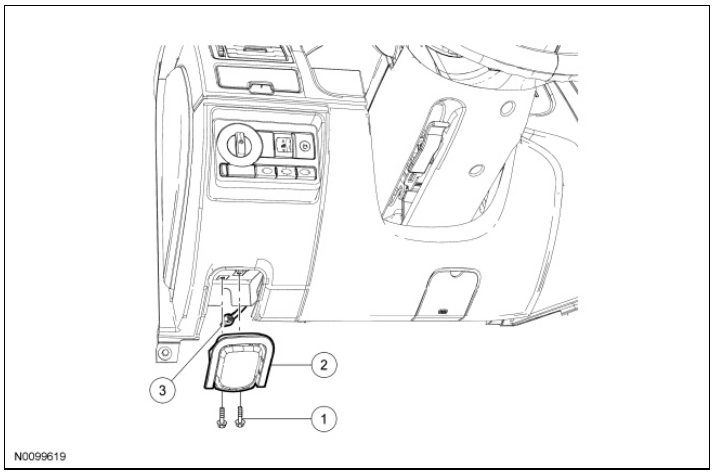
1. Remove the 6 (Fusion)/2 (MKZ) radiator grille pin-type retainers and the 4 radiator grille bolts.
2. For MKZ, disconnect the secondary hood latch release cable from the hood latch.
3. **NOTE:** Pull up on the radiator grille to gain access to the hood latch.

   NOTE: Mark the hood latch position prior to removal of the hood latch bolts.

   Remove the 2 hood latch bolts and position the hood latch aside.

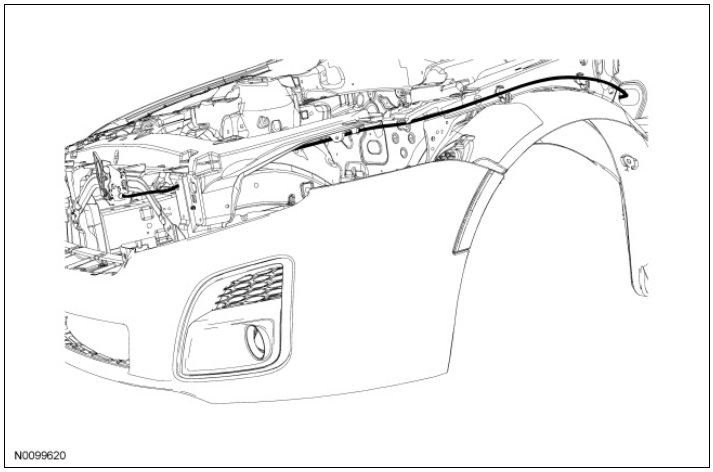
   - To install, tighten to 12 Nm (106 lb-in).
4. Disconnect the hood latch release cable and remove the hood latch.
5. To install, reverse the removal procedure.

Hood Latch Release Handle



Item	Part Number	Description
1	-	Hood latch release handle bolts (2 required)
2	16916	Hood latch release handle
3	16916	Hood latch release cable

Hood Latch Release Cable Routing



Removal and Installation

1. Remove the hood latch. For additional information, refer to Hood Latch in this section.
2. Remove the LH fender splash shield. For additional information, refer to Section 501-02 .
3. Release the 2 hood latch release cable locators from the radiator grille opening panel reinforcement.
4. Disconnect the hood latch release cable from the LH fender opening, open the 2 hood latch release cable locators and position the cable aside.

5. Release the hood latch release cable locator from the wiring harness.

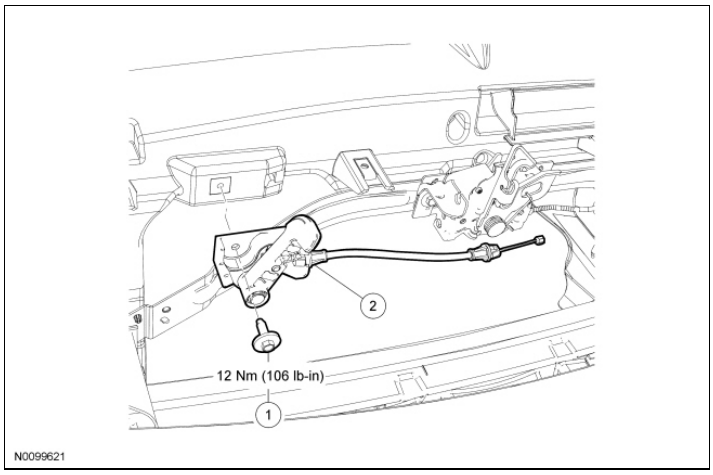
6. Remove the Smart Junction Box (SJB). For additionalnformation, refer to Section 419-10 .

7. Remove the 2 hood latch release handle bolts.

8. Remove the hood latch release handle and cable assembly.

9. To install, reverse the removal procedure.

Hood Latch Release Handle - Secondary



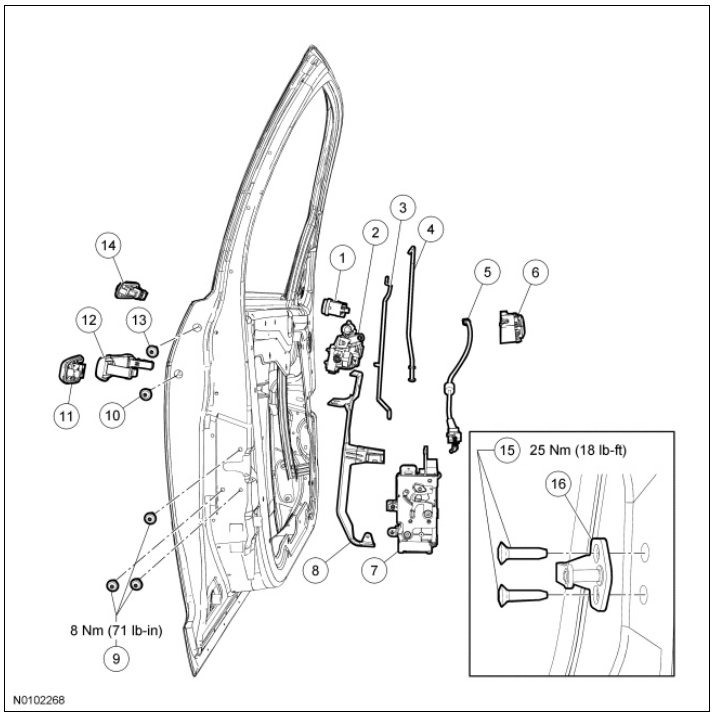
Item	Part Number	Description
1	N808727-S307	Secondary hood latch release handle bolt
2	16916	Secondary hood latch release handle and cable

Removal and Installation

1. Remove the 2 radiator grille pin-type retainers and the 4 radiator grille bolts.
2. **NOTE:** Pull up on the radiator grille to gain access to the hood latch.

   Disconnect the secondary hood latch release cable from the hood latch.
3. Remove the secondary hood latch release handle bolt.
   - To install, tighten to 12 Nm (106 lb-in).
4. To install, reverse the removal procedure.

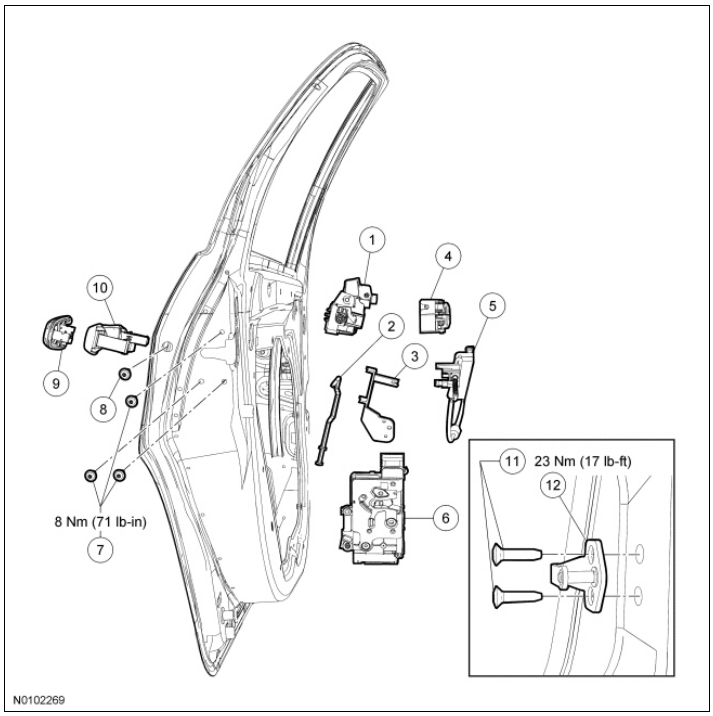
Front Door Handles, Locks and Latches - Exploded View



Item	Part Number	Description
1	5421991	Door lock cylinder (driver door only)
2	5426685/ 5426684	Exterior front door handle reinforcement (LH/RH)
3	5422135	Front door lock cylinder actuating rod (driver door only)
4	5422153/ 5422152	Exterior door handle actuating rod (LH/RH)
5	54221A00	Interior door handle actuating cable
6	5422601/ 5422600	Interior door handle (LH/RH)
7	5421813/ 5421812	Front door latch (LH/RH)
8	-	Door latch carrier (LH/RH)
9	W705830-S901	Front door latch bolts (3 required)
10	-	Grommet
11	54218A14/ 5422088	Exterior door handle bezel (LH/RH)
12	5422404	Exterior front door handle
13	-	Grommet
14	14A626	Keyless entry keypad
15	W711379-S900	Striker bolts d)
16	5422008	Striker

1. For additional information, refer to the procedures in this section.

Rear Door Handles, Locks and Latches - Exploded View

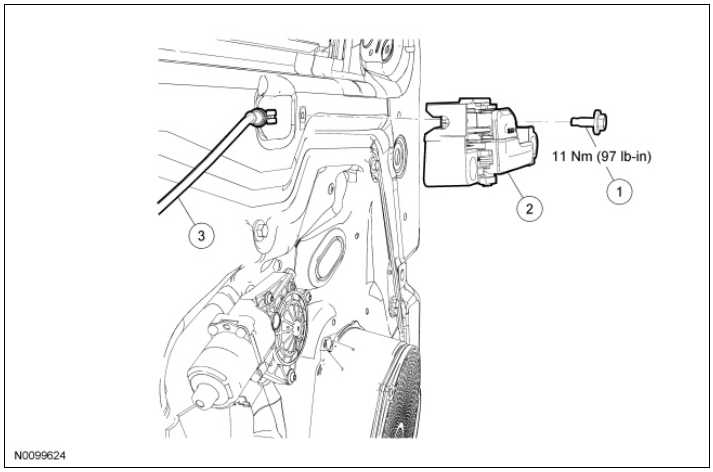


Item	Part Number	Description
1	5426685/ 5426684	Exterior rear door handle reinforcement (LH/RH)
2	5426597/ 5426596	Exterior door handle actuating rod (LH/RH)
3	-	Door latch carrier
4	5422601/ 5422600	Interior rear door handle (LH/RH)
5	54221A01/ 54221A00	Door latch release cable (LH/RH)
6	5426413/ 5426412	Rear door latch (LH/RH)
7	W705830-S901	Door latch bolts (3 required)
8	-	Grommet
9	5422088	Exterior door handle bezel
10	5422404	Exterior door handle
11	W710881-S900	Striker bolts (2 required)
12	5422008	Striker

1. For additional information, refer to the procedures in this section.

Interior Door Handle

NOTE: LH front door shown, other doors similar.



Item	Part Number	Description
1	W709494-S438	Interior door handle bolt
2	5422601/ 5422600	Interior door handle (LH/RH)
3	54221A00	Interior door handle release cable

Removal and Installation

1. Remove the door trim panel. For additional information, refer to Section 501-05 .

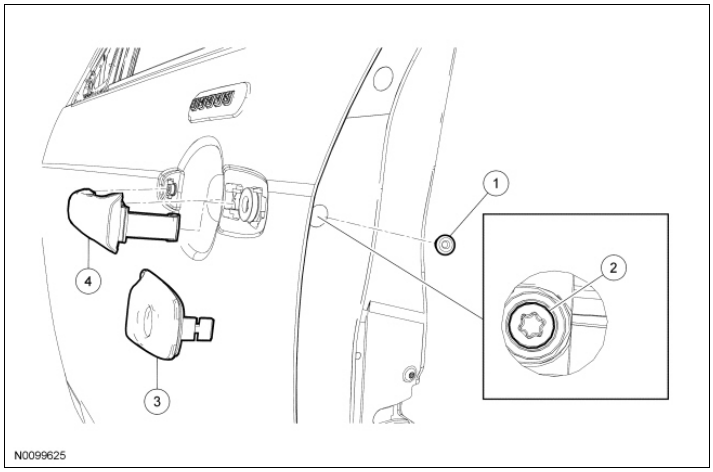
2. Remove the interior door handle bolt.
   - To install, tighten to 11 Nm (97 lb-in).

3. Disconnect the interior door handle release cable and remove the interior door handle.

4. To install, reverse the removal procedure.

Exterior Door Handle

NOTE: LH front door shown, other doors similar.



Item	Part Number	Description
1	-	Grommet
2	-	Exterior door handle bezel retaining screw
3	54218A14/ 5422088	Exterior door handle bezel (with key hole/without key hole)
4	5422404	Exterior door handle

Removal and Installation

1. Remove the grommet from the rear of the door.

2. Loosen, but do not remove the exterior door handle bezel retaining screw and remove the exterior door handle bezel.

3. **NOTE:** Pull the exterior door handle outward and to the rear to release it from the exterior door handle reinforcement.

   Remove the exterior door handle.

4. To install, reverse the removal procedure.

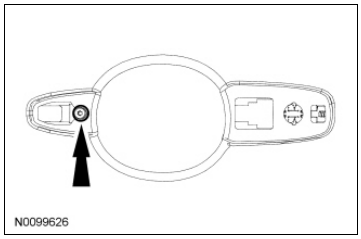
Front Door Latch

Removal and Installation

1. Remove the front door window regulator and motor. For additional information, refer to Section 501-11 .

2. Remove the exterior door handle. For additional information, refer to Exterior Door Handle in this section.

3. Loosen the exterior door handle reinforcement bolt.
   - To install, tighten to 6 Nm (53 lb-in)



4. Slide the exterior front door handle reinforcement to the front of the vehicle and push inside the door.

5. Remove the 3 front door latch bolts.
   - To install, tighten to 8 Nm (71 lb-in).

6. Remove the complete latch, carrier, and handle reinforcement assembly from the door.

7. Open the clip and disconnect the exterior front door handle actuating rod.

8. If required, disconnect the front door lock cylinder actuating rod.

9. Remove the 2 screws and remove the front door latch from the carrier.

10. To install, reverse the removal procedure.

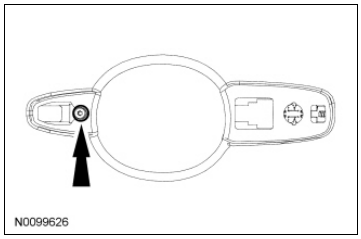
Door Handle Reinforcement - Exterior, Front

Removal and Installation

1. Remove the front door window regulator and motor. For additional information, refer to Section 501-11 .

2. Remove the exterior door handle. For additional information, refer to Exterior Door Handle in this section.

3. Loosen the exterior door handle reinforcement bolt.
   - To install, tighten to 6 Nm (53 lb-in)



4. Slide the exterior front door handle reinforcement to the front of the vehicle and push inside the door.

5. Remove the 3 front door latch bolts.
   - To install, tighten to 8 Nm (71 lb-in).

6. Remove the complete latch, carrier, and handle reinforcement assembly from the door.

7. Open the clip and disconnect the exterior front doondle actuating rod.

8. If required, disconnect the front door lock cylinder actuating rod.

9. Remove the screw and remove the front exterior door handle reinforcement from the carrier.

10. To install, reverse the removal procedure.

Rear Door Latch

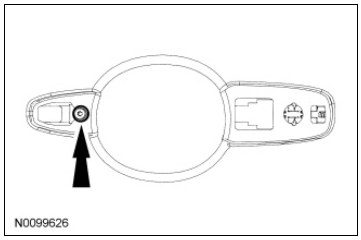
Removal and Installation

1. Remove the rear door window regulator and motor. For additional information, refer to Section 501-11 .

2. Remove the exterior door handle. For additional information, refer to Exterior Door Handle in this section.

3. Position the rear door window glass at the top of the door.

4. Loosen the exterior door handle reinforcement bolt.
    - To install, tighten to 6 Nm (53 lb-in).



5. Slide the exterior rear door handle reinforcement to the front of the vehicle and push inside the door.

6. Remove the 3 rear door latch bolts.
    - To install, tighten to 8 Nm (71 lb-in).

7. Remove the complete latch, carrier, and handle reinforcement assembly from the door.

8. Open the clip and disconnect the exterior rear door handle actuating rod.

9. Remove the 2 screws and remove the rear door latch from the carrier.

10. To install, reverse the removal procedure.

Door Handle Reinforcement - Exterior, Rear

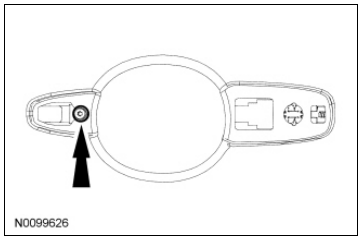
Removal and Installation

1. Remove the rear door window regulator and motor. For additional information, refer to Section 501-11 .

2. Remove the exterior door handle. For additional information, refer to Exterior Door Handle in this section.

3. Position the rear door window glass at the top of the door.

4. Loosen the exterior door handle reinforcement bolt.
   - To install, tighten to 6 Nm (53 lb-in).



5. Slide the exterior rear door handle reinforcement to the front of the vehicle and push inside the door.

6. Remove the 3 rear door latch bolts.
   - To install, tighten to 8 Nm (71 lb-in).

7. Remove the complete latch, carrier, and handle reinforcement assembly from the d

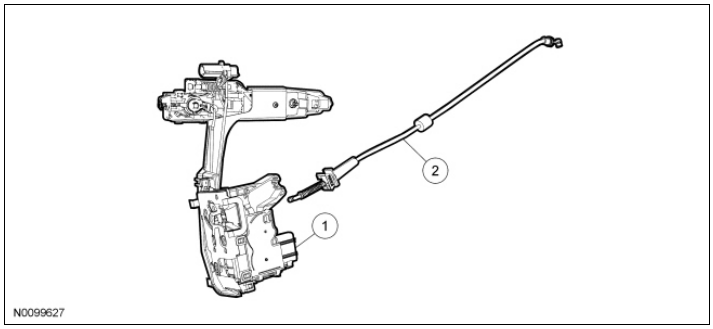
8. Open the clip and disconnect the exterior rear door handle actuating rod.

9. Remove the screw and remove the rear exterior door handle reinforcement from the carrier.

10. To install, reverse the removal procedure.

Door Latch Release Cable

NOTE: LH front shown, other doors similar.



Item	Part Number	Description
1	-	Door latch, carrier, and exterior door handle reinforcement assembly
2	54221A00	Door latch release cable

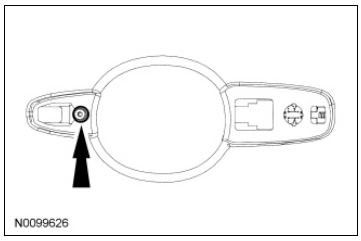
Removal and Installation

1. Remove the door window regulator and motor. For additional information, refer to Section 501-11 .

2. Remove the exterior door handle. For additional information, refer to Exterior Door Handle in this section.

3. On the rear doors, position the door window glass at the top of the door.

4. Loosen the exterior door handle reinforcement bolt.
   - To install, tighten to 6 Nm (53 lb-in).



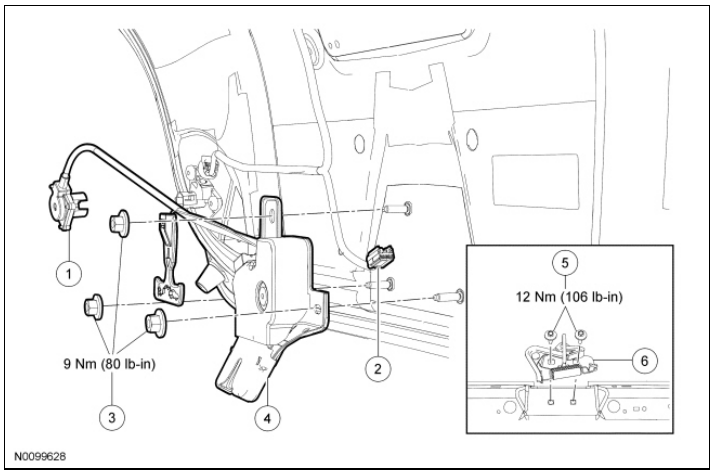
5. Slide the exterior door handle reinforcement to the front of the vehicle and push inside the door.

6. Remove the 3 door latch bolts.
   - To install, tighten to 8 Nm (71 lb-in).

8. Remove the release cable from the latch.
   - Slide the cable housing off the latch.
   - Unhook the cable from the latch lever.

9. To install, reverse the removal procedure.

Luggage Compartment Lid Latch



Item	Part Number	Description
1	-	Luggage compartment lid lock cylinder actuating cable (part of 5443200)
2	-	Luggage compartment lid latch electrical connector (part of 13A412)
3	W705760-S424	Luggage compartment lid latch nuts (3 required)
4	5443200	Luggage compartment lid latch
5	-	Luggage compartment striker bolts (2 required)
6	5443252	Luggage compartment striker

Removal and Installation

1. Remove the 10 pin-type retainers and the luggage compartment lid trim panel.

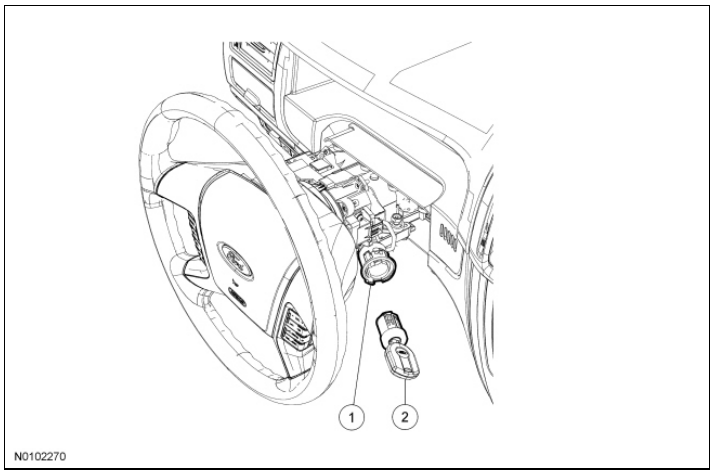
2. Disconnect the luggage compartment lid lock cylinder actuating cable from the luggage compartment lid lock cylinder.

3. Disconnect the electrical connector from the luggage compartment lid latch.

4. Remove the 3 nuts and the luggage compartment lid latch.
   - To install, tighten to 9 Nm (80 lb-in).

5. To install, reverse the removal procedure.

Ignition Lock Cylinder



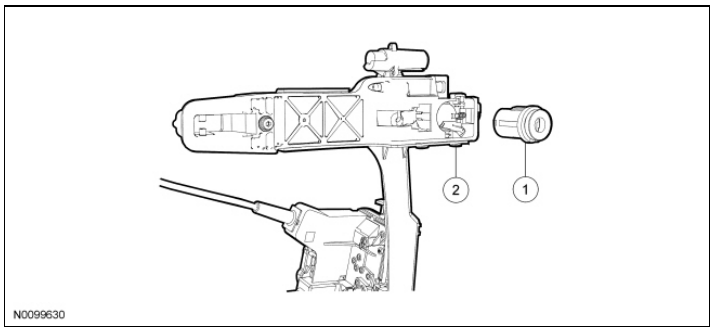
Item	Part Number	Description
1	3511	Steering column lock module
2	11582	Ignition lock cylinder

Removal and Installation

NOTE: For non-functional ignition lock cylinders, the steering column lock module has to be replaced. For additional information, refer to Section 211-05 .

1. Remove the Passive Anti-Theft System (PATS) transceiver. For additional information, refer to Section 419-01B or Section 419-01C .
2. Turn the ignition key to the ACC position.
3. Using a suitable tool, press the ignition lock cylinder release button and remove the ignition lock cylinder.
4. If a new lock cylinder with keys is replaced, the new PATS keys must be programmed. For additional information, refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in Section 419-01B or Section 419-01C .
5. To install, reverse the removal procedure.

Door Lock Cylinder



Item	Part Number	Description
1	5421991	Door lock cylinder
2	5426685	Exterior door handle reinforcement

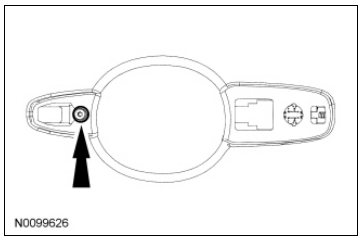
Removal and Installation

NOTE: Individual lock cylinders are repaired by discarding the inoperative cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current key code of the vehicle.

1. Remove the front door window regulator and motor. For additional information, refer to Section 501-11 .

2. Remove the exterior door handle. For additional information, refer to Exterior Door Handle in this section.

3. Loosen the exterior door handle reinforcement bolt.
   - To install, tighten to 6 Nm (53 lb-in).

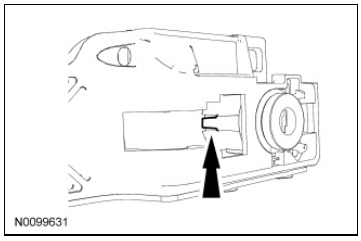


4. Slide the exterior front door handle reinforcement to the front of the vehicle and push inside the door.

5. Remove the 3 front door latch bolts.
   - To install, tighten to 8 Nm (71 lb-in).

6. Remove the complete latch, carrier, and handle reinforcement assembly from the door.

7. Release the tab and remove the door lock cylinder.

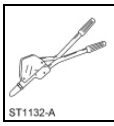


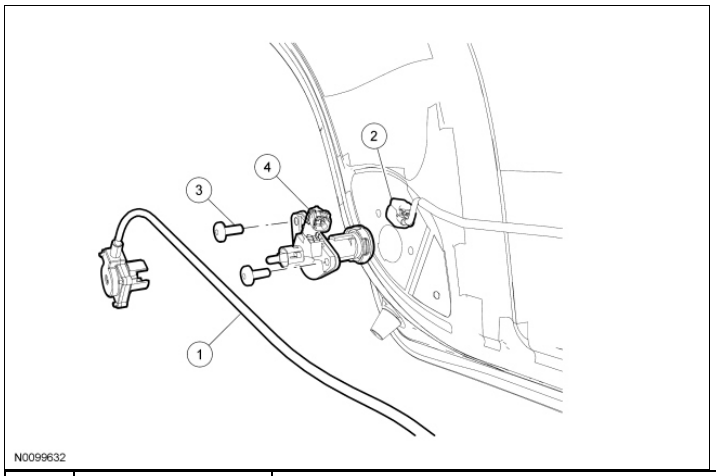
8. **NOTE:** Upon installation, make sure that the d-slot in the lock cylinder lines up with the d-slot in the lock cylinder lever.

   To install, reverse the removal procedure.

Luggage Compartment Lid Lock Cylinder

Special Tool(s)

 ST1132-A	Heavy Duty Riveter 501-D011 (D80L-23200-A) or equivalent



Item	Part Number	Description
1	-	Luggage compartment lid lock cylinder actuating cable (part of 5443200)
2	-	Luggage compartment lid lock cylinder electrical connector (part of 13A412) (if equipped)
3	W525174-S300	Luggage compartment lid lock cylinder rivets (2 required)
4	5443262	Luggage compartment lid lock cylinder

Removal and Installation

1. Remove the 10 pin-type retainers and the luggage compartment lid trim panel.

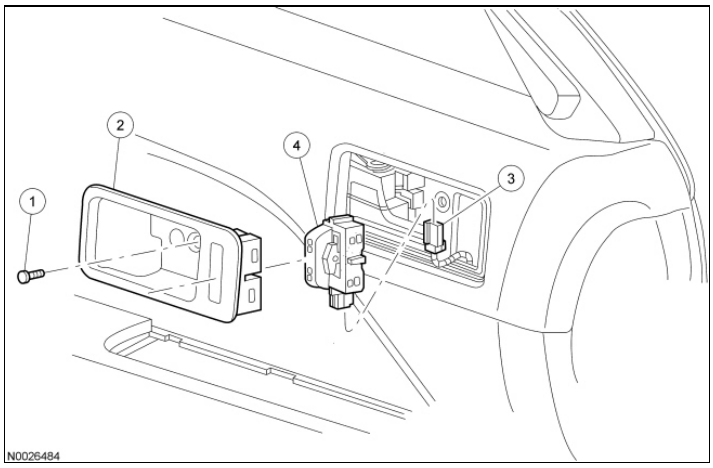
2. Disconnect the luggage compartment lid lock cylinder actuating cable from the luggage compartment lid lock cylinder.

3. If equipped, disconnect the electrical connector from the luggage compartment anti-theft inhibit switch.

4. Remove the 2 rivets and the luggage compartment lid lock cylinder.

5. To install, reverse the removal procedure.
   - Use the special tool to install new rivets.

Door Lock Control Switch



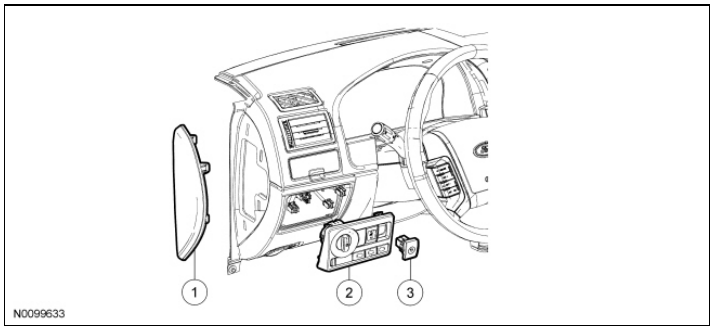
Item	Part Number	Description
1	-	Interior front door handle finish panel screw
2	5422620/ 5422621	Interior front door handle finish panel (RH/LH)
3	-	Door lock control switch electrical connector (part of 14630/14631)
4	14028	Door lock control switch

Removal and Installation

1. Open the cover, remove the screw and position the interior front door handle finish panel aside.
2. Disconnect the door lock control switch electrical connector.
3. Release the locking clips and remove the door lock control switch.
4. To install, reverse the removal procedure.

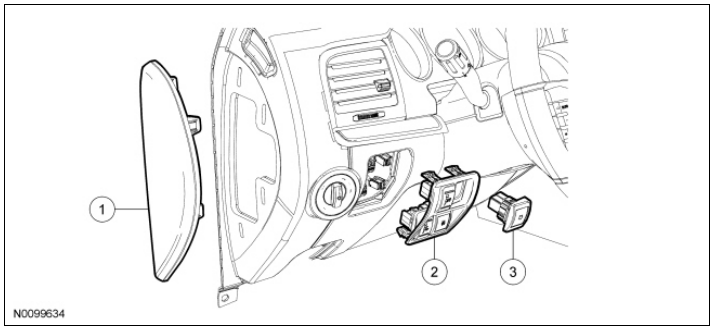
Luggage Compartment Lid Release Switch

Fusion



Item	Part Number	Description
1	5404481	Instrument panel side finish panel
2	5404338	Switch bezel
3	54432A38	Luggage compartment lid release switch

MKZ



Item	Part Number	Description
1	5404481	Instrument panel side finish panel
2	5404338	Switch bezel
3	54432A38	Luggage compartment lid release switch

Removal and Installation

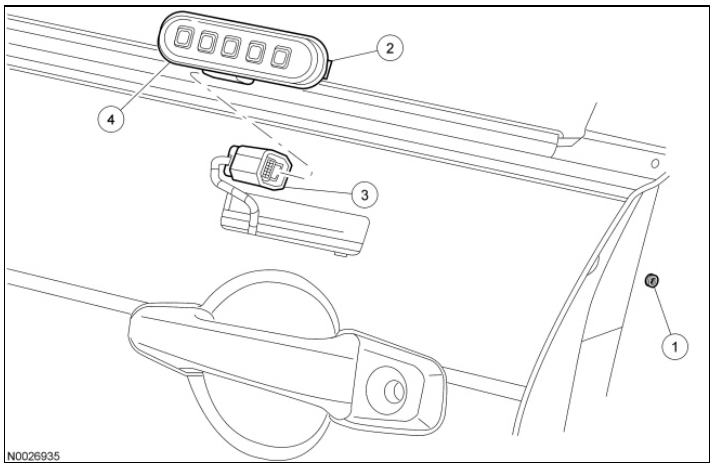
1. Remove the instrument panel side finish panel.
2. **NOTE:** The switch bezel is removed by pushing from behind.

   Remove the switch bezel.

   - Disconnect the electrical connectors.
3. Release the tabs and remove the luggage compartment lid release switch.

4. To install, reverse the removal procedure.

Keyless Entry Keypad



Item	Part Number	Description
1	-	Grommet
2	-	Keyless entry keypad retaining clip (2 required) (part of 14A626)
3	-	Keyless entry keypad electrical connector (part of 14631)
4	14A626	Keyless entry keypad

Removal and Installation

1. Remove the grommet.

2. Using a suitable tool, release the rear keyless entry keypad retaining clip and position the keyless entry keypad aside.

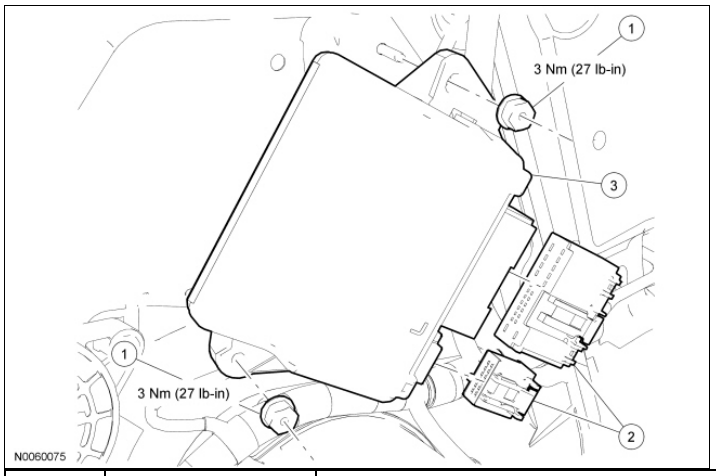
3. Remove the keyless entry keypad.
   - Disconnect the electrical connector.

4. To install, reverse the removal procedure.

Driver Door Module (DDM)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool



Item	Part Number	Description
1	-	Driver Door Module (DDM) nuts (2 required)
2	-	DDM electrical connectors (part of 14631)
3	13C791	DDM

Removal and Installation

NOTICE: **Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.**

NOTE: Prior to the removal of the module, it is necessary to upload the module configuration information to the appropriate scan tool. This information needs to be downloaded into the new module once installed. For additional information, refer to Section 418-01 .

1. **NOTE:** This step is necessary only if the Driver Door Module (DDM) is being replaced.

   Upload the module configuration information from the DDM into the scan tool. For additional information, refer to Section 418-.

2. Remove the driver door trim panel. For additional information, refer to Section 501-05 .

3. Remove the 2 nuts.
   - To install, tighten to 3 Nm (27 lb-in).

4. Disconnect the 2 electrical connectors and remove the DDM .

5. To install, reverse the removal procedure.
    - **NOTE:** If the DDM was not replaced, this substep is not necessary.

      Download the DDM configuration from the scan tool into the new DDM . For additional information, refer to Section 418-01 .

Material

Item	Specification	Fill Capacity
Motorcraft® Premium Quality Windshield Washer Fluid (Canada) CXC-37-(A, B, D, and F) (Canada)	-	-
Motorcraft® Premium Windshield Washer Concentrate (US) ZC-32-A or B (US)	WSB-M8B16-A2	-

Torque Specifications

Description	Nm	lb-in
Windshield washer reservoir bolts	7	62
Windshield washer reservoir nut	7	62
Windshield wiper mounting arm and pivot shaft assembly bolts	5	44
Wiper motor-to-wiper mounting arm bolts	8	71
Wiper pivot arm nuts	20	177

Wipers and Washers

NOTE: The Smart Junction Box (SJB) may also be identified as the Generic Electronic Module (GEM).

The windshield wiper and washer system consists of the following:

- Windshield wiper pivot arm
- Windshield wiper mounting arm and pivot shaft
- Windshield wiper motor
- Windshield washer reservoir
- Windshield washer pump
- Multifunction switch
- Wiper/washer module
- SJB
- Rain sensor (if equipped)
- Rain sensor bracket (if equipped)

Wipers

The wiper system is activated by the multifunction switch. The multifunction switch provides input to the wiper/washer module to activate wash, low, high and intermittent modes.

Washer

The washer system consists of the washer reservoir and washer pump. When the multifunction switch is placed into the wash mode, the wiper/washer module integral electronics activate the washer pump to direct washer fluid to the windshield.

Wiper Activated Headlamps (If Equipped with Autolamp System)

When the headlamp control switch is in the AUTOLAMP position and the wipers are on for greater than 3 seconds, the SJB will activate the headlamps. When the SJB detects that the wipers have been turned off, the SJB will turn off the headlamps after 30 seconds.

Speed Sensitive Wipers

When the wiper control is set on any intermittent setting except INT 1, the speed dependant wipers will automatically adjust with the vehicle speed. This feature decreases the time between wipes when the vehicle speed increases.

Rain Sensitive Wipers (if equipped)

When equipped, the rain sensitive wipers feature replaces the standard intermittent wiper feature. The multifunction switch must be positioned to any of the 5 auto/intermittent settings to activate the rain sensitive wipers. The lowest setting (closest to OFF) is the least sensitive to moisture. The highest setting is the most sensitive to moisture. The windshield wipers cycle when the multifunction switch is placed into or changing between the auto/intermittent settings. When the rain sensitive wiper feature is active, the system adjusts the wiper speed automatically when moisture is detected on the windshield.

A lens/bracket service kit is available to repair/replace a detached bracket or a damaged/contaminated gel-type lens. The rain sensor gel-type lens cannot be reused on a rain sensor of this type. When reinstalling a rain

sensor, a new lens from the lens/bracket service kit must be installed to the rain sensor. Refer to Rain Sensor .

Wipers and Washers

Special Tool(s)

 ST2574-A	Flex Probe Kit 300-NUD105-R025DE or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Windshield Wiper Operation

The multifunction switch supplies ground inputs to the wiper/washer module (located behind the Smart Junction Box (SJB) to determine the wiper speed, including low, high and intermittent. The wiper/washer module also receives feedback from the wiper motor to determine the park position. The wiper/washer module sends power to the wiper motor through the high and low circuits.

Wiper Activated Headlamps (If Equipped with Autolamp System)

The SJB sends a voltage signal to the wiper/washer module in order to monitor the status of the wipers. When the wipers are turned on, the wiper/washer module will pull the voltage down. Once the SJB detects a drop in voltage it will turn on the headlamps after 3 seconds. When the SJB detects the voltage raising, it will determine that the wipers have been turned off and the SJB will turn off the headlamps after 30 seconds.

Rain Sensitive Wipers (if equipped)

The rain sensitive feature replaces the intermittent wiper feature. When the rain sensitive wiper system is active, the rain sensor sends data to the wiper/washer module. The wipers activate based on the amount of moisture detected on the windshield and the setting on the multifunction switch.

The rain sensor optically senses water on the windshield. An infrared beam lights a section of the windshield. The intensity of the reflected beam is measured and compared to the intensity of the transmitted beam. If there is water on the surface of the windshield, the beam distorts, reducing the intensity of the beam. If the beam is not reflected completely, it is interpreted as rain on the windshield and the windshield wipers are activated.

If a fault is detected with the rain sensor input by the wiper/washer module, the wiper/washer module to a default intermittent mode. The timing of the wipers correspond to a standard intermittent setting based on the selection on the multifunction switch.

A gel-type lens is used as the interface between the rain sensor and the windshield. If the lens is missing or damaged, the rain sensing wipers may be inoperative. If the rain sensitive wipers are inoperative and do not default to the intermittent mode, inspect the rain sensor and confirm that the gel-type lens over the rain sensor is undamaged.

Speed Sensitive Wipers

When the wiper control is set on any intermittent setting except INT 1, the speed dependant wipers will automatically adjust with the vehicle speed. Vehicle speed is supplied to the wiper/washer module from the PCM. The wiper/washer module is hardwired to the PCM. This feature decreases the time between wipes when the vehicle speed increases.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Wiper linkage • Washer nozzles • Washer pump hoses • Washer reservoir • Wiper pivot shaft mounting • Wiper blades	• Battery Junction Box (BJB) fuse 9 (20A) • Smart Junction Box (SJB) fuse 45 (5A) • Multifunction switch • Wiper motor • Washer pump • Rain sensor • Wiper/washer module • Loose or corroded connections • Wiring harness

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

4. **NOTE:** The wiper/washer module does not communicate on the network.

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the SJB .

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

8. Clear the CMDTCs and carry out the self-test diagnostics for the SJB .

9. If the DTCs retrieved are related to the concern, go to Smart Junction Box (SJB) DTC Chart. For all other DTCs, refer to Section 419-10 .

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

DTC Chart

Smart Junction Box (SJB) DTC Chart

DTC	Description	Action
B2008	Wipers On Signal Circuit Short to Ground	GO to Pinpoint Test G .
All other DTCs	-	REFER to the Master DTC Chart in Section 419-10 .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The Wipers are Inoperative

Refer to Wiring Diagrams Cell 81 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Wipers and Washers for schematic and connector information.

Normal Operation

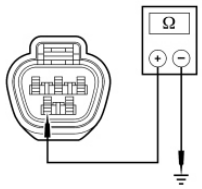
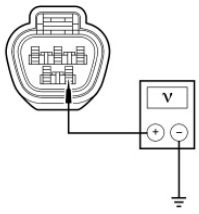
The wiper/washer module is hot at all times through circuit SBB09 (RD). When the ignition switch is in the RUN or ACCESSORY position, voltage is supplied to the wiper/washer module through circuit CBP45 (YE). The wiper/washer module and wiper motor are grounded through circuit GD121 (BK/YE). The multifunction switch is grounded through circuit GD116 (BK/VT). The multifunction switch sends open and ground input signals to the wiper/washer module through circuits CRW17 (GN/VT), CRW18 (VT/WH), CRW19 (BU/OG) and CRW08 (VT/OG) in order to activate the wiper motor to the requested modes. The wiper/washer module supplies voltage to the wiper motor through circuits CRW16 [(GY/BN) low] and CRW15 [(BN/WH) high].

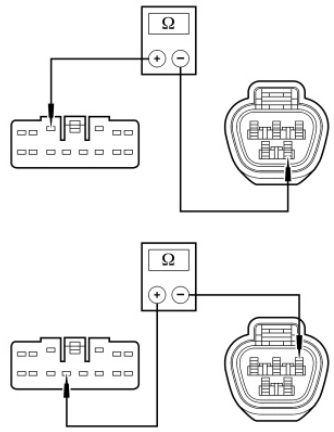
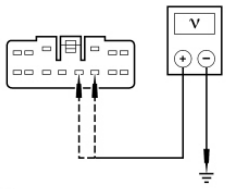
This pinpoint test is intended to diagnose the following:

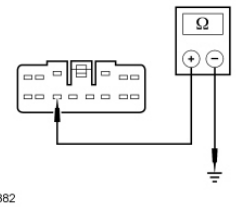
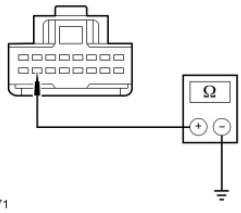
- Fuse(s)
- Wiring, terminals or connectors
- Multifunction switch
- Wiper motor
- Wiper/washer module

PINPOINT TEST A: THE WIPERS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK WIPER MOTOR GROUND	
• Ignition OFF. • Disconnect: Wiper Motor C125. • Measure the resistance between front wiper motor C125-4, circuit GD121 (BK/YE), harness side and ground.  N0097813 • **Is the resistance less than 5 ohms?**	**Yes** GO to A2 . **No** REPAIR the circuit. TEST the system for normal operation.
A2 CHECK WIPER MOTOR FOR VOLTAGE	
• Ignition ON. • With the multifunction switch in the low position, measure the voltage between wiper motor C125-5, circuit CRW16 (GY/BN), harness side and ground.  N0042116 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new wiper motor. REFER to Wiper Motor in this section. TEST the system for normal operation. **No** GO to A3 .
A3 CHECK WIPER MOTOR HIGH/LOW CIRCUITS FOR AN OPEN	

• Ignition OFF. • Disconnect: Wiper/Washer Module C2157. • Measure the resistance between wiper/washer module C2157-4, circuit CRW16 (GY/BN), harness side and wiper motor C125-5, circuit CRW16 (GY/BN), harness side; and between wiper/washer module C2157-11, circuit CRW15 (BN/WH), harness side and wiper motor C125-3, circuit CRW15 (BN/WH), harness side.  N0102828 • **Are the resistances less than 5 ohms?**	**Yes** GO to A4 . **No** REPAIR the circuit(s). TEST the system for normal operation
A4 CHECK WIPER/WASHER MODULE FOR VOLTAGE	
• Ignition ON. • Measure the voltage between wiper/washer module C2157-9, circuit SBB09 (RD), harness side and ground; and between wiper/washer module C2157-10, circuit CBP45 (YE), harness side and ground.  N0097811 • **Is the voltage greater than 10 volts?**	**Yes** GO to A5 . **No** VERIFY Battery Junction Box (BJB) fuse 9 (20A) and Smart Junction Box (SJB) fuse 45 (5A) are OK. If OK, REPAIR the circuit. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. REPAIR the circuit. TEST the system for normal operation.
A5 CHECK WIPER/WASHER MODULE FOR GROUND	
• Ignition OFF. • Measure the resistance between wiper/washer module C2157-12, circuit GD121 (BK/YE), harness side and ground.	**Yes** GO to A6 . **No** REPAIR the circuit. TEST the system for normal operation.

 N0097882 • **Is the resistance less than 5 ohms?**	
A6 CHECK THE MULTIFUNCTION SWITCH	
• Disconnect: Multifunction Switch C202. • Carry out the Multifunction Switch Component Test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the multifunction switch pass the component test?**	**Yes** GO to A7 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 .
A7 CHECK MULTIFUNCTION SWITCH FOR GROUND	
• Measure the resistance between multifunction switch C202-15, circuit GD116 (BK/VT), harness side and ground.  N0037071 • **Is the resistance less than 5 ohms?**	**Yes** GO to A8 . **No** REPAIR the circuit. TEST the system for normal operation.
A8 CHECK THE WIPER/WASHER MODULE FOR PROPER OPERATION	
• Check for: ♦ corrosion. ♦ pushed-out pins. • Connect the wiper/washer module connector and make sure it is seated correctly, and reconnect the related wiper components. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new wiper/washer module. REFER to Wiper/Washer Module in this section. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test B: The Wipers Stay On Continuously

Refer to Wiring Diagrams Cell 81 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Wipers and Washers for schematic and connector information.

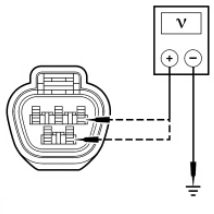
Normal Operation

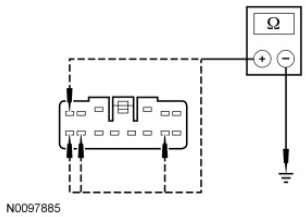
Under normal operation, the wiper motor receives open and ground inputs from the multifunction switch through circuits CRW08 (VT/OG), CRW17 (GN/VT), CRW18 (VT/WH) and CRW19 (BU/OG) to activate the wipers to the appropriate speeds. The wiper/washer module supplies voltage to the wiper motor through circuits CRW16 ([GY/BN] low) and CRW15 ([BN/WH] high).

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Multifunction switch
- Wiper/washer module

PINPOINT TEST B: THE WIPERS STAY ON CONTINUOUSLY

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK WIPER MOTOR FOR SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Wiper Motor C125. • Disconnect: Wiper/Washer Module C2157. • Ignition ON. • With the wipers in the OFF position, measure the voltage between wiper motor C125-3, circuit CRW15 (BN/WH), harness side and ground; and between wiper motor C125-5, circuit CRW16 (GY/BN), harness side and ground.  N0097812 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit(s) for a short to voltage. TEST the system for normal operation. **No** GO to B2 .
B2 CHECK THE MULTIFUNCTION SWITCH	
• Disconnect: Multifunction Switch C202. • Carry out the Multifunction Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the multifunction switch pass the component test?**	**Yes** GO to B3 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 .
B3 CHECK FOR A SHORT TO GROUND IN THE MULTIFUNCTION SWITCH HARNESS	

• Measure the resistance between ground and wiper/washer module: ♦ C2157-8, circuit CRW08 (VT/OG), harness side. ♦ C2157-13, circuit CRW17 (GN/VT), harness side. ♦ C2157-14, circuit CRW19 (BU/OG), harness side. ♦ C2157-6, circuit CRW18 (VT/WH), harness side.  N0097885 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B4 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
B4 CHECK FOR CORRECT WIPER/WASHER MODULE OPERATION	
• Disconnect all wiper/washer module connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all wiper/washer module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new wiper/washer module. REFER to Wiper/Washer Module in this section. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test C: The High/Low Wiper Speeds Do Not Operate Correctly

Refer to Wiring Diagrams Cell 81 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Wipers and Washers for schematic and connector information.

Normal Operation

Under normal operation, the wiper/washer module receives open and ground inputs from the multifunction switch through circuits CRW08 (VT/OG), CRW17 (GN/VT), CRW18 (VT/WH) and CRW19 (BU/OG) to activate the wiper motor in the high and low speeds. The wiper/washer module supplies voltage to the wiper motor through circuits CRW16 ([GY/BN] low) and CRW15 ([BN/WH] high).

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Wiper motor
- Multifunction switch
- Wiper/washer module

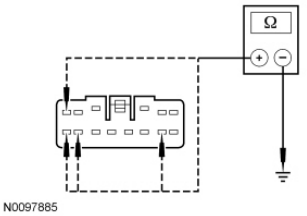
PINPOINT TEST C: THE HIGH/LOW WIPER SPEEDS DO NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>C1 CHECK THE MULTIFUNCTION SWITCH</td><td></td></tr>
<tr><td>• Ignition OFF.
• Disconnect: Multifunction Switch C202.
• Carry out the Multifunction Switch component test.

Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing.
• Did the multifunction switch pass the component test?</td><td>Yes
GO to C2 .

No
INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.</td></tr>
<tr><td>C2 CHECK FOR A SHORT TO GROUND IN THE MULTIFUNCTION SWITCH HARNESS</td><td></td></tr>
<tr><td>• Disconnect: Wiper/Washer Module C2157.
• Measure the resistance between ground and wiper/washer module:
♦ C2157-8, circuit CRW08 (VT/OG), harness side.
♦ C2157-13, circuit CRW17 (GN/VT), harness side.
♦ C2157-14, circuit CRW19 (BU/OG), harness side.
♦ C2157-6, circuit CRW18 (VT/WH), harness side.

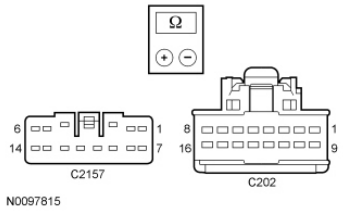
 
N0097885
• Is the resistance greater than 10,000 ohms?</td><td>Yes
GO to C3 .

No
REPAIR the circuit(s) in question. TEST the system for normal operation.</td></tr>
<tr><td>C3 CHECK FOR AN OPEN IN THE MULTIFUNCTION SWITCH HARNESS</td><td></td></tr>
<tr><td>• Measure the resistance between multifunction switch C202, harness side and wiper/washer module C2157, harness side using the following chart:

<table><tr><th>Multifunction Switch</th><th>Circuit</th><th>Wiper/Washer Module</th></tr><tr><td>C202-16</td><td>CRW19 (BU/OG)</td><td>C2157-14</td></tr><tr><td>C202-9</td><td>CRW08 (VT/OG)</td><td>C2157-8</td></tr><tr><td>C202-12</td><td>CRW17</td><td>C2157-13</td></tr></table></td><td>Yes
GO to C4 .

No
REPAIR the circuit(s) in question. TEST the system for normal operation.</td></tr>
</table>

	(GN/VT)	
C202-11	CRW18 (VT/WH)	C2157-6



- **Is the resistance less than 5 ohms?**

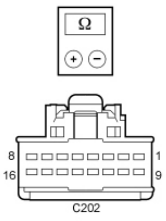
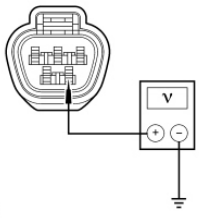
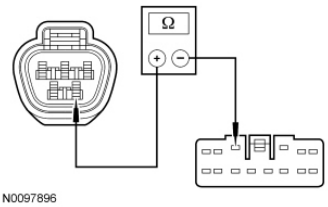
C4 CHECK FOR A SHORT IN THE WIPER/WASHER MODULE HARNESS

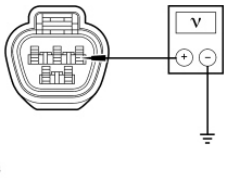
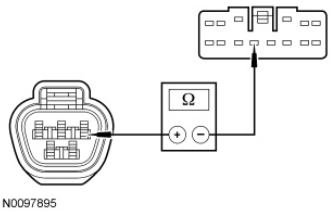
- Measure the resistance between multifunction switch C202, harness side, using the following chart:

Multifunction Switch	Circuitry	Multifunction Switch
C202-16	CRW19 (BU/OG)/ CRW18 (VT/WH)	C202-11
C202-16	CRW19 (BU/OG)/ CRW08 (VT/OG)	C202-9
C202-16	CRW19 (BU/OG)/ CRW17 (GN/VT)	C202-12
C202-11	CRW18 (VT/WH)/ CRW08 (VT/OG)	C202-9
C202-11	CRW18 (VT/WH)/ CRW17 (GN/VT)	C202-12
C202-9	CRW08 (VT/OG)/ CRW17 (GN/VT)	C202-12

Yes
GO to C5 .

No
REPAIR the circuit(s). TEST the system for normal operation.

 • **Is the resistance greater than 10,000 ohms for all measurements?**	
C5 CHECK WIPER MOTOR LOW SPEED FOR VOLTAGE	
• Connect: Wiper/Washer Module C2157. • Connect: Multifunction Switch C202. • Ignition ON. • With the multifunction switch in the low position, measure the voltage between wiper motor C125-5, circuit CRW16 (GY/BN), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to C7 . **No** GO to C6 .
C6 CHECK WIPER MOTOR LOW SPEED FOR AN OPEN	
• Ignition OFF. • Measure the resistance between wiper motor C125-5, circuit CRW16 (GY/BN), harness side and wiper/washer module C2157-4, circuit CRW16 (GY/BN), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to C9 . **No** REPAIR the circuit. TEST the system for normal operation.
C7 CHECK WIPER MOTOR HIGH SPEED FOR VOLTAGE	
• With the multifunction switch in the high position, measure the voltage between wiper motor C125-3, circuit CRW15 (BN/WH), harness side and ground.	**Yes** INSTALL a new wiper motor. REFER to Wiper Motor in this section. TEST the system for normal operation. **No**

 N0042123 • **Is the voltage greater than 10 volts?**	GO to C8 .
C8 CHECK WIPER MOTOR HIGH SPEED FOR AN OPEN	
• Ignition OFF. • Measure the resistance between wiper motor C125-3, circuit CRW15 (BN/WH), harness side and wiper/washer module C2157-11, circuit CRW15 (BN/WH), harness side.  N0097895 • **Is the resistance less than 5 ohms?**	**Yes** GO to C9 . **No** REPAIR the circuit. TEST the system for normal operation.
C9 CHECK FOR CORRECT WIPER/WASHER MODULE OPERATION	
• Disconnect all wiper/washer module connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all wiper/washer module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new wiper/washer module. REFER to Wiper/Washer Module in this section. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test D: The Intermittent Wiper Speed Does Not Operate Correctly (High/Low Speeds OK)

Refer to Wiring Diagrams Cell 81 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Wipers and Washers for schematic and connector information.

Normal Operation

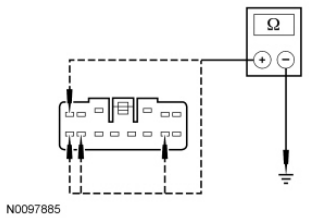
Under normal operation, the wiper/washer module receives open and ground inputs from the multifunction switch through circuits CRW08 (VT/OG), CRW17 (GN/VT), CRW18 (VT/WH) and CRW19 (BU/OG) to activate the wiper motor in the high, low and intermittent speeds.

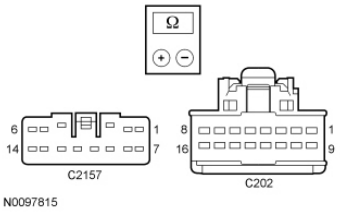
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Multifunction switch
- Wiper/washer module

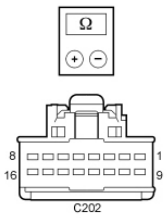
PINPOINT TEST D: THE INTERMITTENT WIPER SPEED DOES NOT OPERATE CORRECTLY (HIGH/LOW SPEEDS OK)

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 VERIFY IF THE VEHICLE IS EQUIPPED WITH RAIN SENSITIVE WIPERS	
NOTE: If sent here from Pinpoint Test E, GO to D2. • Inspect the vehicle for rain sensitive wipers. • **Is the vehicle equipped with rain sensitive wipers?**	**Yes** GO to Pinpoint Test E . **No** GO to D2 .
D2 CHECK THE MULTIFUNCTION SWITCH	
• Ignition OFF. • Disconnect: Multifunction Switch C202. • Carry out the Multifunction Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the multifunction switch pass the component test?**	**Yes** GO to D3 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.
D3 CHECK FOR A SHORT TO GROUND IN THE MULTIFUNCTION SWITCH HARNESS	
• Disconnect: Wiper/Washer Module C2157. • Measure the resistance between ground and wiper/washer module: ♦ C2157-8, circuit CRW08 (VT/OG), harness side. ♦ C2157-13, circuit CRW17 (GN/VT), harness side. ♦ C2157-14, circuit CRW19 (BU/OG), harness side. ♦ C2157-6, circuit CRW18 (VT/WH), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D4 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

D4 CHECK FOR AN OPEN IN THE MULTIFUNCTION SWITCH HARNESS	
• Measure the resistance between multifunction switch C202, harness side and wiper/washer module C2157, harness side using the following chart: **Multifunction Switch / Circuit / Wiper/Washer Module** C202-16 / CRW19 (BU/OG) / C2157-14 C202-9 / CRW08 (VT/OG) / C2157-8 C202-12 / CRW17 (GN/VT) / C2157-13 C202-11 / CRW18 (VT/WH) / C2157-6  N0097815 • **Is the resistance less than 5 ohms?**	**Yes** GO to D5 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
D5 CHECK FOR A SHORT IN THE WIPER/WASHER MODULE HARNESS	
• Measure the resistance between multifunction switch C202, harness side, using the following chart: **Multifunction Switch / Circuitry / Multifunction Switch** C202-16 / CRW19 (BU/OG)/ CRW18 (VT/WH) / C202-11 C202-16 / CRW19 (BU/OG)/ CRW08 (VT/OG) / C202-9	**Yes** GO to D6 . **No** REPAIR the circuit(s). TEST the system for normal operation.

C202-16	CRW19 (BU/OG)/ CRW17 (GN/VT)	C202-12
C202-11	CRW18 (VT/WH)/ CRW08 (VT/OG)	C202-9
C202-11	CRW18 (VT/WH)/ CRW17 (GN/VT)	C202-12
C202-9	CRW08 (VT/OG)/ CRW17 (GN/VT)	C202-12



- **Is the resistance greater than 10,000 ohms for all measurements?**

D6 CHECK FOR CORRECT WIPER/WASHER MODULE OPERATION	
• Disconnect all wiper/washer module connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all wiper/washer module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new wiper/washer module. REFER to Wiper/Washer Module in this section. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test E: The Rain Sensitive Wipers Are Inoperative

Refer to Wiring Diagrams Cell 81 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Wipers and Washers for schematic and connector information.

Normal Operation

Voltage is supplied to the rain sensor when the ignition is ON. The rain sensor sends data to the wiper/washer module on a dedicated circuit. When the multifunction switch is in one of the 5 auto/intermittent settings, the rain sensitive wipers activate.

The rain sensor optically senses water on the windshield. An infrared beam lights a section of the windshield. The intensity of the reflected beam is measured and compared to the intensity of the transmitted beam. When there is water on the surface of the windshield, the beam distorts, reducing the intensity of the beam. When the beam is not reflected completely, it is interpreted as rain on the windshield and the windshield wipers activate based on the sensitivity setting.

If a fault is detected with the rain sensor input by the wiper/washer module, the wiper/washer module switches to a default intermittent mode. The timing of the wipers correspond to a standard intermittent setting based on the selection on the multifunction switch.

A gel-type lens is used as the interface between the rain sensor and the windshield. If the lens is missing or damaged, the rain sensing wipers may be inoperative. If the rain sensitive wipers are inoperative and do not default to the intermittent mode, inspect the rain sensor and confirm that the gel-type lens over the rain sensor is undamaged.

This pinpoint test is intended to diagnose the following:

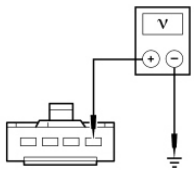
- Fuse
- Wiring, terminals or connectors
- Wiper blades
- Rain sensor mounting bracket not secured to the windshield
- Rain sensor gel-type lens
- Rain sensor
- Foreign material on windshield, such as dirt, dust or bugs
- Damaged windshield
- Wiper motor
- Wiper/washer module
- SJB

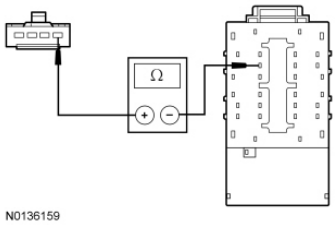
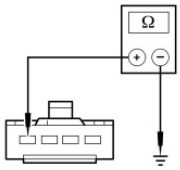
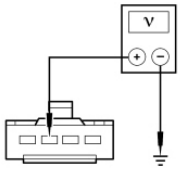
PINPOINT TEST E: THE RAIN SENSITIVE WIPERS ARE INOPERATIVE

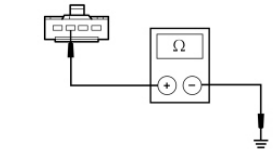
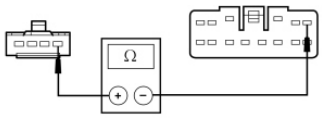
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 CHECK THE INPUT FROM THE MULTIFUNCTION SWITCH	
• Ignition ON. • Cycle the multifunction switch from off through each of the auto/intermittent settings, waiting 10 seconds between cycling the switch to the next setting. • Set the multifunction switch to the wipers off setting. • **Do the wipers cycle when the switch is changed to each setting?**	**Yes** GO to E2 . **No** GO to Pinpoint Test D .
E2 CHECK THE RAIN SENSITIVE WIPERS FOR DEFAULT INTERMITTENT MODE	

• **NOTE:** Make sure the windshield is dry when carrying out this step. • **NOTE:** The windshield wipers activate when the multifunction switch is cycled through the auto/intermittent settings. The initial wiper activation after changing the setting should not be considered part of an intermittent wiper operation. • Cycle the multifunction switch to auto/intermittent setting 5, the most sensitive to moisture. • **Do the wipers default to a standard intermittent setting?**	**Yes** GO to E9 . **No** GO to E3 .
E3 CHECK THE WINDSHIELD FOR DAMAGE	
• Ignition OFF. • Inspect the windshield glass for any cracks, pits or other visible damage around the area of the rain sensor. • **Is any windshield damage present near the area of the rain sensor?**	**Yes** INSTALL a new windshield. REFER to Section 501-11 . TEST the system for normal operation. **No** GO to E4 .
E4 CHECK THE WINDSHIELD GLASS FOR STREAKING	
• Ignition ON. • Turn the multifunction switch to the low speed wiper setting and while applying water to the windshield surface. Observe the wipe quality, especially around the area or the rain sensor. • **Is any streaking present on the windshield around the area of the rain sensor?**	**Yes** GO to E5 . **No** GO to E7 .
E5 CHECK THE WINDSHIELD WIPER BLADES FOR STREAKING	
• Ignition OFF. • Clean the windshield glass with glass cleaner. • Clean the wiper blades with isopropyl alcohol swabs. Wipe the entire length of the wiper blades. • Ignition ON. • Turn the multifunction switch to the low speed wiper setting and while applying water to the windshield surface. Observe the wipe quality, especially around the area or the rain sensor. • **Was there noticeable improvement in the wipe quality after cleaning the glass and the wiper blades?**	**Yes** GO to E6 . **No** INSTALL new wiper blades. GO to E6 .
E6 RECHECK THE RAIN SENSITIVE WIPERS OPERATION	
• Turn the multifunction switch to the auto/intermittent 5 setting (most sensitive to moisture) while applying water on the windshield above the rain sensor. • **Do the wipers operate when water is applied to the windshield surface?**	**Yes** The system is operating correctly at this time. The concern may have been caused by poor wipe quality on the windshield around the rain sensor.

	No GO to E7 .
E7 CHECK FOR THE PRESENCE OF THE LENS GEL	
• Ignition OFF. • Lightly press the rain sensor against the windshield and release the rain sensor clips. • **Does the rain sensor remain adhered to the windshield?**	**Yes** ATTACH the retaining clips. GO to E8 . **No** The sensor lens is missing or damaged. INSTALL a new gel-type lens using the rain sensor bracket service kit. TEST the system for normal operation.
E8 INSPECT THE RAIN SENSOR MOUNTING AREA	
NOTE: The rain sensor gel-type lens can be damaged or contaminated during rain sensor removal, rain sensor bracket separation or incorrect installation. • From the outside of the vehicle, inspect the area of the windshield glass where the rain sensor is mounted. The rain sensor contact area should appear black, with no bubbles, air pockets or contaminants between the windshield glass and the rain sensor. • **Does the rain sensor contact area appear black, with no bubbles, air pockets or contaminants between the windshield glass and the rain sensor?**	**Yes** GO to E9 . **No** REMOVE the gel-type lens. INSTALL a new gel-type lens using the rain sensor bracket service kit. TEST the system for normal operation. If the concern is still present, GO to E9 .
E9 CHECK FOR VOLTAGE TO THE RAIN SENSOR	
• Ignition OFF. • Disconnect: Rain Sensor C914. • Ignition ON. • Measure the voltage between the rain sensor C914-4, circuit CBP43 (GY), harness side and ground.  N0092556 • **Is the voltage greater than 10 volts?**	**Yes** GO to E11 . **No** VERIFY SJB fuse 43 (10A) is OK. If OK, GO to E10 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
E10 CHECK THE RAIN SENSOR VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: SJB C2280D. • Measure the resistance between the rain sensor C914-4, circuit CBP43 (GY), harness side and the SJB C2280D-22, circuit CBP43 (GY), harness side.	**Yes** GO to E16 . **No** REPAIR the circuit. TEST the system for normal operation.

 N0136159 • **Is the resistance less than 5 ohms?**	
E11 CHECK THE RAIN SENSOR GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between the rain sensor C914-1, circuit GD139 (BK/YE), harness side and ground.  N0092557 • **Is the resistance less than 5 ohms?**	**Yes** GO to E12 . **No** REPAIR the circuit. TEST the system for normal operation.
E12 CHECK THE RAIN SENSOR SIGNAL CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Wiper/Washer Module C2157. • Ignition ON. • Measure the voltage between the rain sensor C914-2, circuit VMC05 (VT/OG), harness side and ground.  N0092558 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to E13 .
E13 CHECK THE RAIN SENSOR SIGNAL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the rain sensor C914-2, circuit VMC05 (VT/OG), harness side and ground.	**Yes** GO to E14 . **No** REPAIR the circuit. TEST the system for normal operation.

 N0136160 • **Is the resistance greater than 10,000 ohms?**	
E14 CHECK THE RAIN SENSOR SIGNAL CIRCUIT FOR AN OPEN	
• Measure the resistance between the rain sensor C914-2, circuit VMC05 (VT/OG), harness side and the wiper/washer module C2157-1, circuit VMC05 (VT/OG), harness side.  N0138459 • **Is the resistance less than 5 ohms?**	**Yes** GO to E15 . **No** REPAIR the circuit. TEST the system for normal operation.
E15 CHECK FOR CORRECT RAIN SENSOR OPERATION	
• Check for: ♦ corrosion. ♦ pushed-out pins. • Connect the rain sensor connector and make it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new rain sensor. REFER to Rain Sensor . TEST the system for normal operation. If the concern is still present, GO to E17 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
E16 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
E17 CHECK FOR CORRECT WIPER/WASHER MODULE OPERATION	

• Check for: ♦ corrosion. ♦ pushed-out pins. • Connect the wiper/washer module connector and make it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new wiper/washer module. REFER to Wiper/Washer Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test F: The Washer Pump is Inoperative

Refer to Wiring Diagrams Cell 81 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Wipers and Washers for schematic and connector information.

Normal Operation

The multifunction switch provides a ground signal to the wiper/washer module through circuit CRW07 (GY/BN) when the wash function is selected on the multifunction switch. When the wiper/washer module detects this input, the wiper/washer module activates an internal washer relay that provides voltage to the washer pump through circuit CRW14 (BU/WH). The washer pump is grounded through circuit GD123 (BK/GY).

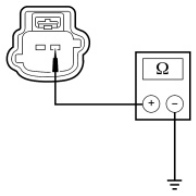
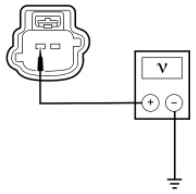
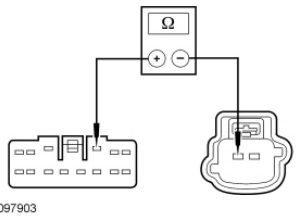
This pinpoint test is intended to diagnose the following:

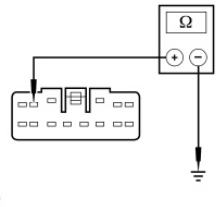
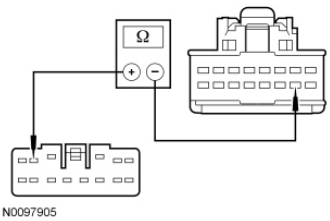
- Wiring, terminals or connectors
- Blocked washer hose/washer jet
- Multifunction switch
- Washer pump motor
- Wiper/washer module

PINPOINT TEST F: THE WASHER PUMP IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 CHECK WASHER PUMP MOTOR FOR GROUND	
• Disconnect: Washer Pump Motor C137. • Ignition OFF. • Measure the resistance between washer pump motor C137-2, circuit GD123 (BK/GY) harness side and ground.	**Yes** GO to F2 . **No** REPAIR the circuit. TEST the system for normal operation.

 N0042127 • **Is the resistance less than 5 ohms?**	
F2 CHECK WASHER PUMP MOTOR FOR VOLTAGE	
• Ignition ON. • Measure the voltage between washer pump motor C137-1, circuit CRW14 (BU/WH), harness side and ground while depressing the multifunction switch to the WASH position.  N0042128 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new washer pump. REFER to Washer Pump in this section. **No** GO to F3 .
F3 CHECK WASHER PUMP MOTOR VOLTAGE CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Wiper/Washer Module C2157. • Measure the resistance between wiper/washer module C2157-3, circuit CRW14 (BU/WH), harness side and washer pump motor C137-1, circuit CRW14 (BU/WH), harness side.  N0097903 • **Is the resistance less than 5 ohms?**	**Yes** GO to F4 . **No** REPAIR the circuit. TEST the system for normal operation.
F4 CHECK MULTIFUNCTION SWITCH WASHER OUTPUT CIRCUIT	
• Measure the resistance between wiper/washer module C2157-5, circuit CRW07 (GY/BN) harness side and ground while depressing the multifunction switch to the WASH position.	**Yes** GO to F6 . **No** GO to F5 .

 N0097904 • **Is the resistance less than 5 ohms?**	
F5 CHECK MULTIFUNCTION SWITCH OUTPUT CIRCUIT FOR AN OPEN	
• Disconnect: Multifunction Switch C202. • Measure the resistance between wiper/washer module C2157-5, circuit CRW07 (GY/BN), harness side and multifunction switch C202-10, circuit CRW07 (GY/BN), harness side.  N0097905 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
F6 CHECK FOR CORRECT WIPER/WASHER MODULE OPERATION	
• Disconnect all wiper/washer module connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all wiper/washer module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new wiper/washer module. REFER to Wiper/Washer Module in this section. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test G: The Headlamps Do Not Illuminate When the Wipers are On

Refer to Wiring Diagrams Cell 81 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Front Wipers and Washers for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends a 12 volt reference signal on circuit CRW01 (WH) to the wiper motor module in order to monitor the status of the wipers. When the headlamp control switch is in the AUTOLAMP position and the wipers are on, the wiper motor module will pull the voltage reference signal low. After 3

seconds, the SJB will activate the headlamps.

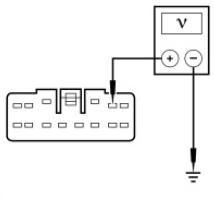
- DTC B2008 (Wipers On Signal Circuit Short to Ground) - Sets when a short to ground is detected on the wiper motor status input circuit.

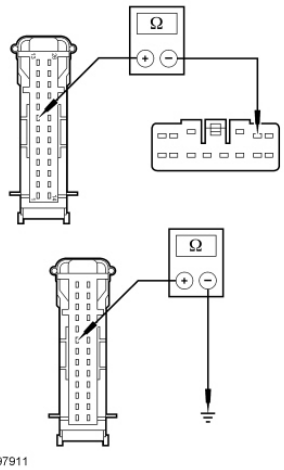
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Wiper/washerodule
- SJB

PINPOINT TEST G: THE HEADLAMPS DO NOT ILLUMINATE WHEN THE WIPERS ARE ON

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
G1 CHECK WIPER ON SIGNAL FOR VOLTAGE	
• Disconnect: Wiper/Washer Module C2157. • Ignition ON. • Measure the voltage between wiper/washer module C2157-2, circuit CRW01 (WH), harness side and ground.  N0097910 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new wiper/washer module. REFER to Wiper/Washer Module in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to G2 .
G2 CHECK WIPER ON SIGNAL FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280F. • Measure the resistance between SJB C2280F-8, circuit CRW01 (WH), harness side and wiper/washer module C2157-2, circuit CRW01 (WH); and between SJB C2280F-8, circuit CRW01 (WH), harness side and ground.	**Yes** GO to G3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 • **Is the resistance less than 5 ohms between the SJB and wiper/washer module and greater than 10,000 ohms between the SJB and ground?**	
G3 CHECK FOR CORRECT MODULE OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all the SJB connectors and make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test H: The Speed Dependent Interval Mode Does Not Operate Correctly

Refer to Wiring Diagrams Cell 81 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Front Wipers and Washers for schematic and connector information.

Normal Operation

Under normal operation, the windshield wiper/washer module receives vehicle speed information from the PCM through circuit VMC05 (VT/OG). The windshield wiper/washer module then determines the speed of the windshield wiper motor. The speed dependant wipers function in all INT modes except INT 1.

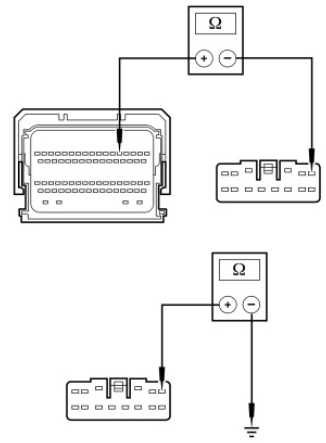
This pinpoint test is intended to diagnose the following:

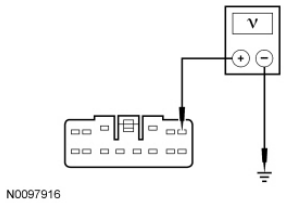
- Wiring, terminals or connectors
- Wiper/washer module

PINPOINT TEST H: THE SPEED DEPENDENT INTERVAL MODE DOES NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take

H1 CHECK PCM FOR DTCs	
• Review the DTCs from the PCM self-test. • **Are any Vehicle Speed Sensor (VSS) related DTCs present?**	**Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnose the VSS . **No** GO to H2 .
H2 CHECK THE VEHICLE SPEED CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Disconnect: Wiper/Washer Module C2157. • Disconnect: PCM C175B. • Measure the resistance between wiper/washer module C2157-1, circuit VMC05 (VT/OG), harness side and PCM C175B-5, circuit VMC05 (VT/OG), harness side; and between wiper/washer module C2157-1, circuit VMC05 (VT/OG), harness side and ground.  N0097915 • **Is the resistance less than 5 ohms between wiper/washer module and PCM; and greater than 10,000 ohms between wiper/washer module and ground?**	**Yes** GO to H3 . **No** REPAIR the circuit. TEST the system for normal operation.
H3 CHECK THE VEHICLE SPEED CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between wiper/washer module C2157-1, circuit VMC05 (VT/OG), harness side and ground.	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to H4 .

 N0097916 • **Is any voltage present?**	
H4 CHECK FOR CORRECT WIPER/WASHER MODULE OPERATION	
• Disconnect all wiper/washer module connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all wiper/washer module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new wiper/washer module. REFER to Wiper/Washer Module in this section. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test I: The Wipers Will Not Park at the Correct Position

Refer to Wiring Diagrams Cell 81 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Front Wipers and Washers for schematic and connector information.

Normal Operation

Under normal operation, the wiper motor sends a ground signal through circuit CRW09 (BN/BU) to the wiper/washer module when the wipers are in the park position. If there is a open or short in circuit CRW09 (BN/BU) the wipers will not park and will stop in the position the wipers are currently in when the wipers are turned off.

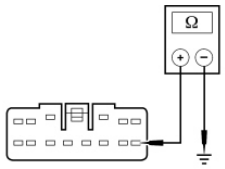
This pinpoint test is intended to diagnose the following:

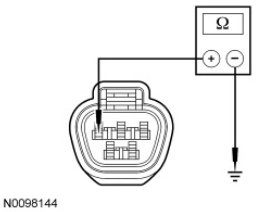
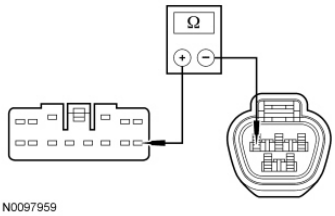
- Damaged wiper mounting arm and pivot shaft
- Pivot arm adjustment
- Wiring, terminals or connectors
- Wiper motor
- Wiper/washer module

PINPOINT TEST I: THE WIPERS WILL NOT PARK AT THE CORRECT POSITION

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
I1 CHECK FOR WIPER MOUNTING ARM AND PIVOT SHAFT DAMAGE	

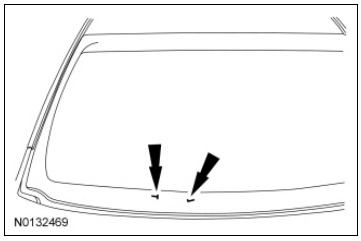
• Check the wiper mounting arm and pivot shaft for damage. • **Is there damage to wiper mounting arm or pivot shaft?**	**Yes** If there is damage to mounting arm or pivot shaft, INSTALL a new wiper mounting arm or INSTALL a new pivot shaft. REFER to Wiper Mounting Arm and Pivot Shaft or Wiper Pivot Arm in this section. **No** GO to I2 .
I2 CHECK WIPER PIVOT ARM ALIGNMENT	
• Check the wiper pivot arm adjustment. • **Is the wiper pivot arm correctly adjusted?**	**Yes** GO to I3 . **No** ADJUST the wiper blade and pivot arm. REFER to Wiper Blade and Pivot Arm Adjustment in this section. TEST the system for normal operation.
I3 CHECK WIPER MOTOR FOR A INTERNAL SHORT TO GROUND	
• Ignition ON. • Operate the wipers until the wipers are no longer in the PARK position and turn off the wipers. • Ignition OFF. • Disconnect: Wiper/Washer Module C2157. • Measure the resistance between wiper/washer module C2157-7, circuit CRW09 (BN/BU), harness side and ground.  N0098199 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I5 . **No** GO to I4 .
I4 CHECK WIPER PARK SIGNAL FOR A SHORT TO GROUND	
• Disconnect: Wiper Motor C125. • Measure the resistance between wiper motor C125-1, circuit CRW09 (BN/BU), harness side and ground.	**Yes** INSTALL a new wiper motor. REFER to Wiper Motor in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

 N0098144 • **Is the resistance greater than 10,000 ohms?**	
I5 CHECK WIPER PARK SIGNAL FOR AN OPEN	
• Measure the resistance between wiper/washer module C2157-7, circuit CRW09 (BN/BU), harness side and wiper motor C125-1, circuit CRW09 (BN/BU), harness side.  N0097959 • **Is the resistance less than 5 ohms?**	**Yes** GO to I6 . **No** REPAIR the circuit. TEST the system for normal operation.
I6 CHECK FOR CORRECT WIPER/WASHER MODULE OPERATION	
• Disconnect all wiper/washer module connectors. • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect all wiper/washer module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new wiper/washer module. REFER to Wiper/Washer Module in this section. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Wiper Blade and Pivot Arm Adjustment

1. Cycle and park the windshield wipers.

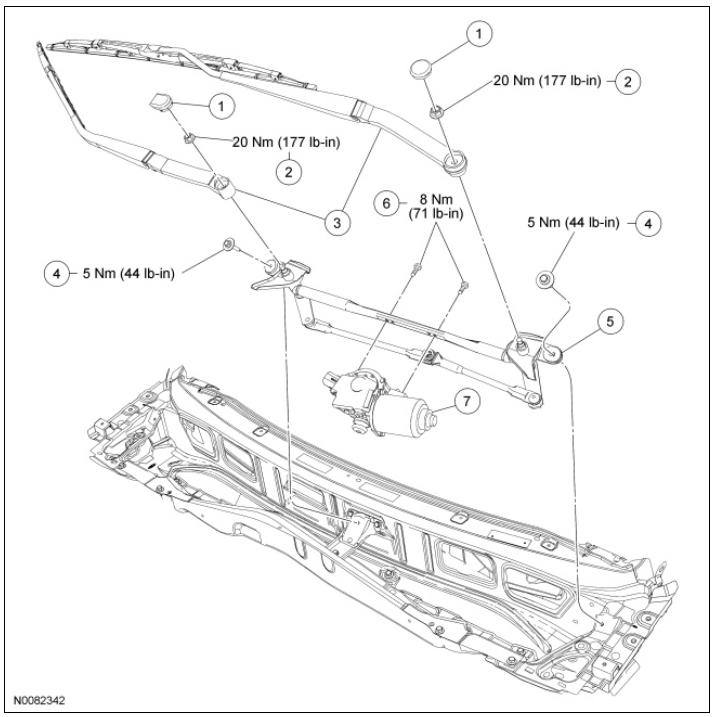
2. Verify that the RH and LH wiper blades are located at the alignment marks on the glass.



3. If necessary, remove the nuts and the windshield wiper pivot arms and reposition them to the correct locations.
    - To install, tighten to 20 Nm (177 lb-in).

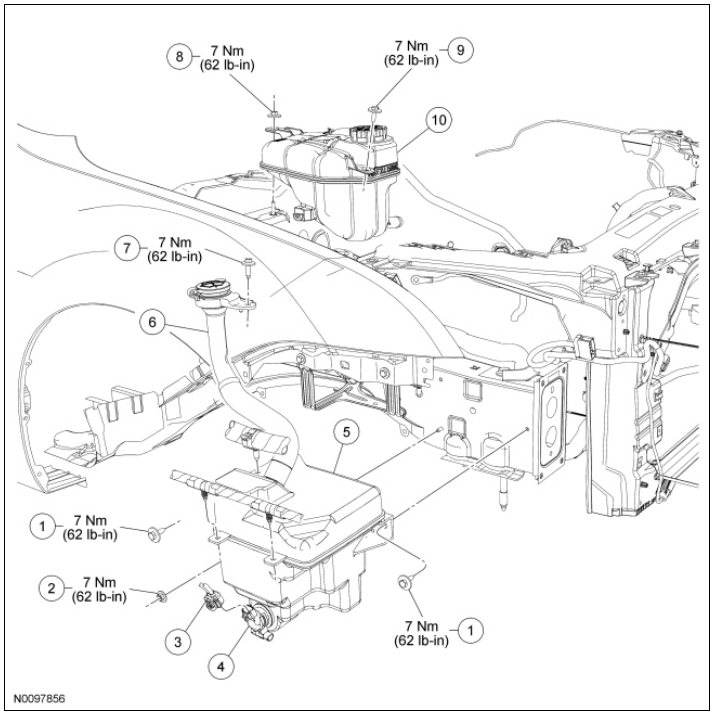
Wiper and Washer System - Exploded View

Windshield Wipers



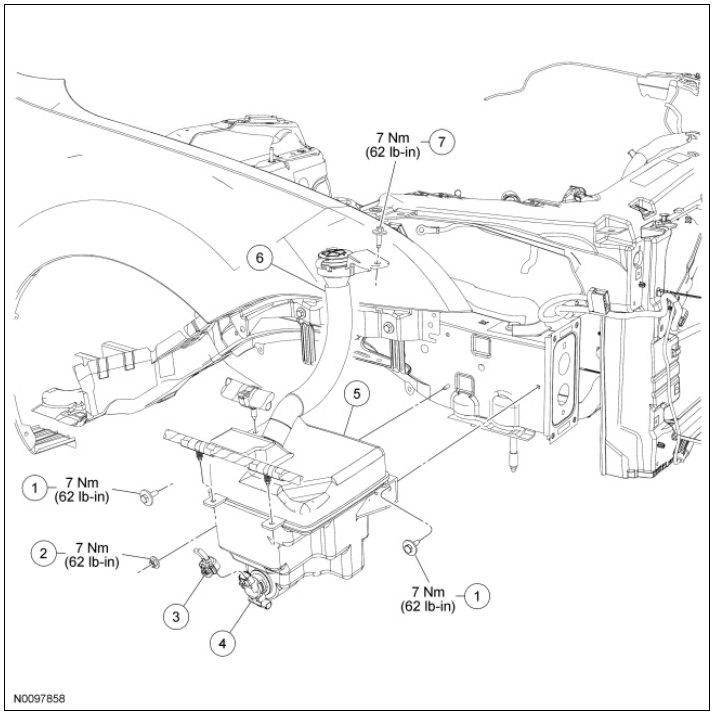
Item	Part Number	Description
1	17C526	Wiper pivot arm caps (2 required)
2	W520403	Wiper pivot arm nuts (2 required)
3	17526	Wiper pivot arm assembly
4	W701121	Windshield wiper mounting arm and pivot shaft assembly bolts (2 required)
5	17566	Windshield wiper mounting arm and pivot shaft assembly
6	-	Wiper motor-to-wiper mounting arm bolts (part of 17508) (2 required)
7	17508	Wiper motor assembly

Washer Pump and Reservoir - Hybrid



Item	Part Number	Description
1	W707399	Windshield washer reservoir bolts (2 required)
2	W702751	Windshield washer reservoir nut
3	14A005	Windshield washer pump electrical connector
4	17664	Windshield washer pump
5	17618	Windshield washer reservoir
6	17618	Windshield washer reservoir filler neck
7	W500214	Windshield washer reservoir filler neck retaining bolt
8	W702751	Coolant reservoir nut
9	W505252	Coolant reservoir bolt
10	8A080	Coolant reservoir

Washer Pump and Reservoir - Non-Hybrid



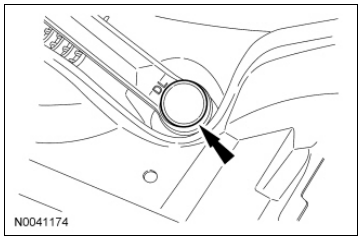
Item	Part Number	Description
1	W707399	Windshield washer reservoir bolts (2 required)
2	W702751	Windshield washer reservoir nut
3	14A005	Windshield washer pump electrical connector
4	17664	Windshield washer pump
5	17618	Windshield washer reservoir
6	17618	Windshield washer reservoir filler neck
7	W500214	Windshie washer reservoir filler neck retaining bolt

1. For additional information, refer to the procedures in this section.

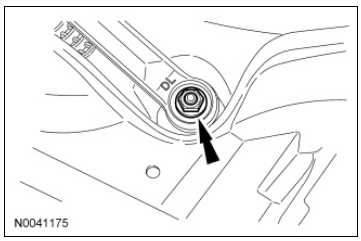
Wiper Pivot Arm

Removal and Installation

1. Remove the wiper pivot arm cap.



2. Remove the wiper pivot arm retaining nut and the wiper pivot arm.
   - To install, tighten to 20 Nm (177 lb-in).



3. To install, reverse the removal procedure.

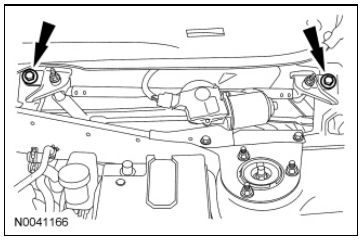
Wiper Mounting Arm and Pivot Shaft

Removal and Installation

1. Remove the upper cowl panel grille. For additional information, refer to Section 501-02 .

2. Disconnect the windshield wiper motor electrical connector.

3. Remove the 2 windshield wiper mounting arm and pivot shaft assembly bolts and the windshield wiper mounting arm and pivot shaft assembly.
    - To install, tighten to 5 Nm (44 lb-in).



4. To install, reverse the removal procedure.

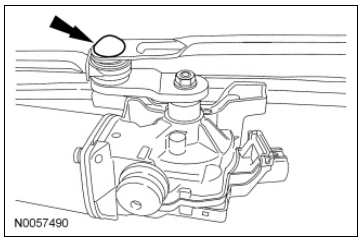
Wiper Motor

Removal and Installation

1. Remove the wiper pivot arms. For additional information, refer to Wiper Pivot Arm in this section.

2. Remove the windshield wiper mounting arm and pivot shaft. For additional information, refer to Wiper Mounting Arm and Pivot Shaft in this section.

3. Separate the wiper motor linkage arm from the wiper mounting arm and pivot shaft assembly.



4. Remove the 2 wiper motor-to-wiper mounting arm bolts and the wiper motor.
    - To install, tighten to 8 Nm (71 lb-in).

5. To install, reverse the removal procedure.

Washer Pump

Material

Item	Specification
Motorcraft® Premium Quality Windshield Washer Fluid (Canada) CXC-37-(A, B, D, and F) (Canada)	-
Motorcraft® Premium Windshield Washer Concentrate (US) ZC-32-A or B (US)	WSB-M8B16-A2

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the RH front fender splash shield. For additional information, refer to Section 501-02 .

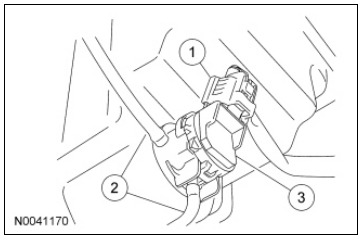
3. ⚠ **WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.**

   NOTICE: **When installing the windshield washer pump, be careful not to damage the rubber grommet.**

   NOTE: To prevent spilling windshield washer fluid, dn the windshield washer reservoir before washer pump removal.

   Remove the windshield washer pump.

   1. Disconnect the electrical connector.
   2. Disconnect the hoses.
   3. Remove the windshield washer pump.



4. ***NOTICE:*** **Do not operate the windshield washer pump prior to filling the windshield washer reservoir. Failure to follow these instructions may result in premature pump failure.**

   To install, reverse the removal procedure.

- Fill the windshield washer reservoir with windshield washer fluid.

Washer Reservoir

Material

Item	Specification
Motorcraft® Premium Quality Windshield Washer Fluid (Canada) CXC-37-(A, B, D, and F) (Canada)	-
Motorcraft® Premium Windshield Washer Concentrate (US) ZC-32-A or B (US)	WSB-M8B16-A2

Removal and Installation

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the RH front fender splash shield. For additional information, refer to Section 501-02 .

3. Disconnect the windshield washer pump electrical connector.

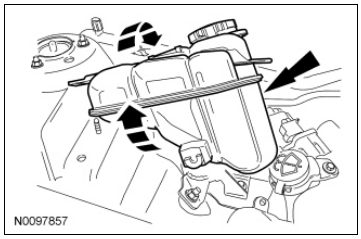
4. ⚠ **WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.**

   NOTE: To prevent spilling windshield washer fluid,ain the windshield washer reservoir before removal.

   Disconnect the washer pump hose.

Hybrid vehicles

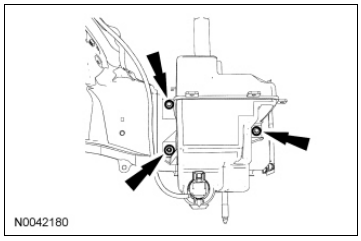
5. Remove the coolant reservoir bolt and nut and position the reservoir aside in order to gain access to the washer reservoir filler neck.
   - To install, tighten to 7 Nm (62 lb-in).



All vehicles

6. Remove the bolt and the windshield washer reservoir filler neck.
    - To install, tighten to 7 Nm (62 lb-in).

7. Remove the windshield washer reservoir fasteners and the windshield washer reservoir.
    - To install, tighten to 7 Nm (62 lb-in).



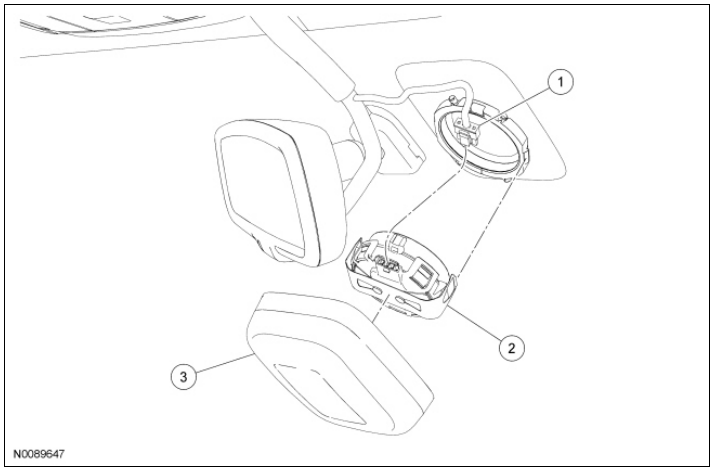
8. ***NOTICE:*** **Do not operate the windshield washer pump prior to filling the windshield washer reservoir. Failure to follow these instructions may result in premature pump failure.**

    To install, reverse the removal procedure.

    - Fill the windshield washer reservoir with windshield washer fluid.

Rain Sensor

NOTE: Vehicle without Headlamp Control Module 2 (HCM-2) shown, vehicle with HCM-2 similar.



Item	Part Number	Description
1	-	Electrical connector (part of 17C712)
2	17D547	Rain sensor
3	17D550	Rain sensor cover

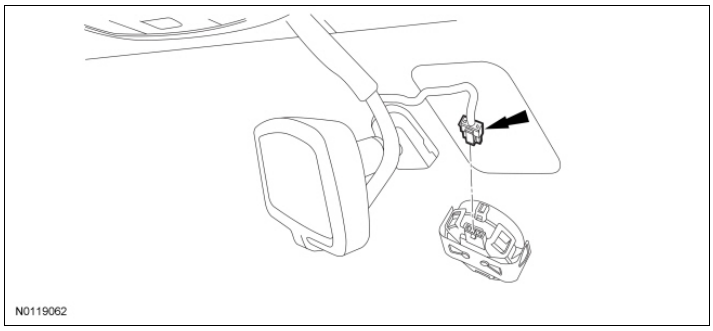
Removal

NOTE: If reinstalling the original rain sensor, a new lens/bracket service kit (19G382) must be acquired prior to performing this procedure.

1. On vehicles equipped with a Headlamp Control Module 2 (HCM-2), remove the HCM-2 . For additional information, refer to Section 417-01 .

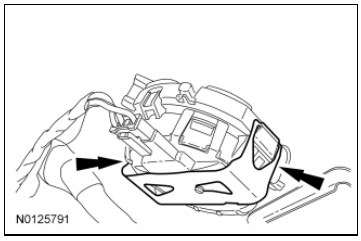
2. On vehicles equipped with only a rain sensor, remove the rain sensor cover.

3. Disconnect the rain sensor electrical connector.



4. **NOTE:** Lightly press the rain sensor against the windshield to relieve the clip tension.

   Release the 2 rain sensor retaining clips and remove the rain sensor.

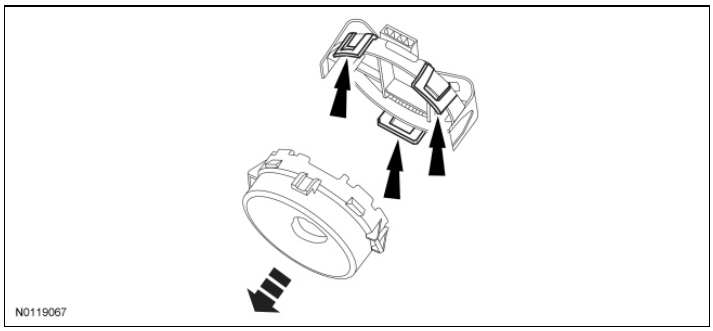


Installation

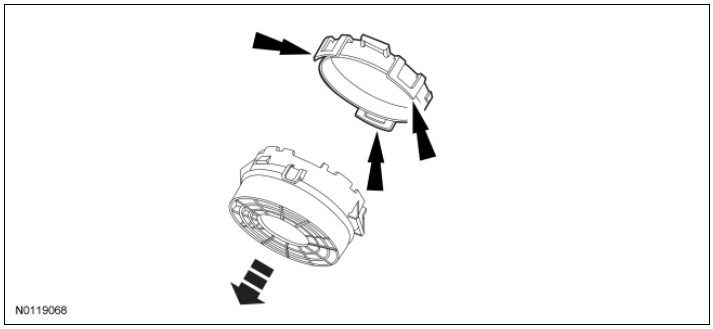
Reinstalling the original rain sensor

NOTICE: **Do not touch the rain sensor lens-to-windshield contact area or allow it to become contaminated with dust or debris. Touching or contaminating the rain sensor lens will result in the rain sensitive wiper feature being inoperative or working incorrectly.**

1. Disengage the 3 rain sensor plastic clips and separate the electronics backing plate from the rain sensor lens.
    - Discard the rain sensor lens.

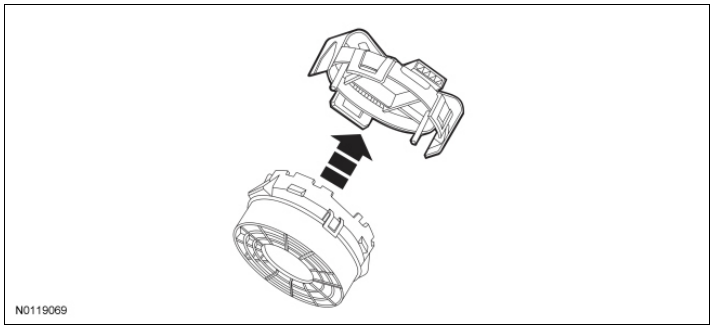


2. Disengage the 3 rain sensor plastic clips on the rain sensor lens protective backing and separate the rain sensor protective backing from the new rain sensor lens.



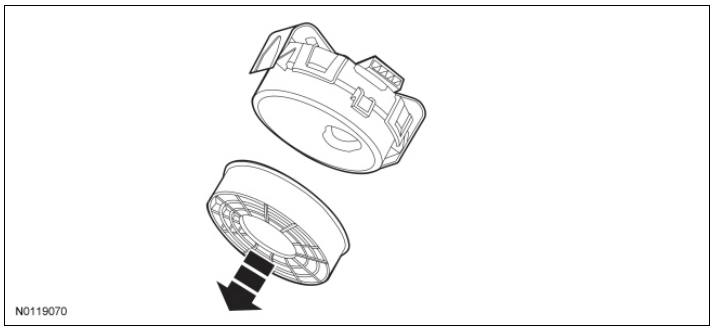
3. **NOTE:** Do not remove the white rain sensor lens protective cover at this time.

   Install the rain sensor lens onto the electronics backing plate.



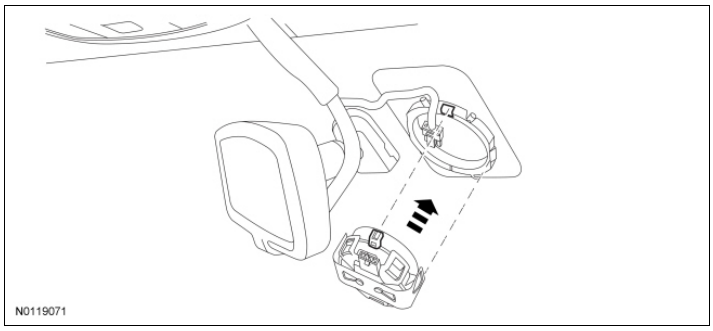
All rain sensors

4. Remove the white rain sensor lens protective cover from the rain sensor lens.

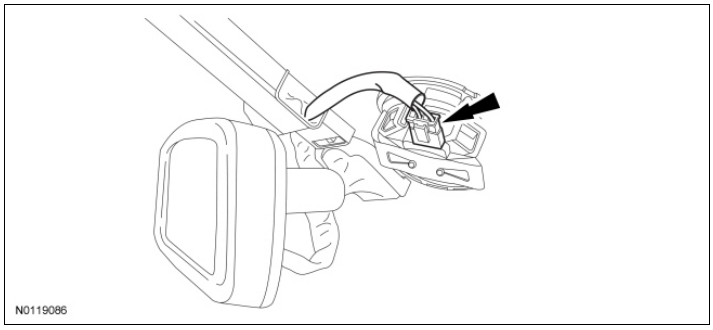


5. Clean any residual rain sensor lens material from the rain sensor viewing window.

6. Install the rain sensor onto the rain sensor mounting bracket, making sure that the alignment tab on the rain sensor is aligned with the notch on the mounting bracket.
    - Press the metal rain sensor mounting bracket clips to engage the clips onto the mounting bracket.



7. Connect the rain sensor electrical connector.



8. On vehicles equipped with only a rain sensor, install the rain sensor cover.

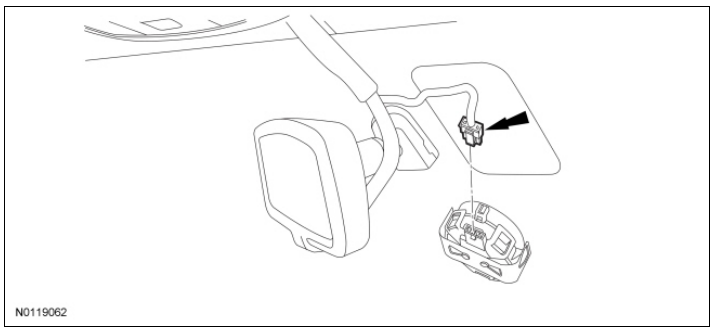
9. On vehicles equipped with a Headlamp Control Module 2 (HCM-2), install the HCM-2 . For additional information, refer to Section 417-01 .

Rain Sensor Bracket

NOTE: The rain sensor bracket primer and adhesive are not included in service kit (part number 19G382) and will have to be ordered separately. The rain sensor bracket primer and adhesive part numbers and ordering instructions are available in the parts ordering system.

NOTE: The rain sensor bracket adhesive will take at least 6 hours to dry.

1. Disconnect the rain sensor electrical connector.



2. ***NOTICE:*** **Make sure not to scratch the windshield glass.**

   Using a razor blade, carefully remove any residual glue from the windshield glass.

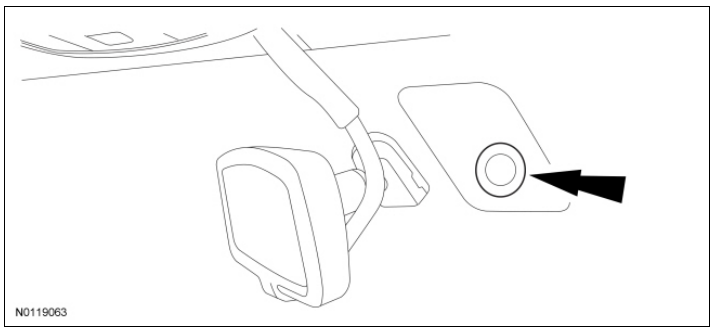
3. Using a clean cloth, wipe the windshield glass to remove any loose glue particles and any residual rain sensor lens material.

4. Apply specified primer onto a clean cloth.

5. Insert a cotton swab, or equivalent, onto the wet area of the cloth.

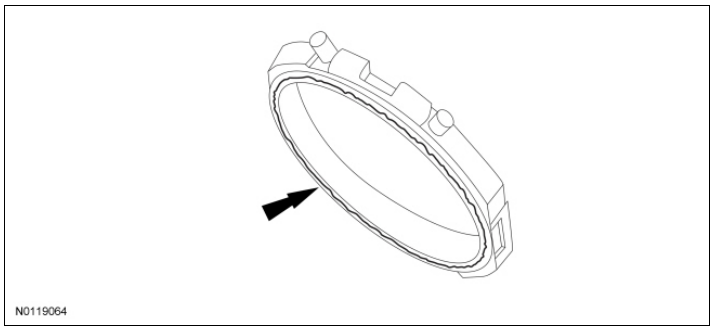
6. ***NOTICE:*** **Do not apply primer to the rain sensor view window area.**

   Using the cotton swab, or equivalent, apply the primer onto the contact area of the rain sensor mounting bracket area of the windshield glass.



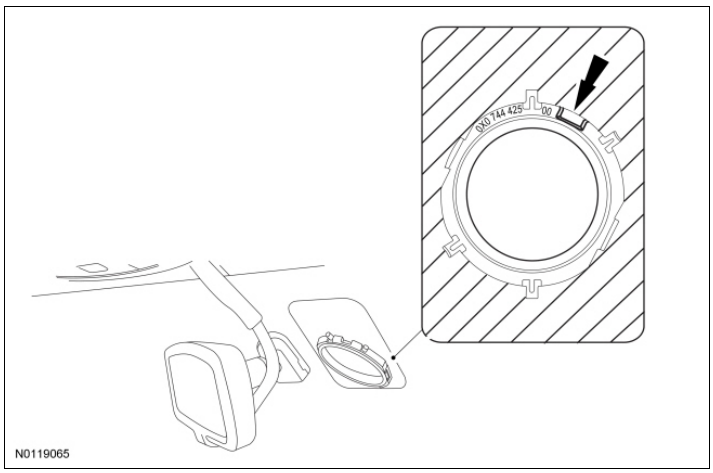
7. **NOTE:** Apply the adhesive to the side of the rain sensor bracket that is opposite of the notch and that does not contain numbers and letters.

Using a 3M® EPX Plus II applicator or equivalent, apply a 2 to 3 mm (0.078 in to 0.118 in) bead of specified adhesive to the rain sensor mounting bracket.



8. **NOTE:** If the rain sensor mounting bracket is not mounted in the correct location on the windshield glass, the rain sensor trim cover will not install correctly.

   Apply the rain sensor mounting bracket onto the windshield making sure that the notch on the bracket is in the 1 o'clock position and that the bracket is centered around the rain sensor view window area.

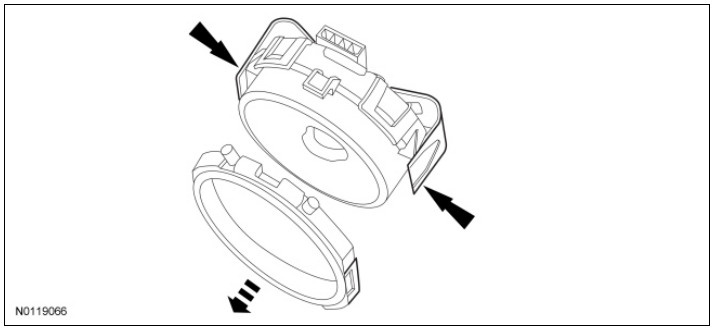


9. **NOTE:** Do not apply masking tape onto the rain sensor view window area.

   Apply masking tape onto the rain sensor mounting bracket and the windshield glass in order to hold the bracket onto the windshield.

10. Allow the adhesive to dry for at least 6 hours.

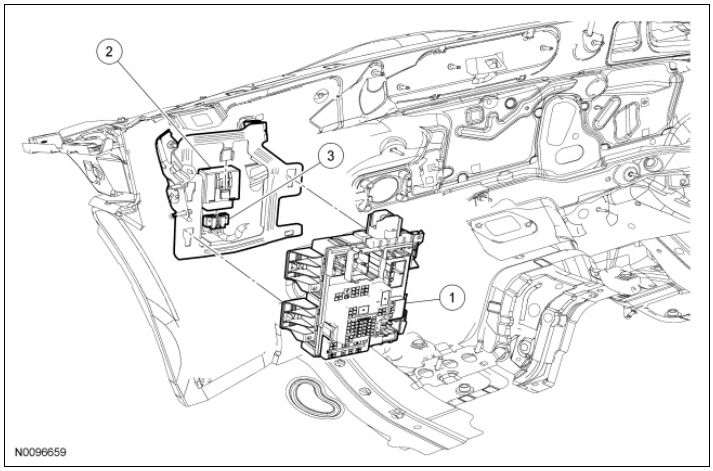
11. Disengage the metal rain sensor mounting clips from the old rain sensor bracket and separate the old rain sensor bracket from the rain sensor.
    - Discard the old rain sensor bracket, it is not to be reused.



12. Install the rain sensor. For additional information, refer to Rain Sensor in this section.

Wiper/Washer Module

NOTE: Instrument panel removed for clarity.



Item	Part Number	Description
1	15605	Smart Junction Box (SJB)
2	14B205	Wiper/washer module
3	14401	Wiper/washer module electrical connector

Removal and Installation

1. Position the Smart Junction Box (SJB) aside by pushing upward then pulling outward to release it from the SJB bracket.
2. Disconnect the wiper/washer module connector.
3. Pull down on the wiper/washer module to release it from the SJB bracket.
4. To install, reverse the removal procedure.

General Specifications

Item	Specification
Front edge of roof panel-to-roof opening panel	-1.5 to 0 mm (-0.059 to 0 in)
Rear edge of roof panel-to-roof opening panel	0 to 1.5 mm (0 to 0.059 in)

Torque Specifications

Description	Nm	lb-in
Roof opening panel air deflector screws	1	9
Roof opening panel frame bolts	12	106
Roof opening panel glass screws	6	53
Roof opening panel motor screws	4	35

Roof Opening Panel

The roof opening panel consists of the following:

- Concertina blinds
- Air deflector
- Trough assembly
- Roof opening panel glass
- Roof opening panel motor/module
- Roof opening panel shield
- Roof opening panel switch
- Roof opening panel drain hoses

The roof opening panel is an electronically operated panel that can be opened or closed by pressing a switch located on the overhead console. It also has one-touch open, one-touch close, one-touch vent open and one-touch vent close features.

When the roof opening panel is in the fully CLOSED position, pressing the roof opening panel control switch rearward to the second detent and then releasing it will activate the one-touch open feature. Pressing the roof opening panel control switch in either direction with the roof opening panel moving will cancel the one-touch open operation.

With the roof opening panel glass in any OPEN position except VENT, rocking the roof opening panel control switch forward and then releasing it will activate the one-touch close feature. Pressing the roof opening panel control switch in either direction with the roof opening panel moving will cancel the one-touch close operation and the motion will immediately stop. Near the end of the forward travel, the rear portion of the roof opening panel glass moves upward on 2 lifter arms. This allows a weather-tight seal when the roof opening panel glass is closed.

If an obstacle contacts the leading edge of the roof opening panel glass during one-touch close operation, the roof opening panel glass will reverse direction and open to approximately the mid position and stop. The operator cannot stop this open motion once it has begun.

If an obstacle contacts the rear edge of the roof opening panel glass during one-touch vent close operation, the roof opening panel glass will reverse direction to the vent OPEN position.

When the roof opening panel glass is in the fully CLOSED position, pressing the roof opening panel control switch forward and then releasing it will activate the one-touch vent feature. Pressing the roof opening panel control switch in either direction with the roof opening panel moving will cancel the one-touch vent operation. There is a one-touch vent close feature.

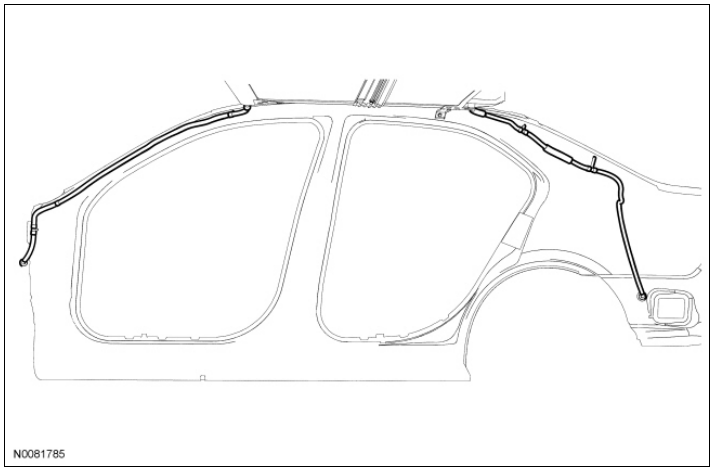
Global Open

NOTE: The global open feature may be enabled/disabled via scan tool or in some cases modified by the customer following a procedure listed in the vehicle Owner's Literature. For a complete list of available programmable parameters, refer to the Module Configuration and Parameter Chart in Section 418-01 .

NOTE: The Smart Junction Box (SJB) may also be identified as the Generic Electronic Module (GEM).

When the unlock button of the Remote Keyless Entry (RKE) is held for 2 seconds, the SJB sends a signal on the global open circuit, to both front door window motors and the roof opening panel motor, to open the windows. If the accessory delay relay is active, the global open feature will not operate.

Roof Opening Panel Drain Hose Routing



Roof Opening Panel

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent

Principles of Operation

Roof Opening Panel

The roof opening panel assembly uses an integrated motor and module to operate the roof opening panel. The roof opening panel motor and module are installed new as an assembly. The roof opening panel is an electronically operated glass panel that can be opened, closed or tilted by the roof opening panel switch. Actuating the switch in either a forward or rearward motion supplies a ground to the roof opening panel motor/module. The roof opening panel has one-touch open and one-touch close features that are activated when the switch is momentarily pressed to the double detent OPEN or CLOSE position. These functions are controlled by the roof opening panel motor/module.

The roof opening panel motor must be initialized whenever the roof opening panel motor has been removed from the roof opening panel system, the roof opening panel assembly has been removed from the vehicle, a new roof opening panel motor has been installed or a new roof opening panel assembly has been installed.

Global Open

NOTE: The global open feature may be enabled/disabled via scan tool or in some cases modified by the customer following a procedure listed in the vehicle Owner's Literature. For a complete list of available programmable parameters, refer to the Module Configuration and Parameter Chart in Section 418-01 .

NOTE: The Smart Junction Box (SJB) may also be identified as the Generic Electronic Module (GEM).

When the unlock button of the Remote Keyless Entry (RKE) transmitter is held for 2 seconds, the global open activates. The SJB sends a signal to activate the one-touch vent operation of the roof opening panel. The global open feature does not operate if the delay accessory is active.

Inspection and Verification

1. Verify the customer concern by operating the system.

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

Visual Inspection Chart

Mechanical	Electrical
• Roof opening panel • Roof opening panel frame • Roof opening panel drain hoses • Roof opening panel lifter assemblies • Roof opening panel trough • Roof opening panel air deflector assembly • Roof opening panel seal • Roof opening panel shield	• Battery Junction Box (BJB) fuse 33 (20A) • Smart Junction Box (SJB) fuse 41 (15A) • Circuitry • Accessory delay relay • Roof opening panel motor and module assembly • Roof opening panel switch

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

4. If the concern is not visually evident, determine the symptom. GO to Symptom Chart - Roof Opening Panel or GO to Symptom Chart - NVH .

Symptom Chart - Roof Opening Panel

Symptom Chart - Roof Opening Panel

Symptom Chart - NVH

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

ConditionPossible SourcesAction

- The roof opening panel has excessive wind noise

- Incorrect adjustment
- Roof opening panel weatherstrip/seals
- Mechanism mistimed

- GO to Pinpoint Test A .

- The roof opening panel rattles

- Roof opening panel
- Roof opening panel tracks
- Roof opening panel air deflector assembly
- Roof opening panel trough
- Roof opening panel lifter assemblies
- Roof opening panel water trough guide
- Headliner
- Motor pad
- Rear side brackets

- GO to Pinpoint Test C .

- The roof opening panel is noisy during operation

- Roof opening panel
- Roof opening panel tracks
- Roof opening panel lifter assemblies
- Roof opening panel adjustment
- Roof opening panel motor/module assembly

- GO to Pinpoint Test D .

Pinpoint Tests

Pinpoint Test A: The Roof Opening Panel Has Excessive Wind Noise

Normal Operation

When the roof opening panel glass is completely closed, it is flush with the roof panel.

This pinpoint test is intended to diagnose the following:
- Incorrect roof opening panel alignment
- Poorly fitting roof opening panel seal/weatherstrip
- Incorrect installation of the roof opening panel and motor/module
- Incorrect curvature of the air deflector

PINPOINT TEST A: THE ROOF OPENING PANEL HAS EXCESSIVE WIND NOISE

Test Step	Result / Action to Take
A1 VERIFY ROOF OPENING PANEL NOISE	
• Road test the vehicle with the roof opening panel in the CLOSED and OPEN positions. • **Is the wind noise present only in the OPEN position?**	**Yes** GO to A4 . **No** GO to A2 .
A2 CHECK THE ROOF OPENING PANEL WEATHERSTRIP	

NOTE: Make sure the weatherstrip is secured to the glass, not cut, cracked, pinched, loose or obstructed in CLOSED, VENT and OPEN positions. • Check the roof opening panel weatherstrip. • **Is the roof opening panel weatherstrip OK?**	**Yes** GO to A3 . **No** INSTALL a new roof opening panel weatherstrip. REFER to Roof Opening Panel - Exploded View in this section. TEST the system for normal operation.
A3 CHECK ROOF OPENING PANEL ALIGNMENT	
• Check the roof opening panel alignment. • **Is the alignment OK?**	**Yes** CHECK for correct installation of the roof opening panel and motor/module. REFER to Roof Opening Panel - Exploded View , Roof Opening Panel Frame and Roof Opening Panel Motor in this section. TEST the system for normal operation. **No** ALIGN the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation.
A4 CHECK THE AIR DEFLECTOR	
• Make sure the air deflector is securely attached. • **Is the air deflector OK?**	**Yes** PARTIALLY CLOSE the roof opening panel until the noise is eliminated. If the noise is eliminated, INFORM the customer that changing glass location will eliminate the wind noise. If the wind noise is not eliminated, INSTALL a new air deflector. TEST the system for normal operation. **No** INSTALL new air deflector assembly. REFER to Roof Opening Panel - Exploded View and Air Deflector in this section. TEST the system for normal operation.

Pinpoint Test B: The Roof Opening Panel Leaks

Normal Operation

When the roof opening panel glass is completely closed, it is flush with the roof panel.

NOTE: Water may accumulate on both outside front corners of the glass panel after rain or after a car wash. If the glass panel is opened with water in the front corners, this water will fall into the channel for the glass panel track (which is not sealed) and down into the headliner. If the source of a suspected leak cannot be determined, this situation may be the source. This is a normal condition, do not replace any part of the roof opening panel system due to this condition.

This pinpoint test is intended to diagnose the following:
- Incorrect roof opening panel adjustments
- Damaged roof opening panel drain hoses
- Damaged roof opening panel seal/weatherstrip
- Damaged roof opening panel frame

- Incorrect position of the roof opening panel glass

PINPOINT TEST B: THE ROOF OPENING PANEL LEAKS

Test Step	Result / Action to Take
B1 CHECK THE ALIGNMENT OF THE ROOF OPENING PANEL	
• **NOTE:** Make sure the roof opening panel weatherstrip is not cracked or loose. • Check the roof opening panel weatherstrip. • **Does the roof opening panel seal correctly?**	**Yes** GO to B2 . **No** ALIGN the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation.
B2 CHECK THE ROOF OPENING PANEL DRAIN HOSES	
• **NOTE:** Make sure the roof opening panel drain hoses are not cracked, slit, pinched or obstructed. • Check the 4 roof opening panel drain hoses for correct operation. • **Are the roof opening panel drain hoses OK?**	**Yes** GO to B3 . **No** REPAIR or INSTALL a new roof opening panel drain hose(s). TEST the system for normal operation.
B3 CHECK THE ROOF OPENING PANEL DRAIN HOSE ATTACHMENT POINTS	
• **NOTE:** Make sure the roof opening panel drain hose attachment points are not damaged or obstructed. • Check the roof opening panel drain hose attachment points for correct attachment. • **Are the roof opening panel drain hose attachment points OK?**	**Yes** GO to B4 . **No** REPAIR or INSTALL a new roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation.
B4 CHECK THE ROOF OPENING PANEL REAR TROUGH CONDITION	
• Check the roof opening panel rear trough for damage. • **Is the roof opening panel trough OK?**	**Yes** GO to B5 . **No** REPAIR or INSTALL a new roof opening panel rear trough. REFER to Roof Opening Panel - Exploded View , Roof Opening Panel Frame and Trough Assembly in this section.

	TEST the system for normal operation.
B5 CHECK THE CONDITION OF THE ROOF OPENING PANEL FRAME	
• Check the roof opening panel frame for damage that may cause the roof opening panel glass seal to seat incorrectly. • **Is the roof opening panel frame OK?**	**Yes** INSTALL a new roof opening panel glass. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Glass in this section. TEST the system for normal operation. **No** REPAIR or INSTALL a new roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation.

Pinpoint Test C: The Roof Opening Panel Rattles

Normal Operation

When the roof opening panel glass is completely closed, it is flush with the roof panel. All components should be secured correctly.

This pinpoint test is intended to diagnose the following:

- Roof opening panel
- Roof opening panel air deflector assembly
- Roof opening panel trough
- Roof opening panel lifter assemblies
- Headliner
- Roof opening panel motor/module pad
- Roof opening panel frame

PINPOINT TEST C: THE ROOF OPENING PANEL RATTLES

Test Step	Result / Action to Take
C1 CHECK THE ROOF OPENING PANEL WEATHERSTRIP	
• **NOTE:** Make sure the weatherstrip is secured to the glass, not cut, cracked, pinched, loose or obstruct in CLOSED, VENT and OPEN positions. • Check the roof opening panel weatherstrip. • **Is the roof opening panel weatherstrip OK?**	**Yes** GO to C2 . **No** INSTALL a new roof opening panel weatherstrip. REFER to Roof Opening Panel - Exploded View in this section. TEST the system for normal operation.
C2 CHECK THE ROOF OPENING PANEL TIGHTNESS	
• Manually push up and fore/aft. • **Is the roof opening panel loose?**	**Yes** ALIGN the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST

	the system for normal operation. **No** GO to C3 .
C3 CHECK THE ROOF OPENING PANEL TRACKS	
• Open the roof opening panel. • Check the roof opening panel tracks for obstructions and damage. • **Are the roof opening panel tracks OK?**	**Yes** GO to C4 . **No** REMOVE all the roof opening panel track obstructions and REPAIR the roof opening panel tracks. If the roof opening panel tracks cannot be repaired, INSTALL a new roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation.
C4 CHECK THE ROOF OPENING PANEL TROUGH AND TROUGH GUIDES	
• Check the water roof opening panel trough and trough guides for any loose obstructions. • **Are the roof opening panel tugh and trough guides installed securely and free from obstructions?**	**Yes** GO to C5 . **No** REMOVE all obstructions from the roof opening panel trough guides and INSTALL securely. INSTALL a new roof opening panel frame if the trough guides are damaged. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation.
C5 CHECK THE ROOF OPENING PANEL SHIELD (SUNSHADE)	
• Check the roof opening panel shield for correct installation. • **Is the roof opening panel shield installed correctly?**	**Yes** GO to C6 . **No** INSTALL the roof opening panel shield correctly. REFER to Roof Opening Panel Shield in this section. TEST the system for normal operation.
C6 CHECK THE ROOF OPENING PANEL AIR DEFLECTOR ASSEMBLY	
• Check the roof opening panel air deflector assembly for obstructions and damage. • **Is the roof opening panel air deflector assembly OK?**	**Yes** GO to C7 . **No** REMOVE all obstructions and REPAIR or INSTALL a new roof opening panel air deflector assembly. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this secti. TEST the system for normal operation.
C7 CHECK THE ROOF OPENING PANEL GLASS	

• Verify the roof opening panel glass is free from obstructions and damage, and is securely fastened. • **Is the roof opening panel glass OK?**	**Yes** GO to C8 . **No** REPAIR or INSTALL a new roof opening panel glass. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Glass in this section. TEST the system for normal operation.
C8 CHECK THE ROOF OPENING PANEL LIFTER ASSEMBLIES	
• Verify the roof opening panel lifter assemblies are free from obstructions and damage. • **Are the roof opening panel lifter assemblies OK?**	**Yes** GO to C9 . **No** REMOVE all obstructions from the roof opening panel lifter assemblies and REPAIR any damage. If the roof opening panel lifter assemblies cannot be repaired, INSTALL a new roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation.
C9 CHECK ROOF OPENING PANEL FRAME INSTALLATION	
• Check all roof opening fasteners for correct torque and verify correct installation of the roof opening panel frame. Refer to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. • **Is the roof opening panel correctly installed and tightened to specification?**	**Yes** GO to C10 . **No** TIGHTEN the loose fasteners or REINSTALL the roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation.
C10 CHECK THE ROOF OPENING PANEL FRAME FOR RATTLES	
• Check the roof opening panel frame assembly for any loose parts or for any condition that will cause rattles. • **Is there a condition that will cause rattles?**	**Yes** INSTALL a suitable sound damper material to correct the condition. If the rattle still persists, INSTALL a new roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation. **No** INSTALL a new roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation.

Pinpoint Test D: The Roof Opening Panel is Noisy During Operation

Normal Operation

The roof opening panel operates smoothly while opening and closing.

This pinpoint test is intended to diagnose the following:

- Obstructed or damaged roof opening panel
- Obstructed or damaged roof opening panel lifter assemblies
- Incorrect roof opening panel adjustment
- Noisy roof openinnel motor/module assembly

PINPOINT TEST D: THE ROOF OPENING PANEL IS NOISY DURING OPERATION

Test Step	Result / Action to Take
D1 CHECK THE ROOF OPENING PANEL FOR OBSTRUCTIONS OR DAMAGE	
• Check the roof opening panel for any obstructions and damage. • **Are there any obstructions and/or damage?**	**Yes** REMOVE all obstructions. REPAIR any damage. If the damage cannot be repaired, INSTALL a new roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation. **No** GO to D2 .
D2 CHECK THE ROOF OPENING PANEL OPERATION	
• Check the roof opening panel durinoperation. • **Is the roof opening panel loose or incorrectly aligned?**	**Yes** ALIGN the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation. **No** GO to D3 .
D3 CHECK THE ROOF OPENING PANEL TRACKS	
• Open the roof. • Check the roof opening panel tracks for obstructions and damage. • **Are the roof opening panel tracks OK?**	**Yes** GO to D4 . **No** REMOVE all obstructions and REPAIR any damage. If the roof opening panel tracks cannot be repaired, INSTALL a new roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation.
D4 CHECK THE ROOF OPENING PANEL SHIELD	
• Check the roof opening panel shield for correct movement.	**Yes** GO to D5 . **No**

• **Is the roof opening panel shield moving correctly?**	REMOVE and REINSTALL the roof opening panel shield. REFER to Roof Opening Panel Shield in this section. TEST the system for normal operation.
D5 CHECK THE ROOF OPENING PANEL LIFTER ASSEMBLIES	
• Check the roof opening panel lifter assemblies for obstructions and damage. • **Are the roof opening panel lifter assemblies OK?**	**Yes** GO to D6 . **No** REMOVE all obstructions and REPAIR any damage. If the roof opening panel lifter assemblies cannot be repaired, INSTALL a new roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. TEST the system for normal operation.
D6 CHECK THE ROOF OPENING PANEL MOTOR/MODULE	
• Remove the roof opening panel motor/module and leave the electrical connector connected. • Operate the roof opening panel to the full OPEN and CLOSED position. • **Does the motor/module make excessive noise?**	**Yes** INSTALL a new roof opening panel motor/module. REFER to Roof Openg Panel - Exploded View and Roof Opening Panel Motor in this section. TEST the system for normal operation. **No** REINSTALL the roof opening panel motor/module. TEST the system for normal operation. If the roof opening panel is still noisy, INSTALL a new roof opening panel frame. REFER to Roof Opening Panel - Exploded View and Roof Opening Panel Frame in this section. If the roof opening panel is no longer noisy, the system is operating correctly. The concern may have been caused by an incorrectly installed roof opening panel motor.

Pinpoint Test E: The Roof Opening Panel Does Not Open or Close

Refer to Wiring Diagrams Cell 101 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Roof Opening Panel for schematic and connector information.

The roof opening panel motor must be initialized whenever the roof opening panel motor has been removed from the roof opening panel system, the roof opening panel assembly has been removed from the vehicle, a new roof opening panel motor has been installed or a new roof opening panel assembly has been installed. Refer to Roof Opening Panel Motor Initialization in this section.

Normal Operation

The roof opening panel motor/module receives voltage from the accessory delay relay when the ignition is in the ACC or RUN position. The overhead console switch supplies ground signals to the roof opening panel motor/module to operate the roof opening panel.

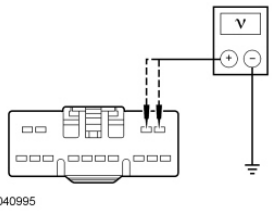
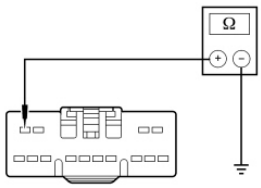
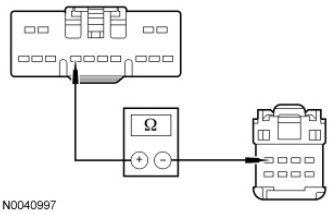
This pinpoint test is intended to diagnose the following:

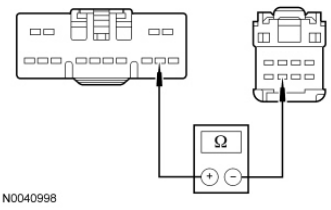
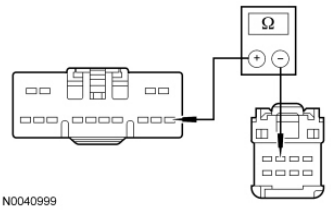
- Fuse(s)

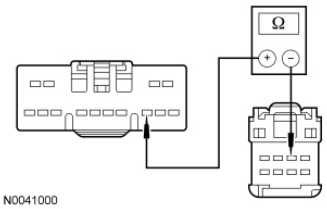
- Wiring, terminals or connectors
- Roof opening panel switch
- Roof opening panel motor/module assembly
- Accessory delay relay
- Roof opening panel motor not initialized

PINPOINT TEST E: THE ROOF OPENING PANEL DOES NOT OPEN OR CLOSE

Test Step	Result / Action to Take
E1 CHECK THE ROOF OPENING PANEL OPERATION	
• Ignition ON. • Attempt to operate the roof opening panel to the VENT position. • **Does the roof opening panel operate to the VENT position?**	**Yes** GO to E2 . **No** GO to E3 .
E2 CHECK THE MOTOR/MODULE FOR INITIALIZATION	
• Carry out the roof opening panel motor initialization procedure. Refer to Roof Opening Panel Motor Initialization in this section. • **Is the concern still present?**	**Yes** GO to E3 . **No** The system is operating normally at this time. The roof opening panel motor was not initialized.
E3 CHECK THE POWER WINDOWS	
• Ignition ON. • Verify the power windows operate. • **Do the power windows operate?**	**Yes** GO to E4 . **No** REFER to Section 501-11 to diagnose the accessory delay relay circuit.
E4 CHECK THE ROOF OPENING PANEL SWITCH	
• Ignition OFF. • Disconnect: Roof Opening Panel Switch C912. • Carry out the Roof Opening Panel Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Is the roof opening panel switch OK?**	**Yes** GO to E5 . **No** INSTALL a new roof opening panel switch. REFER to Roof Opening Panel Control Switch in this section. TEST the system for normal operation.
E5 CHECK VOLTAGE TO THE ROOF OPENING PANEL MOTOR/MODULE	

• Ignition OFF. • Disconnect: Roof Opening Panel Motor/Module C921. • Ignition ON. • Measure the voltage between roof opening panel motor/module C921-2, circuit CBP41 (BU) and C921-1, circuit SBB33 (RD), harness side and ground.  N0040995 • **Is the voltage greater than 10 volts?**	**Yes** GO to E6 . **No** VERIFY Smart Junction Box (SJB) fuse 41 (15A) and Battery Junction Box (BJB) fuse 33 (20A) are OK. If OK, REPAIR the circuit. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
E6 CHECK THE ROOF OPENING PANEL GROUND	
• Ignition OFF. • Measure the resistance between roof opening panel motor/module C921-4, circuit GD139 (BK/YE), harness side and ground.  N0040996 • **Is the resistance less than 5 ohms?**	**Yes** GO to E7 . **No** REPAIR the circuit. TEST the system for normal operation.
E7 CHECK SWITCH COMMON CIRCUIT FOR AN OPEN	
• Measure the resistance between overhead console C912-4, circuit CPR39 (VT/WH) and roof opening panel motor/module C921-11, circuit CPR39 (VT/WH), harness side.  N0040997	**Yes** CHECK the overhead console jumper harness for loose pins, an open or a short in circuit CPR39 (VT/WH) between the roof opening panel switch socket and overhead console C912-4. If the overhead console jumper harness is not OK, INSTALL a new overhead console jumper harness and TEST the system for normal operation. If the overhead console jumper harness is OK, GO to E8 . **No** REPAIR the circuit. TEST the system for normal operation.

• **Is the resistance less than 5 ohms?**	
E8 CHECK SWITCH CLOSE CIRCUIT FOR AN OPEN	
• Measure the resistance between overhead console C912-7, circuit CPR40 (YE/OG) and roof opening panel motor/module C921-6, circuit CPR40 (YE/OG), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** CHECK the overhead console jumper harness for loose pins, an open or a short in circuit CPR40 (YE/OG) between the roof opening panel switch socket and overhead console C912-7. If the overhead console jumper harness is not OK, INSTALL a new overhead console jumper harness and TEST the system for normal operation. If the overhead console jumper harness is OK, GO to E9 . **No** REPAIR the circuit. TEST the system for normal operation.
E9 CHECK SWITCH OPEN CIRCUIT FOR AN OPEN	
• Measure the resistance between overhead console C912-3, circuit CPR31 (VT/BN) and roof opening panel motor/module C921-5, circuit CPR31 (VT/BN), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** CHECK the overhead console jumper harness for loose pins, an open or a short in circuit CPR31 (VT/BN) between the roof opening panel switch socket and overhead console C912-3. If the overhead console jumper harness is not OK, INSTALL a new overhead console jumper harness, and TEST the system for normal operation. If the overhead console jumper harness is OK, GO to E10 . **No** REPAIR the circuit. TEST the system for normal operation.
E10 CHECK SWITCH AUTO CIRCUIT FOR AN OPEN	
• Measure the resistance between overhead console C912-2, circuit CPR38 (WH/BU) and roof opening panel motor/module C921-7, circuit CPR38 (WH/BU), harness side.	**Yes** CHECK the overhead console jumper harness for loose pins, an open or a short in circuit CPR38 (WH/BU) between the roof opening panel switch socket and overhead console C912-2. If the overhead console jumper harness is not OK, INSTALL a new overhead console jumper harness and TEST the system for normal operation. If the overhead console jumper harness is OK, GO to E11 . **No** REPAIR the circuit. TEST the system for normal operation.

 • **Is the resistance less than 5 ohms?**	
E11 CHECK THE ROOF OPENING PANEL MOTOR/MODULE FOR CORRECT OPERATION	
• Disconnect the roof opening panel motor/module connector. • Check for: ♦ corrosion. ♦ bent or pushed-out pins. • Connect the roof opening panel motor/module connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new roof opening panel motor/module. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test F: The Global Open Function is Inoperative/Does Not Operate Correctly

NOTE: The global open feature may be enabled/disabled via scan tool or in some cases modified by the customer following a procedure listed in the vehicle Owner's Literature. For a complete list of available programmable parameters, refer to the Module Configuration and Parameter Chart in Section 418-01 .

Refer to Wiring Diagrams Cell 101 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Roof Opening Panel for schematic and connector information.

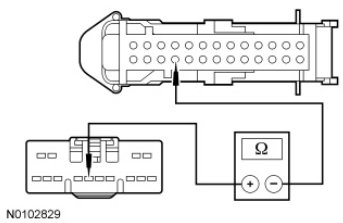
Normal Operation

When the global open feature is activated, the Smart Junction Box (SJB) sends a signal to the roof opening panel motor to place the roof opening panel in the VENT position. The global open feature does not function when the delayed accessory is active. Any interference in the circuit or the window motor may cause the global open feature to not operate correctly.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Roof opening panel motor
- SJB
- Remote Keyless Entry (RKE) transmitters
- Roof opening panel not initialized
- Door window motor

PINPOINT TEST F: THE GLOBAL OPEN FUNCTION IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

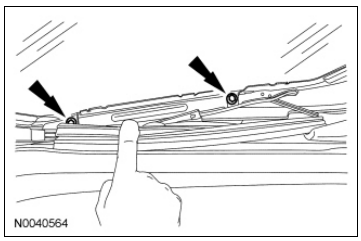
NOTE: One-touch open must be operational for the global open function to operate correctly. Make sure the one-touch open is operational before proceeding with this diagnostic.

Test Step	Result / Action to Take
F1 VERIFY THE POWER WINDOWS ARE OPERATIONAL	
• Operate the power windows using the global open procedure. • **Do the power windows operate correctly?**	**Yes** GO to F2 . **No** REFER to Section 501-11 to diagnose the inoperative windows.
F2 CHECK LF DRIVER WINDOW MOTOR	
• Remove LF driver door window motor SJB fuse 1 (30A). • Operate the power windows using the global open procedure. • **Does the roof opening panel operate correctly?**	**Yes** INSTALL a new LF driver window motor. REFER to Section 501-11 . TEST the system for normal operation. **No** REINSTALL SJB fuse 1 (30A). GO to F3 .
F3 CHECK RF PASSENGER WINDOW MOTOR	
• Remove RF passenger door window motor SJB fuse 4 (30A). • Operate the power windows using the global open procedure. • **Does the roof opening panel operate correctly?**	**Yes** INSTALL a new RF passenger window motor. REFER to Section 501-11 . TEST the system for normal operation. **No** REINSTALL SJB fuse 4 (30A). GO to F4 .
F4 CHECK GLOBAL OPEN CIRCUIT FOR AN OPEN	
• Disconnect: Roof Opening Panel Motor C921. • Disconnect: SJB C2280C. • Measure the resistance between roof opening panel motor C921-10, circuit CPW01 (BN/BU), harness side and the C2280C-10, circuit CPW01 (BN/BU), harness side.  N0102829 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new roof opening panel motor. REFER to Roof Opening Panel Motor in this section. INITIALIZE the roof opening panel motor. REFER to Roof Opening Panel Motor Initialization in this section. TEST the system for normal operation. **No** REPAIR the circuit. INITIALIZE the roof opening panel motor. REFER to Roof Opening Panel Motor Initialization in this section. TEST the system for normal operation.

Roof Opening Panel Alignment

1. Open the roof opening panel to the VENT position.

2. Loosen the 4 roof opening panel glass screws.
   - To access the glass screws, unclip the top portion of the concertina blind and position aside as shown.

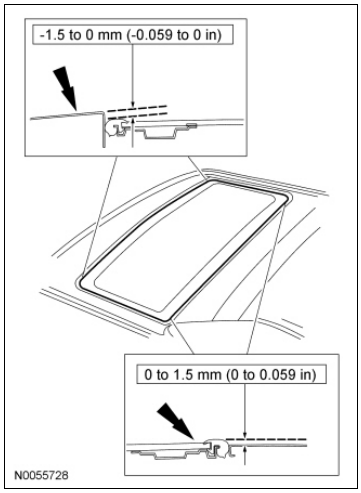


3. Close the roof opening panel glass.

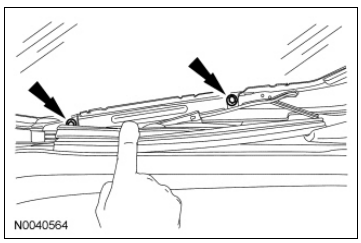
4. **NOTE:** The correct position of the roof opening panel glass to the roof panel should be -1.50 mm to 0 mm (-0.059 to 0 in) at the front edge and 0 mm to 1.5 mm (0 to 0.059 in) at the rear edge of the roof panel.

   Make sure the roof opening panel is centered in the roof opening.

   Adjust the roof opening panel glass.

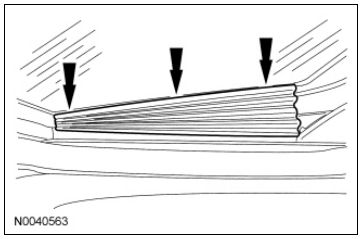


5. Tighten the 4 roof opening panel glass screws to 6 Nm (53 lb-in).



6. Open roof opening panel to the VENT position.

7. Reattach the concertina blind making sure that it is fully seated on the 3 clips in the roof panel glass.



Roof Opening Panel Motor Initialization

⚠ WARNING: Keep objects and body parts clear of the glass panel when carrying out the initialization procedure. During the initialization procedure, the glass panel closes with high force and cannot detect objects in its path. Failure to follow this instruction may result in serious personal injury.

NOTE: A new roof opening panel motor must be initialized after installation. It will only move toward the VENT position until initialized.

NOTE: The roof opening panel motor initialization procedure must be done when repairs are carried out on any part of the roof opening panel system, including: any time the roof opening panel motor has been removed from the roof opening panel assembly, a new roof opening panel motor has been installed or when a new roof opening panel assembly has been installed.

1. Turn the ignition to the RUN position.

2. For a new roof opening panel motor, press and hold the roof opening panel control switch forward until the roof opening panel glass moves to the full VENT position.

3. **NOTE:** Make sure the front door is open during this step.

   Cycle the ignition from ON to OFF and then back to ON.

4. Within 5 seconds:
   - press and release the roof opening panel control switch forward.
   - press and hold the roof opening panel control switch forward.

5. Continue holding the roof opening panel control switch forward for 5 seconds after the roof opening panel motor stops moving to confirm this position to the roof opening panel motor.

6. **NOTE:** Only complete open and close motions count towards the cycle count. If the roof opening panel reverses during closing operations, perform the cycles with the roof opening panel control switch continuously held during the closing motions.

   Release the roof opening panel switch and test the system for normal operation by checking the one-touch open, one-touch close, one-touch vent and close operations. Five complete cycles must be carried out for the roof opening panel motor to be correctly initialized.

   - If the roof opening panel does not operate correctly, repeat Steps 2 through 6.

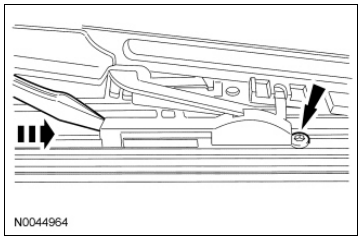
Timing Adjustment

NOTE: Anytime a roof opening panel motor is removed, the cables/mechanisms can experience free-play movement. It is important that the cables do not move. They are timed to be parallel with each other. If one or both are moved in either direction, they must be re-timed.

1. Remove the roof opening panel glass. For additional information, refer to Roof Opening Panel Glass in this section.

2. Remove the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor in this section.

3. Using a flat-blade screwdriver, push on the back of the drive slide until it contacts the timing screw. Repeat on other side.



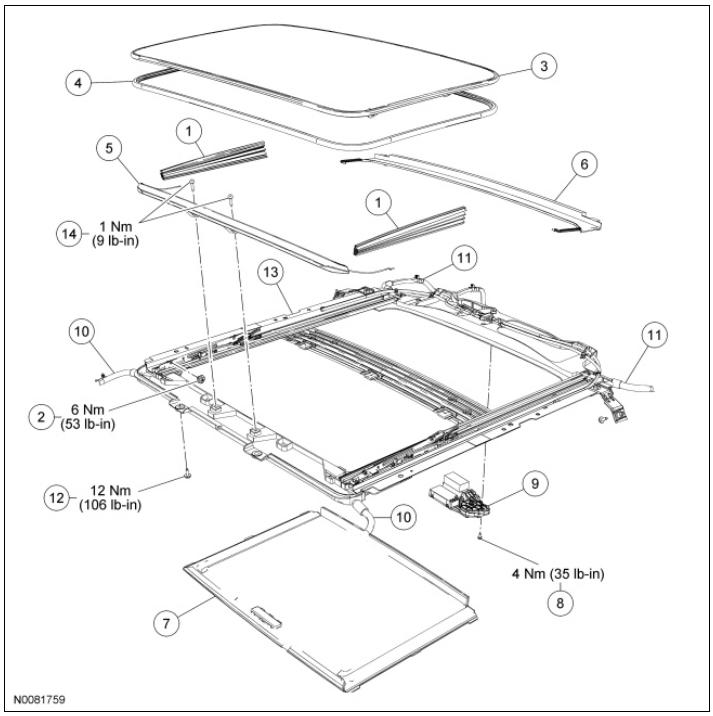
4. Reinstall the roof opening panel motor, but do not carry out the roof opening panel motor initialization. For additional information, refer to Roof Opening Panel Motor in this section.

5. Reinstall the roof opening panel glass. For additional information, refer to Roof Opening Panel Glass in this section.

6. Operate the roof opening panel to the full VENT position and hold for 6 seconds.

7. Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

Roof Opening Panel - Exploded View



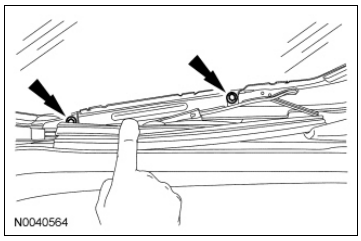
Item	Part Number	Description
1	500A66	Concertina blinds (2 required)
2	-	Roof opening panel glass screw (4 required) (part of roof opening panel glass)
3	54500A18	Roof opening panel glass
4	5451884	Roof opening panel glass seal
5	54500A26	Roof opening panel air deflector
6	7854022	Roof opening panel trough
7	54519A02	Roof opening panel shield
8	-	Roof opening panel motor screw (3 required) (part of roof opening panel motor)
9	15B689	Roof opening panel motor
10	502C52A	Front drain hoses
11	502C52B	Rear drain hoses
12	W302325	Roof opening panel frame bolt (8 required)
13	54502C22	Roof opening panel frame
14	-	Air deflector screws (part of roof opening panel air deflector)

1. For additional informatioo the individual procedures in this section.

Roof Opening Panel Glass

1. Open the roof opening panel to the VENT position.

2. Remove the 4 roof opening panel glass screws.
   - To access the glass screws, unclip the top portion of the concertina blind and position aside as shown.
   - To install, tighten to 6 Nm (53 lb-in).



3. To install, reverse the removal procedure.
   - Verify that the roof opening panel glass is centered and aligned before tightening the roof opening panel glass screws. For additional information, refer to Roof Opening Panel Alignment in this section.
   - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

Roof Opening Panel Shield

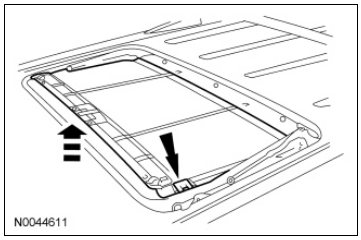
Removal and Installation

1. Remove the roof opening panel glass. For additional information, refer to Roof Opening Panel Glass in this section.

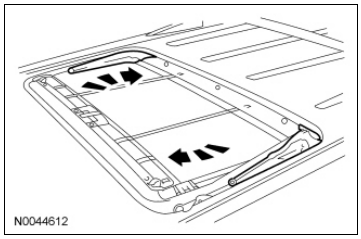
2. Remove the trough assembly. For additional information, refer to Trough Assembly in this section.

3. Slide the roof opening panel shield forward halfway.

4. Disengage the roof opening panel shield guide feet.
    - Lift the front portion of the roof opening panel shield upward at center until able to disengage one of the front guide feet.



5. With one of the guide feet released, carefully rotate the roof opening panel in a clockwise manner to disengage the remaining guide feet.



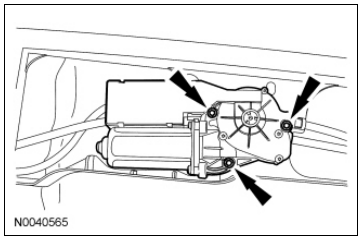
6. To install, reverse the removal procedure.
    - Verify that the roof opening panel glass is centered and aligned before tightening the roof opening panel glass screws. For additional information, refer to Roof Opening Panel Alignment in this section.
    - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

Roof Opening Panel Motor

Removal and Installation

NOTE: Anytime a roof opening panel motor is removed, the cables/mechanisms can experience free-play movement. It is important that the cables do not move. They are timed to be parallel with each other. If one or both are moved in either direction, they must be re-timed.

1. Close the roof opening panel glass.
2. Remove the 4 passenger assist handles.
3. Remove the A-pillar trim panels. For additional information, refer to Section 501-05 .
4. Remove the B-pillar trim panels. For additional information, refer to Section 501-05 .
5. Remove the C-pillar trim panels. For additional information, refer to Section 501-05 .
6. Remove the overhead console.
   - Disconnect the electrical connector.
7. If equipped, disconnect the automatic-dimming rear view mirror electrical connector.
8. If equipped, disconnect the windshield rain sensor electrical connector.
9. Remove the sun visors and the sun visor clips.
   - If equipped, disconnect the electrical connectors.
10. Remove the 2 headliner pushpins at the rear.
11. Remove the interior lamp.
    - Disconnect the electrical connector.
12. Position the headliner forward to gain access to the roof opening panel motor.
13. Remove the 3 roof opening panel motor screws and the roof opening panel motor.
    - Disconnect the electrical connector.
    - To install, tighten to 4 Nm (35 lb-in).



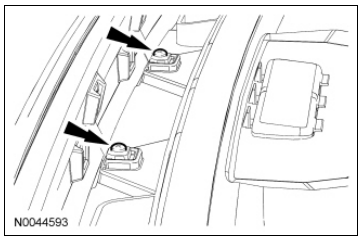
14. To install, reverse the removal procedure.
    - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

Air Deflector

Removal and Installation

1. Position the roof opening panel glass to the full OPEN position.

2. Disengage the front portion of the roof opening panel air deflector. Remove the 2 screws.
   - To install, tighten to 1 Nm (9 lb-in).



3. Lift upward and pull to unlock the spring on each side to remove the air deflector assembly.

4. To install, reverse the removal procedure.
   - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

Roof Opening Panel Frame

Removal and Installation

NOTE: If installing a new roof opening panel frame, the following components will need to be transferred from the original assembly: concertina blinds, roof opening panel glass, roof opening panel air deflector, roof opening panel trough, roof opening panel shield, roof opening panel motor, front and rear drain hoses.

1. Remove the roof opening panel glass. Refer to Roof Opening Panel Glass .

2. If installing a new roof opening panel frame, transfer all components from the original assembly to be installed on the new opening panel frame. Refer to Roof Opening Panel - Exploded View .

3. Remove the headliner. For additional information, refer to Section 501-05 .

4. Disconnect the 4 roof opening panel drain hoses.

5. Disconnect the electrical connector.

6. Remove the 8 roof opening panel frame bolts and remove the roof opening panel frame.
   - To install tighten to 12 Nm (106 lb-in).

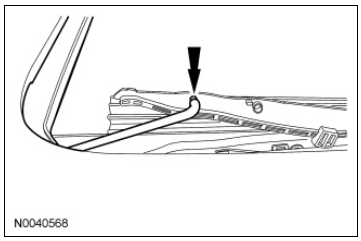
7. To install, reverse the removal procedure.
   - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

Trough Assembly

Removal and Installation

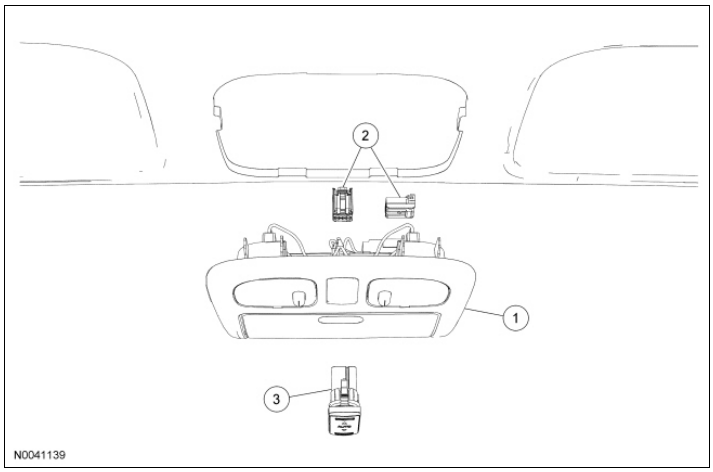
1. Remove the roof opening panel glass. For additional information, refer to Roof Opening Panel Glass in this section.

2. Remove the trough assembly.
    - Pull the trough assembly arms outward to release the trough assembly guide arm pins from the roof opening panel frame to remove.



3. To install, reverse the removal procedure.
    - Verify that the roof opening panel glass is centered and aligned before tightening the roof opening panel glass screws. For additional information, refer to Roof Opening Panel Alignment in this section.
    - Initialize the roof opening panel motor. For additional information, refer to Roof Opening Panel Motor Initialization in this section.

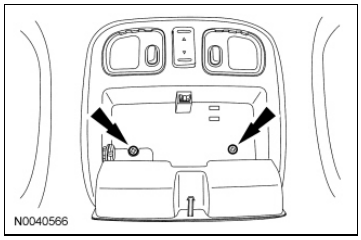
Roof Opening Panel Control Switch



Item	Part Number	Description
1	54519A70	Overhead console
2	-	Overhead console electrical connectors
3	15B69	Roof opening panel control switch

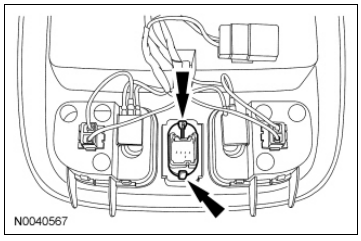
Removal and Installation

1. Open the storage compartment cover and remove the 2 screws.



2. Disconnect the overhead console electrical connectors.

3. Disengage the clips and remove the switch from the overhead console.



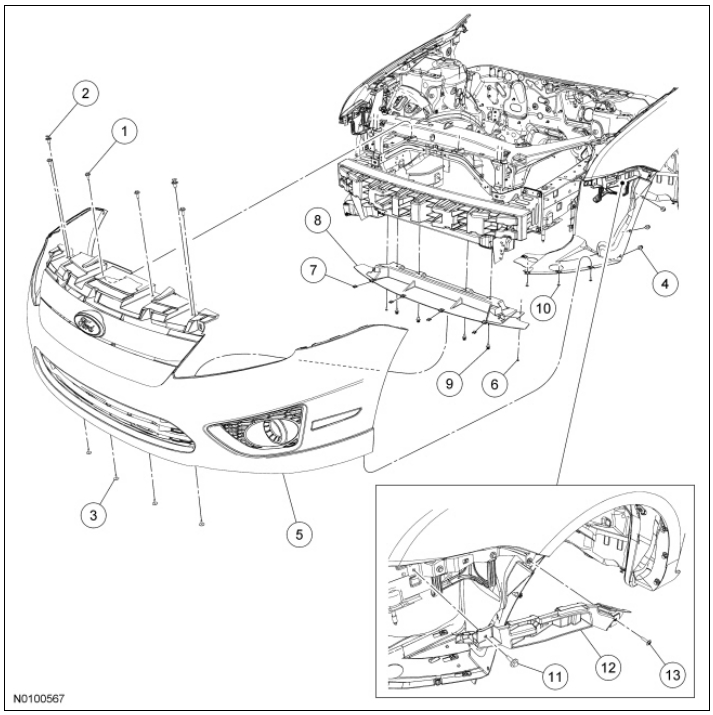
4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Front bumper bolts	25	18	-
Rear bumper bolts	25	18	-
Rear bumper nuts	25	18	-
Rear bumper stud	15	-	133

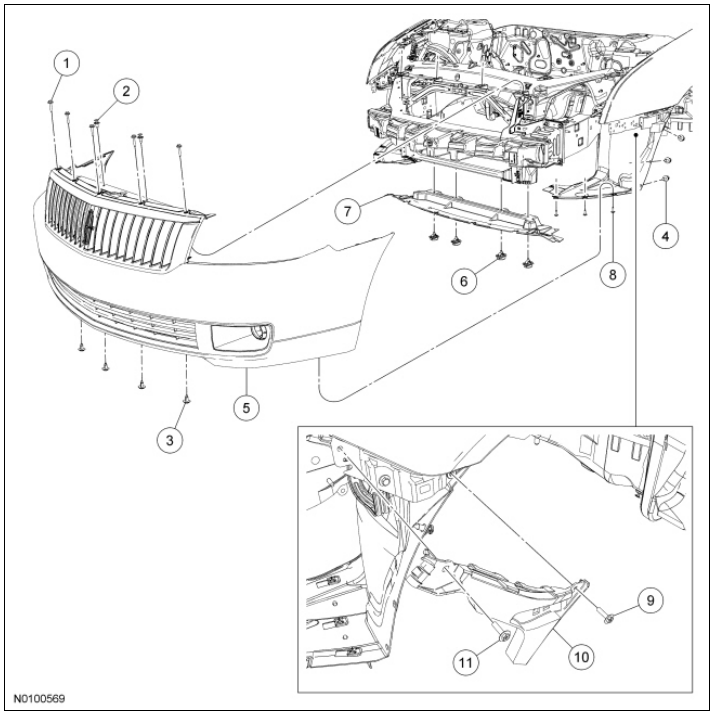
Bumper - Exploded View, Front

Fusion



Item	Part Number	Description
1	W711676	Upper radiator grille bolt (4 required)
2	N807389	Upper radiator grille pin-type retainer (2 required)
3	W709976	Lower air deflector screw (4 required)
4	N807389	Fender splash shield pin-type retainer (6 required)
5	17C831	Front bumper cover
6	W709976	Lower air deflector screw (2 required)
7	W704277	Lower air deflector clip (part of 8327) (4 required)
8	8327	Lower air deflector
9	N807389	Lower air deflector pin-type retainer (4 required)
10	W709976	Fender splash shield screw (6 required)
11	W711676	Bumper cover mounting bracket front bolt
12	17D958 LH/ 17D959 RH	Bumper cover mounting bracket
13	N808650	Bumper cover mounting bracket rear bolt

MKZ



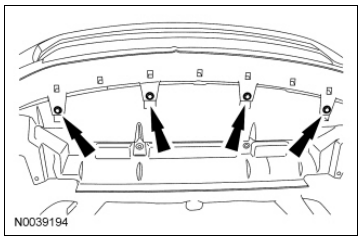
Item	Part Number	Description
1	W711676	Upper radiator grille bolt (2 required)
2	N807389	Upper radiator grille pin-type retainer (2 required)
3	W709976	Lower air deflector screw (4 required)
4	N807389	Fender splash shield pin-type retainer (4 required)
5	17C831	Front bumper cover
6	N807389	Lower air deflector pin-type retainer (4 required)
7	8327	Lower air deflector
8	W709976	Fender splash shield screw (6 required)
9	N808650	Bumper cover mounting bracket rear bolt
10	17D958 LH/ 17D959 RH	Bumper cover mounting bracket
11	W711676	Bumper cover mounting bracket front bolt

1. For additional information, refer to the procedures in this section.

Bumper Cover - Front

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the 6 pin-type retainers (3 each side).
3. Remove the 6 fender splash shield screws (3 each side).
4. Remove the 4 lower air deflector screws.



5. If equipped, disconnect the fog lamp electrical connectors.
6. Remove the 2 bolts and the 2 pin-type retainers from the top of the radiator grille.

Fusion only

7. Remove the 4 bolts and 2 pin-type retainers from the top of the radiator grille.

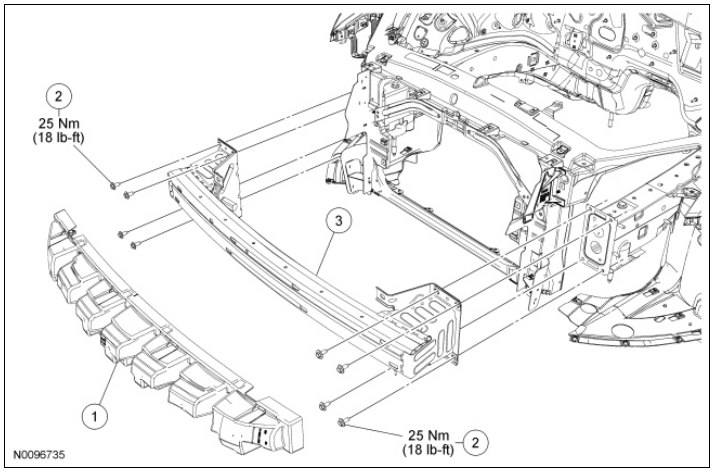
All vehicles

8. **NOTE:** The rearward upper portion of the bumper cover must be pulled outward to unclip it from the bumper cover mounting bracket.

   Remove the front bumper cover.

9. To install, reverse the removal procedure.

Bumper - Front



Item	Part Number	Description
1	17C882	Front bumper isolator
2	N811479	Front bumper mounting bolts (8 required)
3	17757	Front bumper

Removal and Installation

1. Remove the front bumper cover. For additional information, refer to Bumper Cover - Front in this section.

2. Remove the front bumper isolator from the front bumper.
   - Pull the isolator rearward while releasing the retainers.

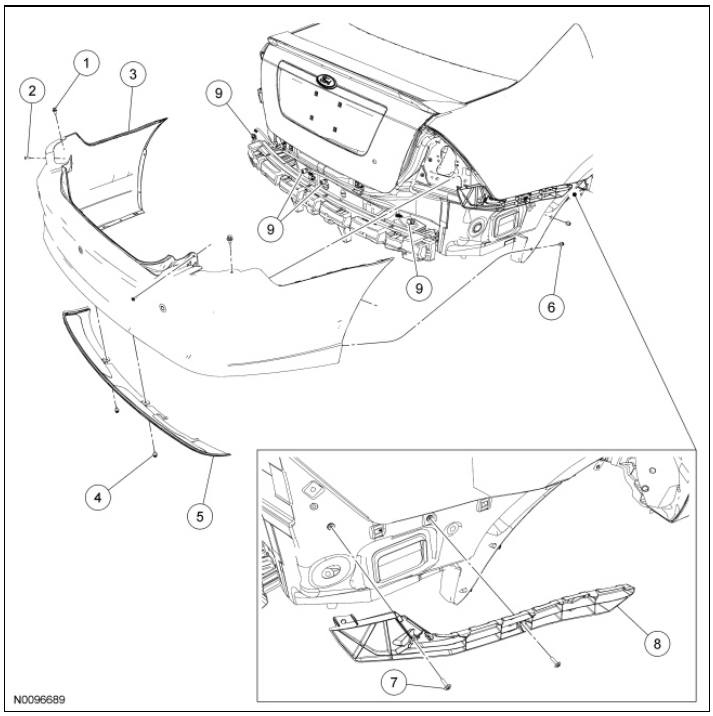
3. Remove the 8 front bumper bolts (4 each side).
   - To install, tighten to 25 Nm (18 lb-ft).

4. Remove the front bumper.

5. To install, reverse the removal procedure.

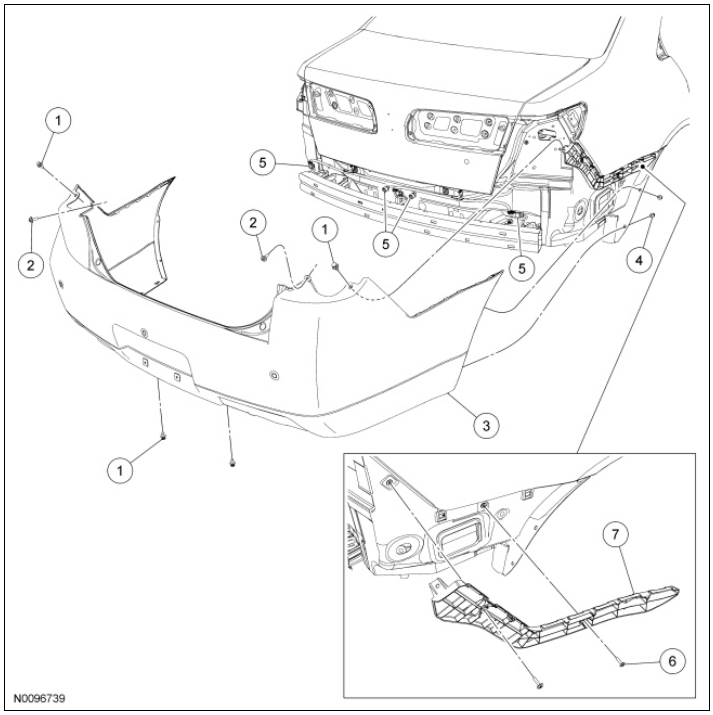
Bumper - Exploded View, Rear

Fusion



Item	Part Number	Description
1	N807389	Rear bumper cover pin-type retainer (2 required)
2	N806034	Rear bumper cover screw (2 required)
3	17K835	Rear bumper cover
4	N807389	Rear bumper cover valence pin-type retainer (2 required)
5	17808	Rear bumper cover valence
6	N807389	Fender splash shield pin-type retainer (4 required)
7	N806034	Rear bumper cover bracket screw (4 required)
8	17D948 LH/ 17D949 RH	Rear bumper cover bracket
9	-	Rear parking assist electrical connectors (part of 14N139)

MKZ



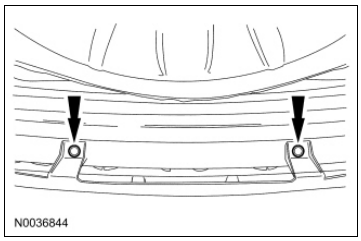
Item	Part Number	Description
1	N807389	Rear bumper cover pin-type retainers (4 required)
2	N806034	Rear bumper cover screws (2 required)
3	17K835	Rear bumper cover
4	N807389	Fender splash shield pin-type retainer (4 required)
5	-	Rear parking assist electrical connectors (part of 14N139)
6	N806034	Rear bumper cover bracket screw (4 required)
7	17D948 LH/ 17D949 RH	Rear bumper cover bracket

1. For additional information, refer to the procedures in this section.

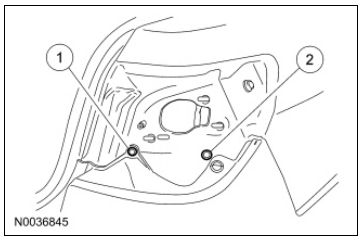
Bumper Cover - Rear

Removal and Installation

1. Remove the rear lamp assemblies. For additional information, refer to Section 417-01 .
2. Remove the 6 pin-type retainers (3 each side) from the rear splash shield.
3. Remove the 2 pin-type retainers from the lower rear bumper cover.



4. Remove the 2 bolts and 2 pin-type retainers from the top of the rear bumper cover.
    1. Remove the 2 bolts (1 shown).
    2. Remove the 2 pin-type retainers (1 shown).



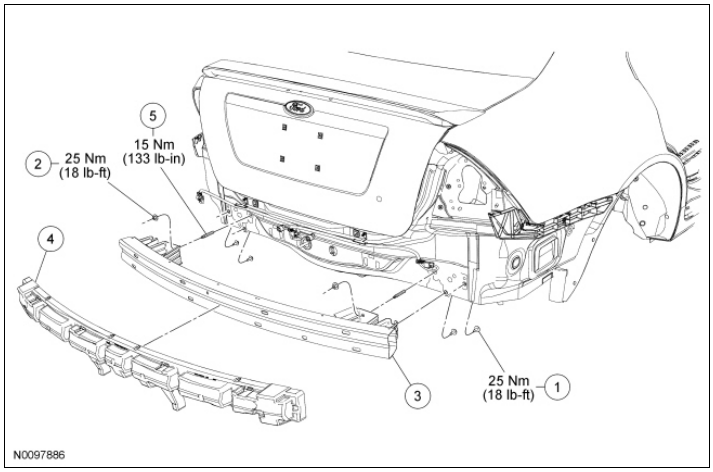
5. Remove the 2 upper bumper cover screws (1 each side).
6. If equipped, disconnect the license plate lamp electrical connector.
7. **NOTE:** The forward upper portion of the bumper cover must be pulled outward to unclip it from theper cover mounting bracket.

   Reposition the bumper cover.

   - Pull outward on both sides of the bumper cover.

8. If equipped, disconnect the parking aid system electrical connector.
9. Route the wiring harness out of the body.
10. Remove the rear bumper cover.
11. To install, reverse the removal procedure.

Bumper - Rear



Item	Part Number	Description
1	N811479	Rear bumper bolt (4 required)
2	W709361	Rear bumper nut (2 required)
3	17906	Rear bumper
4	17787	Rear bumper isolator
5	N808889	Rear bumper stud (2 required)

Removal and Installation

1. Remove the rear bumper cover. For additional information, refer to Bumper Cover - Rear in this section.

2. Remove the rear bumper isolator from the rear bumper.
   - Pull the isolator rearward to remove it from the retaining pins.

3. Remove the 2 rear bumper nuts.
   - To install, tighten to 25 Nm (18 lb-ft).

4. Remove the 4 rear bumper bolts.
   - To install, tighten to 25 Nm (18 lb-ft).

5. Remove the rear bumper.

6. tall, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Front Safety Belts			
D-ring bolt	40	30	-
Front safety belt buckle bolt	40	30	-
Safety belt retractor anchor bolt	40	30	-
Safety belt retractor and pretensioner bolt (lower)	40	30	-
Safety belt retractor and pretensioner bolt (upper)	10	-	89
Safety belt shoulder height adjuster bolt	40	30	-
Second Row Safety Belts			
Center safety belt anchor bolt	48	35	-
Center safety belt retractor bolt	40	30	-
Child safety seat tether anchor bolts	28	21	-
Rear outboard safety belt anchor bolt	48	35	-
Rear outboard safety belt retractor boltop" align="center">40	30	-	
Rear safety belt buckle bolt	48	35	-

Safety Belt System

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas must be inspected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

When installing any new active occupant restraint components, use only Ford specified service parts.

The active restraint system consists of the following serviceable items:

- Front safety belt shoulder height adjusters
- Front row safety belt buckles attached to the inboard side of the seats
- Front row safety belt retractors and pretensioners located behind the lower B-pillar trim panels
- Rear center safety belt retractor, attached to the parcel shelf sheet metal and LH safety belt buckle assembly, attached to the floor pan under the rear seat cushion
- Rear dual safety belt buckle assembly, attached to the floor pan under the seat cushion
- Child safety seat tether anchors attached to the parcel shelf sheet metal at all 3 rear seating positions
- Lower anchors and tethers for children serviced with the rear seat backrest pivot assemblies

The lower anchors and tethers for children at the inboard side of the LH rear seat position is welded to the floor pan below the rear seat cushion and is not serviceable.

Safety Belt Retractors

The safety belt retractors consist of the following features:

- Safety belt pretensioner (front only)
- Dual locking mode
    - Emergency Locking Retractor (ELR)

- ♦ Automatic Locking Retractor (ALR) (all except driver seat)

Safety Belt Retractor and Pretensioner

The pretensioner is a pyrotechnic device that deploys when activated by the Restraints Control Module (RCM) to remove excess safety belt webbing from the shoulder and lap safety belt in the event of an impact. If a deployment of the safety belt retractor and pretensioners occurs, a new assembly must be installed. Refer to Safety Belt Retractor and Pretensioner in this section.

For safety belt retractor and pretensioner diagnostic and disposal information, refer to Section 501-20B .

Emergency Locking Retractor (ELR)

The ELR is a vehicle sensitive feature designed to activate and lock the safety belt webbing when braking hard, cornering hard or in an impact of approximately 8 km/h (15 mph). The ELR feature helps to reduce the forward movement of the driver and passengers. For testing, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Automatic Locking Retractor (ALR)

The ALR mode is used when locking a child seat in an outboard seating position. The ALR mode is automatically activated when the safety belt webbing is fully extracted from the retractor and then allowed to retract. As the safety belt webbing is retracted back onto the spool, an audible clicking sound is made indicating the safety belt retractor is in ALR mode and the safety belt webbing will not pull back out of the safety belt retractor. To disengage the ALR mode, allow the safety belt webbing to fully retract back onto the spool. The ALR mode is disengaged when the webbing is free to extract and retract back into the retractor. For testing, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Buckles

The front seat safety belt buckles are attached to the front seat tracks.

The rear dual seat safety belt buckles are attached to the floor pan behind the rear seat cushion.

Child Safety Seat Restraints

The child safety seat restraints include the following items:

- Child safety seat tether anchors located at each second row seating position attached to the parcel shelf.
- Non-serviceable lower anchors and tethers for children system located at the outboard seating positions and is a structural member of the seat frame and floor pan beneath the rear seat cushion.

If a child safety seat was in use during a collision, inspect the child safety seat component mounting areas and repair any damage and restore the vehicle to the original production configuration.

Safety Belt System

Principles of Operation

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas must be inspected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

Safety Belt Warning System

The safety belt warning indicator illuminates and a chime sounds to remind the occupants to fasten their safety belts.

The conditions of operation for the safety belt warning indicator and chime are as follows:

- If the driver and/or front passenger safety belt is not buckled before the ignition switch is turned to ON, the safety belt warning indicator illuminates for 1 to 2 minutes and the warning chime sounds for 4 to 8 seconds.
- If the driver and/or front passenger safety belt is buckled while the warning indicator is illuminated and the warning chime is sounding, the safety belt warning indicator and warning chime turn off.
- If the driver and/or front passenger safety belt is buckled before the ignition switch is turned to ON, the safety belt warning indicator and warning chime remain off.

Belt-Minder®

The Belt-Minder® feature is a supplemental warning to the safety belt warning function. This feature provides additional reminders to the driver that the driver and/or front passenger safety belt is unbuckled by

intermittently sounding a chime and illuminating the safety belt warning indicator in the Instrument Panel Cluster (IPC).

Either the driver or front passenger safety belt systems may activate the Belt-Minder®. If the Belt-Minder® warnings have expired (warnings for approximately 5 minutes) for one occupant (driver or front passenger), the other occupant can still activate the Belt-Minder® feature.

When a MyKey ™ is in the ignition, deactivation of the Belt-Minder® will be ignored. The Belt-Minder® feature can be activated or deactivated by the administrator key. Using a MyKey ™ (non-administrator key) will override the 5-minute Belt-Minder® timer and the deactivation of the Belt-Minder® feature. Refer to Section 419-01B or the Owner's Literature for further information on MyKey ™ functionality.

The passenger Belt-Minder® feature is activated only when the Occupant Classification Sensor (OCS) system detects a passenger front seat and the passenger weight exceeds a programmed limit. For information on the OCS system, refer to Section 501-20B .

To activate or deactivate the Belt-Minder® feature, refer to Section 413-01 .

If...	Then...
the driver and/or front passenger safety belt is buckled before the ignition switch is turned to the ON position or less than 1-2 minutes have elapsed since the ignition switch has been turned ON...	the Belt-Minder® feature will not activate.
the driver and/or front passenger safety belt is not buckled before the vehicle has reached at least 5 km/h (3 mph) and 1-2 minutes have elapsed since the ignition switch has been turned to ON...	the Belt-Minder® feature is activated - the safety belt warning indicator illuminates and the warning chime sounds for 6 seconds every 30 seconds, repeating for approximately 5 minutes or until the safety belt(s) is buckled.
the driver or front passenger safety belt becomes unbuckled for approximately 1 minute while the vehicle is traveling at least 5 km/h (3 mph) and more than 1-2 minutes have elapsed since the ignition switch has been turned to ON...	the Belt-Minder® feature is activated - the safety belt warning indicator illuminates and the warning chime sounds for 6 seconds every 30 seconds, repeating for approximately 5 minutes or until the safety belt(s) is buckled.

Inspection and Verification

1. Verify the customer concern by operating the active restraint system to duplicate the condition.

2. Inspect to determine if any of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
• Cut, frayed or incorrectly routed safety belt webbing	• Wiring, terminals or connectors

• Safety belt buckle and tongue assembly • Safety belt retractor	• Safety belt warning indicator burned out or broken • High Speed Controller Area Network (HS-CAN) network concern

3. If the inspection reveals an obvious concern(s) that can be readily identified, service as required. With the exception of removing a twist from the safety belt webbing, do not attempt to repair a component of the safety belt system; new componenst be installed.

4. If the concern remains after the inspection, determine the symptom. GO to Symptom Chart .

5. To check the active restraint system for correct operation, carry out the appropriate Functional Test(s).

Symptom Chart

Symptom Chart

Component Test

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- ♦ Retractors
- ♦ Buckles
- ♦ Child safety seat tether bracket assemblies
- ♦ Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- ♦ Belt tension sensor (BTS) (if equipped)
- ♦ Front safety belt buckle support assemblies (slide bar) (if equipped)
- ♦ Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas must be inspected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

Carry out the appropriate Functional Test(s) as determined in Inspection and Verification.

Functional Test - Buckle and Tongue

The safety belt buckle and tonguessembly must operate freely during the latching and unlatching function. Fasten the safety belt by inserting the tongue (male portion) into the buckle (female portion).

1. Verify the following during the latching sequence:
    - Tongue insertion is not hindered by excessive effort.
    - A click is heard when the safety belt buckle latches the tongue.

2. Verify the system integrity by forcefully pulling on the safety belt webbing.

3. Unlatch the safety belt by fully depressing the safety belt buckle release button and allowing the safety belt to release and retract.

4. Verify the following during the unlatching process:
    - Push-button depression does not require excessive effort.
    - The tongue can be removed easily from the buckle.

5. Repeat the above steps 3 times.

6. If the functional test reveals a concern(s), install a new safety belt buckle or safety belt retractor as required.

Functional Test - Safety Belt Retractor

The safety belt retractor must be freely operational for extraction and retraction of the safety belt webbing between full extension and in-vehicle stowed positions.

1. Extract and retract the safety belt between the full extension and stowed positions.

2. Verify the safety belt retractor operates without excessive effort or binding.

3. Install a new safety belt retractor if any concern is found or the complaint has been verified.

Functional Test - Safety Belt Retractor, Automatic Locking Retractor (ALR) Mode

1. Position the seat backrest fully upright (if adjustable).

3. Fasten the safety belt.

4. Pull out the safety belt webbing until the ALR feature is activated.

5. Allow the safety belt webbing to retract until it stops.

6. Pull on the safety belt webbing to check that the safety belt retractor has remained in the ALR mode. If the safety belt retractor is not locked, install a new safety belt retractor.

7. Unfasten the safety belt and allow the safety belt webbing to retract to its stowed position.

8. Pull out and retract the safety belt webbing to verify the safety belt retractor has converted automatically out of ALR mode. If the safety belt retractor remains locked in the ALR mode, install a new safety belt retractor.

Functional Test - Safety Belt Retractor, Road Test Inspection

⚠ WARNING: The driver and passenger must be prepared brace themselves in the event the safety

belt retractor does not lock. Failure to follow this instruction may result in serious personal injury.

NOTE: Make sure there is no excessive slack in the safety belt webbing across the torso during testing.

NOTE: Do not jerk on the safety belt webbing when carrying out this test.

1. Test the safety belts in the following sequence:
    1. Fasten the safety belts and proceed to a safe area.
    2. Attain a speed of 24 km/h (15 mph).
    3. ⚠ **WARNING: Apply maximum brake force only on dry concrete or equivalent hard surface, NEVER on wet pavement or gravel. Failure to follow this instruction may result in serious personal injury.**

       Grasp the shoulder harness, lean forward and apply the brakes, making a maximum braking application without a skid.
    4. The safety belts should lock up with minimum webbing extension.
    5. If there is a lockup of all safety belt retractors being tested, the safety belt retractors are functioning correctly. If any safety belt retractor fails to lock up, install a new safety belt retractor(s).

Safety Belt Cleaning

1. ⚠ **WARNING: Do not bleach or re-dye the safety belt webbing, as the webbing may weaken. Failure to follow this instruction may increase the risk of serious personal injury or death in a crash.**

   Clean the safety belt webbing only with a mild soap solution recommended for cleaning upholstery or carpets. Follow the instructions provided with the soap.

Safety Belt Maintenance

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas must be inspected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

1. The safety belt assemblies should be periodically inspected to make sure that they have not become damaged and that they remain in correct operating condition, particularly if they have been subjected to severe stress.

2. Before installing the new safety belt assembly, the safety belt retaining areas must be inspected for damage and distortion. If the retaining points are damaged and distorted, the sheet metal must be reworked back to its original shape and structural integrity.

3. Install the new safety belt(s) using the appropriate instructions. Carry out the appropriate Functional Test Procedure. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System , Component Test, in this section.

Safety Belt Procedure After a Collision

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas must be inspected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

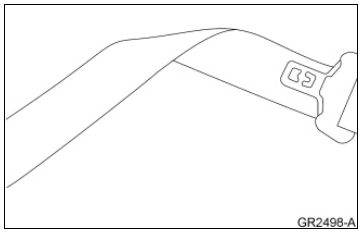
Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

1. Before installing a new safety belt assembly, the safety belt attaching areas must be inspected for damage and distortion. If the attaching points are damaged and distorted, the sheet metal must be worked back to its original shape and structural integrity.

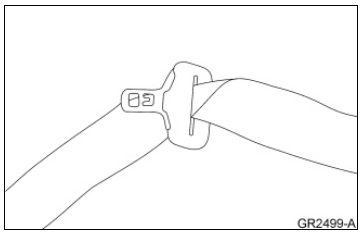
2. Install the new safety belt(s). For additional information, refer to the appropriate procedure in this section. Carry out all applicable Functional Tests for the component(s). For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Tongue Rotated on Belt

1. Fold the safety belt as indicated.



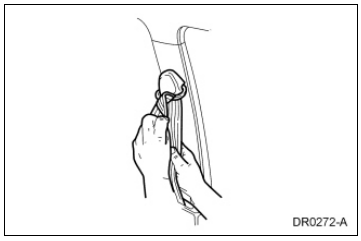
2. Pull the safety belt tongue over the fold in the safety belt.



Safety Belt Twisted at the Safety Belt Guide

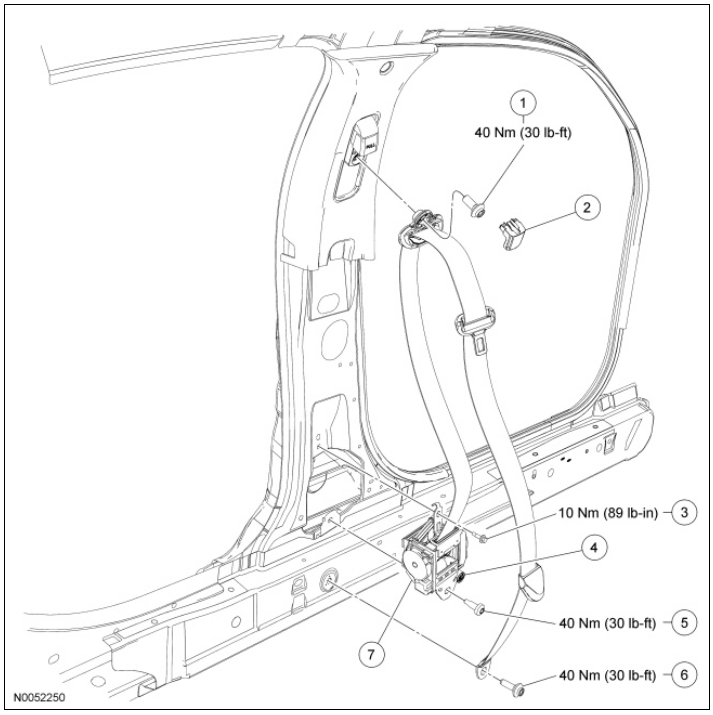
NOTE: Typical D-ring shown, others similar.

1. Grasp the belt webbing at the shoulder belt guide (D-ring).
2. Rotate and fold the belt webbing over itself to remove the twist.
3. Feed the folded portion of the belt through the safety belt guide (D-ring).



Safety Belt Retractor and Pretensioner

NOTE: LH shown, RH similar.



Item	Part Number	Description
1	-	Bolt, D-ring (part of 611B09 LH/ 611B08 RH)
2	60262	Cover, D-ring
3	W505253	Bolt, safety belt retractor (upper)
4	-	Electrical connector
5	W700883	Bolt, safety belt retractor and pretensioner (lower)
6	-	Bolt, safety belt retractor anchor (part of 611B08 RH/ 611B09 LH)
7	611B08 RH/ 611B09 LH	Safety belt retractor and pretensioner

Removal and Installation

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas must be inspected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safet pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

⚠ WARNING: Never disassemble or tamper with safety belt buckle/retractor pretensioners, adaptive load limiting retractors, safety belt inflators, or probe the electrical connectors. Failure to follow this instruction may result in the accidental deployment of the safety belt pretensioners, adaptive load limiting retractors, or safety belt inflators, which increases the risk of serious personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .

2. **NOTE:** Inspect the D-ring cover for damage. If the cover is damaged or does not remain attached, install a new D-ring cover.

   Remove the D-ring cover.

3. Remove the bolt and D-ring.
   - To install, tighten to 40 Nm (30 lb-ft).

4. Remove the lower B-pillar trim panel. For additional information, refer to Section 501-05 .

5. Remove the safety belt retractor anchor.
   - For passenger seat, remove the seat side shield cover.
   - Remove the bolt and safety belt retractor anchor.
     - ♦ To install, tighten to 40 Nm (30 lb-ft).

6. Disconnect the electrical connector.

7. Remove the upper bolt.
   - To install, tighten to 10 Nm (89 lb-in).

8. Remove the lower bolt and safety belt retractor and pretensioner.
   - To install, tighten to 40 Nm (30 lb-ft).

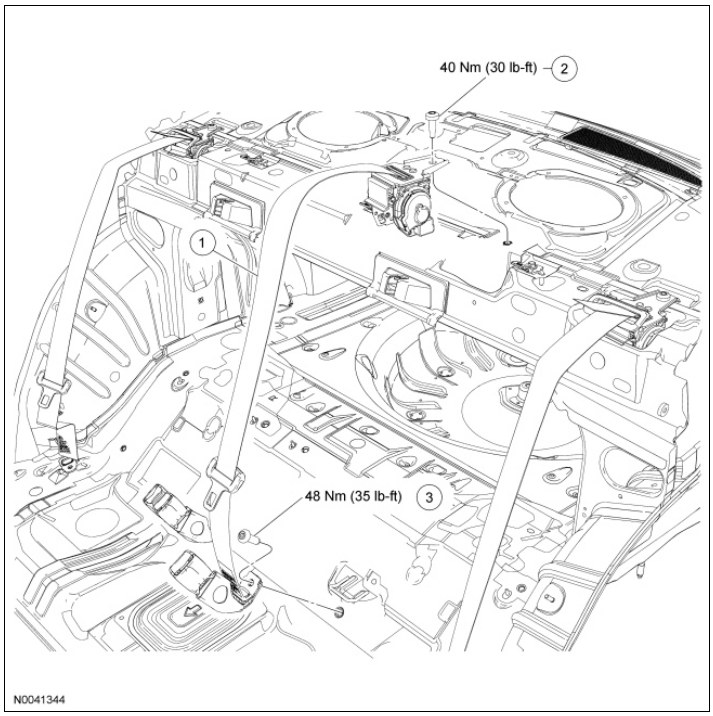
9. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   To install, reverse the removal procedure.

10. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of Section 501-20B .

11. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Retractor - Rear, Center



Item	Part Number	Description
1	611B66	Rear center safety belt retractor
2	-	Bolt, safety belt retractor (part of 611B66)
3	-	Bolt, safety belt anchor (part of 611B66)

Removal and Installation

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas mustected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

1. Remove the parcel shelf. For additional information, refer to Section 501-05 .

2. Remove the bolt and safety belt retractor anchor.
   - To install, tighten to 48 Nm (35 lb-ft).

3. Remove the bolt and center safety belt retractor.
   - To install, tighten to 40 Nm (30 lb-ft).

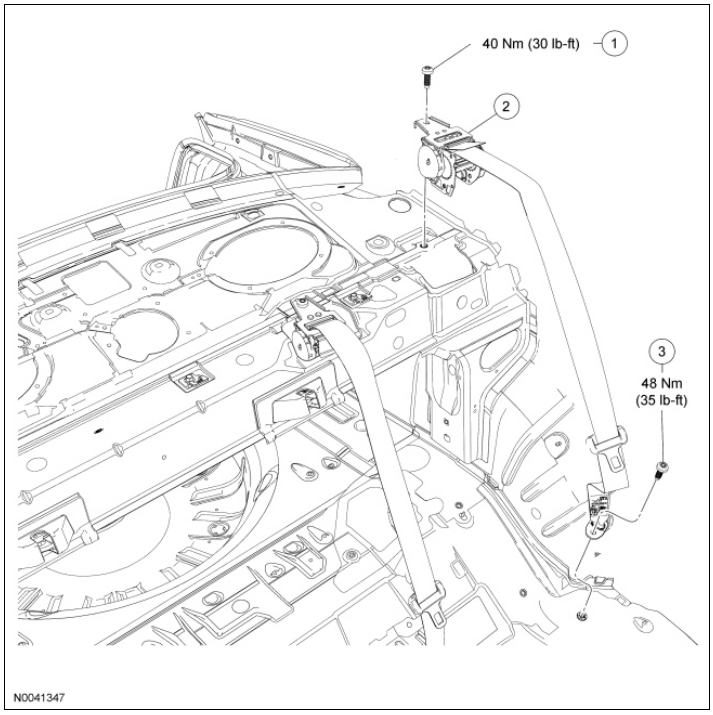
4. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   To install, reverse the removal procedure.

5. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Retractor - Rear, Outboard

NOTE: LH shown, RH similar.



Item	Part Number	Description
1	-	Bolt, safety belt retractor (part of 611B68)
2	611B68	Safety belt retractor assembly
3	-	Bolt, safety belt anchor (part of 611B68)

Removal and Installation

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components. r>Safety belt assembly attaching areas must be inspected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

1. Remove the parcel shelf. For additional information, refer to Section 501-05 .

2. Remove the bolt and safety belt retractor anchor.
   - To install, tighten to 48 Nm (35 lb-ft).

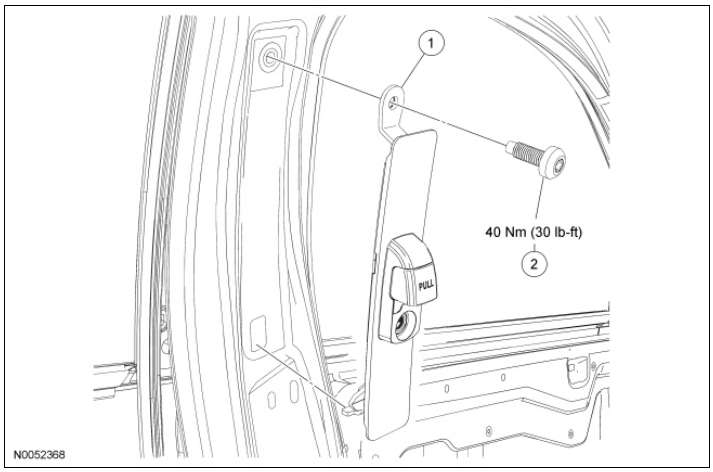
3. Remove the bolt and safety belt retractor.
   - To install, tighten to 40 Nm (30 lb-ft).

4. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   To install, reverse the removal procedure.

5. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Shoulder Height Adjuster



Item	Part Number	Description
1	602B82	Safety belt shoulder height adjuster
2	-	Bolt (part of 602B82)

Removal and Installation

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas must be inspected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

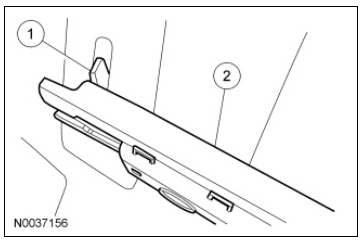
1. Remove the upper B-pillar trim panel. For additional information, refer to Section 501-05 .

2. Position the safety belt shoulder height adjuster down and remove the bolt.
   - To install, tighten to 40 Nm (30 lb-ft).

3. **NOTE:** When installing the safety belt shoulder height adjuster, the lower T-tab must be engaged into the body prior to installing the bolt.

   Remove the safety belt shoulder height adjuster.

   1. Rotate the safety belt shoulder height adjuster downward to release the lower tab.
   2. Remove the safety belt shoulder height adjuster.



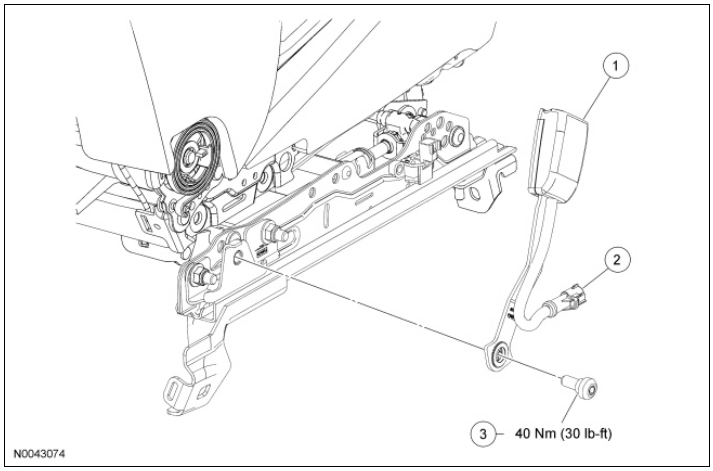
4. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   To install, reverse the removal procedure.

5. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Buckle - Front

NOTE: LH shown, RH similar.



Item	Part Number	Description
1	61203 LH/ 61202 RH	Safety belt buckle
2	-	Electrical connector
3	-	Bolt (part of 61203 LH/ 61202 RH)

Removal and Installation

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas must cted. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

All seats

1. Remove the seat. For additional information, refer to Section 501-10 .

2. Disconnect the electrical connector.
   - Release the retainer on the side of the seat cushion cover to remove the wire for the safety belt buckle switch.

3. Remove the bolt.
   - To install, tighten to 40 Nm (30 lb-ft).

4. Remove the safety belt buckle through the opening in the seat cushion cover.

5. To install, reverse the removal procedure.
   - For correct installation, make sure the safety belt buckle is routed through the seat cushion cover.

6. Install the seat. **If the passenger seat has been serviced, do not prove out the SRS at this time.** For additional information, refer to Section 501-10 .

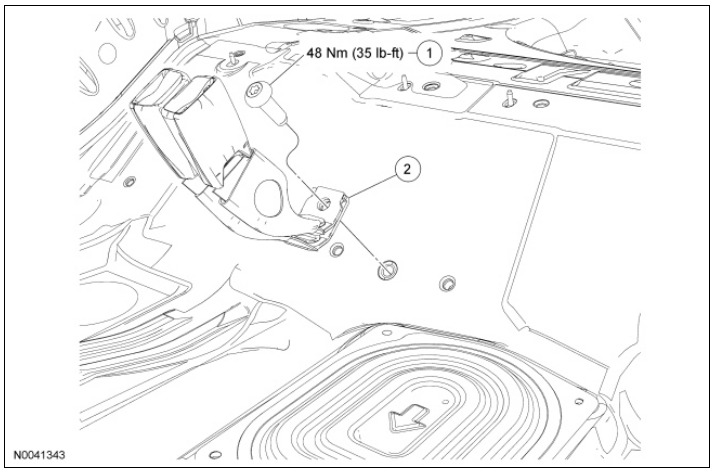
Passenger seat

7. Carry out the Occupant Classification Sensor (OCS) System Reset. For additional information, refer to General Procedures in Section 501-20B .

All seats

8. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Safety Belt Buckle - Rear



Item	Part Number	Description
1	-	Bolt (part of 60044)
2	60044	RH and center safety belt buckle assembly

Removal and Installation

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas must be inspected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembl new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

NOTE: The LH safety belt buckle is a part of the center safety belt retractor assembly and is not serviced separately. To remove the LH safety belt buckle, refer to Safety Belt Retractor - Rear, Center in this section.

1. Remove the rear seat cushion. For additional information, refer to Section 501-10 .

2. Remove the bolt and dual safety belt buckle assembly.
    - To install, tighten to 48 Nm (35 lb-ft).

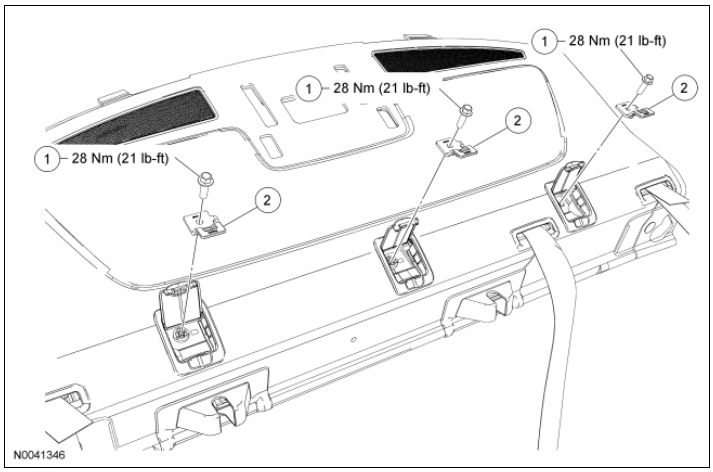
3. **NOTE:** Before installation, make sure the safety belt webbing is not twisted and the safety belts and buckles are accessible to the occupants.

   NOTE: The anti-rotation tab of the safety belt anchor buckle assembly must be correctly aligned before tightening fastener for correct installation.

   To install, reverse the removal procedure.

4. Check the active restraint system for correct operation. For addition information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Child Safety Seat Tether Anchor



Item	Part Number	Description
1	-	Bolts (part of 613D26)
2	613D26	Safety seat tether anchors

Removal and Installation

⚠ WARNING: After a crash, the following safety belt components and attaching hardware must be inspected and tested to verify correct function:

- Retractors
- Buckles
- Child safety seat tether bracket assemblies
- Automatic locking retractor (ALR) feature for child safety seats (passenger seating positions only)
- Belt tension sensor (BTS) (if equipped)
- Front safety belt buckle support assemblies (slide bar) (if equipped)
- Safety belt shoulder belt height adjusters (if equipped)

Components that do not operate correctly or pass all Functional Tests in the Component Tests of this section must be replaced with new components.

Safety belt assembly attaching areas must be inspected. Damaged or distorted attaching areas must be restored to their original structural integrity and a new safety belt assembly with new attaching hardware must be installed.

After deployment of the front safety belt pretensioners, a new safety belt system (including retractors, buckles and height adjusters) must be installed.

Failure to follow this instruction may result in incorrect operation of the safety belt system and increases the risk of serious personal injury or death in a crash.

1. Open the cover and remove the bolt and child safety seat tether anchor.
   - To install, tighten to 28 Nm (21 lb-ft).

2. **WARNING: Always tighten the child safety seat tether anchor/bolt to specification. Failure to follow this instruction may result in the child's safety seat being incorrectly secured, which increases the risk of serious personal injury or death to the child in a sudden stop or crash.**

   To install, reverse the removal procedure.

3. Check the active restraint system for correct operation. For additional information, refer to the appropriate Functional Test procedure in Safety Belt System in this section.

Torque Specifications

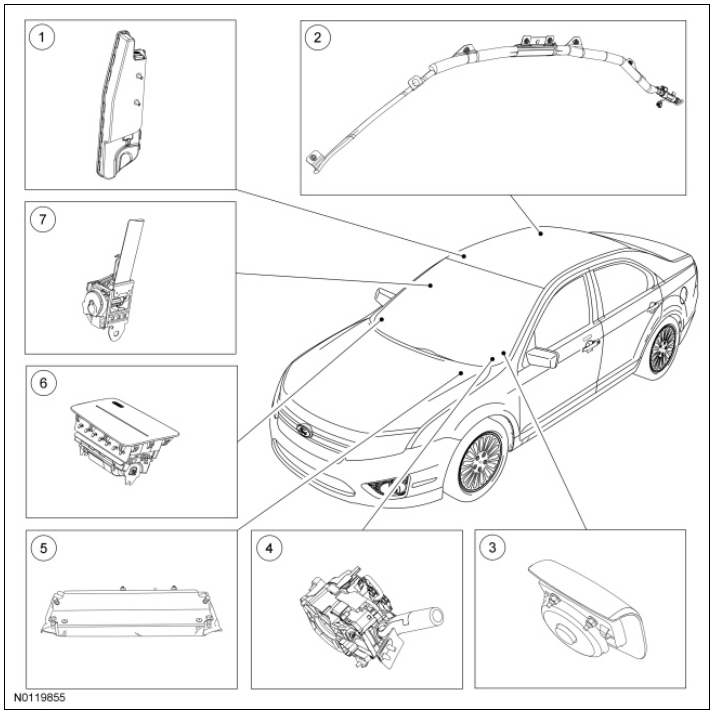
Description	Nm	lb-ft	lb-in
Front impact severity sensor bolts	12	-	106
Knee air bag module bolts - driver (Hybrid)	9	-	80
Occupant Classification System (OCS) weight sensor assembly bolts	25	18	-
Passenger air bag module-to-deployment chute bolts	9	-	80
Passenger air bag module bolts (to cross-car beam bracket)	9	-	80
Passenger air bag module deployment chute nuts	10	-	89
Restraints Control Module (RCM) bolts	12	-	106
Seat position sensor bolt	6	-	53
Seat risers-to- OCS weight sensor assembly bolts	25	18	-
Seat track-to-floor bolts	47 35	-	
Side air bag module nuts	8	-	71
Side air curtain module bolts	8	-	71
Side impact sensor (front door) bolt	2	-	18
Side impact sensor (C-pillar) bolt	12	-	106
Steering column opening cover reinforcement	3	-	27

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

The Supplemental Restraint System (SRS) is designed to provide increased crash protection for front seat and second row outboard occupants, in addition to that provided by the 3-point safety belt system. Safety belt use is necessary to obtain the best occupant protection and to receive the full advantage of the SRS .

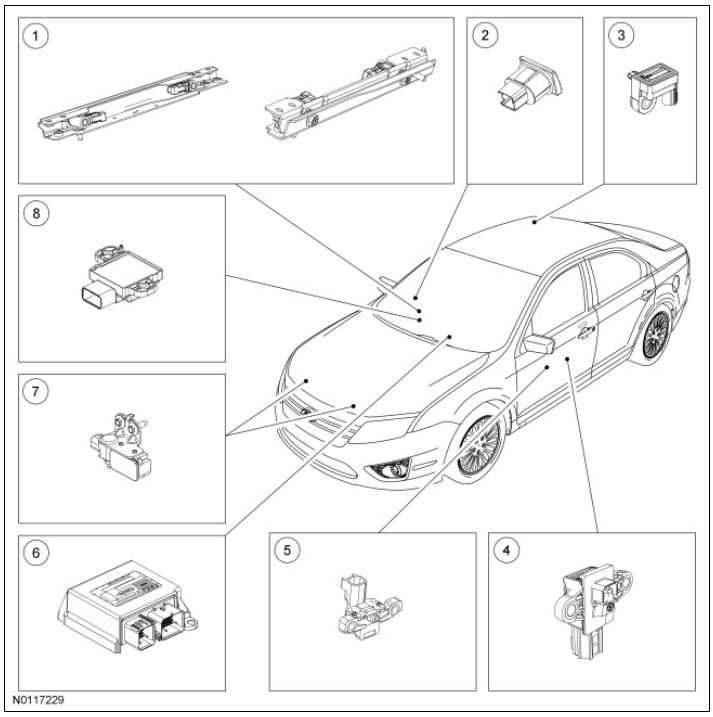
The serviceable air bag and safety belt pretensioner SRS components are shown in the following illustrations.

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) Components (1 of 2)



Item	Part Number	Description
1	611D10 RH/ 611D11 LH	Seat side air bag module
2	042D94 RH/ 042D95 LH	Side air curtain modules
3	043B13	Driver air bag module
4	14A664	Clockspring
5	045J77	Driver knee air bag module (hybrid vehicles only)
6	044A74	Passenger air bag module assembly
7	611B08 RH/ 611B09 LH	Safety belt retractor pretensioner

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) Components (2 of 2)



Item	Part Number	Description
1	61708 RH/ 61709 LH	Occupant Classification System (OCS) weight sensor assembly (2 required)
2	10A936	Passenger Air Bag Deactivation (PAD) indicator (Fusion)
3	14B345	Side impact sensor (C-pillar)
4	14B345	Side impact sensor (front door) (pressure sensor)
5	14B416	Driver seat track position sensor
6	14B321	Restraints Control Module (RCM)
7	14B345	Front impact severity sensor (2 required)
8	14B056	Occupant Classification System Module (OCSM)

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Refer to Wiring Diagrams Cell 46 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information.

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

The Restraints Control Module (RCM) continuously receives/monitors all inputs from the following Supplemental Restraint System (SRS) components.

- LH and RH front impact severity sensor
- Driver and Passenger front door side impact sensor
- Driver and Passenger C-pillar side impact sensor
- Safety belt buckle switches (driver and passenger)
- Driver seat track position sensor
- Occupant Classification System Module (OCSM)

If the RCM detects sudden vehicle deceleration and/or lateral deceleration based on all the information received from all sensors and switches and determines that deployment is required, the RCM sends voltage and current to deploy the appropriate SRS components.

During a frontal or side crash, the RCM may deploy the following SRS components, based on crash severity and sensor input.

- Safety belt retractor pretensioner(s)
- Seat side air bag(s)
- Side air curtain(s)
- Driver/passenger dual-stage air bag (one or both stages)

The fact that the safety belt retractor pretensioners, side air curtains and side air bags did not activate for both front seat occupants in a crash does not mean that something is wrong with the system.

The RCM performs a self-test of the SRS during each startup. If a SRS fault exists, the air bag warning indicator will illuminate and remain illuminated for the rest of the ignition cycle. In addition to the self-test at

start up, the RCM continuously monitors all of its SRS components and circuitry for correct operation.

Air Bag Warning Indicator

The air bag warning indicator:

- located in the Instrument Panel Cluster (IPC) will prove out by lighting for 6 seconds then turn off.
- will flash and/or illuminate based on the message the IPC receives from the RCM .
- will illuminate if the IPC does not receive a message from the RCM .

Air Bag Module Second Stage Deployment Check

Because the driver and passenger front air bags each have 2 deployment stages, it is possible that stage 1 has deployed and stage 2 has not.

If a front air bag module has deployed, it is **mandatory** that the front air bag module be remotely deployed using the appropriate air bag disposal procedure.

- For information on driver air bag module and/or passenger air bag module remote deployment, refer to Pyrotechnic Device Disposal in this section.

Clockspring

The clockspring allows for continuous electrical connections between the driver air bag module and the RCM when the steering wheel is turned.

Driver Air Bag Module

The driver air bag module is a dual-stage air bag, deploying at 1 of 2 different rates depending upon impact severity and sensor input.

High Speed Controller Area Network (HS-CAN)

This vehicle utilizes a communication system called a High Speed Controller Area Network (HS-CAN). The RCM communicates with various modules for required information about the vehicle. Refer to Section 418-00 for additional information about the HS-CAN .

Impact Sensors

For these vehicles, the SRS employs 7 impact sensors. One of the sensors is integral to the RCM and is not separately serviceable. The RCM is mounted on the center tunnel between the front seats. There are 2 front impact severity sensors located in the front-center of the vehicle, behind the grille. In addition, there are 4 side impact sensors. The first row side impact sensors are pressure sensors mounted to each front door behind the trim panel. The second row side sensors are located on or near the base of the C-pillar. Mounting orientation is critical for correct operation of all impact sensors.

The side impact sensors are **not** interchangeable.

Occupant Classification System (OCS) System

The Occupant Classification System (OCS) system is found only on the front passenger seat. The OCS system classified the size of the front passenger seat occupant and provides this information to the Restraints Control Module (RCM). The RCM uses this information (and other inputs) in determining the deployment strategy of the passenger air bag module and pretensioner. The front passenger OCS system is comprised of the following: 4 OCS weight sensor bolts that are mounted to each corner of the seat track and an OCSM which is mounted to the electrical bracket underneath the seat cushion pan. The weight of any occupant or object on the front passenger seat is electronically communicated to the OCSM . The OCS weight sensor bolts are serviced as an assembly (2 weight sensor bolts and mounting bracket per side), the OCSM is serviced separately.

The OCS system is also used for operation of the passenger Belt-Minder®. For information on the passenger Belt-Minder® feature, refer to Section 501-20A . To deactivate or reactivate the passenger Belt-Minder® feature, refer to Section 413-01 or the Owner's Literature.

Passenger Air Bag Deactivation (PAD) Indicator

The RCM controls the state of the Passenger Air Bag Deactivation (PAD) indicator, based on information provided by the OCS system. The PAD indicator is lit to indicate the front passenger air bag module is disabled. An exception to this is when the front passenger seat is determined to be empty, and therefore indication of a deactivated passenger air bag module is not necessary. In all cases, the PAD indicator is off when the passenger air bag module is enabled.

The RCM briefly activates the PAD indicator to prove-out the indicator function and verify to the front occupants correct functional operation of the PAD indicator.

The following table indicates the passenger air bag status and the PAD indicator status based on the size of the front passenger occupant.

Passenger Air Bag and PAD Indicator Status

Occupant Size	Passenger Safety Belt Buckle Status	Pass. Air Bag Status	PAD Ind. Status
Empty	Unbuckled	Disabled	Unlit
Empty	Buckled	Disabled	Lit
Infant or Small Child	Buckled/ Unbuckled	Disabled	Lit
Adult Sized	Buckled/ Unbuckled	Enabled	Unlit

Passenger Air Bag Module

The passenger air bag module is a dual-stage air bag, deploying at 1 of 2 different rates depending upon impact severity, sensor input, safety belt usage and passenger seat occupant classification.

Restraints Control Module (RCM)

⚠ WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to

the original production configuration. A new RCM and sensors must be installed whether or not the air bags have deployed. Failure to follow these instructions may result in serious personal injury or death in a crash.

NOTE: This vehicle is equipped with the SYNC® feature which contains the 911 assist option. Refer to the Owner's Literature.

The RCM carries out the following functions:

- Deploys the air bag(s)/side air curtain(s) in the event of a deployable collision
- Activates the safety belt retractor pretensioner to control tension on the safety belt in the event of a deployable collision
- Monitors the SRS for faults
- Sends a message to the IPC to flash/illuminate the air bag warning indicator if a fault is detected
- Communicates through the DLC the current or historical DTCs

The RCM monitors the SRS for possible faults. If a SRS fault exists, the RCM sends a message to the span title="Instrument Panel Cluster" class="popup" onmouseover="this.className='popupnounderline';" onmouseout="this.className='popup';">IPC to illuminate the air bag warning indicator.

When the ignition is cycled (OFF and then ON), the IPC will prove out the air bag warning indicator by lighting for 6 seconds and then turn off. If a fault is detected, the RCM requests illumination of the air bag warning indicator and will remain illuminated for the rest of the ignition cycle. If the RCM requests illumination of the air bag warning indicator and the air bag warning indicator does not function, the IPC will automatically activate an audible chime.

The RCM includes a backup power supply. This feature provides sufficient backup power to deploy the air bags in the event that the ignition circuit is lost or damaged during impact. The backup power supply will deplete its stored energy approximately one minute after power and/or ground has been removed from the RCM .

Event Notification Signal

The purpose of the deployment event notification feature is to provide other vehicle subsystems with information pertaining to restraint system deployment or fuel cutoff status. Signal communication between the RCM and fuel pump control module allows the PCM to initiate fuel cut-off to disable the fuel system in the event of a crash.

The RCM does not monitor for any circuit faults and will not set a DTC if a fault occurs.

Safety Belt Retractor Pretensioners

The safety belt retractor pretensioners remove excess slack from the safety belt webbing. The pretensioners are activated by the RCM when the module detects a crash event force exceeding a programmed limit.

Safety Belt Buckle Switches

Safety belt buckle switches indicate to the RCM whether the safety belts are buckled or unbuckled. The RCM uses this information in determining the deployment of the dual-stage driver and passenger air bag modules.

Seat Track Position Sensor

The seat track position sensor indicates to the RCM the position of the driver seat, forward or rearward. The RCM uses this information in determining the deployment of the dual-stage driver air bag module.

Secondary Air Bag Warning (Chime)

The secondary air bag warning chime, is an audible chime controlled by the IPC . If the IPC has detected a fault with the air bag warning indicator, a DTC will be stored in the memory of the IPC . Upon receiving the message from the RCM that a SRS fault has been detected, the IPC will sound the secondary air bag warning chime in a pattern of 5 sets of 5 beeps.

Seat Side Air Bag Module

The seat side air bag module:

- will deploy upon receiving a flow of current from the RCM , initiated by the side impact sensor and internal RCM circuitry.
- is mounted in the seat backrest.
- is used in conjunction with a side air curtain module.

Side Air Curtain Module

⚠ WARNING: Anytime the Safety Canopy® or side air curtain module has deployed, a new headliner and new A-, B- and C-pillar upper trim panels and attaching hardware must be installed. Remove any other damaged components and hardware and install new components and hardware as needed. Failure to follow these instructions may result in the Safety Canopy® or side air curtain module deploying incorrectly and increases the risk of serious personal injury or death in a crash.

The side air curtain module:

- is mounted above the headliner.
- attaches from the A-pillar frame to the C-pillar frame.

Driver Knee Bolster Air Bag Module (Hybrid Vehicles Only)

The driver knee bolster air bag module is mounted behind the steering column opening trim panel and deploys upon receiving a flow of current from the RCM .

Inspection and Verification

1. Verify the customer concern by checking the air bag warning indicator in the IPC . Refer to Prove Out the System in this section.

2. Visually inspect for obvious signs of mechanical or electrical damage. Do not disconnect electrical connectors until directed to do so within the pinpoint test.

Visual Inspection Chart

Mechanical	Electrical
• Damaged Restraints Control Module (RCM) or loose mounting • Damaged front impact severity sensor(s) or loose mounting • Damaged side impact sensor(s) or loose mounting • Damaged or disconnected Passenger Air Bag Deactivation (PAD) indicator • Damaged or disconnected Occupant Classification System Module (OCSM) or loose mounting	• Open Smart Junction Box (SJB) fuse 32 (10A) (RCM) or fuse 46 (7.5A) (OCSM and PAD indicator) • Damaged wiring harness • Loose, damaged or corroded connectors • Circuitry open/shorted • Damaged shorting bars • Loose, damaged or pinched passenger seat wire harness

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

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

   If the cause is not visually evident, connect the scan tool to the DLC .

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record on-demand and CMDTCs from the RCM and OCSM .

8. If the DTCs retrieved are related to the concern, go to the DTC Charts. For all other DTCs, refer to Section 419-10 .

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

DTC Charts

The DTCs can be retrieved from the RCM and the OCSM with a scan tool via the DLC .

Restraints Control Module (RCM) DTC Chart

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the Master Parts Catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC [a]	Description	Action To Take
Continuous lamp	The Air Bag Indicator is Illuminated Continuously	GO to Pinpoint Test A .
B0001:11	Driver Frontal Stage 1 Deployment Control: Circuit Short to Ground	GO to Pinpoint Test B .
B0001:12	Driver Frontal Stage 1 Deployment Control: Circuit Short to Battery	GO to Pinpoint Test B .
B0001:13	Driver Frontal Stage 1 Deployment Control: Circuit Open	GO to Pinpoint Test B .
B0001:1A	Driver Frontal Stage 1 Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test B .
B0001:2B	Driver Frontal Stage 1 Deployment Control: Signal Cross Coupled	GO to Pinpoint Test AC .
B0001:4A	Driver Frontal Stage 1 Deployment Control: Incorrect Component Installed	GO to Pinpoint Test AD .
B0002:11	Driver Frontal Stage 2 Deployment Control: Circuit Short to Ground	GO to Pinpoint Test C .
B0002:12	Driver Frontal Stage 2 Deployment Control: Circuit Short to Battery	GO to Pinpoint Test C .
B0002:13	Driver Frontal Stage 2 Deployment Control: Circuit Open	GO to Pinpoint Test C .
B0002:1A	Driver Frontal Stage 2 Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test C .
B0002:2B	Driver Frontal Stage 2 Deployment Control: Signal	GO to Pinpoint Test AC .

	Cross Coupled	
B0002:4A	Driver Frontal Stage 2 Deployment Control: Incorrect Component Installed	GO to Pinpoint Test AD .
B0004:11	Driver Knee Bolster Deployment Control: Circuit Short to Ground	GO to Pinpoint Test D .
B0004:12	Driver Knee Bolster Deployment Control: Circuit Short to Battery	GO to Pinpoint Test D .
B0004:13	Driver Knee Bolster Deployment Control: Circuit Open	GO to Pinpoint Test D .
B0004:1A	Driver Knee Bolster Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test D .
B0004:2B	Driver Knee Bolster Deployment Control: Signal Cross Coupled	GO to Pinpoint Test AC .
B0004:4A	Driver Knee Bolster Deployment Control: Incorrect Component Installed	GO to Pinpoint Test AD .
B0010:11	Passenger Frontal Stage 1 Deployment Control: Circuit Short to Ground	GO to Pinpoint Test E .
B0010:12	Passenger Frontal Stage 1 Deployment Control: Circuit Short to Battery	GO to Pinpoint Test E .
B0010:13	Passenger Frontal Stage 1 Deployment Control: Circuit Open	GO to Pinpoint Test E .
B0010:1A	Passenger Frontal Stage 1 Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test E .
B0010:2B	Passenger Frontal Stage 1 Deployment Control: Signal Cross Coupled	GO to Pinpoint Test AC .
B0010:4A	Passenger Frontal Stage 1 Deployment Control: Incorrect Component Installed	GO to Pinpoint Test AD .
B0011:11	Passenger Frontal Stage 2 Deployment Control: Circuit Short to Ground	GO to Pinpoint Test F .
B0011:12	Passenger Frontal Stage 2 Deployment Control: Circuit Short to Battery	GO to Pinpoint Test F .
B0011:13		GO to Pinpoint Test F .

	Passenger Frontal Stage 2 Deployment Control: Circuit Open	
B0011:1A	Passenger Frontal Stage 2 Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test F .
B0011:2B	Passenger Frontal Stage 2 Deployment Control: Signal Cross Coupled	GO to Pinpoint Test AC .
B0011:4A	Passenger Frontal Stage 2 Deployment Control: Incorrect Component Installed	GO to Pinpoint Test AD .
B0020:11	Left Side Airbag Deployment Control: Circuit Short to Ground	GO to Pinpoint Test G .
B0020:12	Left Side Airbag Deployment Control: Circuit Short to Battery	GO to Pinpoint Test G .
B0020:13	Left Side Airbag Deployment Control: Circuit Open	GO to Pinpoint Test G .
B0020:1A	Left Side Airbag Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test G .
B0020:2B	Left Side Airbag Deployment Control: Signal Cross Coupled	GO to Pinpoint Test AC .
B0020:4A	Left Side Airbag Deployment Control: Incorrect Component Installed	GO to Pinpoint Test AD .
B0021:11	Left Curtain Deployment Control 1: Circuit Short to Ground	GO to Pinpoint Test H .
B0021:12	Left Curtain Deployment Control 1: Circuit Short to Battery	GO to Pinpoint Test H .
B0021:13	Left Curtain Deployment Control 1: Circuit Open	GO to Pinpoint Test H .
B0021:1A	Left Curtain Deployment Control 1: Circuit Resistance Below Threshold	GO to Pinpoint Test H .
B0021:2B	Left Curtain Deployment Control 1: Signal Cross Coupled	GO to Pinpoint Test AC .
B0021:4A	Left Curtain Deployment Control: Incorrect Component Installed	GO to Pinpoint Test AD .
B0028:11	Right Side Airbag Deployment Control: Circuit Short to Ground	GO to Pinpoint Test I .

B0028:12	Right Side Airbag Deployment Control: Circuit Short to Battery	GO to Pinpoint Test I .
B0028:13	Right Side Airbag Deployment Control: Circuit Open	GO to Pinpoint Test I .
B0028:1A	Right Side Airbag Deployment Control 1: Circuit Resistance Below Threshold	GO to Pinpoint Test I .
B0028:2B	Right Side Airbag Deployment Control: Signal Cross Coupled	GO to Pinpoint Test AC .
B0028:4A	Right Side Airbag Deployment Control: Incorrect Component Installed	GO to Pinpoint Test AD .
B0029:11	Right Curtain Deployment Control 1: Circuit Short to Ground	GO to Pinpoint Test J .
B0029:12	Right Curtain Deployment Control 1: Circuit Short to Battery	GO to Pinpoint Test J .
B0029:13	Right Curtain Deployment Control 1: Circuit Open	GO to Pinpoint Test J .
B0029:1A	Right Curtain Deployment Control 1: Circuit Resistance Below Threshold	GO to Pinpoint Test J .
B0029:2B	Right Curtain Deployment Control 1: Signal Cross Coupled	GO to Pinpoint Test AC .
B0029:4A	Right Curtain Deployment Control 1: Incorrect Component Installed	GO to Pinpoint Test AD .
B0050:11	Driver Seatbelt Sensor: Circuit Short to Ground	GO to Pinpoint Test K .
B0050:12	Driver Seatbelt Sensor: Circuit Short to Battery	GO to Pinpoint Test K .
B0050:13	Driver Seatbelt Sensor: Circuit Open	GO to Pinpoint Test K .
B0050:1D	Driver Seatbelt Sensor: Circuit Current Out of Range	GO to Pinpoint Test K .
B0050:2B	Driver Seatbelt Sensor: Signal Cross Coupled	GO to Pinpoint Test AC .
B0050:4A	Driver Seatbelt Sensor: Incorrect Component Installed	GO to Pinpoint Test AD .
B0052:11	Passenger Seatbelt Sensor: Circuit Short to Ground	GO to Pinpoint Test L .
B0052:12		GO to Pinpoint Test L .

	Passenger Seatbelt Sensor: Circuit Short to Battery	
B0052:13	Passenger Seatbelt Sensor: Circuit Open	GO to Pinpoint Test L .
B0052:1D	Passenger Seatbelt Sensor: Circuit Current Out of Range	GO to Pinpoint Test L .
B0052:2B	Passenger Seatbelt Sensor: Signal Cross Coupled	GO to Pinpoint Test AC .
B0052:4A	Passenger Seatbelt Sensor: Incorrect Component Installed	GO to Pinpoint Test AD .
B0090:11	Left Frontal Restraints Sensor: Circuit Short to Ground	GO to Pinpoint Test M .
B0090:4A	Left Frontal Restraints Sensor: Incorrect Component Installed	GO to Pinpoint Test AD .
B0090:81	Left Frontal Restraints Sensor: Invalid Serial Data Received	INSTALL a new LH front impact severity sensor. REFER to Front Impact Severity Sensor in this section.
B0090:93	Left Frontal Restraints Sensor: No Operation	GO to Pinpoint Test M .
B0090:96	Left Frontal Restraints Sensor: Component Internal Failure	INSTALL a new LH front impact severity sensor. REFER to Front Impact Severity Sensor in this section.
B0091:11	Left Side Restraints Sensor 1: Circuit Short to Ground	GO to Pinpoint Test N .
B0091:4A	Left Side Restraints Sensor 1: Incorrect Component Installed	GO to Pinpoint Test AD .
B0091:81	Left Side Restraints Sensor 1: Invalid Serial Data Received	INSTALL a new driver front door side impact sensor. REFER to Side Impact Sensor - Front Door in this section.
B0091:93	Left Side Restraints Sensor 1: No Operation	GO to Pinpoint Test N .
B0091:96	Left Side Restraints Sensor 1: Component Internal Failure	INSTALL a new driver front door side impact sensor. REFER to Side Impact Sensor - Front Door in this section.
B0092:11	Left Side Restraints Sensor 2: Circuit Short to Ground	GO to Pinpoint Test O .
B0092:4A	Left Side Restraints Sensor 2: Incorrect Component Installed	GO to Pinpoint Test AD .
B0092:81	Left Side Restraints Sensor 2: Invalid Serial Data Received	INSTALL a new driver C-pillar side impact sensor. REFER to Side Impact Sensor - C-Pillar in this section.
B0092:93	Left Side Restraints Sensor 2: No Operation	GO to Pinpoint Test O .
B0092:96	Left Side Restraints Sensor 2: Component Internal Failure	INSTALL a new driver C-pillar side impact sensor. REFER to Side Impact Sensor - C-Pillar in this section.
B0095:11	Right Frontal Restraints Sensor: Circuit Short to	GO to Pinpoint Test P .

	Ground	
B0095:4A	Right Frontal Restraints Sensor: Incorrect Component Installed	GO to Pinpoint Test AD .
B0095:81	Right Frontal Restraints Sensor: Invalid Serial Data Received	INSTALL a new RH front impact severity sensor. REFER to Front Impact Severity Sensor in this section.
B0095:93	Right Frontal Restraints Sensor: No Operation	GO to Pinpoint Test P .
B0095:96	Right Frontal Restraints Sensor: Component Internal Failure	INSTALL a new RH front impact severity sensor. REFER to Front Impact Severity Sensor in this section.
B0096:11	Right Side Restraints Sensor 1: Circuit Short to Ground	GO to Pinpoint Test O .
B0096:4A	Right Side Restraints Sensor 1: Incorrect Component Installed	GO to Pinpoint Test AD .
B0096:81	Right Side Restraints Sensor 1: Invalid Serial Data Received	INSTALL a new passenger front door side impact sensor. REFER to Side Impact Sensor - Front Door in this section.
B0096:93	Right Side Restraints Sensor 1: No Operation	GO to Pinpoint Test O .
B0096:96	Right Side Restraints Sensor 1: Component Internal Failure	INSTALL a new passenger front door side impact sensor. REFER to Side Impact Sensor - Front Door in this section.
B0097:11	Right Side Restraints Sensor 2: Circuit Short to Ground	GO to Pinpoint Test N .
B0097:4A	Right Side Restraints Sensor 2: Incorrect Component Installed	GO to Pinpoint Test AD .
B0097:81	Right Side Restraints Sensor 2: Invalid Serial Data Received	INSTALL a new passenger C-pillar side impact sensor. REFER to Side Impact Sensor - C-Pillar in this section.
B0097:93	Right Side Restraints Sensor 2: No Operation	GO to Pinpoint Test N .
B0097:96	Right Side Restraints Sensor 2: Component Internal Failure	INSTALL a new passenger C-pillar side impact sensor. REFER to Side Impact Sensor - C-Pillar in this section.
B00A0:09	Occupant Classification System: Component Failure	GO to Pinpoint Test S .
B00A0:4A	Occupant Classification System: Incorrect Component Installed	GO to Pinpoint Test S .
B00A0:63	Occupant Classification System: Circuit / Component Protection Time-Out	GO to Pinpoint Test S .
B00A0:64	Occupant Classification System: Signal Plausibility Failure	GO to Pinpoint Test S .
B00A0:68		GO to Pinpoint Test S .

	Occupant Classification System: Event Information	
B00B5:11	Driver Seat Track Position Restraints Sensor: Circuit Short to Ground	GO to Pinpoint Test Y .
B00B5:12	Driver Seat Track Position Restraints Sensor: Circuit Short to Battery	GO to Pinpoint Test Y .
B00B5:13	Driver Seat Track Position Restraints Sensor: Circuit Open	GO to Pinpoint Test Y .
B00B5:1D	Driver Seat Track Position Restraints Sensor: Circuit Current Out of Range	GO to Pinpoint Test Y .
B00B5:2B	Driver Seat Track Position Restraints Sensor: Signal Cross Coupled	GO to Pinpoint Test AC .
B00B5:4A	Driver Seat Track Position Restraints Sensor: Incorrect Component Installed	GO to Pinpoint Test AD .
B00D5:11	Restraint System Passenger Disable Indicator: Circuit Short to Ground	GO to Pinpoint Test Z .
B00D5:12	Restraint System Passenger Disable Indicator: Circuit Short to Battery	GO to Pinpoint Test Z .
B00D5:13	Restraint System Passenger Disable Indicator: Circuit Open	GO to Pinpoint Test Z .
B00D5:4A	Restraint System Passenger Disable Indicator: Incorrect Component Installed	GO to Pinpoint Test AD .
B1193:00	Crash Event Storage Full and Locked: No Sub Type Information	This DTC indicates the vehicle has been involved in a collision. INSTALL a new RCM and impact sensors. REFER to Inspection and Repair After a Supplemental Restraint System (SRS) Deployment in this section.
B1211:11	Driver Seatbelt Retractor Pretensioner Deployment Control: Circuit Short to Ground	GO to Pinpoint Test AA .
B1211:12	Driver Seatbelt Retractor Pretensioner Deployment Control: Circuit Short to Battery	GO to Pinpoint Test AA .
B1211:13	Driver Seatbelt Retractor Pretensioner Deployment Control: Circuit Open	GO to Pinpoint Test AA .
B1211:1A	Driver Seatbelt Retractor Pretensioner Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test AA .

B1211:2B	Driver Seatbelt Retractor Pretensioner Deployment Control: Signal Cross Coupled	GO to Pinpoint Test AC .
B1211:4A	Driver Seatbelt Retractor Pretensioner Deployment Control: Incorrect Component Installed	GO to Pinpoint Test AD .
B1214:11	Passenger Seatbelt Retractor Pretensioner Deployment Control: Circuit Short to Ground	GO to Pinpoint Test AB .
B1214:12	Passenger Seatbelt Retractor Pretensioner Deployment Control: Circuit Short to Battery	GO to Pinpoint Test AB .
B1214:13	Passenger Seatbelt Retractor Pretensioner Deployment Control: Circuit Open	GO to Pinpoint Test AB .
B1214:1A	Passenger Seatbelt Retractor Pretensioner Deployment Control: Circuit Resistance Below Threshold	GO to Pinpoint Test AB .
B1214:2B	Passenger Seatbelt Retractor Pretensioner Deployment Control: Signal Cross Coupled	GO to Pinpoint Test AC .
B1214:4A	Passenger Seatbelt Retractor Pretensioner Deployment Control: Incorrect Component Installed	GO to Pinpoint Test AD .
U0028:08	Vehicle Communication Bus A: Bus Signal / Message Failure	GO to Pinpoint Test AG .
U0028:88	Vehicle Communication Bus A: Bus Off	GO to Pinpoint Test AG .
U0154:00	Lost Communication With Restraints Occupant Classification System Module: No Sub Type Information	**NOTE:** The DTC will set in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new RCM as part of repair. REFER to Section 418-00 to diagnose the no communication with the Occupant Classification System Module (OCSM).
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	**NOTE:** The DTC will set in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new RCM as part of repair. REFER to Section 418-00 to diagnose the no communication with the Instrument Panel Cluster (IPC).
U0253:00		

	Lost Communication With Accessory Protocol Interface Module: No Sub Type Information	**NOTE:** This DTC will set in the RCM if a message is not received from the Accessory Protocol Interface Module (APIM). Check for additional RCM and APIM DTCs. REFER to the appropriate section to diagnose DTCs concern. If no other DTCs are present, REFER to APIM Software Level Check in the General Procedures portion of Section 415-00 .
U0300:00	Internal Control Module Software Incompatibility: No Sub Type Information	CARRY OUT Programmable Module Installation (PMI). RETRIEVE RCM DTCs. If RCM DTC U0300:00 is retrieved on-demand during self-test, INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section.
U0554:00	Invalid Data Received From Accessory Protocol Interface Module: No Sub Type Information	CHECK for additional RCM and APIM DTCs. REFER to the appropriate section to diagnose the DTCs. If no other DTCs are present, REFER to Accessory Protocol Interface Module (APIM) Software Level Check in the General Procedures portion of Section 415-00 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CARRY OUT PMI . RETRIEVE RCM DTCs. If RCM DTC U2100:00 is retrieved on-demand, INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section.
U2200:00	Control Module Configuration Memory Corrupt: No Sub Type Information	INSTALL a new RCM and CARRY OUT Programmable Module Installation (PMI). Use as-built data when CARRYING out PMI for this DTC. REFER to Restraints Control Module (RCM) in this section.
U3000:46	Control Module: Calibration / Parameter Memory Failure	INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section.
U3000:49	Control Module: Internal Electronic Failure	INSTALL a new RCM and CARRY OUT Programmable Module Installation (PMI). If DTC U2200:00 is also present, use as-built data when CARRYING out PMI . REFER to Restraints Control Module (RCM) in this section.
U3000:4A	Control Module: Incorrect Component Installed	GO to Pinpoint Test AD .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AI .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test AI .

[a] DTC: Retrieved using scan tool.

Occupant Classification System Module (OCSM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC [a]	Description	Action To Take
B00A0:54	Occupant Classification System: Missing Calibration	GO to Pinpoint Test AE .
B00A0:67	Occupant Classification System: Signal Incorrect After Event	CARRY OUT the OCS System Reset. REFER to Occupant Classification Sensor (OCS) System Reset in this section.
B00A0:76	Occupant Classification System: Wrong Mounting Position	GO to Pinpoint Test AE .
B00A0:97	Occupant Classification System: Component or System Operation Obstructed or Blocked	GO to Pinpoint Test T .
B00C0:12	Passenger Seat Occupant Classification Sensor "A": Circuit Short To Battery	GO to Pinpoint Test U .
B00C0:13	Passenger Seat Occupant Classification Sensor "A": Circuit Open	GO to Pinpoint Test U .
B00C0:1A	Passenger Seat Occupant Classification Sensor "A": Circuit Resistance Below Threshold	GO to Pinpoint Test U .
B00C0:49	Passenger Seat Occupant Classification Sensor "A": Internal Electronic Failure	GO to Pinpoint Test AE .
B00C0:81	Passenger Seat Occupant Classification Sensor "A": Invalid Serial Data	CARRY out the Occupant Classification System (OCS) System Reset. REFER to Occupant Classification Sensor (OCS) System Reset in this section.
B00C1:12	Passenger Seat Occupant Classification Sensor "B": Circuit Short To Battery	GO to Pinpoint Test V .
B00C1:13	Passenger Seat Occupant Classification Sensor "B": Circuit Open	GO to Pinpoint Test V .
B00C1:1A	Passenger Seat Occupant Classification Sensor "B": Circuit Resistance Blow Threshold	GO to Pinpoint Test V .
B00C1:49	Passenger Seat Occupant Classification Sensor "B": Internal Electronic Failure	GO to Pinpoint Test AE .
B00C1:81	Passenger Seat Occupant Classification Sensor "B": Invalid Serial Data	CARRY out the Occupant Classification System (OCS) System Reset. REFER to Occupant Classification Sensor (OCS) System Reset in this section.
B00C2:12	Passenger Seat Occupant Classification Sensor "C": Circuit Short To Battery	GO to Pinpoint Test W .
B00C2:13	Passenger Seat Occupant Classification Sensor "C":	GO to Pinpoint Test W .

	Circuit Open	
B00C2:1A	Passenger Seat Occupant Classification Sensor "C": Circuit Resistance Blow Threshold	GO to Pinpoint Test W .
B00C2:49	Passenger Seat Occupant Classification Sensor "C": Internal Electronic Failure	GO to Pinpoint Test AE .
B00C2:81	Passenger Seat Occupant Classification Sensor "C": Invalid Serial Data	CARRY out the Occupant Classification System (OCS) System Reset. REFER to Occupant Classification Sensor (OCS) System Reset in this section.
B00C3:12	Passenger Seat Occupant Classification Sensor "D": Circuit Short To Battery	GO to Pinpoint Test X .
B00C3:13	Passenger Seat Occupant Classification Sensor "D": Circuit Open	GO to Pinpoint Test X .
B00C3:1A	Passenger Seat Occupant Classification Sensor "D": Circuit Resistance Blow Threshold	GO to Pinpoint Test X .
B00C3:49	Passenger Seat Occupant Classification Sensor "D": Internal Electronic Failure	GO to Pinpoint Test AE .
B00C3:81	Passenger Seat Occupant Classification Sensor "D": Invalid Serial Data	CARRY out the Occupant Classification System (OCS) System Reset. REFER to Occupant Classification Sensor (OCS) System Reset in this section.
B1193:00	Crash Event Storage Full and Locked: No Sub Type Information	INSTALL new OCS left and right weight sensor assemblies. REFER to Inspection and Repair After a Supplemental Restraint System (SRS) Deployment in this section.
B1A59:01	Sensor 5 Volt Supply: General Electrical Failure	GO to Pinpoint Test AF .
B1A59:11	Sensor 5 Volt Supply: Circuit Short to Ground	GO to Pinpoint Test AF .
U0100:00	Lost Communication With ECM/PCM "A": No Sub Type Information	U0100:00 will set in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new OCSM as part of repair for DTC U0100:00. REFER to Section 418-00 to diagnose lost communication with the PCM.
U0151:00	Lost Communication With Restraints Control Module: No Sub Type Information	U0151:00 will set in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new OCSM as part of repair for DTC U0151:00. REFER to Section 418-00 to diagnose lost communication with the Restraints Control Module (RCM).
U0401:00	Invalid Data Received From ECM/PCM "A": No Sub Type Information	U0401:00 will set in a module that is reporting a communication fault from another module on the data bus. The module that reports the fault is not the problem module. Do not install a new

		OCSM as part of repair for DTC U0401:00. CARRY OUT PCM Self Test. REPAIR any speed-related DTCs. REFER to DTC chart in Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U200D:12	Control Module Output Power A: Circuit Short To Battery	GO to Pinpoint Test AH .
U3000:49	Control Module: Internal Electronic Failure	INSTALL a new OCSM . REFER to Occupant Classification System Module (OCSM) in this section.
U3000:53	Control Module: Deactivated	INSTALL a new OCSM . REFER to Occupant Classification System Module (OCSM) in this section.
U3000:54	Control Module: Missing Calibration	CARRY out the Occupant Classification System (OCS) System Reset. REFER to Occupant Classification Sensor (OCS) System Reset in this section.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AI .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test AI .

[a] DTC: Retrieved using scan tool.

Symptom Chart

Symptom Chart

Pinpoint Test - Supplemental Restraint System (SRS)

Pinpoint Test A: The Air Bag Warning Indicator is Illuminated Continuously

Refer to Wiring Diagrams Cell 46 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Supplemental Restraint System for schematic and connector information.

Normal Operation

During normal operation, the Instrument Panel Cluster (IPC) will illuminate the air bag warning indicator continuously for 6 seconds. If the Supplemental Restraint System (SRS) is fault free, the air bag warning indicator will turn off and remain off. If a fault is detected in the SRS , the air bag warning inditor will illuminate and remain illuminated for the rest of the ignition cycle until the fault is no longer detected. The Restraints Control Module (RCM) communicates to the IPC via the High Speed Controller Area Network (HS-CAN). The IPC will illuminate the air bag warning indicator based on messaging from the RCM or if there is no communication between the RCM and IPC .

This pinpoint test is intended to diagnose the following:

- IPC
- RCM

PINPOINT TEST A: THE AIR BAG WARNING INDICATOR IS ILLUMINATED CONTINUOUSLY

⚠ **WARNING: Always tighten the fasteners of the restraints control module (RCM) and impact sensor (if equipped) to the specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.**

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the Ford Catalog AdvantageTM to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
A1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Were any DTCs retrieved on-demand dug self-test?**	**Yes** GO to the DTC Charts in this section for diagnostic direction. Do not clear any DTCs until all DTCs have been resolved. **No** If the RCM **does communicate** with the scan tool, REFER to Section 413-01 to diagnose the IPC concern. Do not clear any DTCs until all DTCs have been resolved.

Pinpoint Test B: DTCs B0001:11, B0001:12, B0001:13 and B0001:1A

Refer to Wiring Diagrams Cell 46 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) continuously monitors the driver air bag module stage 1 and circuits for the following faults:

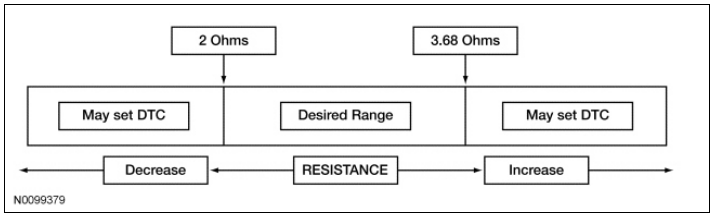
- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted driver air bag module

If a fault is detected, the RCM will store DTC B0001:11, B0001:12, B0001:13 or B0001:1A in memory and send a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement in combination with an age correction factor to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM . If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle ages. Small

variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test will require the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at time of diagnosis. Following this direction will help make sure that minor changes in resistance do not create a repeat concern. This test will use a process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring
- Connections
- Clockspring
- Driver air bag module
- RCM



DTC Description	Fault Trigger Condition
• B0001:11 - Driver Frontal Stage 1 Deployment Control: Circuit Short to Ground	When the RCM senses a short to ground on either driver air bag stage 1 circuit, a fault will be indicated.
• B0001:12 - Driver Frontal Stage 1 Deployment Control: Circuit Short to Battery	When the RCM senses a short to voltage on either driver air bag stage 1 circuit, a fault will be indicated.
• B0001:13 - Driver Frontal Stage 1 Deployment Control: Circuit Open	When the RCM measures greater than the desired range between driver air bag stage 1 circuits, a fault will be indicated.
• B0001:1A - Driver Frontal Stage 1 Deployment Control: Circuit Resistance Below Threshold	When the RCM measures less than the desired range between driver air bag stage 1 circuits, a fault will be indicated.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Clockspring
- Driver air bag module
- RCM

PINPOINT TEST B: DTCs B0001:11, B0001:12, B0001:13 AND B0001:1A

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failureollow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

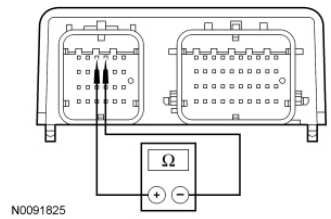
NOTE: Supplemental Restraint System (SRS) components should only be disconnected or reconnected when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the Ford Catalog AdvantageTM to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

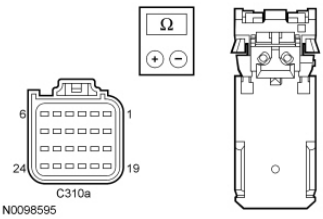
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
B1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was DTC B0001:11, B0001:12, B0001:13 or B0001:1A retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0001:13 or B0001:1A, GO to B2 . For DTC B0001:11, GO to B11 . For DTC B0001:12, GO to B14 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code (CMDTC) only. For DTC B0001:13 or B0001:1A, GO to B19 . For DTC B0001:11, GO to B20 . For DTC B0001:12, GO to B21 .
B2 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_00_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - RCM . ♦ DEPLOY_00_R PID • **Does the PID value read between 2 and 3.68 ohms?**	**Yes** GO to B18 . **No** GO to B3 .
B3 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_00_R) PID WHILE CARRYING OUT THE	

HARNESS TEST	
• Remove the lower steering column shroud to access the clockspring connectors. • While monitoring the DEPLOY_00_R PID, carry out the harness test of the driver air bag circuits and accessible connectors (including any in-line connectors) by wiggling and flexing the wire harness, connectors, tilting and rotating the steering wheel frequently. • **Does the PID value read between 2 and 3.68 ohms while carrying out the harness test?**	**Yes** DEPOWER the SRS and REPAIR the connector, terminals or wire harness or INSTALL a new clockspring as needed. REFER to Clockspring in this section. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to B23 . **No** For PID value less than 2 ohms, GO to B4 . For PID value greater than 3.68 ohms, GO to B7 .
B4 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED)	
NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Air Bag Module in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module disconnected, open circuit faults would normally be retrieved on stage 1 and 2. • **Did the on-demand DTC change from B0001:1A to B0001:13?**	**Yes** GO to B16 . **No** GO to B5 .
B5 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED) (CLOCKSPRING DISCONNECTED)	
	Yes GO to B17 .

NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Disconnect: Clockspring C218A. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module / clockspring disconnected, open circuit faults would normally be retrieved on stage 1 and 2. • **Did the on-demand DTC change from B0001:1A to B0001:13?**	**No** GO to B6 .
B6 CHECK THE RCM FOR LOW RESISTANCE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B. • Measure the resistance between RCM C310A pins 3 and 4, component side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR circuits CR101 (VT/BN) and RR101 (YE/GN). Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to B23 . **No** GO to B18 .
B7 CHECK THE DRIVER AIR BAG STAGE 1 CIRCUITS FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Air Bag Module in this section. • Disconnect: RCM C310A and C310B. • Measure the resistance between RCM C310A, harness side and driver air bag module stage 1 electrical connector, harness side, using the following chart.	**Yes** GO to B9 . **No** GO to B8 .

RCM	Circuit	Driver Air Bag Module Stage 1 Electrical Connector
C310A-4	CR101 (VT/BN)	Driver Air Bag Module Stage 1 electrical connector
C310A-3	RR101 (YE/GN)	Driver Air Bag Module Stage 1 electrical connector

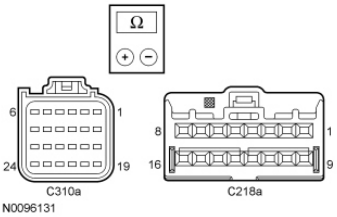


- **Are the resistances less than 1 ohm?**

B8 CHECK THE DRIVER AIR BAG STAGE 1 CIRCUITS FOR AN OPEN (CLOCKSPRING DISCONNECTED)

- Disconnect: Clockspring C218A.
- Measure the resistance between RCM C310A, harness side and clockspring C218A, harness side using the following chart.

RCM	Circuit	Clockspring
C310A-4	CR101 (VT/BN)	C218A-1
C310A-3	RR101 (YE/GN)	C218A-9



- **Are the resistances less than 0.5 ohm?**

Yes
GO to B17 .

No
REPAIR circuit CR101 (VT/BN) or RR101 (YE/GN).

Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information.

GO to B23 .

B9 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)

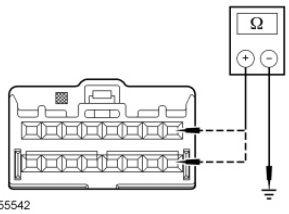
NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault.

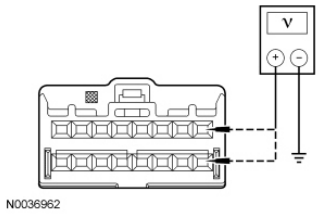
Yes
GO to B16 .

No
GO to B10 .

• Connect: RCM C310A and C310B. • Connect a fused jumper wire between driver air bag module stage 1 electrical connector pins 1 and 2, harness side. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag stage 1 circuits shorted together, a low resistance fault would normally be retrieved on stage 1. Stage 2 will show an open circuit fault due to the driver air bag being disconnected. • **Was DTC B0001:1A retrieved on-demand during self-test?**	
B10 CHECK THE DRIVER AIR BAG STAGE 1 CIRCUITS FOR AN OPEN (CLOCKSPRING DISCONNECTED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: Clockspring C218A. • Connect a fused jumper wire between clockspring electrical connector C218A pins 1 and 9, harness side. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the clockspring stage 1 circuits shorted together, a low resistance fault would normally be retrieved on stage 1. Stage 2 will show an open circuit fault due to the driver air bag being disconnected. • **Was DTC B0001:1A retrieved on-demand during self-test?**	**Yes** GO to B17 . **No** GO to B18 .
B11 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	
NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF.	**Yes** GO to B16 . **No** GO to B12 .

• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Air Bag Module in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module disconnected, open circuit faults would normally be retrieved on stage 1 and 2. • **Did the on-demand DTC change from B0001:11 to B0001:13?**	
B12 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED) (CLOCKSPRING DISCONNECTED)	
NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Disconnect: Clockspring C218A. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the clockspring disconnected, open circuit faults would normally be retrieved on driver air bag stage 1 and 2. • **Did the on-demand DTC change from B0001:11 to B0001:13?**	**Yes** GO to B17 . **No** GO to B13 .
B13 CHECK THE DRIVER AIR BAG STAGE 1 CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B. • Measure the resistance between clockspring: ♦ C218A-1, circuit CR101 (VT/BN), harness side and ground. ♦ C218A-9, circuit RR101 (YE/GN), harness side and ground.	**Yes** GO to B18 . **No** Due to the shorting bar feature in the RCM electrical connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar. REPAIR circuit CR101 (VT/BN) or RR101 (YE/GN). Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ

 • **Are the resistances greater than 10,000 ohms?**	Hybrid), Connector Repair Procedures for schematic and connector information. GO to B23 .
B14 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO BATTERY INDICATED) (CLOCKSPRING DISCONNECTED)	
NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Air Bag Module in this section. • Disconnect: Clockspring C218A. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module/clockspring disconnected, open circuit faults would normally be retrieved on driver air bag stage 1 and 2. • **Did the on-demand DTC change from B0001:12 to B0001:13?**	**Yes** GO to B17 . **No** GO to B15 .
B15 CHECK THE DRIVER AIR BAG STAGE 1 CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Measure the voltage between clockspring: ♦ C218A-1, circuit CR101 (VT/BN), harness side and ground.	**Yes** Due to the shorting bar feature in the RCM electrical connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar. REPAIR circuit CR101 (VT/BN) or RR101 (YE/GN). Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information.

♦ C218A-9, circuit RR101 (YE/GN), harness side and ground.  • **Is voltage present on either circuit?**	GO to B23 . **No** GO to B18 .
B16 CONFIRM THE DRIVER AIR BAG MODULE FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • If installed previously, remove the fused jumper wire from the air bag electrical connector. • Install the driver air bag module. Refer to Driver Air Bag Module in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new driver air bag module. REFER to Driver Air Bag Module in this section. GO to B23 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** For DTC B0001:13 or B0001:1A, GO to B19 . For DTC B0001:11, GO to B20 . For DTC B0001:12, GO to B21 .
B17 CONFIRM THE CLOCKSPRING FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Connect: Clockspring C218A. • Install the driver air bag module. Refer to Driver Air Bag Module in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON.	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to B23 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** For DTC B0001:13 or B0001:1A, GO to B19 . For DTC B0001:11, GO to B20 .

• Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was the original DTC retrieved on-demand during self-test?**	For DTC B0001:12, GO to B21 .
B18 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • If installed previously, remove the fused jumper wire from the air bag electrical connector. • Prior to reconnecting any previously disconnected SRS component: ♦ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ♦ inspect wire harness for any damaged, pinched, cut or pierced wires. ♦ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ♦ repair any concerns found. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. • If previously removed, install the driver air bag module. Refer to Driver Air Bag Module in this section. • Connect: Clockspring C218A (if previously disconnected). • Connect: RCM C310A and C310B (if previously disconnected). • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to B23 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** For DTC B0001:13 or B0001:1A, GO to B19 . For DTC B0001:11, GO to B20 . For DTC B0001:12, GO to B21 .
B19 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_00_R) PID FOR AN INTERMITTENT LOW RESISTANCE OR OPEN CIRCUIT FAULT	

• Enter the following diagnostic mode on the scan tool: DataLogger - RCM . ♦ DEPLOY_00_R PID • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • **Does the PID value read between 2 and 3.68 ohms?**	**Yes** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to B22 . **No** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to B23 .
B20 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO GROUND FAULT	
• Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was DTC B0001:11 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to B23 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to B22 .
B21 CHECK THE DRIVER FRONTAL STAGE 1 DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO BATTERY FAULT	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Air Bag Module in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON.	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to B23 .

• Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was DTC B0001:12 retrieved on-demand during self-test?**	**No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to B22 .
B22 CHECK THE HARNESS AND CONNECTORS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module: ♦ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals. ♦ inspect wire harness for any damage, pinched, cut or pierced wires. • Inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. • **Were any concerns found?**	**Yes** REPAIR as necessary. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to B23 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to B23 .
B23 CHECK FOR ADDITIONAL SRS DTCs	
• Ignition OFF. • ⚠ **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - Restraints. • **NOTE:** When selecting Restraints from the Self Test menu, DTCs will be retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . Repair is complete. RETURN the vehicle to the customer.

Pinpoint Test C: DTCs B0002:11, B0002:12, B0002:13 and B0002:1A

Refer to Wiring Diagrams Cell 46 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Supplemental Restraint System for schematic and connector information.

Normal Operation

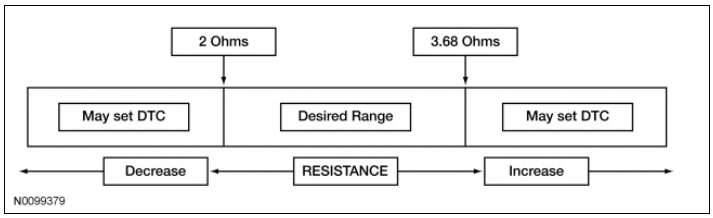
The Restraints Control Module (RCM) continuously monitors the driver air bag module stage 2 and circuits for the following faults:

- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted driver air bag module

If a fault is detected, the RCM will store DTC B0002:11, B0002:12, B0002:13 or B0002:1A in memory and send a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement in combination with an age correction factor to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM . If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle ages. Small variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test will require the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at time of diagnosis. Following this direction will help make sure that minor changes in resistance do not create a repeat concern. This test will use a process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring
- Connections
- Clockspring
- Driver air bag module
- RCM



DTC Description	Fault Trigger Condition
• B0002:11 - Driver Frontal Stage 2 Deployment Control: Circuit Short to Ground	When the RCM senses a short to ground on either driver air bag stage 2 circuit, a fault will be indicated.
• B0002:12 - Driver Frontal Stage 2 Deployment Control: Circuit Short to Battery	When the RCM senses a short to voltage on either driver air bag stage 2 circuit, a fault will be indicated.
• B0002:13 - Driver Frontal Stage 2 Deployment Control: Circuit Open	When the RCM measures greater than the desired range between driver air bag stage 2 circuits, a fault will be indicated.

• B0002:1A - Driver Frontal Stage 2 Deployment Control: Circuit Resistance Below Threshold	When the RCM measures less than the desired range between driver air bag stage 2 circuits, a fault will be indicated.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Clockspring
- Driver air bag module
- RCM

PINPOINT TEST C: DTCs B0002:11, B0002:12, B0002:13 AND B0002:1A

⚠ WARNING: Never probe the electrical connectors on aig, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

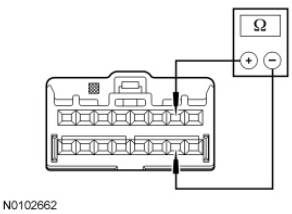
NOTE: Supplemental Restraint System (SRS) components should only be disconnected or reconnected when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the Ford Catalog AdvantageTM to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

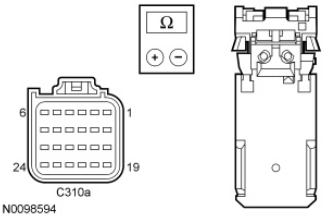
Test Step	Result / Action to Take
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was DTC B0002:11, B0002:12, B0002:13 or B0002:1A retrieved on-demand during self-test?**	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test. For DTC B0002:13 or B0002:1A, GO to C2 . For DTC B0002:11, GO to C11 . For DTC B0002:12, GO to C14 . **No** This is an intermittent fault when present as a Continuous Memory Diagnostic Trouble Code

	(CMDTC) only. For DTC B0002:13 or B0001A, GO to C19 . For DTC B0002:11, GO to C20 . For DTC B0002:12, GO to C21 .
C2 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_01_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - RCM . ♦ DEPLOY_01_R PID • **Does the PID value read between 2 and 3.68 ohms?**	**Yes** GO to C18 . **No** GO to C3 .
C3 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_01_R) PID WHILE CARRYING OUT THE HARNESS TEST	
• Remove the lower steering column shroud to access the clockspring connector. • While monitoring the DEPLOY_01_R PID, carry out the harness test of the driver air bag circuits and accessible connectors (including any in-line connectors), by wiggling and flexing the wire harness, connectors, tilting and rotating the steering wheel frequently. • **Does the PID value read between 2 and 3.68 ohms while carrying out the harness test?**	**Yes** DEPOWER the SRS and REPAIR the connector, terminals or wire harness or INSTALL a new clockspring as needed. REFER to Clockspring in this section. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to C23 . **No** For PID value less than 2 ohms, GO to C4 . For PID value greater than 3.68 ohms, GO to C7 .
C4 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED)	
NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.	**Yes** GO to C16 . **No** GO to C5 .

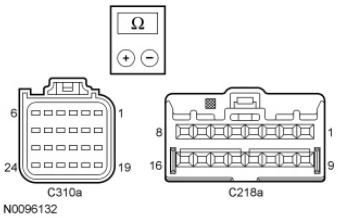
• Remove the driver air bag module. Refer to Driver Air Bag Module in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module disconnected, open circuit faults would normally be retrieved on stage 1 and 2. • **Did the on-demand DTC change from B0002:1A to B0002:13?**	
C5 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (LOW RESISTANCE INDICATED) (CLOCKSPRING DISCONNECTED)	
NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Disconnect: Clockspring C218A. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module/clockspring disconnected, open circuit faults would normally be retrieved on stage 1 and 2. • **Did the on-demand DTC change from B0002:1A to B0002:13?**	**Yes** GO to C17 . **No** GO to C6 .
C6 CHECK FOR A SHORT BETWEEN DRIVER AIR BAG STAGE 2 CIRCUITS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B. • Measure the resistance between C218A-2, circuit CR102 (BU), harness side and C218A-10, circuit RR102 (WH), harness side.  N0102662	**Yes** GO to C18 . **No** REPAIR circuits CR102 (BU) and RR102 (WH). Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to C23 .

• **Is the resistance greater than 10,000 ohms?**	
C7 CHECK THE DRIVER AIR BAG STAGE 2 CIRCUITS FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Air Bag Module in this section. • Disconnect: RCM C310A and C310B. • Measure the resistance between RCM C310A, harness side and driver air bag module stage 2 electrical connector, harness side using the following chart. • **Are the resistances less than 1 ohm?**	**Yes** GO to C9 . **No** GO to C8 .
C8 CHECK THE DRIVER AIR BAG STAGE 2 CIRCUITS FOR AN OPEN (CLOCKSPRING DISCONNECTED)	
• Disconnect: Clockspring C218A. • Measure the resistance between RCM C310A, harness side and clockspring C218A, harness side using the following chart.	**Yes** GO to C17 . **No** REPAIR circuit CR102 (BU) or RR102 (WH). Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to C23 .

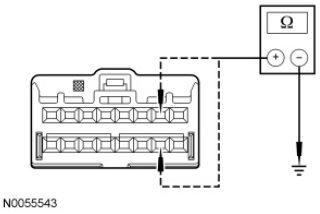
RCM	Circuit	Driver Air Bag Module Stage 2 Electrical Connector
C310A-7	CR102 (BU)	Driver Air Bag Module Stage 2 electrical connector
C310A-8	RR102 (WH)	Driver Air Bag Module Stage 2 electrical connector

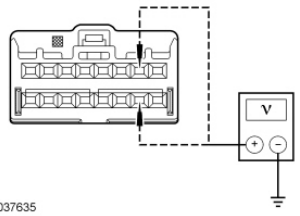


RCM	Circuit	Clockspring
C310A-7	CR102 (BU)	C218A-2
C310A-8	RR102 (WH)	C218A-10

 • **Are the resistances less than 0.5 ohm?**	
C9 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (OPEN INDICATED)	
NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Connect: RCM C310A and C310B. • Connect a fused jumper wire between driver air bag module stage 2 electrical connector pins 1 and 2, harness side. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with driver air bag module stage 2 circuits shorted together, a low resistance fault would normally be rrieved on stage 2. Stage 1 will show an open circuit fault due to the driver air bag being disconnected. • **Was DTC B0002:1A retrieved on-demand during self-test?**	**Yes** GO to C16 . **No** GO to C10 .
C10 CHECK THE DRIVER AIR BAG STAGE 2 CIRCUITS FOR AN OPEN (CLOCKSPRING DISCONNECTED)	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the fused jumper wire from the driver air bag module stage 2 electrical connector. • Disconnect: Clockspring C218A. • Connect a fused jumper wire between clockspring electrical connector C218A pins 2 and 10, harness side. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the clockspring stage 2 circuits shorted together, a low resistance fault would normally be retrieved on stage 2.	**Yes** GO to C17 . **No** GO to C18 .

Stage 1 will show an open circuit fault due to the driver air bag being disconnected. • **Was DTC B0002:1A retrieved on-demand during self-test?**	
C11 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)	
NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Air Bag Module in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module disconnected, open circuit faults would normally be retrieved on stage 1 and 2. • **Did the on-demand DTC change from B0002:11 to B0002:13?**	**Yes** GO to C16 . **No** GO to C12 .
C12 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED) (CLOCKSPRING DISCONNECTED)	
NE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Disconnect: Clockspring C218A. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module/clockspring disconnected, open circuit faults would normally be retrieved on stage 1 and 2. • **Did the on-demand DTC change from B0002:11 to B0002:13?**	**Yes** GO to C17 . **No** GO to C13 .
C13 CHECK THE DRIVER AIR BAG STAGE 2 CIRCUITS FOR A SHORT TO GROUND	

Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B. • Measure the resistance between clockspring: ♦ C218A-2, circuit CR102 (BU), harness side and ground. ♦ C218A-10, circuit RR102 (WH), harness side and ground.  N0055543 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to C18 . **No** REPAIR circuit CR102 (BU) or RR102 (WH). Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to C23 .
C14 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL DTC FOR A FAULT STATUS CHANGE (SHORT TO BATTERY INDICATED) (CLOCKSPRING DISCONNECTED)	
NOTE: This pinpoint test step will attempt to change the fault reported by the RCM by inducing a different fault condition. If the fault reported changes, this indicates the RCM is functioning correctly and is not the source of the fault. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Air Bag Module in this section. • Disconnect: Clockspring C218A. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **DIAGNOSTIC TIP:** When viewing DTCs with the driver air bag module/clockspring disconnected, open circuit faults would normally be retrieved on stage 1 and 2. • **Did the on-demand DTC change from B0002:12 to B0002:13?**	**Yes** GO to C17 . **No** GO to C15 .
C15 CHECK THE DRIVER AIR BAG STAGE 2 CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Disconnect: RCM C310A and C310B. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Measure the voltage between clockspring: ♦ C218A-2, circuit CR102 (BU), harness side and ground. ♦ C218A-10, circuit RR102 (WH), harness side and ground.  • **Is voltage present on either circuit?**	**Yes** REPAIR circuit CR102 (BU) or RR102 (WH). Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to C23 . **No** GO to C18 .
C16 CONFIRM THE DRIVER AIR BAG MODULE FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • If installed previously, remove the fused jumper wire from the driver air bag electrical connector. • Install the driver air bag module. Refer to Driver Air Bag Module in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was the original DTC retrieved on-demand during self-test?**	**Yes** INSTALL a new driver air bag module. REFER to Driver Air Bag Module in this section. GO to C23 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** For DTC B0002:13 or B0002:1A, GO to C19 . For DTC B0002:11, GO to C20 . For DTC B0002:12, GO to C21 .
C17 CONFIRM THE CLOCKSPRING FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to C23 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install**

• If installed previously, remove the fused jumper wire from the clockspring electrical connector C218A. • Connect: Clockspring C218A. • Install the driver air bag module. Refer to Driver Air Bag Module in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was the original DTC retrieved on-demand during self-test?**	**any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** For DTC B0002:13 or B0002:1A, GO to C19 . For DTC B0002:11, GO to C20 . For DTC B0002:12, GO to C21 .
C18 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs will be recorded. • Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • If installed previously, remove the fused jumper wire from the clockspring electrical connector C218A. • Prior to reconnecting any previously disconnected SRS component: ♦ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ♦ inspect wire harness for any damage, pinched, cut or pierced wires. ♦ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. ♦ repair any concerns found. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. • If previously removed, install the driver air bag module. Refer to Driver Air Bag Module in this section. • Connect: Clockspring C218A (if previously disconnected). • Connect: RCM C310A and C310B (if previously disconnected). • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM .	**Yes** INSTALL a new RCM . REFER to Restraints Control Module (RCM) in this section. GO to C23 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. **Do not install any new SRS components at this time. SRS components shod only be installed when directed to do so in the pinpoint test.** For DTC B0002:13 or B0002:1A, GO to C19 . For DTC B0002:11, GO to C20 . For DTC B0002:12, GO to C21 .

• **Was the original DTC retrieved on-demand during self-test?**	
C19 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL RESISTANCE (DEPLOY_01_R) PID FOR AN INTERMITTENT LOW RESISTANCE OR OPEN CIRCUIT FAULT	
• Enter the following diagnostic mode on the scan tool: DataLogger - RCM . ♦ DEPLOY_01_R PID • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • **Does the PID value read between 2 and 3.68 ohms?**	**Yes** The fault is not present and cannot be recreated this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to C22 . **No** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to C23 .
C20 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO GROUND FAULT	
• Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was DTC B0002:11 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to C23 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to C22 .
C21 CHECK THE DRIVER FRONTAL STAGE 2 DEPLOYMENT CONTROL FOR AN INTERMITTENT SHORT TO BATTERY FAULT	

• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. Refer to Driver Air Bag Module in this section. • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON. • Attempt to recreate the fault by wiggling connectors (including any in-line connectors) and flexing the wire harness, tilting and rotating the steering wheel frequently. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Was DTC B0002:12 retrieved on-demand during self-test?**	**Yes** DEPOWER the SRS and REPAIR as necessary. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to C23 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to C22 .
C22 CHECK HARNESS AND CONNECTORS	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Remove the driver air bag module. ♦ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals. ♦ inspect wire harness for any damage, pinched, cut or pierced wires. • Inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) in this section. • **Were any concerns found?**	**Yes** REPAIR as necessary. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. GO to C23 . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to C23 .
C23 CHECK FOR ADDITIONAL SRS DTCs	
• Ignition OFF. • ⚠ **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section. • Ignition ON.	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the DTC Charts in this section for pinpoint test direction. **No** CLEAR all RCM and OCSM CMDTCs . PROVE OUT the SRS . Repair is complete. RETURN the vehicle to the customer.

• Enter the following diagnostic mode on the scan tool: Self Test - Restraints. • **NOTE:** When selecting Restraints from the Self Test menu, DTCs will be retrieved from the RCM and OCSM . • **Are any RCM and/or OCSM DTCs retrieved on-demand during self-test?**	

Pinpoint Test D: DTCs B0004:11, B0004:12, B0004:13 and B0004:1A

Refer to Wiring Diagrams Cell 46 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Supplemental Restraint System for schematic and connector information.

Normal Operation

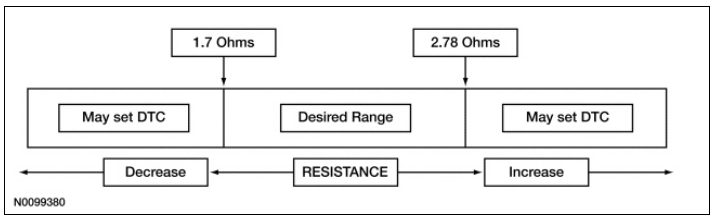
The Restraints Control Module (RCM) continuously monitors the driver knee bolster air bag module and circuits for the following faults:

- Resistance out of range
- Unexpected voltage
- Short to ground
- Faulted driver knee bolster air bag module

If a fault is detected, the RCM will store DTC B0004:11, B0004:12, B0004:13 or B0004:1A in memory and send a message to the Instrument Panel Cluster (IPC) to illuminate the air bag warning indicator.

The RCM analyzes the deployment loop resistance and uses this measurement in combination with an age correction factor to determine if a fault exists. The value displayed in the PID is the deployment loop resistance as measured by the RCM . If the value displayed is lower or higher than the desired range (refer to diagram below), the RCM can set a DTC. As the deployment loop resistance drifts farther outside the desired range, the chance for a DTC increases. The RCM fault trigger threshold may vary as the vehicle ages. Small variations in resistance can occur due to the effect of road vibrations on terminal fit and/or temperature changes. These variables can result in an intermittent fault. For this reason, the test will require the PID value to be within the desired range before the fault is considered repaired, regardless if the module is reporting an on-demand DTC at time of diagnosis. Following this direction will help make sure that minor changes in resistance do not create a repeat concern. This test will use a process of elimination to diagnose each part of the deployment loop circuit including:

- Wiring
- Connections
- Driver knee bolster air bag module
- RCM



DTC Description	Fault Trigger Condition
	When the RCM senses a short to ground on either driver knee bolster air bag module circuit, a fault will be indicated.

• B0004:11 - Driver Knee Bolster Deployment Control: Circuit Short to Ground	
• B0004:12 - Driver Knee Bolster Deployment Control: Circuit Short to Battery	When the RCM senses a short to voltage on either driver knee bolster air bag module circuit, a fault will be indicated.
• B0004:13 - Driver Knee Bolster Deployment Control: Circuit Open	When the RCM measures greater than the desired resistance range between driver knee bolster air bag module circuits, a fault will be indicated.
• B0004:1A - Driver Knee Bolster Deployment Control: Circuit Resistance Below Threshold	When the RCM measures less than the desired resistance range between driver knee bolster air bag module circuits, a fault will be indicated.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Driver knee bolster air bag module
- RCM

PINPOINT TEST D: DTCs B0004:11, B0004:12, B0004:13 AND B0004:1A

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test. <

NOTE: Supplemental Restraint System (SRS) components should only be disconnected or reconnected when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the Ford Catalog AdvantageTM to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
D1 RETRIEVE RCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM .	**Yes** This fault cannot be cleared until it is corrected and the DTC is no longer retrieved on-demand during self-test.

• **Was DB0004:11, B0004:12, B0004:13 or B0004:1A retrieved on-demand during self-test?**	For DTC B0004:13 or B0004:1A, GO to D2 . For DTC B0004:11, GO to D8 . For DTC B0004:12, GO to D10 . **No** This is an intermittent fault when present as a CMDTC only. For DTC B0004:13 or B0004:1A, GO to D13 . For DTC B0004:11, GO to D14 . For DTC B0004:12, GO to D15 .
D2 CHECK THE DRIVER KNEE BOLSTER DEPLOYMENT CONTROL RESISTANCE (DEPLOY_02_R) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - RCM . ♦ DEPLOY_02_R PID • **Does the PID value read between 1.7 and 2.78 ohms?**	**Yes** GO to D12 . **No** GO to D3 .
D3 CHECK THE DRIVER KNEE BOLSTER DEPLOYMENT CONTROL RESISTANCE (DEPLOY_02_R) PID WHILE CARRYING OUT THE HARNESS TEST	

Supplemental Restraint System (SRS) Depowering and Repowering

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Depowering Procedure

⚠ WARNING: Always wear eye protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

⚠ WARNING: To rduce the risk of accidental deployment, do not use any memory saver devices. Failure to follow this instruction may result in serious personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Turn all vehicle accessories OFF.

2. Turn the ignition to OFF.

3. At the Smart Junction Box (SJB), located below the LH side of the instrument panel, remove the cover and the RCM fuse 32 (10A) from the SJB . For additional information, refer to the Wiring Diagrams manual.

4. Turn the ignition ON and monitor the air bag indicator for at least 30 seconds. The air bag warning indicator will remain lit continuously (no flashing) if the correct RCM fuse has been removed. If the air bag warning indicator does not remain lit continuously, remove the correct RCM fuse before proceeding.

5. Turn the ignition OFF.

6. **⚠ WARNING: Always deplete the backup power supply before repairing or installing any new front or side air bag supplemental restraint system (SRS) component and before servicing, removing, installing, adjusting or striking components near the front or side impact sensors or the restraints control module (RCM). Nearby components include doors, instrument panel, console, door latches, strikers, seats and hood latches. Refer to the Description and Operation portion of Section 501-20B for location of the RCM and impact sensor(s). To deplete the backup**

power supply energy, disconnect the battery ground cable and wait at least 1 minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped). Failure to follow these instructions may result in serious personal injury or death in the event of an accidental deployment.

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

Repowering Procedure

1. Turn the ignition from OFF to ON.

2. Install RCM fuse 32 (10A) in the SJB and close the cover.

3. ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**

   Connect the battery ground cable.

4. Prove out the SRS as follows:
   Turn the ignition from ON to OFF. Wait 10 seconds, then turn the ignition ON and monitor the air bag warning indicator with the air bag modules installed. The air bag warning indicator will light continuously for approximately 6 seconds and then turn off. If an air bag SRS fault is detected, the air bag warning indicator will:
   - fail to light.
   - remain lit continuously.
   - flash.

   The flashing might not occur until approximately 30 seconds after the ignition has been turned from the OFF to the ON position. This is the time required for the RCM to complete the testing of the SRS . If the air bag warning indicator is inoperative and a SRS fault exists, a chime will sound in a pattern of 5 sets of 5 beeps. If this occurs, the air bag warning indicator and any SRS fault discovered must be diagnosed and repaired.
   Clear all RCM and OCSM CMDTCs .

Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Deactivation

⚠ WARNING: Always wear eye protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: To reduce the risk of accidental deployment, do not use any memory saver devices. Failure to follow this instruction may result in serious personal injury or death.

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental eployment of these modules, which increases the risk of serious personal injury or death.

⚠ WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

All vehicles

1. Turn all vehicle accessories OFF.
2. Turn the ignition OFF.
3. At the Smart Junction Box (SJB), located below the LH side of the instrument panel, remove the cover and the RCM fuse 32 (10A) from the SJB . For additional information, refer to the Wiring Diagrams manual.
4. Turn the ignition ON and monitor the air bag warning indicator for at least 30 seconds. The air bag warning indicator will remain lit continuously (no flashing) if the correct RCM fuse has been removed. If the air bag warning indicator does not remain lit continuously, remove the correct RCM fuse before proceeding.
5. Turn the ignition OFF.

6. ⚠ **WARNING: Always deplete the backup power supply before repairing or installing any new front or side air bag supplemental restraint system (SRS) component and before servicing, removing, installing, adjusting or striking components near the front or side impact sensors or the restraints control module (RCM). Nearby components include doors, instrument panel, console, door latches, strikers, seats and hood latches. Refer to the Description and Operation portion of Section 501-20B for location of the RCM and impact sensor(s). To deplete the backup power supply energy, disconnect the battery ground cable and wait at least 1 minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped). Failure to follow these instructions may result in serious personal injury or death in the event of an accidental deployment.**

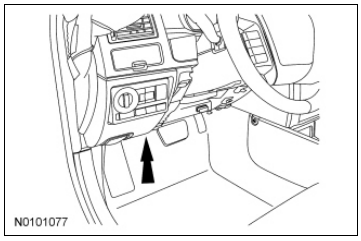
   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

7. Remove the driver air bag module. For additional information, refer to Driver Air Bag Module in this section.

Hybrid vehicles

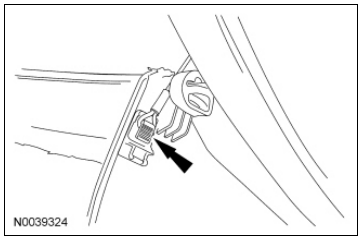
8. Remove the steering column opening trim panel.
   - Remove the 2 screws.
   - Pull downward to release the retainers and remove the steering column opening panel.

9. Disconnect the knee air bag module electrical connector.



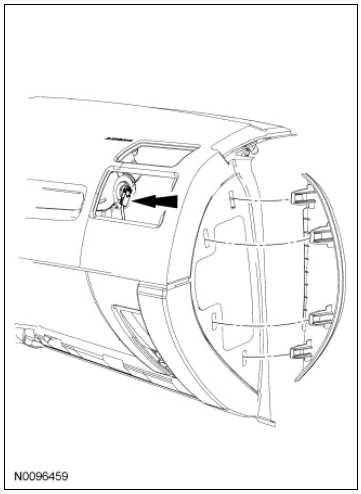
All vehicles

10. Disconnect the glove compartment damper and lower the glove compartment.

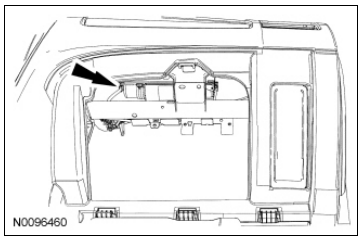


11. **NOTE:** RH HVAC register omitted for clarity.

    Remove the RH instrument panel side finish panel to access the RH passenger air bag module electrical connector.

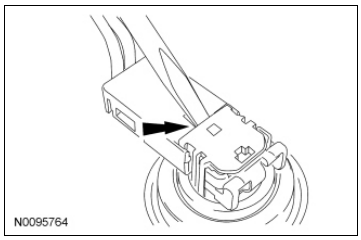


12. Through the glove compartment opening, access the LH passenger air bag electrical connector.

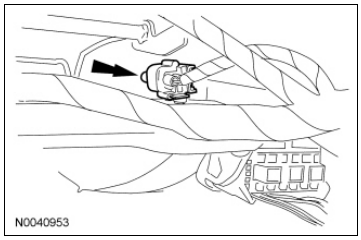


13. ***NOTICE:*** **Do not pull the electrical connectors out by the Connector Position Assurance (CPA) clip. Damage to the clip can occur.**

    Using an appropriate tool, lift up and release the Connector Position Assurance (CPA) clips and disconnect the 2 electrical connectors.



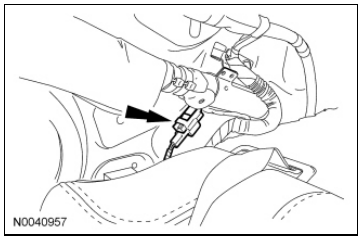
14. From under the rear of the passenger seat, slide and disengage the passenger seat side air bag module electrical connector locking clip, and then release the tab and disconnect the passenger seat side air bag module electrical connector.



15. Remove the RH C-pillar trim cover retainer cap.

16. Remove the retainer and RH C-pillar trim cover.

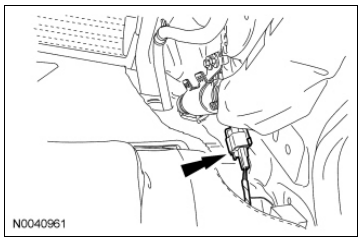
17. Disconnect the RH side air curtain module electrical connector.



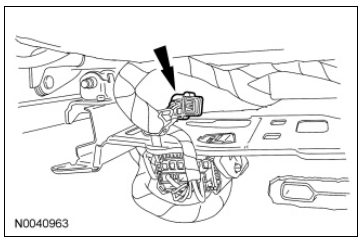
18. Remove the LH C-pillar trim cover retainer cap.

19. Remove the retainer and LH C-pillar trim cover.

20. Disconnect the LH side air curtain module electrical connector.



21. From under the rear of the driver seat, slide and disengage the driver seat side air bag module electrical connector locking clip, and then release the tab and disconnect the driver seat side air bag module electrical connector.



22. Install RCM fuse 32 (10A) in the SJB .

23. Connect the battery ground cable. For additional information, refer to Section 414-01 .

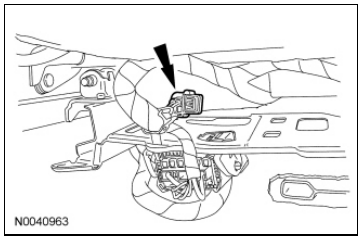
Reactivation

All vehicles

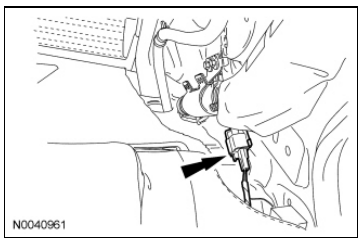
1. Remove RCM fuse 32 (10A) from the SJB .

2. Disconnect the battery ground cable and wait at least one minute.

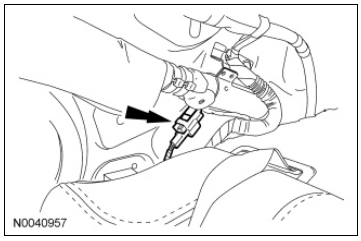
3. Connect the driver seat side air bag module electrical connector and then slide and engage the seat side air bag electrical connector locking clip.



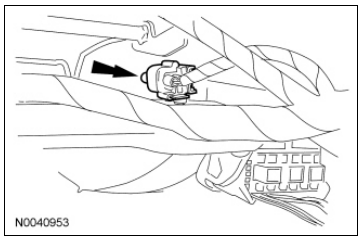
4. Connect the LH side air curtain module electrical connector.



5. Install the LH C-pillar trim cover and retainer.
6. Install the LH C-pillar trim cover retainer cap.
7. Connect the RH side air curtain module electrical connector.



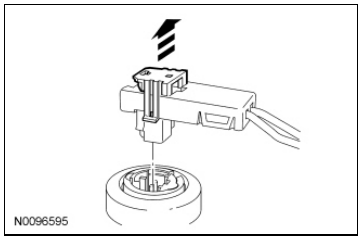
8. Install the RH C-pillar trim cover and retainer.
9. Install the RH C-pillar trim cover retainer cap.
10. Connect the passenger seat side air bag module electrical connector and slide and engage the seat side air bag electrical connector locking clip.



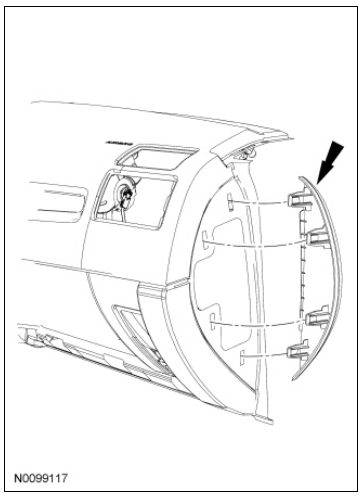
11. ***NOTICE:*** **The Connector Position Assurance (CPA) clip must be in the released position before installing the electrical connector. Failure to have the CPA clip in the released position may break the tabs on the clip causing DTCs to set in the Restraints Control Module (RCM).**

    Through the RH instrument panel side finish panel opening, connect the RH passenger air bag module electrical connector and push in to seat the CPA clip.

    - Verify that the clip is fully seated.



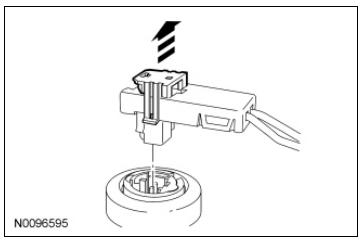
12. Install the RH instrument panel side finish panel.



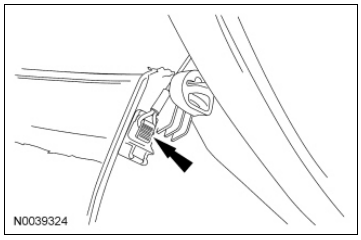
13. ***NOTICE:*** **The Connector Position Assurance (CPA) clip must be in the released position before installing the electrical connector. Failure to have the CPA clip in the released position may break the tabs on the clip causing DTCs to set in the Restraints Control Module (RCM).**

    Through the glove compartment opening, connect the LH passenger air bag electrical connector and push in to seat the CPA clip.

    - Verify that the clip is fully seated.

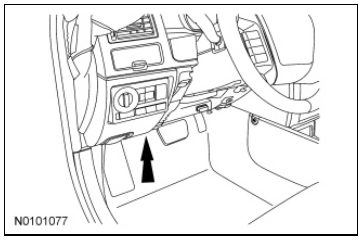


14. Attach the glove compartment damper cable.



Hybrid vehicles

15. Connect the knee air bag module electrical connector.



16. Install the steering column opening trim panel and 2 screws.

All vehicles

17. Install the driver air bag module. For additional information, refer to Driver Air Bag Module in this section.

18. Turn the ignition from OFF to ON.

19. Install RCM fuse 32 (10A) in the SJB and close the cover.

20. ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.**

    Connect the battery ground cable.

21. Prove out the SRS as follows:
    Turn the ignition from ON to OFF. Wait 10 seconds, then turn the ignition ON and monitor the air bag warning indicator with the air bag modules installed. The air bag warning indicator will light continuously for approximately 6 seconds and then turn off. If an air bag SRS fault is detected, the air bag warning indicator will:
    - fail to light.
    - remain lit continuously.
    - flash.

    The flashing might not occur until approximately 30 seconds after the ignition has been turned from the OFF to the ON position. This is the time required to complete testing of the SRS . If the air bag warning indicator is inoperative and a SRS fault exists, a chime will sound in a pattern of 5 sets of 5 beeps. If this occurs, the air bag warning indicator and any SRS fault discovered must be diagnosed and repaired.
    Clear all RCM and OCSM CMDTCs .

Inspection and Repair After a Supplemental Restraint System (SRS) Deployment

⚠ **WARNING: Remove restraint system diagnostic tools from the vehicle prior to road testing. If tools are not removed, the supplemental restraint system (SRS) device may not deploy in a crash. Failure to follow this instruction may result in serious personal injury or death in a crash and possibly violate vehicle safety standards.**

NOTE: After diagnosing or repairing a SRS , the restraint system diagnostic tools (if required) must be removed before operating the vehicle over the road.

NOTE: Deployable devices (such as air bag modules, pretensioners) may deploy alone or in various combinations depending on the impact event.

NOTE: Always refer to the appropriate workshop manual procedures prior to carrying out vehicle repairs affecting the SRS and safety belt system.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

All vehicles

1. **NOTE:** Refer to the correct removal and installation procedure for all SRS components being installed.

   When any deployable device or combination of devices have deployed and/or the RCM has DTC B1231/B1193:00 (Event Threshold Exceeded) in memory, the repair of the vehicle SRS is to include the removal of all deployed devices and the installation of new deployable devices, the removal and installation of new impact sensors and the removal and installation of a new RCM . DTCs must be cleared from all required modules after repairs are carried out.

Vehicles with an OCS

2. **NOTE:** After installation of new OCS components, carry out the OCS Reset procedure as instructed in the workshop manual. Refer to the appropriate workshop manual for OCS removal and installation procedure.

   When a vehicle has been involved in a collision and the OCSM has DTC B1231/B1193:00 stored in memory, the repair of the OCS is to include the following procedures for the specified system:

   - For rail-type OCS , inspect the passenger side floorpan for damage and repair as necessary. Install new OCS rails. Do not install a new OCSM unless DTC B1231 cannot be cleared.
   - For weight sensor bolt-type OCS , inspect the passenger side floorpan for damage and repair as necessary. Install a new seat track with OCS weight sensor bolts. DTC must be cleared from the OCSM before carrying out OCS Reset. Do not install a new OCSM unless DTC B1231/B1193:00 cannot be cleared.
   - For bladder-type OCS , inspect for damage and repair as necessary. If installation of an OCS component is required, an OCS service kit must be installed.

All vehicles

3. When any damage to the impact sensor mounting points or mounting hardware has occurred, repair or install new mounting points and mounting hardware as needed.

4. When the driver air bag module has deployed, a new clockspring must be installed.

5. New driver and/or front passenger safety belt systems (including retractors, buckles, anchors and height adjusters) must be installed if the vehicle is involved in a collision that results in deployment of the driver and/or front passenger safety belt pretensioners. For additional information, refer to Section 501-20A .

6. Inspect the entire vehicle for damage, including the following components:
    - Steering column (deployable column if equipped)
    - Instrument panel knee bolsters and mounting points
    - Instrument panel braces and brackets
    - Instrument panel and mounting points
    - Seats and seat mounting points
    - Safety belts, safety belt buckles, safety belt retractors and safety belt anchors. For additional information, refer to Section 501-20A .
    - SRS wiring, wiring harnesses and connectors

7. After carrying out the review and inspection of the entire vehicle for damage, repair or install new components as needed.

Occupant Classification Sensor (OCS) System Reset

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

⚠ WARNING: The following precautions must be taken before carrying out the following procedure on the front passenger seat:

- Park the vehicle on level ground.
- Make sure the occupant classification system (OCS) is stabilized at a temperature in the range of 5ï¿½C to 48ï¿½C (41ï¿½F to 118ï¿½F) and is not exposed to temperatures outside that range.
- Make sure the front passenger seat is empty and dry.
- Make sure the front passenger seat repair is complete and all attached components (head restraint, seat side shield) are correctly installed.
- Make sure nothing is placed in the map pockets (if equipped) of the front passenger seat.
- Make sure nothing is underneath the front passenger seat.
- Make sure no non-factory installed items (seat covers, DVD screens) are on or contacting the front passenger seat. If any non-factory items were installed to the seat, remove the item(s) and communicate to the customer that any alteration/modification to the front passenger seat may affect performance of the OCS. Refer to the Owner's Literature.
- Make sure the seat is correctly installed in the vehicle.

Failure to follow these instructions may result in incorrect operation of the OCS and increases the risk of serious personal injury or death in a crash.

NOTE: After installation of new OCS system component(s) and the completion of Inspection and Repair After a Supplemental Restraint System (SRS) Deployment , the OCSM will have DTC B1193:00 stored in memory. In the event of a crash, DTC B1193:00 must be cleared before carrying out the Occupant Classification System (OCS) System Reset.

1. If a SRS deployment has occurred, carry out the following steps:
   - Verify that all steps have been carried out as outlined in the Inspection and Repair After a Supplemental Restraint System (SRS) Deployment procedure in this section.
   - **NOTE:** A new RCM must be installed before clearing OCSM DTC B1193:00, if a new RCM is not installed first, the OCSM DTC B1193:00 will not clear.

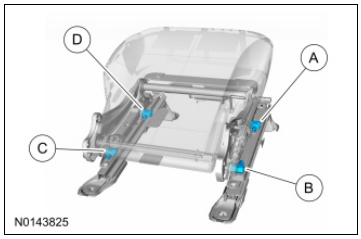
     Clear OCSM DTC B1193:00.
   - **Proceed to Step 4 to carry out the System Reset** .
2. If SRS deployment has **NOT** occurred, if the front passenger seat has been removed and/or serviced or new OCS components have been installed, **proceed to Step 3 to carry out the System Reset** .

NOTE: After installation of new OCS system component(s), (seat track assembly or OCSM), the OCSM will have DTC B00A0:54 stored in memory. This DTC will clear after a successful System Reset.

3. Carry out the RCM self-test. If DTC B00A0:09 is retrieved on-demand, retrieve OCSM DTCs.
   - If OCSM DTCs are retrieved on-demand and **NO** new components have been installed, refer to the OCSM DTC Chart for diagnostic direction.
   - If no OCSM DTCs are retrieved on-demand, CLEAR the DTC from the RCM and **proceed to step 4 to carry out the System Reset**

4. Turn the ignition to the OFF position.

5. Prepare the passenger seat for a System Reset and make sure:
   - the OCS weight sensor bolt harness connections are correct for each sensor at the correct locations. Refer to Wiring Diagrams cell 46 for schematic and connector information. Refer to the illustration for correct sensor location on the seat.
   - the seat wiring harnesses are routed and secured correctly and are not twisted, pinched, pulling down or pushing up on any seat component.
   - all seat fasteners have been tightened to specification as identified in the Workshop Manual. Refer to Section 501-10 .
   - make sure the seat track and backrest frame are not bent, twisted or damaged.
   - move the seat and backrest to all seating positions. Make sure the seat track does not bind or have any resistance when moved to all seating positions. Make sure that there are no obstructions contacting any seat component when the seat is moved to all seating positions.
   - the seat is correctly installed in the vehicle.
   - the passenger safety belt buckle is **unbuckled** .
   - the front passenger seat is empty and there is nothing underneath the seat. Remove any items that were not factory components installed and make sure that the seat is correctly installed in the vehicle
   - the seat backrest is in a normal seating (vertical) position.
   - the seat is at the mid-point of seat track travel.
   - the hysteresis has been removed from the front passenger seat by firmly hitting the seat backrest 3 times.
   - the vehicle electrical system voltage is **below 18 volts and above 11.5 volts** before continuing with the OCS System Reset.



NOTE: Typical seat track shown, others similar.

6. Turn the ignition ON, wait 8 seconds.

7. Carry out the OCSM System Reset.
   - If the System Reset was successful, carry out the OCS Zero Seat Weight Test. For additional information, refer to Occupant Classification Sensor (OCS) System Zero Seat Weight Test in this section.
   - If the System Reset was unsuccessful, **proceed to step 8** .

8. **NOTE:** Do not install any new OCS system components at this time. OCS system components should only be installed when directed to do so.

   Retrieve OCSM DTCs.

- If DTC B00A0:54 is retrieved on-demand, refer to the DTC Charts for diagnostic direction of this DTC.
- If any other DTCs are retrieved on-demand from the OCSM , **proceed to Step 9** .

9. Inspect all the items listed in **Step 5** for causes of a unsuccessful System Reset, repair as necessary. **Retest the system.**

10. If the System Reset was successful, carry out the Occupant Classification Sensor (OCS) System Zero Seat Weight Test in this section.
    If the System Reset was unsuccessful, install OCS weight sensor assemblies, refer to Occupant Classification Sensor .

Occupant Classification Sensor (OCS) System Zero Seat Weight Test

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

⚠ **WARNING: The following precautions must be taken before carrying out the following procedure on the front passenger seat:**

- Park the vehicle on level ground.
- Make sure the occupant classification system (OCS) is stabilized at a temperature in the range of 5ï¿½C to 48ï¿½C (41ï¿½F to 118ï¿½F) and is not exposed to temperatures outside that range.
- Make sure the front passenger seat is empty and dry.
- Make sure the front passenger seat repair is complete and all attached components (head restraint, seat side shield) are correctly installed.
- Make sure nothing is placed in the map pockets (if equipped) of the front passenger seat.
- Make sure nothing is underneath the front passenger seat.
- Make sure no non-factory installed items (seat covers, DVD screens) are on or contacting the front passenger seat. If any non-factory items were installed to the seat, remove the item(s) and communicate to the customer that any alteration/modification to the front passenger seat may affect performance of the OCS. Refer to the Owner's Literature.
- Make sure the seat is correctly installed in the vehicle.

Failure to follow these instructions may result in incorrect operation of the OCS and increases the risk of serious personal injury or death in a crash.

NOTICE: **Make sure the Occupant Classification System (OCS) weight sensor bolt protection brackets are correctly installed to the seat track and that it does not contact the cushion side shield, wire harness or any other surrounding parts. Failure to follow this instruction may result in the incorrect operation of the OCS system.**

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: The Zero Seat Weight Test is done with the passenger seat positioned in 2 different positions to make sure that there is nothing to affect the performance and operation of the Occupant Classification System (OCS) system.

NOTE: The Zero Seat Weight Test verifies the OCS system measures zero weight for an empty seat. It is necessary to carry out the Zero Seat Weight Test procedure after a successful System Reset or as directed to do so in the workshop manual procedures.

NOTE: If the Occupant Classification System Module (OCSM) has any on-demand DTCs present, the fault condition(s) must be repaired and the DTCs cleared before carrying out the Zero Seat Weight Test on the front passenger seat. Failure to follow this instruction will result in an unsuccessful Zero Seat Weight Test and the incorrect operation of the OCS system.

1. ⚠ **WARNING: The following precautions must be taken before carrying out the following procedure on the front passenger seat:**

    - ♦ Park the vehicle on level ground.
    - ♦ Make sure the occupant classification system (OCS) is stabilized at a temperature in the range of 5ï¿½C to 48ï¿½C (41ï¿½F to 118ï¿½F) and is not exposed to temperatures outside that range.
    - ♦ Make sure the front passenger seat is empty and dry.
    - ♦ Make sure the front passenger seat repair is complete and all attached components (head restraint, seat side shield) are correctly installed.
    - ♦ Make sure nothing is placed in the map pockets (if equipped) of the front passenger seat.
    - ♦ Make sure nothing is underneath the front passenger seat.
    - ♦ Make sure no non-factory installed items (seat covers, DVD screens) are on or contacting the front passenger seat. If any non-factory items were installed to the seat, remove the item(s) and communicate to the customer that any alteration/modification to the front passenger seat may affect performance of the OCS. Refer to the Owner's Literature.
    - ♦ Make sure the seat is correctly installed in the vehicle.

    Failure to follow these instructions may result in incorrect operation of the OCS and increases the risk of serious personal injury or death in a crash.Make sure the front passenger seat is empty and there is nothing underneath the seat. Remove any items from the seat that were not factory installed and make sure that the seat is correctly installed in the vehicle. For additional information, refer to Occupant Classification System (OCS) System in Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.
    Make sure the passenger safety belt buckle is unbuckled.
    Make sure the vehicles electrical system voltage is **below 18 volts and above 11.5 volts** before continuing.

2. Position the front passenger seat in the first position.
    - Position the seat backrest in the upright position.
    - Position the seat in the full forward position of seat track travel.
    - Position the seat height to its highest position (power seat only).

3. ⚠ **WARNING: Remove binding or resistance between all components of the front passenger seat as directed in the following procedure. Failure to follow this instruction may result in incorrect operation of the occupant classification system (OCS) and increases the risk of serious personal injury or death in a crash.**

    Remove hysteresis from the front passenger seat by firmly hitting the seat backrest 3 times.

4. Turn the ignition to the OFF position.

5. ⚠ **WARNING: Make sure nothing is placed on the front passenger seat during the following procedure. Do not press, touch or lay anything on the front passenger seat until the following procedure has been completed. Failure to follow these instructions may result in incorrect operation of the occupant classification system (OCS) and increase the risk of serious personal injury or death in a crash.**

    Turn the ignition ON.

6. **NOTE:** Make sure a minimum 8-second time period has passed after cycling the ignition ON before carrying out the Zero Seat Weight Test active command.

    Carry out the Zero Seat Weight Test using the scan tool.

- If the system passed, **proceed to Step 7.**
- If the system did not pass (DTC B00A0:67 Occupant Classification System: Signal Incorrect After Event retrieved on-demand), **proceed to Step 9.**

7. Position the front passenger seat to the second position.
   - Position the seat in the full rearward position of seat track travel.
   - Position the seat height to its lowest position (power seat only).

8. Carry out the Zero Seat Weight Test using the scan tool.
   - If the system passed, repair is complete, **Proceed to Step 10.**
   - If the system did not pass (DTC B00A0:67 Occupant Classification System: Signal Incorrect After Event retrieved on-demand), **proceed to Step 9.**

9. **NOTE:** Check the repair history of the vehicle for any previous repair that required the removal or service of the passenger seat. The repair history may lead to an area of concern.

   Inspect the following for causes of an unsuccessful Zero Seat Weight Test.

   - Make sure the front passenger seat is empty and there is nothing underneath the seat. Remove any items from the seat that were not factory installed and make sure that the seat is correctly installed in the vehicle.
   - Make sure the passenger safety belt buckle is unbuckled.
   - Make sure the seat wiring harnesses are routed and secured correctly and are not twisted, pinched, pulling down or pushing up on any seat component.
   - Make sure the OCS weight sensor bolt protection brackets are correctly installed to the seat track and are not contacting the cushion side shield, wire harness or any other surrounding parts.
   - Make sure the seat track and backrest frame are not bent, twisted or damaged.
   - Move the seat and backrest to all seating positions. Make sure the seat track does not bind or have any resistance when moved to all seating positions. Make sure that there are no obstructions contacting any seat component when the seat is moved to all seating positions.
   - Make sure the vehicles electrical system voltage is **below 18 volts and above 11.5 volts** .
   - Make sure the seat is assembled correctly and all fasteners are tightened to specifications.
     - ♦ If a concern was found, repair as necessary, **proceed to Step 1.**
     - ♦ If no concern was found, install new OCS weight sensor assemblies. Refer to Occupant Classification Sensor in this section.

10. Prove out the SRS as follows:
    Turn the ignition from ON to OFF. Wait 10 seconds, then turn the ignition back to ON and visually monitor the air bag warning indicator with the air bag modules installed. The air bag warning indicator will light continuously for approximately 6 seconds and then turn off. If an air bag SRS fault is present, the air bag warning indicator will:
    â fail to light.
    â remain lit continuously.
    â flash at a 5 Hz rate (RCM not configured).
    The air bag warning indicator might not light until approximately 30 seconds after the ignition has been turned from the OFF to the ON position. This is the time required for the RCM to complete the testing of the SRS . If the air bag warning indicator is inoperative and a SRS fault exists, a chime will sound in a pattern of 5 sets of 5 beeps. If this occurs, the air bag warning indicator and any SRS fault discovered must be diagnosed and repaired.
    Repair any unresolved DTCs.
    Clear all continuous DTCs from the RCM and OCSM using a scan tool.

Pyrotechnic Device Disposal

Disposal of Deployable Devices and Pyrotechnic Devices That are Undeployed/Inoperative

NOTE: All inoperative air bag modules and safety belt pretensioners have been placed on the Mandatory Return List. All discolored or damaged air bag modules must be treated the same as any inoperative live air bag being returned.

1. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Remove the undeployed/inoperative device. Refer to the appropriate procedure in this section or Section 501-20A .

3. **NOTE:** When installing a new air bag module or inflatable safety belt inflator, a prepaid return postcard is provided with the replacement air bag module. The serial number for the new part and the VIN must be recorded and sent to Ford Motor Company.

   If installing a new air bag module or inflatable safety belt inflator, record the necessary information and return the inoperative air bag module to Ford Motor Company.

Disposal of Deployable Devices and Pyrotechnic Devices That Are Deployed

1. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Remove the deployed device. Refer to the appropriate procedure in this section or Section 501-20A .

3. **NOTE:** If a dual stage driver or passenger air bag module has deployed due to a crash event, the air bag module requires manual deployment to make sure both stages and the active canister vent have deployed before scrapping the vehicle or disposing of the air bag module. To determine if a vehicle is equipped with dual stage driver or passenger air bag modules, refer to the Description and Operation portion of this section.

   Dispose of the deployed device in the same manner as any other part to be scrapped.

Disposal of Deployable Devices and Pyrotechnic Devices That Require Manual Deployment

1. Safety and environmental concerns require consideration and treatment of restraints system deployable and pyrotechnic devices when disposing of vehicles, deployable devices or pyrotechnic devices. Deploying deployable and pyrotechnic devices before scrapping a vehicle or the device eliminates the potential for hazardous exposures or reactions during processing. If special handling procedures are followed, deployable and pyrotechnic devices can be deployed safely and recycled with the vehicle, shipped separately to a recycling facility or disposed of safely.

   NOTE: To determine the deployable devices a vehicle is equipped with, refer to the Description and Operation portion of this section.

A vehicle equipped with any of the following deployable devices requires manual deployment of the devices before scrapping the vehicle or component. Refer to the appropriate portion of this procedure.

- Driver air bag module
- Inflatable safety belt inflators
- Knee air bag module
- Passenger air bag module
- Seat side air bag modules
- Safety Canopy® modules
- Side air curtain modules

2. **NOTE:** To determine the pyrotechnic devices a vehicle is equipped with, refer to the Description and Operation portion of this section.

   A vehicle equipped with any of the following pyrotechnic devices requires manual deployment of the devices before scrapping the vehicle or component. Refer to the appropriate portion of this procedure.

   - Safety belt buckle pretensioners
   - Safety belt retractor pretensioners
   - Safety belt anchor pretensioners
   - Adaptive load-limiting retractors
   - Deployable steering column

3. **NOTE:** To determine if a vehicle is equipped with dual stage driver or passenger air bag modules, refer to the Description and Operation portion of this section.

   If a dual stage driver or passenger air bag module has deployed due to a crash event, the air bag module requires manual deployment to make sure both stages and the active canister vent have deployed before scrapping the vehicle or disposing of the air bag module. Refer to Driver Air Bag Module, Passenger Air Bag Module, Knee Air Bag Module and Seat Side Air Bag Module - Remote Deployment in this procedure.

Driver Air Bag Module, Passenger Air Bag Module, Knee Air Bag Module and Seat Side Air Bag Module - Remote Deployment

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

⚠ WARNING: Always carry or place a live air bag module with the air bag and deployment door/trim cover/tear seam pointed away from the body. Do not set a live air bag module down with the deployment door/trim cover/tear seam face down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.

⚠ WARNING: Always carry or place a live Safety Canopy®, or side air curtain module, with the module and tear seam pointed away from your body. Failure to follow this instruction may result in serious personal injury or in the event of an accidental deployment.

⚠ WARNING: Deploy all supplemental restraint system (SRS) devices (air bags, pretensioners, load limiters, etc.) outdoors with all personnel at least 9 meters (30 feet) away to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

NOTE: For air bag modules with multiple loops, deploy all of the loops on the air bag module.

NOTE: Some driver and passenger front air bags have 2 deployment stages and an active canister vent. After a collision it is possible that Stage 1 has deployed and Stage 2 and the active canister vent have not.

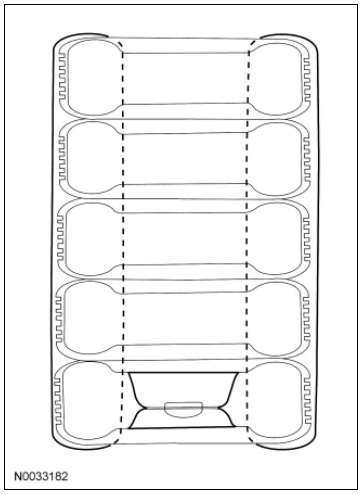
If a front air bag module has deployed, it is **mandatory** that the front air bag module be remotely deployed using the appropriate air bag disposal procedure.

NOTE: A typical air bag disposal is shown that is similar for all vehicles.

All driver, passenger, knee and seat side air bag modules

1. Make a container to house the air bag module for deployment.
   - **NOTE:** The tires must be of sufficient size to accommodate the air bag module.

     Obtain a tire and wheel assembly and an additional 4 tires (without wheels) of the same size.
   - With the tire and wheel assembly on the bottom, stack the tires.
   - Securely tie all of the tires together.



2. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

3. Remove the air bag module. Refer to the appropriate procedure in this section.

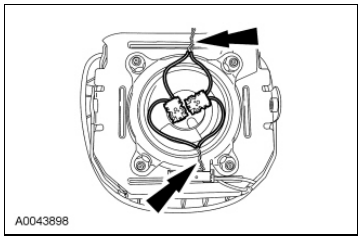
4. **NOTE:** If the air bag module does not have a hard-wired pigtail, cut the wires and connector(s) from the vehicle wire harness and reconnect to the air bag module.

   Cut each of the air bag module wires near the electrical connector that connects to the vehicle wire harness.

5. Remove any sheathing (if present) and strip the insulation from the ends of the cut wires.

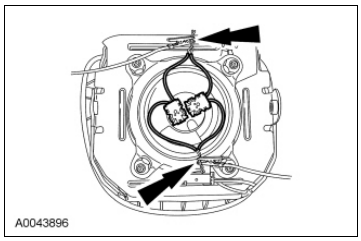
6. **NOTE:** Typical driver air bag module with 2 loops shown, other air bag modules with multiple loops or multiple features (canister vent, active tether) similar.

   For air bag modules with multiple loops, twist together a wire from each loop then repeat for the remaining wires from each loop.



7. Make a jumper harness to deploy the air bag module.
    - Obtain 2 wires (20 gauge minimum) at least 9.14 m (30 ft) long and strip both ends of each wire.
    - At one end of the jumper harness, connect the wires together.

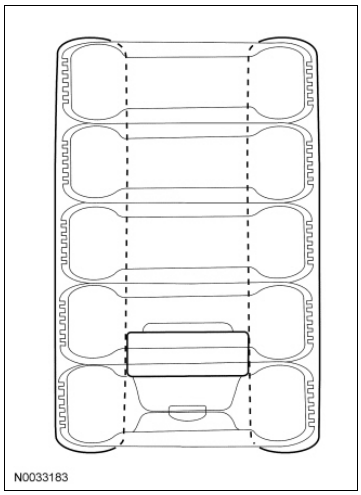
8. Using the end of the jumper harness where the wires are not connected together, attach each wire of the jumper harness to each wire of the air bag module or to the twisted-together wires if multiple loops. Use tape or other insulating material to make sure that the leads do not make contact with each other.



Driver air bag modules

9. **NOTE:** Make sure the air bag connections are maintained.

    For driver air bag modules, with the stack of tires upright and the wheel on the bottom, carefully place the driver air bag module, with the trim cover facing up, on the wheel.

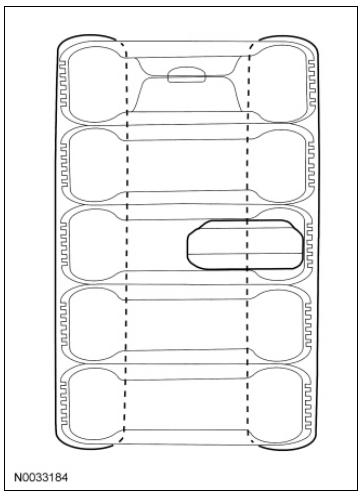


Passenger, knee and seat side air bag modules

10. **NOTE:** Make sure the air bag connections are maintained.

    Tip the stack of tires on its side and place the air bag module inside the center tire, making sure that there are 2 tires beneath the tire containing the air bag module and 2 tires (including the tire and wheel assembly) above the tire containing the air bag module.

11. Place the tire stack upright, with the wheel on top.



All driver, passenger, knee and seat side air bag modules

12. Remain at least 9.14 m (30 ft) away from the air bag module.

13. From the end of the jumper harness that is not connected to the air bag module, disconnect the 2 wires of the jumper harness from each other.

14. Deploy the air bag module by touching the ends of the 2 wires of the jumper harness to the terminals of a 12-volt battery.

15. To allow for cooling, wait at least 10 minutes before approaching the deployed air bag module.

16. Dispose of the deployed air bag module in the same manner as any other part to be scrapped.

Safety Belt Anchor Pretensioners, Safety Belt Buckle Pretensioners, Safety Belt Retractor Pretensioners, Adaptive Load Limiting Safety Belt Retractors and Safety Belt Inflators - Remote Deployment

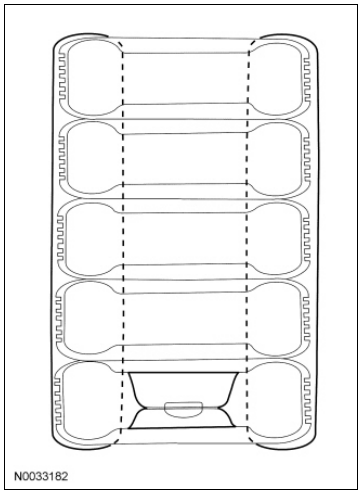
⚠ WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Ner back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

⚠ WARNING: Deploy all supplemental restraint system (SRS) devices (air bags, pretensioners, load limiters, etc.) outdoors with all personnel at least 9 meters (30 feet) away to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

NOTE: A typical safety belt buckle, retractor and inflator disposal is shown that is similar for all vehicles.

1. Make a container to house the safety belt buckle or retractor for deployment.
   - **NOTE:** The tires must be of sufficient size to accommodate the safety belt buckle, retractor or inflator.

     Obtain a tire and wheel assembly and 4 additional tires (without wheels) of the same size.
   - With the tire and wheel assembly on the bottom, stack the tires.
   - Securely tie all of the tires together.



2. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

3. Remove the safety belt buckle, retractor or inflator. Refer to the appropriate procedure in Section 501-20A .
    - When deploying a safety belt buckle pretensioner, install a nut and bolt of sufficient length and of the same diameter as was used to retain it to the seat.

4. **NOTE:** If the safety belt anchor, buckle, retractor or inflator does not have a hard-wired pigtail, it will be necessary to cut the wires and connector(s) from the vehicle wire harness and reconnect to the safety belt buckle, retractor or inflator.

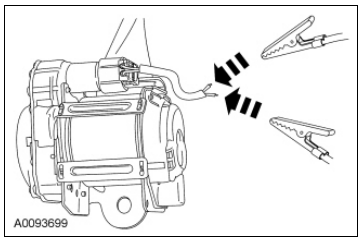
   Cut each of the safety belt anchor, buckle, retractor or inflator wires near the electrical connector that connects to the vehicle wire harness.

5. Remove any sheathing (if present) and strip the insulation from the ends of the cut wires.

6. Make a jumper harness to deploy the safety belt buckle, retractor or inflator.
    - Obtain 2 wires (20 gauge minimum) at least 9.14 m (30 ft) long and strip both ends of each wire.
    - At one end of the jumper harness, connect the wires together.

7. **NOTE:** Typical safety belt retractor pretensioner shown, other safety belt anchor pretensioners, buckle pretensioners, load-limiting retractors and safety belt inflators similar.

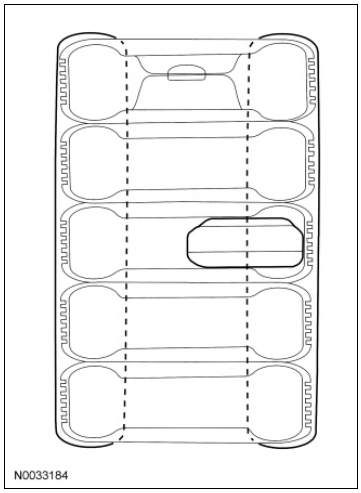
   Using the end of the jumper harness that the wires are not connected together, attach each wire of the jumper harness to each wire of the safety belt anchor, buckle, retractor or inflator. Use tape or other insulating material to make sure that the leads do not make contact with each other.



8. **NOTE:** Make sure the safety belt anchor, buckle, retractor or inflator connections are maintained.

Tip the stack of tires on its side and place the safety belt anchor, buckle, retractor or inflator inside the center tire, making sure that there are 2 tires beneath the tire containing the safety belt anchor, buckle, retractor or inflator and 2 tires (including the tire and wheel assembly) above the tire containing the safety belt anchor, buckle, retractor or inflator.

9. Place the tire stack upright, with the wheel on top.



10. Remain at least 9.14 m (30 ft) away from the safety belt anchor, buckle, retractor or inflator.

11. From the end of the jumper harness that is not connected to the safety belt anchor, buckle, retractor or inflator, disconnect the 2 wires of the jumper harness from each other.

12. Deploy the safety belt anchor pretensioner, buckle pretensioner, retractor pretensioner or inflator by touching the ends of the 2 wires of the jumper harness to the terminals of a 12-volt battery.

13. To allow for cooling, wait at least 10 minutes before approaching the deployed safety belt anchor pretensioner, buckle pretensioner, retractor pretensioner or inflator.

14. Dispose of the deployed safety belt anchor, buckle, retractor or inflator in the same manner as any other part to be scrapped.

Safety Belt Anchor Pretensioners, Safety Belt Buckle Pretensioners, Safety Belt Retractor Pretensioners and Load Limiting Safety Belt Retractors - In-Vehicle Deployment

⚠ WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

⚠ WARNING: Deploy all supplemental restraint system (SRS) devices (air bags, pretensioners, load limiters, etc.) outdoors with all personnel at least 9 meters (30 feet) ay to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

NOTE: A typical safety belt buckle and retractor disposal is shown that is similar for all vehicles.

1. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Access the safety belt anchor, buckle or retractor electrical connectors. For additional information, refer to Section 501-20A .

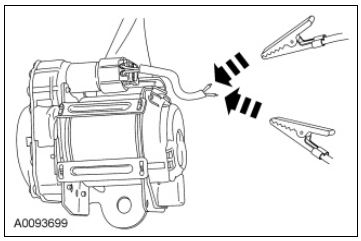
3. Cut each of the safety belt anchor, buckle or retractor wires, leaving at least 101.6 mm (4 in) to work with.

4. Remove any sheathing (if present) and strip the insulation from the ends of the cut wires.

5. Make a jumper harness to deploy the safety belt anchor, buckle or retractor.
   - Obtain 2 wires (20 gauge minimum) at least 9.14 m (30 ft) long and strip both ends of each wire.
   - At one end of the jumper harness, connect the wires together.

6. **NOTE:** Typical safety belt retractor pretensioner shown, other safety belt anchor pretensioners, buckle pretensioners and load-limiting retractors are similar.

   Using the end of the jumper harness that the wires are not connected together, attach each wire of the jumper harness to each wire of the safety belt anchor, buckle or retractor. Use tape or other insulating material to make sure that the leads do not make contact with each other.



7. Remain at least 9.14 m (30 ft) away from the safety belt anchor, buckle or retractor.

8. From the end of the jumper harness that is not connected to the safety belt anchor, buckle or retractor, disconnect the 2 wires of the jumper harness from each other.

9. Deploy the safety belt anchor pretensioner, buckle pretensioner or retractor pretensioner by touching the ends of the 2 wires of the jumper harness to the terminals of a 12-volt battery.

10. To allow for cooling, wait at least 10 minutes before approaching the deployed safety belt anchor pretensioner, buckle pretensioner or retractor pretensioner.

11. Dispose of the deployed safety belt anchor, buckle or retractor in the same manner as any other part to be scrapped.

Safety Canopy® Modules and Side Air Curtain Modules - In-Vehicle Deployment

⚠ WARNING: Deploy all supplemental restraint system (SRS) devices (air bags, pretensioners, load limiters, etc.) outdoors with all personnel at least 9 meters (30 feet) away to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

NOTE: The Safety Canopy® module deployment for a scrapped vehicle will occur in its installed position in the vehicle.

NOTE: A typical Safety Canopy® module disposal is shown that is similar for all vehicles.

1. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

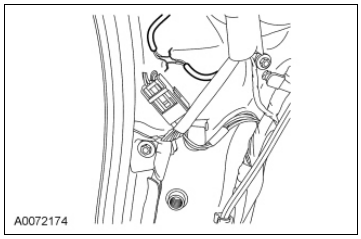
2. Access the Safety Canopy®/side air curtain module electrical connectors. For additional information, refer to the appropriate procedure in this section.

3. Cut each of the Safety Canopy®/side air curtain module wires leaving at least 101.6 mm (4 in) to work with.

4. Remove any sheathing (if present) and strip the insulation from the ends of the cut wires.

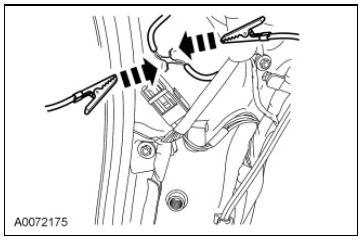
5. **NOTE:** Typical Safety Canopy®/side air curtain module with 2 loops shown, other Safety Canopy®/side air curtain modules wioops are similar.

   For Safety Canopy®/side air curtain modules with multiple loops, twist together a wire from each loop then repeat for the remaining wires from each loop.



6. Make a jumper harness to deploy the Safety Canopy®/side air curtain module.
   - Obtain 2 wires (20 gauge minimum) at least 9.14 m (30 ft) long and strip both ends of each wire.
   - At one end of the jumper harness, connect the wires together.

7. Using the end of the jumper harness where the wires are not connected together, attach each wire of the jumper harness to each wire of the Safety Canopy®/side air curtain module or to the twisted-together wires if multiple loops. Use tape or other insulating material to make sure that the leads do not make contact with each other.



8. From the end of the jumper harness that is not connected to the Safety Canopy®/side air curtain module, disconnect the 2 wires of the jumper harness from each other.

9. Deploy the Safety Canopy®/side air curtain module by touching the ends of the 2 wires of the jumper harness to the terminals of a 12-volt battery.

10. To allow for cooling, wait at least 10 minutes before apping the deployed Safety Canopy®/side air curtain module.

11. Dispose of the deployed Safety Canopy®/side air curtain module in the same manner as any other part to be scrapped.

Deployable Steering Column - In-Vehicle Deployment

⚠ WARNING: Deploy all supplemental restraint system (SRS) devices (air bags, pretensioners, load limiters, etc.) outdoors with all personnel at least 9 meters (30 feet) away to make sure of personal safety. Due to the loud report which occurs when an SRS device is deployed, hearing protection is required. Failure to follow these instructions may result in serious personal injury.

1. Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. **NOTE:** It may be necessary to lower or remove the deployable steering column from the instrument panel to access the deployable steering column electrical connector.

   Access the deployable steering column electrical connector.

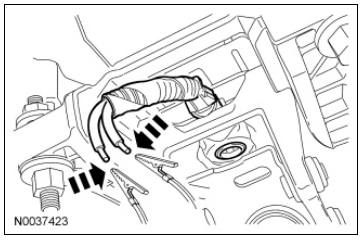
3. **NOTE:** If the deployable steering column does not ha hard-wired pigtail, it will be necessary to cut the wires and connector(s) from the vehicle wire harness and reconnect to the deployable steering column.

   Cut each of the deployable steering column wires, leaving at least 101.6 mm (4 in) to work with.

4. Remove any sheathing (if present) and strip the insulation from the ends of the cut wires.

5. Make a jumper harness to deploy the deployable steering column.
   - Obtain 2 wires (20 gauge minimum) at least 9.14 m (30 ft) long and strip both ends of each wire.
   - At one end of the jumper harness, connect the wires together.

6. Using the end of the jumper harness where the wires are not connected together, attach each wire of the jumper harness to each wire of the deployable steering column. Use tape or other insulating material to make sure that the leads do not make contact with each other.



7. Remain at least 9.14 m (30 ft) away from the deployable steering column.

8. From the end of the jumper harness that is not connected to the deployable steering column, disconnect the 2 wires of the jumper harness from each other.

9. Deploy the deployable steering column by touching the ends of the 2 wires of the jumper harness to the terminals of a 12-volt battery.

10. To allow for cooling, wait at least 10 minutes before approaching the deployed steering column.

11. Dispose of the deployed steering column in the same manner as any other part to be scrapped.

Rivet Nut Replacement

⚠ WARNING: Always wear eye protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.

NOTICE: **If the Safety Canopy®/side air curtain module has deployed, the tether cord rivet nut must be inspected and replaced if damagd before installing a new Safety Canopy®.**

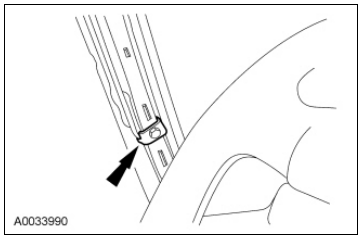
NOTE: A typical rivet nut replacement is shown that is similar for all vehicles.

NOTE: LH shown, RH similar.

1. Depower the Supplemental Restraint System (SRS). For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

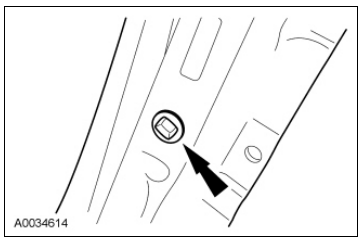
2. Remove the necessary trim panel(s). For additional information, refer to Section 501-05 .

3. Remove the bolt and bracket for the tether cord (if present).



4. If needed, position and secure the Safety Canopy®/side air curtain tether cord and bracket assembly aside.

5. Using the appropriate service tool, sand the rivet nut shoulder until the shoulder surface is removed.



6. Punch the remaining portion of the rivet nut through the rivet nut hole.

7. **NOTE:** Use only Ford Motor Company factory-authorized replacement parts for rivet nut repair procedure.

   Obtain the correct square shank rivet nut for the vehicle application from the Ford Catalog AdvantageTM or equivalent and insert it into the rivet nut hole.

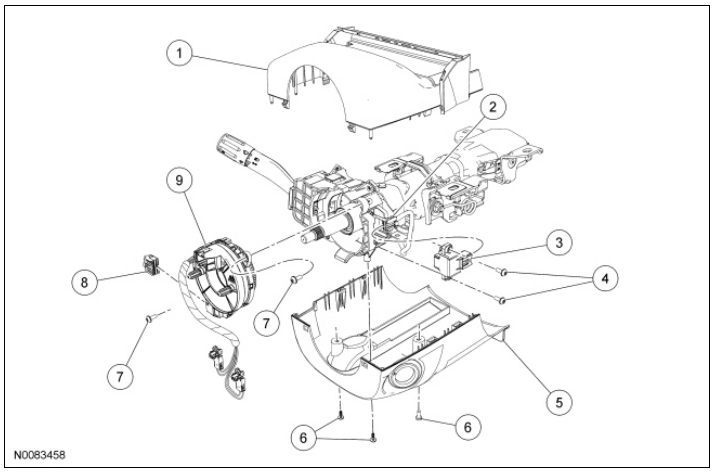
8. Using a suitable rivet nut installing tool, install the rivet nut. For additional information, refer to the tool manufacturer's operating instructions.

9. If present, position the tether cord. Install the bolt. See the appropriate component removal and installation procedure or Specifications for the correct torque specification.

10. **NOTE:** The tether cord must be positioned correctly in place before installing the A-pillar trim panel.

    Install the necessary trim panel(s). For additional information, refer to Section 501-05 .

Clockspring



Item	Part Number	Description
1	3530	Upper steering column shroud
2	-	Steering wheel rotation sensor electrical connector (part of 14401)
3	3F818	Steering wheel rotation sensor
4	W506942	Steering wheel rotation sensor screws (2 required)
5	3K512	Lower steering column shroud
6	-	Lower steering column shroud screws (3 required) (part of 3K512)
7	W506942	Clockspring screws (2 required)
8	-	Clockspring electrical connector (part of 14401)
9	14A664	Clockspring

Removal

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Remove the driver air bag module. For additional information, refer to Driver Air Bag Module in this section.

2. *NOTICE:* **Make sure the road wheels are in the straight-ahead position. Damage to the clockspring may occur.**

   Remove the steering wheel. For additional information, refer to steering wheel Removal and Installation in Section 211-04 .

3. Release the upper steering column shroud by pressing inward on the sides, lift upwards and remove.
4. Remove the 3 screws and lower steering column shroud.
5. Remove the steering wheel rotation sensor.
   - Disconnect the electrical connector.

- Remove the 2 screws and sensor.

6. Remove the clockspring.
   - Disconnect the electrical connector.
   - Remove the 2 screws.
   - Remove the clockspring.

Installation

⚠ **WARNING: If the clockspring is not correctly centralized, it may fail prematurely. If in doubt, repeat the centralizing procedure. Failure to follow these instructions may increase the risk of serious personal injury or death in a crash.**

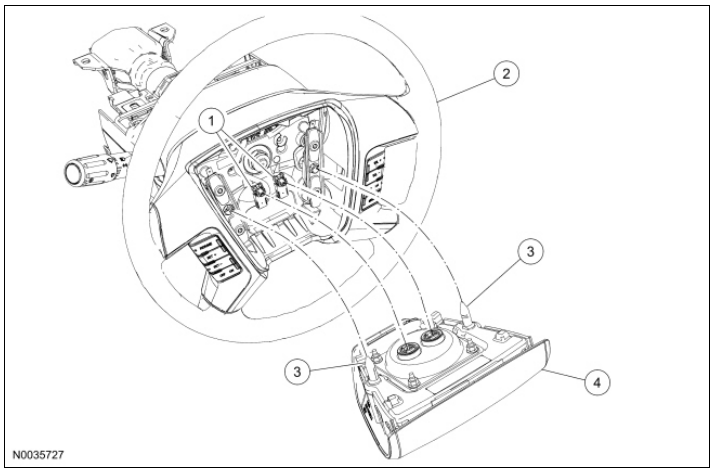
NOTICE: **Do not over-rotate the clockspring inner rotor. The internal ribbon wire is connected to the clockspring rotor. The internal ribbon wire acts as a stop and can be broken from its internal connection. Failure to follow this instruction may result in component damage and/or system failure.**

NOTICE: **If installing a new clockspring, do not remove the clockspring anti-rotation key until the steering wheel is installed. If the anti-rotation key has been removed before installing the steering wheel, the clockspring must be centered. Failure to follow this instruction may result in component damage and/or system failure.**

1. Install the clockspring and 2 screws.
2. Connect the clockspring electrical connector.
3. Install the steering wheel rotation sensor and 2 screws.
4. If a new clockspring was installed and the anti-rotation key has not been removed, **proceed to Step 8** , otherwise **proceed to Step 6** .
5. If a new clockspring was installed and the anti-rotation key has been removed before the steering wheel is installed or the same clockspring is being installed, rotate the clockspring inner rotor **counterclockwise** and carefully feel for the ribbon wire to run out of length with slight resistance. Stop rotating the clockspring inner rotor at this point.
6. Starting with the clockspring inner rotor in the 12 o'clock position, rotate the inner rotor **clockwise** through approximately 2.25 turns to center the clockspring.
   - The clockspring inner rotor must be in the 12 o'clock position to be correctly centered.
7. *NOTICE:* **To prevent damage to the clockspring, make sure the road wheels are in the straight-ahead position.**

   Install the steering wheel. For additional information, refer to Section 211-04 .
8. If a new clockspring was installed, remove the anti-rotation key.
9. Install the driver air bag module. For additional information, refer to Driver Air Bag Module in this section.
10. Install the upper and lower steering column shrouds.
    - Clip the lower steering column shroud to the upper steering column shroud.
    - Install the 3 screws.
11. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in this section.

Driver Air Bag Module



Item	Part Number	Description
1	-	Driver air bag module electrical connectors (part of 14A664)
2	3600	Steering wheel
3	-	Driver air bag module locking pins (part of 43B13)
4	43B13	Driver air bag module

Removal

⚠ WARNING: Always carry or place a live air bag module with the air bag and deployment door/trim cover/tear seam pointed away from the body. Do not set a live air bag module down with the deployment door/trim cover/tear seam face down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

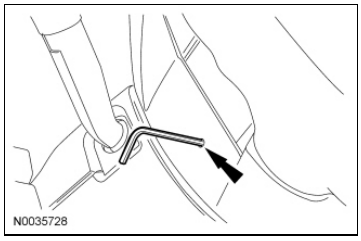
NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition switch is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

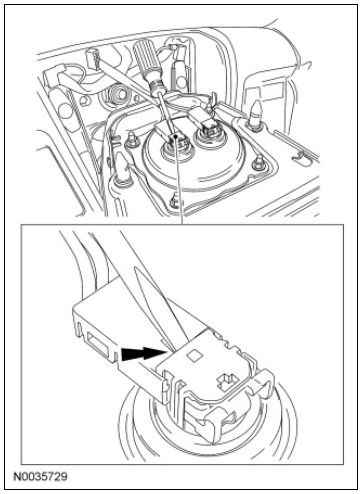
2. **NOTE:** Repeat this step for both locking pins.

   Using a 3-mm Allen wrench or a suitable tool through the access hole on the backside of the steering wheel, position the tool against the spring clip and push in, disengaging the clip from the locking pin. With the spring clip disengaged from the locking pin, gently pull back on that side of the driver air bag module to release it from the steering wheel.



3. ***NOTICE:*** **Do not pull the driver air bag module electrical connectors out by the locking buttons. Damage to the locking buttons can occur.**

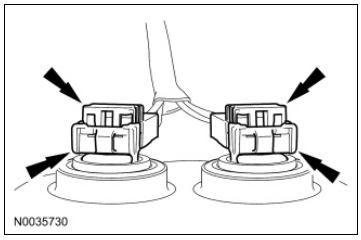
   Using a small screwdriver as shown, lift up and release the locking buttons on the driver air bag module electrical connectors. With the locking buttons released, remove the electrical connectors and the driver air bag module.



Installation

1. ***NOTICE:*** **The driver air bag module electrical connector locking buttons must be in the released position when connected. Do not install the driver air bag module electrical connectors by the locking buttons. Failure to follow these instructions may cause connector damage.**

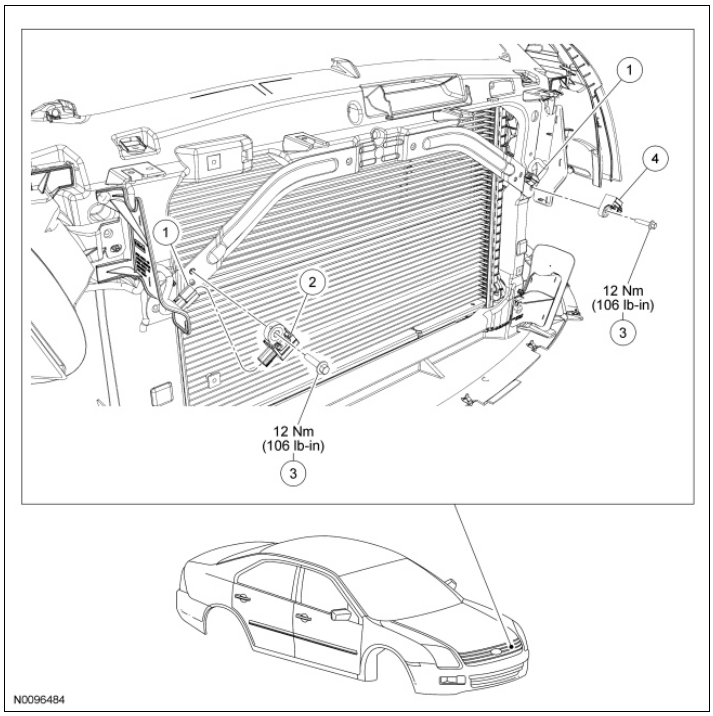
   With the locking buttons released, install the driver air bag module electrical connectors fully into the driver air bag module and seat the locking buttons.



2. Align the driver air bag module locking pins to the steering wheel and, while pushing inward, seat the 2 driver air bag module locking pins to the steering wheel wire clips.

3. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

Front Impact Severity Sensor



Item	Part Number	Description
1	-	Front impact severity sensor electrical connectors (part of 14290)
2	14B006	RH front impact severity sensor
3	W505256	Front impact severity sensor bolts
4	14B006	LH front impact severity sensor

Removal and Installation

⚠ WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to the original production configuration. A new RCM and sensors must be installed whether or not the air bags have deployed. Failure to follow these instructions may result in serious personal injury or death in a crash.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint Sysm (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Remove the front bumper cover. For additional information, refer to Section 501-19 .

3. Disconnect the front impact severity sensor electrical connector.

4. Remove the bolt and front impact severity sensor.
    - To install, tighten to 12 Nm (106 lb-in).

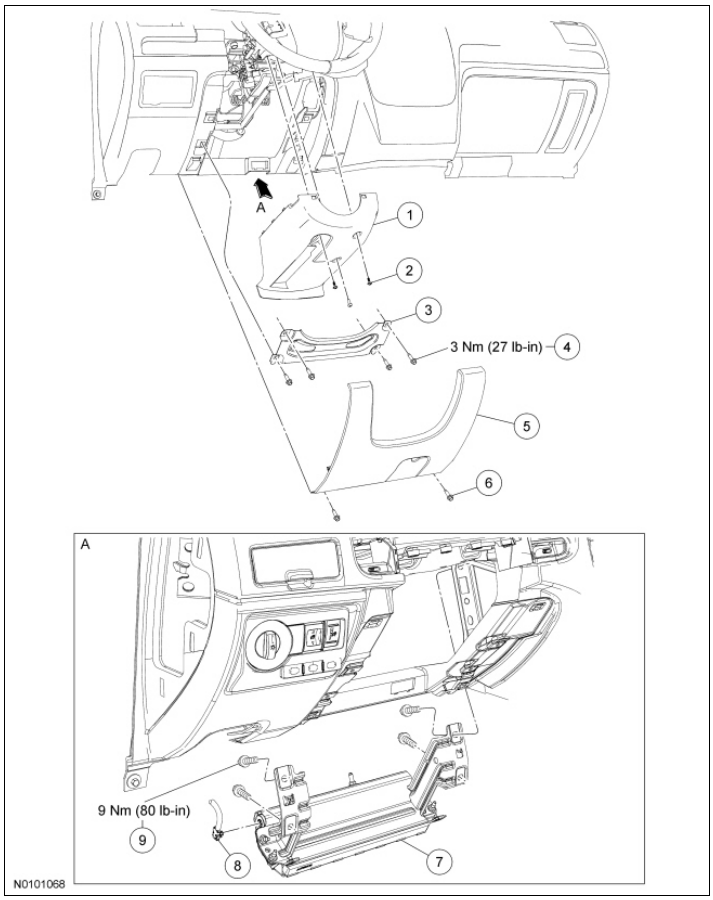
5. ⚠ **WARNING: Always tighten the fasteners of the restraints control module (RCM) and impact sensor (if equipped) to the specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.**

   NOTE: Make sure the radiator support and front impact severity sensor and bracket assembly mating surfaces are clean and free of foreign material.

   To install, reverse the removal procedure.

6. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

Knee Air Bag Module



Item	Part Number	Description
1	3K512	Lower steering column shroud
2	W707658	Lower steering column shroud screw (3 required)
3	017A28	Steering column opening cover reinforcement
4	W505422	Steering column opening cover reinforcement bolt (4 required)
5	04459	Steering column opening trim panel
6	-	Steering column opening trim panel screw (2 required)
7	045J77	Knee air bag module
8	-	Electrical connector (part of 14401)
9	W503924	Bolt (4 required)

Removal

⚠ WARNING: Always carry or place a live air bag module with the air bag and deployment door/trim cover/tear seam pointed away from the body. Do not set a live air bag module down with the deployment door/trim cover/tear seam face down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

NOTE: Always make sure the correct Supplemental Restraint System (SRS) component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the Master Parts Catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

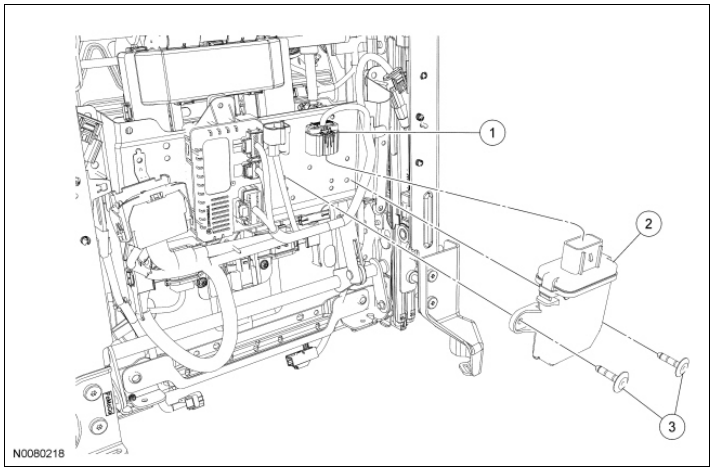
1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.
2. Remove the 2 screws and steering column opening trim panel.
3. Remove the three screws and lower steering column shroud.
4. Remove the 4 bolts and steering column opening cover reinforcement.
5. Disconnect the knee air bag module electrical connector.
6. Remove the wiring harness from the knee air bag module bracket.
7. From the back side of the instrument panel bracket, remove the 4 knee air bag module bolts.
8. Remove the knee air bag module.
9. Remove and discard the 4 J-nuts.

Installation

1. Install 4 new J-nuts.
2. Install the knee air bag module and 4 bolts.
    - Tighten to 9 Nm (80 lb-in).
3. Connect the knee air bag module electrical connector.
4. Attach the wiring harness to the knee air bag module bracket.
5. Install the lower steering column shroud.
6. Install the steering column opening cover reinforcement and 4 bolts.
    - Tighten to 3 Nm (27 lb-in).
7. Install the steering column opening trim panel and 2 screws.
8. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

Occupant Classification System Module (OCSM)

NOTE: Power seat shown, manual seat similar.



Item	Part Number	Description
1	-	Occupant Classification System Module (OCSM) electrical connector (part of 14A698)
2	14B422	OCSM
3	-	OCSM rivets (2 required)

Removal and Installation

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition switch is ON.

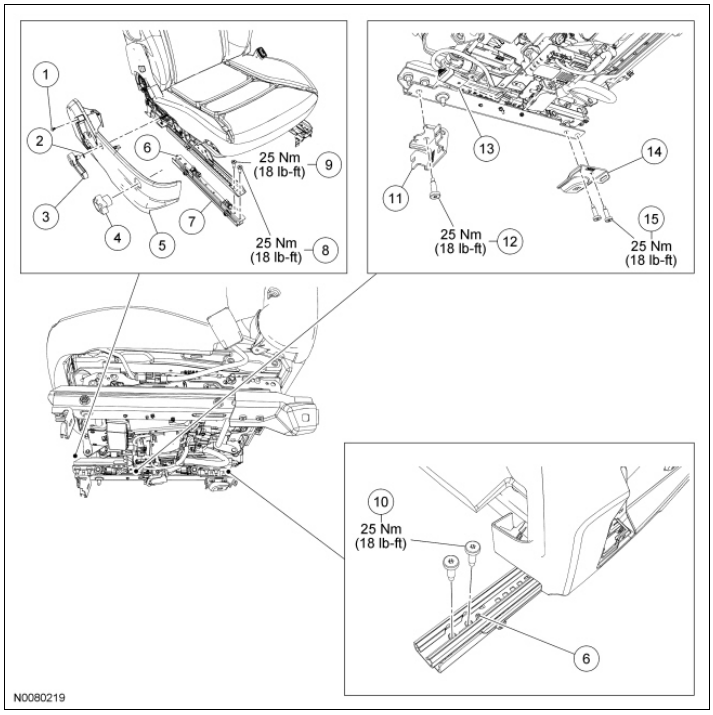
NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Remove the passenger seat. For additional information, refer to Section 501-10 .
2. Disconnect the electrical connector.
3. *NOTICE:* **Make sure to remove all metal chips from the Occupant Classification System Module (OCSM) and the surrounding areas after drilling out the rivets. Failure to follow this instruction may result in component damage and/or system failure.**

   Drill out the 2 rivets and remove the Occupant Classification System Module (OCSM).
4. To install, reverse the removal procedure.
5. If installing a new OCSM , carry out the system reset procedure. For additional information, refer to Occupant Classification Sensor (OCS) System Reset in the General Procedures portion of this section.

Occupant Classification Sensor

NOTE: Outboard shown, inboard similar.



Item	Part Number	Description
1	-	Cushion side shield scrivet (if equipped)
2	-	Manual recliner handle spring clip (part of 61198) (if equipped)
3	61198	Manual recliner handle (if equipped)
4	62622	Manual lumbar control knob (if equipped)
5	62186	Cushion side shield
6	-	Occupant Classification System (OCS) weight sensor assembly locating pin (part of 61708)
7	61708	OCS weight sensor assembly
8	-	OCS weight sensor assembly front mounting position front bolt (part of 61708)
9	-	OCS weight sensor assembly front mounting position rear bolt (part of 61708)
10	-	OCS weight sensor assembly rear bolt (part of 61708) (2 required)
11	61913	Forward seat riser
12	-	Forward seat riser bolt
13	-	OCS weight sensor assembly electrical connector (part of 14A698)

14	61913	Rearward seat riser
15	-	Rearward seat riser bolt (2 required)

Removal

⚠ **WARNING: Use care when handling the front passenger seat and track assembly. Dropping the assembly, placing excessive weight on or sitting on a front passenger seat that is not secured in the vehicle may result in damaged seat components. Failure to follow these instructions may result in incorrect operation of the occupant classification system (OCS) and increases the risk of serious personal injury or death in a crash.**

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition switch is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

All Occupant Classification System (OCS) weight sensor assemblies

1. Remove the passenger seat. For additional information, refer to Section 501-10 .

Outboard OCS weight sensor assembly

2. If equipped, remove the manual lumbar control knob.

3. If equipped, remove the spring clip and the manual recliner handle.

4. *NOTICE:* **Do not reinstall the cushion side shield or side shield retainers after removal. These are one-time-use items that become damaged during removal and may not remain attached if reinstalled. Install a new side shield (includes new retainers attached).**

   Remove and discard the cushion side shield.

   - If equipped, remove the scrivet.
   - Pull out on the side and rear of the cushion side shield and release the retainers.
     - Separate the wire harness from the cushion side shield.
   - Remove the side shield and any remaining side shield retainers from the seat and discard.

Seat receiving a new OCS weight sensor assembly

5. Remove the bolt and the forward seat riser from the affected side OCS weight sensor assembly.

6. Remove the 2 bolts and the rearward seat riser from the affected side OCS weight sensor assembly.

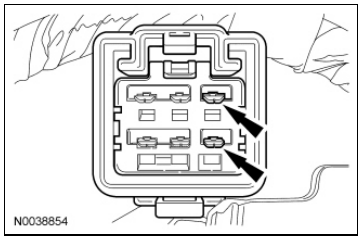
All OCS weight sensor assemblies

7. **NOTE:** Note the position and the routing of the OCS system electrical wiring and connector for installation.

   On the affected side, disconnect the OCS weight sensor assembly electrical connector.

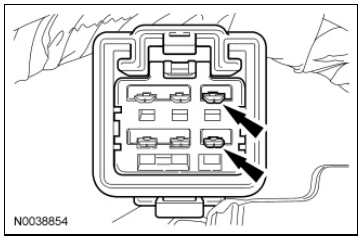
8. If equipped, disconnect the power seat track motor electrical connector.

9. Move the seat to the forward most position.
   - If equipped with a power seat track, apply power and ground to the pins shown.



10. Remove the 2 rear bolts from the affected OCS weight sensor assembly.

11. Move the seat to the rearward most position.
    - If equipped with a power seat track, apply power and ground to the pins shown.



12. Remove the 2 front bolts and the OCS weight sensor assembly.

Installation

All Occupant Classification System (OCS) weight sensor assemblies

NOTE: If installing a new seat track, position it so the seat will be in the rearward most position before installing the OCS weight sensor assembly.

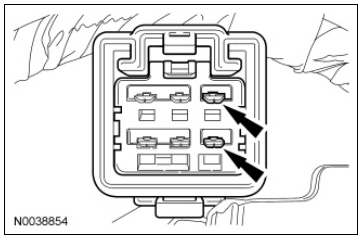
1. **NOTE:** To make sure of correct installation, the OCS weight sensor assembly bolts must be installed in the sequence shown.

   While holding the OCS weight sensor assembly firmly in position, install the OCS weight sensor assembly front mounting position rear bolt.

   - Tighten to 25 Nm (18 lb-ft).

2. While still holding the OCS weight sensor assembly firmly in position, install the OCS weight sensor assembly front mounting position front bolt.
   - Tighten to 25 Nm (18 lb-ft).

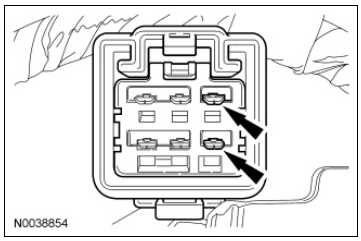
3. Move the seat to the forward most position.
   - If equipped with a power seat track, apply power and ground to the pins shown.



4. Install the 2 rear OCS weight sensor assembly bolts.
   - Tighten to 25 Nm (18 lb-ft).

5. Connect the OCS weight sensor assembly electrical connector.

6. Center the seat track to the seat cushion pan.
   - If equipped with a power seat track, apply power and ground to the pins shown.



7. If equipped, connect the power seat track motor electrical connector.

Seat receiving a new OCS weight sensor assembly

8. Install the rearward seat riser and the 2 bolts.
   - Tighten to 25 Nm (18 lb-ft).

9. Install the forward seat riser and bolt.
   - Tighten to 25 Nm (18 lb-ft).

Outboard OCS weight sensor assembly

10. ***NOTICE:*** **Do not reinstall the cushion side shield or side shield retainers after removal. These are one-time-use items that become damaged during removal and may not remain attached if reinstalled. Install a new side shield (includes new retainers attached).**

    Install a new cushion side shield.

11. If equipped, install the spring clip and the manual recliner handle.

12. If equipped, install the manual lumbar control knob.

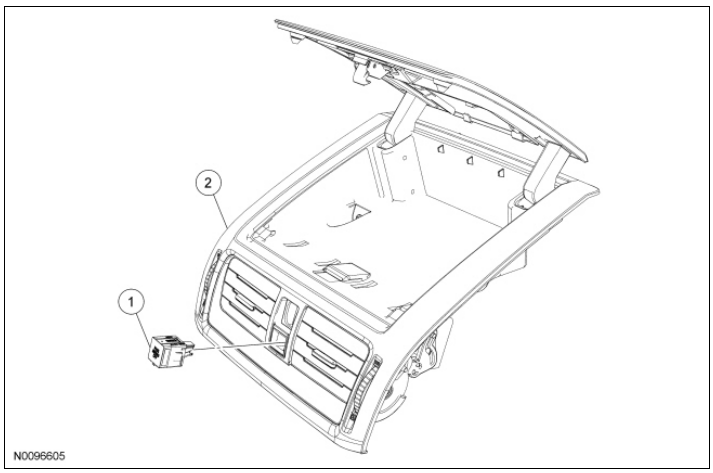
All OCS weight sensor assemblies

13. Install the passenger seat. **Do not prove out the SRS at this time.** For additional information, refer to Section 501-10 .

14. Carry out the Occupant Classification System (OCS) System Reset procedure and prove out the SRS . For additional information, refer to Occupant Classification Sensor (OCS) System Reset in this section.

Passenger Air Bag Deactivation (PAD) Indicator

Fusion



Item	Part Number	Description
1	10A936	Passenger Air Bag Deactivation (PAD) indicator
2	13594	Upper storage compartment

NOTE: The MKZ Passenger Air Bag Deactivation (PAD) indicator is part of the Front Controls Interface Module (FCIM) and is not serviceable separately. For additional information, refer to Section 412-01 .

NOTE: A DTC will set in the Restraints Control Module (RCM) if the PAD electrical connector is disconnected with the ignition ON. The RCM memory must be cleared before releasing the vehicle.

1. ⚠ **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.**

   Turn the ignition OFF and wait one minute.

2. Remove the upper storage compartment. For additional information, refer to Section 501-12 .

3. Release the tab and remove the PAD indicator.

4. To install, reverse the removal procedure.

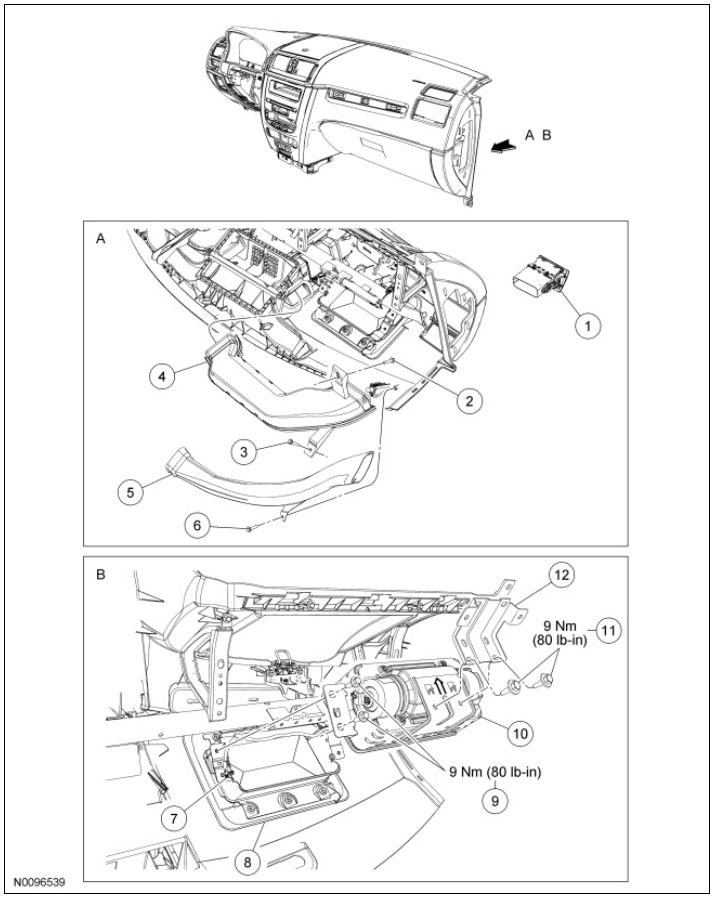
5. Prove out the Supplemental Restraint System (SRS) as follows:
   Turn the ignition from ON to OFF. Wait 10 seconds, then turn the ignition ON and monitor the air bag warning indicator with the air bag modules installed. The air bag warning indicator will light continuously for approximately 6 seconds and then turn off. If an air bag SRS fault is detected, the air bag warning indicator will:
   - fail to light.
   - remain lit continuously.
   - flash.
   The flashing might not occur until approximately 30 seconds after the ignition has been turned from the OFF to the ON position. This is the time required to complete testing of the SRS . If the air bag

warning indicator is inoperative and a SRS fault exists, a chime will sound in a pattern of 5 sets of 5 beeps. If this occurs, the air bag warning indicator and any SRS fault discovered must be diagnosed and repaired.

Clear all RCM and Occupant Classification System Module (OCSM) Continuous Memory Diagnostic Trouble Codes (CMDTCs).

Passenger Air Bag Module

NOTE: Fusion shown, MKZ similar.



Item	Part Number	Description
1	19893	RH instrument panel register
2	-	Screw
3	-	Screw
4	19B680	Ventilation duct
5	19B680	Defroster duct
6	-	Screw
7	-	Passenger air bag module electrical connector (part of 14401) (2 required)
8	-	Passenger air bag module deployment chute (part of instrument panel)
9	W505253	Passenger air bag module-to-deployment chute bolts (4 required)
10	044A74	Passenger air bag module
11	W505253	Passenger air bag module bracket bolts (2 required)
12	-	

		Passenger air bag module bracket (part of 044A74)

Removal

⚠ WARNING: Always carry or place a live air bag module with the air bag and deployment door/trim cover/tear seam pointed away from the body. Do not set a live air bag module down with the deployment door/trim cover/tear seam face down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.

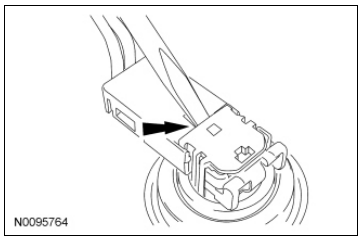
⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Remove the instrument panel. For additional information, refer to Section 501-12 .
2. Remove the RH instrument panel register.
3. Remove the screw and RH ventilation duct.
4. Remove the screw and RH defroster duct.
5. ***NOTICE:*** **Do not pull the electrical connectors out by the Connector Position Assurance (CPA) clip. DTCs can be set in the Restraints Control Module (RCM).**

   Using an appropriate tool, lift up and release the Connector Position Assurance (CPA) clips and disconnect the passenger air bag module electrical connectors.



6. Remove the 4 passenger air bag module-to-deployent chute bolts.
7. Remove the passenger air bag module from the deployment chute.
8. Remove the 2 bolts and passenger air bag module bracket.

Installation

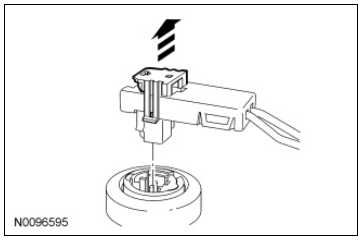
1. Install the passenger air bag module in the instrument panel.
2. Install the 4 passenger air bag module-to-deployment chute bolts.
   - Tighten to 9 Nm (80 lb-in).
3. Install the passenger air bag module bracket and 2 bolts.

- Tighten to 9 Nm (80 lb-in).

4. ***NOTICE:*** **The Connector Position Assurance (CPA) clip must be in the released position before installing the connector. Failure to have the CPA clip in the released position may break the tabs causing Diagnostic Trouble Codes (DTCs) to set in the Restraints Control Module (RCM).**

   Connect the passenger air bag module electrical connectors.

   - Lift up the CPA clip and install the electrical connector fully and lock the clip.

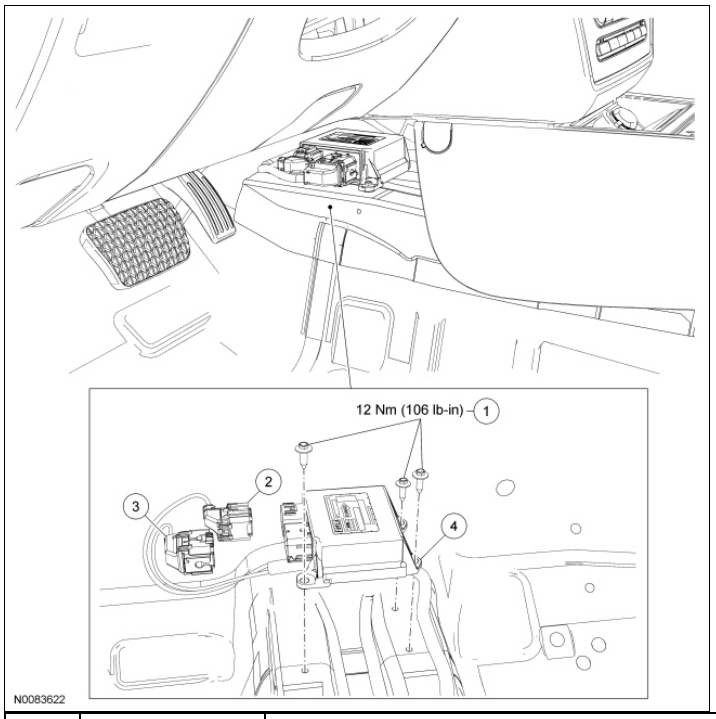


5. Install the RH instrument panel register.
6. Install the RH defroster duct and screw.
7. Install the RH ventilation duct and screw.
8. Install the instrument panel. For additional information, refer to Section 501-12 .

Restraints Control Module (RCM)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool



Item	Part Number	Description
1	W707722	Restraints Control Module (RCM) bolts (3 required)
2	-	RCM small connector (part of 14A005)
3	-	RCM large connector (part of 14A005)
4	14B321	RCM

Removal

⚠ WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy® and cause serious personal injury or death.

⚠ WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to the original production configuration. A new RCM and sensors must be installed whether or not the air bags have deployed. Failure to follow these instructions may resulserious personal injury or death in a crash.

NOTICE: **When installing a new Restraints Control Module (RCM), it is necessary to carry out Programmable Module Installation (PMI). System failure may occur if PMI is not performed. For additional information, refer to Section 418-01 .**

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: When installing a new RCM always make sure the correct RCM is being installed. If an incorrect RCM is installed, DTCs will be set.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Carrying out Programmable Module Installation (PMI) will not enable the 911 assist option that is disabled. The RCM and Accessory Protocol Interface Module (APIM) must be configured correctly to fully support 911 assist functionality.

NOTE: This vehicle is equipped with the SYNC® V2 feature which contains the 911 assist option. Refer to the Owners' Literature.

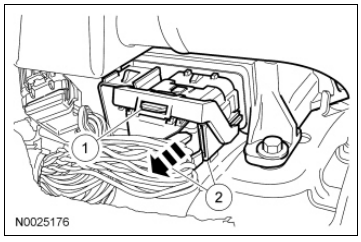
NOTE: Always make sure the correct SRS component is being installed. Parts released for other vehicles may not be compatible even if they appear physically similar. Check the part number listed in the Master Parts Catalog to make sure the correct component is being installed. If an incorrect SRS component is installed, DTCs may set.

1. If installing a new RCM , carry out the steps necessary to prepare for Programmable Module Installation (PMI). For additional information, refer to Section 418-01 .

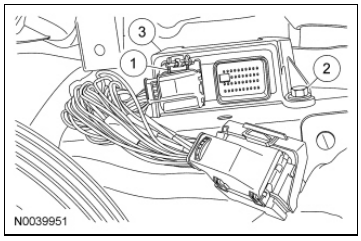
2. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

3. Remove the 2 RH RCM bolts.
   - Position the carpet back at the RH side of the center tunnel area under the instrument panel and remove the 2 bolts.

4. Disconnect the large RCM connector.
   1. Pinch the thumb tab and pivot the Connector Position Assurance (CPA) lever back.
   2. Disconnect the RCM connector.



5. Remove the RCM .
   1. Disconnect the small RCM connector.
   2. Remove the LH bolt.
   3. Remove the RCM .



Installation

1. ⚠ **WARNING: Always tighten the fasteners of the restraints control module (RCM) and impact sensor (if equipped) to the specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.**

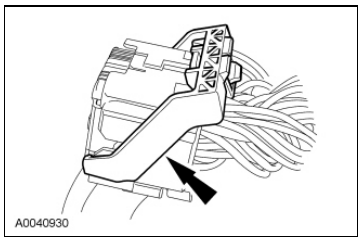
   Position the RCM .

   - Install the 2 RH RCM bolts.
     - ♦ Tighten to 12 Nm (106 lb-in).
   - Position the carpet back at the RH side of the center tunnel area under the instrument panel.

2. Install the RCM .
   - Install the LH RCM bolt.
     - ♦ Tighten to 12 Nm (106 lb-in).

3. Connect the small RCM connector.

4. Verify that the CPA lever is positioned back completely (as shown) before connecting the large RCM connector.

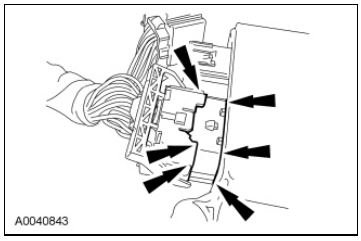


5. ***NOTICE:*** **Placing the large Restraints Control Module (RCM) electrical wiring connector into the RCM on an angle can cause bad electrical connections and damaged components.**

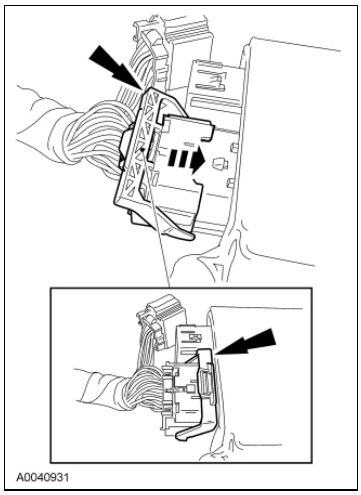
   Position the large RCM electrical connector into the RCM .

   - ***NOTICE:*** **Do not push the connector such that the Connector Position Assurance (CPA) lever pivots and seats. Use light force to insert the connector into the Restraints Control Module (RCM) before using the CPA lever to lock the connector. Damage to the connector or component may occur.**

     With the large RCM electrical connector uniformly aligned to the RCM , push in until a slight resistance is felt.



6. Connect the large RCM connector.
    - Insert the connector into the RCM .
        - ♦ Push to lock the CPA lever thumb tab to the RCM .

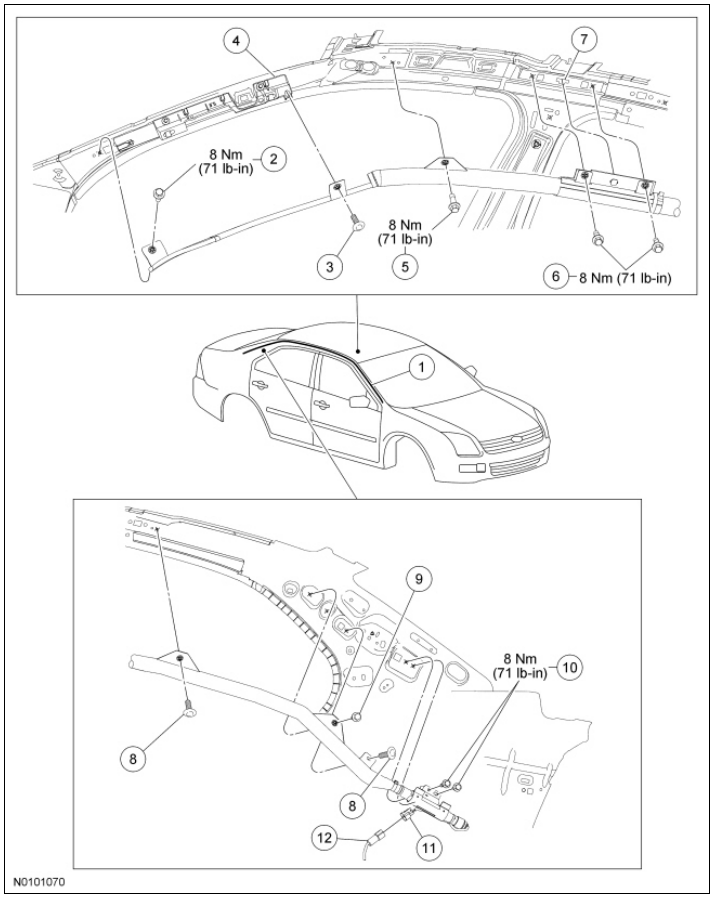


7. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

8. If a new RCM was installed, carry out the appropriate steps necessary to complete PMI . For additional information, refer to Section 418-01 .

Side Air Curtain Module

NOTE: RH shown, LH similar.



Item	Part Number	Description
1	042D94 RH/ 042D95 LH	Side air curtain module
2	W713437	Side air curtain module front tether bracket bolt
3	W709453	Pin-type retainer (to garnish moulding bracket) (part of 042D94 RH/ 042D95 LH)
4	026A52 RH/ 026A53 LH	Garnish moulding bracket
5	W713437	Side air curtain module bolt (rear of A-pillar)
6	W713437	Side air curtain module center guide bolts
7	-	Side air curtain center guide hook sheet metal slot
8	-	Pin-type retainers (part of 042D94 RH/ 042D95 LH)
9	W713437	Side air curtain module middle rear bolt
10	W713437	Side air curtain module rear bracket bolts
11	-	Side air curtain module electrical connector (part of 042D94 RH/ 042D95 LH)

12	-	Rear body wire harness (part of 14A005)

Removal and Installation

⚠ WARNING: Always carry or place a live Safety Canopy®, or side air curtain module, with the module and tear seam pointed away from your body. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.

⚠ WARNING: Anytime the Safety Canopy® or side air curtain module has deployed, a new headliner and new A-, B- and C-pillar upper trim panels and attaching hardware must be installed. Remove any other damaged components and hardware and install new components and hardware as needed. Failure to follow these instructions may result in the Safety Canopy® or side air curtain module deploying incorrectly and increases the risk of serious pury or death in a crash.

⚠ WARNING: Do not obstruct or place objects in the deployment path of the Safety Canopy® or side air curtain module. Failure to follow this instruction may result in the Safety Canopy® or side air curtain module deploying incorrectly and increases the risk of serious personal injury or death in a crash.

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Remove the headliner. For additional information, refer to Section 501-05 .

2. Depower the ~~SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.~~

3. Disconnect the side air curtain module electrical connector and detach the pin-type retainer from the C-pillar sheet metal.

4. Remove the bolt and side air curtain module front tether.
   - To install, tighten to 8 Nm (71 lb-in).

5. Detach the pin-type retainer from the garnish moulding bracket.

6. Remove the side air curtain module bolt, located to the rear of the A-pillar.
   - To install, tighten to 8 Nm (71 lb-in).

7. Remove the 2 side air curtain module middle rear bolts.
   - To install, tighten to 8 Nm (71 lb-in).

8. **NOTE:** Note the position of the side air curtain module rear bracket hook for installation.

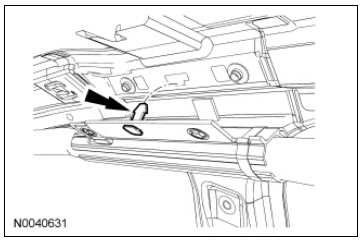
   Remove the side air curtain module 2 rear bracket bolts.

   - To install, tighten to 8 Nm (71 lb-in).

9. **NOTE:** Note the position of the side air curtain module center guide hook retainer for installation.

Remove the side air curtain module 2 center guide bolts. Detach the side air curtain module center guide hook retainer from the vehicle sheet metal.

- To install, tighten to 8 Nm (71 lb-in).



10. Remove the side air curtain module.
    - Move the side air curtain module toward the front of the vehicle to release the rear bracket hook from the C-pillar sheet metal.

11. **⚠ WARNING: When installing a new headliner on a vehicle equipped with Safety Canopy® or side air curtain modules, make sure the headliner has the word AIRBAG on the headliner where it meets each B-pillar trim panel. Otherwise, you have the wrong headliner. Failure to follow this instruction may result in the Safety Canopy® or side air curtain module not deploying or deploying incorrectly, increasing the risk of personal injury or death in a crash.**

    ⚠ WARNING: Before installing a Safety Canopy® or side air curtain module, inspect the roofline for any damage. If necessary, the sheet metal must be reworked to its original condition and structural integrity. Install new fasteners if damaged and remove foreign material. Failure to follow these instructions may result in the Safety Canopy® or siir curtain deploying incorrectly, which increases the risk of serious personal injury or death in a crash.

    ⚠ WARNING: Inspect a Safety Canopy® or side air curtain module before installation. If the module is damaged, the cover has separated or the Safety Canopy® or side air curtain material has been exposed, install a new module. Do not attempt to repair the module. Failure to follow these instructions may result in the Safety Canopy® or side air curtain deploying incorrectly, which increases the risk of serious personal injury or death in a crash.

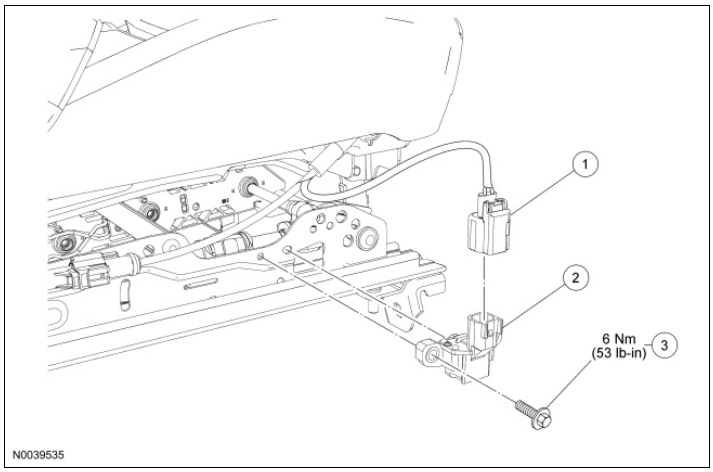
    ⚠ WARNING: Never put any type of fastener or tie strap around any part of a Safety Canopy® module, side air curtain module or interior trim panel. This will prevent the Safety Canopy® or side air curtain module from deploying correctly. Failure to follow this instruction may increase the risk of serious personal injury or death in a crash.

    NOTE: Make sure all side air curtain module bolt holes line up with each sheet metal hole.

    To install, reverse the removal procedure.

12. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

Seat Position Sensor



Item	Part Number	Description
1	-	Seat position sensor electrical connector (part of 14A699)
2	14B416	Seat position sensor
3	W505256	Seat position sensor bolt

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition switch is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Remove the driver seat. For additional information, refer to Section 501-10 .

2. Disconnect the seat position sensor electrical connector.

3. Remove the bolt and seat position sensor.
   - To install, tighten to 6 Nm (53 lb-in).

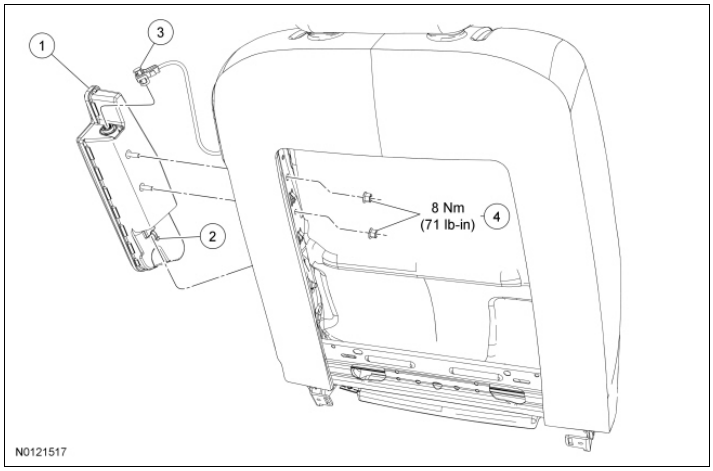
4. ⚠ **WARNING: Always tighten the seat position sensor retaining bolt to specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.**

   To install, reverse the removal procedure.

5. Install the driver seat. For additional information, refer to Section 501-10 .

Side Air Bag Module

NOTE: Drivers seat shown, passenger seat similar.



Item	Part Number	Description
1	611D10	Side air bag module
2	-	Side air bag module locator hook (part of 611D10)
3	-	Side air bag module electrical connector (part of 14K155)
4	N620480	Side air bag module nuts (2 required)

Removal

⚠ WARNING: Always carry or place a live air bag module with the air bag and deployment door/trim cover/tear seam pointed away from the body. Do not set a live air bag module down with the deployment door/trim cover/tear seam face down. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.

⚠ WARNING: Never probe the electrical connectors on air bag, Safety Canopy® or side air curtain modules. Failure to follow this instruction may result in the accidental deployment of these modules, which increases the risk of serious personal injury or death.

⚠ WARNING: Front seat backrest trim covers installed on seats equipped with seat side air bags cannot be repaired. A new trier must be installed. Cleaning is permissible. Failure to follow these instructions may result in the seat side air bag module deploying incorrectly and increase the risk of serious personal injury or death in a crash.

NOTE: If a side air bag deployment took place, a new seat backrest foam pad, backrest cover, side air bag module and nuts must be installed. The seat backrest frame should be replaced if necessary. For additional information, refer to the front seat backrest disassembly and assembly procedure in Section 501-10 .

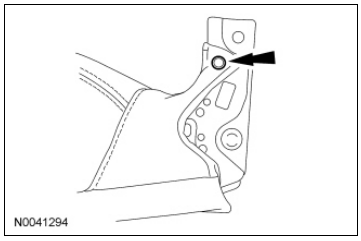
NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

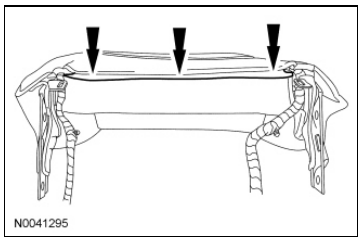
1. Remove the seat backrest. For additional information, refer to Section 501-10 .

2. **NOTE:** RH shown, LH similar.

   Separate the seat backrest cover from the inboard and outboard recliners on the seat backrest frame.



3. Release the seat backrest cover J-clip.

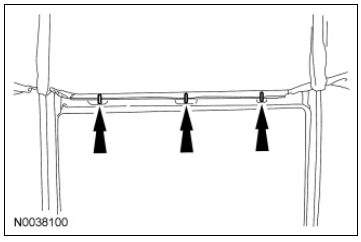


4. ⚠ **WARNING: Front seat backrest trim covers installed on seats equipped with seat side air bags cannot be repaired. A new trim cover must be installed. Cleaning is permissible. Failure to follow these instructions may result in the seat side air bag module deploying incorrectly and increase the risk of serious personal injury or death in a crash.**

   NOTICE: **Use care when separating the seat backrest cover from the hook-and-loop strips, or the hook-and-loop strip can be torn from the seat backrest foam pad.**

   Place a hand between the seat backrest cover and foam pad and carefully separate the hook-and-loop strips, then carefully roll up the seat backrest cover in an inside out fashion to the row of hog rings in the front.

5. Remove and discard the 3 hog rings.



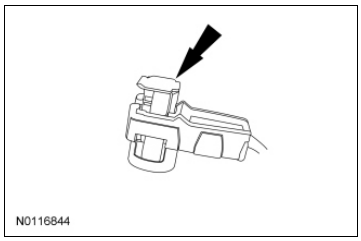
6. Detach the hook-and-loop strips and invert the seat backrest cover up enough to expose the side air bag.

7. Remove and discard the 2 side air bag module nuts.
   - Pull outward on the side air bag module until the studs clear the backrest frame and then lift upwards to detach the locator hook from the frame.

8. ***NOTICE:*** **Do not pull the side air bag electrical connector out by the locking button. Damage to the locking button can occur.**

Using a small screwdriver, lift up and release the locking button and disconnect the electrical connector.

- Remove the side air bag module.



Installation

1. With the locking button released, install the electrical connector fully into the side air bag module and seat the locking button.

2. **⚠ WARNING: If the seat side air bag cover has been damaged or separated from its mounting, or if the air bag material has been exposed, install a new seat side air bag module. Never try to repair the seat side air bag module. Failure to follow these instructions may result in the seat side air bag deploying incorrectly, which increases the risk of serious personal injury or death in a crash.**

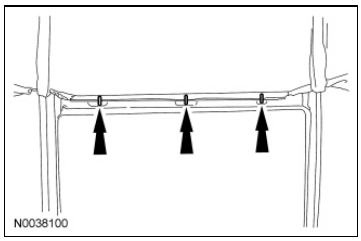
   ⚠ WARNING: Inspect the seat side air bag module and mounting surfaces for any damage or foreign material before installing the seat side air bag module. If any damage is found, install new components. If any foreign material is found, remove it. Failure to follow these instructions may result in the seat side air bag module deploying incorrectly and increase the risk of serious personal injury or death in a crash.

   NOTICE: **Make sure that the side air bag module locator hook is correctly positioned into the backrest frame before tightening the nuts or damage to the side air bag module can occur.**

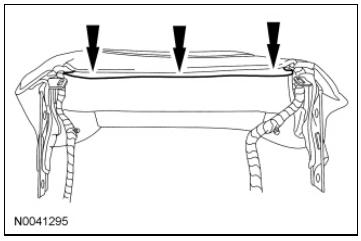
   Position the side air bag module to the seat backrest frame and install 2 new nuts.

   - Tighten to 8 Nm (71 lb-in).

3. Roll the seat backrest cover down, attaching the hook-and-loop strips and install the 3 hog rings.

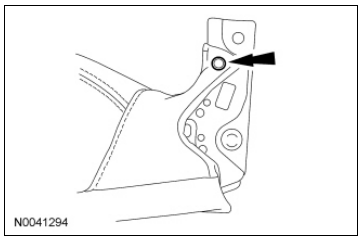


4. Roll the seat backrest cover down attaching the remaining hook-and-loop strips and attach the seat backrest cover J-clip.



5. **NOTE:** RH shown, LH similar.

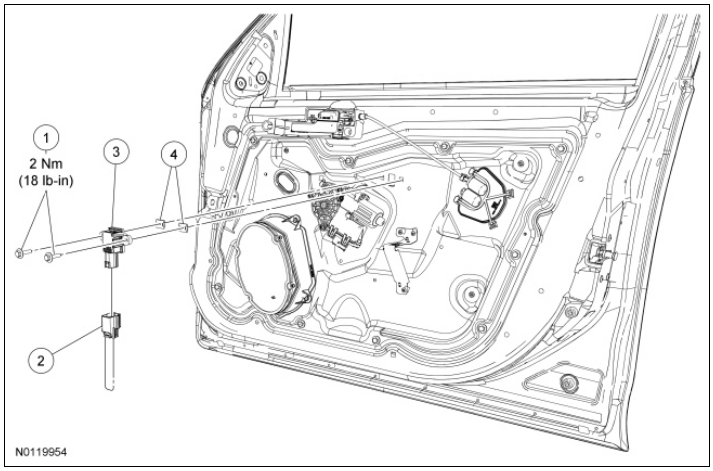
   Attach the backrest cover to the inboard and outboard recliners on the seat backrest frame.



6. Install the seat backrest. For additional information, refer to Section 501-10 .

Side Impact Sensor - Front Door

NOTE: RH shown, LH similar.



Item	Part Number	Description
1	W705314	Side impact sensor bolts (2 required)
2	-	Side impact sensor electrical connector (part of 14630)
3	14B345	Side impact sensor
4	W713617	Side impact sensor pushnuts (2 required)

Removal and Installation

⚠ WARNING: If a vehicle has been in a crash, inspect the restraints control module (RCM) and the impact sensor (if equipped) mounting areas for deformation. If damaged, restore the mounting areas to the original production configuration. A new RCM and sensors must be installed whether or not the air bags have deployed. Failure to follow these instructions may result in serious personal injury or death in a crash.

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Res System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .

2. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

3. Slide the locking wedge back and disconnect the side impact sensor electrical connector.

4. Remove the 2 bolts and the side impact sensor.
   - To install, tighten to 2 Nm (18 lb-in).

5. ⚠ **WARNING: Always tighten the fasteners of the restraints control module (RCM) and impact sensor (if equipped) to the specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.**

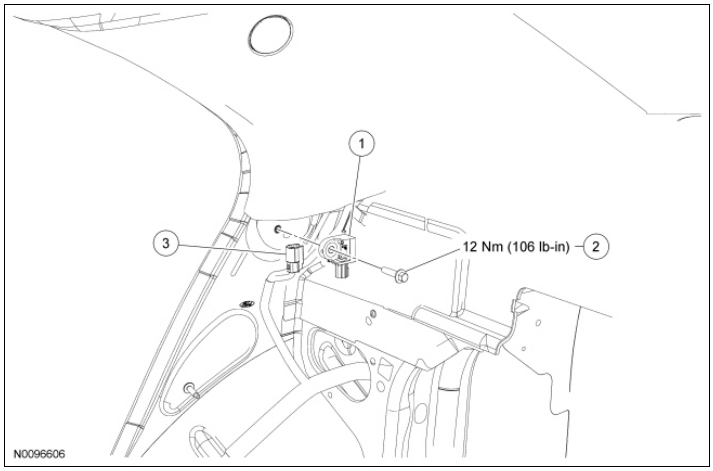
   NOTE: Make sure the door sheet metal and side impact sensor mating surfaces are clean.

   To install, reverse the removal procedure.

6. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

Side Impact Sensor - C-Pillar

NOTE: RH shown, LH similar.



Item	Part Number	Description
1	14B006	Side impact sensor
2	W505256	Side impact sensor bolt
3	-	Side impact sensor electrical connector (part of 14A005)

NOTE: The air bag warning indicator illuminates when the correct Restraints Control Module (RCM) fuse is removed and the ignition is ON.

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

1. Depower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

2. Remove the rear seat bolster. For additional information, refer to Section 501-10 .

3. Disconnect the side impact sensor electrical connector.

4. Remove the bolt and side impact sensor.
   - To install, tighten to 12 Nm (106 lb-in).

5. ⚠ **WARNING: Always tighten the fasteners of the restraints control module (RCM) and impact sensor (if equipped) to the specified torque. Failure to do so may result in incorrect restraint system operation, which increases the risk of personal injury or death in a crash.**

   NOTE: Make sure the C-pillar and side impact sensor mating surfaces are clean.

   To install, reverse the removal procedure.

6. Repower the SRS . For additional information, refer to Supplemental Restraint System (SRS) Depowering and Repowering in the General Procedures portion of this section.

Material

Item	Specification	Fill Capacity
Clear Silicone Rubber TA-32	ESB-M4G92-A	-
Flexible Foam Repair Fusor® 121, or equivalent; obtain locally	-	-
Metal Bonding Adhesive TA-1	-	-
Motorcraft® Acid Neutralizer ZC-1-A	-	-
Motorcraft® Alkaline Neutralizer ZC-2-A	-	-
3MTM Perfect-ItTM Show Car Liquid Wax 39026	-	-
Motorcraft® Detail Wash ZC-3-A	-	-
Motorcraft® Metal Surface Prep ZC-31-A	-	-
Premium Undercoating ValuGardTM VG101, VG101A (aerosol)	-	-
Rust Inhibitor ValuGardTM VG104, VG104A (aerosol)	-	-
Plastic Bonding Adhesive TA-9	-	-
Roof Ditch Sealer Fusor® 122EZ, 3MTM 08307	-	-
Seam Sealer TA-2	-	-
Trim and Weatherstrip Adhesive Permatex® 81850 or equivalent	-	-

General Equipment
3 Phase Inverter Spot Welder 254-00002

Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-00014

General Specifications -Welding Specifications

Item	Specification
Plug Weld Hole	8 mm (0.31 in)
Weld Wire ER70S-3 or equivalent	0.9-1.1 mm (0.035-0.045 in)

Weld Nugget Chart

Test Thickness of Metal (mm)	Nugget Size
0.7 + 0.7	4.3 mm (0.16 in)
0.7 + 0.7 + 0.7	4.3 mm (0.16 in)
0.9 + 0.9	4.7 mm (0.18 in)
0.9 + 0.9 + 0.9	4.7 mm (0.18 in)
1.0 + 1.0	5.2 mm (0.2 in)
1.0 + 1.0 + 1.0	5.2 mm (0.2 in)
2.0 + 2.0	7.1 mm (0.27 in)
2.0 + 2.0 + 2.0	7.1 mm (0.27 in)
3.0 + 3.0	8.7 mm (0.34 in)
3.0 + 3.0 + 3.0	8.7 mm (0.34 in)
3.0 + 0.7	4.3 mm (0.16 in)
0.7 + 3.0 + 1.0	5.2 mm (0.2 in)
2.0 + 2.0 + 0.7	4.3 mm (0.16 in)
0.9 + 0.9 + 2.0	4.7 mm (0.18 in)
2.0 + 0.9 + 1.0	5.2 mm (0.2 in)
1.0 + 3.0 + 1.0	5.2 mm (0.2 in)
3.0 + 1.0 + 2.0	7.1 mm (0.27 in)
0.9 + 0.7 + 0.9	4.3 mm (0.16 in)

Descriptions of Ford Steel Families

Grade	Alloy Content	Heat Treatment	Typical Applications	Comments
Mild Steel, Bake Hardened, Solid Solution Strengthened	Low	Fully annealed/dead soft	Body panels (closures, floor pan, dash panel)	-
High-Strength Low Alloy (HSLA)	Low	Fully annealed/dead soft	Rails, structural members	Strengthened with fine particles and small grain size
Dual Phase	MediumManganese Silicon, Molybdenum Chromium)	Fully annealed/partially hardened	Rails, structural members	15-50% of structure is hard martensite
Ultra High Strength Steel (UHSS) (Martensitic, Boron)	Low	Fully hardened	Rocker reinforcements, door beams, bumper beams	100% of structure is hard martensite
Transformation Induced Plasticity Steel	High (Manganese, Phosophorus, Silicon, Aluminum)	Fully annealed/ partially hardened	To be determined	Complex microstructure for high strength and ductility

Ford Recommended Steel Repairability Matrix

Grade	Trade Descrip-tions	Welding Method			Cold Repairs	Use of Heat for Repair	Temp-erature Range	Max-imum Heat
		Metal Inert Gas (MIG)	Squeeze-Type Resist-ance Spot Welding (STRW)	MIG Braze				
Mild Steel	Mild	Yes	Yes	NA	Yes [a]	Yes	Up to 650°C (1,200°F)	90 sec. x 2
Laminate Steel	Quiet Steel	No	Yes	No	Yes [a]	NA	NA	NA
Bake Hardened	BH 180, BH210, BH 250, BH 280	Yes	Yes	Yes [b]	Yes [a]	Yes	Up to 650°C (1,200°F)	90 sec. x 2
Solid Solution Strength- ened	-	Yes	Yes	Yes [b]	Yes [a]	Yes	Up to 650° C (1,200°F)	90 sec. x 2
High- Strength Low Alloy (HSLA)	HSLA 250, HSLA 350, HSLA 550	Yes	Yes	Yes [b]	Yes [a]	Yes	Up to 650°C (1,200°F)	90 sec. x 2
Dual Phase = 600 MPa Ultimate Tensile Strength	DP 500, DP 600	Yes	Yes	Yes [b]	Yes [a]	No	NA	NA
Dual Phase = 600 MPa Ultimate Tensile Strength	DP 700, DP 780, DP 900	Yes [d]	Yes	Yes [b]	No	No	NA	NA

particular to 780 and 980 grades) [c]								
Ultra High Strength Steel (UHSS) (Martens-itic, Boron) [e]	Boron	Yes [a]	Yes	Yes [b]	No	No	NA	NA
Trans- formation Induced Plasticity Steel (TRIP) Steel	TRIP 590, TRIP 780, TRIP 980	NA	NA	NA	NA	NA	NA	NA

[a] Cold repairs can be performed if damage excludes kinks. May section only if approved procedure in workshop manual.
[b] MIG braze allowed for non-structural applications only.
[c] Dual phase steels DP 700, DP 780 and DP 980 must be replaced at factory joints, no sectioning unless approved procedure in workshop manual.
[d] For DP 980, use MIG plug welding only, no stitch welding.
[e] Boron components must be replaced at factory joints, no sectioning allowed.

Body

NOTICE: **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or belo60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For information, refer to Section 414-03 .**

NOTE: For information regarding vehicles equipped with High Voltage Traction Battery (HVTB) systems, refer to Section 414-03 .

The body consists of the following:

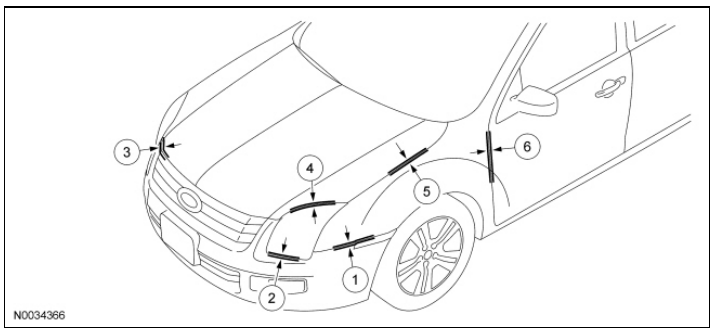
- Unibody construction
- Radiator support bolster constructed of glass fiber polypropylene material and is non-repairable
- High-Strength Low Alloy (HSLA) and mild steels
- Dual Phase Steel (DP) steel in select body structure components
- Bolted, removable steel front fenders, hinged doors and hood
- Underhood and body side door opening dimensions common between Ford Fusion and Lincoln MKZ
- Steel doors incorporating serviceable outer panels
- Steel luggage compartment lid
- Rear body openings unique for each model
- Bolt-on front and rear bumper beams constructed of Ultra High Strength Steel (UHSS), martensitic grade steel
- Front and rear subframe assembliessing suspension and steering components
- Underbody common between Ford Fusion and Lincoln MKZ
- Tailor-welded blanks used in underbody (front floor rails and rear frame rails)

For dimensional information, refer to the following illustrations:

NOTE: The following dimensional illustrations apply to the Ford Fusion and Lincoln MKZ unless otherwise indicated.

Body Margins

NOTE: Dimensions apply to right and left side.

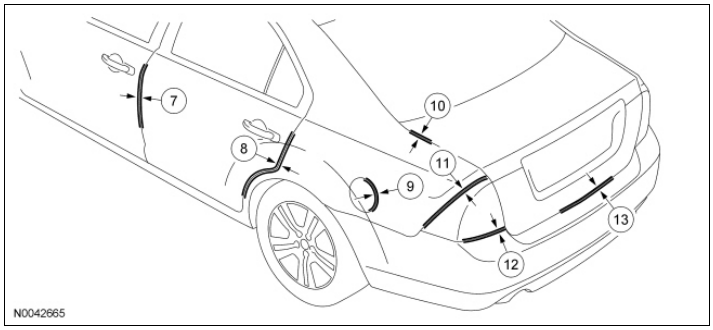


Item	Description	Specification	Flushness Specification

1	Fender to side marker lamp	1.0 mm (0.039 in) ± 1.0 mm (0.039 in)	-
2	Headlamp assembly to fascia	2.0 mm (0.078 in) ± 1.7 mm (0.039 in)	-
3	Hood to fascia	5.0 mm (0.196 in) ± 3.0 mm (0.118 in)	-
4	Hood to headlamp	5.0 mm (0.196 in) ± 3.0 mm (0.118 in) (overslam clearance of 9.0 mm [0.35 in])	-
5	Hood to fender	3.0 mm (0.118 in) ± 1.5 mm (0.059 in)	0.0 mm (in) ± 1.5 mm (0.059 in)
6	Fender to door	4.0 mm (0.157 in) ± 1.5 mm (0.059 in)	0.5 mm (0.019 in) ± 1.5 mm (0.059 in)

Body Margins

NOTE: Dimensions apply to the right and left side.

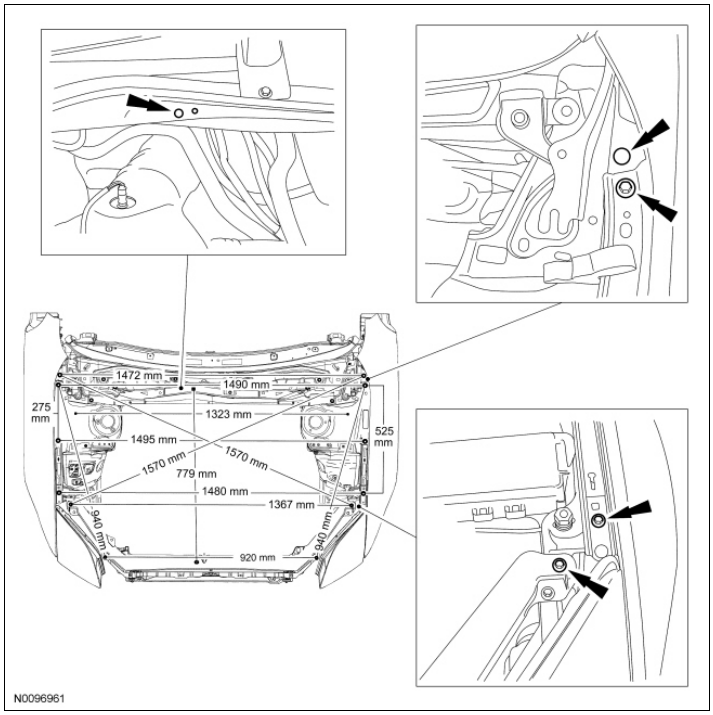


Item	Description	Specification	Flushness Specification
7	Front dr	4.0 mm (0.157 in) ± 1.5 mm (0.059 in)	0.0 mm (in) ± 1.5 mm (0.059 in)
8	Rear door to quarter panel	4.0 mm (0.157 in) ± 1.5 mm (0.059 in)	0.0 mm (in) ± 1.5 mm (0.059 in)
9	Fuel door to quarter panel	3.0 mm (0.118 in) ± 1.0 mm (0.039 in)	1.0 mm (0.039 in) ± 1.25 mm (0.049 in)
10	Quarter panel to luggage compartment lid	3.0 mm (0.118 in) ± 1.5 mm (0.059 in)	0.0 mm (in) ± 1.5 mm (0.059 in)
11	Lamp assembly to quarter panel	1.2 mm (0.047 in) + 1.2 mm (0.047 in) / - 0.0 mm (in)	1.0 mm (0.039 in) ± 1.0 mm (0.039 in)
12	Lamp assembly to fascia	2.0 mm (0.078 in) ± 1.7 mm (0.066 in)	-
13	Luggage compartment lid to fascia	6.0 mm (0.236 in) ± 2.5 mm (0.098 in)	-

Underhood Dimensions

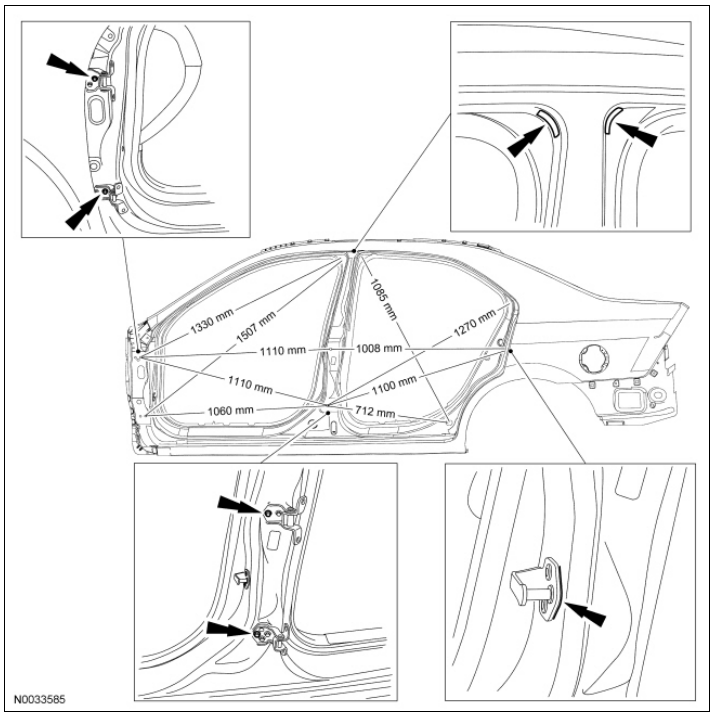
NOTICE: **The radiator bolster is glass fiber polypropylene material. If damage occurs to the radiator support component, it should not be repaired. A new component should be installed. Refer to Section 303-03A .**

NOTE: Measurements are obtained on center, unless otherwise indicated.



Body Side Closure Dimensions

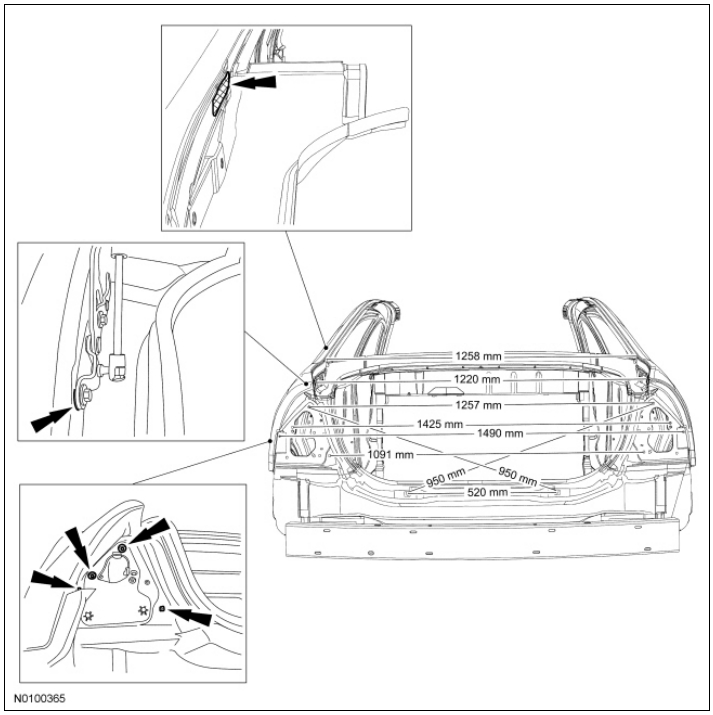
NOTE: Measurements are obtained on center, unless otherwise indicated.



Rear Opening Dimensions

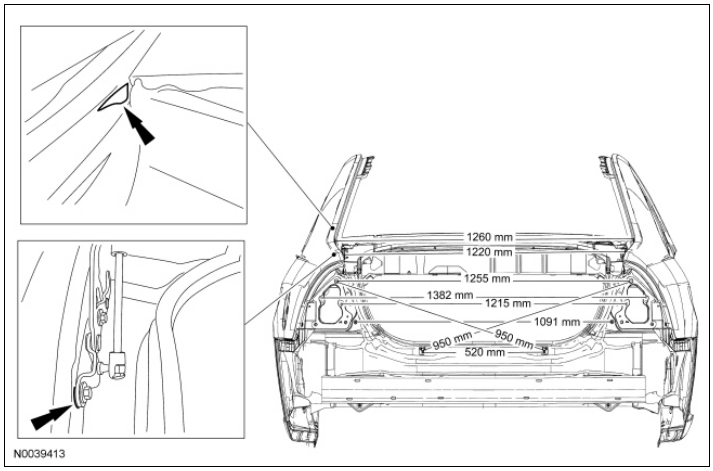
Ford Fusion

NOTE: Measurements are obtained on center, unless otherwise indicated.



Lincoln MKZ

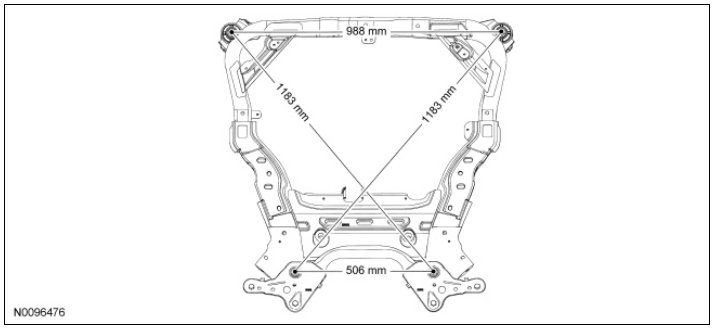
NOTE: Measurements are obtained on center, unless otherwise indicated.



Underbody Dimensions

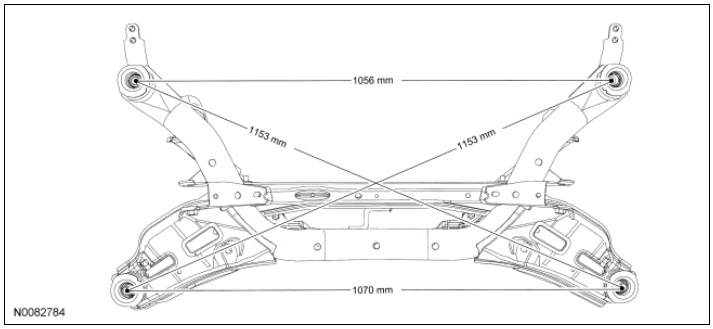
Front Subframe

NOTE: Measurements are obtained on center, unless otherwise indicated.



Rear Subframe

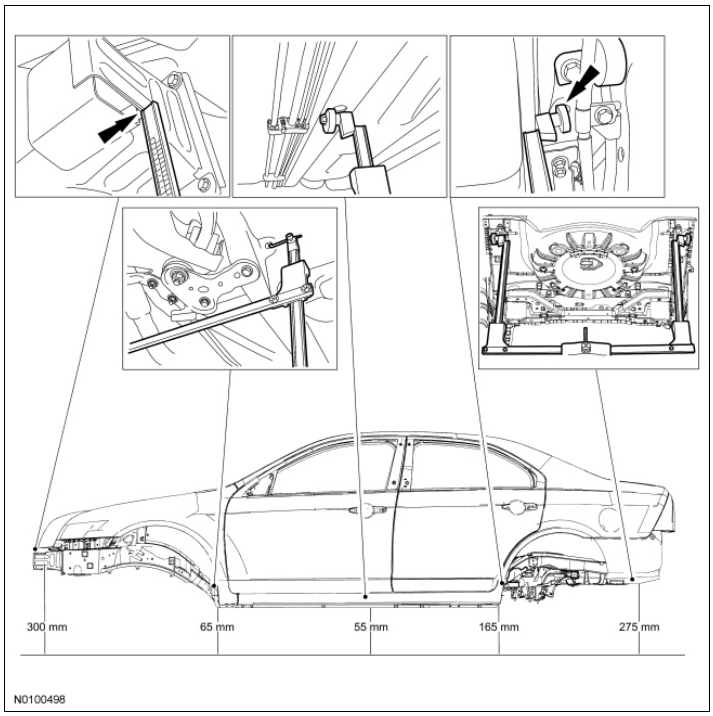
NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) common dimensionally. Measurements are obtained on center, unless otherwise indicated.



NOTICE: **A structural frame rail or unibody service sectioning kit is available for this vehicle. For information regarding frame rail sectioning, refer to Frame Members - Front or Frame Members - Rear in this section.**

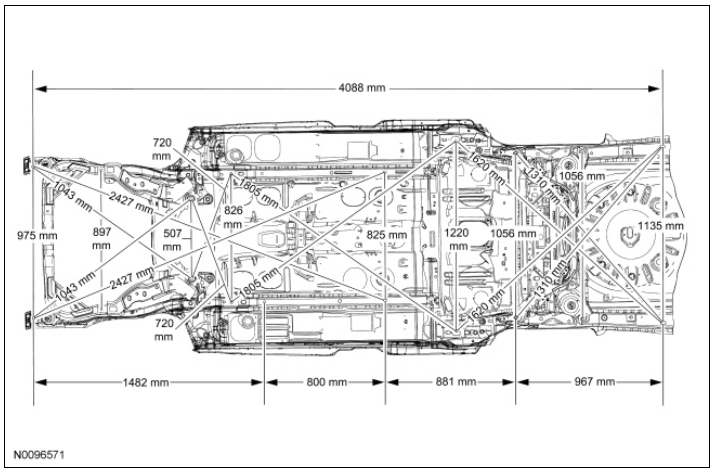
Frame Datum Height

NOTE: Datum height determined measuring from holes and slots on center, unless otherwise indicated.



Underbody Dimensions

NOTE: Measurements are obtained on center, unless otherwise indicated.



Welding Precautions - Steel

General Equipment
3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-00014
Inverter Welder with MIG Welder 254-00015

Weld Nugget Chart

Test Thickness of Metal (mm)	Nugget Size
0.7 + 0.7	4.3 mm (0.16 in)
0.7 + 0.7 + 0.7	4.3 mm (0.16 in)
0.9 + 0.9	4.7 mm (0.18 in)
0.9 + 0.9 + 0.9	4.7 mm (0.18 in)
1.0 + 1.0	5.2 mm (0.2 in)
1.0 + 1.0 + 1.0	5.2 mm (0.2 in)
2.0 + 2.0	7.1 mm (0.27 in)
2.0 + 2.0 + 2.0	7.1 mm (0.27 in)
3.0 + 3.0	8.7 mm (0.34 in)
3.0 + 3.0 + 3.0	8.7 mm (0.34 in)
3.0 + 0.7	
0.7 + 3.0 + 1.0	5.2 mm (0.2 in)
2.0 + 2.0 + 0.7	4.3 mm (0.16 in)
0.9 + 0.9 + 2.0	4.7 mm (0.18 in)
2.0 + 0.9 + 1.0	5.2 mm (0.2 in)
1.0 + 3.0 + 1.0	5.2 mm (0.2 in)
3.0 + 1.0 + 2.0	7.1 mm (0.27 in)
0.9 + 0.7 + 0.9	4.3 mm (0.16 in)

General Specifications

Item	Specification
Plug weld hole	8 mm (0.31 in)
Weld wire ER70S-3 or equivalent	0.9-1.1 mm (0.035-0.045 in)

⚠ WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Hybrid vehicles contain a High Voltage Traction Battery (HVTB). Before welding near the HVTB , the HVTB must be removed to avoid heat damage. For information, refer to Section 414-03 .**

The correct equipment and settings must be used when welding mild or high-strength steel. Metal Inert Gas (MIG) and Squeeze-Type Resistance Spot Welding (STRW) are the preferred methods. Surfaces must be clean and free of foreign materials.

- Correct eye protection must be worn.
- The correct protective clothing should always be worn.
- Adequate ventilation must be provided to avoid accumulation of poisonous gases.
- Refer to the Ford Recommended Steel Repairability Matrix in the Specifications portion of this section for specific information regarding steel descriptions.
- A test weld should always be carried out on a test sample.
- Use cleaning brushes and abrasive grinding wheels dedicated to the type of materials being welded.
- Follow equipment manufacturer's prescribed procedures and equipment settings for the type of welder being used. ER70S-3 or ER70S-6 wire are typically used for MIG welding steel.
- On non-hybrid vehicles, disconnect the battery ground cable. Refer to Section 414-01 .
- Disconnect on-vehicle modules and protect them from possible heat damage and electrical currents when welding.
- Corrosion protection must be restored whenever bare metal repairs are made. Refer to Restoring Corrosion Protection Following Repair in this section.
- Weld through primer is recommended when welding overlapping surfaces or substrates.
- Components made of high-strength steel should not be heated should not be heated to straighten or repair. If components are severely bent or kinked, new components should be installed.
- Adequate power supply needs to be used to make sure of correct equipment performance.
- Factory spot welds may be substituted with either STRW or MIG plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.
- Vehicles equipped with optional safety canopy require removal of these components prior to any welding procedures being carried out in the roof-line or body side areas of the vehicle. Refer to Section 501-20B .

Sound Deadeners and Insulators

NOTICE: **Mastic is made of a combustible material and should be removed prior to carrying out welding procedures to the area. Heat zones from welding near the mastic may cause the mastic material to burn.**

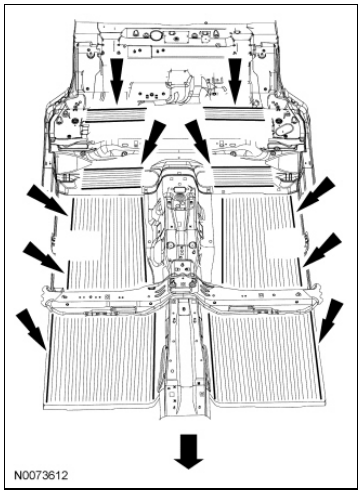
NOTICE: **Corrosion protection must be restored to the area AFTER the mastic material is applied. Corrosion protection products contain wax and loss of adhesion may occur.**

NOTE: To restore the vehicle to design intent, missing or damaged sound deadeners and insulators should be installed with the correct service replacement component.

NOTE: The following illustrations serve as a reference to indicate mastic sound deadener locations. Sound deadener material is applied from the factory in a pumpable form. Additional insulators and sound deadeners are used beyond those indicated in the illustration.

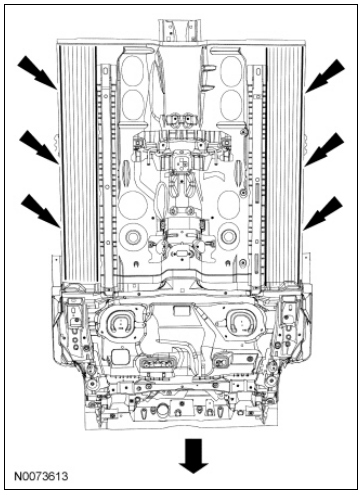
Interior Floor Pan

NOTE: Arrow indicates rear of vehicle.



Exterior Floor Pan

NOTE: Arrow indicates rear of vehicle.



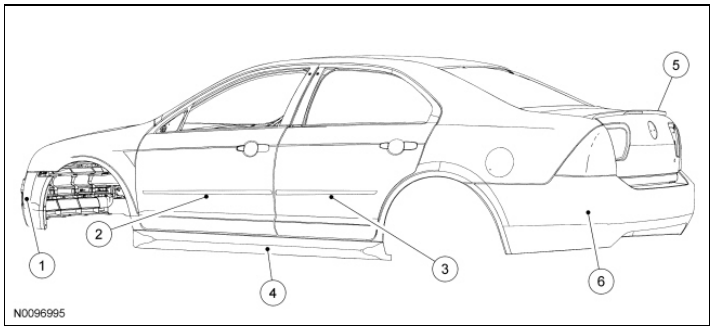
1. Whenever replacement of an existing mastic insulator is carried out, the surface must be thoroughly cleaned to make sure correct adhesion will occur. The surface should be 10°C (50°F) or greater before applying the mastic. The use of a heat gun to warm the metal surface will aid in adhesion.

Plastic Components

Exterior Plastic Components - Painted

NOTE: Ford Fusion shown, Lincoln MKZ similar.

NOTE: The following illustration(s) are not all-inclusive of trim levels available. The actual trim level of the vehicle will determine the viability of carrying out a plastic repair.



Item	Part Number	Description
1	17C831	Bumper cover (front) - Thermoplastic Olefin (TPO)
2	25557 LH/ 25556 RH	Door moulding (front) - TPO
3	20879 LH/ 20878 RH	Door moulding (rear) - TPO
4	10155 LH/ 10154 RH	Rocker moulding - TPO
5	40602	Spoiler - Acrylonitrile Butadiene Styrene (ABS)
6	17K835	Bumper cover (rear) - TPO

Several considerations will detty of plastic repair procedure(s):

- Is the damage cosmetic or structural?
- Can the repair be carried out on the vehicle?
- Is the part readily available?
- Is component repair the most cost effective method?
- Can the component be economically restored to original strength and appearance?
- Will the repair provide for the fastest, highest quality repair?

Several types of plastic are in use for automotive application. However, all plastics will fall into 2 primary categories of thermoplastic or thermosetting plastic.

Thermosetting Plastic

Generally, thermosetting plastics are made with 2-part thermosetting resins. When mixed together, heat is generated, producing a cure that is irreversible. Because of this, thermosetting plastics will require the use of a 2-part adhesive for repair.

Sheet-Molded Composite

Sheet-Molded Composite (SMC) is a type of thermosetting plastic that uses glass fibers or nylon fibers in combination with thermosetting polyester resins. When fully cured, SMC is strong and rigid.

SMC is similar to, but not identical to fiberglass. Ford Motor Company uses SMC in components such as fenders, hoods and liftgates.

Thermoplastic Compounds

Thermoplastic compounds are manufactured by a process that is reversible. Thermoplastics can be remolded repeatedly by reheating. This characteristic of thermoplastics makes plastic welding a possible repair alternative. A repair of thermoplastic compounds is still possible through the use of 2-part adhesive and filler repair materials and reinforcements as needed. Thermoplastics are widely used in interior trim components, wheel flares, body side cladding and bumper covers.

Polyolefin

Polyolefins fall into the family of thermoplastics with one unique characteristic: An oily or waxy feel to the material when sanded or ground. Polyolefin lends itself very well to remolding through the use of heat. Because of this, components made of this material lend themselves well to the possibility of plastic welding. Most adhesive repair materials and paint will not bond to surface of a polyolefin unless an adhesion promoter specially formulated for plastic is first applied to the exposed raw surface. Otherwise, polyolefins are repaired like most other thermoplastics. Some typical uses of polyolefins are:

- bumper covers.
- fan shrouds.
- wheel housings.

Proper identification of the various types of plastic is necessary to select the appropriate repair method(s) to carry out high quality plastic repairs. For information, refer to Plastics Identification in this section.

Sealers

⚠ WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

The correct sealing of joints is essential to repairing the vehicle correctly. Sealers are used to prevent wind noise, water leaks, exhaust fumes and dust from entering the vehicle. They also provide anti-corrosion barriers. Sealers are applied to areas such as door and rear compartment hem flanges, wheelhouse, quarter outer, floor, cowl, roof and other panel-to-panel attaching points. The following joint sealers are recommended for use depending upon the application:

- Brushable Seam Sealer - A sealer intended to restore the original brushed seam appearance. It is used to seal lap joints in sheet metal that are spot welded (for example, floorpans and cowls). Use a product obtained locally.
- Roof Ditch Sealer - A self-leveling sealer used for drip rails, roof seams, quarter panels to rear deck and for water leaks.
- Seam Sealer - Heavy-bodied, non-sag adhesive/sealer for use on standing cosmetic seams, truck bed seams, tooled door skin seams and floor pans. Also used for water leaks and noise concerns.

Sealers should remain flexible after curing and must be paintable. Follow the manufacturer's directions for correct application of these materials.

Any damage to originally sealed joints should be repaired by resealing. Along with attaching points of new panels, open joints that require bridging of sealer to close a gap should be sealed using a heavy-bodied sealer.

Adhesives

Material

Item	Specification
Clear Silicone Rubber TA-32	ESB-M4G92-A
Metal Bonding Adhesive TA-1	-
Plastic Bonding Adhesive TA-9	-
Seam Sealer TA-2	-
Trim and Weatherstrip Adhesive TA-14-A	-

NOTICE: **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or below 60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For information, refer to Section 414-03 .**

1. Depower the High Voltage Traction Battery (HVTB) before carrying out any removal or installation procedures affecting the high-voltage battery system. Refer to Section 414-03 for the correct procedure to depower the HVTB system on hybrid-equipped vehicles.

NOTE: When it is necessary to carry out weld-bonding procedures, refer to Weld-Bonding in this section.

Adhesives are used in a variety of applications. Typical uses for adhesives include roof panels, door skins and quarter panels. Trim applications include body side mouldings, emblems, stationary glass and weatherstripping. Combination sealer/adhesives are also used. Surface preparation is critical to a high quality repair. Following the label instructions for the product is essential.

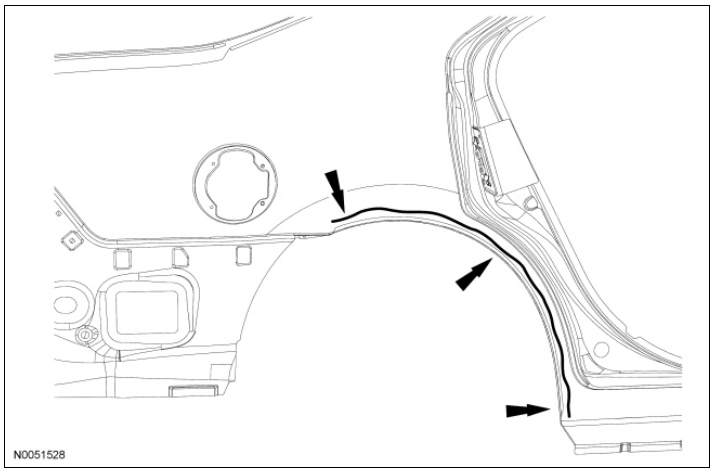
Work in a well-ventilated area and protect adjacent surfaces when working with adhesives. The use of eye protection and protective clothing is also recommended when working with adhesives. Carry out a trial fit, mark and align the surfaces before bonding the materials together.

Seam sealers and corrosion protection may be necessary once the adhesive(s) has cured, depending on the application. The following is a list of adhesives recommended for certain types of applications:

- Metal Bonding Adhesive - For bonding cold-rolled steel, galvanized steel, aluminum and correctly prepared E-coat. It is used for door skin and roof panel replacement and OEM structural adhesive replacement.
- Plastic Bonding Adhesive - For bonding a variety of plastics to plastics and plastics to primed, painted or E-coated metals. Also for general purpose bonding of trim components.
- Seam Sealer - Heavy-bodied, non-sag adhesive/sealer for use on: standing cosmetic seams, truck bed seams, tooled doo seams and floor pans.
- Trim and Weatherstrip Adhesive - For use on body side moulding, emblems, trim, bumper impact strips and carpeting.
- Clear Silicone Rubber - Used for sealing water leaks, noise concerns, remounting trim and repairing torn weatherstripping.

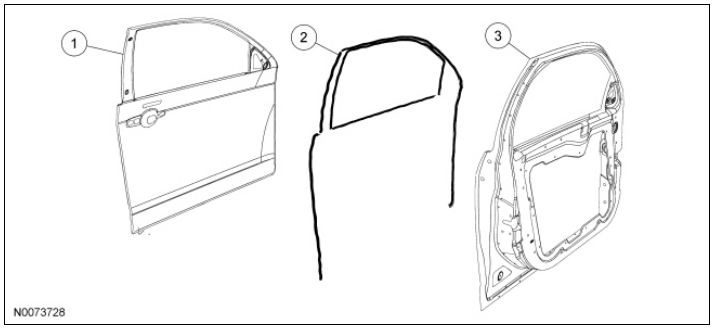
NOTE: The following illustration identifies structural adhesive location(s).

Rear Bodyside Outer to Inner



Door Panel

NOTE: Front door shown, rear door similar.



Item	Part Number	Description
1	20201 LH/ 20200 RH	Door panel outer
2	TA-1	Metal bonding adhesive
3	20125 LH/ 20124 RH	Door shell assembly

Sectioning Guidelines

Special Tool(s)

 ST2738-A	Heat Treatment Induction Resistance Spot Welder 254-00001
 ST2956-A	Pro 230 MIG Welder 208-00030

Material

Item	Specification
Metal Bonding Adhesive TA-1	-
Motorcraft® Metal Surface Prep ZC-31-A	-
Rust Inhibitor ValuGardTM VG104, VG104A (aerosol)	-
Seam Sealer TA-2	-

⚠ WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

⚠ WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommendesons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: On vehicles equipped with Safety Canopy® options, prior to carrying out any sectioning repairs near the roof line or sail panel areas of the vehicle, remove the Safety Canopy® module and related components. Failure to comply may result in accidental deployment or damage to the Safety Canopy®. Refer to Section 501-20B . Failure to follow these instructions may result in serious injury to technician or vehicle occupant(s).

⚠ WARNING: Do not cut or grind body side components within 50 mm (1.96 in) of restraint anchoring points. Welding within 50 mm (1.96 in) of restraint anchoring points may result in incorrect operation of restraint devices. For additional restraints anchoring location information, refer to Section 501-20A and Section 501-20B . Failure to follow these instructions may result in serious injury to vehicle occupant(s).

⚠ WARNING: Do not carry out body side sectioning repairs in areas of laser welds. Factory laser welds cannot be duplicated with conventional welding equipment and structural integrity may be compromised. Failure to follow this instruction may result in serious injury to vehicle occupant(s).

⚠ WARNING: Do not carry out body side sectioning repairs in areas of door hinge or striker anchoring points. Welding within 50 mm (1.96 in) of door hinge or striker locations may compromise structural integrity during a collision. Failure to follow these instructions may result in serious injury to vehicle occupant(s).

NOTE: Factory spot welds may be substituted with either Squeeze-Type Resistance Spot Welding (STRW) or Metal Inert Gas (MIG) plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original location. Plug weld hole should equal 8 mm (0.31 in) diameter.

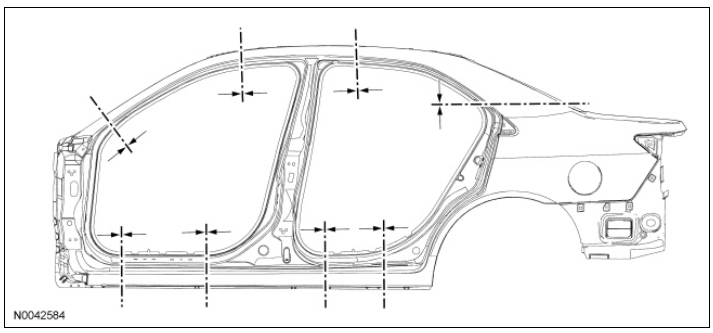
NOTE: The design of the front and rear doors incorporates a new precision weatherstrip seal retainer flange above the belt line. Dimensions of this flange are critical to maintain correct sealing from water leaks or wind noise. If these upper channels are damaged in a collision, the entire door shell should be replaced. The door assembly also incorporates:

- an open bottom hem flange for improved corrosion protection.
- flat modified front and rear door hem flanges, below the belt lines. After hemming the production doors, a secondary operation adds a taper to the inside surface of the hem that reduces the variability of the door dimensions. This allows for smaller factory margins between the doors, fenders and quarter panels.

NOTE: Illustration applicable to Ford Fusion and Lincoln MKZ. Cut lines shown in illustration are approximate.

NOTE: When it is necessary to carry out weld-bonding procedures, refer to Weld-Bonding in this section.

1. Corrosion protection needs to be restored whenever it is necessary to sand or grind through painted surfaces or E-coat, or when bare metal repairs are carried out. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.



2. ***NOTICE:*** **Electronic modules and related wiring may be damaged when exposed to heat from welding procedures. Carefully disconnect and remove, or position away from heat affected areas. For additional information, refer to Welding Precautions - Steel in this section.**

Where possible, create a backer piece using a portion of the old panel. This will create a stronger joint.

3. ***NOTICE:*** **Hybrid vehicles contain a High Voltage Traction Battery (HVTB). Before welding near the HVTB , the HVTB must be removed to avoid heat damage. For additional information, refer to Section 414-03 .**

   When welding overlapping surfaces or substrates, apply a weld through primer or similar anti-corrosion material between the surfaces prior to welding. When the repair area has been welded and refinished, apply rust inhibitor to the exterior surfaces or substrates.

   - Make sure horizontal joints and flanges are correctly sealed with seam sealer to prevent moisture intrusion. Water and moisture migrate to horizontal joints and corrosion tends to occur more rapidly in these areas. Surfaces must be clean and dry before applying seam sealer.

4. ***NOTICE:*** **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or below 60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For additional information, refer to Section 414-03 .**

   Proceed with refinish procedures following Ford-approved paint guidelines.

Restoring Corrosion Protection Following Repair

Special Tool(s)

 ST3049-A	Rust Inhibitor Installation Kit 286-00002
 ST3048-A	Undercoating Spray Gun 286-00001

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Premium Undercoating ValuGardTM VG101, VG101A (aerosol)	-
Rust Inhibitor ValuGardTM VG104, VG104A (aerosol)	-

⚠ WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Drilling access holes in body panels is not recommended. Drilling holes will break the original paint finish and promote corrosion.**

NOTE: Corrosion protection needs to be restored whenever it is necessary to sand or grind through painted surfaces or E-coat, or when bare metal repairs are made.

NOTE: Refer to product label for preparation and handling instructions.

1. The surfaces must be free of oil, dirt and other foreign material. Carry out the process in the following sequence.
    1. Thoroughly clean and deetal surfaces using metal surface prep to remove wax and grease.
    2. For best results, the vehicle should be at room temperature. Attach the rust inhibitor canister to the Rust Inhibitor Installation Kit 286-00002.
    3. Rust inhibitor should be applied after the welding and refinishing process. Product cannot be welded through.
    4. Air pressure setting for applicator gun is 448-517 kPa (65-75 psi).
        - Use the long wand when spraying enclosed areas. The spray nozzle provides a 360-degree spray pattern. Insert the wand as far as possible into the access hole, pull

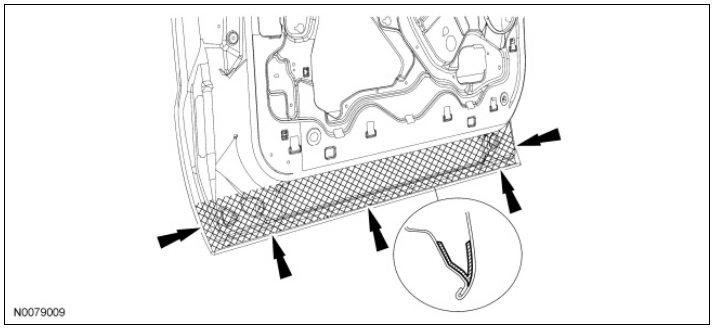
the trigger and wait 2-3 seconds and slowly pull the wand out of the access hole.
- The short, hook-shaped wand sprays in one direction and must be rotated to provide complete coverage.
- Apply the material in light mist coats.
- Material displaces moisture.

5. Clean up any overspray with a mild solvent such as mineral spirits or bug and tar remover.

NOTE: The following illustrations provide typical applications of body seams and spot welded flanges and are not vehicle specific.

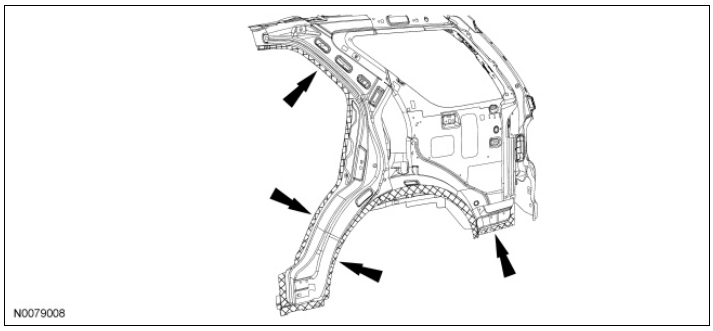
2. **NOTE:** Door assembly lower view.

   Apply rust inhibitor as shown to the inside of the door shell on all the interior metal surfaces using the most suitable applicator wand. Apply material to the exposed edges after carrying out the welding process. Make sure horizontal surfaces are well protected as they are more susceptible to corrosion. Keep door drain holes clear to prevent moisture buildup.



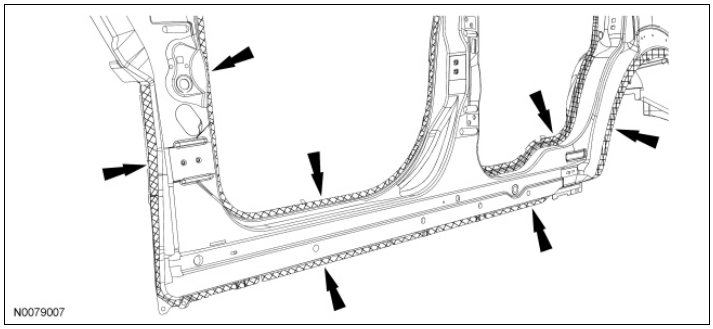
3. **NOTE:** Quarter panel inner view.

   Apply rust inhibitor to the closed channel portion of the spot weld flange areas using the short, hook-shaped wand. Apply material to the exposed edges after carrying out the welding process. Make sure horizontal surfaces are well protected as they are more susceptible to corrosion.



4. **NOTE:** Door frame opening view.

   Apply rust inhibitor to the closed channel portion of the spot weld flange areas using the short, hook-shaped wand. Make sure horizontal surfaces are well protected as they are more susceptible to corrosion.



Body and Frame Undercoating

1. **⚠ WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.**

   ⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

   NOTICE: **Do not allow undercoating on powertrain components. Failure to follow these instructions may result in incorrect operation of these components.**

   NOTE: Refer to product label for preparation and handling instructions.

   NOTE: Avoid high-pressure water spray cleaning to treated underbody area for 24 hours.

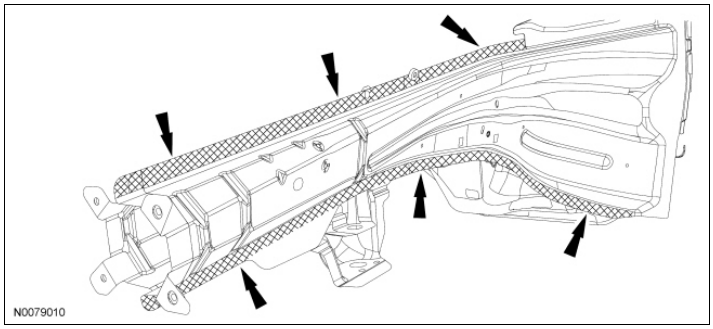
   Wire brush the area and make sure the surfaces are free of oil, dirt and other foreign material. Carry out the undercoating process in the following sequence.

   1. Thoroughly clean and degrease metal surfaces using metal surface prep to remove wax and grease.
   2. For best results, the vehicle should be at room temperature.
      - ♦ Canister attaches directly to the dispensing gun. Attach the undercoating canister to the Undercoating Spray Gun 286-00001.
   3. Undercoat should be applied after the welding and refinishing process. Product cannot be welded through.
   4. Air pressure setting for applicator gun is 552-621 kPa (80-90 psi).
      - ♦ Apply light mist coats, applicator sprays in fogging pattern.
      - ♦ Material displaces moisture.
   5. Clean up any overspray with a mild solvent such as mineral spirits or bug and tar remover.

NOTE: The following illustrations provide typical applications to frame rails and are not vehicle specific.

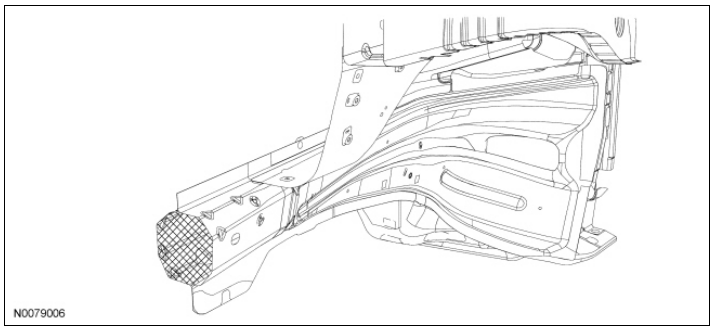
2. **NOTE:** Frame rail exterior spot-weld flange view.

   Apply undercoat material to the exterior exposed edges after carrying out the welding and refinishing process.



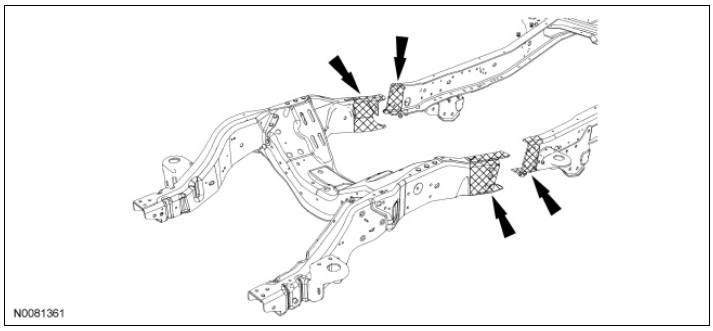
3. **NOTE:** Cross section view of typical unibody frame rail shown.

   Apply rust inhibitor to the inner surfaces of the rail after carrying out welding process. Use the long wand and insert as far as possible, depress trigger and wait 2-3 seconds and slowly pull the wand to make sure the area is completely fogged.



4. **NOTE:** Full frame vehicle, front rail-to-mid rail section repair shown.

   Apply undercoat material to the exposed surfaces after carrying out the welding process. Make sure to completely cover any bare metal areas.



Refinishing - Environmental Damage

Material

Item	Specification
Motorcraft® Acid Neutralizer ZC-1-A	-
Motorcraft® Alkaline Neutralizer ZC-2-A	-
3MTM Perfect-ItTM Show Car Liquid Wax 39026	-
Motorcraft® Detail Wash ZC-3-A	-

Iron Oxide (Rail Dust) or Acid Rain Decontamination

NOTICE: **In extreme cases of contamination, the vehicle may require refinishing. To avoid paint failure, follow the appropriate decontamination procedure prior to carrying out any panel refinishing procedure.**

NOTE: Iron oxide contamination appears as tiny rust spots on horizontal surfaces and in severe cases can be felt. This damage is typically caused from rail shipment, storage near railroad tracks or fallout from industrial manufacturing facilities.

NOTE: Acid rain contamination can be identified as water spotting and in severe cases staining within the water spots.

1. ***NOTICE:*** **Never paint over iron particles as rust spots will reoccur. Use only the recommended decontamination procedure detailed below.**

   Rinse any dust, dirt and foreign material from the vehicle body with cold water. Flush liberally.

2. Prepare the acid neutralizer by mixing 8 parts of water to 1 part neutralizer in a bucket.

3. ***NOTICE:*** **To avoid paint failure, do not allow the product to dry on the vehicle.**

   NOTE: Use a separate wash mitt for eac to the vehicle.

   Working quickly and beginning at the top of the vehicle and working to the sides, apply the acid neutralizer mix to the entire vehicle. Keep the vehicle wet with the solution and lightly agitate for 5 to 7 minutes. Continue around the vehicle 4 to 5 times. For severe conditions, work the product for up to 8 minutes.

4. Rinse the vehicle completely with cold water to remove the product.

5. Dry only the horizontal surfaces of the vehicle, do not dry the glass at this time.

6. *NOTICE:* **Do not apply the alkaline neutralizer directly to the vehicle plastic trim as the plastic can be damaged.**

   NOTE: Use a separate wash mitt for each product applied to the vehicle.

   NOTE: Alkaline neutralizer is a ready-to-use product. Do not mix with water.

   Pour the alkaline neutralizer into a squirt bottle and apply the solution to a clean wash mitt.

7. *NOTICE:* **To avoid paint failure, do not allow the alkaline neutralizer to dry on the vehicle.**

   Apply the product to the vehicle keeping the solution wet and lightly agitate for 5 to 7 minutes. For severe conditions, work the product for up to 8 minutes.

8. Rinse the vehicle completely with cold water to remove the product.

9. Prepare the detail wash by mixing 29.5 ml (1 oz) with 3.78L (1 gal) of water.

10. Using a clean wash mitt, shampoo the entire vehicle and rinse with cold water. Dry the vehicle completely.

11. Visually inspect the paint surface for any remaining evidence of ferrous metal particles. Repeat procedure as necessary.

12. *NOTICE:* **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or below 60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For additional information, refer to Section 414-03 .**

    If required, proceed with the refinish process following paint manufacturer's guidelines.

Surface Finishing Following Decontamination

1. *NOTICE:* **When attempting to affect a repair by buffing, polishing or color sanding, do not remove an excess of 0.3 MIL of paint film or refinishing will be required.**

   NOTE: Acid rain discoloring or etching may require color sanding in addition to buffing and polishing. In extreme cases, refinishing may be required if the following procedure does not restore the vehicle finish.

   NOTE: Do not intermix buffing products. Use only one manufacturer's product.

   NOTE: Always follow the manufacturer's product usage sequence. Use the appropriate buffing or polishing pad at the recommended buffing speed as specified by the product manufacturer.

   Apply rubbing compound to the vehicle surface as recommended by the product manufacturer.

2. Apply machine glaze to the vehicle surface ammended by the product manufacturer.

3. Use an alcohol and water mixture (1 to 1) to clean the buffed and polished areas. Verify removal of

scratches and swirls before the application of the final polish.

4. Apply a final clear coat polish material by hand, with a dual-action sander and foam pad, or with an orbital polisher and appropriate polishing bonnet.

5. Wash and dry the vehicle.

Refinishing - Manufacturing Damage

Material

Item	Specification
Motorcraft® Detail Wash ZC-3-A	-
Rust Inhibitor ValuGardTM VG104, VG104A (aerosol)	-

⚠ **WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.**

NOTICE: **Protect adjacent areas/substrates when preparing for and during refinishing to avoid overspray damage.**

NOTE: Peeling/delamination concerns can be described as lack of adhesion, either between the substrate and topcoats or between individual coats of paint.

1. Wash the repair area with pH-neutral soap and water.

2. Remove any trim, emblems and hardware from the area to be repaired.

3. **NOTE:** All delamination must be removed.

   Sand or media blast the damaged surface, keeping the repair area as minimal as possible.

4. Treat any bare metal surface to prevent flash corrosion, and prime and block sand as necessary prior to refinishing.

5. Mask the adjacent panels to protect from overspray.

6. ***NOTICE:*** **The High Voltage Traction Battery (HVTB) in a Hybrid Elecle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or below 60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For additional information, refer to Section 414-03 .**

   Spot repair the base coat as necessary, following the paint manufacturer's prescribed procedures.

7. Following paint manufacturer's guidelines, apply clear coat to the entire panel.

Weld-Bonding

General Equipment

Heat Treatment Induction Resistance Spot Welder 254-00001
Pro 230 MIG Welder 208-00030

Material

Item	Specification
Metal Bonding Adhesive TA-1	-
Motorcraft® Metal Surface Prep ZC-31-A	-
Premium Undercoating ValuGardTM VG101, VG101A (aerosol)	-
Rust Inhibitor ValuGardTM VG104, VG104A (aerosol)	-
Seam Sealer TA-2	-

Weld-Bonding - Squeeze-Type Resistance Spot Welding (STRW) Method

⚠ WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

⚠ WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protectioner's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

⚠ **WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.**

NOTE: Corrosion protection needs to be restored whenever it is necessary to grind through painted surfaces or E-coat, or when bare metal repairs are made. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

NOTE: Weld-bonding is a method used to join metals using Squeeze-Type Resistance Spot Welding (STRW) or Metal Inert Gas (MIG) and structural adhesive. The steps listed in this procedure apply to both types of welding. STRW is the preferred method. MIG welding should only be used when areas to be welded cannot be accessed using STRW -type machinery.

NOTE: Factory spot welds should be substituted with either resistance spot welds or MIG plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

1. Verify the vehicle is dimensionally correct on a frame machine. Straighten if necessary.

2. Depower the High Voltage Traction Battery (HVTB) before carrying out any removal or installation procedures affecting the high-voltage battery system. Refer to Section 414-03 for the correct procedure to depower the HVTB system on hybrid-equipped vehicles.

3. Remove damaged panels with an air saw or air chisel. Remove only large portions of the damaged panel. Avoid cutting into mating flanges or adjacent parts.

4. Drill out the spot welds using an appropriate spot-weld cutter and remove the remaining portions of the panel to be replaced.

5. Prepare any damaged flanges on the vehicle using hammer and dolly.

6. Grind the mating surface of the original flanges not greater than 25 mm (0.98 in) where the metal bonding adhesive will be applied.
   - Be sure to remove galvanizing on metal. Metal should have a shiny appearance.
   - Be careful not to damage the corners or thin the metal. The E-coat should also be removed on the opposite side of the flange only where the spot welds are to be placed.

7. Dry-fit and clamp the replacement service parts to verify a correct fit.
   - Remove the service part after verifying correct fit and alignment.

8. **NOTE:** The ends of welding clamps should be insulated on the ends using tape or similar material when welding is carried out.

   Follow manufacturer's prescribed welding procedures and settings. For additional information, refer to Welding Precautions - Steel in this section.

-34. ***NOTICE:*** **Hybrid vehicles contain a High Voltage Traction Battery (HVTB). Before welding near the HVTB , the HVTB must be removed to avoid heat damage. For additional information, refer to Section 414-03 .**

   NOTE: Welding can be carried out anytime during the adhesive curing process, or after the adhesive is fully cured. Welder settings will vary when welding through wet adhesive versus welding through fully cured adhesive. Refer to welder manufacturer's recommended settings for welding through fully cured adhesive. It is recommended to place a shunt weld in an area with no adhesive to make sure of

conductivity, particularly when welding through fully cured adhesive.

Create a test sample.

1. Prepare the metal and adhesive as described. Apply a 6-9 mm (0.23-0.35 in) bead of adhesive and weld the sample.
2. Place the welded sample in a vise and perform destructive weld tests by peeling the scrap metal apart using large lock-type pliers. Measure the weld nugget to determine that the nugget meets Ford weld nugget requirements. If the weld nugget does not meet required size, adjust welder settings until the correct weld nugget size is achieved.
3. When the correct weld nugget size is achieved, the service part can be weld-bonded.

Weld Nugget Chart

Test Thickness of Metal (in millimeters)	Nugget Size
0.7 + 0.7	4.3 mm (0.16 in)
0.7 + 0.7 + 0.7	4.3 mm (0.16 in)
0.9 + 0.9	4.7 mm (0.18 in)
0.9 + 0.9 + 0.9	4.7 mm (0.18 in)
1.0 + 1.0	5.2 mm (0.2 in)
1.0 + 1.0 + 1.0	5.2 mm (0.2 in)
2.0 + 2.0	7.1 mm (0.27 in)
2.0 + 2.0 + 2.0	7.1 mm (0.27 in)
3.0 + 3.0	8.7 mm (0.34 in)
3.0 + 3.0 + 3.0	8.7 mm (0.34 in)
3.0 + 0.7	4.3 mm (0.16 in)
0.7 + 3.0 + 1.0	5.2 mm (0.2 in)
2.0 + 2.0 + 0.7	4.3 mm (0.16 in)
0.9 + 0.9 + 2.0	4.7 mm (0.18 in)
2.0 + 0.9 + 1.0	5.2 mm (0.2 in)
1.0 + 3.0 + 1.0	5.2 mm (0.2 in)
3.0 + 1.0 + 2.0	7.1 mm (0.27 in)
0.9 + 0.7 + 0.9	4.3 mm (0.16 in)

11. **NOTE:** Refer to the product label for preparation and handling instructions.

    Apply a 6-9 mm (0.23-0.35 in) bead of metal bonding adhesive to the vehicle prepared flange surface.

12. Place the service part(s) in the correct position on the vehicle.
    - When positioned, do not pull the component away from the vehicle. If repositioning is necessary, slide the service part(s). This will make sure of correct contact between the components and adhesive.

13. Clamp evenly and tightly. The adhesive contains glass beads which will prevent over-clamping the component.

14. **NOTE:** If welding will not be carried out immediately, allow a minimum of 1.5 to 2 hours of adhesive cure time at 21°C (70°F) before removing clamps. Cure time at lower temperatures should

be increased. Clamps may be removed immediately after the component is welded.

Wipe excess adhesive from the panel before it cures.

15. Finish any cosmetic section seams with fiber-filled body filler. Rough sand the filler, after the adhesive cures, apply conventional body filler and block-sand the area.

16. Use seam sealer wherever a cosmetic seam sealer is required.

17. Mix and apply primer surfacer per Ford-approved paint recommdations.

18. ***NOTICE:*** **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or below 60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For additional information, refer to Section 414-03 .**

    Mix and apply basecoat per paint manufacturer's recommendations.

19. Mix and apply clearcoat per paint manufacturer's recommendations. Refinishing materials may be force-dried following paint manufacturer's recommendations.

20. Apply rust inhibitor or undercoating as required to provide corrosion protection to the repair area.

Weld-Bonding - Metal Inert Gas (MIG) Welding Method

⚠ WARNING: Invisible ultraviolet and infrared rays emitted ng can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTE: Metal Inert Gas (MIG) weld-bonding can be substituted as an alternative to Squeeze-Type Resistance Spot Welding (STRW). It may only be used to weld areas that are inaccessible to STRW machinery. However, when accessible, STRW is the preferred method.

NOTE: Corrosion protection needs to be restored whenever it is necessary to grind through painted surfaces or E-coat, or when bare metal repairs are made. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

NOTE: Factory spot welds should be substituted with either resistance spot welds or MIG plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld

directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

1. Verify the vehicle is dimensionally correct on a frame machine. Straighten if necessary.

2. Depower the High Voltage Traction Battery (HVTB) before carrying out any removal or installation procedures affecting the high-voltage battery system. Refer to Section 414-03 for the correct procedure to depower the HVTB system on hybrid-equipped vehicles.

3. Remove damaged panels with an air saw or air chisel. Remove only large portions of the damaged panel. Avoid cutting into mating flanges or adjacent parts.
    - Drill out the spot welds using an appropriate spot-weld cutter and remove the remaining portions of the panel to be replaced.

4. After removing the damaged sheet metal panel(s), repair any damaged flanges on the vehicle using a hammer and dolly.

5. Using an appropriate grinder, carefully grind around the entire receiving flange area following the original welds. Be sure to remove all E-coat, paint or galvanized coating from the mating surfaces of the joint.
    - Be sure to remove galvanizing on metal. Metal should have a shiny appearance.
    - Be careful not to damage the corners or thin the metal. The E-coat should also be removed on the opposite side of the flange only where the spot welds are to be placed.

6. Repeat the procedure from Step 3 on the mating surface of the replacement service part(s).

7. Prepare the new service panel for plug welds.
    - Using the original panel as a reference, drill or punch 8 mm (0.31 in) diameter holes in the exact number as the original spot welds. The holes should be positioned as close as possible to the original spot weld locations, without lining up exactly on top of an original spot weld site.
    - To make sure of correct weld performance, grind the immediate perimeter of plug weld hole. Grind only in the area of the plug weld, this will keep corrosion to a minimum.

8. Dry-fit and clamp the replacement service parts to verify a correct fit and alignment.
    - Remove the service part after verifying correct fit and alignment.

9. The vehicle prepared flange areas where plug welds will be located must be kept free of adhesive. Apply 25 mm (0.98 in) tape to the plug weld areas to prevent contamination from the adhesive.

10. Prepare the adhesive. Dispense a small amount of metal bonding adhesive from the cartridge to make sure of an even flow of both components. Attach the mixing tip and dispense a mixing tip length of adhesive to make sure of correct mix ratio.

11. **NOTE:** Refer to the product label for preparation and handling instructions.

    Apply a 6-9 mm (0.23-0.35 in) bead of adhesive to the vehicle prepared flange surface. Remove the tape from the plug weld areas.

12. Place the service part(s) in the correct position on the vehicle.
    - When positioned, do not pull the component away from the vehicle. If repositioning is necessary, slide the service part(s). This will make sure of correct contact between the components and adhesive.

13. Clamp evenly and tightly. The adhesive contains glass beads which will prevent over-clamping the

component.

14. **NOTE:** Welding can be carried out anytime during the adhesive curing process, or after the adhesive is fully cured.

    NOTE: If welding will not be carried out immediately, allow a minimum of 1.5 to 2 hours of adhesive cure time at 21°C (70°F) before removing clamps. Cure time at lower temperatures should be increased. Clamps may be removed immediately after the component is welded.

    Wipe excess adhesive from the panel before it cures.

15. Finish any cosmetic section seams with fiber-filled body filler. Rough sand the filler, apply conventional body filler after the adhesive cures and block-sand the area.

16. Usseam sealer wherever a cosmetic seam sealer is required.

17. Mix and apply primer surfacer per Ford-approved paint recommendations.

18. ***NOTICE:*** **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or below 60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For additional information, refer to Section 414-03 .**

    Mix and apply basecoat per Ford-approved paint recommendations.

19. Mix and apply clearcoat per Ford-approved paint recommendations. Refinishing materials may be force-dried following paint manufacturer's recommendations.

20. Apply rust inhibitor or undercoating as required to provide corrosion protection to the repair area.

Plastics Identification

⚠ WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTE: Identification of the various plastic types is necessary to select the appropriate repair methods to make high quality plastic repairs. Plastics can generally be broken down into 2 categories, thermoplastics and thermosetting plastics. Thermoplastics can be remolded by heating. This makes plastic welding a possible repair alternative.

1. **NOTE:** In some instances, a code or material designation is stamped indicating the plastic type.

   Thermoplastics are solvent reactive. Types of thermoplastics include Thermoplastic Olefin (TPO), Polyvinyl Chloride (PVC) and Acrylonitrile Butadiene Styrene (ABS). Polyolefins have an oily or waxy appearance. Examples include some bumper covers, stone shields, fender aprons and fan shrouds. Polyolefins require an adhesion promoter prior to carrying out any refinish procedure.

   - To determine if the part is a polyolefin, grind the damaged area in an out-of-sight area. Grinding a polyolefin will melt and smear the plastic and leave a ragged edge. If the part is non-polyolefin, the area will grind or sand smoothly, producing a powdery dust.

Rigid Plastic Parts

Code	Family Name	Common Trade Name	Typical Application
ABS	Acrylonitrile Butadiene Styrene	ABS, Cycolac, Lustran, Kralistic	A-Pillars, Consoles, Grilles
SMC	Sheet Molded Composite	SMC	Body Panels

Flexible Plastic Parts

Code	Family Name	Common Trade Name	Typical Application
RRIM	Reinforced Reaction Injection-Mold Material PUR	RRIM	Fascias, Body Panels, Body Trims
TPO	Thermoplastic Polyolefin	Polytrope, Renflex, Santropren Telcar, Vistaflex, ETA, Apex, TPO	Bumpers, End Caps, Rubber Strips, Sight Shields, Claddings, Interior B-Post

2. Polyolefin plastic can also be identified by placing a small sliver in a container of water, if the sample floats, it is a polyolefin plastic. A non-polyolefin will sink when placed in a container of water.

3. Generally, thermosetting plastics are rigid or semi-rigid. Sheet-Molded Composite (SMC) is reinforced with glass and other fibers and are strong and rigid. SMC is used for large panels such as hoods, liftgates, fenders and quarter panels.
    - A burn test can be a reliable method to determine if a plastic is a thermosetting plastic. Extreme care must be exercised when using this method.
        - ***NOTICE:*** **The component must be isolated away from the vehicle and all combustible materials to perform this test.**

          Apply an open flame to the corner of the damaged component. If the material crystallizes and becomes hard, it is a thermosetting plastic.

Plastics Refinishing

All Components

⚠ WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not paint any air bag module trim covers or deployment doors. Paint may cause the air bag to deploy incorrectly. Failure to follow this instruction may increase the risk of serious personal injury or death in a crash.

NOTE: When using any Ford-approved refinishing product, it is recommended to stay within the same paint system throughout the process. For example, do not use one manufacturer's primers and another manufacturer's topcoats.

1. **NOTE:** Care must be used if applying heat to parts. Thermoplastics soften and tend to lose their shape when heated.

   The first step for any repair or refinish procedure is to identify the type of plastic. Is it thermosetting or thermoplastic, grained or smooth? This will determine how it should be cleaned and prepared for refinishing. For additional information, refer to Plastics Identification in this section.

   - It is essential that the correct cleaner is used, depending on which painting system is employed, solvent-based or water-based.
   - Clean part with warm water/mild detergent, then with plastic cleaner to remove wax, silicone and other contaminants. Do not allow parts to remain wet for extended periods.
   - As a general rule, if water beads on the part, it requires additional cleaning as all the manufacturing release agents have not been removed.

2. New parts may require baking in a spray booth or heating with heat lamps to release trapped solvents or mold release agents used in the manufacturing processes.

Non-grained components

3. After cleaning, lightly sand with 600-grit or finer sandpaper. Remove sanding residue with plastic cleaner and wipe dry.

Grained components

4. After cleaning, light use of a gray scuff pad is permissible providing the graining not be flattened. Remove sanding residue with plastic cleaner and wipe dry.

All components

5. Apply a plastics adhesion promoter to any bare plastic part following manufacturer's recommendation. Throughout the refinish procedure, any time bare plastic is exposed for any reason, it is essential that adhesion promoter be reapplied to that area.

6. A sealer may be required to prevent wrinkling and lifting of the topcoat prior to carrying out the refinish procedure.

7. Flexible and non-flexible components should be refinished separately as a flex additive may be required when refinishing flexible parts (refer to the paint manufacturer's recommendation).

8. It is recommended to carry out refinishing of exterior components on-vehicle (after cut-in) to control color match and blending to adjacent panels.

9. Proceed with the refinish process and follow the Ford-approved paint system procedures. Steps may vary between paint manufacturers.

Plastics Repair

Material

Item	Specification
Plastic Bonding Adhesive TA-9	-

⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always refer to Material Safety Data Sheet (MSDS) when handling chemicals and wear protective equipment as directed. Examples may include but are not limited to respirators and chemically resistant gloves. Failure to follow these instructions may result in serious personal injury.

1. In deciding whether to repair or install a new component, follow these guidelines.
   - Is a part readily available?
   - Can the damaged part be economically returned to its original strength and appearance, or will the labor cost exceed the cost of a new component?
   - Will repair provide for the fastest, highest quality repair?

2. ***NOTICE:*** **Never apply solvents such as lacquer thinner or reducer at any stage of plastic repair. Solvents, cleaners and water are absorbed by many types of plastics and by the glass fibers used for reinforcements. If this occurs, the plastic may swell in the area of repair and cause the repair to fail. Remove cleaners and water quickly and use air and heat to speed up dryg.**

   NOTICE: **During the repair of many plastics and particularly polyolefin plastics, an adhesion promoter must be applied to the substrate to allow repair materials and paint to bond correctly. Reapplication is required when grinding or sanding through the sealer or primered layers.**

   NOTE: When possible, it is recommended to carry out as much of the plastic repair as possible on the vehicle. Parts mounted on the vehicle are held in correct alignment throughout the repair. Attempting to repair the part off the vehicle may cause misalignment. This could lead to failure of the repair.

   Select the correct repair method by identifying the type of plastic being repaired. For additional information, refer to Plastics Identification in this section to determine the type of plastic being repaired.

3. **NOTE:** Always refer to the manufacturer's label directions for the type of repair materials, fillers and bonding agents being used as they are material specific.

   Determine whether a reinforcement piece is needed as a backer on large repairs.

   - Construct a reinforcement piece from a scrap piece of the type of plastic being repaired and follow manufacturer's label directions for the type of system being used.
   - When repairing Sheet-Molded Composite (SMC), a reinforcement piece can be constructed using several layers of glass cloth saturated with resin or structural adhesive. The weave of the cloth or screening should be loose enough to allow the resin to thoroughly penetrate. Reinforcement should cover the entire area of damage and extend outward beyond the

damage or joint area.

Sheet-Molded Composite (SMC) Panel Repair

NOTE: The following procedure applies to repair of structural cracks and large gouges. If damage is cosmetic, use of reinforcing cloth may not be necessary.

1. Panels to be repaired should be dry and at room temperature 18°C (65°F) to 24°C (75°F) prior to carrying out any repairs. Both sides of the panel must be thoroughly cleaned before sanding or grinding.

2. Cover the break in the SMC (front and back) with masking tape. This protects the damaged area from absorbing the prep cleaner and eliminates wicking of the cleaner through the fibers into the SMC .

3. Remove all waxes, silicones, dirt and road oils from the area surrounding both sides of the damaged area with a plastics wax and grease remover.
    - Remove the tape and sand the back of the repair area with an angle grinder, Dual Action (D/A) sander or by hand using 80-grit sandpaper. Remove all dust with a vacuum and tack cloth.

4. Create a reinforcing patch using a piece of scrap SMC that conforms well to the back of the damaged area or form a patch from fiberglass cloth.
    - Cut a section of cloth large enough to cover the repair, plus 25.4 mm (1 in) around the repair area.
    - Cut a section of plastic film backing approximately 25.4 mm (1 in) larger than the cloth. Lay the plastic smooth, flat surface where it will be used to create a pyramid patch.

5. Follow manufacturer's directions and apply plastic repair adhesive to the plastic film backing and smooth with plastic spreader to recommended thickness. Place the pre-cut fiberglass cloth on the adhesive-coated plastic film. Cover the cloth with a coat of repair adhesive and spread to the recommended thickness.

6. Apply the prepared patch to the backside of the panel and compress. Follow manufacturer's instructions for adhesive cure. Remove plastic film after adhesive cures and sand as necessary to remove roughness.

7. Remove masking tape from the front side of damaged area and grind down to the backing patch. Use an angle grinder with a 30- to 40-grit wheel. Make a gradual taper in the area, this will prevent bull's-eyes or read-through in the finished repair. Sand prepared area with a D/A sander or hand-sand with 80-grit sandpaper.

8. Build a pyramid patch using fiberglass cloth or equivalent and plastic repair adhesive. Following manufacturer's directions, apply patch to damaged area.

9. Rough-grind area to remove excess adhesive. Sand repair area with 80-grit sandpaper, making sure to cut slightly below the SMC finished surface. This will allow for a finish coat of plastic body repair material.

10. Apply a finish coat of plastic repair filler material per manufacturer's directions.

11. Finish-sand, prime and topcoat using Ford-approved paint systems.

Thermoplastic Compounds

1. In deciding whether to repair or install a new component, follow these guidelines.
   - Is a part readily available?
   - Can the damaged part be economically returned to its original strength and appearance, or will the labor cost exceed the cost of a new component?
   - Will repair provide for the fastest, highest quality repair?

2. **NOTE:** The following steps are to be used as a guideline. Depending on what brand of adhesives or patch materials are used, procedures may vary slightly.

   Thoroughly clean the damaged area with wax and grease remover formulated for use with plastics.

3. Hand sand the repair area with 80-grit sandpaper and remove any foreign material with compressed air.

4. Apply a plastics adhesion promoter per label directions to the repair area.

5. For small repairs, a plastic adhesive filler can be applied to the damaged area. Follow manufacturer's directions and build layers to form a thickness above the damaged area. This will allow the area to be sanded smooth.

6. To repair large holes or cracks, measure and cut a piece of fiberglass cloth or equivalent 25.4 mm (1 in) larger than the crack or hole.
   - Apply plastic repair adhesive to the damaged area and immediately apply fiberglass cloth into plastic adhesive for reinforcement. Apply additional plastic repair adhesive for strength and shape as required.

7. Contour and shape the repair as necessary with a D/A sander. Avoid sanding through the repair.

8. Finish-sand the area and carry out any required paint operations using Ford-approved paint systems.

Tab Repair - Bumper

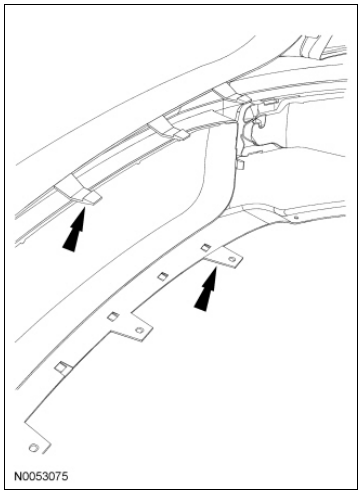
1. **NOTE:** Inspect the bumper cover to determine if part of it can be repaired to an acceptable level of quality of appearance, fit and durability. Will labor and material cost of the repair meet or exceed the cost of a new replacement bumper cover? If the bumper cover is determined to be repairable, proceed to the following steps.

   NOTE: The following steps are to be used as a guideline. Depending on what brand of adhesives or patch materials are used, procedures may vary slightly.

   Remove the affected bumper. For additional information, refer to Section 501-19 .

NOTE: Illustration is not vehicle specific.

2. Clean the broken tab(s) with a plastics wax and grease remover.



3. Hand sand the repair area with 80-grit sandpaper and remove any foreign material with compressed air.

4. Apply a plastics adhesion promoter per label directions to the repair area.

5. Measure and cut a patch of fiberglass cloth or equivalent large enough to form the front of the tab, then slope back in a wedge shape approximately 51 mm (2 in) from original tab.

Inner Body Reinforcing Panels

Special Tool(s)

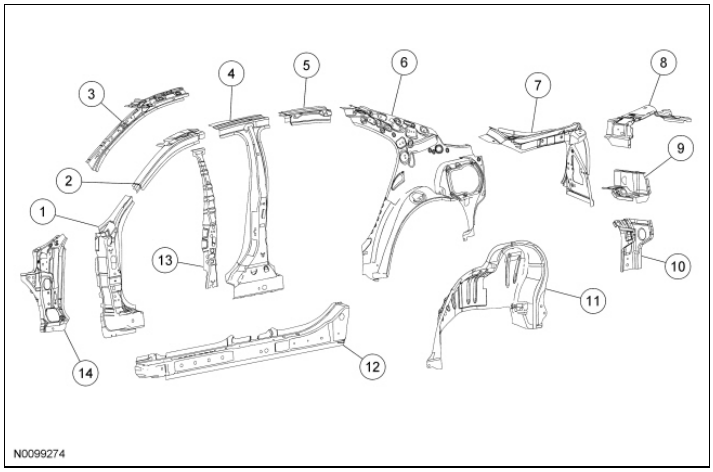
 ST2738-A	Heat Treatment Induction Resistance Spot Welder 254-00001
 ST2956-A	Pro 230 MIG Welder 208-00030

Material

Item	Specification
Metal Bonding Adhesive TA-1	-
Premium Undercoating ValuGardTM VG101, VG101A (aerosol)	-
Rust Inhibitor ValuGardTM VG104, VG104A (aerosol)	-
Motorcraft® Metal Surface Prep ZC-31-A	-
Seam Sealer TA-2	-

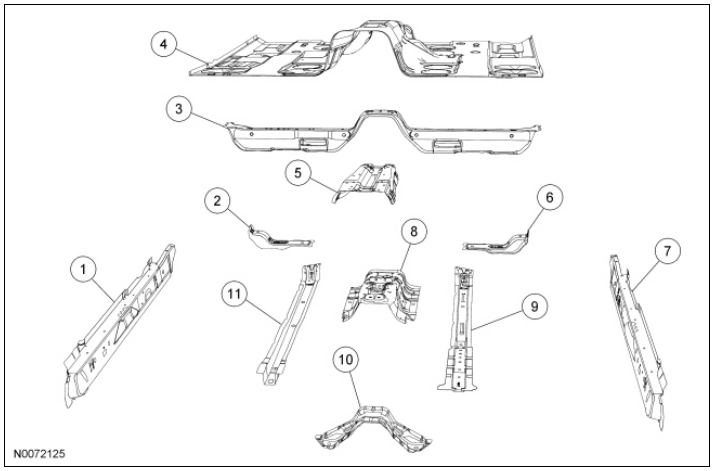
Exploded View

NOTE: Left side shown, right side similar.



Item	Part Number	Description
1	02527 LH/ 02526 RH	Front body pillar reinforcement - High-Strength Low Alloy (HSLA) 250 steel (part of 025A01 LH/ 025A00 RH service assembly)
2	513A13 LH/ 513A12 RH	A-pillar reinforcement - HSLA 300 steel (part of 025A01 LH/ 025A00 RH service assembly)
3	-	Reinforcement - HSLA 300 steel (part of 02509 LH/ 02508 RH service assembly)
4	24321 LH/ 24320 RH	B-pillar inner - HSLA 300 steel (part of 24301 LH/ 24300 RH service assembly)
5	-	Roof rail reinforcement HSLA 250 steel (part of 24301 LH/ 24300 RH service assembly)
6	27791 LH/ 27790 RH	Body side inner panel - mild steel
7	45115 LH/ 45114 RH	Luggage compartment drain trough - mild steel
8	46571 LH/ 46570 RH	Package tray support panel - mild steel
9	46561 LH/ 46560 RH	Package tray support on lower body - mild steel
10	46775 LH/ 46774 RH	Package tray to wheelhouse strainer - mild steel
11	27887 LH/ 27886 RH	Quarter panel inner wheelhouse - mild steel
12	10143 LH/ 10142 RH	Rocker panel reinforcement - Dual Phase Steel (DP) 600 (part of 24301 LH/ 24300 RH service assembly)
13	244A29 LH/ 24428 RH	Center body pillar reinforcement - HSLA 350 steel (part of 24301 LH/ 24300 RH service assembly)
14	-	Cowl side panel - HSLA 300 steel (part of 02509 LH/ 02508 RH service assembly)

Underbody - Front



Item	Part Number	Description

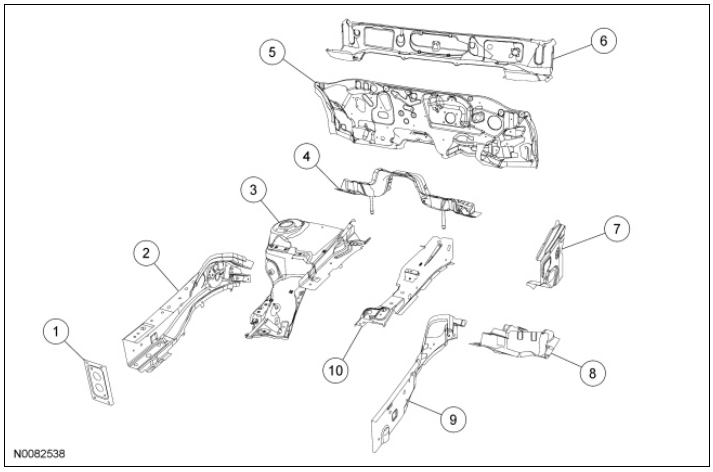
1	10136	Floor side member (RH) - High-Strength Low Alloy (HSLA) 250 steel
2	617C50	Seat track reinforcement (RH) - mild steel
3	10684	Crossmember No. 3 - mild steel
4	11135	Floor pan - mild steel
5	111K36	Floor tunnel reinforcement - mild steel
6	612K55	Seat track reinforcement (LH) - mild steel
7	10137	Floor side member (LH) - HSLA 250 steel
8	54611	Floor tunnel reinforcement - mild steel
9	10063	Floor side member extension (LH) - HSLA 250 steel
10	53656	Crossmember reinforcement - mild steel
11	10062	Floor side member extension (RH) - HSLA 250 steel

Underbody - Rear

Item	Part Number	Description
12	101A14	Floor side member assembly (RH) - High-Strength Low Alloy (HSLA) 300
13	17A750	Bumper mount bracket - HSLA 350 steel
14	10692A	Crossmember - mild steel
15	11160	Center floor pan - mild steel
16	11215	Rear floor pan - mild steel
17	11250B	Rear floor pan extension assembly (RH) - mild steel
18	11251B	Rear floor pan extension assembly (LH) - mild steel
19	17A750	Bumper mount bracket - HSLA 350 steel
20	101A15	Floor side member assembly (LH) - HSLA 300
21	10692B	Crossmember - mild steel
22	10716	Crossmember - mild steel
23	11B42	Floor panel - mild steel

Front Structure - Exploded View

NOTE: Left side shown, right side similar



Item	Part Number	Description
1	17B750	Bumper bracket - mild steel
2	5410063 LH/ 5410062 RH	Front rail inner - Dual Phase Steel (DP) 600
3	5416055 LH/ 5416054 RH	Apron assembly - mild steel
4	5410414	Lower dash crossmember - mild steel
5	16A50	Dash panel - mild steel
6	5402030	Upper dash panel - mild steel
7	024A15 LH/ 024A14 RH	Cowl reinforcement - mild steel
8	54381 LH/ 54380 RH	Torque box - mild steel
9	5410633 LH/ 5410632 RH	Front rail outer - DP 600 steel
10	16155 LH/ 16154 RH	Fender reinforcement upper - mild steel

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Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

⚠ WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: On vehicles equipped with Safety Canopy® options, prior to carrying out any sectioning repairs near the roof line or sail panel areas of the vehicle, remove the Safety Canopy® module and related components. Failure to comply may result in accidental deployment or damage to

the Safety Canopy®. Refer to Section 501-20B . Failure to follow these instructions may result in serious injury to technician or vehicle occupant(s).

⚠ WARNING: Do not cut or grind body side components within 50 mm (1.96 in) of restraint anchoring points. Welding within 50 mm (1.96 in) of restraint anchoring points may result in incorrect operation of restraint devices. For additional restraints anchoring location information, refer to Section 501-20A and Section 501-20B . Failure to follow these instructions may result in serious injury to vehicle occupant(s).

⚠ WARNING: Do not carry out body side sectioning repairs in areas of laser welds. Factory laser welds cannot be duplicated with conventional welding equipment and structural integrity may be compromised. Failure to follow this instruction may result in serious injury to vehicle occupant(s).

⚠ WARNING: Do not carry out body side sectioning repairs in areas of door hinge or striker anchoring points. Welding within 50 mm (1.96 in) of door hinge or striker locations may compromise structural integrity during a collision. Failure to follow these instructions may result in serious injury to vehicle occupant(s).

NOTE: Factory spot welds may be substituted with either Squeeze-Type Resistance Spot Welding (STRW) or Metal Inert Gas (MIG) plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

1. ***NOTICE:*** **Hybrid vehicles contain a High Voltage Traction Battery (HVTB). Before welding near the HVTB , the HVTB must be removed to avoid heat damage. For additional information, refer to Section 414-03 .**

   NOTICE: **Electronic modules and related wiring may be damaged when exposed to heat from welding procedures. Carefully disconnect and remove, or position away from heat-affected areas. For additional information, refer to Welding Precautions - Steel in this section.**

   Detrim the vehicle and remove the outer body sheet metal from the affected area, prior to performing any reinforcing panel replacement. For additional information, refer to Sectioning Guidelines in this section.

2. Where possible, create a backer piece using a portion of the old panel. This will create a stronger joint.

3. When welding overlapping surfaces or substrates, apply a weld-through primer between the surfaces prior to welding.
   - Make sure horizontal joints and flanges are correctly sealed with seam sealer to prevent moisture intrusion. Water and moisture migrate to horizontal joints and corrosion tends to occur more rapidly in these areas. Metal surfaces must be clean and dry before applying seam sealer.

4. ***NOTICE:*** **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or below 60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For additional information, refer to Section 414-03 .**

   Refinish the repair area as required, per Ford-apppaint guidelines. apply corrosion protection to the

repair area as required.

Roof Panel

Special Tool(s)

 ST1073-A	Heat Gun 107-R0300

General Equipment

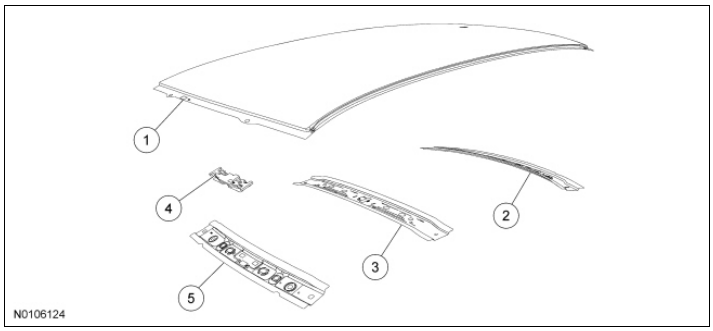
3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-00014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Metal Bonding Adhesive TA-1	-
Roof Ditch Sealer Fusor® 122EZ, 3MTM 08307	-
Seam Sealer TA-2	-

Roof Assembly

NOTE: Windshield header damper assembly, part No. 034A08, is used on Ford models only and is provided as a separate service component.



Item	Part Number	Description
1	50202	Roof panel - mild steel

2	42220	Rear window frame - High-Strength Low Alloy (HSLA) 350 steel
3	51269	Roof bow - HSLA 350 steel
4	034A08	Damper - mild steel
5	03410	Windshield header - HSLA 350 steel

Removal

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Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

⚠ WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Be sure to adequately protect all glass, exterior finish and interior trim to avoid damage during the repair procedure.**

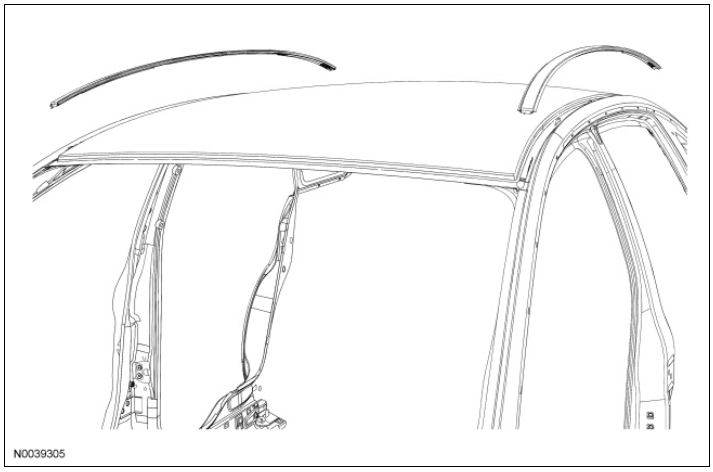
NOTE: The roof panel is affixed using a process not previously employed on a Ford Motor Company vehicle. The driver and passenger sides of the roof panel are laser skip-welded. Installation of a new roof panel will employ a weld-bonding technique. The use of mechanical welding and chemical bonding are both part of the installation technique.

1. Depower the High Voltage Traction Battery (HVTB) before carrying out any removal or installation procedures affecting the high-voltage battery system. Refer to Section 414-03 for the correct procedure to depower the HVTB system on hybrid-equipped vehicles.

2. Remove the windshield and rear window glass. For additional information, refer to Section 501-05 .

3. Remove the headliner. For additional information, refer to Section 501-05 .

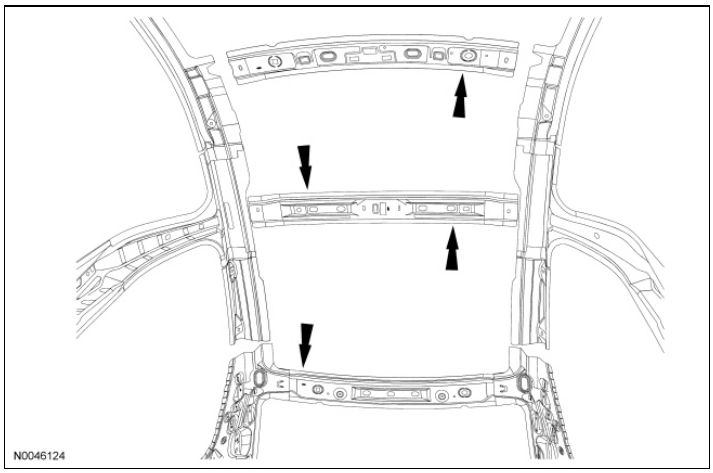
4. Remove the roof ditch mouldings.



5. **NOTE:** For installation purpose, particular attention must be paid to the depth (thickness) of the sealer removed.

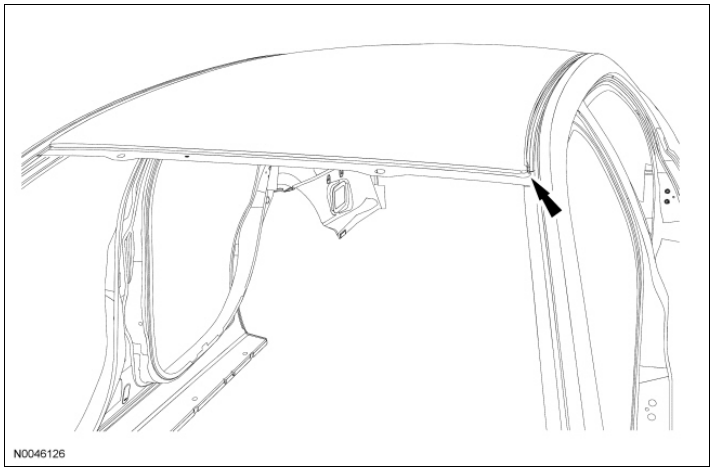
   Using a Heat Gun and a narrow scraper, remove the sealant along the entire length of the roof sides. Remove sealer as completely as possible.

6. From inside the vehicle, leaving as much of the foam as possible intact, separate the NVH foam along the roof bows from the roof panel using a flexible and sharp broad scraper or knife.



7. Remove (drill out) all the roof panel spot welds from the windshield and rear window glass openings.

8. Using a cut-off wheel, plasma cutter or an air hammer equipped with a panel cutter bit, carefully separate the panel from the vehicle by cutting the entire length along the inner portion of the roof ditch seam on each side of the roof panel.



9. **NOTE:** If the windshield header is damaged and requires service, Ford and Mercury models use a damper which is welded to the header and is serviced as a separate component. The damper can be transferred to the replacement header if it is not damaged.

   With the help of an assistant, remove the roof panel from the vehicle.

10. Using an air hammer equipped with a flat chisel, remove the remaining portion of the roof panel from the roof ditch area.

Installation

NOTICE: **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or below 60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For additional information, refer to Section 414-03 .**

NOTICE: **Be sure to adequately protect all glass, exterior finish and interior trim to avoid damage during the repair procedure.**

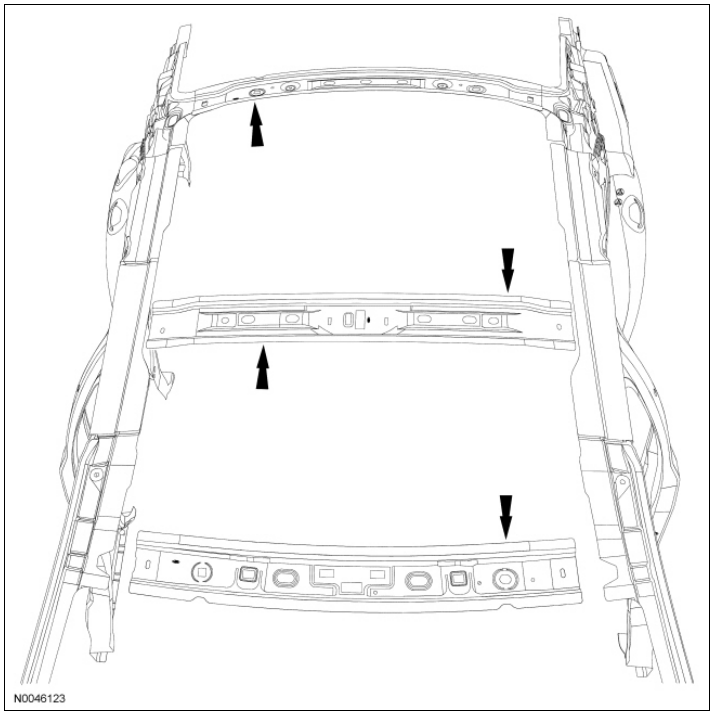
1. Using a hammer any, straighten any damage caused to flange areas during removal.

2. Using a grinder, carefully prepare the roof ditch area for the new roof panel.

3. With the help of an assistant, position the new roof panel on the vehicle.

4. Properly align and index-mark the positioning of the panel-to-vehicle and remove the panel.

5. Apply a 13 mm (0.51 in) tall bead of seam sealer TA-2 directly to the NVH foam remaining on the roof bows and immediately reinstall the roof panel aligning it to the index marks made during the test fitting.
   - If necessary, application of flexible foam repair (locally obtained), may be used with the seam sealer.



6. Make sure good contact is made with the sealer and carefully clamp the roof panel on all sides.

7. Using the resistance spot welder, weld the roof panel to the vehicle in the windshield and rear window glass areas. Spot welds should match factory welds in both location and quantity.

8. Using the Metal Inert Gas (MIG) welder, seam-weld the roof panel sides with 10 mm (0.39 in) long weld beads spaced 40 mm (1.57 in) apart. Each corner must have a 10 mm (0.39 in) weld bead applied.

9. Prepare the repair area for refinish material application following the paint manufacturer's recommendations.

10. Apply a quality primer-sealer following the paint manufacturer's recommendation for both compatibility and application.

11. **NOTE:** Always use refinishing materials from a single paint manufacturer. Combining products from more than one manufacturer may result in refinishing material incompatibility issues and potential void of warranty for each product applied.

    If required, follow up with a quality primer-surfacer following the paint manufacturer's recommendations. Block sand to level using the recommended grit sandpaper.

12. ***NOTICE:*** **Failure to purge air bubbles from the roof ditch sealer may result in air trapped in the roof ditch which may cause refinishing materials to pop.**

    Stand the roof ditch sealer vertically (nose up) for a minimum of 30 minutes prior to application to permit trapped air to rise to the top so it may be purged.

13. Position the vehicle so it is level front-to-rear.

14. Using masking tape, form a dam at each end of the roof ditch (both sides) to prevent roof ditch sealer run-off.

15. Apply the roof ditch sealer following product directions to a depth equal to the sealer noted during removal.

16. Allow the material to cure 40-60 minutes at room temperature before refinishing. If roof ditch sealer has been allowed to cure in excess of 2 hours, scuff the surface using a red scuff pad.

17. Refinish the roof and repair area following Ford-approved paint system recommendations.

18. Allow refinishing materials sufficient cure time to permit safe handling (refer to paint manufacturer's specification) and install the roof ditch moulding.

19. Install the headliner. For additional information, refer to Section 501-05 .

20. Install the windshield and rear window glass. For additional information, refer to Section 501-11 .

Door Outer Panel

Special Tool(s)

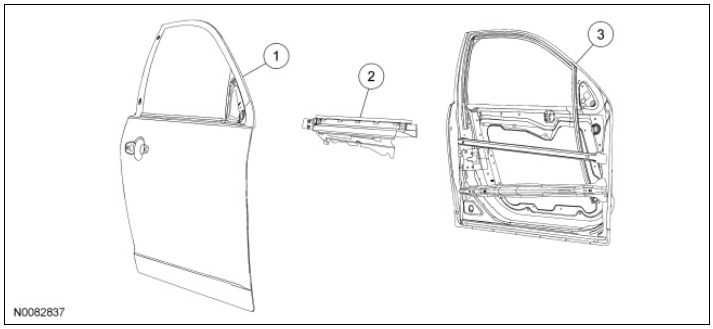
 ST1073-A	Heat Gun 107-R0300
 ST2956-A	Pro 230 MIG Welder 208-00030

Material

Item	Specification
Metal Bonding Adhesive TA-1	-
Rust Inhibitor ValuGardTM VG104, VG104A (aerosol)	-

Door Assembly

NOTE: Front door shown, rear door similar.



Item	Part Number	Description
1	20205 LH/ 20204 RH	Door outer panel - mild steel
2	-	Upper belt reinforcement (part of door assembly) - mild steel
3	20125 LH/ 20124 RH	Door assembly - mild and High-Strength Steel (HSS)

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⚠ WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

1. Remove the door trim panel from the affected door and window glass. For additional information, refer to Section 501-11 .

2. Remove the outside door handle and mirror assembly. For additional information, refer to Section 501-09 .

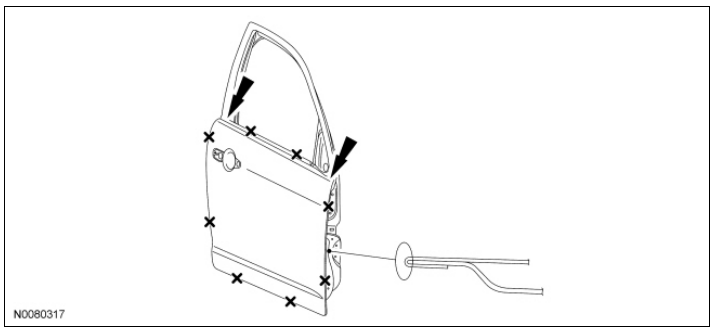
3. Remove door trim including mouldings and weatherstrips.

4. Remove the door assembly and secure on a workstand.

5. ***NOTICE:*** **Use extreme care to avoid cutting the door shell or inner panel.**

   Using a high-speed cut off wheel, make cuts to the beltline portion of the outer panel in the areas indicated by the arrows.

   - Using a grinder, grind along the perimeter of the outer door panel hem to separate the hem edges as indicated in the illustration.



6. **NOTE:** The use of a heat gun may be required to soften door panel adhesive.

   Prior to removing the outer panel, use a sharp knife to cut the adhesive between the door outer panel, flutter beam, beltline reinforcement and intrusion beam.

   - Using a flat-blade chisel or equivalent, remove the original panel.
   - Using a sharp knife or broad edge scraper, remove the remaining portion of the hem flange from the door shell.

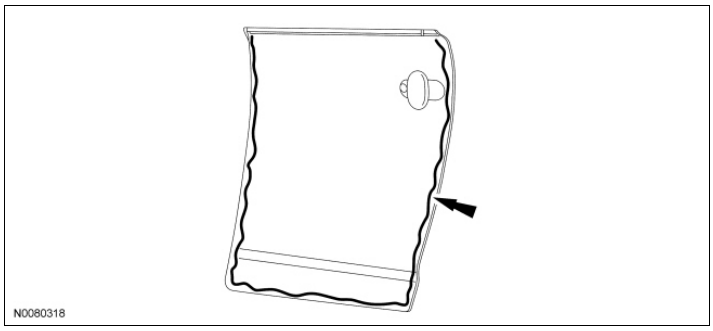
- Remove any remaining adhesive from the door shell flange.

7. Trial fit the service replacement panel to the door shell assembly and carefully mark the cut lines on the panel to match the cut lines on the original panel.

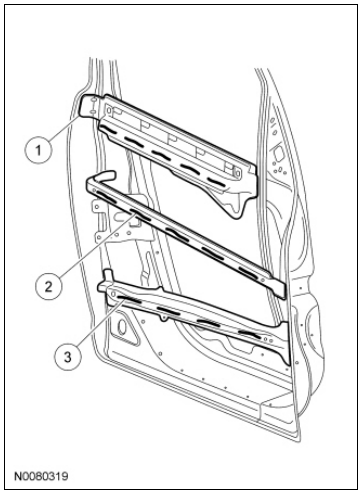
8. Cut the service replacement panel and recheck the fit to make sure of proper alignment.

9. Temporarily secure the outer panel to the door assembly and install on the vehicle to verify correct alignment and fit.

10. Prepare the service replacement panel joint areas by grinding clean all mating surfaces.



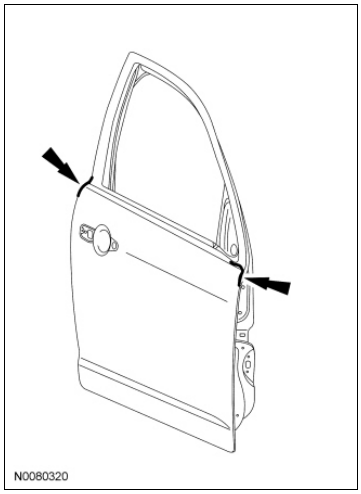
11. Prepare the door shell assembly by grinding all the mating surfaces including:
    1. the inner hem and outer belt reinforcement.
    2. the flutter beam.
    3. the intrusion beam.



12. Apply metal bonding adhesive to the following areas: service replacement hem flange, intrusion beam-to-outer panel, flutter beam-to-outer panel, and outer belt reinforcement-to-outer panel.

13. Position and align the new door skin to the door shell assembly, carefully turn the assembly over and begin the hemming process.
    - Using a door panel installation tool or the hammer and dolly method, close the perimeter door hem and smooth any residual adhesive in the joints.

14. Turn the door over and Metal Inert Gas (MIG) weld the upper beltline joint. Finish grind and trial fit the upper beltline moulding and mirror.



15. Prime and paint the door using Ford approved paint system.

16. Apply rust inhibitor inside the door to all hem areas and upper beltline area. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

17. Reassemble and install door and align. For additional information regarding door fitment specifications, refer to Body in this section.

Frame Members - Front

Special Tool(s)

 ST3049-A	Rust Inhibitor Installation Kit 286-00002
 ST3048-A	Undercoating Spray Gun 286-00001

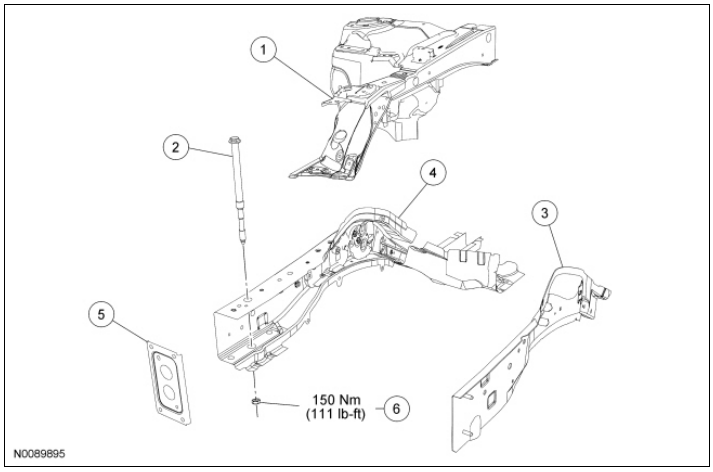
General Equipment

3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-00014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Premium Undercoating ValuGardTM VG101, VG101A (aerosol)	-
Rust Inhibitor ValuGardTM VG104, VG104A (aerosol)	-

Front Frame Rail



Item	Part Number	Description
1	-	Front structure assembly - mild steel
2	3057-A	Subframe bolt
3	10219 LH/ 10218 RH	Member assembly - front side outer - Dual Phase Steel (DP) 600
4	10063 LH/ 10062 RH	Member assembly - front side inner - DP 600 steel
5	17B750 LH/ 17B749 RH	Bumper bracket - mild steel
6	-	Subframe nut

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⚠ WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Frame rail crush zones absorb crash energy during a collision and must be replaced if damaged. Prior to replacement of frame rail crush zones, straighten damaged frame rails to correct frame dimensions. Failure to follow these instructions may adversely affect frame rail crush zone performance and may result in serious personal injury to vehicle occupants in a crash.

⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

NOTE: Corrosion protection needs to be restored whenever it is necessary to sand or grind through painted surfaces or E-coat, or when bare metal repairs are made. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

NOTE: Observe prescribed welding procedures when carrying out repairs to the frame assembly. For additional information, refer to Welding Precautions - Steel in this section.

NOTE: The following repair procedure illustrates the sectioning of the lower front apron rail inner and outer assemblies. Damage extending beyond this area requires the entire frame rail be replaced at the original factory seams.

All vehicles

1. Position the vehicle on a frame repair rack following the manufacturer's recommendations. Measure the vehicle to determine if the body requires straightening and alignment. If necessary, rough pull the vehicle to restore the vehicle to manufactured dimensions. For dimensional information, refer to Body in this section.
    - Remove the front bumper. For additional information, refer to Section 501-19 .
2. On non-hybrid vehicles remove the battery. For additional information, refer to Section 414-01 .
3. Remove the fender(s) from the affected side(s). For additional information, refer to Section 501-02 .

Hybrid vehicles

4. Depower the High Voltage Traction Battery (HVTB) before carrying out any removal or installation procedures affecting the high-voltage battery system. Refer to Section 414-03 for the correct procedure to depower the HVTB system.

Left hand side

5. Remove the Air Cleaner (ACL), intake air resonator and bracket. For additional information, refer to the appropriate 303-12 section.

Right hand side

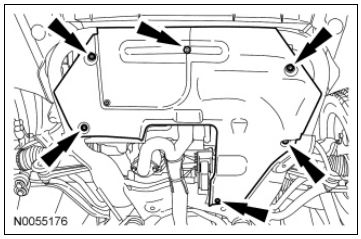
6. Remove the windshield washer reservoir. For additional information, refer to Section 501-16 .

All vehicles

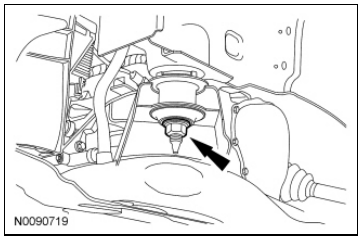
7. **NOTE:** MKZ shown, Fusion similar.

   Remove the bolts and the underbody shield, if equipped.

    - To install, tighten to 7 Nm (62 lb-in).



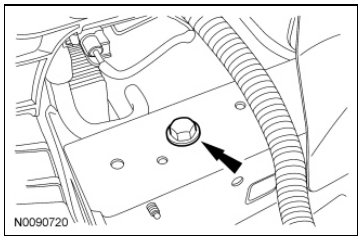
8. Remove the subframe nut from the affected side.
    - To install, tighten to 150 Nm (111 lb-ft).



9. **NOTE:** The original subframe bolt is welded to the frame rail.

   Remove the subframe bolt.

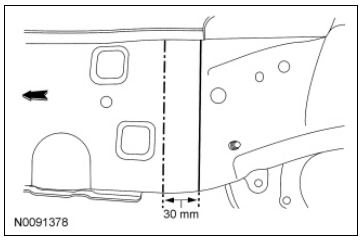
   - Grind off the head of the bolt.
   - Drive the bolt out and discard.



10. ***NOTICE:*** **The frame rail must not be cut or welded at the factory locator line.**

    Mark and measure the outer rail.

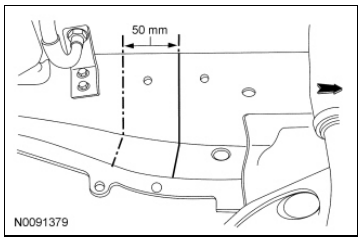
    - Identify the locator line on the frame outer rail.
    - Measure 30 mm (1.181 in) forward of locator line and scribe.



11. ***NOTICE:*** **The frame rail must not be cut or welded at the factory locator line.**

    Mark and measure the inner frame rail.

    - Identify the locator line on the frame inner rail.
    - Measure 50 mm (1.968 in) rearward of the locator line and scribe.



12. **NOTE:** Factory spot welds may be substituted with either resistance spot welds or Metal Inert Gas (MIG) plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm

(0.31 in) diameter.

Drill out all the spot welds forward of the scribe line made on the inner frame rail.

13. Using a die-grinder, plasma cutter or reciprocating saw, carefully cut the OUTER RAIL ONLY along the scribe line and remove the outer frame rail.

14. Using a die-grinder, plasma cutter or reciprocating saw, carefully cut the INNER RAIL ONLY along the scribe line and remove the inner frame rail. Clean surfaces with metal surface prep or equivalent.

Installation

All vehicles

1. Measure mark and cut 50 mm (1.968 in) rearward of the locator line on the replacement INNER frame rail.

2. Prepare all the mating surfaces for MIG welding.
    1. Chamfer the mating surfaces of the inner frame rail on the vehicle and the replacement rail from the inside to improve butt weld condition. Clean metal surfaces with metal surface prep or equivalent.
    2. Remove E-coat from the immediate weld area on the vehicle frame rail and the replacement rail section.
    3. Apply a commercially available weld-through primer to the immediate weld area on both mating surfaces.

3. Install and clamp the replacement inner frame rail in position. Verify correct dimensions. For additional information, refer to Body in this section.

4. Seam weld along the inside of the section joint using a MIG welder and ER70S-3 wire 0.9 mm (0.035 in) to 1.1 mm (0.043 in) diameter.

5. Use a dye penetrant to determine if any cracks or voids exist in the weld joint. If cracks or other defects exist, grind out the defect and repair until the weld is free of defects.

6. Measure mark and cut 30 mm (1.181 in) forward of the locator line on the replacement outer frame rail.

7. Prepare all the mating surfaces for MIG welding.
    1. Chamfer the mating surfaces of the outer frame rail on the vehicle and the replacement rail from the inside, to improve butt weld condition.
    2. Remove E-coat from the immediate weld area on the vehicle frame rail and the replacement rail section.
    3. Apply a commercially available weld-through primer to the immediate weld area on both mating surfaces.

8. If Squeeze-Type Resistance Spot Welding (STRW) is to be replaced with MIG plug welds, drill 8 mm (0.314 in) plug weld holes in the replacement outer frame rail mating flange. These must equal factory spot welds in both location and quantity.
    1. Remove E-coat from the immediate weld area of both inner and outer frame rail mating surfaces.
    2. Apply a commercially available weld-through primer to the immediate weld area only on the mating surfaces.
        - If resistance spot welds are to be used on the frame rail flange surfaces, E-coat

preparation is not necessary.

9. Position and clamp the replacement outer frame rail to the inner frame rail. All mating surfaces must make full contact.
    - Verify correct dimensions. For additional information, refer to Body in this section.

10. Seam weld the butt joint using a MIG welder and ER70S-3 wire 0.9 mm (0.035 in) to 1.1 mm (0.043 in) diameter.

11. Using a MIG welder or STRW welder, plug or spot weld the inner and outer frame rail flange mating surfaces.
    - Restore corrosion protection to the inner and outer surface of the repair area. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

12. Install new subframe bolt and position the subframe in place.
    - Install the subframe washer and nut. Tighten to 150 Nm (111 lb-ft).

13. Remove E-coat from the immediate weld area of the frame rail and bumper mounting bracket.
    - Apply a commercially available weld-through primer to the immediate weld area only on both mating surfaces.

14. Clamp the replacement bumper bracket to the vehicle, install the steel bumper and verify correct dimensions and alignment. Remove the bumper.

15. Seam weld the butt joint using a MIG welder and ER70S-3 wire 0.9 mm (0.035 in) to 1.1 mm (0.043 in) diameter.

16. Restore corrosion protection to the inner and outer surface of the repair area. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

17. Refinish the outer portion of the repair following Ford-approved paint recommendations.

18. ***NOTICE:*** **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or below 60°C (140°F) with a bake time o minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For additional information, refer to Section 414-03 .**

    Refinish the outer portion of the repair following Ford-approved paint recommendations.

Right hand side

19. Install the windshield washer reservoir. For additional information, refer to Section 501-16 .

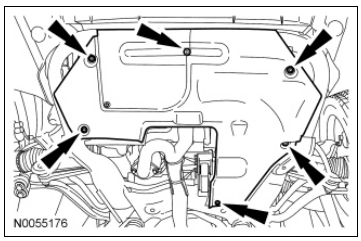
Left hand side

20. Install the ACL bracket, ACL and intake resonator. For additional information, refer to the appropriate 303-12 section.

All vehicles

21. Install the underbody shield and bolts, if equipped.

- To install, tighten to 7 Nm (62 lb-in).



22. Install the fender(s) on the affected side(s). For additional information, refer to Section 501-02 .

23. Install the bumper. For additional information, refer to Section 501-19 .
    - On hybrid vehicles, repower the HVTB . For additional information, refer to Section 414-03 .

24. On non-hybrid vehicles, install the battery. For additional information, refer to Section 414-01 .

Frame Members - Rear

Special Tool(s)

 ST3049-A	Rust Inhibitor Installation Kit 286-00002
 ST3048-A	Undercoating Spray Gun 286-00001

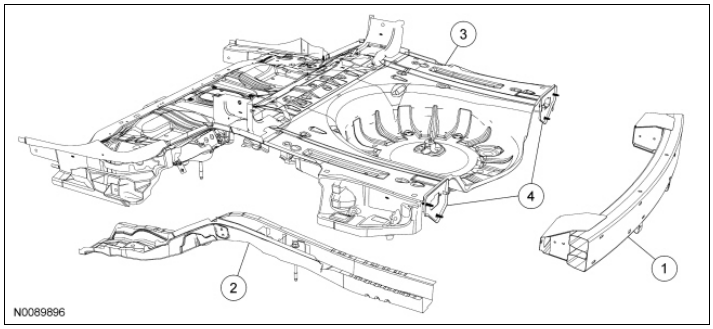
General Equipment

3 Phase Inverter Spot Welder 254-00002
Compuspot 700F Welder 190-50080
I4 Inverter Spot Welder 254-00014
Inverter Welder with MIG Welder 254-00015

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Premium Undercoating ValuGardTM VG101, VG101A (aerosol)	-
Rust Inhibitor ValuGardTM VG104, VG104A (aerosol)	-

Rear Frame Rail



Item	Part Number	Description

1	17906	Rear bumper - Ultra High Strength Steel (UHSS) martensitic steel
2	10457 LH/ 10456 RH	Frame member assembly - High-Strength Low Alloy (HSLA) 300 steel
3	-	Rear floor pan assembly - mild steel
4	17787	Rear bumper brackets - HSLA 300 steel

⚠ WARNING: Collision damage repair must conform to the instructions contained in this workshop manual. Replacement components must be new, genuine Ford Motor Company parts. Recycled, salvaged, aftermarket or reconditioned parts (including body parts, wheels or safety restraint components) are not authorized by Ford.

Departure from the instructions provided in this manual, including alternate repair methods or the use of substitute components, risks compromising crash safety. Failure to follow these instructions may adversely affect structural integrity and crash safety performance, which could result in serious personal injury to vehicle occupants in a crash.

⚠ WARNING: Invisible ultraviolet and infrared rays emitted in welding can injure unprotected eyes and skin. Always use protection such as a welder's helmet with dark-colored filter lenses of the correct density. Electric welding will produce intense radiation, therefore, filter plate lenses of the deepest shade providing adequate visibility are recommended. It is strongly recommended that persons working in the weld area wear flash safety goggles. Also wear protective clothing. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Frame rail crush zones absorb crash energy during a collision and must be replaced if damaged. Prior to replacement of frame rail crush zones, straighten damaged frame rails to correct frame dimensions. Failure to follow these instructions may adversely affect frame rail crush zone performance and may result in serious personal injury to vehicle occupants in a crash.

⚠ WARNING: Always wear protective equipment including eye protection with side shields, and a dust mask when sanding or grinding. Failure to follow these instructions may result in serious personal injury.

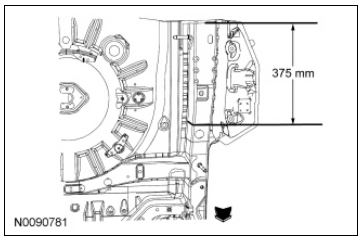
NOTE: Corrosion protection needs to be restored whenever it is necessary to sand or grind through painted surfaces or E-coat, or when bare metal repairs are made. For additional information, refer to Restoring Corrosion Protection Following Repair in this section.

NOTE: Observe prescribed welding procedures when carrying out repairs to the frame assembly. For additional information, refer to Welding Precautions - Steel in this section.

NOTE: The following repair procedure illustrates the sectioning of the rear frame rail assembly. Damage extending beyond this area requires the entire frame rail be replaced at the original factory seams.

1. Position the vehicle on a frame repair rack following the manufacturer's recommendations. Measure the vehicle to determine if the body requires straightening and alignment. For additional dimensional information, refer to Body in this section.
    - Remove the rear bumper. For additional information, refer to Section 501-19 .
2. Depower the High Voltage Traction Battery (HVTB) before carrying out any removal or installation procedures affecting the high-voltage battery system. Refer to Section 414-03 for the correct procedure to depower the HVTB system on hybrid-equipped vehicles.
3. Position aside the exhaust system (if required).
4. Drill out the spot welds and remove the bumper bracket.

5. Measure and mark 375 mm (14.763 in) forward of the bumper bracket attachment flange on the frame rail of the affected side.



6. ***NOTICE:*** **If equipped, the frame rail must not be cut or welded at the factory locator line.**

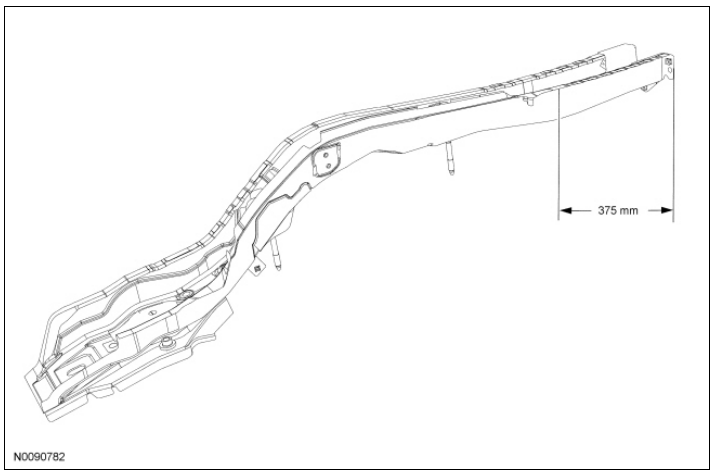
   Using a die-grinder, plasma cutter or reciprocating saw, carefully cut the rear frame rail at the mark.

7. ***NOTICE:*** **Do not drill pilot holes in an attempt to aid in spot weld removal.**

   Drill out the spot welds using a spot weld cutter or equivalent rearward of the rail mark and remove the rail section.

Installation

1. Measure and mark 375 mm (14.763 in) forward of the bumper bracket attachment flange on the replacement frame rail.



2. ***NOTICE:*** **Hybrid vehicles contain a High Voltage Traction Battery (HVTB). Before welding near the HVTB , the HVTB must be removed to avoid heat damage. For additional information, refer to Section 414-03 .**

   NOTE: Factory spot welds may be substituted with either resistance spot welds or Metal Inert Gas (MIG) plug welds. Spot/plug welds should equal factory welds in both location and quantity. Do not place a new spot weld directly over an original weld location. Plug weld hole should equal 8 mm (0.31 in) diameter.

   Prepare all mating surfaces for MIG welding.

   1. Grind smooth all spot weld nuggets on the vehicle floor pan.
   2. Drill or punch plug weld holes in the replacement frame rail.
   3. Chamfer the mating surfaces of the inner frame rail and the replacement rail section.
   4. Remove the E-coat from the immediate weld area on the vehicle frame rail and the replacement rail section. Clean the surfaces with metal surface prep or equivalent.

5. Apply a commercially available weld-through primer to the immediate weld area only, on all mating surfaces.

3. Install and clamp the replacement frame rail to the vehicle. Verify correct dimensions and alignment. For additional information, refer to Body in this section.

4. Seam weld the section joint using a MIG welder and ER70S-3 wire 0.9 mm (0.035 in) to 1.1 mm (0.043 in) diameter.

5. Plug weld the replacement rail to the floor pan using a MIG welder and ER70S-3 wire 0.9 mm (0.035 in) to 1.1 mm (0.043 in) diameter.

6. Use a dye penetrant to determine if any cracks or large voids exist in the weld joint. If cracks or other defects exist, grind out the defect and repair until the weld is defect free.

7. Position and install the bumper bracket.

8. ***NOTICE:*** **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must set at or below 60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth. For additional information, refer to Section 414-03 .**

   Apply rust inhibitor to the inner surface of the repair area. Refinish the exterior following Ford-approved paint procedures.

9. Apply undercoating to the exterior surface of the frame rail.

10. Reinstall the exhaust components as required.

11. Reinstall the bumper assembly. For additional information, refer to Section 501-19 .

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake caliper anchor plate bolts	26	19	-
Crossmember-to-front subframe nuts	65	48	-
Driveshaft bolts	83	61	-
Electronic Power Assist Steering (EPAS) ground wire bolt	10	-	89
Front bushing brace-to-body bolts	25	18	-
Front subframe nuts	150	111	-
Front subframe support bracket bolts	103	76	-
Lower control arm ball joint lower nuts	200	148	-
Lower control arm-to-strut through bolts	103	76	-
Motor Electronics Cooling System (MECS) bolt	10	-	89
Parking brake cable-to-trailing link bracket bolts	22	16	-
Power steering pressure line bracket bolt	9	-	80
Power steering return line bolts	9	-	80
Rear hub spindle-to-brake caliper bolts	59	44	-
Rear shock-to-trailing link lower bolts	115	85	-
Rear subframe front mounting nuts	115	85	-
Rear subframe rear mounting nuts	115	85	-
Roll restrictor bolt	90	66	-
Stabilizer bar link nuts	42	31	-
Steering column shaft bolt	20	15	-
Steering gear mounting bolts	107	79	-
a			
Tie-rod end nuts	48	35	-
Trailing arm-to-frame bolts	125	92	-
Trailing links-to-vehicle body	103	76	-
Underbody shield bolts	7	-	62
Upper arm bolts	110	81	-

[a] Refer to the procedure in this section.

Subframe and Mounting Systems

Front Subframe

The front subframe is bolted to the body and is used to:

- aid in structural support.
- provide mounting surfaces for the front suspension control arms.
- provide a mounting point for the engine isolators.
- provide the mounting surface for the steering gear.
- provide the mounting surface for the sway bar.

Rear Subframe

The rear subframe is bolted to the body and is used to:

- aid in structural support.
- provide the mounting surface for the rear suspension upper control arms, rear suspension lower control arms and (if equipped) a mounting location for the rear differential.

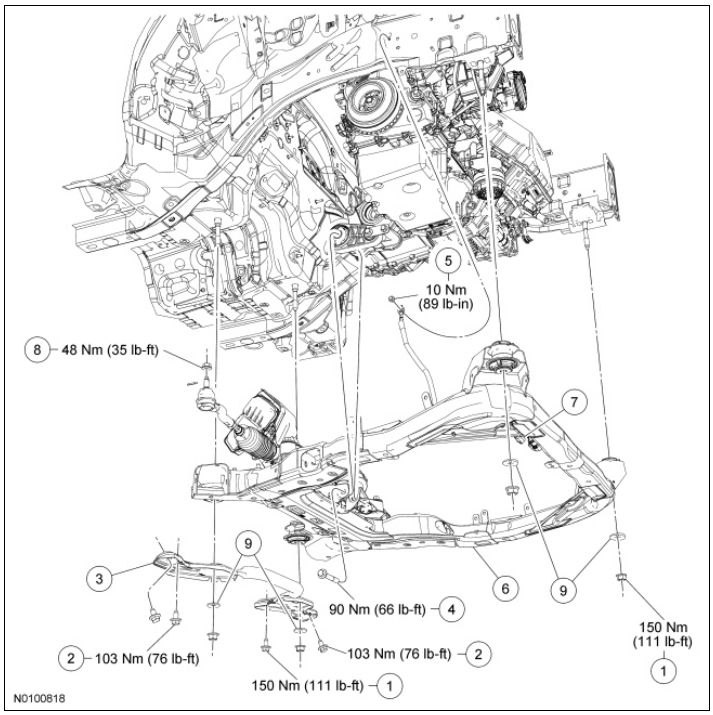
Underbody misalignment can affect front and rear wheel alignment, the operation of the suspension parts and drivetrain operation. Door and window opening concerns and air or water leaks at the doors are often caused by incorrectly tightened bolts and body misalignment. For information on underbody dimensions, refer to Section 501-35 .

Subframe - Front

Special Tool(s)

 ST2330-A	Remover, Front Hub 205-D070 (D93P-1175-B) or equivalent
 ST2138-A	Installer, Halfshaft 204-161 (T97P-1175-A)
 ST2945-A	Ball Joint Separator 204-592
 ST1682-A	Powertrain Lift 300-OTC1585AE or equivalent

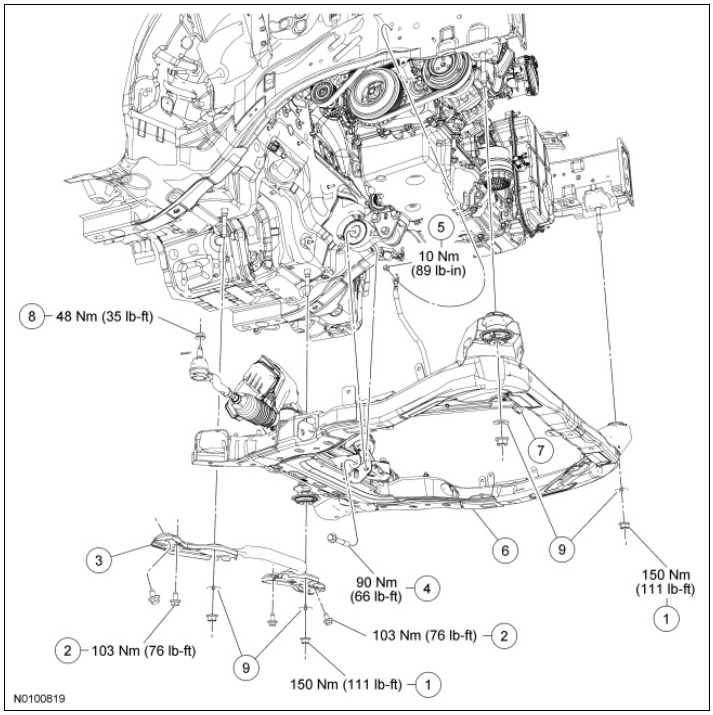
2.5L Hybrid



Item	Part Number	Description
1	W520416	Front subframe nuts (4 required)
2	3C496	Front subframe support bracket bolts (4 required)
3	5884	Subframe support bracket

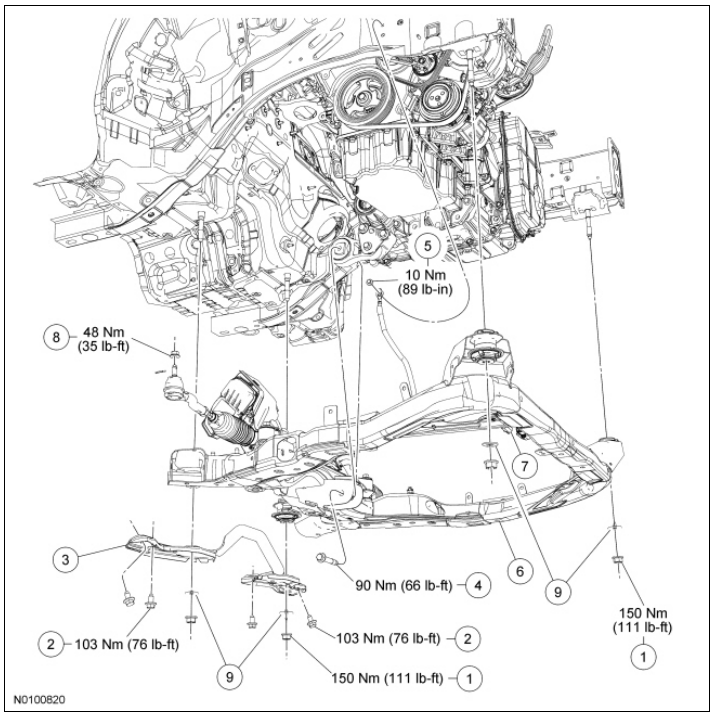
4	W500545	Roll restrictor bolt
5	W506410	Electronic Power Assist Steering (EPAS) ground wire bolt
6	5C145	Front subframe
7	-	EPAS jumper harness connector (part of 3F720)
8	6E5C	Tie-rod end nut (2 required)
9	5A552	Front subframe washers

2.5L



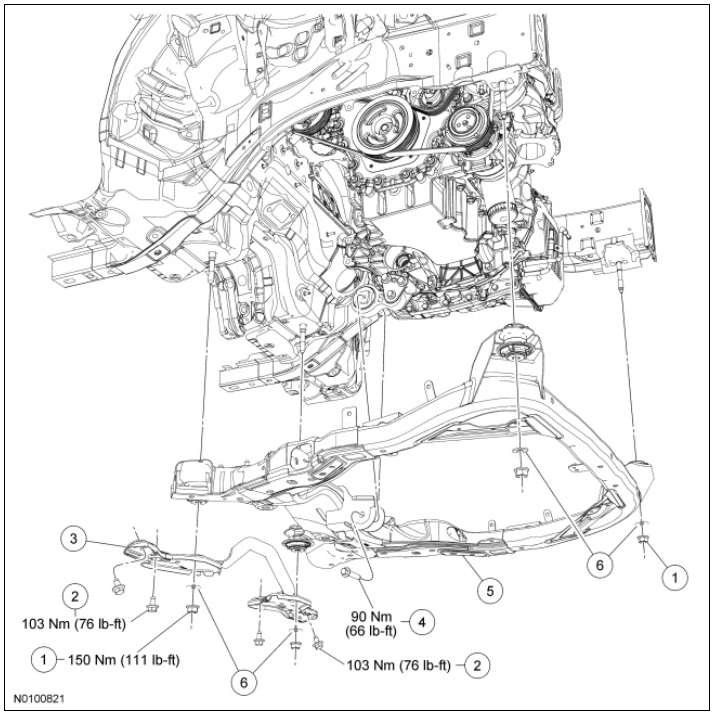
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7	-	EPAS jumper harness connector (part of 3F720)
8	6E5C	Tie-rod end nut (2 required)
9	5A552	Front subframe washers

3.0L



Item	Part Number	Description
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2	3C496	Front subframe support bracket bolts (4 required)
3	5884	Subframe support bracket
4	W500545	Roll restrictor bolt
5	W506410	Electronic Power Assist Steering (EPAS) ground wire bolt
6	5C145	Front subframe
7	-	EPAS jumper harness connector (part of 3F720)
8	6E5C	Tie-rod end nut (2 required)
9	5A552	Front subframe washers

3.5L



Item	Part Number	Description
1	W520416	Front subframe nuts (4 required)
2	3C496	Front subframe support bracket bolts (4 required)
3	5884	Subframe support bracket
4	W500545	Roll restrictor bolt
5	5C145	Front subframe
6	5A552	Front subframe washers

Removal

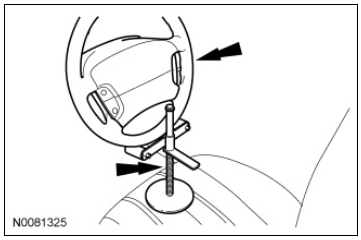
All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

Vehicles equipped with Electronic Power Assist Steering (EPAS)

2. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.



3. Remove the 2 lower steering column shaft joint cover nuts and the cover.

4. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected from the steering gear or damage to the clockspring may occur. If there is**

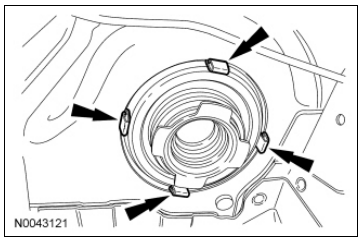
evidence that the steering column has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .

Remove the bolt and disconnect the steering column shaft from the steering gear.

- Discard the bolt.

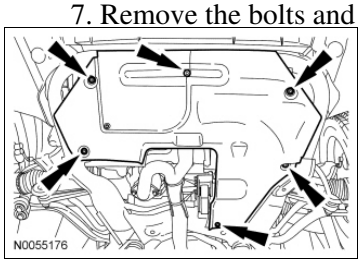
5. *NOTICE:* **Remove the steering gear/dash seal or damage to the seal may occur.**

   Remove the steering gear/dash seal.



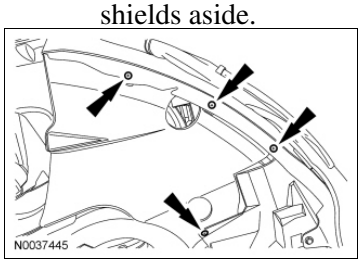
All vehicles

6. Remove the wheels and tires. For additional information, refer to Section 204-04 .
7. Remove the bolts and the underbody shield, if equipped.

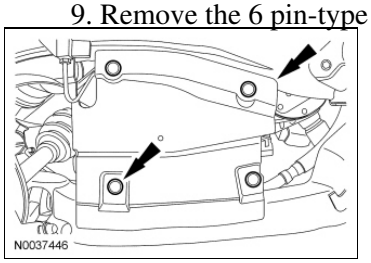


8. **NOTE:** RH side shown, LH side similar.

   Remove the 4 screws from each side and position the RH and LH fender splash shields aside.

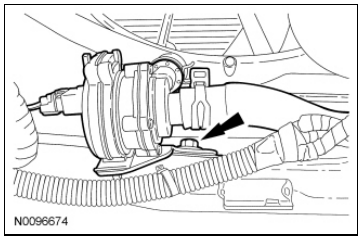


9. Remove the 6 pin-type retainers (4 shown) from the LH and RH splash shields.



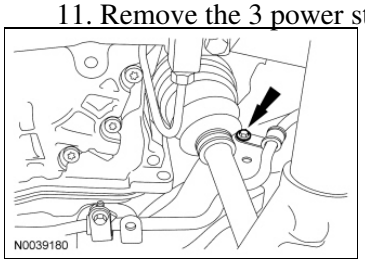
2.5L Hybrid

10. Remove the Motor Electronics Cooling System (MECS) bolt and position the MECS aside.

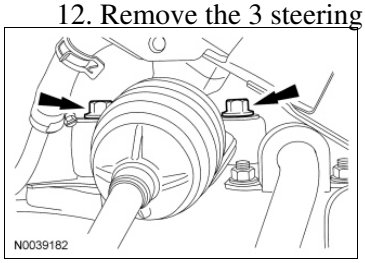


Vehicles equipped with Hydraulic Power Assist Steering (HPAS)

11. Remove the 3 power steering return line bolts.



12. Remove the 3 steering gear mounting bolts.

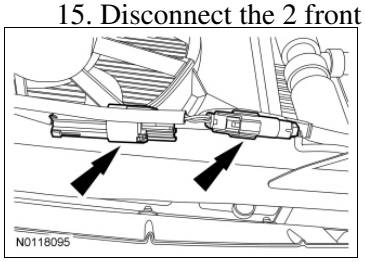


13. **NOTE:** The steering gear is not removed with the front subframe and must be positioned aside.

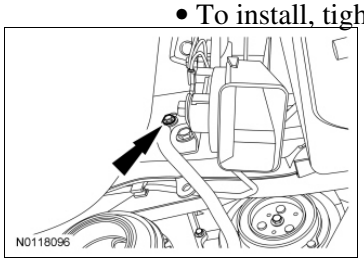
    Position the steering gear aside using mechanic's wire.

Vehicles equipped with EPAS

14. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .
15. Disconnect the 2 front EPAS in-line electrical connectors and the 4 wiring retainers.

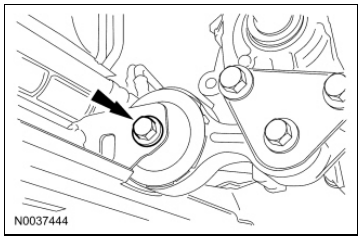


16. Remove the EPAS ground wire bolt.
    - To install, tighten to 10 Nm (89 lb-in).

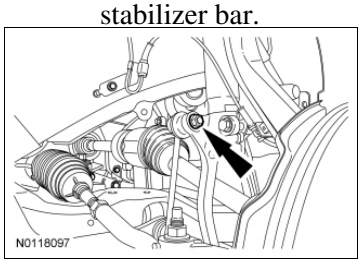


All vehicles

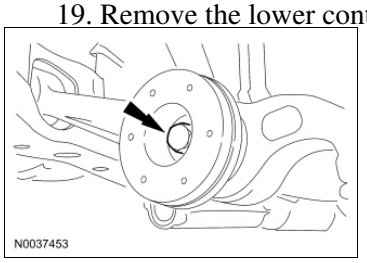
17. Remove the bolt from the roll restrictor.



18. Remove the 2 upper stabilizer bar link nuts (one each side) and separate from the stabilizer bar.

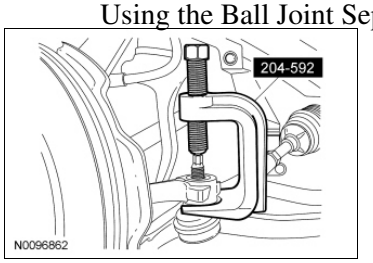


19. Remove the lower control arm-to-strut through bolts and flagnuts.



20. Remove the 2 outer tie-rod end cotter pins and nuts.
    - Discard the cotter pins.
21. ***NOTICE:*** **Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.**

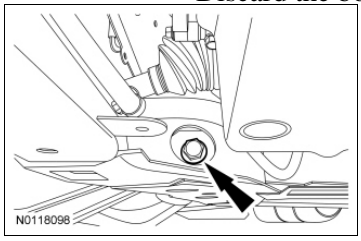
    Using the Ball Joint Separator, separate the outer tie-rod ends from the knuckle.



22. **NOTE:** Left side shown.

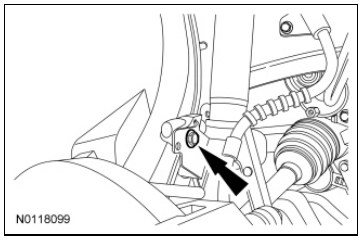
    Remove the front lower arm-to-subframe bolts.

    - Discard the bolts.



23. **NOTE:** Left side shown.

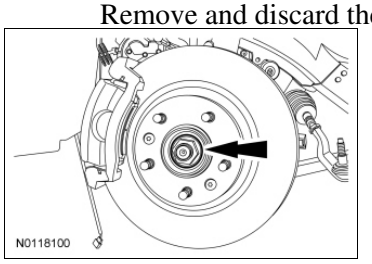
    Remove the brake flexible hose bracket-to wheel knuckle bolts and position the hose and brackets aside.



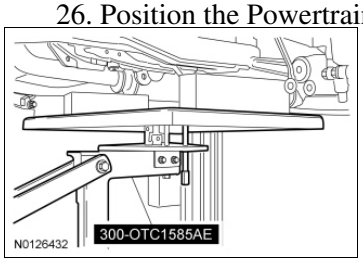
24. **NOTE:** Left side shown.

    NOTE: Apply the brake to keep the halfshaft from rotating.

    Remove and discard the wheel hub nuts.



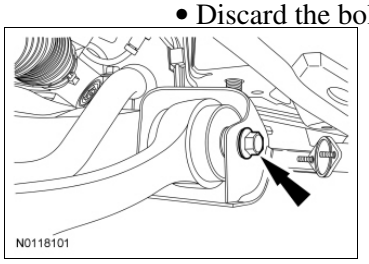
25. Using a wax pencil (or equivalent) apply witness marks to the vehicle and subframe to aid in installation.
26. Position the Powertrain Lift under the subframe.



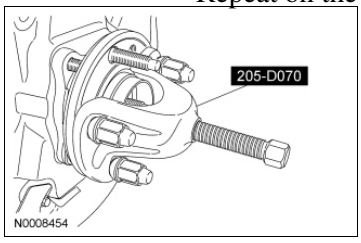
27. Remove the 4 front subframe support bracket bolts.
28. Remove and discard the 4 front subframe nuts.
29. Partially lower the subframe.
30. **NOTE:** Left side shown.

    Remove the rear lower arm-to subframe bolts.

    - Discard the bolt and washer.



31. Using the Front Hub Remover, separate the halfshaft from the wheel hub.
    - Using mechanics wire or equivalent, support the halfshaft.
    - Repeat on the opposite side.

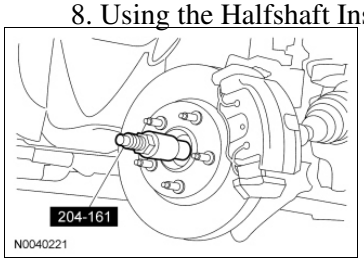


32. Position aside the lower control arms.
33. Lower the subframe from the vehicle.

Installation

All vehicles

1. Partially raise the subframe.
2. Position the halfshafts to the wheel hubs.
3. Position the lower control arms to the subframe.
    - Loosely install new rear lower arm-to-subframe bolts.
4. Raise the subframe and align to the witness marks made during removal.
5. Install the 4 new front subframe nuts.
    - Tighten to 150 Nm (111 lb-ft).
6. Install the 4 front subframe bracket bolts.
    - Tighten to 103 Nm 76 lb-ft).
7. Remove the Powertrain Lift.
8. Using the Halfshaft Installer, in the halfshafts Into the wheel hubs.

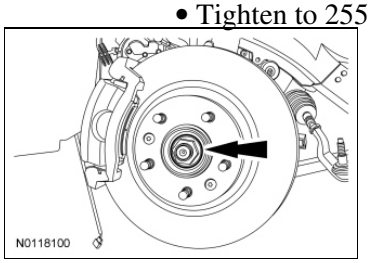


9. ***NOTICE:*** **Do not tighten the halfshaft nuts with the vehicle on the ground. The nuts must be tightened to specification before the vehicle Is lowered onto the wheels. Wheel bearing damage will occur If the wheel bearing Is loaded with the weight of the vehicle applied.**

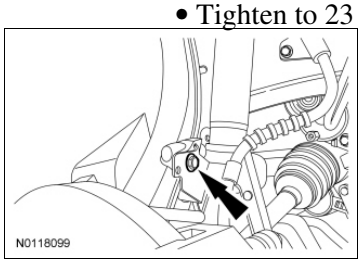
    NOTE: Apply the brake to keep the halfshaft from rotating.

    Install the wheel hub nuts.

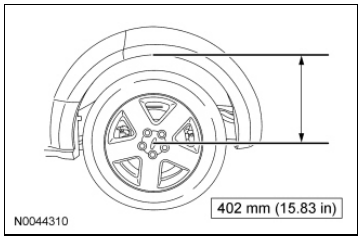
    - Tighten to 255 Nm (189 lb-ft).



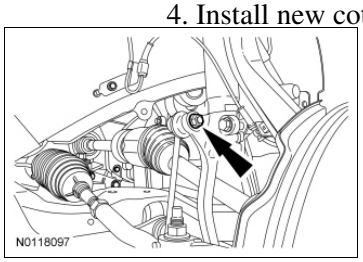
10. Position the brake flexible hose and brackets and install the bolts.
    - Tighten to 23 Nm (17 lb-ft).



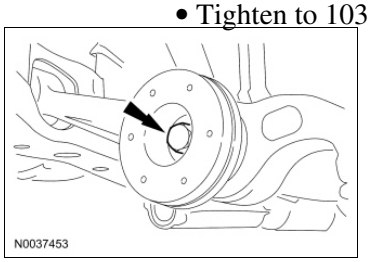
11. Before tightening any suspension busing fasteners, the suspension must be at 402 mm (15.826 in) between the center of the hub and the lip of the fender. This will prevent incorrect clamp load and bushing damage.
    - Use a suitable jack to raise the suspension to specification.



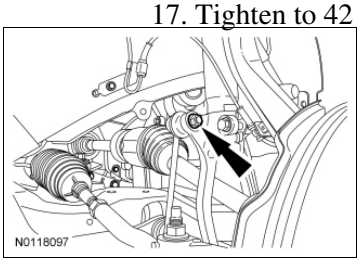
12. Tighten the front lower arm-to-subframe bolts.
    1. Tighten to 110 Nm (81 lb-ft).
    2. Tighten an additional 90° with the suspension at the bushing fastener tightening position.
13. Tighten the rear lower arm-to-subframe bolts to 110 Nm (81 lb-ft).
14. Install the outer tie-rod ends to the control arms.
    1. Position to the wheel hubs.
    2. Install the nuts.
    3. Tighten to 48 Nm (35 lb-ft).
    4. Install new cotter pins.



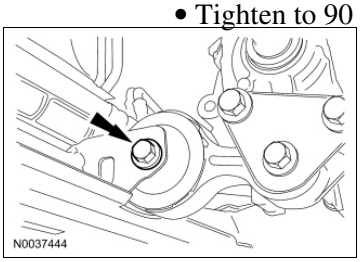
15. Install the lower control arm-to-strut through bolts and flagnuts.
    - Tighten to 103 Nm (76 lb-ft).



16. Position the stabilizer bar links and install the nuts.
17. Tighten to 42 Nm (31 lb-ft).

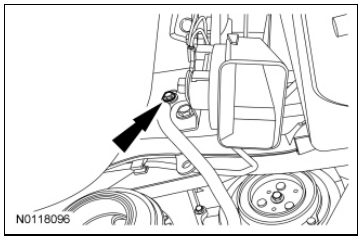


17. Install the roll restrictor bolt.
    - Tighten to 90 Nm (66 lb-ft).

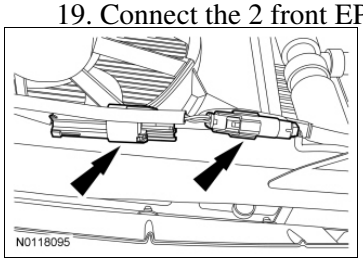


Vehicles equipped with EPAS

18. Install the EPAS ground wire and bolt.
    - Tighten to 10 Nm (89 lb-in).



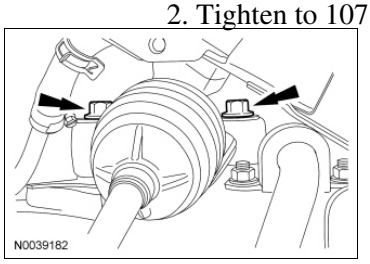
19. Connect the 2 front EPAS in-line electrical connectors and the 4 wiring retainers.



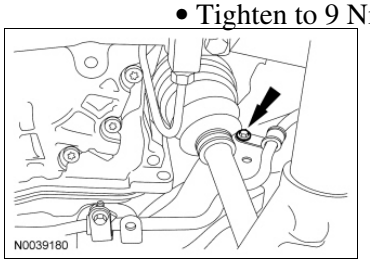
20. Install the exhaust flexible pipe. For additional Information, refer to Section 309-00 .

Vehicles equipped with HPAS

21. Position the steering gear.
    1. Install the 3 steering gear mounting bolts.
    2. Tighten to 107 Nm (79 lb-ft).

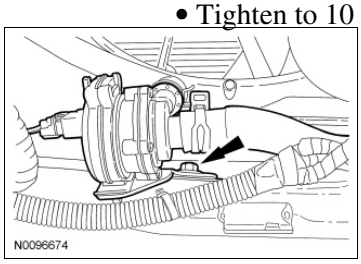


22. Install the 3 power steering return line bolts.
    - Tighten to 9 Nm (80 lb-in).



2.5L Hybrid

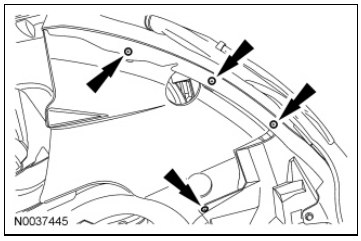
23. Install the MECS and bolt.
    - Tighten to 10 Nm (89 lb-in).



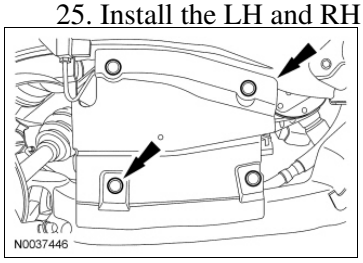
All vehicles

24. **NOTE:** RH side shown, LH side similar.

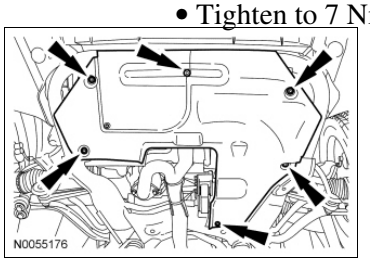
    Position the LH and RH fender splash shields and Install the screws.



25. Install the LH and RH splash shields and pin-type retainers 6 each side, 4 shown).



26. Install the underbody shield and bolts (if equipped).
    - Tighten to 7 Nm (62 lb-in).



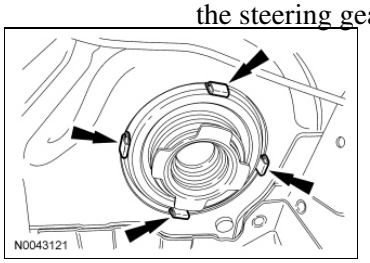
27. Install the wheels and tires. For additional information, refer to Section 204-04 .

Vehicles equipped with EPAS

28. ***NOTICE:*** **The steering gear/dash seal must be fully seated In the steering valve tower groove before the retaining clips are fully engaged Into the body. If the steering gear/dash seal Is not seated to the steering gear valve tower groove and the clips are not fully engaged to the body, water and foreign material may enter the passenger compartment and damage the vehicle Interior.**

    Install the steering gear/dash seal.

    - To install, apply hand force to the center of the seal, install the steering gear/dash seal onto the steering gear valve tower until fully seated In the valve tower groove. Install the steering gear/dash seal until the clips are fully engaged Into the body.

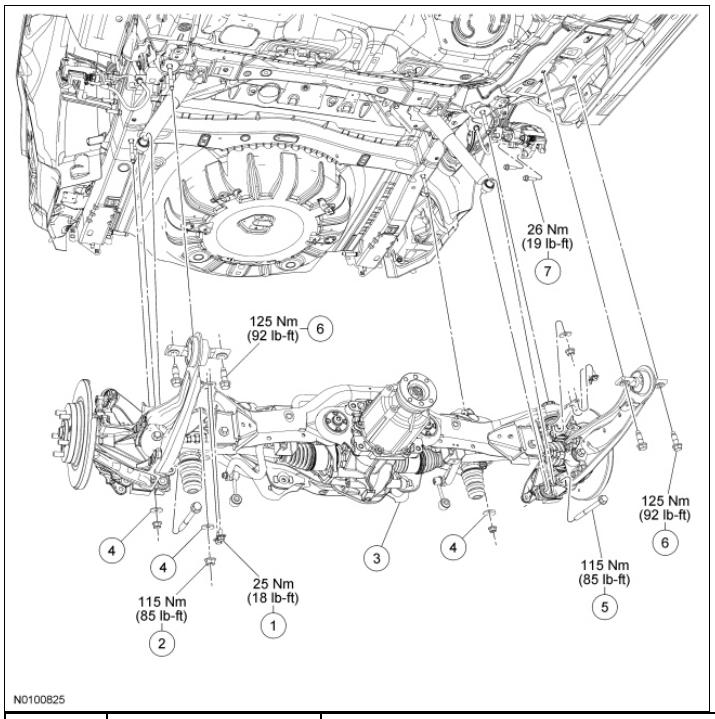


29. Position the steering column shaft to the steering gear.
    - Install a new steering column shaft bolt.
    - Tighten to 20 Nm (15 lb-ft).
30. Install the steering column shaft joint cover and nuts.
31. Remove the steering wheel holding device.

Subframe - Rear

Special Tool(s)

 ST1682-A	Powertrain Lift 300-OTC1585AE or equivalent



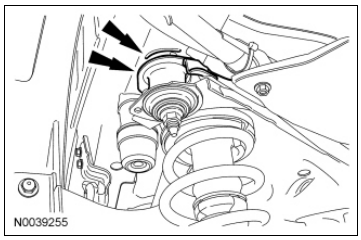
Item	Part Number	Description
1	W712755	Front bushing brace-to-body bolt (4 required)
2	W520515	Rear subframe nut (4 required)
3	5K067	Rear subframe
4	5E028	Rear subframe washers
5	W704586	Shock absorber lower bolt
6	W711493	Trailer arm-to-frame bolts (4 required)
7	-	Brake caliper anchor plate bolts (4 required)

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

All vehicles

1. Remove the rear wheels. For additional information, refer to Section 204-04 .

2. With a wax pencil, mark the relationship alignment of the rear subframe to the underbody at the mounting locations.



3. Remove the LH and RH rear lower arms. For additional information, refer to Section 204-02 .

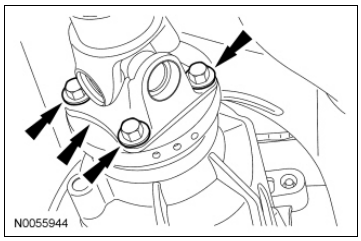
4. Remove the catalytic converter, muffler and tailpipe as an assembly.

All-Wheel Drive (AWD) only

5. **NOTE:** Index-mark the rear axle pinion flange and the driveshaft yoke.

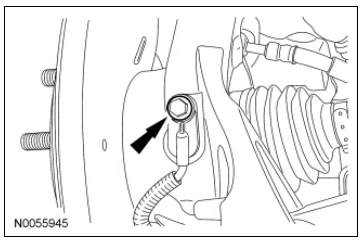
   Remove the 4 driveshaft bolts.

   - To install, tighten to 83 Nm (61 lb-ft).

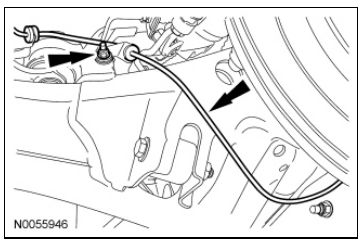


All vehicles

6. Remove the bolt from the LH and RH wheel speed sensors.

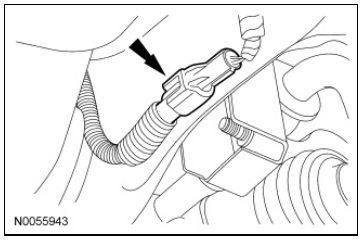


7. Remove the RH and LH wheel speed sensor nuts from the stud and position aside.



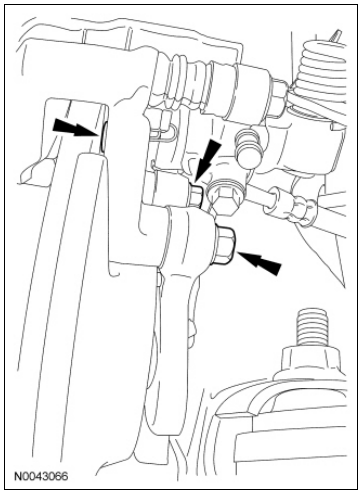
AWD only

8. Disconnect the differential electrical connector on the LH side of the subframe.

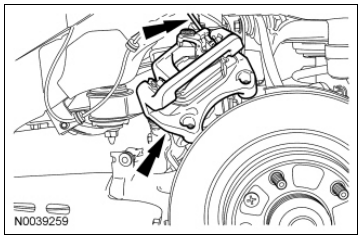


All vehicles

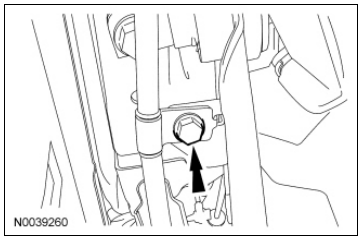
9. Remove the 4 bolts (2 each side) from the rear hub spindle-to-brake caliper.
    - To install, tighten to 59 Nm (44 lb-ft).



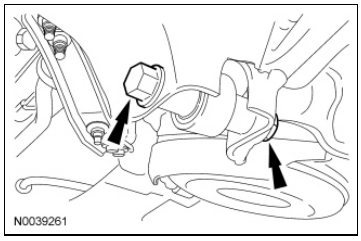
10. Position the brake calipers aside using mechanic's wire. It is not necessary to disconnect the hydraulic brake lines.



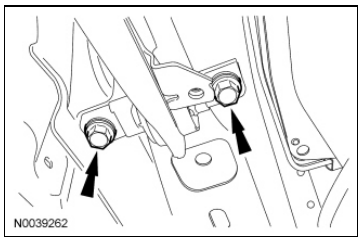
11. Remove the bolts from the parking brake cable-to-trailing link bracket.
    - To install, tighten to 22 Nm (16 lb-ft).



12. Remove and discard the rear shock-to-trailing link lower bolts and flagnuts.
    - To install, tighten to 115 Nm (85 lb-ft) with the suspension at the bushing fastener tightening position.



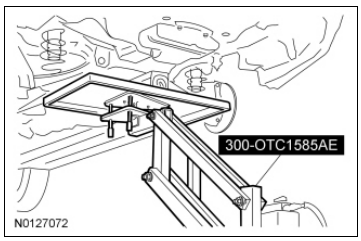
13. Remove the 4 bolts and cone washers (2 each side) from the trailing links-to-vehicle body.
    - To install, tighten to 103 Nm (76 lb-ft).



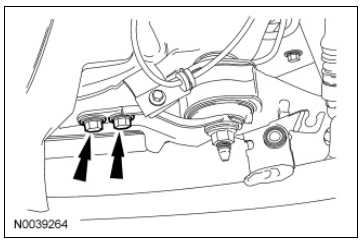
NOTICE: **The rear subframe must be secured to the lifting table. The rear subframe can become unstable and fall from the lifting table.**

NOTE: For All-Wheel Drive (AWD) vehicles, the rear differential is removed with the rear subframe.

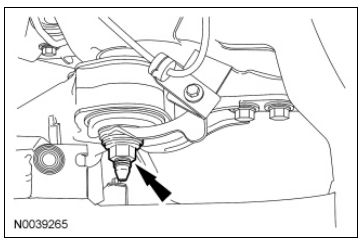
14. Position the Powertrain Lift under the rear subframe.



15. Remove the 4 front (2 each side) bushing brace-to-body bolts.
    - To install, tighten to 25 Nm (18 lb-ft).

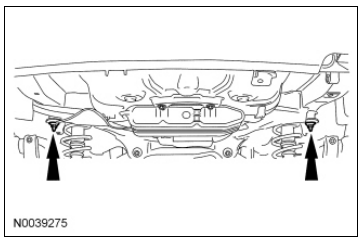


16. Remove the 2 front (1 each side) mounting nuts and washers.
    - To install, tighten to 115 Nm (85 lb-ft).



17. Remove the 2 rear mounting nuts.

- To install, tighten to 115 Nm (85 lb-ft).

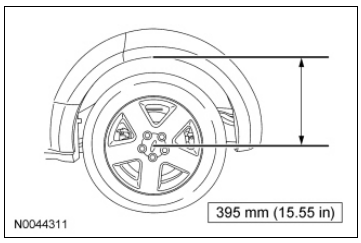


18. Remove the rear subframe.

19. Transfer the components as necessary.

20. **NOTE:** Make sure the vehicle is at the correct vehicle ride height. For additional information, refer to Section 204-00 .

    To install, reverse the removal procedure.



Material

Item	Specification	Fill Capacity
Dye-Lite® Gasoline Engine Oil Leak Detection Dye 164-R3700 (Rotunda)	-	29.6 ml (1 oz)
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	-
Threadlock 262 TA-26	WSK-M2G351-A6	-

Engine

NOTICE: **When repairing engines, all parts must be contamination free. If contamination/foreign material is present when repairing an engine, premature engine failure may occur.**

NOTE: Specifications show the expected minimum or maximum condition. Refer to the appropriate section in Group 303 for the procedure.

NOTE: If a component fails to meet the specifications, it is necessary to refinish it or install a new component. Wear limits are provided as an aid to determine if the component can be refinished. A new component must be installed when any component fails to meet specifications and cannot be refinied.

NOTE: This section contains information, steps and procedures that may not be specific to this engine.

This section covers general procedures and diagnosis and testing of the engine system, except for exhaust emission control devices, which are covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

The engine incorporates the following features: Refer to the appropriate section in Group 303 for the procedure.

- Crankcase ventilation or breather system
- Exhaust emission control system
- Evaporative Emission (EVAP) control system

Some engines incorporate a fail-safe cooling system. Refer to the appropriate section in Group 303 for the procedure.

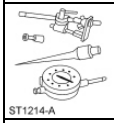
The engine, fuel system, ignition system, emissions system and exhaust system all affect exhaust emission levels and must be maintained according to the maintenance schedule. Refer to the scheduled Maintenance Guide.

Correct engine identification is required to order parts. Refer to the appropriate section in Group 303 for the procedure.

For complete vehicle and engine identification codes, refer to Section 100-01 .

Engine

Special Tool(s)

 ST1300-A	12 Volt Master UV Diagnostic Inspection Kit 164-R0756 or equivalent (Leak Detector)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1298-A	Engine Cylinder Leak Detection/Air Pressurization Kit 014-00708 or equivalent
 ST2312-A	EngineEAR 107-R2100 or equivalent
 ST2048-A	EngineEAR/ChassisEAR 107-R2102 or equivalent
 ST1296-A	Oil Pressure Gauge 303-088 (T73L-6600-A)
 ST1299-A	Quick Disconnect Compression Tester 134-R0212 or equivalent
 ST1297-A	Vacuum/Pressure Tester 164-R0253 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Dye-Lite® Gasoline Engine Oil Leak Detection Dye 164-R3700 (Rotunda)	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

There are 2 diagnostic paths that can be followed depending on the type of engine concern. Carry out Inspection and Verification - Engine Performance or Inspection and Verification - NVH.

Inspection and Verification - Engine Performance

1. Verify the customer concern by operating the engine to duplicate the condition.

2. Visually inspect for obvious signs of mechanical damage. Refer to the following chart.

Visual Insrt

Mechanical
• Engine coolant leaks • Engine oil leaks • Fuel leaks • Damaged or severely worn parts • Loose mounting bolts, studs and nuts

3. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

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

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the Battery Control Module - High Voltage Traction Battery (BCM-HVTB) and PCM.

9. If the DTCs retrieved are related to the concern, go to the Battery Control Module - High Voltage Traction Battery (BCM-HVTB) DTC Chart, refer to Section 414-03 . For all other DTCs, refer to Section 419-10 .

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

Inspection and Verification - NVH

1. NVH symptoms should be identified using the diagnostic tools and techniques that are available. For a list of these techniques, tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 .

2. Verify the customer concern by operating the engine to duplicate the condition.

3. Check the engine oil level and check the oil for contamination. Low engine oil level or contaminated oil are a common cause of engine noise. If the oil is contaminated, the source of the contamination must be identified and repaired as necessary.

4. Visually inspect for obvious signs of mechanical damage. Refer to the following chart.

Visual Inspection Chart

Mechanical
• Loose mounting bolts, studs and nuts • Damaged or leaking powertrain mounts • Damaged or disconnected vacuum hoses • Obstruction of cooling fan • Obstruction of Front End Accessory Drive (FEAD) • Obstruction of Rear End Accessory Drive (READ), if equipped • Damaged or disconnected air intake components

5. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.

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

   If the cause is not visually evident, connect the scan tool to the DLC .

7. **NOTE:** The VCM LED prove out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

8. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

9. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .

- If the network test passes, retrieve and record continuous memory DTCs.

10. Clear the continuous DTCs and carry out the self-test diagnostics for the BCM-HVTB and PCM.

11. If the DTCs retrieved are related to the concern, go to the Battery Control Module - High Voltage Traction Battery (BCM-HVTB) DTC Chart, refer to Section 414-03 . For all other DTCs, refer to Section 419-10 .

12. If no DTCs related to the concern are retrieved, continue the inspection and verification if a noise concern is related to the engine. For vibration concerns and noise concerns, such as powertrain mounts, air intake system and starter, GO to Symptom Chart - NVH .

In some cases, a noise may be a normal characteristic of that engine type. In other cases the noise may require further investigation. Comparing the noise to a similar year/model vehicle equipped with the same engine will aid in determining if the noise is normal or abnormal.

Once a customer concern has been identified as an abnormal engine noise, it is critical to determine the location of the specific noise. Use the EngineEAR/ChassisEAR or stethoscope to isolate the location of the noise to one of the following areas.

- Fuel injector(s)
- Upper end of engine
- Lower end of engine
- Front of engine
- Rear of engine

Fuel injector noise

A common source of an engine ticking noise can be related to the fuel injector(s). This is normal engine noise that can be verified by listening to another vehicle. If the injector noise is excessive or irregular, use the EngineEAR/ChassisEAR or stethoscope to isolate the noise to a specific fuel injector.

Upper end engine noise

A common source of upper end engine noise (ticking, knocking or rattle) includes the camshaft(s) and valve train. Upper end engine noise can be determined using the EngineEAR/ChassisEAR or stethoscope on the valve cover bolts. If the noise is loudest from the valve cover bolts, then the noise is upper end. The EngineEAR/ChassisEAR or stethoscope can be used to further isolate the noise to the specific cylinder bank and cylinder. Removal of the valve covers will be required to pinpoint the source of the noise.

Lower end engine noise

A common source of lower end engine noise (ticking or knocking) includes the crankshaft, connecting rod(s) and bearings. Lower end noises can be determined by using the oil pan or lower cylinder block. If the noise is loudest from these areas, then the noise is lower end. If an engine noise is isolated to the lower end, some disassembly of the engine may be required to inspect for damage or wear.

Front of engine noise

A common source of noise from the front of the engine (squeal, chirp, whine or hoot) is the Front End Accessory Drive (FEAD) components. To isolate FEAD noise, carry out the Engine Accessory Test, refer to Section 100-04 .

Some other noises from the front of the engine (ticking, tapping or rattle) may be internal to the engine. Use the EngineEAR/ChassisEAR or stethoscope on the engine front cover to determine if the noise is internal to

the engine. Removal of the engine front cover may be necessary to inspect internal engine components.

Rear of engine noise

A common source of noise from the rear of the engine (knocking) is the flywheel/flexplate. Inspection of the flywheel/flexplate will be necessary.

Some engines have timing drive components at the rear of the engine and may be the source of noise (ticking, knocking or rattle). Use the EngineEAR/ChassisEAR or stethoscope on the rear of the engine if it is suspected that the noise is internal to the engine. Some disassembly of the engine may be required to inspect for damage or wear.

If equipped, the Rear End Accessory Drive (READ) can also be a source of noise from the rear of the engine (squeal or chirp). The READ consists of the coolant pump and belt.

13. After localizing the noise, note the characteristics of the noise, including type of noise, frequency and conditions when the noise occurs and GO to Symptom Chart - NVH .

Symptom Chart - Engine Performance

Symptom Chart - Engine Performance

Symptom Chart - NVH

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

ConditionPossible SourcesAction

- Drone type noise
- Powertrain mount(s)
- CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure in this section. TEST the system for normal operation after the repair.
- Drumming noise - occurs inside the vehicle during idle or high idle, hot or cold. Very low-frequency drumming is very rpm dependent
- Engine vibration excites the body resonances inducing interior noise
- CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure in this section. TEST the system for normal operation after the repair.
- Engine drumming noise - accompanied by vibration

- Powertrain mount(s)

- CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure in this section. TEST the system for normal operation after the repair.

- Rattle - occurs at idle or at light acceleration from a stop

- Powertrain mount(s)

- CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate section in Group 303 for the procedure. For automatic transmission, Refer to the appropriate section in Group 307 for the procedure. For manual transmission, REFER to Section 308-03 . TEST the system for normal operation after the repair.

- Whine/moan type noise - pitch increases or changes with vehicle speed

- Powertrain mount(s)

- CHECK the porain mounts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate section in Group 303 for the procedure. For automatic transmission, Refer to the appropriate section in Group 307 for the procedure. For manual transmission, REFER to Section 308-03 . TEST the system for normal operation after the repair.

- Clunk - occurs when shifting from PARK or between REVERSE and DRIVE

- Powertrain mounts

- CHECK the powertrain/drivetrain mounts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate section in Group 303 fothe procedure. For automatic transmission, Refer to the appropriate section in Group 307 for the procedure. For manual transmission, REFER to Section 308-03 . TEST the system for normal operation after the repair.

- Idle speed is too high

- CHECK for the correct idle speed. TEST the system for normal operation after the repair.

- Accessory drive bearing hoot - occurs at idle or high idle in cold temperatures of approximately 4°C (40°F) or colder at the first start of the day

- Accessory drive idler or tensioner pulley bearing is experiencing stick/slip between ball bearings and the bearing race

- CARRY OUT the engine cold soak procedure. REFER to Section 100-04 .
- PLACE the EngineEAR probe directly on the idler/tensioner center post or bolt to verify h bearing is making the noise. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.

- Accessory drive belt noise, squeal or chirping

- Defective/worn or incorrect accessory drive belt
- Misaligned pulley(s)
- Pulley runout
- Damaged or worn accessory drive component or idler
- Fluid contamination of the accessory drive belt or pulleys

- Damaged or worn accessory drive belt tensioner
- Damaged pulley grooves

- CARRY OUT the Engine Accessory Test. REFER to Section 100-04 . INSPECT components and INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.

- Clunking noise

- Coolant pump has excessive end play or imbalance

- CHECK the coolant pump for excessive end play. INSPECT the coolant pump for imbalance with the drive belt off. INSTALL a new coolant pump as necessary. REFER to Section 303-03A or Section 303-03B for Hybrid. TEST the system for normal operation after the repair.

- Whine or moaning noise

- Air intake system

- CHECK the air cleaner and ducts for correct fit. INSPECT the air intake system for leaks or damage. REPAIR as necessary. TEST the system for normal operation after the repair.

- Whistling noise - normally accompanied with poor idle condition

- Air intake system

- CHECK the air intake ducts, air cleaner, Throttle Body (TB) and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. TEST the system for normal operation after the repair.

- Hissing noise - occurs during idle or high idle that is apparent with the hood open

type="disc">
- Vacuum leak

- USE the EngineEAR/ChassisEAR to locate the source. SCAN the air intake system from the inlet to each cylinder intake port. DISCARD the leaking parts, and INSTALL a new component. TEST the system for normal operation after the repair.

- Vehicles with a plastic intake manifold

- Acceptable condition. Some plastic intake manifolds exhibit this noise, which is the effect of the plastic manifold.

- Grinding noise - occurs during engine cranking

- Incorrect starter motor mounting

- INSPECT the starter motor for correct mounting. REPAIR as necessary. REFER to Section 303-06 . TEST the system for normal operation after the repair.

- Starter motor

- CHECK the starter motor. INSTALL a new starter motor as necessary. REFER to Section 303-06 . TEST the system for normal operation after the repair.

- Incorrect starter mor drive engagement

- INSPECT the starter motor drive for wear or damage. INSTALL a new starter motor as necessary. REFER to Section 303-06 . TEST the system for normal operation after the repair.
- INSPECT the flywheel/flexplate for wear or damage. INSTALL a new flywheel/flexplate as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.

- Engine noise, front of engine - knocking noise from lower front of engine

- Damaged or separated crankshaft pulley/damper

- CHECK for obvious signs of damage or wobble during operation. INSTALL new as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.

- Engine noise, front ofngine - ticking, tapping or rattling noise from the front of the engine

- Timing drive components

- REMOVE the accessory drive belt. Refer to the appropriate section in Group 303 for the procedure.
- USE the EngineEAR to isolate the noise to the engine front cover.
- REMOVE the engine front cover and INSPECT the timing drive components. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.

- Engine noise, upper end - ticking noise near the fuel rail and intake manifold

- Fuel rail clip

- CHECK for loose or damaged fuel rail clip(s). REPAIR as necessary.

- Fuel injector

- USE the EngineEAR to isolate the noisy injector(s). INSTALL a new injector(s) as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.

- Engine noise, upper end - ticking, knocking or rattle noise that occurs during idle or high idle during the first cold start of the day and may disappear as the engine warms

- Valve train noise (bled down lash adjuster)

- CARRY OUT the Valve Train Analysis Component Test in this section. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.

- Engine noise, upper end - occurs mostly with a warm engine at light/medium acceleration

- Worn or damaged spark plugs

- REMOVE the spark plugs. INSPECT and INSTALL new as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.

- Carbon accumulation in combon chamber
- Bore scope the cylinder. ELIMINATE carbon buildup. TEST the system for normal operation after the repair.
- Engine noise, upper end - rattling noise from the valve train. Worse when the engine is cold
- Low oil level
- CHECK the oil level. FILL as necessary.
- Thin or diluted oil
- INSPECT the oil for contamination. If the oil is contaminated, CHECK for the source. REPAIR as necessary. CHANGE the oil and filter.
- Low oil pressure
- CARRY OUT an oil pressure test. If not within specifications, REMOVE the engine oil pan. Refer to the appropriate section in Group 303 for the procedure. INSPECT for a blocked oil pick up tube.
- Worn valve train components
- CARRY OUT the Valve Train Analysis Component Test in this section. INSTALL new parts as necessary. TEST the system for normal operation after the repair.
- Worn valve guides
- CARRY OUT the Valve Guide Inner Diameter procedure in this section.
- Excessive runout of the valve seats on the valve face
- CARRY OUT the Valve Seat Inspection procedure in this section.
- Engine noise, upper end - pinging noise
- Gasoline octane too low
- VERIFY with customer the type of gasoline used. CORRECT as necessary. TEST the system for normal operation after the repair.
- Knock Sensor (KS) operation
- CHECK the KS . INSTALL a new KS as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repr.
- Incorrect spark timing
- CHECK the spark timing. REPAIR as necessary. TEST the system for normal operation after the repair.
- High operating temperature
- INSPECT the cooling system for leaks. CHECK the coolant level. REFILL as necessary. CHECK the

coolant for the correct mix ratio. DRAIN and REFILL as needed. VERIFY the engine operating temperature is within specifications. REPAIR as necessary. TEST the system for normal operation after the repair.

- Spark plug
- CHECK the spark plugs. REPAIR or INSTALL new spark plugs as necessary. TEST the system for normal operation after the repair.
- Catalytic converter
- COMPARE with a similar vehicle for what is acceptable noise.
- Engine noise, lower end - ticking or knocking noise near the oil filter adapter
- Oil pump
- USE the EngineEAR to verify the oil pump as the source of the noise at low rpm. REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
- Engine noise, lower end - light knocking noise, also described as piston slap. Noise is most noticeable when the engine is cold with light to medium acceleration. The noise disappears as the engine warms
- Excessive clearance between the piston and the cylinder wall
- CARRY OUT the Piston To Cylinder Bore Clearance procedure in this section. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
- Engine noise, lower end - light double knock or sharp rap sound. Occurs mostly with a warm engine at idle or low speeds in drive. Increases in relation to engine load. Associated with a poor lubrication history
- Excessive clearance between the piston and the piston pin
- CARRY OUT the Piston Pin Bore Diameter and Piston Pin Diameter procedures in this section.
- Engine noise, lower end - light knocking noise. The noise is most noticeable when the engine is warm. The noise tends to decrease when the vehicle is coasting or in NEUTRAL
- Excessive clearance between the connecting rod bearings and the crankshaft
- CARRY OUT the Connecting Rod Bearing Journal-to-Bearing Clearance procedure in this section.
- Engine noise, lower end - Deep knocking noise. The noise is most noticeable when the engine is warm, at lower rpm and under a light load and then at float
- Worn or damaged crankshaft main bearings
- CARRY OUT the Crankshaft Main Bearing Journal-to-Bearing Clearance procedure in this section.
- Engine noise, rear of engine - knocking noise at rear of engine

maged flywheel/flexplate

- CARRY OUT the Flywheel Inspection or the Flexplate Inspection procedure in this section.
- Engine vibration - vibration felt at all times
- Excessive engine pulley runout
- CARRY OUT the Engine Accessory Test. REFER to Section 100-04 . INSTALL a new engine pulley as necessary. TEST the system for normal operation after the repair.
- Damaged or worn accessory component
- CARRY OUT the Engine Accessory Test. REFER to Section 100-04 /a>. REPAIR or INSTALL a new component as necessary. TEST the system for normal operation after the repair.
- Engine vibration - at idle, a low-frequency vibration (5-20 Hz) or mild shake that is felt through the seat/floorpan
- Cylinder misfire
- Using the scan tool, CARRY OUT the cylinder power balance and the relative compression test. REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
- Engine or torque converter out of balance
- VERIFY the torque converter to crankshaft pilot clearance is correct. REPAIR as necessary. RE-INDEX the torque converter on the flexplate by 180 degrees for a 4-bolt converter. Refer to the appropriate section in Group 307 for the procedure. TEST the system for normal operation after the repair.
- Engine vibration - is felt with increases and decreases in engine rpm
- Powertrain mount(s)
- CHECK the powertrain ts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate section in Group 303 for the procedure. For automatic transmission, Refer to the appropriate section in Group 307 for the procedure. For manual transmission, REFER to Section 308-03 . TEST the system for normal operation after the repair.
- Engine or transmission grounded to chassis
- INSPECT the powertrain/drivetrain for correct clearances. REPAIR as necessary. TEST the system for normal operation after the repair.
- Engine vibration - increases intensity as the engine rpm is increased
- Engine out-of-balance
- CARRY OUT the Neutral Engine Run-Up (NERU) Test. REFER to Section 100-04 . ROTATE the torque converter 180 degrees for 4-bolt. INSPECT the torque converter pilot outer diameter-to-crankshaft pilot inner diameter. REPAIR as necessary. Refer to the appropriate section in Group 307 for the procedure. TEST the system for normal operation after the repair.

- Engine vibration - mostly at coast/neutral coast. Condition improves with vehicle acceleration
- Combustion instability
- CHECK the ignition system. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
- Engine vibration or shudder - occurs with light to medium acceleration above 56 km/h (35 mph)
- Worn or damaged spark plugs
- INSPECT the spark plugs for cracks, high resistance or broken insulators. INSTALL a new spark plug(s) as necessary. Referthe appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
- Plugged fuel injector
- REPAIR or INSTALL a new injector as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
- Contaminated fuel
- INSPECT the fuel for contamination. DRAIN the fuel system and refill. TEST the system for normal operation after the repair.

Component Tests

The following component tests are used to diagnose engine concerns.

Engine Oil Leaks

NOTE: If an overnight drive is done, the fan air or road air blast can cause erroneous readings.

NOTE: When diagnosing engine oil leaks, the source and location of the leak must be positively identified prior to repair.

Prior to carrying out this procedure, clean the cylinder block, cylinder heads, valve covers, oil pan and flywheel with a suitable solvent to remove all traces of oil.

Engine Oil Leaks - Fluorescent Oil Additive Method

Use the 12 Volt Master UV Diagnostic Inspection Kit to carry out the following procedure for oil leak diagnosis.

1. Add 29.6 ml (1 oz) of gasoline engine oil leak detection dye to a minimum of 0.47L (1/2 qt) and a maximum of 0.95L (1 qt) engine oil and fill through the engine oil fill. Thoroughly premix the gasoline engine oil dye or it will not have enough time to reach the crankcase, oil galleries and seal surfaces during this particular 15 minute test. The additive must be mixed well with oil and added through the oil fill. Check the level on the oil level indicator to determine what amount of oil to premix. If it is in the middle of the crosshatch area or below the full mark, use 0.95L (1 qt). If it is at the full mark, use 0.47L (1/2 qt).

2. Run the engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using the UV Leak Detector Kit. A clear bright yellow or orange area will identify the leak. For extremely small leaks, several hours may be required for the leak to appear.

3. At the end of the test, make sure the oil level is within the upper and lower oil indicator marks. Remove oil as necessary if it registers above the full mark.

Leakage Points - Underhood

Examine the following areas for oil leakage:

- Valve cover gaskets
- Cylinder head gaskets
- Oil cooler, if equipped
- Oil filter adapter
- Engine front cover
- Oil filter adapter and filter body
- Oil level indicator tube connection
- Oil pressure sensor

Leakage Points - Under Engine, With Vehicle on Hoist

Examine the following areas for oil leakage:

- Oil pan gaskets
- Oil pan sealer
- Engine front cover gasket
- Crankshaft front seal
- Crankshaft rear oil seal
- Oil filter adapter and filter body
- Oil cooler, if equipped

Leakage Points - With Transmission and Flywheel Removed

Examine the following areas for oil leakage:

- Crankshaft rear oil seal
- Rear main bearing cap parting line
- Flexplate mounting bolt holes (with flexplate installed)
- Pipe plugs at the end of oil passages

Oil leaks at crimped seams in sheet metal parts and cracks in cast or stamped parts can be detected when using the dye method.

Compression Test - Hybrid

The compression test requires cranking the engine a minimum of 5 compression strokes with the throttle plate in the wide-open position for each cylinder. The engine cranking diagnostic mode must be used to crank the engine and the brake/accelerator pedals must be used to position the throttle plate during the compression test. The engine cranking diagnostic mode is a PCM strategy which is separate from the normal operating strategy. It allows the engine to crank in a similar fashion as a conventional vehicle with the fuel disabled. When in this mode, the PCM commands the Transmission Control Module (TCM) to spin the generator, which cranks the engine with the speed between 900 and 1,200 rpm. The engine will crank as long as the traction battery state

of charge stays greater than 35%.

1. Make sure the oil in the crankcase is of the correct viscosity and at the correct level. Operate the vehicle until the engine is at normal operating temperature.

2. Using the Vehicle Communication Module (VCM), access the Battery Control Module - High Voltage Traction Battery (BCM-HVTB) and monitor the traction battery state of charge PID. If the monitored PID displays the state of charge below 45%, start and idle the engine with full A/C ON. When the traction battery state of charge exceeds 45%, the engine cranking diagnostic mode c be activated.

3. Turn the ignition switch to the OFF position, then remove all the spark plugs.

4. Install a compression gauge such as the Quick Disconnect Compression Tester in the No. 1 cylinder.

5. Activate the cranking diagnostic mode as follows:
   - Apply the parking brake.
   - Place the gear selector in the PARK position.
   - Verify the key is in the OFF position.
   - **NOTE:** Do not crank the engine.

     Turn the key to the ON position with the engine OFF.
   - Within 5 seconds of the key in the ON position, fully apply the accelerator pedal and hold for 10 seconds.
   - Within 5 seconds release the accelerator pedal, shift the gear selector to the NEUTRAL position and fully apply the accelerator pedal.
   - Hold the accelerator pedal fully applied for 10 seconds.
   - Release the accelerator pedal and shift the gear selector to the PARK position.
     - ♦ If the sequence is correctly executed, the Instrument Cluster (IC) hazard indicator (red triangle) flashes once per second when the gear selector is shifted to the PARK position. The PCM exits the engine cranking diagnostic mode when the traction battery state of charge drops below 35%, the gear selector is shifted to any gear other than PARK or when the ignition key is turned to the OFF or ACC position.

6. **NOTE:** If the ignition key stays in the START position for 15 seconds or longer, the PCM may set DTC P2535.

   NOTE: If the brake pedal is not depressed and held prior to depressing the accelerator pedal, the throttle plate will fail to open.

   Crank the engine as follows:

   - Depress and hold the brake pedal.
   - Fully depress and hold the accelerator pedal.
   - Turn the key to the START position and crank the engine a minimum of 5 compression strokes and record the highest reading. Return the key to the ON position.
   - Release the accelerator pedal.
   - Release the brake pedal.

7. Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes.

8. Position the key to the OFF position to deactivate the cranking diagnostic mode.

9. Clear all DTCs.

Compression Test - All Vehicles Except Hybrid

1. Make sure the oil in the crankcase is of the correct viscosity and at the correct level and that the battery is correctly charged. Operate the vehicle until the engine is at normal operating temperature. Turn the ignition switch to the OFF position, then remove all the spark plugs.

2. Set the throttle plates in the wide-open position.

3. Install a compression gauge such as the Quick Disconnect Compression Tester in the No. 1 cylinder.

4. Install an auxiliary starter switch in the starting circuit. With the ignition switch in the OFF position, and using the auxiliary starter switch, crank the engine a minimum of 5 compression strokes and record the highest reading. Note the approximate number of compression strokes necessary to obtain the highest reading.

5. Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes.

Compression Test - Test Results

The indicated compression pressures are considered within specification if the lowest reading cylinder is at least 75% of the highest reading. Refer to the Compression Pressure Limit Chart.

Compressioessure Limit Chart

Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure	Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure	Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure	Maximum Recorded Cylinder Pressure	Minimum Recorded Cylinder Pressure
924 kPa (134 psi)	696 kPa (101 psi)	1,131 kPa (164 psi)	848 kPa (123 psi)	1,338 kPa (194 psi)	1,000 kPa (145 psi)	1,544 kPa (224 psi)	1,158 kPa (168 psi)
938 kPa (136 psi)	703 kPa (102 psi)	1,145 kPa (166 psi)	855 kPa (124 psi)	1,351 kPa (196 psi)	1,014 kPa (147 psi)	1,558 kPa (226 psi)	1,165 kPa (169 psi)
952 kPa (138 psi)	717 kPa (104 psi)	1,158 kPa (168 psi)	869 kPa (126 psi)	1,365 kPa (198 psi)	1,020 kPa (148 psi)	1,572 kPa (228 psi)	1,179 kPa (171 psi)
965 kPa (140 psi)	724 kPa (105 psi)	1,172 kPa (170 psi)	876 kPa (127 psi)	1,379 kPa (200 psi)	1,034 kPa (150 psi)	1,586 kPa (230 psi)	1,186 kPa (172 psi)
979 kPa (142 psi)	738 kPa (107 psi)	1,186 kPa (172 psi)	889 kPa (129 psi)	1,303 kPa (189 psi)	1,041 kPa (151 psi)	1,600 kPa (232 psi)	1,200 kPa (174 psi)
933 kPa (135 psi)	745 kPa (108 psi)	1,200 kPa (174 psi)	903 kPa (131 psi)	1,407 kPa (204 psi)	1,055 kPa (153 psi)	1,055 kPa (153 psi)	1,207 kPa (175 psi)
1,007 kPa (146 psi)	758 kPa (110 psi)	1,214 kPa (176 psi)	910 kPa (132 psi)	1,420 kPa (206 psi)	1,062 kPa (154 psi)	1,627 kPa (236 psi)	1,220 kPa (177 psi)
1,020 kPa (148 psi)	765 kPa (111 psi)	1,227 kPa (178 psi)	917 kPa (133 psi)	1,434 kPa (208 psi)	1,075 kPa (156 psi)	1,641 kPa (238 psi)	1,227 kPa (178 psi)
1,034 kPa (150 psi)	779 kPa (113 psi)	1,241 kPa (180 psi)	931 kPa (135 psi)	1,448 kPa (210 psi)	1,083 kPa (157 psi)	1,655 kPa (240 psi)	1,241 kPa (180 psi)
1,048 kPa (152 psi)	786 kPa (114 psi)	1,255 kPa (182 psi)	936 kPa (136 psi)	1,462 kPa (212 psi)	1,089 kPa (158 psi)	1,669 kPa (242 psi)	1,248 kPa (181 psi)
1,062 kPa (154 psi)	793 kPa (115 psi)	1,269 kPa (184 psi)	952 kPa (138 psi)	1,476 kPa (214 psi)	1,103 kPa (160 psi)	1,682 kPa (244 psi)	1,262 kPa (183 psi)
1,076 kPa (156 psi)	807 kPa (117 psi)	1,282 kPa (186 psi)	965 kPa (140 psi)	1,489 kPa (216 psi)	1,117 kPa (162 psi)	1,696 kPa (246 psi)	1,269 kPa (184 psi)
1,089 kPa (158 psi)	814 kPa (118 psi)	1,296 kPa (188 psi)	972 kPa (141 psi)	1,503 kPa (218 psi)	1,124 kPa (163 psi)	1,710 kPa (248 psi)	1,202 kPa (174 psi)
1,103 kPa (160 psi)	827 kPa (120 psi)	1,310 kPa (190 psi)	979 kPa (142 psi)	1,517 kPa (220 psi)	1,138 kPa (165 psi)	1,724 kPa (250 psi)	1,289 kPa (187 psi)
1,110 kPa (161 psi)	834 kPa (121 psi)	1,324 kPa (192 psi)	993 kPa (144 psi)	1,631 kPa (237 psi)	1,145 kPa (166 psi)	—	—

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If one or more cylinders reads low, squirt approximately one tablespoon of engine oil meeting Ford specification on top of the pistons in the low-reading cylinders. Repeat the compression pressure check on these cylinders.

Compression Test - Interpreting Compression Readings

1. If compression improves considerably, piston rings are worn or damaged.

2. If compression does not improve, valves are sticking or not seating correctly.

3. If 2 adjacent cylinders indicate low compression pressures and squirting oil on each piston does not increase compression, the head gasket may be leaking between cylinders. Engine oil or coolant in cylinders could result from this condition.
   Use the Compression Pressure Limit Chart when checking cylinder compression so that the lowest reading is within 75% of the highest reading.

Cylinder Leakage Detection

When a cylinder produces a low reading, use of the Engine Cylinder Leak Detection/Air Pressurization Kit will be helpful in pinpointing the exact cause.

The leakage detector is inserted in the spark plug hole, the piston is brought up to Top Dead Center (TDC) on the compression stroke, and compressed air is admitted.

Once the combustion chamber is pressurized, a special gauge included in the kit will read the percentage of leakage. Leakage exceeding 20% is excessive.

While the air pressure is retained in the cylinder, listen for the hiss of escaping air. A leak at the intake valve will be heard in the Throttle Body (TB). A leak at t exhaust valve can be heard at the tailpipe. Leakage past the piston rings will be audible at the PCV connection. If air is passing through a blown head gasket to an adjacent cylinder, the noise will be evident at the spark plug hole of the cylinder into which the air is leaking. Cracks in the cylinder block or gasket leakage into the cooling system may be detected by a stream of bubbles in the radiator.

Excessive Engine Oil Consumption

Nearly all engines consume oil, which is essential for normal lubrication of the cylinder bore walls and pistons and rings. Determining the level of oil consumption may require testing by recording how much oil is being added over a given set of miles.

Customer driving habits greatly influence oil consumption. Mileage accumulated during towing or heavy loading generates extra heat. Frequent short trips, stop-and-go type traffic or extensive idling, prevent the engine from reaching normal operating temperature. This prevents component clearances from reaching specified operating ranges.

The following diagnostic procedure may be utilized to determine internal oil consumption. Make sure that the concern is related to internal oil consumption, and not external leakage, which also consumes oil. Verify there are no leaks before carrying out the test. Once verified, the rate of internal oil consumption can be tested.

A new engine may require extra oil in the early stages of operation. Internal piston-to-bore clearances and sealing characteristics improve as the engine breaks in. Engines are designed for close tolerances and do not require break-in oils or additives. Use the oil specified in the Owner's Literature. Ambient temperatures may determine the oil viscosity specification. Verify that the correct oil is being used for the vehicle in the geographic region in which it is driven.

Basic Pre-checks

1. For persistent complaints of oil consumption, interview the customer to determine the oil

consumption characteristics. If possible, determine the brand and grade of oil currently in the oil pan. Look at the oil filter or oil-change station tags to determine if Ford-recommended maintenance schedules have been followed. Make sure that the oil has been changed at the specified mileage intervals. If vehicle mileage is past the first recommended drain interval, the OEM production filter should have been changed.

2. Ask how the most current mileage was accumulated. That is, determine whether the vehicle was driven under the following conditions:
    - Extended idling or curbside engine operation
    - Stop-and-go traffic or taxi operation
    - Towing a trailer or vehicle loaded heavily
    - Frequent short trips (engine not up to normal operating temperature)
    - Excessive throttling or high engine-rpm driving

3. Verify that there are no external leaks. If necessary, review the diagnostic procedure under Engine Oil Leaks in the Diagnosis and Testing portion of this section.

4. Inspect the crankcase ventilation system for:
    - disconnected hoses at the valve cover or TB .
    - loose or missing valve cover fill cap.
    - missing or incorrectly seated engine oil level indicator.
    - incorrect or dirty PCV valve.
    - a PCV valve grommet unseated in the valve cover (if so equipped).

5. Inspect for signs of sludge. Sludge affects PCV performance and can plug or restrict cylinder head drainback wells. It can also increase oil pressure by restricting passages and reducing the drainback capability of piston oil control rings. Sludge can result from either excessive water ingestion in the crankcase or operation at extremely high crankcase temperatures.

6. Inspect the air filter for dirt, sludge or damage. A hole in the filter element will allow unfiltered air to bypass into the air induction system. This can cause premature internal wear (engine dusting), allowing oil to escape past rings, pistons, valves and guides.

7. If the engine is hot or was recently shut down, wait at least 5 minutes to allow the oil to drain back. Ask the customer if this requirement has been followed. Adding oil without this wait period can cause an overfill condition, leading to excessive oil consumption and foaming which may cause engine damage.

8. Make sure the oil level indicator (dipstick) is correctly and fully seated in the indicator tube. Remove the oil level indicator and record the oil level.

Detailed Pre-checks

1. Check the thermostat opening temperature to make sure that the cooling system is operating at the specified temperature. If it is low, internal engine parts are not running at specified internal operating clearances.

2. Verify the spark plugs are not oil saturated. Oil leaking into one or more cylinders will appear as an oil soaked condition on the plug. If a plug is saturated, a compression check may be necessary at the conclusion of the oil consumption test.

Oil Consumption Test

Once all of the previous conditions are met, carry out an oil consumption test.

1. Drain the engine oil and remove the oil filter. Install a new manufacturer-specified oil filter. Make sure the vehicle is positioned on a level surface. Refill the oil pan to a level **one liter (quart) less** than the specified fill level, using manufacturer-specified oil.

2. Run the engine for 3 minutes (if hot) or 10 minutes (if cold). Allow for a minimum 5-minute drainback period and then record the oil level shown on the oil level indicator. Place a mark on the backside of the oil level indicator noting the oil level location.

3. Add the final one liter (quart) to complete the normal oil fill. Restart the engine and allow it to idle for 2 minutes. Shut the engine down.

4. After a 5-minute drainback period, record the location of the oil level again. Mark the oil level indicator with the new oil level location. (Note: Both marks should be very close to the MIN-MAX upper and lower limits or the upper and lower holes on the oil level indicator. These marks will exactly measure the engine's use of oil, with a one liter (quart) differential between the new marks.) Demonstrate to the customer that the factory-calibrated marks on the oil level indicator are where the oil should fall after an oil change with the specified fill amount. Explain however, that this may vary slightly between MIN-MAX or the upper and lower holes on the oil level indicator.

5. Record the vehicle mileage.

6. Advise the customer that oil level indicator readings must be taken every 320 km (200 mi) or weekly, using the revised marks as drawn. Remind the customer that the engine needs a minimum 5-minute drainback for an accurate reading and that the oil level indicator must be firmly seated in the tube prior to taking the reading.

7. When the subsequent indicator readings demonstrate a full liter (quart) has been used, record the vehicle mileage. The mileage driven between the 2 readings should not be less than 4,800 km (3,000 miles). The drive cycle the vehicle has been operated under must be considered when making this calculation. It may be necessary to have the customer bring the vehicle in for a periodic oil level indicator reading to closely monitor oil usage.

Post Checks, Evaluation and Corrective Action

1. If test results indicate excessive oil consumption, carry out a cylinder compression test. The cylinder compression test should be carried out with a fully charged battery and all spark plugs removed. See the Compression Test Chart in this section for pressure range limits.

2. Compression should be consistent across all cylinders. Refer to the Compression Testing portion of this section. If compression tested within the specifications found in this section, the excessive oil consumption may be due to wear on the valve guides, valves or valve seals.

3. A cylinder leak detection test can be carried out using an Engine Cylinder Leak Detection/Air Pressurization Kit. This can help identify valves, piston rings, or worn valve guides/valve stems, inoperative valve stem seals or other related areas as the source of oil consumption.

NOTE: An oil-soaked appearance on the porcelain tips of the spark plugs also indicates excessive oil use. A typical engine with normal oil consumption will exhibit a light tan to brown appearance. See Spark Plug Analysis in this section for details. A single or adjoining, multiple cylinder leak can be traced by viewing the tips.

4. If an internal engine part is isolated as the root cause, determine if the repair will exceed cost limits and proceed with a repair strategy as required.

5. Once corrective action to engine is complete and verifying that all pre-check items were eliminated in the original diagnosis, repeat the Oil Consumption Test as described above and verify consumption results.

Intake Manifold Vacuum Test

Bring the engine to normal operating temperature. Connect the Vacuum/Pressure Tester to the intake manifold. Run the engine at the specified idle speed.

The vacuum gauge should read between 51-74 kPa (15-22 in-Hg) depending upon the engine condition and the altitude at which the test is conducted. Subtract 4.0193 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 ft) of elevation above sea level.

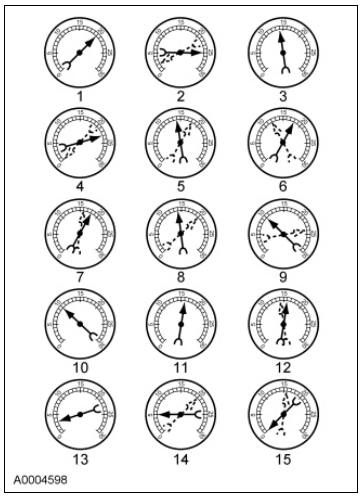
The reading should be steady. If necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust the damper until the needle moves easily without excessive flutter.

Intake Manifold Vacuum Test - Interpreting Vacuum Gauge Readings

A careful study of the vacuum gauge reading while the engine is idling will help pinpoint trouble areas. Always conduct other appropriate tests before arriving at a final diagnostic decision. Vacuum gauge readings, although helpful, must be interpreted carefully.

Most vacuum gauges have a normal band indicated on the gauge face.

The following are potential gauge readings. Some are normal; others should be investigated further.



1. NORMAL READING: Needle between 51-74 kPa (15-22 in-Hg) and holding steady.

2. NORMAL READING DURING RAPID ACCELERATION AND DECELERATION: When the engine is rapidly accelerated (dotted needle), the needle will drop to a low reading (not to zero). When the throttle is suddenly released, the needle will snap back up to a higher than normal figure.

3. NORMAL FOR HIGH-LIFT CAMSHAFT WITH LARGE OVERLAP: The needle will register as low as 51 kPa (15 in-Hg) but will be relatively steady. Some oscillation is normal.

4. WORN RINGS OR DILUTED OIL: When the engine is accelerated (dotted needle), the needle drops to 0 kPa (0 in-Hg). Upon decelerationthe needle runs slightly above 74 kPa (22 in-Hg).

5. STICKING VALVES: When the needle (dotted) remains steady at a normal vacuum but occasionally flicks (sharp, fast movement) down and back about 13 kPa (4 in-Hg), one or more valves may be sticking.

6. BURNED OR WARPED VALVES: A regular, evenly-spaced, downscale flicking of the needle indicates one or more burned or warped valves. Insufficient valve clearance will also cause this reaction.

7. POOR VALVE SEATING: A small but regular downscale flicking can mean one or more valves are not seating.

8. WORN VALVE GUIDES: When the needle oscillates over about a 13 kPa (4 in-Hg) range at idle speed, the valve guides could be worn. As engine speed increases, the needle will become steady if guides are responsible.

9. WEAK VALVE SPRINGS: When the needle oscillation becomes more violent as engine rpm is increased, weak valve springs are indicated. The reading at idle could be relatively steady.

10. LATE VALVE TIMING: A steady but low reading could be caused by late valve timing.

11. IGNITION TIMING RETARDING: Retarded ignition timing will produce a steady but somewhat low reading.

12. INSUFFICIENT SPARK PLUG GAP: When spark plugs are gapped too close, a regular, small pulsation of the needle can occur.

13. INTAKE LEAK: A low, steady reading can be caused by an intake manifold or Throttle Body (TB) gasket leak.

14. BLOWN HEAD GASKET: A regular drop of fair magnitude can be caused by a blown head gasket or warped cylinder head-to-cylinder block surface.

15. RESTRICTED EXHAUST SYSTEM: When the engine is first started and is idled, the reading may be normal, but as the engine rpm is increased, the back pressure caused by a clogged muffler, kinked tailpipe or other concerns will cause the needle to slowly drop to 0 kPa (0 in-Hg). The needle then may slowly rise. Excessive exhaust clogging will cause the needle to drop to a low point even if the engine is only idling.

16. When vacuum leaks are indicated, search out and correct the cause. Excess air leaking into the system will upset the fuel mixture and cause concerns such as rough idle, missing on acceleration or burned valves. If the leak exists in an accessory unit such as the power brake booster, the unit will not function correctly. Always fix vacuum leaks.

Oil Pressure Test

1. Disconnect and remove the Engine Oil Pressure (EOP) switch from the engine.

2. Connect the engine Oil Pressure Gauge to the oil pressure sender oil galley port.

3. Run the engine until normal operating temperature is reached.

4. Run the engine at the specified rpm and record the gauge reading.

5. The oil pressure should be within specifications; for additional information, refer to the specification chart in the appropriate engine section.

6. If the pressure is not within specification, check the following possible sources:
    - Insufficient oil
    - Oil leakage
    - Worn or damaged oil pump
    - Oil pump screen cover and tube
    - Excessive main bearing clearance
    - Excessive connecting rod bearing clearance
    - Chain tensioner leak

Valve Train Analysis

The following component tests are used to diagnose valve train concerns.

Valve Train Analysis - Engine Off, Valve Cover Removed

Check for damaged or severely worn parts and correct assembly. Maksure correct parts are used with the static engine analysis as follows.

Valve Train Analysis - Camshafts

- Check for broken or damaged parts.
- Check for loose mounting bolts on camshaft caps.

Valve Train Analysis - Camshaft Roller Followers and Hydraulic Lash Adjusters - 3.0L Engine

- Check for broken or damaged parts.
- Check for incorrectly installed roller followers.
- Check for collapsed hydraulic lash adjusters.

Valve Train Analysis - Valve Tappet - 2.5L and 3.5L Engines

- Check for valve tappet face wear.
- Check for excessive valve tappet clearance. Refer to Valve Clearance Check. For the 2.5L engine, refer to Section 303-01A . For the 3.5L engine, refer to Section 303-01C . For 2.5L Hybrid engine, refer to Section 303-01D .

Valve Train Analysis - Valve Springs, Valve Spring Retainers and Valve Spring Retainer Keys

NOTE: Valve tap removed on 2.5L and 3.5L engines.

- Check for broken or damaged parts.
- Check for correct seating of the valve spring retainer key on the valve stem and in valve spring retainer.
- Check for correct seating on the valve stem.

Valve Train Analysis - Valves and Cylinder Head

NOTE: Valve tappets must be removed on 2.5L and 3.5L engines.

- Check for plugged oil drain back holes.

- Check for worn or damaged valve tips.
- Check for missing or damaged guide-mounted valve stem seal.
- Check for missing or worn valve spring seats.
- Check for plugged oil metering orifice in cylinder head oil reservoir (if equipped).

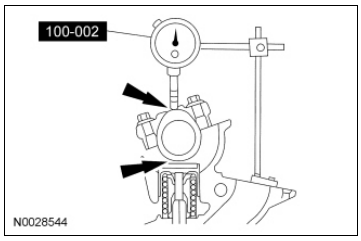
Valve Train Analysis - Camshaft Lobe Lift

Check the lift of each camshaft lobe in consecutive order and make a note of the readings.

1. Remove the spark plugs. Refer to the appropriate 303-07 section.

2. Install the Dial Indicator Gauge with Holding Fixture so the rounded tip of the Dial Indicator Gauge is on top of the camshaft lobe and on the same plane as the valve tappet (2.5L and 3.5L) or hydraulic lash adjuster (3.0L).

3. Rotate the crankshaft using a breaker bar and socket attached to the crankshaft pulley retainer bolt. Rotate the crankshaft until the base circle of the camshaft lobe is reached.



4. Zero the Dial Indicator Gauge. Continue to rotate the crankshaft until the high-lift point of the camshaft lobe is in the fully-raised position (highest indicator reading).

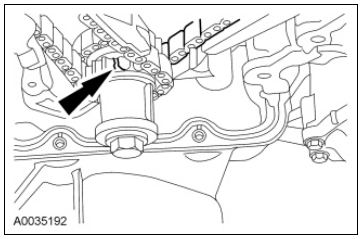
5. To check the accu of the original indicator reading, continue to rotate crankshaft until the base circle is reached. The Dial Indicator Gauge reading should be zero. If zero reading is not obtained, repeat Steps 1 through 6.

6. If the lift on any lobe is below specified service limits, install a new camshaft and camshaft roller followers or valve tappets.

7. Install the spark plugs. Refer to the appropriate 303-07 section.

Sprockets

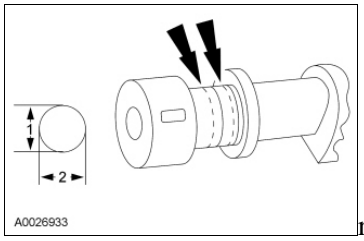
1. Inspect the sprockets for cracks and worn or chipped teeth.



Camshaft Bearing Journal Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure each camshaft journal diameter in 2 directions.



r>

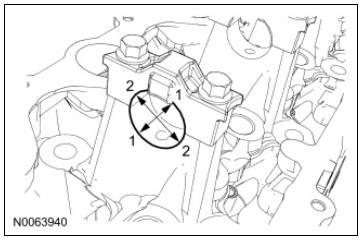
Camshaft Journal to Bearing Clearance - OHC Engines

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. **NOTE:** The camshaft journals must meet specifications before checking camshaft journal clearance.

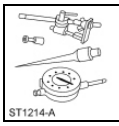
   Measure each camshaft bearing in 2 directions.

   - Subtract the camshaft journal diameter from the camshaft bearing diameter.
   -



Camshaft End Play - OHC Engines

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

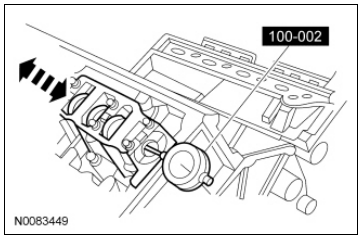
NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Using the Dial Indicator Gauge with Holding Fixture, measure the camshaft end play.

tart="2">
- Position the camshaft to the rear of the cylinder head.

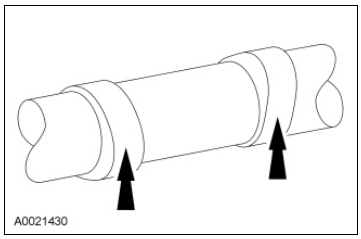
3. Zero the Dial Indicator Gauge.

4. Move the camshaft to the front of the cylinder head. Note and record the camshaft end play.
   - If camshaft end play exceeds specifications, install a new camshaft and recheck end play.
   - If camshaft end play exceeds specification after camshaft installation, install a new cylinder head.



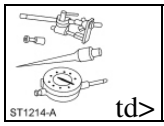
Camshaft Surface Inspection

1. Inspect camshaft lobes for pitting or damage in the contact area. Minor pitting is acceptable outside the contact area.



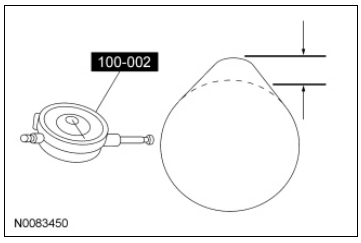
Camshaft Lobe Lift

Special Tool(s)

 td>	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

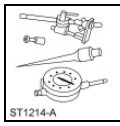
NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Use the Dial Indicator Gauge with Holding Fixture to measure camshaft intake/exhaust lobe lift.
   - Rotate the camshaft and subtract the lowest Dial Indicator Gauge reading from the highest Dial Indicator Gauge reading to figure the camshaft lobe lift.



Camshaft Runout

Special Tool(s)

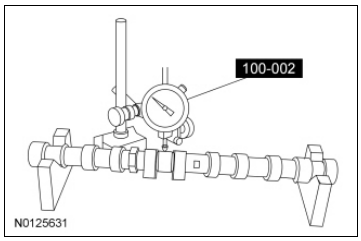
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. **NOTE:** Camshaft journals must be within specifications before checking runout.

   Using the Dial Indicator Gauge with Holding Fixture, measure the camshaft runout.

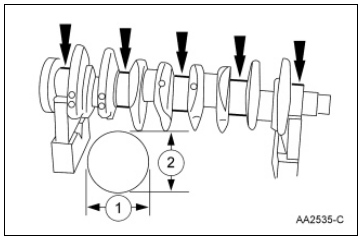
   - Camshaft must be supported on the first and last camshaft bearing journal.
   - Rotate the camshaft and subtract the lowest Dial Indicator Gauge reading from the highest Dial Indicator Gauge reading.



Crankshaft Main Bearing Journal Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

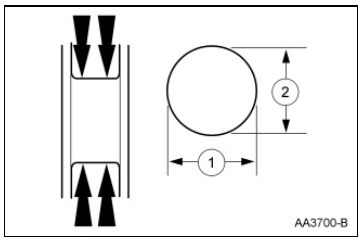
1. Measure each of the crankshaft main bearing journal diameters in at least 2 directions.



Crankshaft Main Bearing Journal Taper and Out-of-Round

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure each of the crankshaft main bearing journal diameters in at least 2 directions at each end of the main bearing journal.



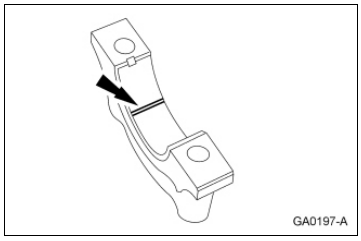
Crankshaft Main Bearing Journal-to-Bearing Clearance

NOTE: Refer to the appropriate Section 303-01 for the specification.

NOTE: Crankshaft main bearing journals must be within specifications before checking journal clearance.

1. Remove the crankshaft main bearing caps and crankshaft main bearing.

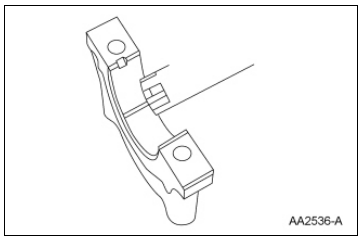
2. Lay a piece of Plastigage across the face of each crankshaft main bearing surface.



- **NOTE:** Do not turn the crankshaft while carrying out this procedure.

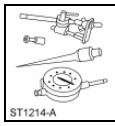
Install and remove the crankshaft main bearing cap.

4. Verify the crankshaft journal clearance.



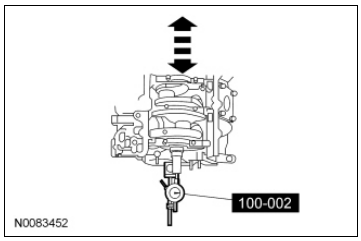
Crankshaft End Play

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

>NOTE: Refer to the appropriate Section 303-01 for the specification.

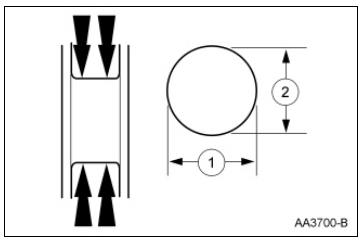
1. Install the Dial Indicator Gauge with Holding Fixture.
2. Position the crankshaft to the rear of the cylinder block.
3. Zero the Dial Indicator Gauge.
4. Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.



Connecting Rod Bearing Journal Taper and Out-of-Round

NOTE: Refer to the appropriate Section 303-01 for the specification.

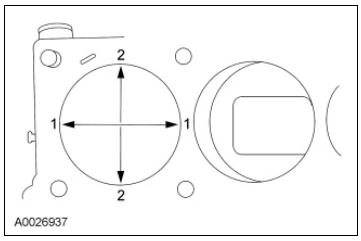
1. Measure the crankshaft connecting rod journal diameters in 2 directions perpendicular to one another at each end of the connecting rod journal. The difference in the measurements from one end to the other is the taper. Verify measurement is within the wear limit.



Cylinder Bore Taper

NOTE: Refer to the appropriate Section 303-01 for the specification.

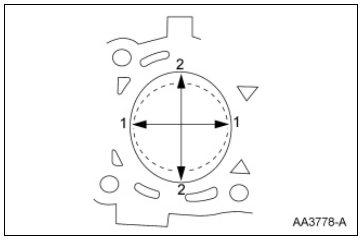
1. Measure the cylinder bore at the top, middle and bottom of piston ring travel in 2 directions as indicated. Verify the cylinder bore is within the wear limit. The difference indicates the cylinder bore taper. If the cylinder bore taper does not meet specification, bore the cylinder to the next oversize limit.



Cylinder Bore Out-of-Round

NOTE: Refer to the appropriate Section 303-01 for the specification.

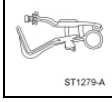
1. Measure the cylinder bore in 2 directions. The difference is the out-of-round.



&np;

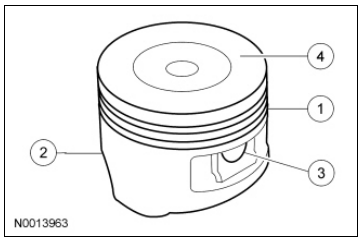
Piston Inspection

Special Tool(s)

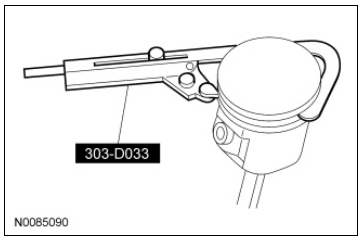
 ST1279-A	Scraper, Piston Ring Groove 303-D033 (D81L-6002-D) or equivalent

NOTICE: **Do not use a caustic cleaning solution or a wire brush to clean the pistons or damage can occur.**

1. Clean and inspect the (1) ring lands, (2) skirts, (3) pin bosses and the (4) tops of the pistons. If wear marks, scores or glazing is found on the piston skirt, check for a bent or twisted connecting rod.



2. Use the Piston Ring Groove Scraper to clean the piston ring grooves.
   - Make sure the oil ring holes are clean.

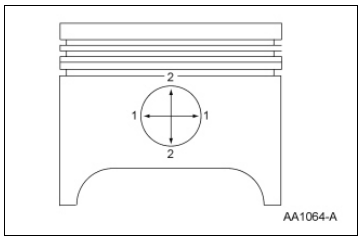


Piston Pin Bore Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. **NOTE:** Piston and piston pins are a matched set and should not be interchanged.

   Measure the piston pin bore diameter in 2 directions on each side. Verify the diameter is within specification.

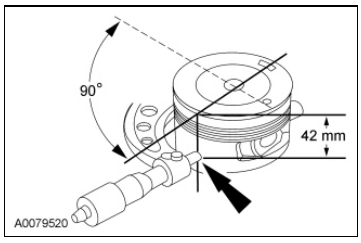


bsp;

Piston Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure the piston diameter 90 degrees from the piston pin and 42 mm (1.65 in) down from the top of the piston at the point indicated.



Piston To Cylinder Bore Clearance

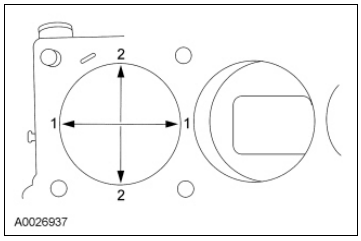
NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance.

Piston Selection

NOTE: The cylinder bore must be within the specifications for taper and out-of-round before fitting a piston.

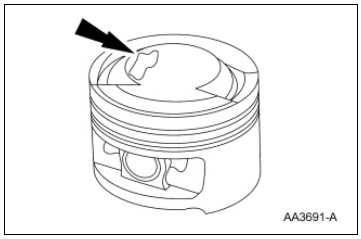
1. Select a piston size based on the cylinder bore.



2. **NOTE:** For precision fit, new pistons are divided into 3 categories within each size rangbased on their relative position within the range. A paint spot or specific size grade on a new piston indicates the position within the size range.

   Choose the piston with the correct paint color or specific size grade.

   - Refer to the appropriate section in Group 303 for the procedure.



Piston Ring End Gap

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

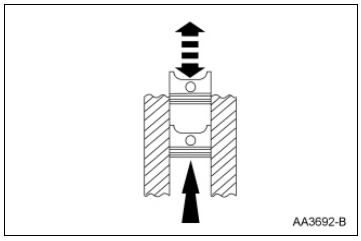
NOTICE: **Use care when fitting piston rings to avoid posble damage to the piston ring or the cylinder bore.**

NOTE: Piston rings should not be transferred from one piston to another.

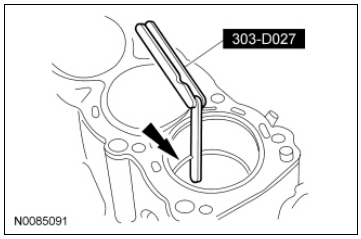
NOTE: Refer to the appropriate Section 303-01 for the specification.

NOTE: The cylinder bore must be within specification for taper and out-of-round.

1. Use a piston without rings to push a piston ring in a cylinder to the bottom of ring travel.



2. Use the Feeler Gauge Set to measure the top piston ring end gap and the second piston ring end gap.



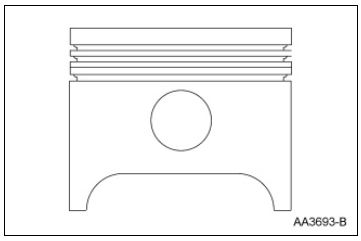
Piston Ring-to-Groove Clearance

Special Tool(s)

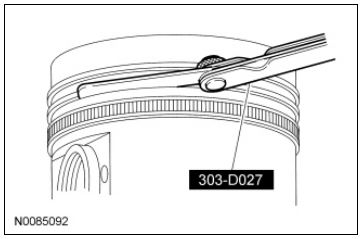
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Secon 303-01 for the specification.

1. Inspect the piston for ring land damage or accelerated wear.



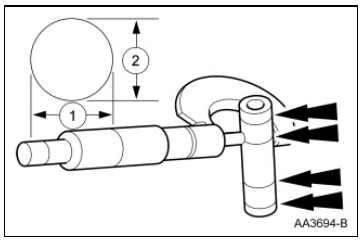
2. Using the Feeler Gauge Set, measure the piston ring-to-groove clearance.



Piston Pin Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure the piston pin diameter in 2 directions at the points shown. Verify the diameter is within specification.



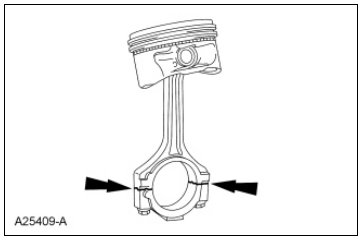
&np;

Connecting Rod Cleaning

NOTICE: **Do not use a caustic cleaning solution or damage to connecting rods can occur.**

1. **NOTE:** The connecting rod large end is a matched set. The connecting rod cap must be installed on the original connecting rod in the original position. Do not reverse the cap. Parts are not interchangeable.

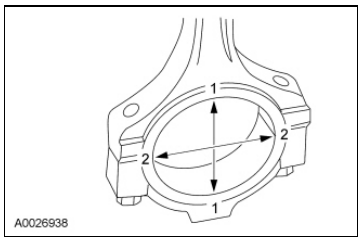
   Mark and separate the parts and clean with solvent. Clean the oil passages.



Connecting Rod Large End Bore

NOTE: Refer to the appropriate Section 303-01 for the specification.

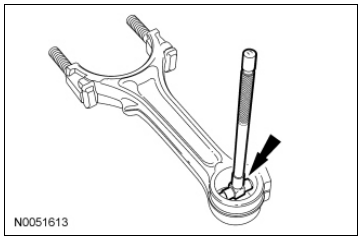
1. Tighten the bolts to specification, then measure the bore in 2 directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round is within specification.



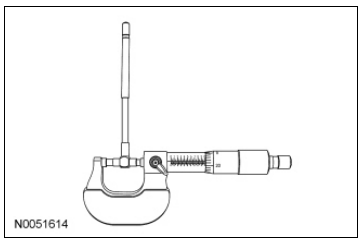
Connecting Rod Bushing Diameter

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Use a telescoping gauge to determine the ID of the connecting rod buing, if equipped.



2. Measure the telescoping gauge with a micrometer. Verify the diameter is within specification.



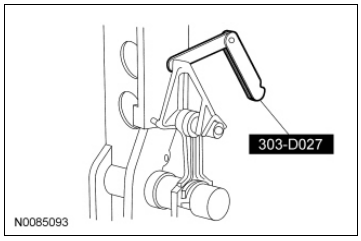
Connecting Rod Bend

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specication.

1. Using the Feeler Gauge Set, measure the connecting rod bend on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the bend measurement is within specification.



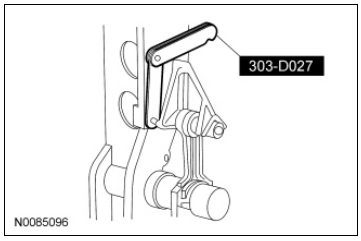
Connecting Rod Twist

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the spification.

1. Using the Feeler Gauge Set, measure the connecting rod twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the measurement is within specification.



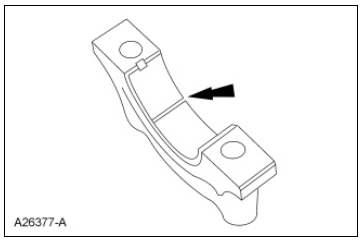
Connecting Rod Bearing Journal-to-Bearing Clearance

NOTE: Refer to the appropriate Section 303-01 for the specification.

NOTE: The crankshaft connecting rod journals must be within specifications to check the connecting rod bearing journal clearance.

1. Remove the connecting rod bearing cap.

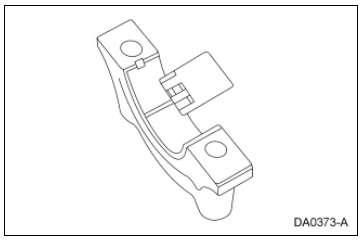
2. Position a piece of Plastigage across the bearing surface.



3. **NOTE:** Do not turn the crankshaft during this step.

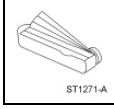
   Install and tighten to specifications, then remove the connecting rod bearing cap.

4. Measure the Plastigage to get the connecting rod bearing journal clearance. The Plastigage should be smooth and flat. A changing width indicates a tapered or damaged connecting rod or connecting rod bearing.



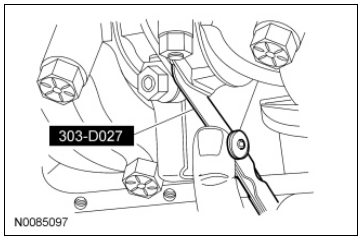
Connecting Rod to Crankshaft Side Clearance

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

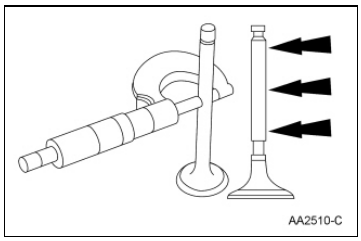
1. Using the Feeler Gauge Set, measure the clearance between the connecting rod and the crankshaft. Verify the measurement is within specification.



Valve Stem Diameter

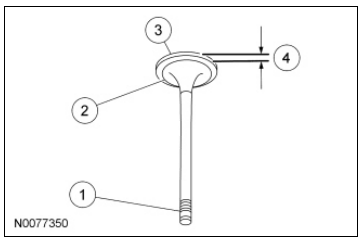
NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure the diameter of each intake and exhaust valve stem at the points shown. Verify the diameter is within specification.



Valve Inspection

1. Inspect the following valve areas:
    1. The end of the stem for grooves or scoring.
    2. The valve face and the edge for pits, grooves or scores.
    3. The valve head for signs of burning, erosion, warpage and cracking.
    4. The valve margin for wear.

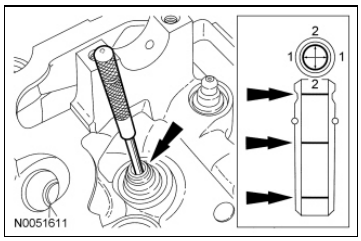


Valve Guide Inner Diameter

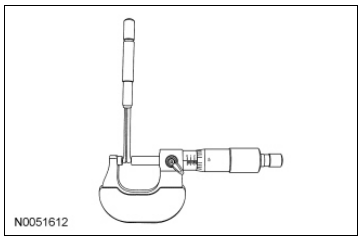
NOTE: Refer to the appropriate Section 303-01 for the specification.

1. **NOTE:** Valve guides tend to wear in an hourglass pattern. The ball gauge can be inserted into the combustion chamber side of the valve guide, if necessary.

   Use a ball gauge to determine the inside diameter of the valve guides in 2 directions at the top, middle and bottom of the valve guide.



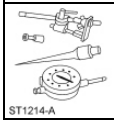
2. Measure the ball gauge with a micrometer.



3. If the valve guide is not within specifications, install a new cylinder head assembly.

Valve Stem to Valve Guide Clearance

Special Tool(s)

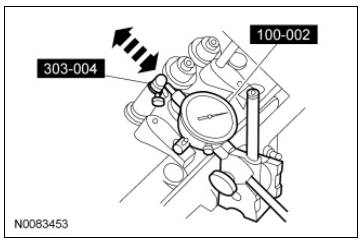
	Clearance Gauge, Valve Guide 303-004 (TOOL-6505-E) or equivalent
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

NOTE: The valve stem diameter must be within specifications before checking valve stem-to-valve guide clearance.

1. **NOTE:** If necessary, use a magnetic base.

   Install a Valve Guide Clearance Gauge on the valve stem and install a Dial Indicator Gauge with Holding Fixture. Lower the valve until the clearance gauge contacts the upper surface of the valve guide.

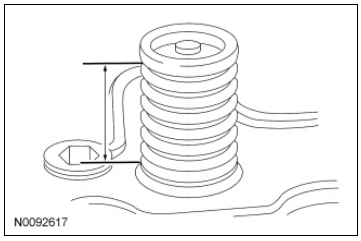


2. Move the Valve Guide Clearance Gauge toward the Dial Indicator Gauge with Holding Fixture and zero the Dial Indicator Gauge. Move the Valve Guide Clearance Gauge away from the Dial Indicator Gauge with Holding Fixture and note the reading. The reading will be DOUBLE the valve stem-to-valve guide clearance.

Valve Spring Installed Length

NOTE: Refer to the appropriate Section 303-01 for the specification.

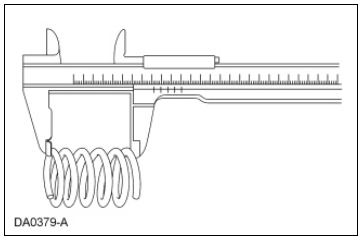
1. Measure the installed length of each valve spring.



Valve Spring Free Length

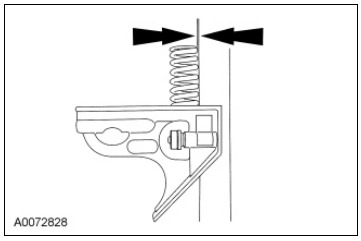
NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Measure the free length of each valve spring.



Valve Spring Squareness

- Measure the out-of-square on each valve spring.
    - Turn the valve spring and observe the space between the top of the valve spring and the square.



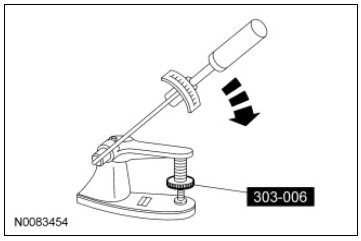
Valve Spring Strength

Special Tool(s)

 ST1278-A	Pressure Gauge, Valve/Clutch Spring 303-006 (TOOL-6513-DD) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. Use the Valve/Clutch Spring Pressure Gauge to check the valve spring for correct strength at the specified valve spring length.



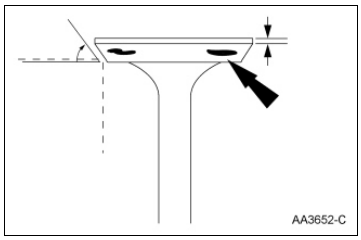
Valve Seat Inspection

Valve and Seat Refacing Measurements

NOTE: Refer to the appropriate Section 303-01 for the specification.

NOTE: After grinding valves or valve seats, check valve clearance.

1. Check the valve head and seat.
   - Check valve angles.
   - Check margin width.
   - Be sure margin width is within specification.

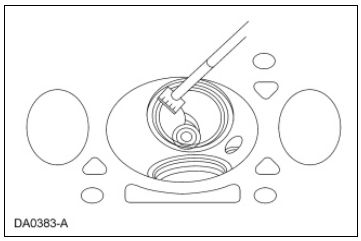


2. Inspect for abnormalities on the valve face and seat. Install a new cylinder head assembly if abnormalities are found.

Valve Seat Width

NOTE: Refer to the appropriate Section 303-01 for the specification.

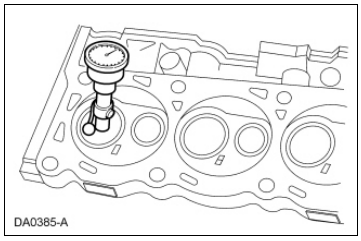
1. Measure the valve seat width. If necessary, grind the valve seat to specification.
    - Measure the intake valve seat width.
    - Measure the exhaust valve seat width.
    - Recheck the valve spring installed length after the seats have been ground, and shim the valve springs as necessary to achieve the correct installed spring length.
    - Dependi on the engine, check the valve lash. Refer to General Procedures in Section 303-01.



Valve Seat Runout

NOTE: Refer to the appropriate Section 303-01 for the specification.

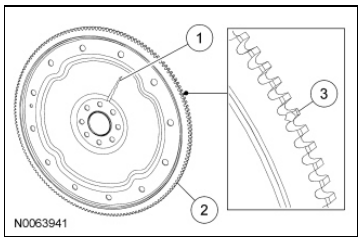
1. Use a valve seat runout gauge to check valve seat runout.



bsp;

Flexplate Inspection

1. Inspect the flexplate for:
    1. any cracks.
    2. worn ring gear teeth.
    3. chipped or cracked ring gear teeth.

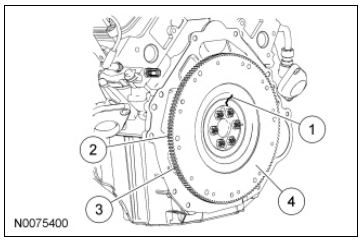


Flywheel Inspection

1. **NOTE:** The flywheel cannot be resurfaced, it must be replaced.

   Inspect the flywheel for:

   1. any cracks.
   2. worn ring gear teeth.
   3. chipped or cracked ring gear teeth.
   4. scratches, nicks and discoloration.



Cylinder Head Distortion

Special Tool(s)

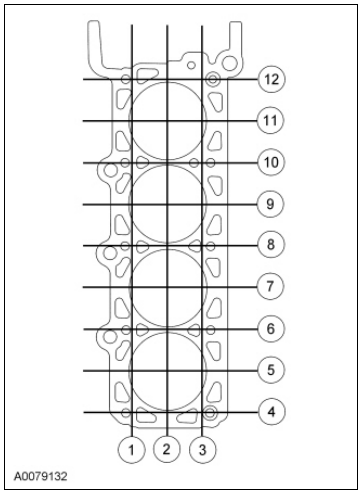
	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, silicone sealant, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

   NOTE: Use a Straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot of length, such as Snap-On® GA438A or equivalent. For example, if the Straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

   Using a Straightedge and a Feeler Gauge Set, inspect the cylinder head for flatness in the sequence shown.



Cylinder Block Distortion

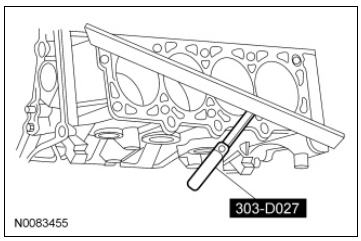
Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

NOTE: Refer to the appropriate Section 303-01 for the specification.

1. **NOTE:** Use a Straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot of length, such as Snap-On® GA438A or equivalent. For example, if the Straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

   Use a Straightedge and a Feeler Gauge Set to inspect the cylinder block for flatness.



Cylinder Bore Cleaning

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

1. ***NOTICE:*** **If these procedures are not followed, rusting of the cylinder bores may occur.**

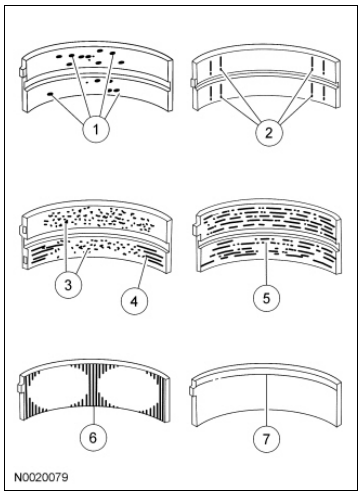
   Clean the cylinder bores with soap or detergent and water.

2. Thoroughly rinse with clean water and wipe dry with a clean, lint-free cloth.

3. Use aan, lint-free cloth and lubricate the cylinder bores.
   - Use clean engine oil meeting Ford specification.

Bearing Inspection

1. Inspect bearings for the following defects:
    1. Cratering - fatigue failure
    2. Spot polishing - incorrect seating
    3. Imbedded dirty engine oil
    4. Scratching - dirty engine oil
    5. Base exposed - poor lubrication
    6. Both edges worn - journal damaged
    7. One edge worn - journal tapered or bearing not seated



Exhaust Manifold Cleaning and Inspection

Special Tool(s)

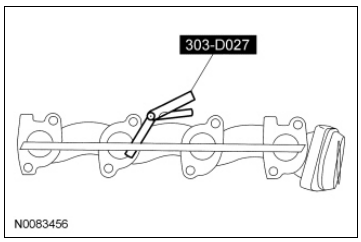
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent

1. Clean the exhaust manifold using a suitable solvent. Use a plastic scraping tool to clean the gasket sealing surfaces.

2. **NOTE:** New exhaust manifold gaskets, studs, nuts and/or bolts must be installed when an exhaust manifold is serviced.

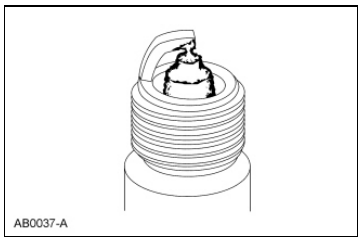
   NOTE: Use a Straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot of length, such as Snap-On® GA438A or equivalent. For example, if the Straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

   Using the Straightedge and a Feeler Gauge Set, check the exhaust manifold sealing surface for warpage. If the warpage is greater than 0.76 mm (0.0299 in), install a new exhaust manifold.

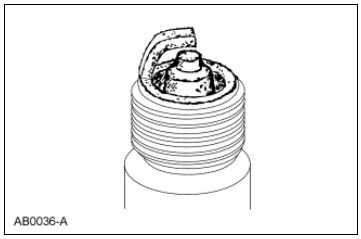


Spark Plug Inspection

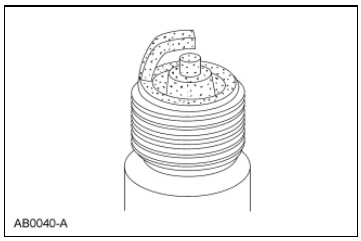
1. Inspect the spark plug for a bridged gap.
    - Check for deposit build-up closing the gap between the electrodes. Deposits are caused by oil or carbon fouling.
    - Install a new spark plug.



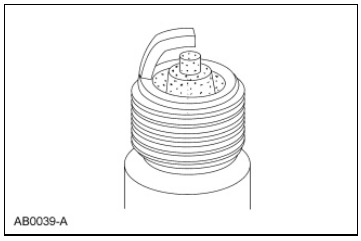
2. Check for oil fouling.
    - Check for wet, black deposits on the insulator shell bore electrodes, caused by excessive oil entering the combustion chamber through worn rings and pistons, excessive valve-to-guide clearance or worn or loose bearings.
    - Correct the oil leak concern.
    - Install a new spark plug.



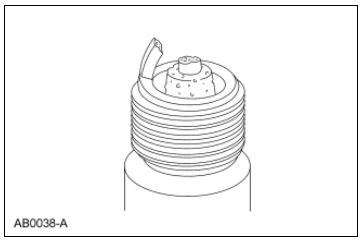
3. Inspect for carbon fouling. Look for black, dry, fluffy carbon deposits on the insulator tips, exposed shell surfaces and electrodes, caused by a spark plug with an incorrect heat range, dirty air cleaner, too rich a fuel mixture or excessive idling.
    - Install new spark plugs.



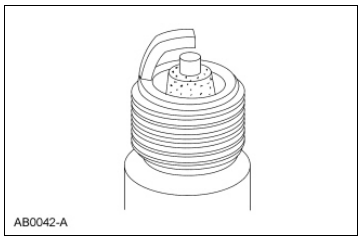
4. Inspect for normal burning.
    - Check for light tan or gray deposits on the firing tip.



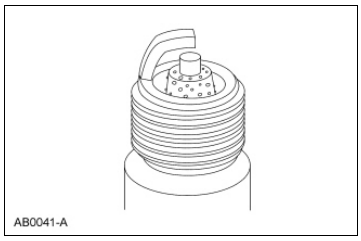
5. Inspect for pre-ignition, identified by melted electrodes and a possibly damaged insulator. Metallic deposits on the insulator indicate engine damage. This may be caused by incorrect ignition timing, wrong type of fuel or the unauthorized installation of a heli-coil insert in place of the spark plug threads.
    - Install a new spark plug.



6. Inspect for overheating, identified by white or light gray spots and a bluish-burnt appearance of electrodes. This is caused by engine overheating, wrong type of fuel, loose spark plugs, spark plugs with an incorrect heat range, low fuel pump pressure or incorrect ignition timing.
    - Install a new spark plug.

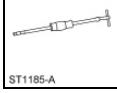


7. Inspect for fused deposits, identified by melted or spotty deposits resembling bubbles or blisters. These are caused by sudden acceleration.
    - Install new spark plugs.



Core Plug Replacement

Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

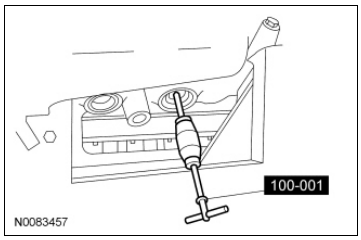
Material

Item	Specification
Threadlock 262 TA-26	WSK-M2G351-A6

All core plugs

1. **NOTE:** Cylinder block core plug shown, cylinder head core plug similar.

   Use the Slide Hammer and a freeze plug remover to remove the core plug.



2. **NOTE:** Oversize plugs are identified by the OS stamped in the flat located on the cup side of the plug.

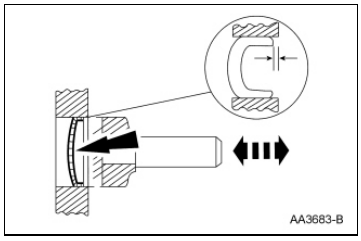
   Inspect the core plug bore for any damage that would interfere with the correct sealing of the plug. If the core plug bore is damaged, bore for the next oversize plug.

Cup-type

3. ***NOTICE:*** **Use care during this procedure so as not to disturb or distort the cup sealing surface.**

   NOTE: When installed, the flanged edge must be below the chamfered edge of the bore to effectively seal the bore.

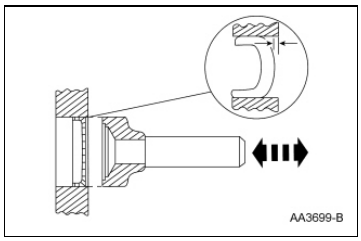
   Coat the cup-type core plug and bore lightly with sealant and install the core plug using a freeze plug installer.



Expansion-type

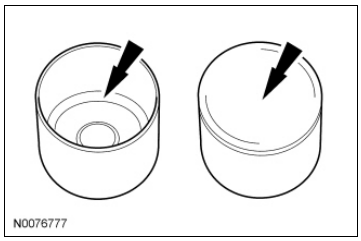
4. ***NOTICE:*** **Do not contact the crown when installing an expansion-type core plug. This could expand the plug before seating and result in leakage.**

   Coat the expansion-type core plug and bore lightly with sealant and install the core plug using a freeze plug installer.



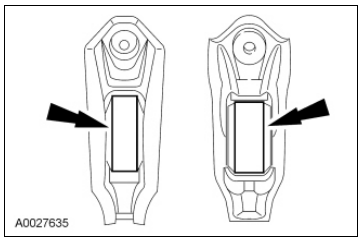
Valve Tappet Inspection

1. Inspect the valve tappet for damage, especially in the indicated areas. If any damage is evident, inspect the camshaft lobes and valves for damage. Install new components as necessary.



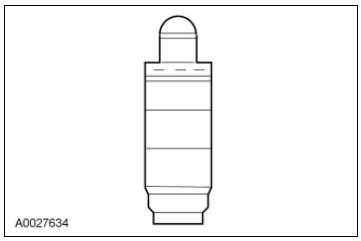
Roller Follower Inspection

1. Inspect the roller follower for flat spots or scoring. If any damage is found, inspect the camshaft lobes and hydraulic lash adjuster for damage.



Hydraulic Lash Adjuster Inspection

1. Inspect the hydraulic lash adjuster and roller follower for damage. If any damage is found, inspect the camshaft lobes and valves for damage.



Powertrain/Drivetrain Mount Neutralizing

NOTE: Refer to the appropriate section and procedure for special instructions on loosening and tightening mount fasteners.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Loosen, but do not remove, the powertrain/drivetrain mount fasteners.
3. Lower the vehicle.
4. ***NOTICE:*** **Do not twist or stra the powertrain/drivetrain mounts or damage to the mounts may occur.**

   Start the vehicle and move it in forward 0.6-1.2 m (2-4 ft). Then move the vehicle in reverse the same distance.
5. Raise and support the vehicle.
6. Tighten the powertrain/drivetrain mount fasteners.
7. Lower the vehicle.
8. Test the system for normal operation.

Material

Item	Specification	Fill Capacity
High Temperature 4x4 Front Axle and Wheel Bearing Grease XG-11	WSS-M1C267-A1	-
Motorcraft® Metal Surface Prep ZC-31-A	-	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	5.0L (5.3 qt) includes filter change
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A	[a]
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D	[a]
Multi-Purpose Grease Motorcraft® XL-5 (aerosol) and/or CRC® SL3151	ESB-M1C93-B	-
Silicone Brake Caliper Grease and Dielectric Compoun>	ESE-M1C171-A	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	-
Motorcraft® Silicone Gasket Remover ZC-30	-	-
Thread Sealant with PTFE TA-24	WSK-M2G350-A2	-

[a] Early build vehicle cooling systems are filled with Motorcraft® Specialty Green Engine Coolant and late build vehicle cooling systems are filled with Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.

General Specifications

Item	Specification
Displacement	2.5L
No. of cylinders	4
Bore/stroke	89.0/100.0
Firing order	1-3-4-2
Oil pressure (normal operating temperature @ 2,000 rpm)	200-450 kPa (29-65 psi)
Compression ratio	9.7:1
Engine weight (without accessory drive components and flexplate or flywheel)	115.8 kg (255.3 lb)
Engine and transaweight (without accessory drive components)	203.8 kg (449.3 lb)
Cylinder Block	
Cylinder bore diameter	89.0-89.03 mm (3.503-3.505 in)
Cylinder bore maximum out-of-round	0.008 mm (0.0003 in)
Main bearing bore diameter	57.018-57.040 mm (2.244-2.245 in)
Head gasket surface flatness	0.1 mm/general 0.05 mm/200 x 200 (0.004 in/general) (0.0019 in/7.87 x 7.87)
Piston	
Diameter (1)	88.965-88.975 mm (3.5025-3.5029 in)
Diameter (2)	88.975-88.985 mm (3.5029-3.5033 in)
Diameter (3)	88.985-88.995 mm (3.5033-3.5037 in)
Piston-to-bore clearance	0.025-0.045 mm (0.0009-0.0017 in)
Ring groove width - top	1.203-1.205 mm (0.0473-0.0474 in)
Ring groove width - 2nd	1.202-1.204 mm

	(0.0473-0.0474 in)
Ring groove width - oil	2.501-2.503 mm (0.0984-0.0985 in)
Piston skirt coatingness	0.008-0.016 mm (0.0003-0.0007 in)
Piston Pin	
Diameter	19.995-20.0 mm (0.8265-0.8267 in)
Length	54.7-55.0 mm (2.1535-2.1653 in)
Cylinder Head	
Cylinder head flatness	0.08 (0.0031 in) maximum overall, a maximum of 0.05 mm (0.0019 in) within 150 mm (5.9 in)
Valve lift @ zero lash (exhaust)	7.7 mm (0.30 in)
Valve lift @ zero lash (intake)	8.8 mm (0.35 in)
Valve guide inner diameter	5.509-5.539 mm (0.216-0.218 in)
Valve seat width - intake/exhaust	0.99-1.84 mm (0.038-0.072 in)
Valve seat angle	45 degrees
Valve seat runout	0.075 mm (0.0029 in)
Valve lash adjuster bore diameter	31.00-31.03 mm (1.220-1.221 in)
Cam bore diameter	25.015-25.040 mm (0.984-0.985 in)
Valve	
Valve head diameter - intake	34.85-35.15 mm (1.37283 in)
Valve head diameter - exhaust	29.85-30.15 mm (1.175-1.187 in)
Valve stem diameter - intake	5.470-5.485 mm (0.2153-0.2159 in)
Valve stem diameter - exhaust	5.465-5.480 mm (0.2151-0.2157 in)
Valve stem-to-guide clearance - intake	0.0027 mm (0.00010 in)
Valve stem-to-guide clearance - exhaust	0.0029 mm (0.00011 in)

Valve face runout	0.05 mm (0.0019 in)
Valve face angle	45 degrees
Valve Spring - Compression Pressure	
Intake and exhaust (installed)	17.5 kg (38.667 lb)
Intake (valve open) 8.9 mm (0.35 in) of lift	44 kg (97.032 lb)
Exhaust (valve open) 7.4 mm (0.29 in) of lift	42 kg (93.338 lb)
Free length	44.92 mm (1.768 in)
Assembled height	37.9 mm (1.492 in)
Crankshaft	
Main bearing journal diameter	51.978-52.002 mm (2.046-2.047 in)
	51.730-51.750 mm (2.036-2.037 in)
Main bearing clearance	0.016-0.047 mm (0.0006-0.0015 in)
Connecting rod journal diameter	51.978-52.002 mm ((2.046-2.047 in)
Production repair	51.730-51.750 mm (2.036-2.037 in)
End play	0.22-0.450 mm (0.008-0.018 in)
Rings	
Width - top	1.17-1.19 mm (0.0460-0.0468 in)
Width - 2nd	1.17-1.19 mm (0.0460-0.0468 in)
Width - oil	2.38-2.45 mm (0.093-0.096 in)
Piston ring end gap - compression (top, gauge diameter)	0.16-0.26 mm (0.006-0.0102 in)
Piston ring end gap - compression (bottom, gauge diameter)	0.31-0.46 mm (0.012-0.018 in)
Piston ring end gap - oil ring (steel rail, gauge diameter)	0.15-0.40 mm (0.01575-0.0591 in)
Valve Tappet	
Diameter	

	30.97-30.98 mm (1.2192-1.2196 in)	
Tappet-to-valve clearance - intake		
Tappet-to-valve clearance - exhaust	0.27-0.33 mm (0.010-0.013 in)	
Tappet-to-bore clearance	0.02-0.06 mm (0.0007-0.0023 in)	
Camshaft		
Lobe lift - intake	8.24999 mm (0.324 in)	
Lobe lift - exhaust	7.80007 mm (0.307 in)	
Runout (1) [a]	0.03 mm (0.001 in)	
Thrust clearance	0.09-0.24 mm (0.003-0.009 in)	
Journal diameter	24.96-24.98 mm (0.982-0.983 in)	
Journal-to-bore clearance	0.035-0.080 mm (0.001-0.003 in)	
Connecting Rod		
Bearing clearance	0.027-0.052 mm (0.001-0.002 in)	
Bearing thickness	1.496-1.520 mm (0.058-0.059 in)	
Crank bore diameter	55.025-55.045 mm (2.166-2.167 in)	
Pin bore diameter	20.010-20.021 mm (0.7878-0.7882 in)	
Length (center-to-center)	151.8 mm (5.976 in)	0.14-0.36 mm (0.005-0.014 in)

[a] No. 3 Journal - Supported by No. 1 and No. 5 journals.

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor mounting bolts	25	18	-
A/C manifold tube bolt	25	18	-
A/C tube nut	8	-	71
A/C tube-to-condenser nut	8	-	71

Accessory drive belt idler pulley and bracket bolts	25	18	-
Accessory drive belt idler pulley bolt	25	18	-
Accessory drive belt tensioner bolts	25	18	-
Balance shaft bolts [a]			
Bellhousing-to-engine bolts	48	35	-
Bellhousing-to-oil pan bolt	48	35	-
Block heater	40	30	-
Camshaft bearing cap bolts [a]	-	-	-
Camshaft sprocket bolt	72	53	-
Clutch pressure plate [a]	-	-	-
Clutch slave cylinder bolts	22	16	-
Clutch tube bracket bolts	22	16	-
Coil-on-plug bolts	8	-	71
Connecting rod cap bolts [a]	-	-	
Coolant outlet bolts	10	-	89
Coolant pump bolts	10	-	89
Coolant pump pulley bolts	20	-	177
Crankcase rear main oil seal retainer plate bolts [a]	-	-	-
Crankcase vent oil separator bolts	10	-	89
Crankshaft Position (CKP) sensor bolts [a]	-	-	-
Crankshaft pulley bolt [a]	-	-	-
Crankshaft rear seal retainer bolts [a]	-	-	-
Cylinder head bolts [a]	-	-	-
Cylinder head studs	17	-	Cylinder Head Temperature (CHT) sensor 12 - 106
Degas bottle nut and bolt	9	-	80
EGR tube	55	41	-
EGR valve bolts	20	-	177
Electronic Power Assist Steering (EPAS) ground wire bolt	12	-	106
Engine front cover bolts [a]	-	-	-
Engine front cover timing hole plug (lower)	12	-	106
Engine front cover timing hole plug (upper)	10	-	89
Engine front cover-to-oil pan bolts	10	-	89
Engine mount bolts	55	41	-
Engine moun valign="top" align="center">115	85	-	
Engine mount bracket nuts	103	76	-
Engine mount damper bolt	23	17	-
Engine mount ground wire bolt	10	-	89

Engine mount nut	55	41	-
Engine oil filter [b]	-	-	-
Engine Oil Pressure (EOP) switch	15	-	133
Engine plug bolt	20	-	177
Engine roll-restrictor bolt	90	66	-
Exhaust flexible pipe bracket bolts	35	26	-
Exhaust manifold heat shield bolts	10	-ign="center">89	
Exhaust manifold nuts [a]	-	-	-
Flexplate bolts [a]	-	-	-
Flywheel bolts [a]	-	-	-
Fuel rail bolts	23	17	-
Generator B+ wiring harness nut	12	-	106
Generator mounting nuts and bolt	47	35	-
Generator stud bolts	24	18	-
Ground wire-to-body bolt	12	-	106
Ground wire-to-engine mount bracket bolt	10	-	89
Intake manifold bolts	18	-	159
Kno"top" align="center">20	-	177	
Main bearing beam bolts [a]	-	-	-
Oil filter adapter bolts	25	18	-
Oil pan bolts [a]	-	-	-
Oil pan-to-bellhousing bolts	48	35	-
Oil pan drain plug	28	21	-
Oil pump bolts [a]	-	-	-
Oil pump drive chain tensioner shoulder bolt	10	-	89
Oil pump drive chain tensioner spring shoulder bolt	10	-	89
Oil pump screen and pickup tube bolts	10	-	89
Oil pump sprocket bolt	25 ter">18	-	
Oil squirters	4	-	35
Positive battery cable nuts	9	-	80
Radio capacitor and nut	10	-	89
Spark plugs	12	-	106
Starter motor solenoid wire nut	5	-	44
Starter motor B+ wire nut	12	-	106
Starter motor bolt and stud bolt	25	18	-
Starter motor stud bolt ground wire nut	18	-	159
Steering column shaft bolt	20	-	177
Subframe nuts	150	111	-
Subframe b	103	76	-
Sway bar link nuts	40	30	-
Thermostat housing bolts	10	-	89
Tie-rod end nuts	48	35	-

Timing chain guide bolts	10	-	89
Timing chain tensioner bolts	10	-	89
Torque converter nuts	35	26	-
Transaxle mount bolts	90	66	-
Transaxle mount through bolt	90	66	-
Valve cover bolts [a]	-	-	-
Variable Camshaft Timing (VCT) solenoid bolt [a]	10	89	
VCT system oil filter plug	17	-	150
Windshield washer reservoir/A/C tube bracket bolt	7	-	62

[a] Refer to the procedure for the specification.

[b] Lubricate the engine oil filter gasket with clean engine oil. Tighten the oil filter three-fourths turn after the oil filter gasket makes contact with the oil filter adapter.

Engine

The 2.5L (153 CID) 4-cylinder engine has the following features:

- DOHC
- Four valves per cylinder
- Sequential Multi-Port Fuel Injection (SFI)
- Aluminum cylinder head
- Aluminum cylinder block
- Electronic ignition system with 4 coil-on-plug ignition coils

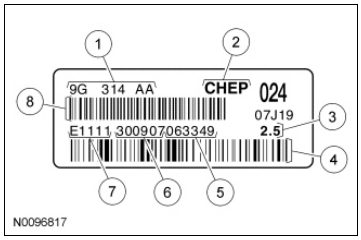
The 2.5L engine is a 4 valve-per-cylinder, dual overhead camshaft engine. The engine uses a coil-on-plug ignition system. The cylinder block is made of aluminum and the bearing caps are integrated into the ladder assembly. An aluminum oil pan bolts to the bottom of the lower cylinder block and to the transmission to provide greater strength. The camshafts are mounted in the cylinder heads and act against valve tappets to open and close the valves. The camshafts are driven off the front of the cylinder head by one timing chain. The chain is driven by a sprocket that is located on the crankshaft. The piston assembly is an aluminum piston with a cast iron connecting rod. The oil pump is driven by the crankshaft via a dedicated chain that is driven by the same sprocket that drives the timing chain.

Engine Identification

Always refer to these labels when installation of new parts is necessary or when checking engine calibrations. The engine parts often differ within a CID family. Verification of the identification codes will make sure that the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions. The Ford Master Parts Catalog contains a complete listing of the codes and their applications.

Engine Code Information Label

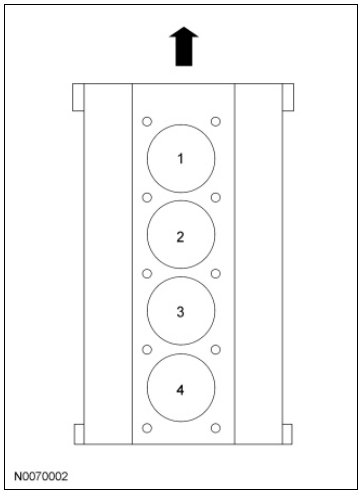
The engine code information label, located on the front side of the valve cover, contains the following:



Item	Description
1	Engine part number
2	Chihuahua engine plant
3	Engine displacement
4	Bar code
5	Running number

6	Engine build date (DDMMYY)
7	Plant shift line
8	Bar code

Engine Cylinder Identification



Exhaust Emission Control System

Operation and necessary maintenance of the exhaust emission control devices used on this engine are covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The SFI provides the fuel/air mixture needed for combustion in the cylinders. The 4 solenoid-operated fuel injectors:

- are mounted in the intake manifold.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.
- are connected in series with the fuel pressure sensor.
- supply fuel from the fuel tank with a fuel pump mounted in the fuel tank.

A constant fuel pressure is maintained across the fuel injectors by the fuel pressure sensor. The fuel pressure sensor is positioned upstream from the fuel injectors on the fuel injection supply manifold.

PCV System

All engines are equipped with a closed-type PCV system recycling the crankcase vapors to the intake manifold.

Lubrication System

The engine lubrication system operates as follows:

- Oil is drawn into the oil pump through the oil pump screen cover and tube in the sump of the oil pan.
- Oil is pumped through the oil filter on the left front side of the cylinder block.
- Oil enters the main gallery where it is distributed to the crankshaft main journals and to the cylinder head.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston ring assembly.

Engine

For basic engine mechanical concerns, refer to Section 303-00 . For driveability concerns, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

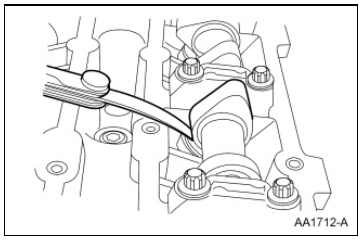
Valve Clearance Check

1. Remove the valve cover. For additional information, refer to Valve Cover in this section.

2. **NOTE:** Turn the engine clockwise only, and only use the crankshaft bolt.

   NOTE: Before removing the camshafts, measure the clearance of each valve at base circle, with the lobe pointed away from the tappet. Failure to measure all clearances prior to removing the camshafts will necessitate repeated removal and installation and wasted labor time.

   Use a feeler gauge to measure the clearanf each valve and record its location.



3. **NOTE:** The number on the valve tappet only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

   NOTE: The nominal clearance is:

   - intake: 0.25 mm (0.0095 in).
   - exhaust: 0.30 mm (0.0115 in).

   NOTE: The acceptable clearances after being fully installed are:

   - intake: 0.22-0.28 mm (0.008-0.011 in).
   - exhaust: 0.27-0.33 mm (0.010-0.013 in).

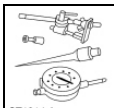
   Select tappets using this formula: ideal tappet thickness = measured clearance + the existing tappet thickness - nominal clearance.
   Select the closest tappet size to the ideal tappet thickness available and mark the installation location.

4. If any tappets do not measure within specifications, install new tappets in these locations. For additional information, refer to Valve Train Components - Exploded View and Valve Tappets in this sectn.

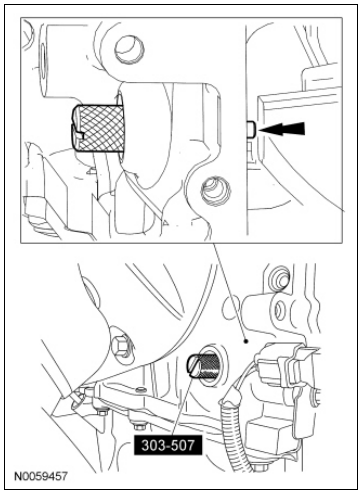
2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Workshop Manual

Balance Shaft Backlash

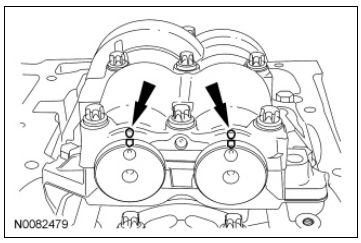
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

1. Install the Crankshaft TDC Timing Peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg. The engine is now at Top Dead Center (TDC).

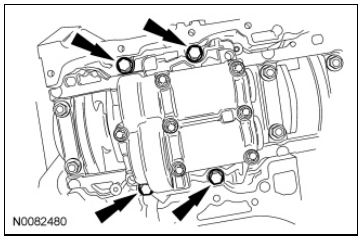


2. Mark the balancer unit and shafts on the top for reference that the balancer unit is at TDC .



3. **NOTE:** Due to the precision interior construction of the balancer unit, it should not be disassembled.

   Remove the 4 bolts and the balancer unit.

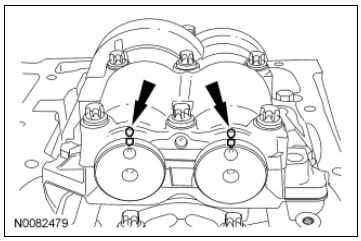


4. Remove the adjustment shims from the seat faces of the balancer unit.

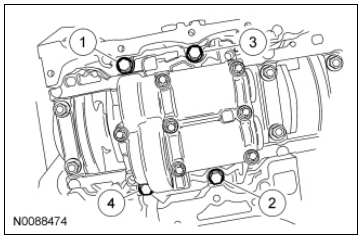
5. ***NOTICE:*** **Visually inspect the balancer unit gear for damage and verify that the shaft turns smoothly. If there is any damage or malfunction, replace the balancer unit.**

   Install the master adjustment shims (No. 50) on the seat faces of the balancer unit.

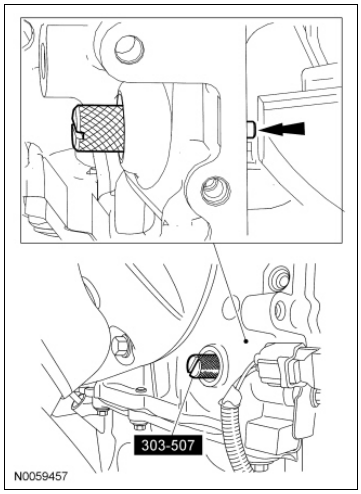
6. With the balancer unit shaft marks at the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.



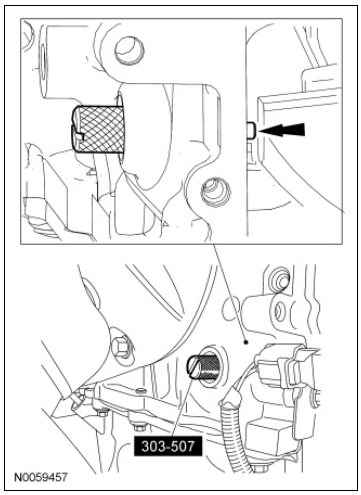
7. Install the balancer unit bolts.
   - Tighten in the sequence shown in 2 stages.
     - ♦ Stage 1: Tighten to 25 Nm (18 lb-ft).
     - ♦ Stage 2: Tighten to 42 Nm (31 lb-ft).



8. Remove the Crankshaft TDC Timing Peg.
   - Rotate the crankshaft to confirm that there are no meshing problems between the balancer unit gear and the crankshaft gear.



9. Install the Crankshaft TDC Timing Peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg.
    - Remove the Crankshaft TDC Timing Peg.



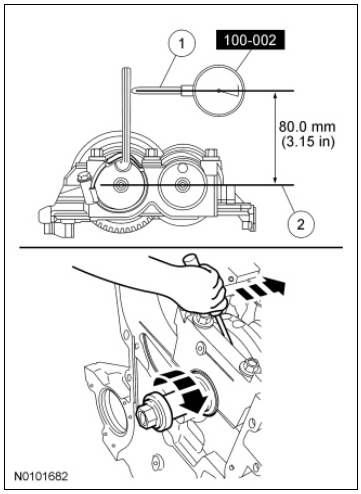
10. **NOTE:** Measure the backlash and verify that it is within specified range at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees. It will be necessary to reset the measuring equipment between measurements.

    NOTE: The measurement must be taken with the Dial Indicator Gauge with Holding Fixture, a 5-mm Allen wrench and worm clamp set up as shown. Mark the Allen wrench with a file 80 mm (3.149 in) above the driven gear shaft center. Make sure the worm clamp and Allen wrench are not touching the balance shaft housing.

    NOTE: For an accurate measurement while measuring the gear backlash, insert a screwdriver as shown into the crankshaft No. 1 crankweight area and set both the rotation and the thrust direction with the screwdriver, using a prying action as shown.

    Position the Dial Indicator Gauge with Holding Fixture as shown. Measure the gear backlash.

    - Position the Dial Indicator Gauge with Holding Fixture (1) on the Allen wrench 80 mm (3.149 in) above the driven gear shaft center (2) on the balancer unit.
    - Rotate the crankshaft clockwise and measure the backlash at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees.



11. **NOTE:** If maximum backlash exceeds 0.101 mm (0.003 in), install a new balancer unit.

    Using the backlash measurement, select the proper shims from the Adjustment Shim Selection Table.

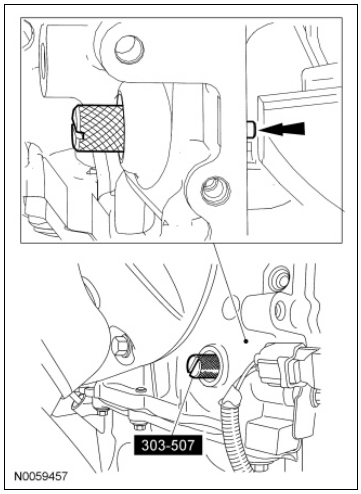
    - Remove the balancer unit from the cylinder block.
    - Install the selected adjustment shims on the seat faces of the balancer unit.

ADJUSTMENT SHIM SELECTION TABLE

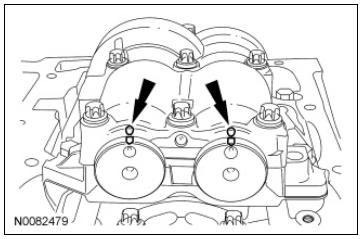
Backlash mm (in)	Selection shim (No.)	Shim thicness mm (in)	Backlash mm (in)	Selection shim (No.)	Shim thicness mm (in)
0.516-0.528 (0.0203-0.0207)	15	1.15 (0.0452)	0.245-0.257 (0.0096-0.0101)	35	1.35 (0.0531)
0.502-0.514 (0.0197-0.0202)	16	1.16 (0.0456)	0.232-.0243 (0.0091-0.0095)	36	1.36 (0.535)
0.489-0.500 (0.0192-0.0196)	17	1.17 (0.0460)	0.218-0.230 (0.0085-0.0090)	37	1.37 (0.539)
0.475-0.487 (0.0187-0.0191)	18	1.18 (0.0464)	0.205-.0216 (0.0080-0.0085)	38	1.38 (0.0543)
0.462-0.473 (0.0181-0.0186)	19	1.19 (0.0468)	0.191-0.203 (0.0075-0.0079)	39	1.39 (0.0547)
0.448-0.460 (0.0176-0.0181)	20	1.20 (0.0472)	0.178-0.189 (0.0070-0.0074)	40	1.40 (0.0551)
0.435-0.446 (0.0171-0.0175)	21	1.21 (0.0476)	0.164-0.176 (0.0064-0.0069)	41	1.41 (0.0555)
0.421-0.433 (0.0165-0.0170)	22	1.22 (0.0480)	0.151-0.162 (0.0059-0.0063)	42	1.42 (0.0559)
0.408-0.419 (0.0160-0.0164)	23	1.23 (0.0484)	0.137-0.149 (0.0053-0.0058)	43	1.43 (0.0562)
0.394-0.406 (0.0155-0.0159)	24	1.24 (0.0488)	0.124-0.135 (0.0048-0.0053)	44	1.44 (0.0566)
0.381-0.392 (0.0150-0.0154)	25	1.25 (0.492)	0.110-0.122 (0.0043-0.0048)	45	1.45 (0.0570)
0.367-0.379 (0.0144-0.0149)	26	1.26 (0.0496)	0.097-0.108 (0.0038-0.0042)	46	1.46 (0.0574)
0.354-0.365 (0.0139-0.0143)	27	1.27 (0.0499)	0.083-0.095 (0.0032-0.0037)	47	1.47 (0.0578)
0.340-0.352 (0.0133-0.0138)	28	1.28 (0.0503)	0.070-0.081 (0.0027-0.0031)	48	1.48 (0.0582)
0.327-0.338 (0.0128-0.0133)	29	1.29 (0.0507)	0.056-0.068 (0.0022-0.0026)	49	1.49 (0.0586)
0.313-0.325 (0.0123-0.0127)	30	1.30 (0.0511)	0.043-0.054 (0.0016-0.0021)	50 (master)	1.50 (0.0590)
0.300-0.311 (0.0118-0.0122)	31	1.31 (0.0515)	0.029-0.041 (0.0011-0.0016)	51	1.51 (0.0594)
0.286-0.298 (0.0112-0.0117)	32	1.32 (0.0519)	0.015-0.027 (0.0005-0.0010)	52	1.52 (0.0598)
0.272-0.284 (0.0107-0.0111)	33	1.33 (0.0523)	0.002-0.014 (0.00007-0.0005)	53	1.53 (0.0602)
0.259-0.271 (0.0101-0.0106)	34	1.34 (0.0527)	0.000-0.000 (0.0000-0.0000)	54	1.54 (0.0606)

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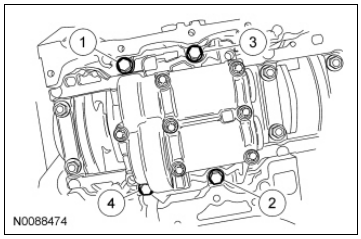
12. Install the Crankshaft TDC Timing Peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg. The engine is now at TDC .



13. With the balancer unit shaft marks in the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.



14. Install the balancer unit bolts.
    - Tighten in the sequence shown in 2 stages.
        - ♦ Stage 1: Tighten to 25 Nm (18 lb-ft).
        - ♦ Stage 2: Tighten to 42 Nm (31 lb-ft).



15. **NOTE:** Remeasure the backlash and verify that it is within specified range at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees. It will be necessary to reset the measuring equipment between measurements.

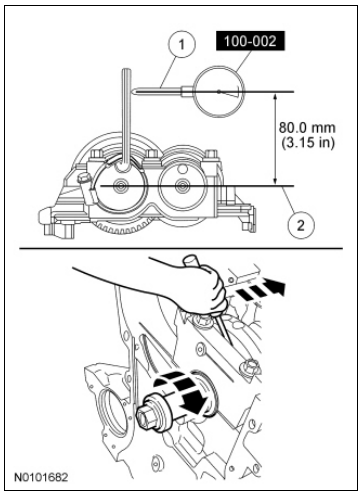
    NOTE: The measurement must be taken with the Dial Indicator Gauge with Holding Fixture, a 5-mm Allen wrench and worm clamp set up as shown. Mark the Allen wrench with a file 80 mm (3.149 in) above the driven gear shaft center. Make sure the worm clamp and Allen wrench are not touching the balance shaft housing.

    NOTE: For an accurate measurement while measuring the gear backlash, insert a screwdriver as shown into the crankshaft No. 1 crankweight area and set both the rotation and the thrust direction with the screwdriver, using a prying action as shown.

    Position the Dial Indicator Gauge with Holding Fixture as shown. Measure the gear backlash.

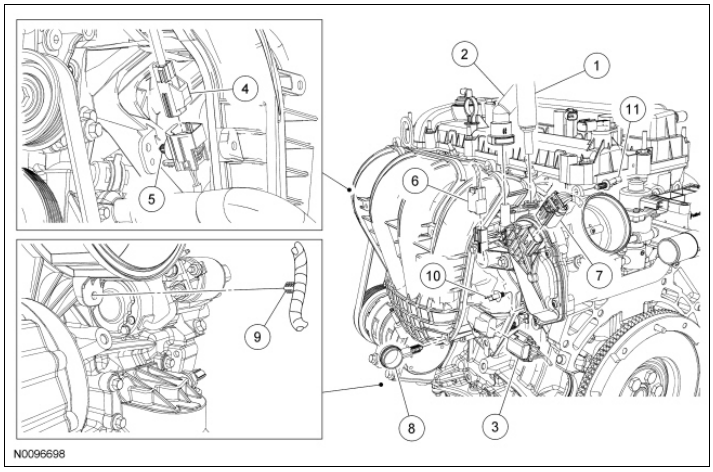
    - Position the Dial Indicator Gauge with Holding Fixture (1) on the Allen wrench 80 mm (3.149 in) above the driven gear shaft center (2) on the balancer unit.

- Rotate the crankshaft clockwise and measure the backlash at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees.
- If the backlash exceeds the specified range of 0.005 to 0.101 mm (0.00019 to 0.0039 in), install a new balancer unit and repeat the procedure.



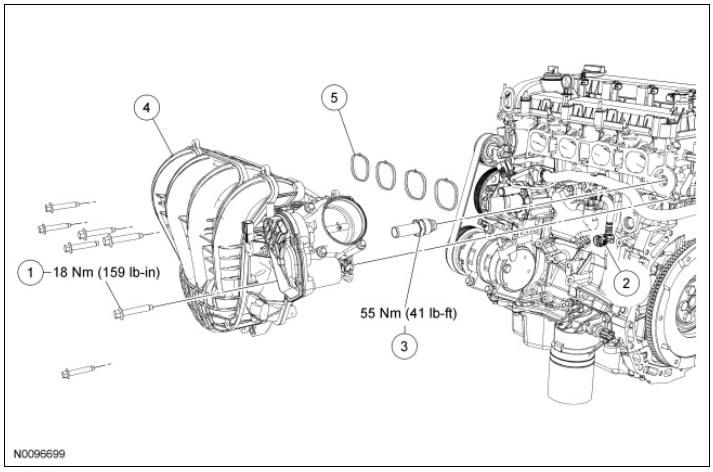
Intake Manifold

Intake Manifold (View 1 of 2)



Item	Part Number	Description
1	19D848	Vacuum supply hose
2	9D289	Fuel vapor return hose
3	14A464	Manifold Absolute Pressure (MAP) sensor electrical connector (part of 12C508)
4	14A464	Knock Sensor (KS) electrical connector (part of 12C508)
5	14A624	KS wire har pin-type retainer (part of 12C508)
6	14A464	Evaporative Emission (EVAP) canister purge valve electrical connector (part of 12C508)
7	14A464	Electronic throttle control electrical connector (part of 12C508)
8	18K580	Heater hose pin-type retainer
9	13A506	A/C compressor wiring harness retainer (part of 14B060)
10	13A506	Wire harness pin-type retainer
11	14197	Wire harness pin-type retainer

Intake Manifold (View 2 of 2)



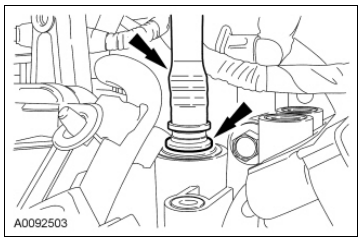
Item	Part Number	Description
1	W500311	Intake manifold bolt (7 required)
2	6A785	Crankcase vent oil separator tube (part of 6A785)
3	9E470	EGR tube
4	9424	Intake manifold
5	9461	Intake manifold gasket

Removal and Installation

1. With vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12A .

3. Disconnect the vacuum supply hose.
   - Depress the quick connect locking ring.
   - Pull the vacuum hose out of the quick connect fitting.



4. Disconnect the fuel vapor return hose from the intake manifold.

5. Disconnect the Manifold Absolute Pressure (MAP) electrical connector.

6. Disconnect the Evaporative Emission (EVAP) canister purge valve electrical connector.

7. Disconnect the electronic throttle control electrical connector.

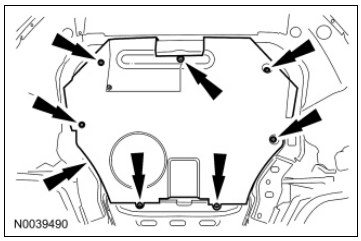
8. Disconnect the Knock Sensor (KS) electrical connector.
   - Detach the wire harness pin-type retainer.

9. Detach the heater hose pin-type retainer.

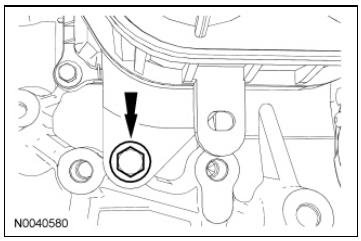
10. Detach the A/C compressor wiring harness retainer.

11. Detach the 2 wiring harness pin-type retainers from the intake manifold and position the wiring harness aside.

12. If equipped, remove the 7 screws and the underbody cover.



13. Remove the intake manifold lower bolt.
    - To install, tighten to 18 Nm (159 lb-in).



14. Remove the 6 bolts and position the intake manifold aside to access the crankcase vent oil separator tube and the EGR tube.
    - To install, tighten to 18 Nm (159 lb-in).

15. Remove the EGR tube.
    - To install, tighten to 55 Nm (41 lb-ft).

16. Squeeze the 2 crankcase vent oil separator tube tabs and disconnect the tube from the intake manifold.
    - Remove the intake manifold.

17. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    To install, reverse the removal procedure.

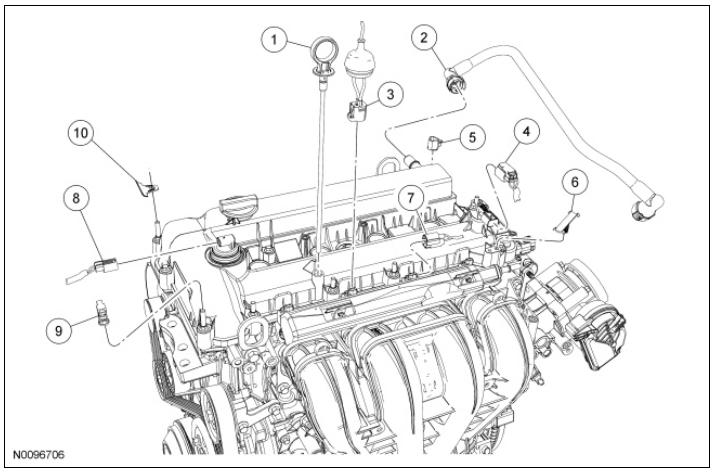
    - Inspect and install new intake manifold gaskets if necessary.

Valve Cover

Material

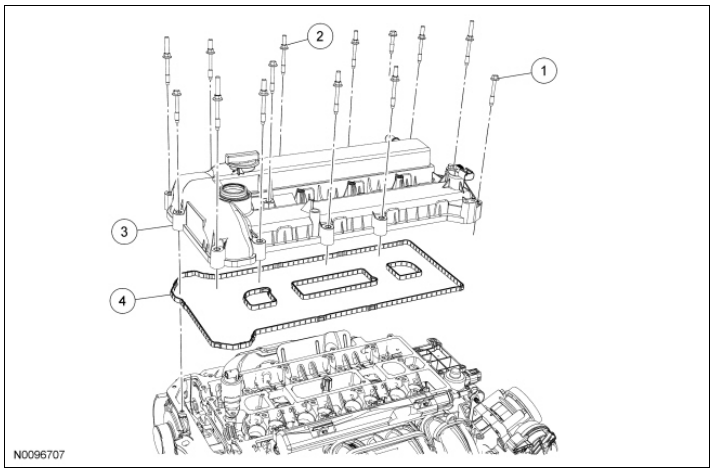
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Valve Cover (View 1 of 2)



Item	Part Number	Description
1	6750	Oil level indicator
2	6853	Crankcase vent hose
3	14A464	Cylinder Head Temperature (CHTr electrical connector (part of 12B637)
4	14A464	Camshaft Position (CMP) sensor electrical connector (part of 12B637)
5	14A464	Wire harness retainer (part of 12C508)
6	13A506	Wire harness retainer (part of 12C508)
7	14A464	Radio capacitor electrical connector (part of 12C508)
8	14A163	Variable Camshaft Timing (VCT) oil control solenoid electrical connector (part of 12C508)
9	14A163	Wire harness retainer (part of 14290)
10	14A163	Wire harness retainer (part of 12C508)

Valve Cover (View 2 of 2)



Item	Part Number	Description
1	6C291	Valve cover retainer (10 required)
2	6C291	Valve cover retainer (4 required)
3	6M293	Valve cover
4	6K260	Valve cover gasket

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. Remove the oil level indicator.
2. Remove the ignition coil-on-plugs. For additional information, refer to Section 303-07A .
3. Disconnect the crankcase vent hose.
4. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.
5. Disconnect the Camshaft Position (CMP) sensor electrical connector.
6. Disconnect the radio capacitor electrical connector.
7. Disconnect the Variable Camshaft Timing (VCT) solenoid electrical connector.
8. Detach all of the wiring harness retainers from the valve cover studs and position the harness aside.
9. Remove the 14 valve cover retainers and the valve cover.
    - Discard the gasket.

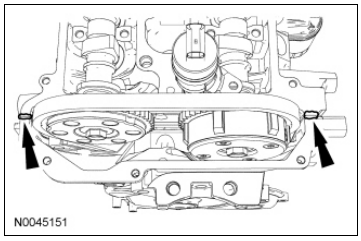
Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.**

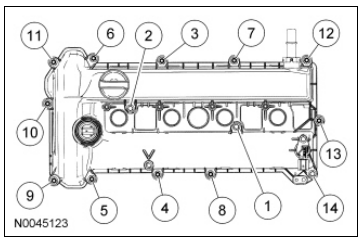
   Clean and inspect the sealing surfaces.

2. **NOTE:** The valve cover must be secured within 4 minutes of silicone gasket application. If the valve cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep.

   Apply silicone gasket and sealant to the locations shown.



3. Install the valve cover, new gasket and retainers.
   - Tighten in the sequence shown to 10 Nm (89 lb-in).



4. Position the wiring harness and attach all of the wiring harness retainers to the valve cover studs.

5. Connect the VCT solenoid electrical connector.

6. Connect the radio capacitor electrical connector.

7. Connect the CMP sensor electrical connector.

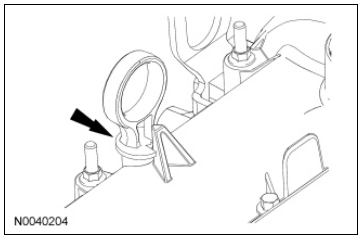
8. Connect the CHT sensor electrical connector.

9. Connect the crankcase vent hose.

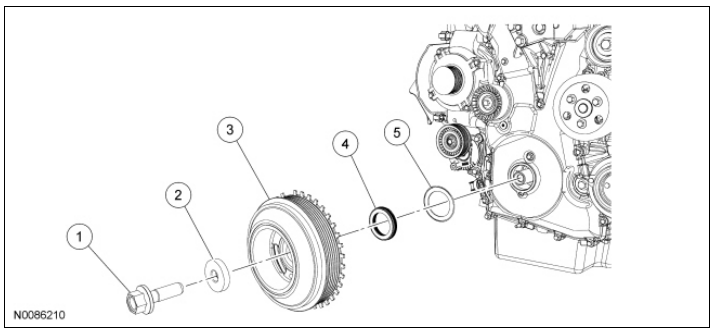
10. Install the ignition coil-on-plugs. For additional information, refer to Section 303-07A .

11. **NOTE:** Make sure the notch on the oil level indicator is aligned with the V-shaped boss on the valve cover and fully engaged into the valve cover.

    Install the oil level indicator.



Crankshaft Pulley and Crankshaft Front Seal - Exploded View



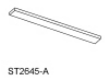
Item	Part Number	Description
1	6K340	Crankshaft pulley bolt
2	-	Crankshaft pulley washer (part of 6K340)
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal
5	6378	Diamond washer

1. ***NOTICE:*** **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools, otherwise severe engine damage can occur.**

   For additional information, refer to the procedures in this section.

Crankshaft Pulley

Special Tool(s)

 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST3054-A	Holding Tool, Crankshaft Damper 303-1416
 ST2638-A	Timing Peg, Crankshaft TDC 303-507
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

General Equipment

6 mm x 18 mm bolt

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

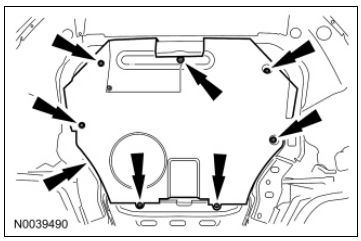
NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools, otherwise severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the front RH wheel and tire. For additional information, refer to Section 204-04 .

3. If equipped, remove the 7 screws and the underbody cover.



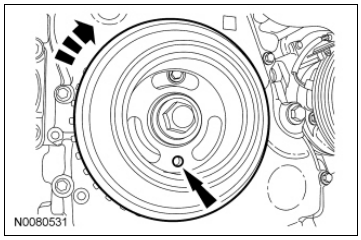
4. Remove the accessory drive belt. For additional information, refer to Section 303-05A in this section.

5. Remove the valve cover. For additional information, refer to Valve Cover in this section.

6. ***NOTICE:*** **Failure to position the No. 1 piston at Top Dead Center (TDC) can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

   Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at Top Dead Center (TDC).

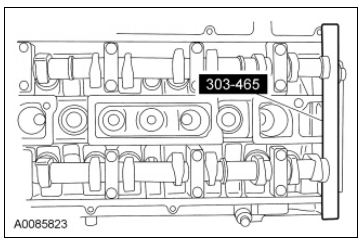
   - The hole in the crankshaft pulley should be in the 6 o'clock position.



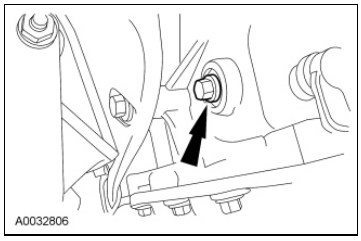
7. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   NOTE: The camshaft timing slots are offset. If the Camshaft Alignment Plate cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

   Install the Camshaft Alignment Plate in the slots on the rear of both camshafts.

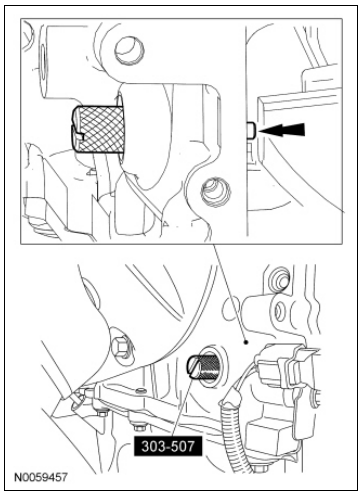


8. Remove the engine plug bolt.



9. **NOTE:** The Crankshaft TDC Timing Peg will contact the crankshaft and prevent it from turning past TDC . However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position during the crankshaft pulley removal and installation.

   Install the Crankshaft TDC Timing Peg.

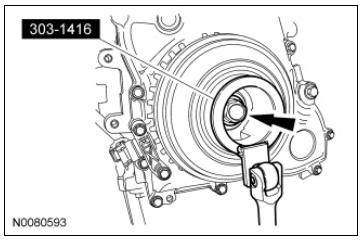


10. ***NOTICE:*** **The crankshaft must remain in the Top Dead Center (TDC) position during removal of the pulley bolt or damage to the engine can occur. Therefore, the crankshaft pulley must be held in place with the Crankshaft Damper Holding Tool and the bolt should be removed using an air impact wrench (1/2-in drive minimum).**

    NOTICE: **The crankshaft sprocket diamond washer may come off with the crankshaft pulley. The diamond washer must be replaced, remove and discard the diamond washer. If the diamond washer is not installed, engine damage may occur.**

    Using the Crankshaft Damper Holding Tool and an air impact wrench, remove the crankshaft pulley.

    - Remove and discard the crankshaft pulley bolt and washer.
    - Remove the crankshaft pulley.
    - Remove the diamond washer and discard.



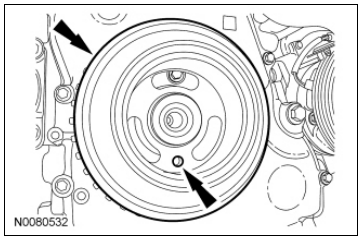
Installation

1. Install a new diamond washer.

2. **NOTE:** Do not install the crankshaft pulley bolt at this time.

   NOTE: Apply clean engine oil on the seal area before installing.

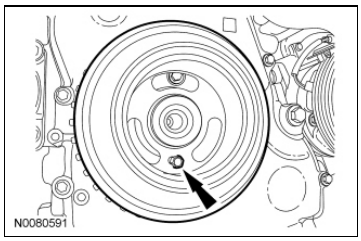
   Position the crankshaft pulley onto the crankshaft with the hole in the pulley at the 6 o'clock position.



3. ***NOTICE:*** **Only hand-tighten the 6 mm bolt or damage to the front cover can occur.**

   NOTE: This step will correctly align the crankshaft pulley to the crankshaft.

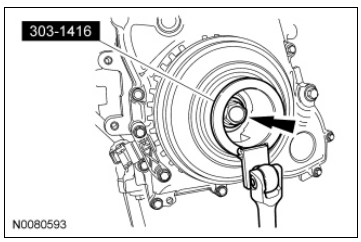
   Install a standard 6 mm x 18 mm bolt through the crankshaft pulley and thread it into the front cover.



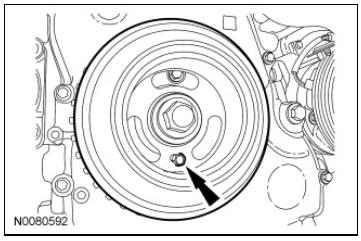
4. ***NOTICE:*** **The crankshaft must remain in the Top Dead Center (TDC) position during installation of the pulley bolt or damage to the engine can occur. Therefore, the crankshaft pulley must be held in place with the Crankshaft Damper Holding Tool and the bolt should be installed using hand tools only.**

   NOTE: Do not reuse the crankshaft pulley bolt.

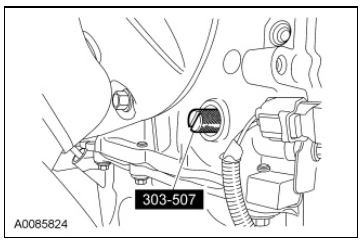
   - Install a new crankshaft pulley bolt. Using the Crankshaft Damper Holding Tool to hold the crankshaft pulley in place, tighten the crankshaft pulley bolt in 2 stages:
   - Stage 1: Tighten to 100 Nm (74 lb-ft).
   - Stage 2: Tighten an additional 90 degrees (one-fourth turn).



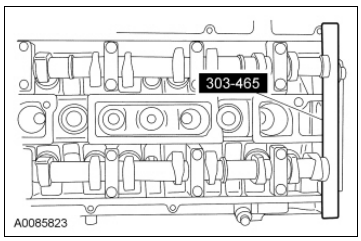
5. Remove the 6 mm x 18 mm bolt.



6. Remove the Crankshaft TDC Timing Peg.



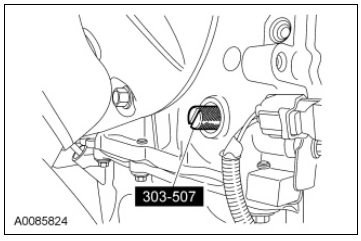
7. Remove the Camshaft Alignment Plate.



8. **NOTE:** Only turn the engine in the normal direction of rotation.

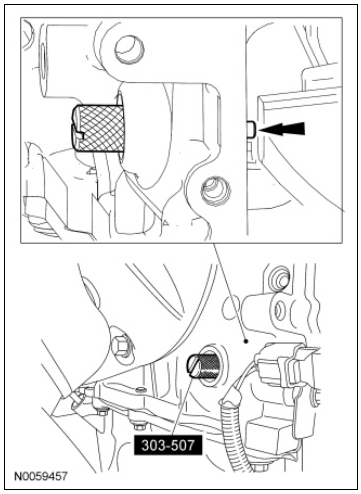
   Turn the crankshaft clockwise one and three-fourths turns.

9. Install the Crankshaft TDC Timing Peg.



10. **NOTE:** Only turn the engine in the normal direction of rotation.

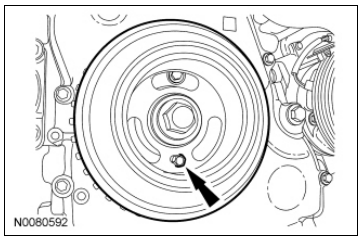
    Turn the crankshaft clockwise until the crankshaft contacts the Crankshaft TDC Timing Peg.



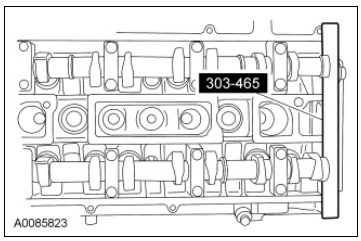
11. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

    Using the 6 mm x 18 mm bolt, check the position of the crankshaft pulley.

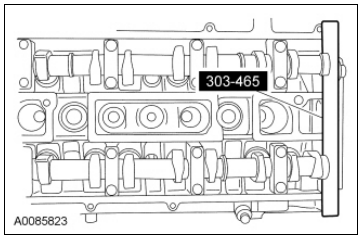
    - If it is not possible to install the bolt, the engine valve timing must be corrected by repeating this procedure.



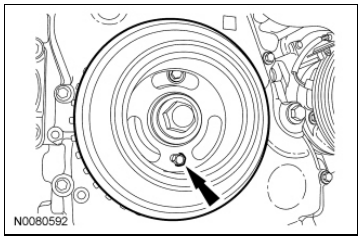
12. Install the Camshaft Alignment Plate to check the position of the camshafts.
    - If it is not possible to install the Camshaft Alignment Plate, the engine valve timing must be corrected by repeating this procedure.



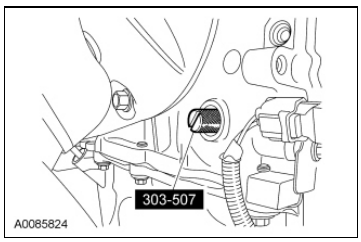
13. Remove the Camshaft Alignment Plate.



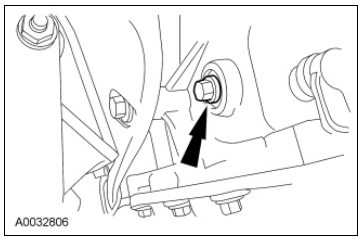
14. Remove the 6 mm x 18 mm bolt.



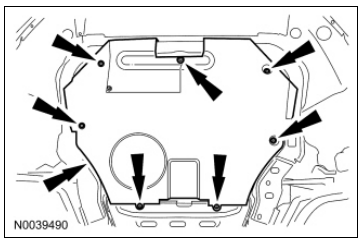
15. Remove the Crankshaft TDC Timing Peg.



16. Install the engine plug bolt.
    - To install, tighten to 20 Nm (177 lb-in).



17. If equipped, install the underbody cover and the 7 screws.



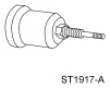
18. Install the accessory drive belt. For additional information, refer to Section 303-05A .

19. Install the valve cover. For additional information, refer to Valve Cover in this section.

20. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

Crankshaft Front Seal

Special Tool(s)

 ST1917-A	Installer, Camshaft Front Oil Seal 303-096 (T74P-6150-A)
	Remover, Oil Seal 303-409 (T92C-6700-CH)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

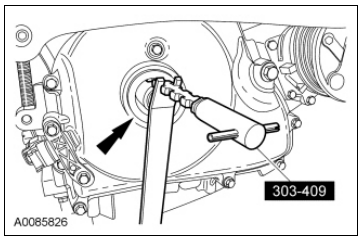
NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools, otherwise severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

2. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removi the seal.**

   Using the Oil Seal Remover, remove the crankshaft front oil seal.

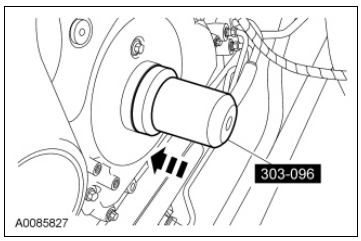


Installation

1. **NOTE:** Remove the through bolt from the Camshaft Front Oil Seal Installer.

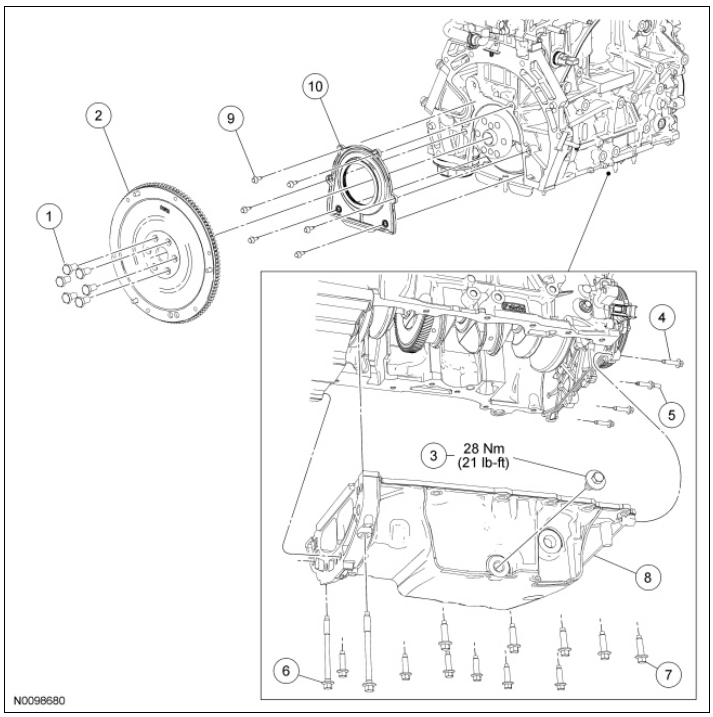
   NOTE: Lubricate the oil seal with clean engine oil.

   Using the Camshaft Front Oil Seal Installer, install the crankshaft front oil seal.



2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

Flexplate or Flywheel and Crankshaft Rear Seal - Exploded View



Item	Part Number	Description			
1	6379	Flexplate or flywheel bolt (6 required)			
2	6K375/6K390	Flexplate or flywheel			
3	6730	Oil pan drain plug			
4	W500215	Engine front cover bolt (4 required)			
5	940604	Engine front cover stud bolt			
6	W706284	Oil pan bolt (2 required)			
7	W500224	Oil pan bolt (11 required)	8	6675	Oil pan
9	W500212	Crankshaft rear oil seal with retainer plate bolt (6 required)			
10	6K318	Crankshaft rear oil seal with retainer plate			

1. For additional information, refer to the procedures in this section.

Flexplate

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the automatic transaxle. For additional information, refer to the appropriate automatic transion section.

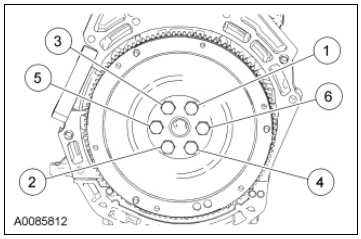
3. Remove the 6 bolts and the flexplate.

Installation

1. **NOTE:** Special bolts are used for installation. Do not use standard bolts.

   Install the flexplate and tighten the bolts in the sequence shown in 3 stages.

   - Stage 1: Tighten to 50 Nm (37 lb-ft).
   - Stage 2: Tighten to 80 Nm (59 lb-ft).
   - Stage 3: Tighten to 112 Nm (83 lb-ft).



2. Install the automatic transaxle. For additional information, refer to the appropriate automatic transmission section.

3. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Flywheel

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Removal

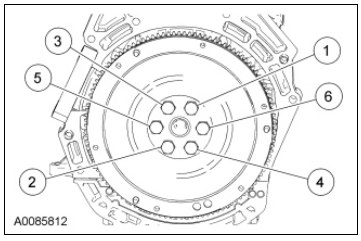
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the clutch. For additional information, refer to Section 308-01 .
3. Remove the 6 bolts and the flywheel.

Installation

1. **NOTE:** Special bolts are used for installation. Do not use standard bolts.

   Install the flywheel and tighten the bolts in the sequence shown in 3 stages.

   - Stage 1: Tighten to 50 Nm (37 lb-ft).
   - Stage 2: Tighten to 80 Nm (59 lb-ft).
   - Stage 3: Tighten to 112 Nm (83 lb-ft).



2. Install the clutch and manual transaxle. For additional information, refer to Section 308-01 .
3. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Crankshaft Rear Seal

Special Tool(s)

 ST1506-A	Installer, Crankshaft Rear Main Oil Seal 303-328 (T88P-6701-B1)

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blr Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the flexplate or flywheel. For additional information, refer to Flexplate or Flywheel in this section.

3. Drain the engine oil.
   - Install the drain plug.
   - Tighten to 28 Nm (21 lb-ft).

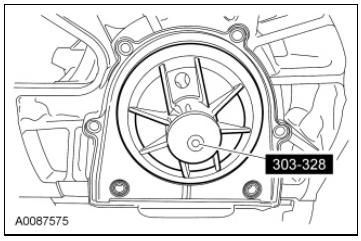
4. ***NOTICE:*** **If the oil pan is not removed, damage to the rear oil seal retainer joint can occur.**

   Remove the 16 bolts, stud bolt and the oil pan.

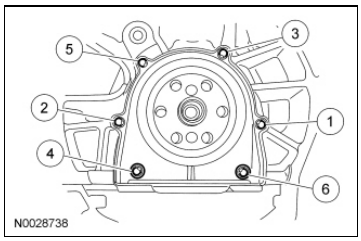
5. Remove the 6 bolts and the crankshaft rear oil seal with retainer plate.

Installation

1. Using the Crankshaft Rear Main Oil Seal Installer, position the crankshaft rear oil seal with retainer plate onto the crankshaft.



2. Install the crankshaft rear oil seal with retainer plate and bolts.
    - To install, tighten in the sequence shown to 10 Nm (89 lb-in).



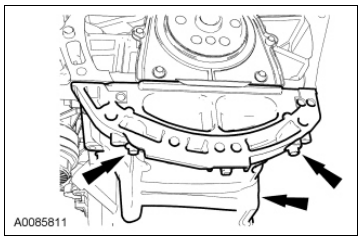
3. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.**

   Clean and inspect all the oil pan, engine front cover and cylinder block mating surfaces.

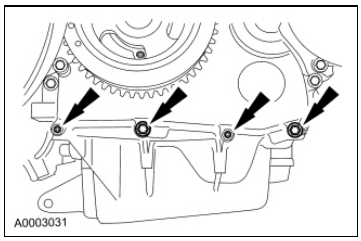
4. **NOTE:** If the oil pan is not secured within 4 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow these instructions can cause future oil leakage.

   NOTE: The oil pan must be installed and the bolts tightened within 4 minutes of applying the silicone gasket and sealant.

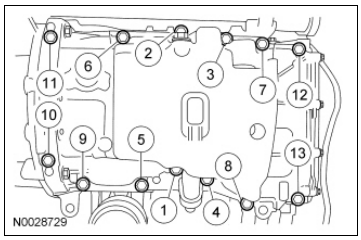
   Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the oil pan. Install the oil pan. Install the 2 oil pan bolts finger-tight.



5. Install the 3 bolts and the stud bolt.
    - To install, tighten to 10 Nm (89 lb-in).



6. Install the remaining oil pan bolts and tighten the oil pan bolts in the sequence shown to 20 Nm (177 lb-in).



7. Install the flexplate or flywheel. For additional information, refer to Flexplate or Flywheel in this section.

8. Fill the engine with clean engine oil.

Engine Front Cover

Special Tool(s)

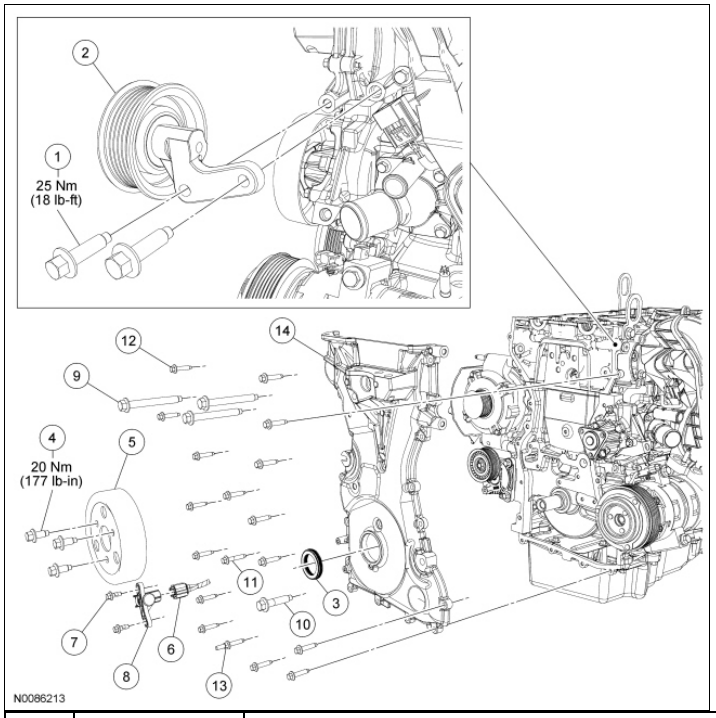
 ST3055A	Alignment Tool, Crank 303-1417
 ST1917-A	Installer, Camshaft Front Oil Seal 303-096 (T74P-6150-A)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)

General Equipment

6 mm x 18 mm bolt

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4



Item	Part Number	Description
1	W500224	Accessory drive belt idler pulley bolt (2 required)
2	19A216	Accessory drive belt idler pulley and bracket
3	6700	Crankshaft front seal
4	W500221	Coolant pump pulley bolt (3 required)
5	8509	Coolant pump pulley
6	14A464	Crankshaft Position (CKP) sensectrical connector (part of 12C508)
7	W701219	CKP sensor bolt (2 required)
8	6C315	CKP sensor
9	W500328	Engine front cover bolt (3 required)
10	W500320	Engine front cover bolt
11	W500300	Engine front cover bolt
12	W500215	Engine front cover bolt (16 required)
13	-	Engine front cover stud bolt
14	6019	Engine front cover

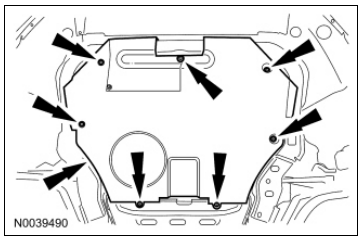
Removal

NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools, otherwise severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

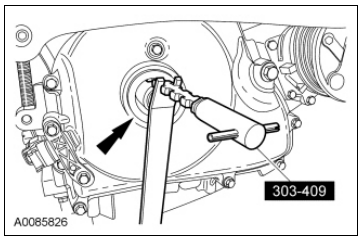
l start="1">
- With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Loosen the 3 coolant pump pulley bolts.
3. Remove the accessory drive belt and the accessory drive idler pulley. For additional information, refer to Section 303-05A .
4. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
5. If equipped, remove the 7 screws and the underbody cover.

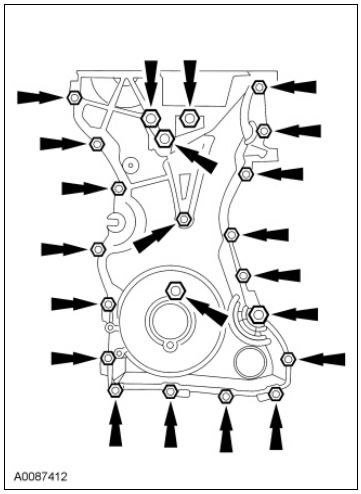


6. Remove the engine mount. For additional information, refer to Engine Mount in this section.
7. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

   Using the Oil Seal Remover, remove and discard the crankshaft front oil seal.



8. Remove the 3 bolts and the coolant pump pulley.
9. Remove the 2 bolts and the accessory drive belt idler pulley and bracket.
10. Disconnect the Crankshaft Position (CKP) sensor electrical connector.
11. Remove the 2 bolts and the CKP sensor.
12. Remove the 22 bolts and the engine front cover.



Installation

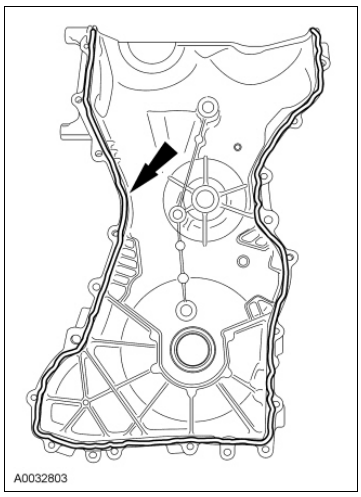
1. *NOTICE:* **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean sealing surfaces. These tools cause scratches and gouges which make leak paths.**

   Clean and inspect the mounting surfaces of the engine and the front cover.

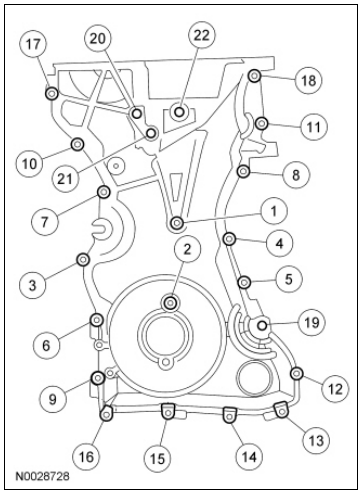
2. **NOTE:** The engine front cover must be installed and the bolts tightened within 4 minutes of applying the silicone gasket and sealant.

   NOTE: If the oil pan is not secured within 4 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow these instructions can cause future oil leakage.

   Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the cylinder head and oil pan joint areas. Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the front cover.



3. Install the engine front cover. Tighten the bolts in the sequence shown, to the following specifications:
   - Tighten the 8-mm bolts to 10 Nm (89 lb-in).
   - Tighten the 13-mm bolts to 48 Nm (35 lb-ft).



4. Install the accessory drive belt idler pulley and bracket and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

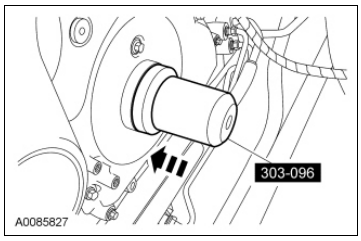
5. **NOTE:** The coolant pump pulley bolts should be tightened after the accessory drive belt is installed.

   Install the coolant pump pulley and bolts.

6. **NOTE:** Remove the through bolt from the Camshaft Front Oil Seal Installer.

   NOTE: Lubricate the oil seal with clean engine oil.

   Using the Camshaft Front Oil Seal Installer, install the crankshaft front oil seal.

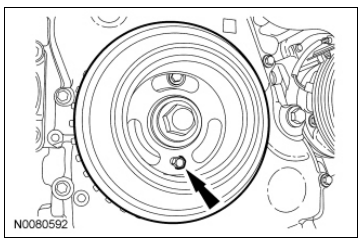


7. Install the engine mount. For additional information, refer to Engine Mount in this section.

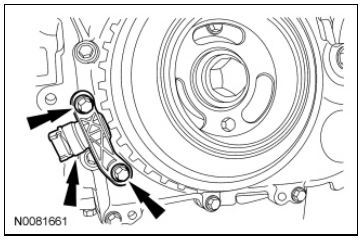
8. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

9. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

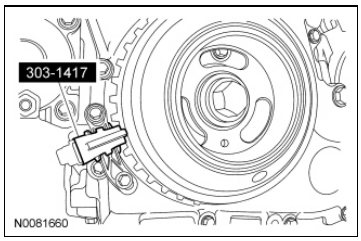
   Install a standard 6 mm x 18 mm bolt through the crankshaft pulley and thread it into the front cover.



10. Install the CKP sensor and the 2 bolts.
    - Do not tighten the bolts at this time.

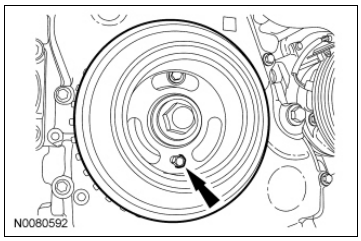


11. Using the Crank Alignment Tool, adjust the CKP sensor.
    - Tighten the bolts to 7 Nm (62 lb-in).

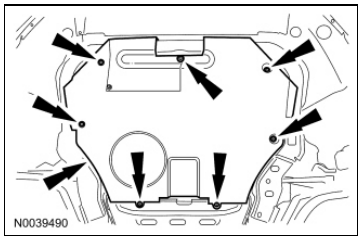


12. Connect the CKP sensor electrical connector.

13. Remove the 6 mm x 18 mm bolt.



14. If equipped, install the underbody cover and the 7 screws.



15. Install the accessory drive belt and the accessory drive idler pulley. For additional information, refer to Section 303-05A .

16. Tighten the 3 coolant pump pulley bolts to 20 Nm (177 lb-in).

Timing Drive Components

Removal

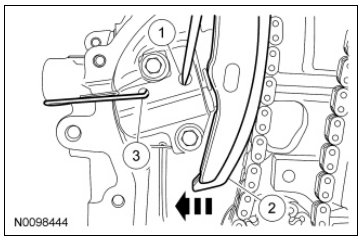
NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools, otherwise severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created whileaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

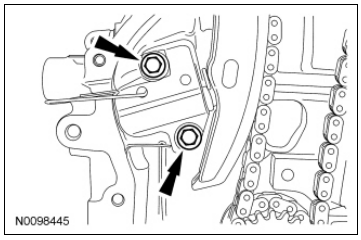
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

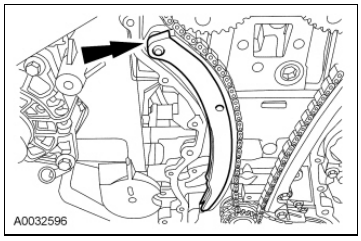
3. Compress the timing chain tensioner in the following sequence.
    1. Using a small pick, release and hold the ratchet mechanism.
    2. While holding the ratchet mechanism in the released position, compress the tensioner by pushing the timing chain arm toward the tensioner.
    3. Insert a paper clip into the hole to retain the tensioner.



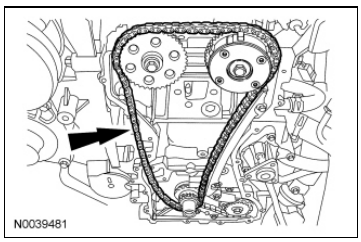
4. Remove the 2 bolts and timing chain tensioner.



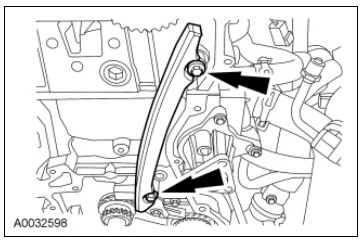
5. Remove the timing chain tensioner arm.



6. Remove the timing chain.

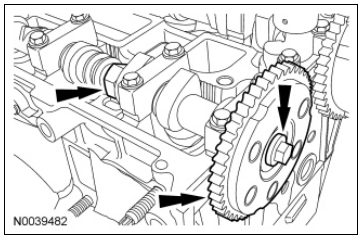


7. Remove the 2 bolts and the timing chain guide.



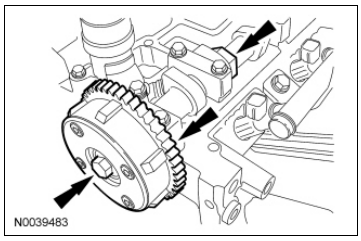
8. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the exhaust camshaft sprocket.



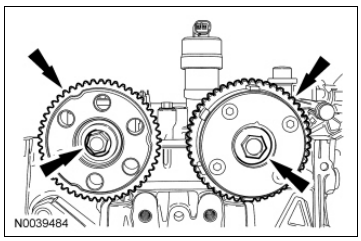
9. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the camshaft phaser and sprocket.

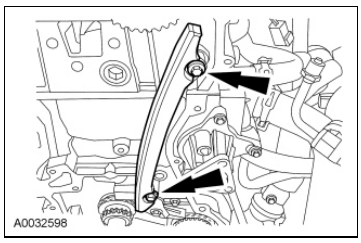


Installation

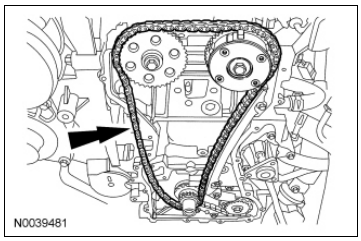
1. Install the camshaft sprockets and the bolts. Do not tighten the bolts at this time.



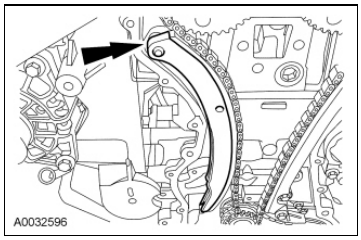
2. Install the timing chain guide and the 2 bolts.
   - To install, tighten to 10 Nm (89 lb-in).



3. Install the timing chain.



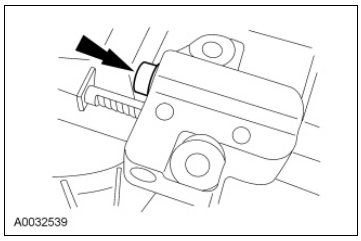
4. Install the timing chain tensioner arm.



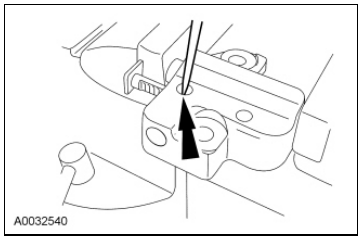
NOTE: If the timing chain tensioner plunger and ratchet assembly are not pinned in the compressed position, follow the next 4 steps.

5. ***NOTICE:*** **Do not compress the ratchet assembly. This will damage the ratchet assembly.**

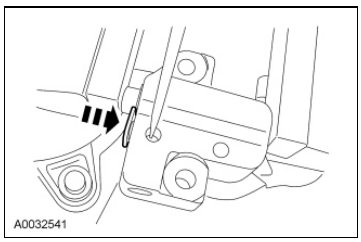
   Using the edge of a vise, compress the timing chain tensioner plunger.



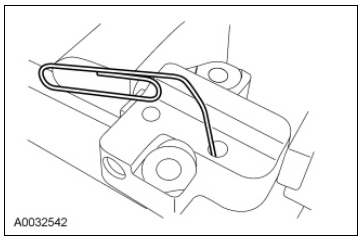
6. Using a small pick, push back and hold the ratchet mechanism.



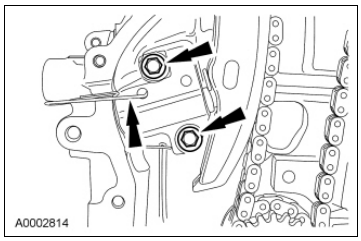
7. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.



8. Install a paper clip into the hole in the tensioner housing to hold the ratchet assembly and the plunger in during installation.



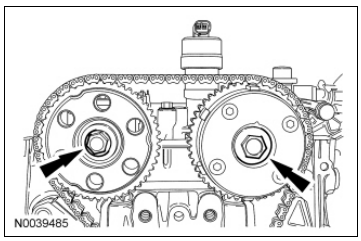
9. Install the timing chain tensioner and the 2 bolts. Remove the paper clip to release the piston.
   - Tighten to 10 Nm (89 lb-in).



10. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

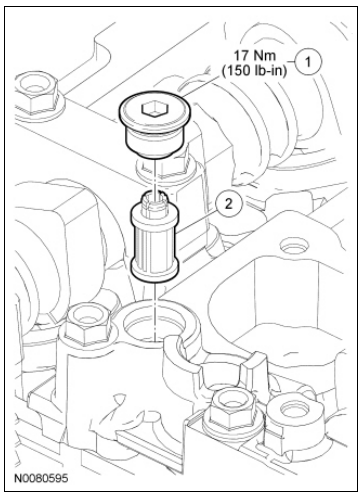
    Using the flats on the camshafts to prevent camshaft rotation, tighten the bolts.

    - Tighten to 72 Nm (53 lb-ft).



11. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Variable Camshaft Timing (VCT) System Oil Filter



Item	Part Number	Description
1	W710451	Plug
2	6C683	Variable Camshaft Timing (VCT) system oil filter

Removal and Installation

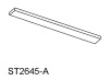
1. Remove the Variable Camshaft Timing (VCT) solenoid. For additional information, refer to Section 303-14A .

2. Remove the plug and the VCT system oil filter from the intake camshaft thrust cap.
   - To install, tighten to 17 Nm (150 lb-in).

3. To install, reverse the removal procedure.

Camshafts

Special Tool(s)

 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

General Equipment

6 mm x 18 mm bolt
M6 x 30 mm bolt

Material

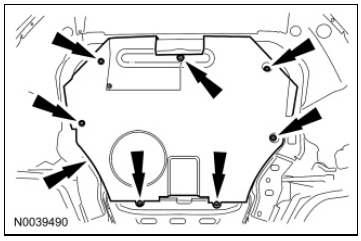
Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

NOTICE: **Do not rotate the camshafts or crankshaft unless instructed to do so in this procedure. Rotating the camshafts or crankshaft with timing components loosened or removed can cause serious damage to the valves or pistons.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the accessory drive belt. For additional information, refer to Section 303-05A .
3. Remove the front RH wheel and tire. For additional information, refer to Section 204-04 .
4. If equipped, remove the 7 screws and the underbody cover.



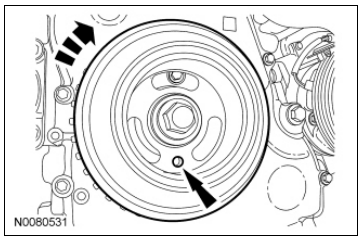
5. Remove the Variable Camshaft Timing (VCT) solenoid. For additional information, refer to Section 303-14A .

6. Check the valve clearance. For additional information, refer to Valve Clearance Check in this section.

7. ***NOTICE:*** **Failure to position the No. 1 piston at Top Dead Center (TDC) can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

   Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at Top Dead Center (TDC).

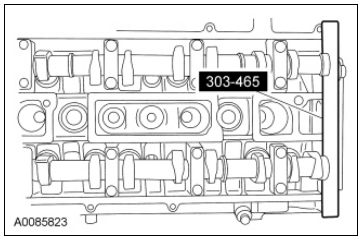
   - The hole in the crankshaft pulley should be in the 6 o'clock position.



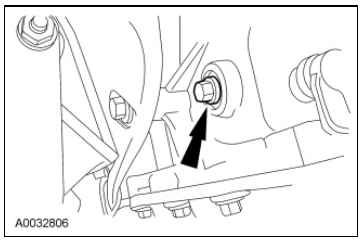
8. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   NOTE: The camshaft timing slots are offset. If the Camshaft Alignment Plate cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

   Install the Camshaft Alignment Plate in the slots on the rear of both camshafts.

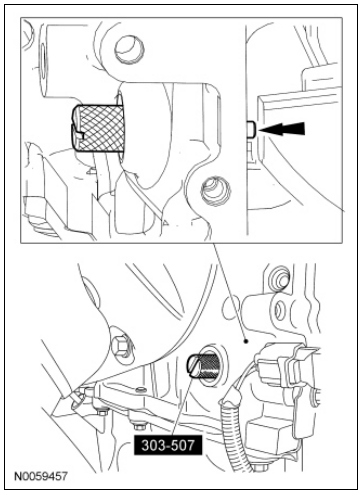


9. Remove the engine plug bolt.



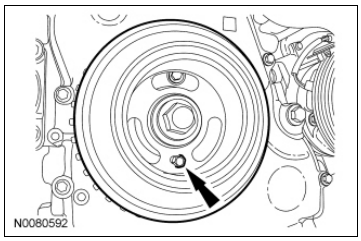
10. **NOTE:** The Crankshaft TDC Timing Peg will contact the crankshaft and prevent it from turning past TDC . However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position during the camshaft removal and installation.

    Install the Crankshaft TDC Timing Peg.

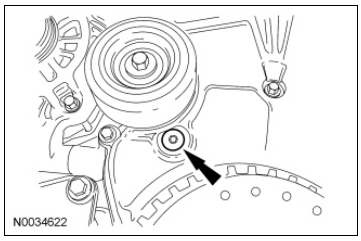


11. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

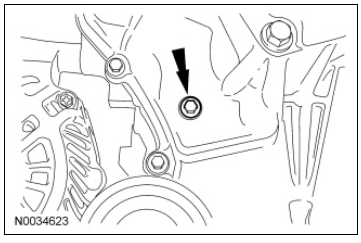
    Install a standard 6 mm x 18 mm bolt through the crankshaft pulley and thread it into the front cover.



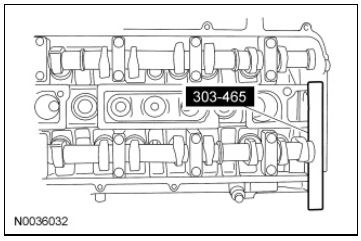
12. Remove the lower timing hole plug from the engine front cover.



13. Remove the upper timing hole plug from the engine front cover.



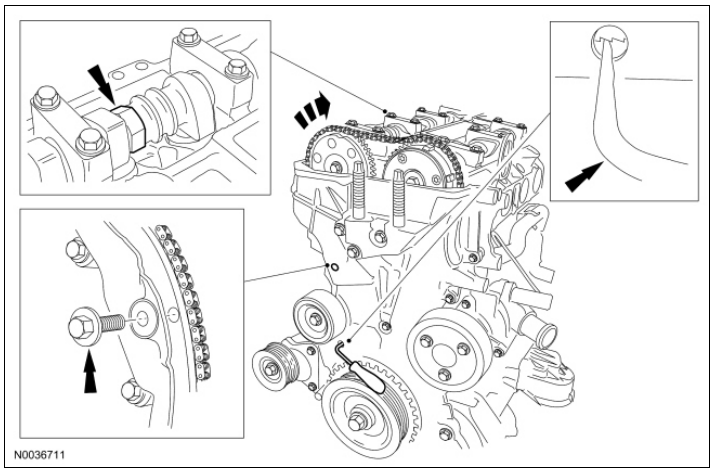
14. Reposition the Camshaft Alignment Plate to the slot on the rear of the intake camshaft only.



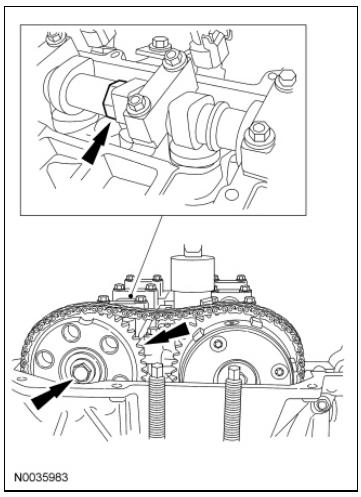
15. **NOTE:** Releasing the ratcheting mechanism in the timing chain tensioner allows the plunger to collapse and create slack in the timing chain. Installing the M6 x 30 mm bolt into the upper front cover timing hole will lock the tensioner arm in a retracted position and allow enough slack in the timing chain for removal of the exhaust camshaft gear.

    Using a small pick tool, release the timing chain tensioner ratchet through the lower front cover timing hole.

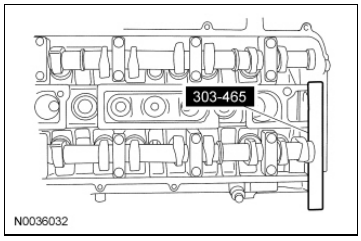
    - Have an assistant rotate the exhaust camshaft clockwise (using the flats of the camshaft) to collapse the timing chain tensioner plunger.
    - Insert the M6 x 30 mm bolt into the upper front cover timing hole to hold the tensioner arm in the retracted position.



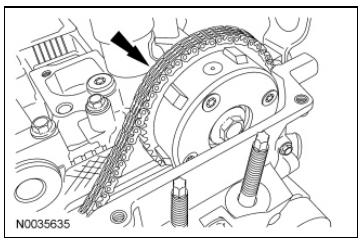
16. Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the exhaust camshaft drive gear.



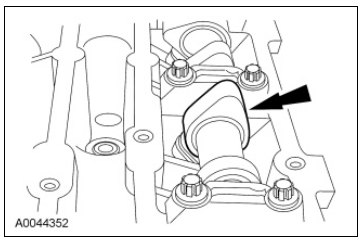
17. Remove the Camshaft Alignment Plate.



18. Remove the timing chain from the intake camshaft drive gear.



19. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.

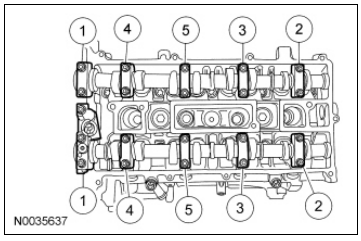


20. ***NOTICE:*** **Failure to follow the camshaft loosening procedure can result in damage to the camshafts.**

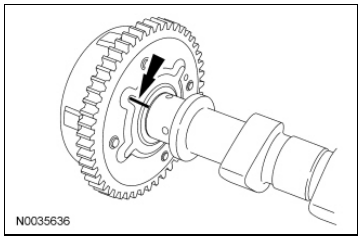
    NOTE: Mark the location and orientation of each camshaft bearing cap.

    Remove the camshafts from the engine.

    - Loosen the camshaft bearing cap bolts, in the sequence shown, one turn at a time until all tension is released from the camshaft bearing caps.
    - Remove the bolts and the camshaft bearing caps.
    - Remove the camshafts.



21. If removal of the camshaft phaser and sprocket is necessary, mark the sprocket and camshaft for reference during installation.
    - If necessary, place the camshaft in a soft-jawed vise. Remove the bolt and the camshaft phaser and sprocket.

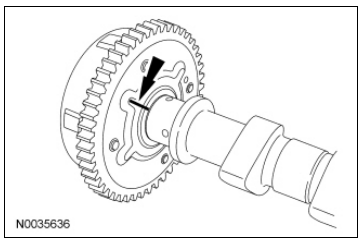


Installation

1. **NOTE:** If new parts are installed, transfer the reference marks made during disassembly to the new parts.

   If necessary, position the camshaft in a soft-jawed vise and install the camshaft phaser and sprocket and the bolt.

   - Align the reference marks on the camshaft phaser and sprocket and the camshaft. Tighten the bolt to 72 Nm (53 lb-ft).

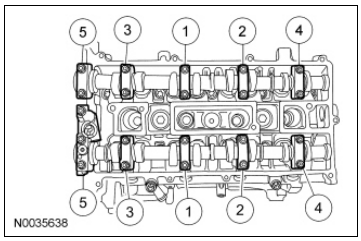


2. ***NOTICE:*** **Install the camshafts with the alignment slots in the camshafts lined up so the Camshaft Alignment Plate can be installed without rotating the camshafts. Make sure the lobes on the No. 1 cylinder are in the same position as noted in the removal procedure. Rotating the camshafts when the timing chain is removed, or installing the camshafts 180 degrees out of position can cause severe damage to the valves and pistons.**

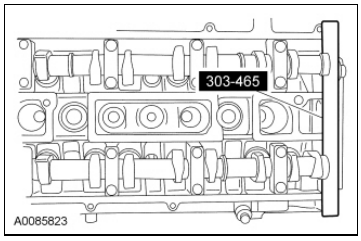
   NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

   Install the camshafts and bearing caps in their original locations and orientation. Tighten the bearing caps in the sequence shown in 3 stages:

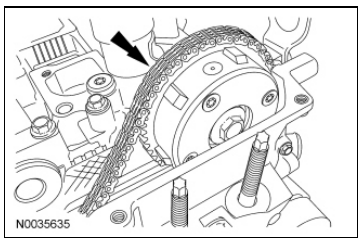
   - Stage 1: Tighten the camshaft bearing cap bolts until finger-tight.
   - Stage 2: Tighten to 7 Nm (62 lb-in).
   - Stage 3: Tighten to 16 Nm (142 lb-in).



3. Install the Camshaft Alignment Plate.



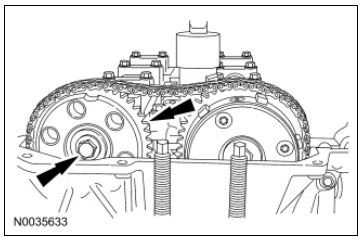
4. Install the timing chain on the intake camshaft drive gear.



5. **NOTE:** The timing chain must be correctly engaged on the teeth of the crankshaft timing sprocket and the intake camshaft drive gear in order to install the exhaust camshaft drive gear onto the exhaust camshaft.

   Position the exhaust camshaft drive gear in the timing chain and install the gear and bolt on the exhaust camshaft.

   - Hand-tighten the bolt.

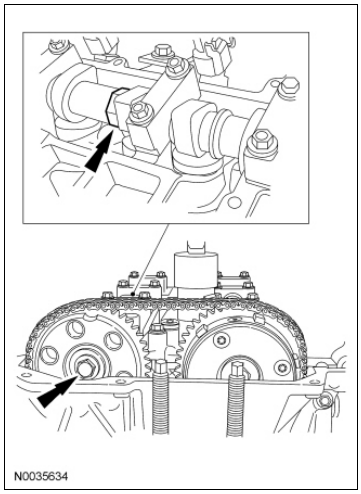


6. **NOTE:** Releasing the tensioner arm will remove the slack from the timing chain.

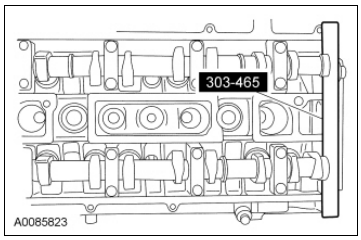
   Remove the M6 x 30 mm bolt from the upper front cover timing hole to release the tensioner arm.

7. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

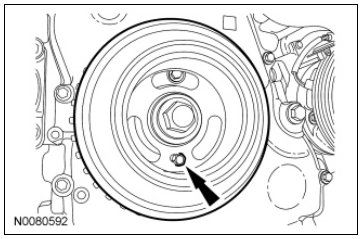
   Using the flats on the camshaft to prevent camshaft rotation, tighten the exhaust camshaft drive gear bolt to 72 Nm (53 lb-ft).



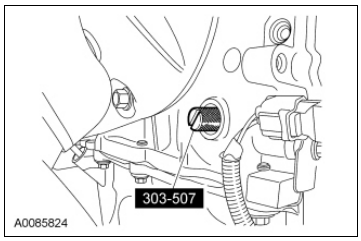
8. Remove the Camshaft Alignment Plate.



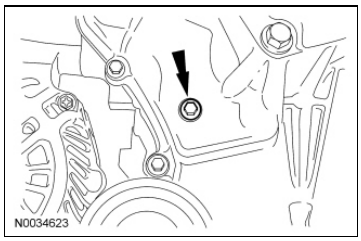
9. Remove the 6 mm x 18 mm bolt.



10. Remove the Crankshaft TDC Timing Peg.

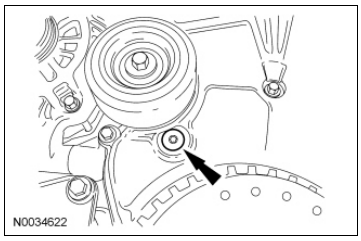


11. Install the upper timing hole plug in the engine front cover.
    - Tighten to 10 Nm (89 lb-in).

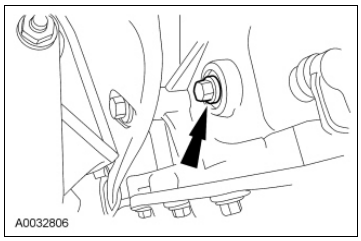


12. Apply silicone gasket and sealant to the threads of the lower timing hole plug.

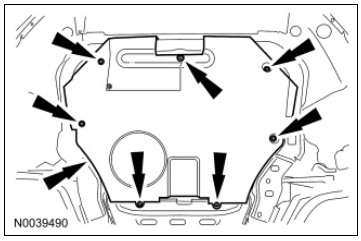
- Install the lower timing hole plug in the engine front cover.
  - ♦ Tighten to 12 Nm (106 lb-in).



13. Install the engine plug bolt.
    - Tighten to 20 Nm (177 lb-in).



14. If equipped, install the underbody cover and the 7 screws.



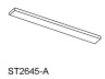
15. Install the front RH wheel and tire. For additional information, refer to Section 204-04 .

16. Install the accessory drive belt. For additional information, refer to Section 303-05A .

17. Install the VCT solenoid. For additional information, refer to Section 303-14A .

Camshaft Phaser and Sprocket

Special Tool(s)

 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

General Equipment

6 mm x 18 mm bolt
M6 x 30 mm bolt

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

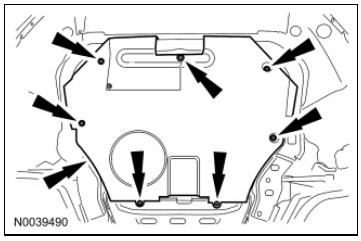
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

NOTICE: **Do not rotate the camshafts or crankshaft unless instructed to do so in this procedure. Rotating the camshafts or crankshaft with timing components loosened or removed can cause serious damage to the valves or pistons.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the accessory drive belt. For additional information, refer to Section 303-05A .

3. If equipped, remove the 7 screws and the undbody cover.



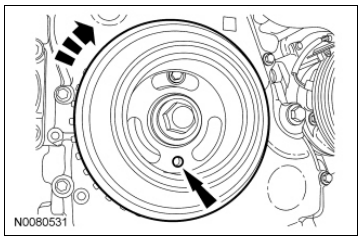
4. Remove the Variable Camshaft Timing (VCT) solenoid. For additional information, refer to Section 303-14A .

5. Check the valve clearance. For additional information, refer to Valve Clearance Check in this section.

6. ***NOTICE:*** **Failure to position the No. 1 piston at Top Dead Center (TDC) can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

   Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at Top Dead Center (TDC).

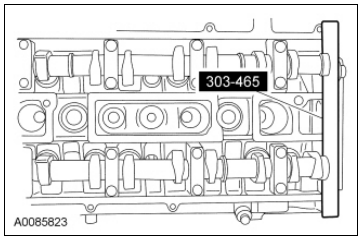
   - The hole in the crankshaft pulley should be in the 6 o'clock position.



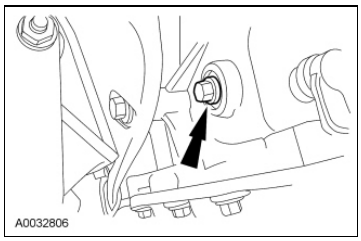
7. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   NOTE: The camshaft timing slots are offset. If the Camshaft Alignment Plate cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

   Install the Camshaft Alignment Plate in the slots on the rear of both camshafts.

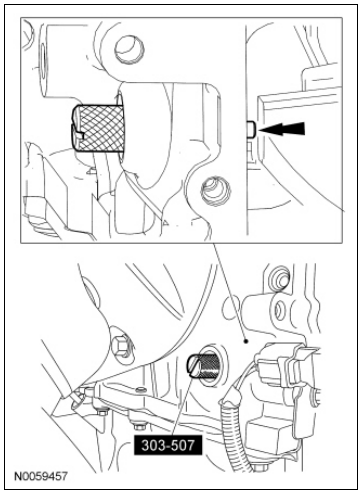


8. Remove the engine plug bolt.



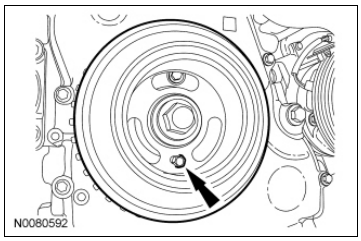
9. **NOTE:** The Crankshaft TDC Timing Peg will contact the crankshaft and prevent it from turning past TDC . However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position during the camshaft removal and installation.

   Install the Crankshaft TDC Timing Peg.

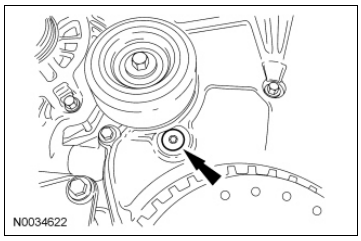


10. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

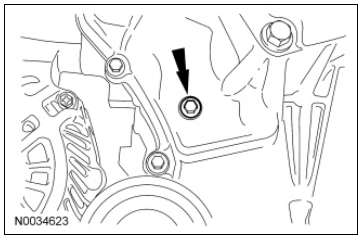
    Install a standard 6 mm x 18 mm bolt through the crankshaft pulley and thread it into the front cover.



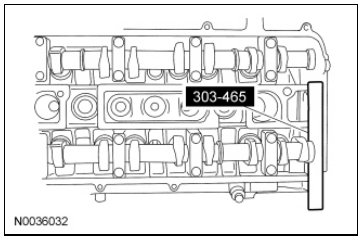
11. Remove the lower timing hole plug from the engine front cover.



12. Remove the upper timing hole plug from the engine front cover.



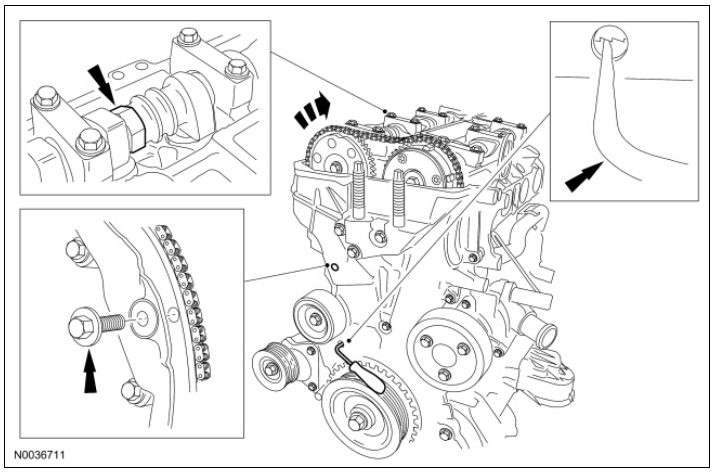
13. Reposition the Camshaft Alignment Plate to the slot on the rear of the intake camshaft only.



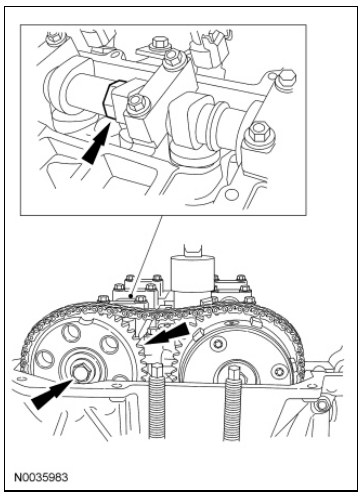
14. **NOTE:** Releasing the ratcheting mechanism in the timing chain tensioner allows the plunger to collapse and create slack in the timing chain. Installing the M6 x 30 mm bolt into the upper front cover timing hole will lock the tensioner arm in a retracted position and allow enough slack in the timing chain for removal of the exhaust camshaft gear.

    Using a small pick tool, release the timing chain tensioner ratchet through the lower front cover timing hole.

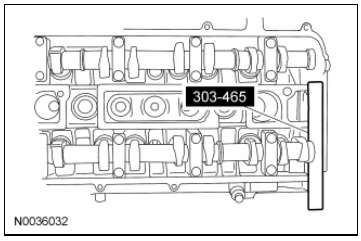
    - Have an assistant rotate the exhaust camshaft clockwise (using the flats of the camshaft) to collapse the timing chain tensioner plunger.
    - Insert the M6 x 30 mm bolt into the upper front cover timing hole to hold the tensioner arm in the retracted position.



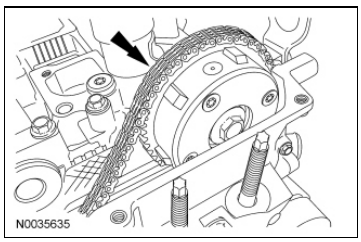
15. Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the exhaust camshaft drive gear.



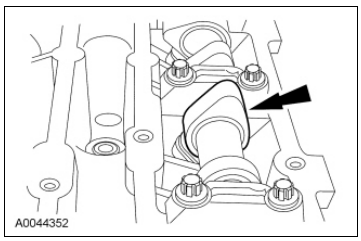
16. Remove the Camshaft Alignment Plate.



17. Remove the timing chain from the intake camshaft drive gear.



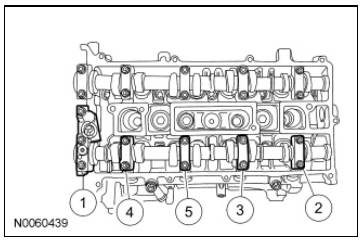
18. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.



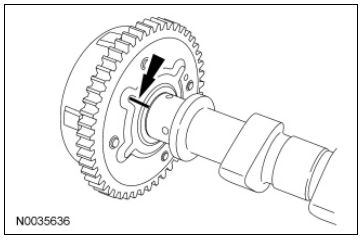
19. ***NOTICE:*** **Failure to follow the camshaft loosening procedure can result in damage to the intake camshaft.**

    Remove the intake camshaft from the engine.

    - Loosen the intake camshaft bearing cap bolts, in the sequence shown, one turn at a time until all tension is released from the camshaft bearing caps.
    - Remove the bolts and the camshaft bearing caps.
    - Remove the intake camshaft.



20. Mark the camshaft phaser and sprocket and the camshaft for reference during installation.



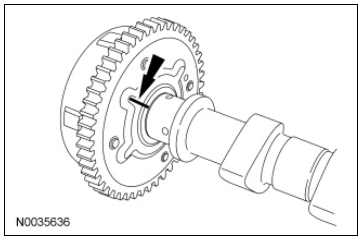
21. Place the camshaft in a soft-jawed vise. Remove the bolt and the camshaft phaser and sprocket.

Installation

1. **NOTE:** If new parts are installed, transfer the reference marks made during disassembly to the new parts.

   Position the camshaft in a soft-jawed vise. Install the camshaft phaser and sprocket and the bolt.

   - Align the reference marks on the camshaft phaser and sprocket and the camshaft. Tighten the bolt to 72 Nm (53 lb-ft).

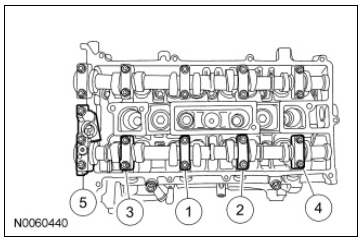


2. ***NOTICE:*** **Install the intake camshaft with the alignment slots in the camshafts lined up so the Camshaft Alignment Plate can be installed without rotating the camshafts. Make sure the lobes on the No. 1 cylinder are in the same position as noted in the removal procedure. Rotating the camshafts when the timing chain is removed, or installing the camshafts 180 degrees out of position can cause severe damage to the valves and pistons.**

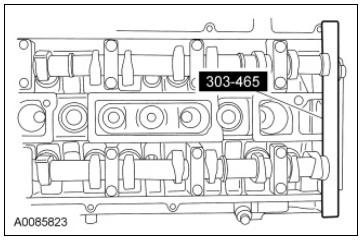
   NOTE: Lubricate the intake camshaft journals and bearing caps with clean engine oil.

   Install the intake camshafts and bearing caps. Tighten the intake camshaft bearing caps in the sequence shown in 3 stages:

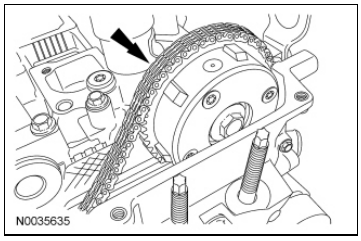
   - Stage 1: Tighten the intake camshaft bearing cap bolts until finger-tight.
   - Stage 2: Tighten to 7 Nm (62 lb-in).
   - Stage 3: Tighten to 16 Nm (142 lb-in).



3. Install the Camshaft Alignment Plate.



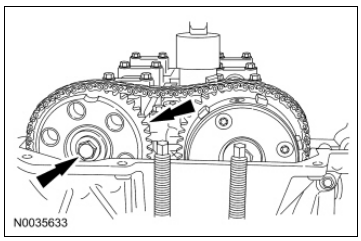
4. Install the timing chain on the intake camshaft drive gear.



5. **NOTE:** The timing chain must be correctly engaged on the teeth of the crankshaft timing sprocket and the intake camshaft drive gear in order to install the exhaust camshaft drive gear onto the exhaust camshaft.

   Position the exhaust camshaft drive gear in the timing chain and install the gear and bolt on the exhaust camshaft.

   - Hand-tighten the bolt.

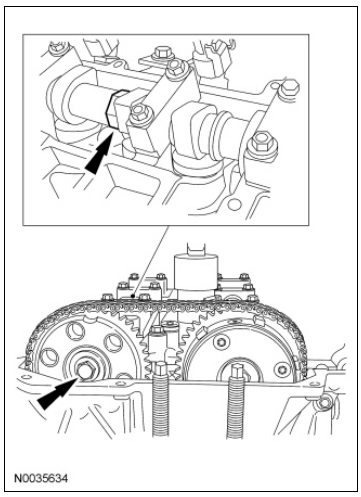


6. **NOTE:** Releasing the tensioner arm will remove the slack from the timing chain.

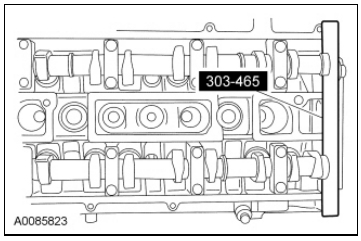
   Remove the M6 x 30 mm bolt from the upper front cover timing hole to release the tensioner arm.

7. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

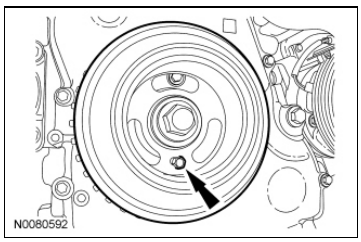
   Using the flats on the camshaft to prevent camshaft rotation, tighten the exhaust camshaft drive gear bolt to 72 Nm (53 lb-ft).



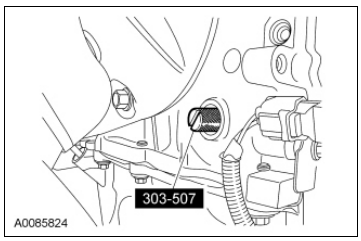
8. Remove the Camshaft Alignment Plate.



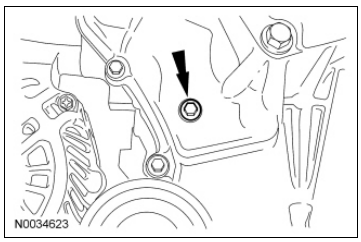
9. Remove the 6 mm x 18 mm bolt.



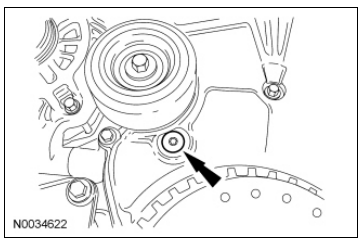
10. Remove the Crankshaft TDC Timing Peg.



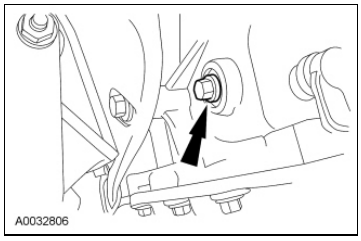
11. Install the upper timing hole plug in the engine front cover.
    - Tighten to 10 Nm (89 lb-in).



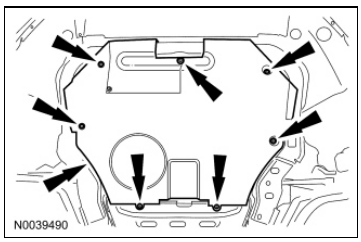
12. Apply silicone gasket and sealant to the threads of the lower timing hole plug.
    - Install the lower timing hole plug in the engine front cover.
        - ♦ Tighten to 12 Nm (106 lb-in).



13. Install the engine plug bolt.
    - Tighten to 20 Nm (177 lb-in).



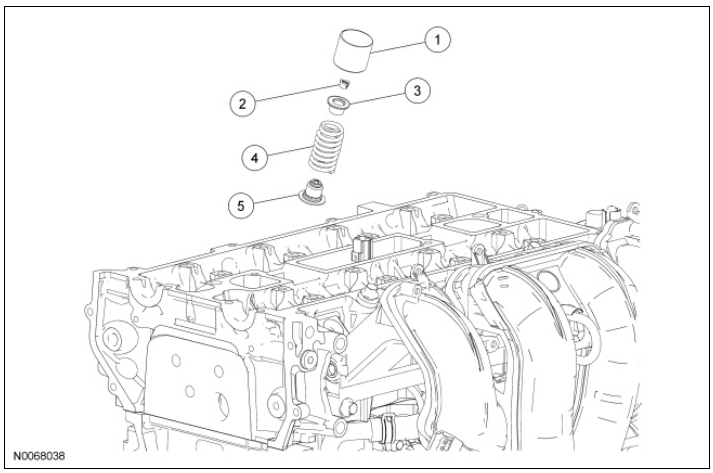
14. If equipped, install the underbody cover and the 7 screws.



15. Install the accessory drive belt. For additional information, refer to Section 303-05A .

16. Install the VCT solenoid. For additional information, refer to Section 303-14A .

Valve Train Components - Exploded View



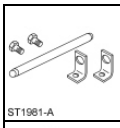
Item	Part Number	Description
1	6500	Valve tappet (16 required)
2	6518	Valve collet (16 required)
3	6514	Valve spring retainer (16 required)
4	6513	Valve spring (16 required)
5	6517	Valve seal (16 required)

1. For additional information, refer to the procedures in this section.

p;

Valve Springs

Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST1902-A	Compressor, Valve Spring 303-472 (T94P-6565-AH)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Multi-Purpose Grease Motorcraft® XL-5 (aerosol) and/or CRC® SL3151	ESB-M1C93-B

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the camshafts. For additional information, refer to Camshafts in this section.

3. **NOTE:** If the camshafts and valve tappets are to be reusmark the location of the valve tappets to make sure they are assembled in their original positions.

   NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

   Remove and inspect the valve tappets. For additional information, refer to Section 303-00 .

4. Remove the spark plugs. For additional information, refer to Section 303-07A .

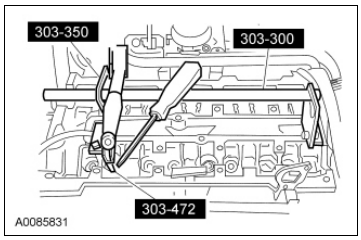
5. *NOTICE:* **Use compressed air at 7-10 bars (100-150 psi). Do not disconnect the compressed air from the cylinder until the valve spring, valve spring retainer and valve collet are installed. Any loss of air pressure will allow the valve to fall into the cylinder.**

   Connect compressed air supply to the No. 1 cylinder.

6. **NOTE:** Place all parts in order to one side.

   Apply compressed air to the cylinder and remove the valve spring.

   - Using the Valve Spring Compressors, compress the valve spring and remove the valve collet, using some grease and a small screwdriver.
   - Remove the valve spring retainer and the valve spring.

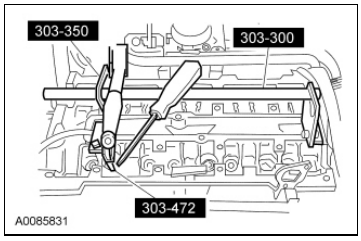


Installation

1. **NOTE:** Check the seating of the valve collet.

   Using the Valve Spring Compressors, install the valve spring.

   - Insert the valve spring and the valve spring retainer.
   - Compress the valve spring and install the valve collet using some grease and a small screwdriver.



2. Disconnect the compressed air supply.

3. Repeat the appropriate removal and installation steps for all of the other cylinders.

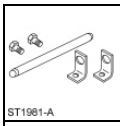
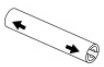
4. Install the spark plugs. For additional information, refer to Section 303-07A .

5. Coat the valve tappets with clean engine oil and insert them.

6. Install the camshafts. For additional information, refer to Camshafts in this section.

Valve Seals

Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST1902-A	Compressor, Valve Spring 303-472 (T94P-6565-AH)
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)
 ST1904-A	Remover, Valve Stem Oil Seal 303-468 (T94P-6510-AH)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Multi-Purpose Grease Motorcraft® XL-5 (aerosol) and/or CRC® SL3151	ESB-M1C93-B

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the camshafts. For additional information, refer to Camshafts in this section.

3. **NOTE:** If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

   NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

   Remove and inspect the valve tappets. For additional information, refer to Section 303-00 .

4. Remove the spark plugs. For additional information, refer to Section 303-07A .

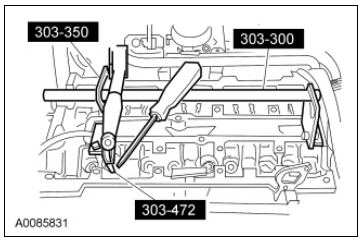
5. ***NOTICE:*** **Use compressed air at 7-10 bars (100-150 psi). Do not disconnect the compressed air from the cylinder until the valve spring, valve spring retainer and valve collet are installed. Any loss of air pressure will allow the valve to fall into the cylinder.**

   Connect compressed air supply to the No. 1 cylinder.

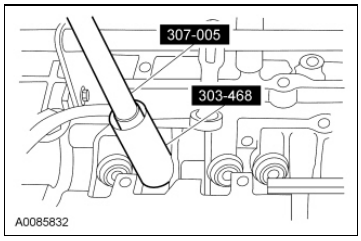
6. **NOTE:** Place all parts in order to one side.

   Apply compressed air to the cylinder and remove the valve spring.

   - Using the Valve Spring Compressors, compress the valve spring and remove the valve collet, using some grease and a small screwdriver.
   - Remove the valve spring retainer and the valve spring.

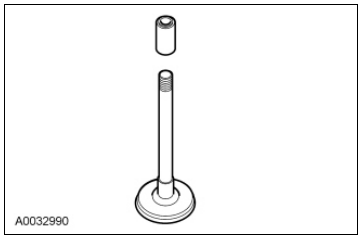


7. Using the Valve Stem Oil Seal Remover and Slide Hammer, remove and discard the valve seal.

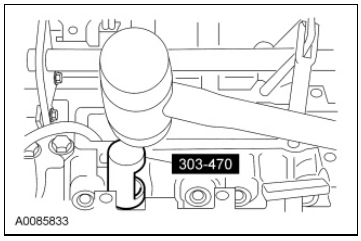


Installation

1. Install the valve stem seal installation sleeve.



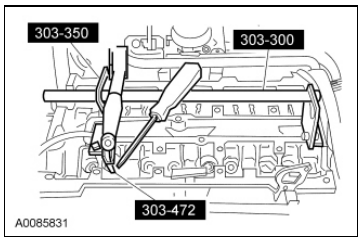
2. Using the Valve Stem Oil Seal Installer, install the valve seal.



3. **NOTE:** Check the seating of the valve collet.

   Using the Valve Spring Compressors, install the valve spring.

   - Insert the valve spring and the valve spring retainer.
   - Compress the valve spring and install the valve collet using some grease and a small screwdriver.



4. Disconnect the compressed air supply.

5. Repeat the appropriate removal and installation steps for all of the other cylinders.

6. Install the spark plugs. For additional information, refer to Section 303-07A .

7. Coat the valve tappets with clean engine oil and insert them.

8. Install the camshafts. For additional information, refer to Camshafts in this section.

Valve Tappets

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the camshafts. For additional information, refer to Camshafts in this section.

3. **NOTE:** If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

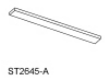
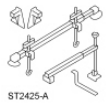
   NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

   Remove and inspect the valve tappets. For additional information, refer to Section 303-00 .

4. To install, reverse the removal procedure.
   - Coat the valve tappets with clean engine oil prior to installation.

Cylinder Head

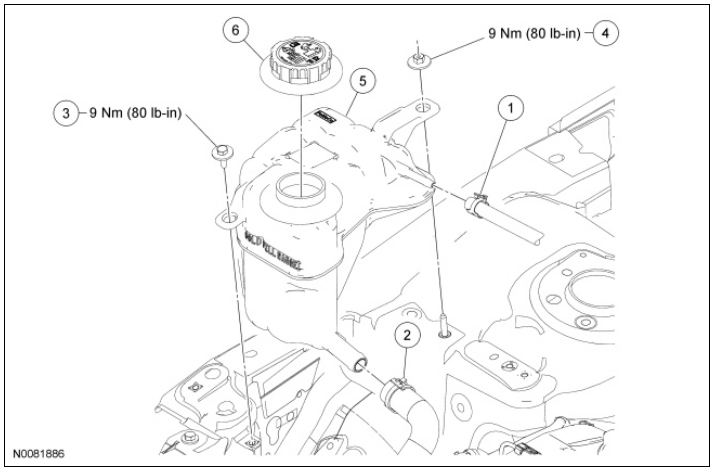
Special Tool(s)

 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST2425-A	Engine Support Bar 303-F072
 ST1595-A	Lifting Bracket, Engine 303-050 (T70P-6000)

Material

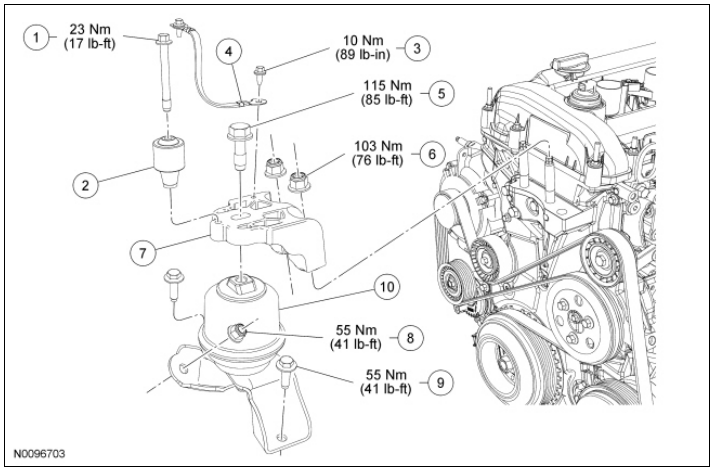
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Motorcraft® Silicone Gasket Remover ZC-30	-

Degas Bottle



Item	Part Number	Description
1	8276	Degas bottle-to-radiator hose
2	8C351	Lower degas bottle hose
3	W707398	Degas bottle-to-fender bolt
4	W709603	Degas bottle-to-fender nut
5	8A080	Degas bottle
6	8100	Pressure relief cap

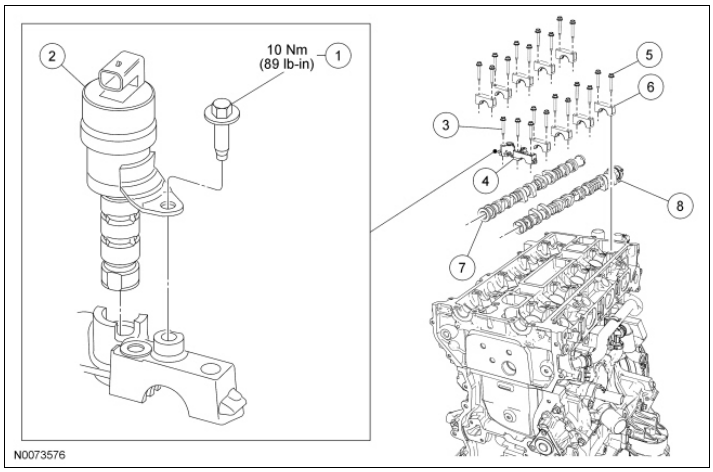
Engine Mount



Item	Part Number	Description
1	W711879	Damper bolt
2	7458	Damper
3	W705936	Ground wire bolt
4	19A095	Ground wire
5	W711684	Engine mount bracket bolt
6	W520214	Engine mount bracket nut (2 required)
7	6A094	Engine mount bracket
8	W711578	Engine mount nut
9	W706496	Engine mount bolt (2 required)

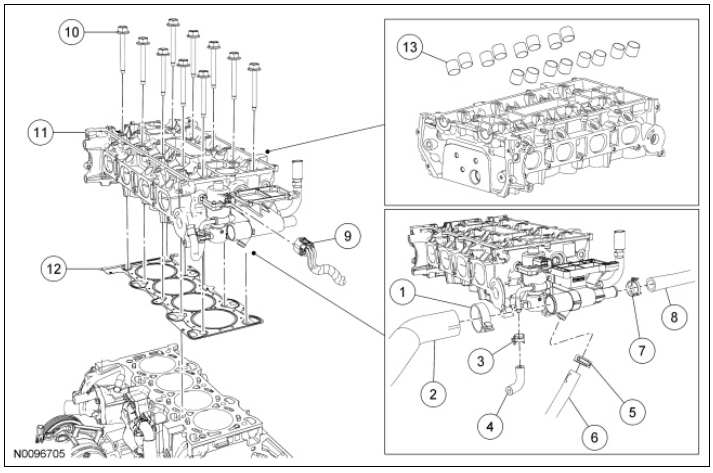
10	6F012	Engine mount

Camshafts



Item	Part Number	Description
1	W500211	Variable Camshaft Timing (VCT) oil control solenoid bolt
2	6M280	VCT oil control solenoid
3	W500301	Intake camshaft bearing cap bolt
4	6A258	Intake camshaft bearing cap
5	W703383	Camshaft bearing cap bolt (20 required)
6	6A284	Camshaft bearing cap (9 required)
7	6A272	Exhaust camshaft
8	6A267	Intake camshaft

Cylinder Head



Item	Part Number	Description
1	W527372	Upper radiator hose clamp

2	8B274	Upper radiator hose
3	15161	EGR coolant tube clamp
4	-	EGR coolant hose (part of 18C266)
5	W525958	Bypass hose clamp
6	8548	Bypass hose
7	-	Heater hose clamp (part of 18C266)
8	18C266	Heater hose
9	14A464	EGR valve electrical connector (part of 12B637)
10	6065	Cylinder head bolt (10 required)
11	6050	Cylinder head
12	6051	Cylinder head gasket
13	6500	Valve tappet (16 required)

Removal

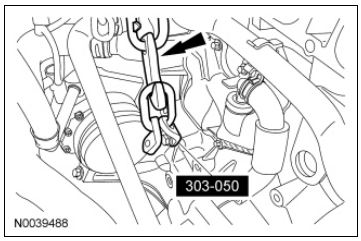
NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools, otherwise severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

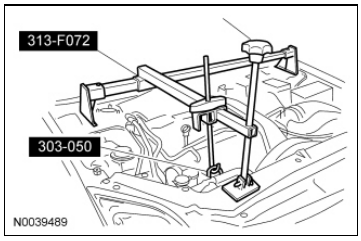
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Release the fuel system pressure. For additional information, refer to Section 310-00 .
3. Check the valve clearance. For additional information, refer to Valve Clearance Check in this section.
4. Drain the engine cooling system. For additional information, refer to Section 303-03A .
5. Disconnect the degas bottle-to-radiator hose from the degas bottle.
6. Remove the nut and bolt and position the degas bottle to access the lower degas bottle hose.
7. Disconnect the lower degas bottle hose and remove the degas bottle.
8. Remove the generator. For additional information, refer to Section 414-00 .
9. Remove the fuel supply rail. For additional information, refer to Section 303-04A .
10. Remove the intake manifold. For additional information, refer to Intake Manifold in this section.
11. Remove the exhaust manifold. For additional information, refer to Exhaust Manifold in this section.
12. Remove the bolt and the engine mount damper from the engine mount bracket.
13. Remove the bolt and the ground wire from the engine mount bracket.

14. Remove the engine mount bracket bolt.

15. Install the Engine Lifting Brackets and a suitable length of chain to the threaded hole in the LH side of the engine block.



16. Using the Engine Support Bar and Engine Lifting Brackets, lift the engine 25 mm (0.98 in).



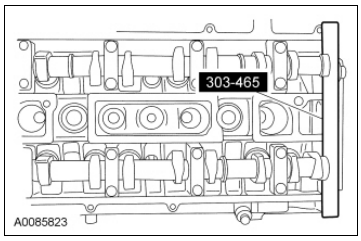
17. Remove the nut, 2 bolts and the engine mount.

18. Lower the engine 25 mm (0.98 in).

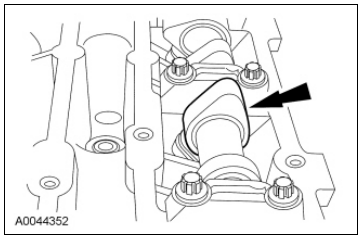
19. Remove the 2 nuts and the engine mount bracket.

20. Remove the timing drive components. For additional information, refer to Timing Drive Components in this section.

21. Remove the Camshaft Alignment Plate.



22. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.



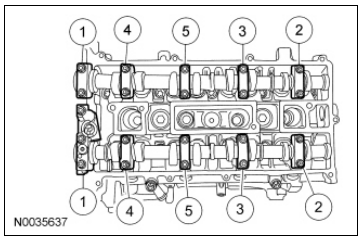
23. Remove the bolt and the Variable Camshaft Timing (VCT) solenoid.

24. **NOTE:** Failure to follow the camshaft loosening procedure can result in damage to the camshafts.

NOTE: Mark the location and orientation of each camshaft bearing cap.

Remove the camshafts from the engine.

- Loosen the camshaft bearing cap bolts, in the sequence shown, one turn at a time until all tension is released from the camshaft bearing caps.
- Remove the bolts and the camshaft bearing caps.
- Remove the camshafts.



25. **NOTE:** If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

    NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

    Remove and inspect the valve tappets. For additional information, refer to Section 303-00 .

26. Disconnect the upper radiator hose, coolant bypass hose and heater hose from the engine coolant outlet.

27. Disconnect the EGR valve electrical connector.

28. Disconnect the coolant hose from the EGR valve.

29. Remove the 10 bolts and the cylinder head.
    - Discard the bolts.
    - Discard the cylinder head gasket.

Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

   NOTICE: **Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.**

   NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

   Clean the cylinder head-to-cylinder block mating surface of both the cylinder head and the cylinder block in the following sequence.

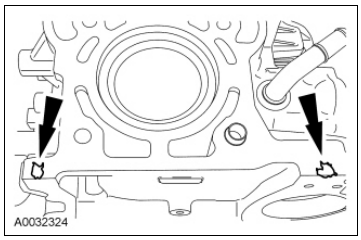
   1. Remove any large deposits of silicone or gasket material with a plastic scraper.
   2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.

3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply metal surface prep, following package directions, to remove any traces of oil or coolant, and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

2. Clean the cylinder head bolt holes in the cylinder block. Make sure all coolant, oil or other foreign material is removed.

3. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

4. Apply silicone gasket and sealant to the locations shown.



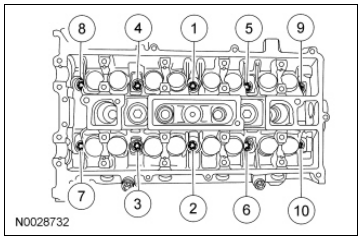
5. Install a new cylinder head gasket.

6. **NOTE:** The cylinder head bolts are a torque-to-yield design and must not be reused. New cylinder head bolts must be installed.

   NOTE: Lubricate the bolts with clean engine oil prior to installation.

   Install the cylinder head and 10 new bolts. Tighten the bolts in the sequence shown in 5 stages:

   - Stage 1: Tighten to 7 Nm (62 lb-in).
   - Stage 2: Tighten to 15 Nm (133 lb-in).
   - Stage 3: Tighten to 45 Nm (33 lb-ft).
   - Stage 4: Turn 90 degrees.
   - Stage 5: Turn an additional 90 degrees.



7. Connect the coolant hose to the EGR valve.

8. Connect the EGR valve electrical connector.

9. Connect the upper radiator hose, coolant bypass hose and heater hose to the engine coolant outlet.

10. **NOTE:** Coat the valve tappets with clean engine oil prior to installation.

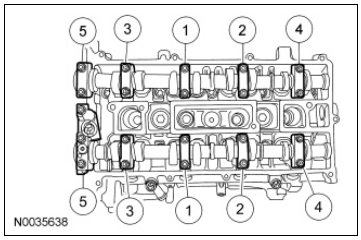
    Install the valve tappets.

11. ***NOTICE:*** **Install the camshafts with the alignment slots in the camshafts lined up so the Camshaft Alignment Plate can be installed without rotating the camshafts. Make sure the lobes on the No. 1 cylinder are in the same position as noted in the removal procedure. Rotating the camshafts when the timing chain is removed, or installing the camshafts 180 degrees out of position can cause severe damage to the valves and pistons.**

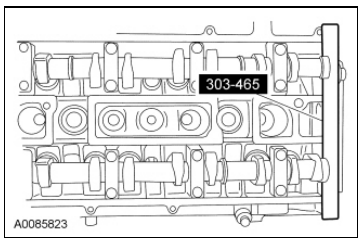
    NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

    Install the camshafts and bearing caps in their original locations and orientation. Tighten the bearing caps in the sequence shown in 3 stages:

    - Stages 1: Tighten the camshaft bearing cap bolts until finger-tight.
    - Stages 2: Tighten to 7 Nm (62 lb-in).
    - Stages 3: Tighten to 16 Nm (142 lb-in).



12. Install the Camshaft Alignment Plate.

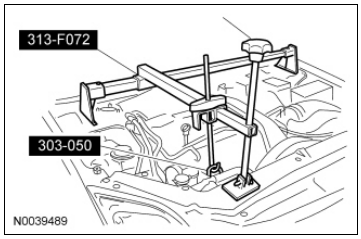


13. Install the VCT solenoid and bolt.
    - Tighten to 10 Nm (89 lb-in).

14. Install the timing drive components. For additional information, refer to Timing Drive Components in this section.

15. Install the engine mount bracket and the 2 nuts.
    - Tighten to 103 Nm (76 lb-ft).

16. Using the Engine Support Bar and Engine Lifting Brackets, lift the engine 25 mm (0.98 in).



17. Install the engine mount, nut and 2 bolts.
    - Tighten to 55 Nm (41 lb-ft).

18. Lower the engine 25 mm (0.98 in).

19. Install the engine mount bracket bolt.
    - Tighten to 115 Nm (85 lb-ft).

20. Install the ground wire-to-engine mount bracket and bolt.
    - Tighten to 10 Nm (89 lb-in).

21. Install the engine mount damper and the bolt.
    - Tighten to 23 Nm (17 lb-ft).

22. Install the exhaust manifold. For additional information, refer to Exhaust Manifold in this section.

23. Install the intake manifold. For additional information, refer to Intake Manifold in this section.

24. Install the fuel supply rail. For additional information, refer to Section 303-04A .

25. Install the generator. For additional information, refer to Section 414-00 .

26. Connect the lower degas bottle hose to the degas bottle.

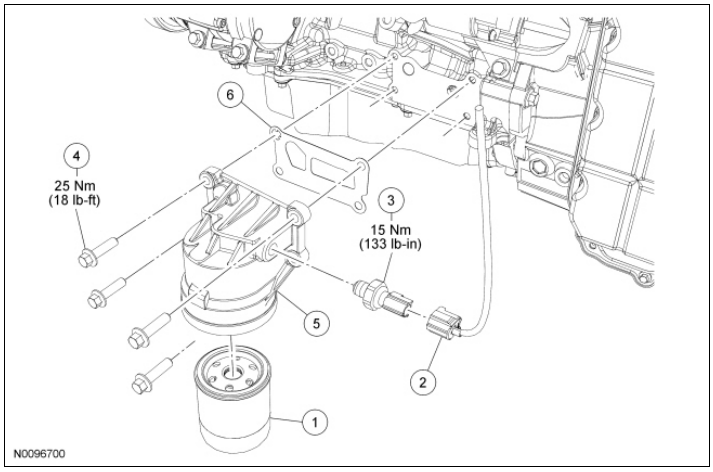
27. Install the degas bottle and the nut and bolt.
    - Tighten to 9 Nm (80 lb-in).

28. Connect the degas bottle-to-radiator hose.

29. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03A .

Engine Lubrication Components - Exploded View

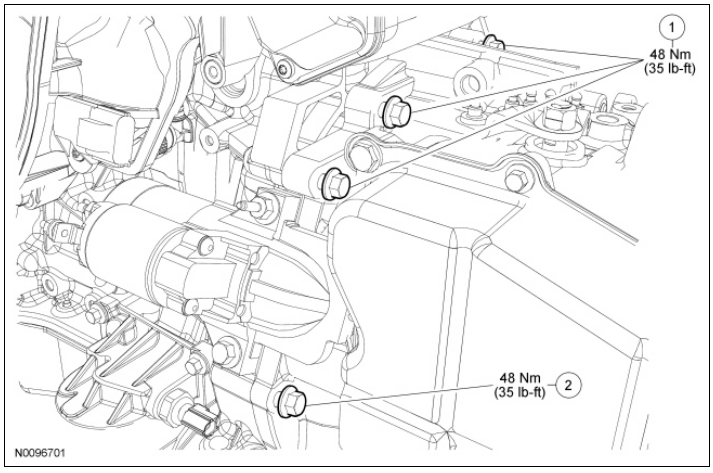
Oil Filter Adapter, Oil Filter and Engine Oil Pressure (EOP) Switch



Item	Part Number	Description
1	6714	Oil filter
2	14A464	Engine Oil Pressure (EOP) switch electrical connector (part of 12C508)
3	9278	EOP switch
4	W500225	Oil filter adapter bolt (4 required)
5	6884	Oil filter adapter
6	6A636	Oil filter adapter gasket

Transmission Bolts for Oil Pan Removal

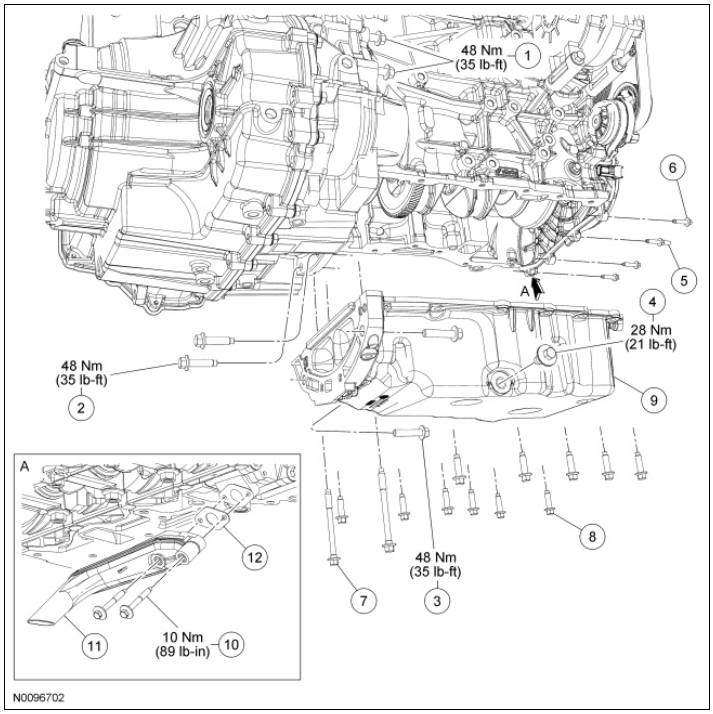
NOTE: Automatic transmission shown, manual transmission similar.



Item		Description

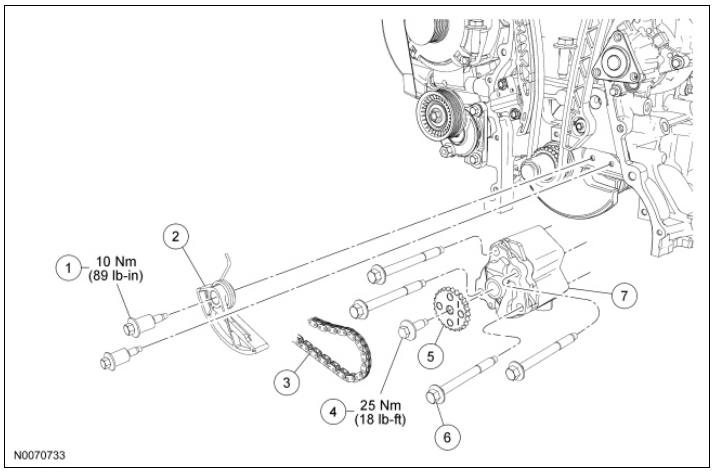
	Part Number	
1	W500121	Upper bellhousing-to-engine bolts
2	W500121	LH bellhousing-to-engine bolt (1 required for automatic transmission, 2 required for manual transmission)

Oil Pan, Oil Pump Screen and Pickup Tube



Item	Part Number	Description
1	W500121	RH engine-to-bellhousing bolts
2	W500235	Bellhousing-to-oil pan bolt (2 required)
3	W500121	Oil pan-to-bellhousing bolt (2 required)
4	6730	Oil pan drain plug
5	940604	Engine front cover-to-oil pan stud bolt
6	W500215	Engine front cover-to-oil pan bolt (3 required)
7	W706284	Oil pan bolt (2 required)
8	W500224	Oil pan bolt (11 required)
9	6675	Oil pan
10	W706282	Oil pump screen and pickup tube bolt (2 required)
11	6622	Oil pump screen and pickup tube
12	6625	Oil pump screen and pickup tube gasket

Oil Pump



Item	Part Number	Description
1	W703651	Oil pump drive chain tensioner shoulder bolt
2	6C271	Oil pump drive chain tensioner
3	6A895	Oil pump drive chain
4	W704397	Oil pump sprocket bolt
5	6652	Oil pump sprocket
6	W703647	Oil pump bolt (4 required)
7	6600	Oil pump

1. For additional information, refer to the procedures in this section.

Oil Filter Adapter

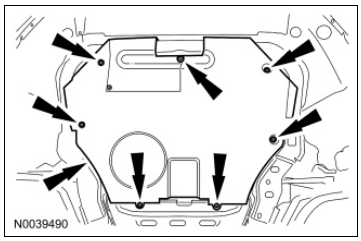
Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. If equipped, remove the 7 screws and the underbody cover.



3. Remove the oil filter.
   - To install, lubricate the oil filter gasket with clean engine oil and tighten the oil filter three-fourths turn after the oil filter gasket makes contact with the oil filter adapter.

4. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

5. **NOTE:** Discard the gasket.

   Remove the 4 bolts and the oil filter adapter.

   - To install, tighten to 25 Nm (18 lb-ft).

6. To install, reverse the removal procedure.

Engine Oil Pressure (EOP) Switch

Material

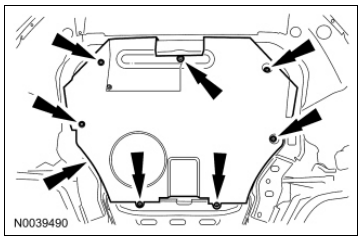
Item	Specification
Thread Sealant with PTFE TA-24	WSK-M2G350-A2

Removal and Installation

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. If equipped,ove the 7 screws and the underbody cover.



Vehicles equipped with manual transaxle

3. Remove the 2 bolts and position the clutch slave cylinder aside.
   - To install, tighten to 22 Nm (16 lb-ft).

All vehicles

4. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

5. Remove the EOP switch.
   - To install, tighten to 15 Nm (133 lb-in).

6. To install, reverse the removal procedure.
   - Apply thread sealant to the EOP switch threads.

Oil Pan

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the Ai (ACL). For additional information, refer to Section 303-12A .

Automatic transmission

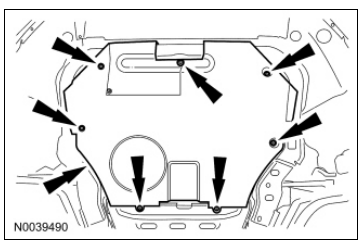
3. Remove the battery tray. For additional information, refer to Section 414-01 .

All vehicles

4. ***NOTICE:*** **To prevent damage to the transmission, do not loosen the transmission-to-engine bolts more than 5 mm (0.19 in).**

   Loosen the 3 upper transaxle-to-engine bolts 5 mm (0.19 in).

5. If equipped, remove the 7 screws and the underbody cover.



6. Loosen the 1 (automatic transmission) or 2 (manual transmission) LH bellhousing-to-engine bolt(s) 5 mm (0.19 in).

7. Loosen the RH engine-to-bellhousing bolt and stud bolt 5 mm (0.19 in).

8. Remove the 2 oil pan-to-bellhousing bolts.

9. Remove the bellhousing-to-oil pan bolt.

10. Slide the transmission rearward 5 mm (0.19 in).

11. Drain the engine oil.
    - Install the drain plug.
    - To install, tighten to 28 Nm (21 lb-ft).

12. Remove the 3 engine front cover-to-oil pan bolts and the stud bolt.

13. Remove the 13 bolts and the oil pan.

Installation

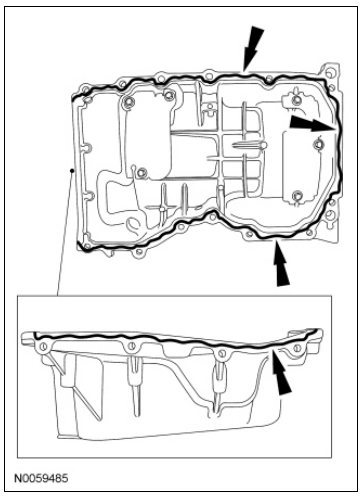
All vehicles

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.**

   Clean and inspect all mating surfaces.

2. **NOTE:** If the oil pan is not secured within 10 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 10 minutes, whichever is longer. Failure to follow these instructions can cause future oil leakage.

   Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the oil pan-to-engine block and to the oil pan-to-engine front cover mating surface.

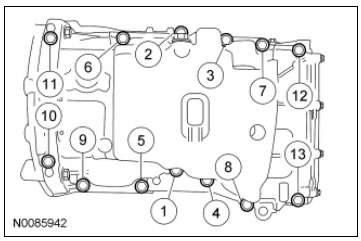


3. Position the oil pan onto the engine and install the oil pan bolts finger-tight.

4. Install the 3 engine front cover-to-oil pan bolts and the stud bolt.
    - Tighten to 10 Nm (89 lb-in).

5. Tighten the oil pan bolts in the sequence shown.

- Tighten to 25 Nm (18 lb-ft).



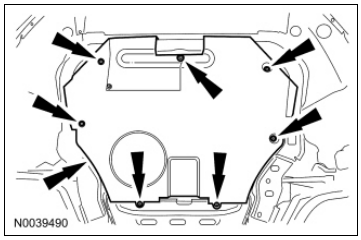
6. Alternate tightening the 1 LH and 1 RH lower bolts to slide the transmission and engine together.
   - Tighten to 48 Nm (35 lb-ft).

7. Tighten the remaining LH bolt (manual transmission) and RH stud bolt.
   - Tighten to 48 Nm (35 lb-ft).

8. Install the bellhousing-to-oil pan bolt.
   - Tighten to 48 Nm (35 lb-ft).

9. Install the 2 oil pan-to-bellhousing bolts.
   - Tighten to 48 Nm (35 lb-ft).

10. If equipped, install the underbody cover and the 7 screws.



11. Tighten the 3 top bellhousing-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).

Automatic transmission

12. Install the battery tray. For additional information, refer to Section 414-01 .

All vehicles

13. Install the ACL assembly. For additional information, refer to Section 303-12A .

14. Fill the engine with clean engine oil.

Oil Pump Screen and Pickup Tube

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the oil pan. For additional information, refer to Engine Lubrication Components - Exploded View and Oil Pan in this section.

3. **NOTE:** Discard the gasket and clean and inspect the gasket mating surfaces.

   Remove the 2 bolts and the oil pump screen and pickup tube.

   - To install, tighten to 10 Nm (89 lb-in).

4. To install, reverse the removal procedure.

Oil Pump

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

1. With the engine in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

3. Drain the engine oil, then install the drain plug.
   - To install, tighten to 28 Nm (21 lb-ft).

4. Remove the 3 oil pan-to-bellhousing bolts.

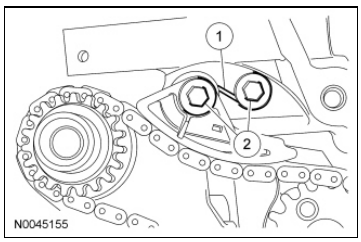
5. Remove the 13 bolts and the oil pan.

6. **NOTE:** Discard the gasket and clean and inspect the gasket mating surfaces.

   Remove the 2 bolts and the oil pump screen and pickup tube.

   - To install, tighten to 10 Nm (89 lb-in).

7. Remove the oil pump drive chain tensioner.
   1. Release the tension on the tensioner spring.
   2. Remove the tensioner and the 2 shoulder bolts.



8. Remove the chain from the oil pump sprocket.

9. Remove the bolt and oil pump sprocket.

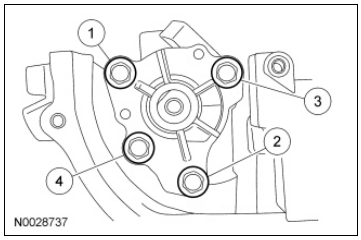
10. Remove the 4 bolts and the oil pump.

Installation

1. **NOTE:** Clean the oil pump and cylinder block mating surfaces with metal surface prep.

   Install the oil pump assembly. Tighten the 4 bolts in the sequence shown in 2 stages:

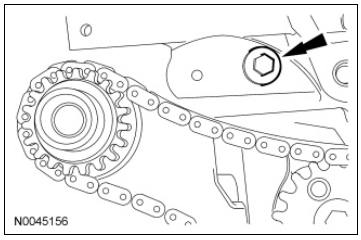
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten to 20 Nm (177 lb-in).



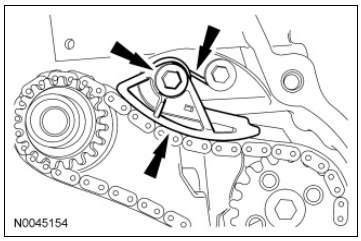
2. Install the oil pump sprocket and bolt.
   - Tighten to 25 Nm (18 lb-ft).

3. Install the chain onto the oil pump sprocket.

4. Install the oil pump drive chain tensioner shoulder bolt.
   - Tighten to 10 Nm (89 lb-in).



5. Install the oil pump chain tensioner and bolt. Hook the tensioner spring around the shoulder bolt.
   - Tighten to 10 Nm (89 lb-in).



6. Install the oil pump screen and pickup tube and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).

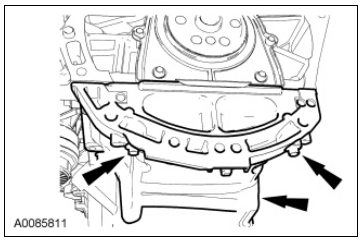
7. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces to sealant.**

Clean all mating surfaces with metal surface prep.

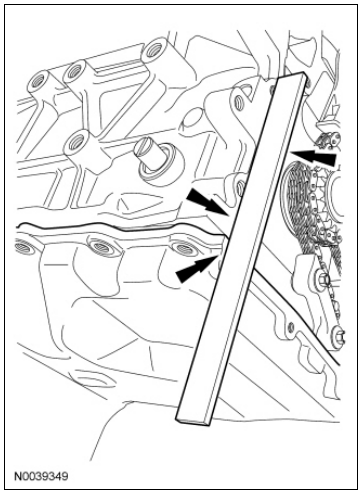
8. **NOTE:** If the oil pan is not secured within 10 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 10 minutes, whichever is longer. Failure to follow these instructions can cause future oil leakage.

   Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the oil pan.

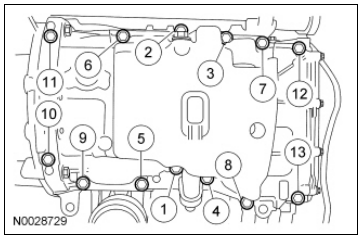
   - Position the oil pan onto the engine and install the 2 rear oil pan bolts finger-tight.



9. Using a suitable straight edge, align the front surface of the oil pan flush with the front surface of the engine block.



10. Install the remaining oil pan bolts.
    - Tighten in the sequence shown to 25 Nm (18 lb-ft).

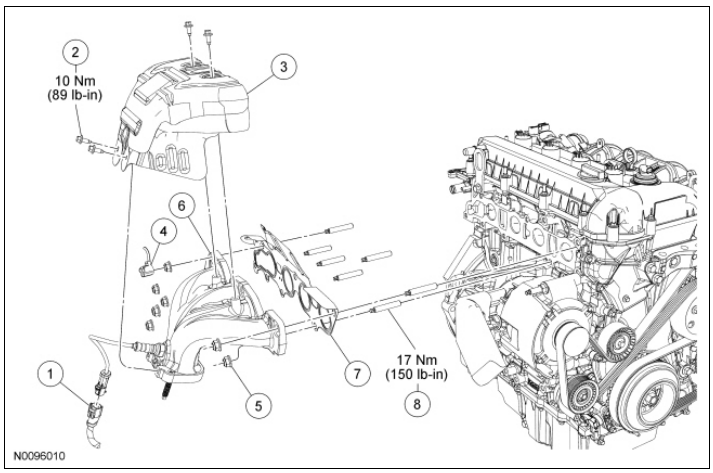


11. Install the 3 oil pan-to-bellhousing bolts.
    - Tighten to 48 Nm (35 lb-ft).

12. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

13. Fill the engine with clean engine oil.

Exhaust Manifold



Item	Part Number	Description
1	14A464	Heated Oxygen Sensor (HO2S) electrical connector (part of 12C508)
2	W713299	Exhaust manifold heat shield bolt (4 required)
3	9N454	Exhaust manifold heat shield
4	-	Block heater wire harness retainer (if equipped)
5	W713652	Exhaust manifold nut (7 required)
6	9430	Exhaust manifold
7	9448	Exhausfold gasket
8	W704474	Cylinder head stud (7 required)

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .
3. Disconnect the Heated Oxygen Sensor (HO2S) electrical connector.
4. Remove the 4 exhaust manifold heat shield bolts and the heat shield.
5. If equipped, detach the block heater wire harness retainer from the exhaust manifold stud.
6. Remove and discard the 7 exhaust manifold nuts.
7. Remove the exhaust manifold and discard the exhaust manifold gasket.
8. Remove and discard the 7 cylinder head studs.
9. Clean and inspect the exhaust manifold. For additional information, refer to Section 303-00 .

Installation

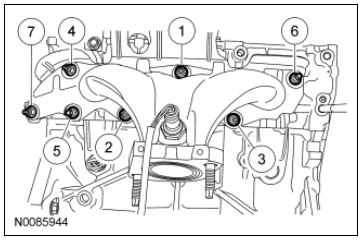
1. Install the 7 new cylinder head studs.
    - Tighten to 17 Nm (150 lb-in).

2. ***NOTICE:*** **Failure to tighten the catalytic converter nuts to specification before installing the converter bracket bolts will cause the converter to develop an exhaust leak.**

   NOTICE: **Failure to tighten the catalytic converter nuts to specification a second time will cause the converter to develop an exhaust leak.**

   Install a new exhaust manifold gasket, the exhaust manifold and 7 new nuts in the sequence shown in 2 stages:

    - Stage 1: Tighten to 48 Nm (35 lb-ft).
    - Stage 2: Tighten to 48 Nm (35 lb-ft).



3. If equipped, attach the block heater wire harness retainer to the exhaust manifold stud.

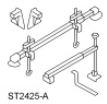
4. Install the exhaust manifold heat shield and the 4 bolts.
    - Tighten to 10 Nm (89 lb-in).

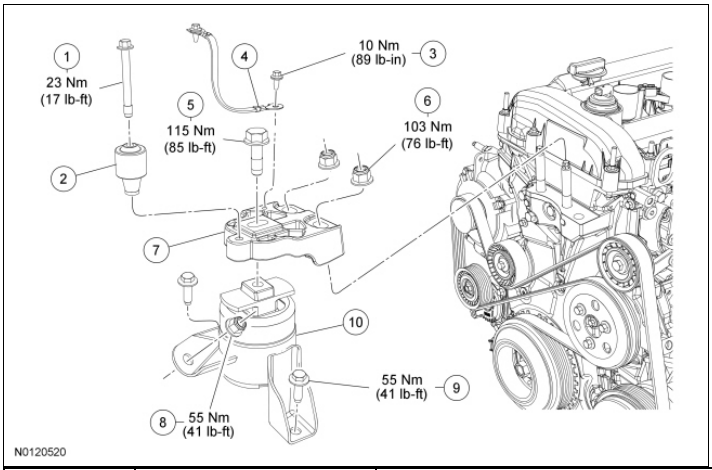
5. Connect the HO2S electrical connector.

6. Install the exhaust flexible pipe. For additional information, refer to Section 309-00 .

Engine Mount

Special Tool(s)

 ST2425-A	Engine Support Bar 303-F072



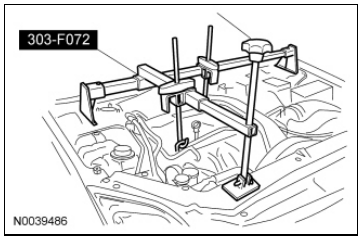
Item	Part Number	Description
1	W711879	Engine mount damper bolt
2	7458	Engmount damper
3	W705936	Ground wire bolt
4	19A095	Ground wire
5	W711684	Engine mount bracket bolt
6	W520214	Engine mount bracket nut (2 required)
7	6061	Engine mount bracket
8	W711578	Engine mount nut
9	W706496	Engine mount bolt (2 required)
10	6038	Engine mount

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the engine coolant degas bottle. For additional information, refer to Section 303-03A .

3. Install the Engine Support Bar to the front and rear engine lifting eyes.

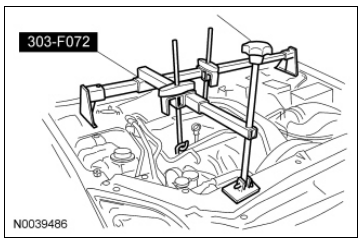


4. Remove the bolt and the engine mount damper.
    - To install, tighten to 23 Nm (17 lb-ft).

5. Remove the bolt and the ground wire.
    - To install, tighten to 10 Nm (89 lb-in).

6. Remove the engine mount bracket bolt.
    - To install, tighten to 115 Nm (85 lb-ft).

7. Use the Engine Support Bar to raise the engine 25 mm (0.98 in).



8. Remove the 2 engine mount bracket nuts.
    - To install, tighten to 103 Nm (76 lb-ft).

9. Remove the nut, 2 bolts and the engine mount.
    - To install, tighten to 55 Nm (41 lb-ft).

10. **NOTE:** If the engine mount bracket is to be removed, the engine must be lowered to avoid contact between the A/C tubes and the engine mount bracket.

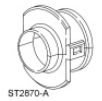
    Use the Engine Support Bar to lower the engine 25 mm (0.98 in).

    - Remove the engine mount bracket.

11. To install, reverse the removal procedure.

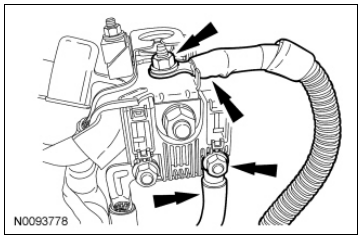
Engine - Automatic Transaxle

Special Tool(s)

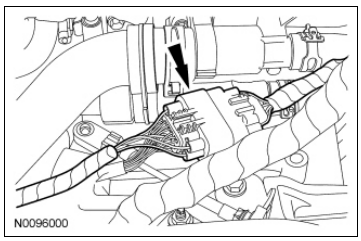
 ST2670-A	Disconnect Tool, Transmission Cooler Line 307-569
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent
 ST1408-A	Remover, Tie-Rod End 211-105
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2743A	Adjustable Grip Arm, 1735A 014-00001 or equivalent

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

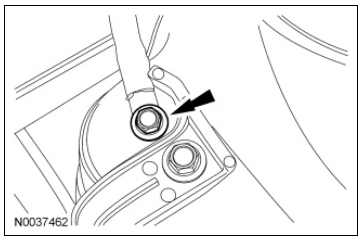
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Release the fuel system pressure. For additional information, refer to Section 310-00 .
3. Remove the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to Section 303-12A .
4. Recover the A/C system. For additional information, refer to Section 412-00A .
5. Remove the battery tray. For additional information, refer to Section 414-01 .
6. Remove the 2 nuts and the battery cables from the positive battery cable.


N0093778

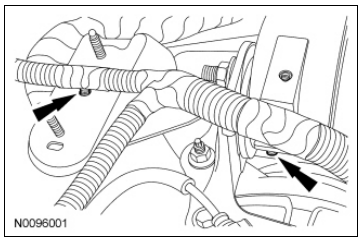
7. Disconnect the engine wiring harness electrical connector.



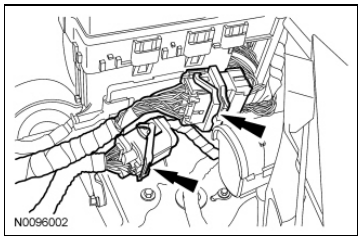
8. Remove the bolt and the ground wire from the body.



9. Detach the 2 negative battery cable pin-type retainers from the transaxle mount and battery tray bracket.

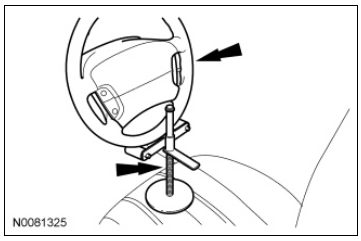


10. Disconnect the 2 engine harness electrical connectors.

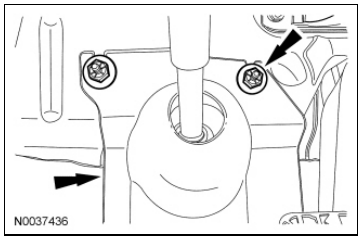


11. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

    Using a suitable holding device, hold the steering wheel in the straight-ahead position.



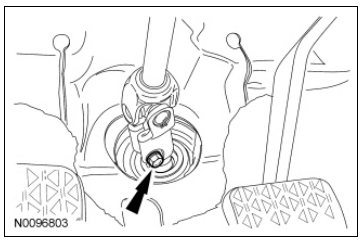
12. Remove the 2 nuts and the steering joint cover.



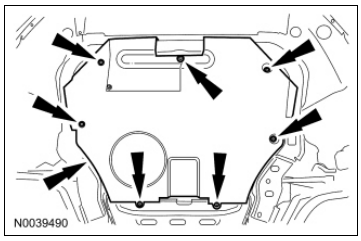
13. ***NOTICE:*** **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

    Remove the bolt and disconnect the steering column shaft from the steering gear.

    - Discard the bolt.



14. If equipped, remove the 7 screws and the underbody cover.

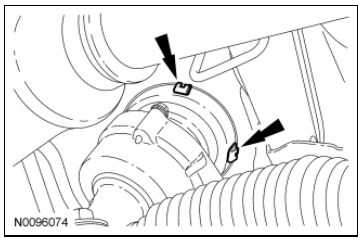


15. Drain the transaxle. For additional information, refer to Section 307-01A .

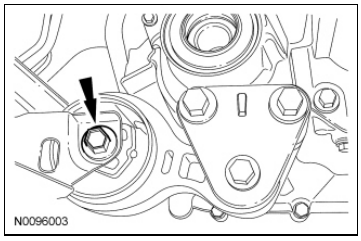
16. Drain the cooling system. For additional information, refer to Section 303-03A .

17. ***NOTICE:*** **The steering gear-to-dash seal must be removed or it will be damaged when lowering the subframe.**

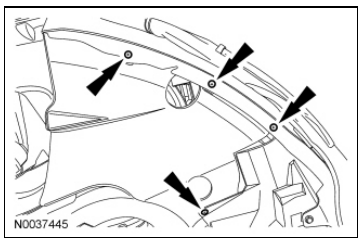
    Release the 4 clips (2 shown) and slide the steering gear-to-dash seal off of the steering gear and into the passenger compartment.



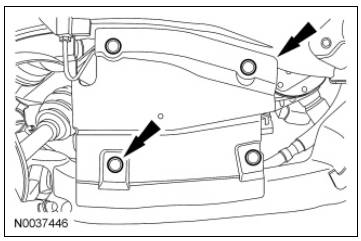
18. Remove the engine roll restrictor bolt.



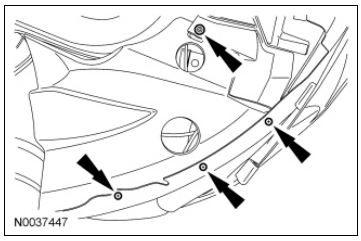
19. Remove the 4 screws and position the RH fender splash shield aside.



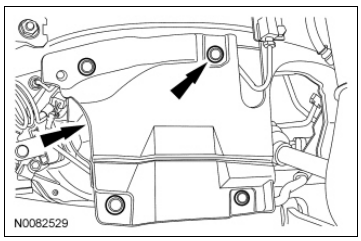
20. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



21. Remove the 4 screws and position the LH fender splash shield aside.

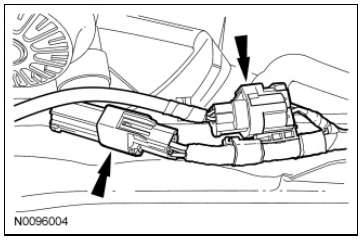


22. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.

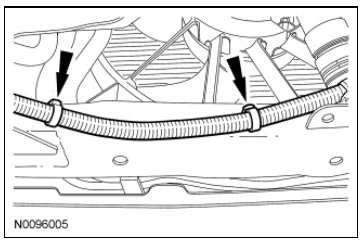


23. Remove the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

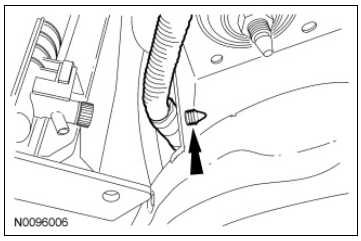
24. Disconnect the 2 Electronic Power Assist Steering (EPAS) system electrical connectors.



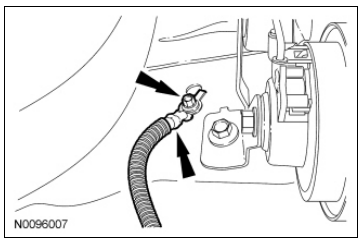
25. Detach the 2 EPAS system wiring harness pin-type retainers from the subframe.



26. Detach the EPAS system wiring harness pin-type retainer from the subframe under the LH fender splash shield.

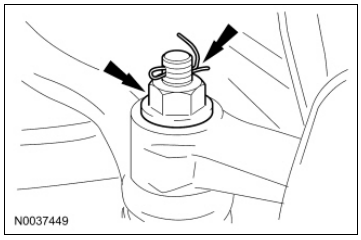


27. Remove the bolt and the EPAS system wiring harness ground.



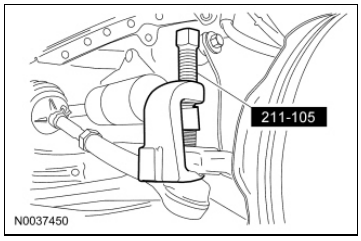
28. **NOTE:** LH shown, RH similar.

    Remove the cotter pins and nuts from the tie-rod ends.



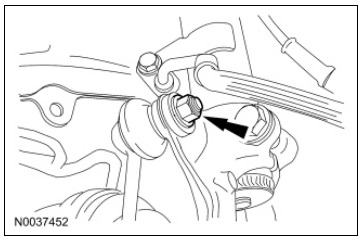
29. **NOTE:** LH shown, RH similar.

    Using the Tie-Rod End Remover, separate the tie-rod ends from the steering knuckles.

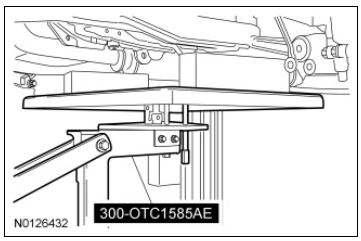


30. **NOTE:** LH shown, RH similar.

    Remove the nuts and separate the sway bar links from the struts.

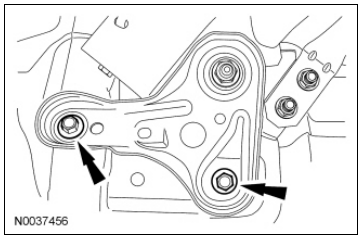


31. Position the Powertrain Lift under the subframe assembly.



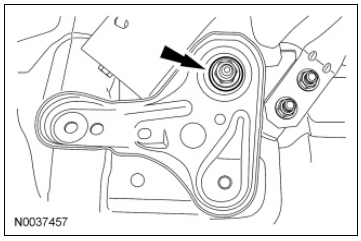
32. **NOTE:** LH shown, RH similar.

    Remove the subframe bracket-to-body bolts.



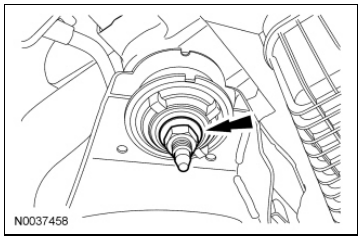
33. **NOTE:** LH shown, RH similar.

    Remove the subframe nuts and the subframe brackets.



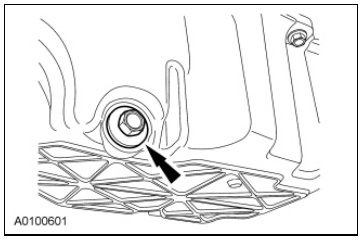
34. **NOTE:** LH shown, RH similar.

    Remove the front subframe nuts.



35. Lower the subframe assembly from the vehicle.

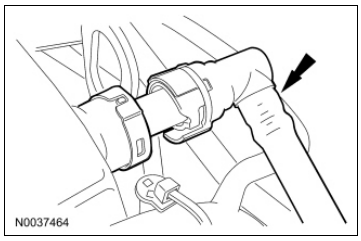
36. Remove the engine oil pan drain plug and drain the engine oil.
    - Install the drain plug and tighten to 28 Nm (21 lb-ft).



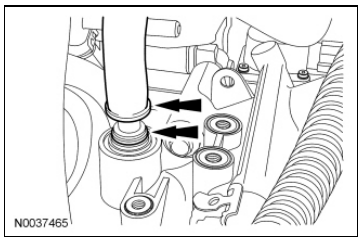
37. Remove the engine oil filter.

38. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .

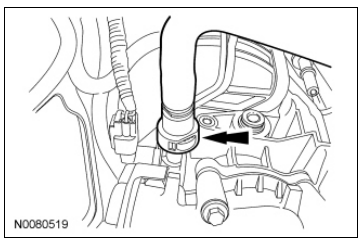
39. Disconnect the crankcase vent tube from the valve cover.



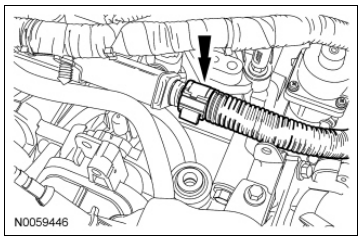
40. Depress the locking ring and disconnect the brake booster vacuum supply tube from the intake manifold.



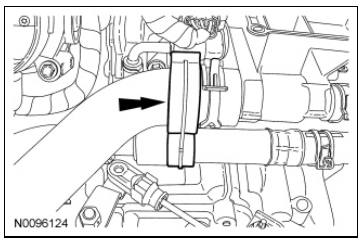
41. Disconnect the fuel vapor return tube.



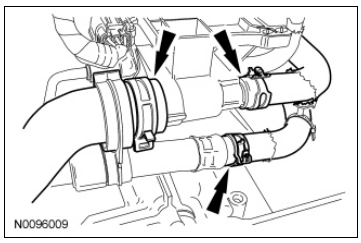
42. Disconnect the fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .



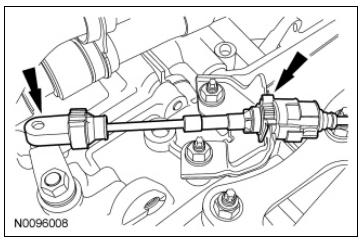
43. Detach the coolant hose retainer.



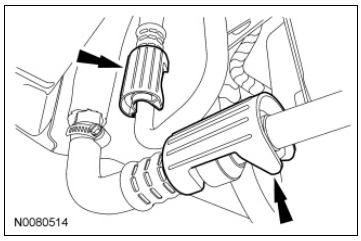
44. Disconnect the upper radiator and heater hoses from the coolant outlet and disconnect the heater hose in-line connector.



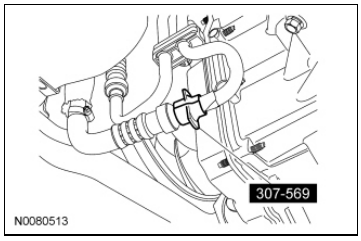
45. Disconnect the shift cable from the transaxle manual lever and remove the transaxle shift cable from the bracket.



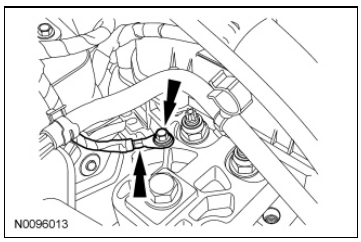
46. Remove the 2 secondary latches from the transaxle fluid cooler tubes.



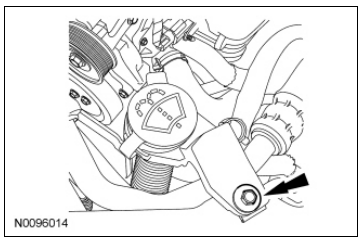
47. Using the Transmission Cooler Line Disconnect Tool, disconnect the 2 transaxle fluid cooler tubes (1 shown).



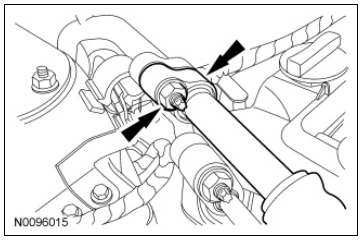
48. Remove the bolt and the ground wire from the engine mount.



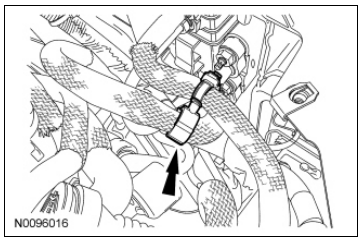
49. Remove the A/C tube/windshield washer reservoir bracket bolt.



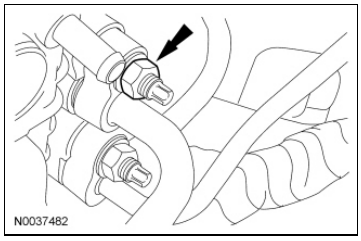
50. Remove the nut and disconnect the A/C tube.
    - Discard the O-ring seal.



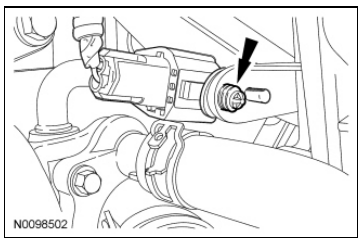
51. Detach the coolant vent hose retaining clip from the A/C tube.



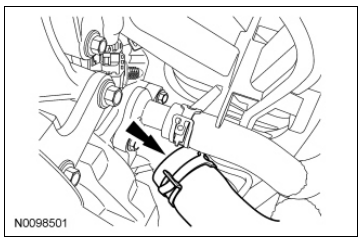
52. Remove the nut and disconnect the upper A/C tube from the condenser.
    - Discard the O-ring seal.



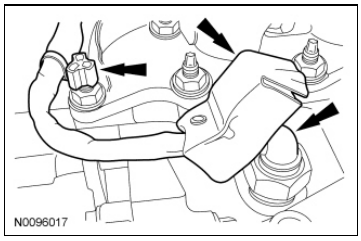
53. Detach the Knock Sensor (KS) electrical connector from the intake manifold.



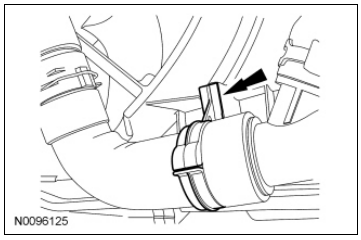
54. Remove the lower radiator hose from the thermostat housing.



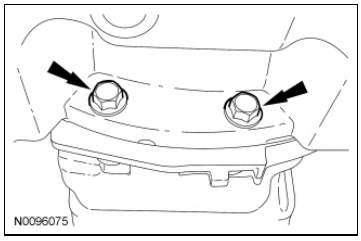
55. If equipped, position the block heater shield aside and disconnect the block heater electrical connector.
    - Detach the 8 block heater wiring harness retainers (1 shown) and remove the block heater wiring harness.



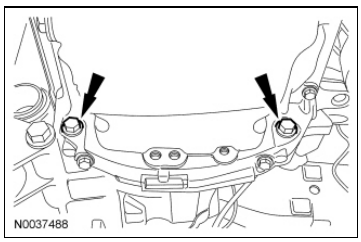
56. Detach the lower radiator hose pin-type retainer from the cooling fan shroud.



57. Remove the 2 bellhousing-to-oil pan bolts.



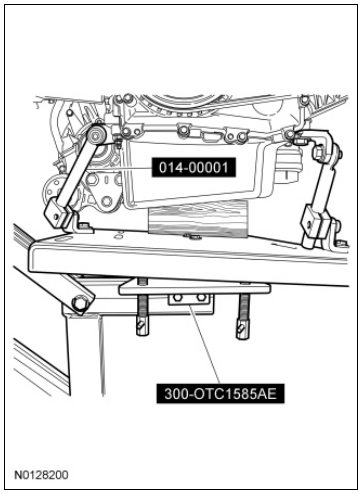
58. Remove the 2 oil pan-to-bellhousing bolts.



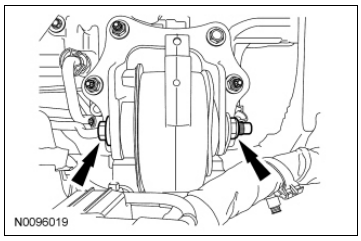
59. **NOTE:** Position a block of wood under the transaxle.

    Install the Powertrain Lift and Adjustable Grip Arm onto the engine.

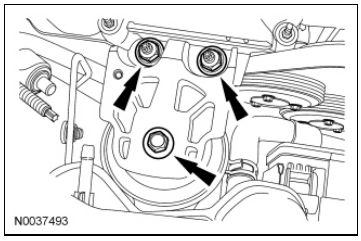
    - Raise the engine and transaxle 25.4 mm (1 in) to neutralize the engine and transaxle mounts.



60. Remove the nut and the transaxle mount through bolt.

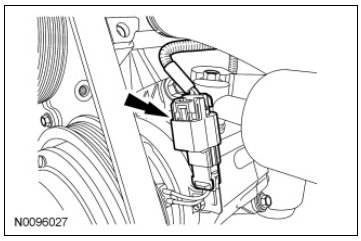


61. Remove the bolt, 2 nuts and the engine mount bracket.

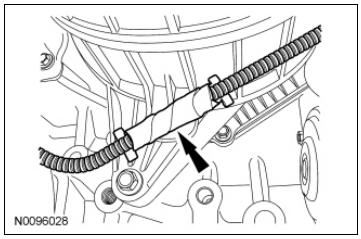


62. Lower the engine and transaxle from the vehicle.

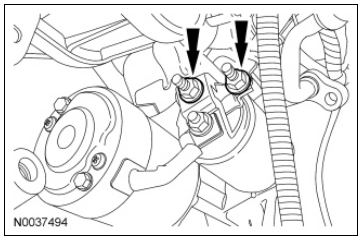
63. Disconnect the A/C compressor electrical connector.



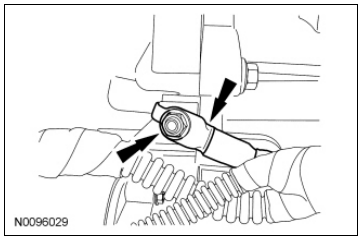
64. Detach the A/C compressor wiring harness pin-type retainer from the intake manifold.



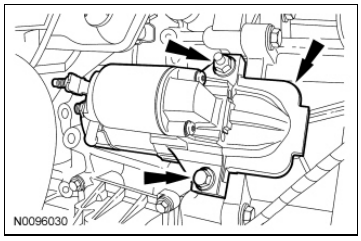
65. Remove the 2 nuts and disconnect the starter motor wires.



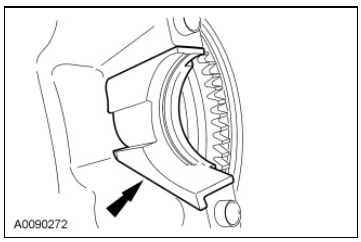
66. Remove the nut and the ground wire from the starter motor stud bolt.



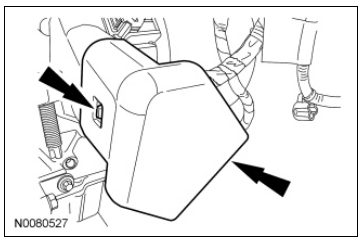
67. Remove the bolt, stud bolt and the starter motor.



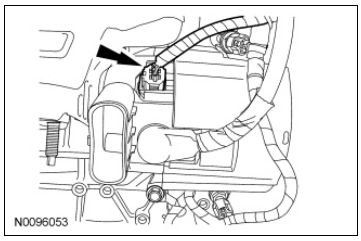
68. Remove the starter motor isolator.



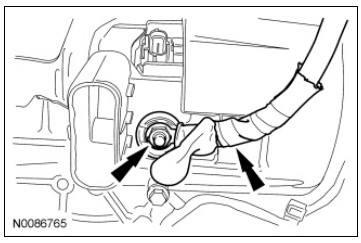
69. Press the locking tab to release the generator air duct and remove.



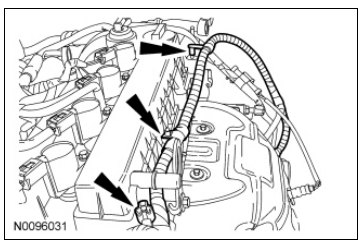
70. Disconnect the generator electrical connection.



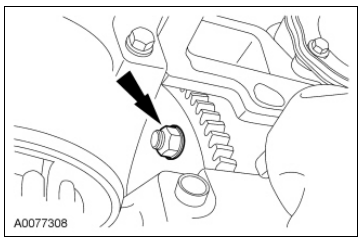
71. Remove the nut and the generator B+ wiring harness.



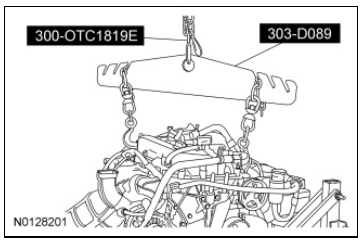
72. Detach the 4 wiring harness retainers (3 shown) from the valve cover stud bolts.



73. Remove the 4 torque converter nuts.



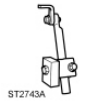
74. Install the Floor Crane and Spreader Bar and remove the engine and transaxle from the Powertrain Lift table.



75. Remove the remaining bellhousing-to-engine retainers.
    - Separate the engine and transaxle.

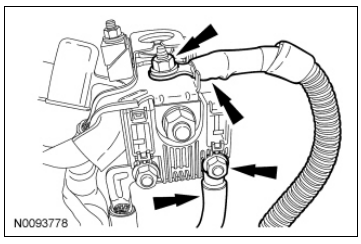
Engine - Manual Transaxle

Special Tool(s)

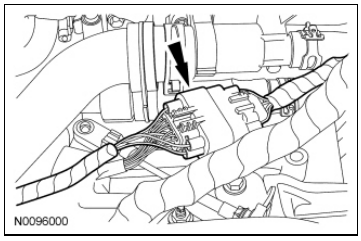
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent
 ST1408-A	Remover, Tie-Rod End 211-105
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2743A	Adjustable Grip Arm, 1735A 014-00001 or equivalent

⚠ **WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.**

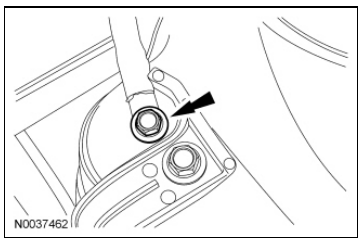
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Release the fuel system pressure. For additional information, refer to Section 310-00 .
3. Remove the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to Section 303-12A .
4. Recover the A/C system. For additional information, refer to Section 412-00A .
5. Remove the battery tray. For additional information, refer to Section 414-01 .
6. Remove the 2 nuts and the battery cables from the positive battery cable.


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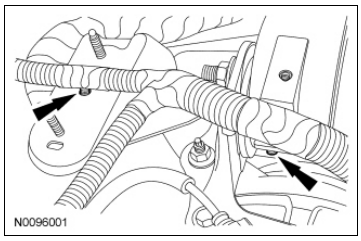
7. Disconnect the engine wiring harness electrical connector.



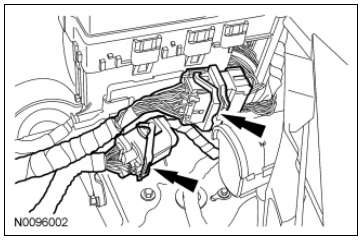
8. Remove the bolt and the ground wire from the body.



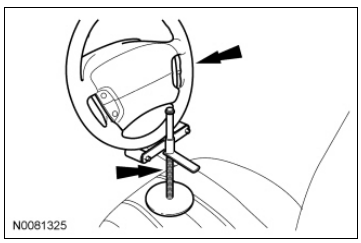
9. Detach the 2 negative battery cable pin-type retainers from the transaxle mount and battery tray bracket.



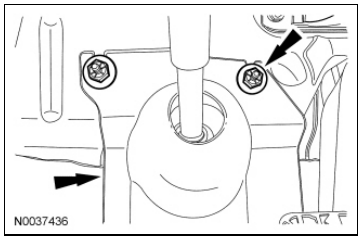
10. Disconnect the 2 engine harness electrical connector.



11. Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).
    - Using a suitable holding device, hold the steering wheel in the straight-ahead position.



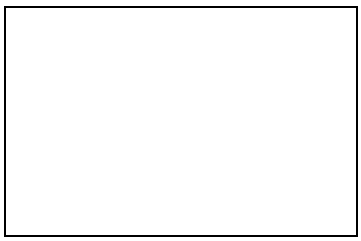
12. Remove the 2 nuts and the steering joint cover.



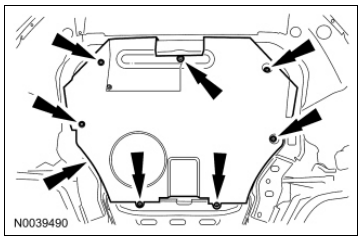
13. ***NOTICE:*** **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

    Remove the bolt and disconnect the steering column shaft from the steering gear.

    - Discard the bolt.



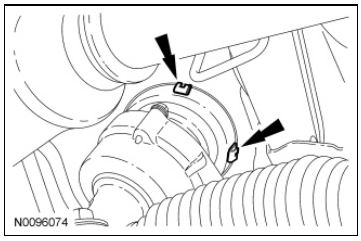
14. If equipped, remove the 7 screws and the underbody cover.



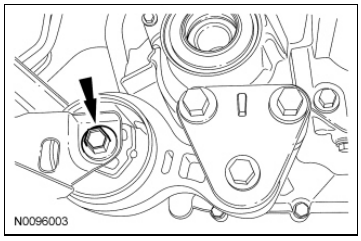
15. Drain the cooling system. For additional information, refer to Section 303-03A .

16. ***NOTICE:*** **The steering gear-to-dash seal must be removed or it will be damaged when lowering the subframe.**

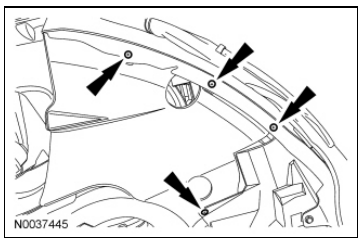
    Release the 4 clips (2 shown) and slide the steering gear-to-dash seal off of the steering gear and into the passenger compartment.



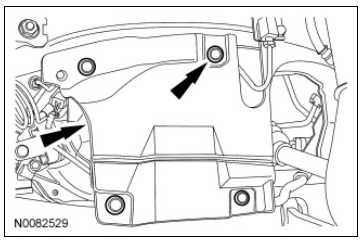
17. Remove the engine roll restrictor bolt.



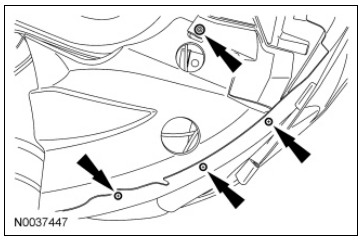
18. Remove the 4 screws and position the RH fender splash shield aside.



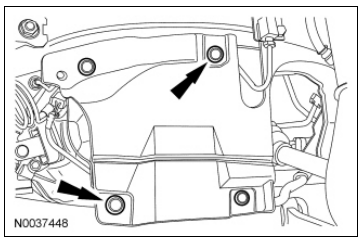
19. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



20. Remove the 4 screws and position the LH fender splash shield aside.

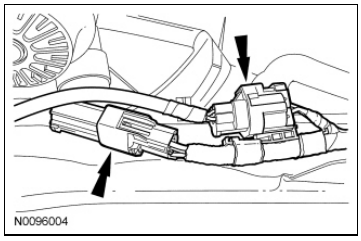


21. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.

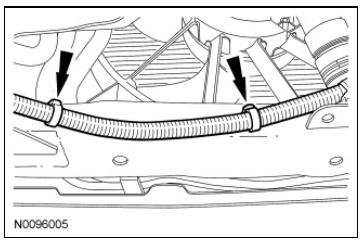


22. Remove the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

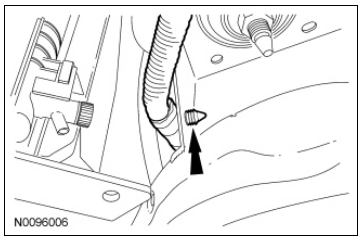
23. Disconnect the 2 Electronic Power Assist Steering (EPAS) system electrical connectors.



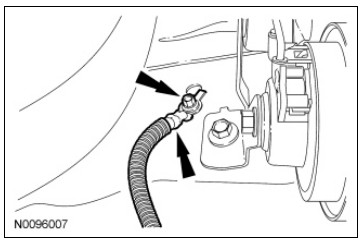
24. Detach the 2 EPAS system wiring harness pin-type retainers from the subframe.



25. Detach the EPAS system wiring harness pin-type retainer from the subframe under the LH fender splash shield.

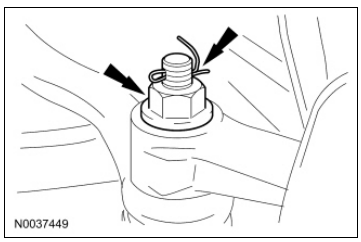


26. Remove the bolt and the EPAS system wiring harness ground.



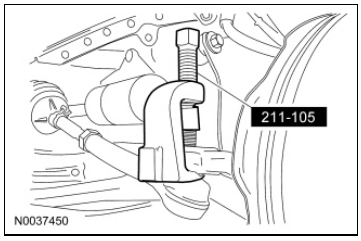
27. **NOTE:** LH shown, RH similar.

    Remove the cotter pins and nuts from the tie-rod ends.



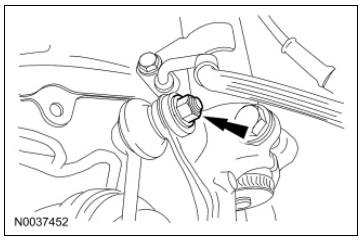
28. **NOTE:** LH shown, RH similar.

    Using the Tie-Rod End Remover, separate the tie-rod ends from the steering knuckles.

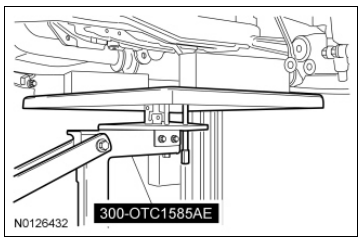


29. **NOTE:** LH shown, RH similar.

    Remove the nuts and separate the sway bar links from the struts.

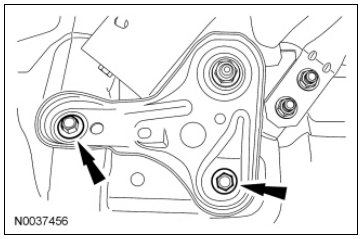


30. Position the Powertrain Lift under the subframe assembly.



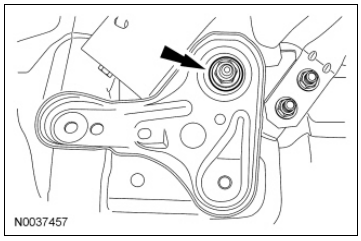
31. **NOTE:** LH shown, RH similar.

    Remove the subframe bracket-to-body bolts.



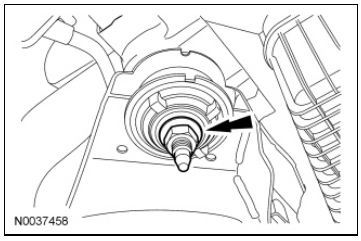
32. **NOTE:** LH shown, RH similar.

    Remove the rear subframe nuts and the subframe brackets.



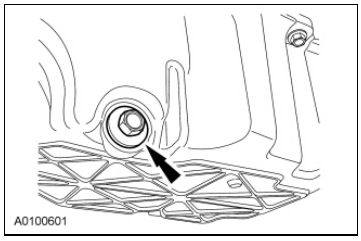
33. **NOTE:** LH shown, RH similar.

    Remove the front subframe nuts.



34. Lower the subframe assembly from the vehicle.

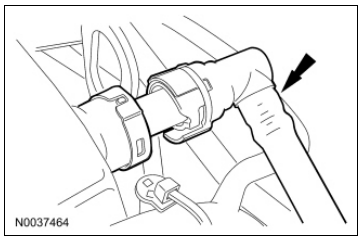
35. Remove the engine oil pan drain plug and drain the engine oil.
    - Install the drain plug and tighten to 28 Nm (21 lb-ft).



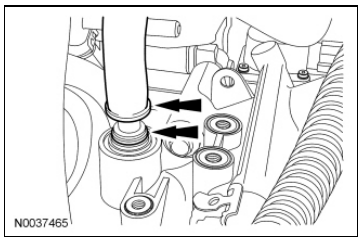
36. Remove the engine oil filter.

37. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .

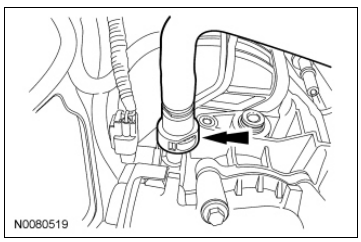
38. Disconnect the crankcase vent tube from the valve cover.



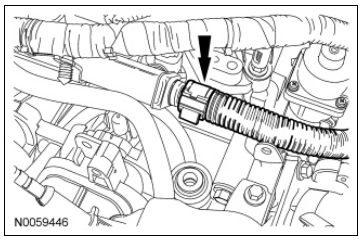
39. Depress the locking ring and disconnect the brake booster vacuum supply tube from the intake manifold.



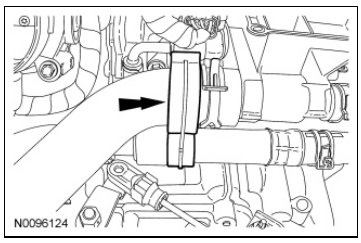
40. Disconnect the fuel vapor return tube.



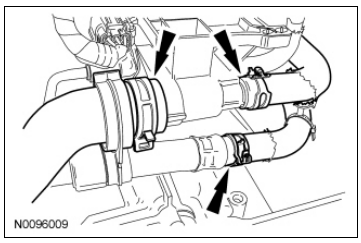
41. Disconnect the fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .



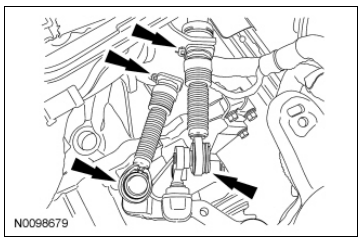
42. Detach the coolant hose retainer.



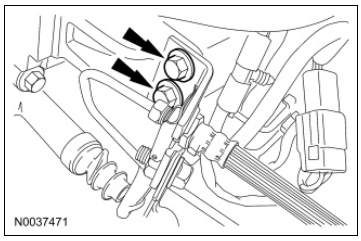
43. Disconnect the upper radiator and heater hoses from the coolant outlet and disconnect the heater hose in-line connector.



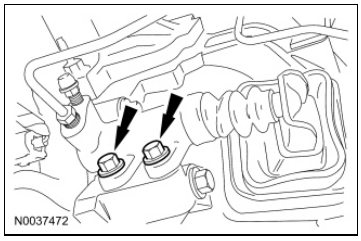
44. Disconnect the transaxle control cables from the control levers.
    - Detach the control cables from the bracket.



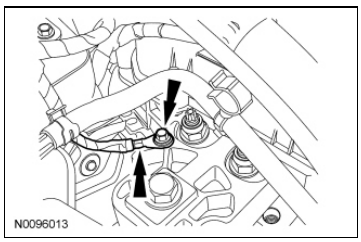
45. Remove the 2 clutch tube bracket bolts.



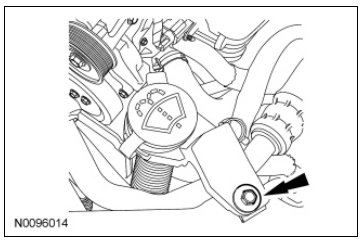
46. Remove the 2 bolts and position the clutch slave cylinder aside.



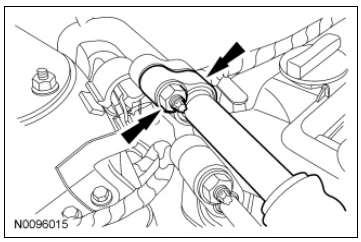
47. Remove the bolt and the ground wire from the engine mount.



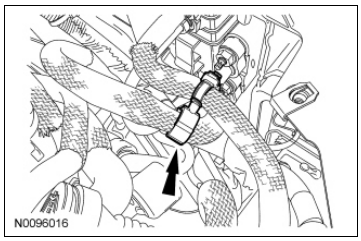
48. Remove the A/C tube/windshield washer reservoir bracket bolt.



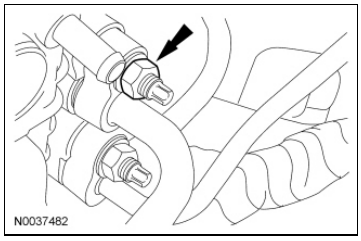
49. Remove the nut and disconnect the A/C tube.
    - Discard the O-ring seal.



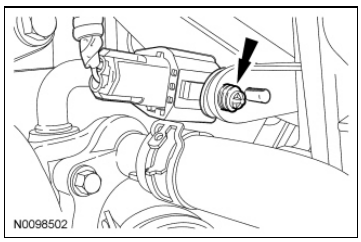
50. Detach the coolant vent hose retaining clip from the A/C tube.



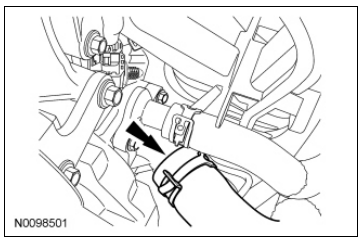
51. Remove the nut and disconnect the upper A/C tube from the condenser.
    - Discard the O-ring seal.



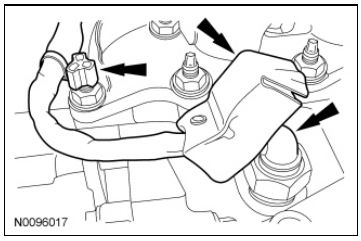
52. Detach the Knock Sensor (KS) electrical connector from the intake manifold.



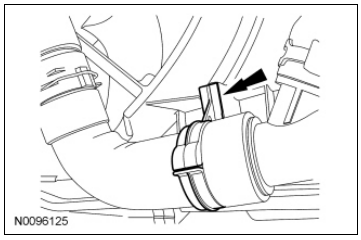
53. Remove the lower radiator hose from the thermostat housing.



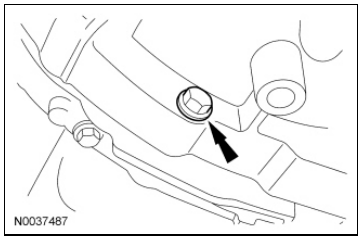
54. If equipped, position the block heater shield aside and disconnect the block heater electrical connector.
    - Detach the 8 block heater wiring harness retainers (1 shown) and remove the block heater wiring harness.



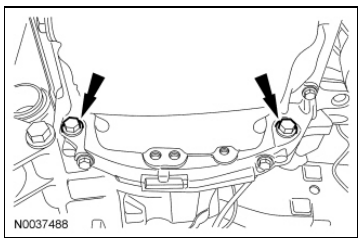
55. Detach the lower radiator hose pin-type retainer from the cooling fan shroud.



56. Remove the bellhousing-to-oil pan bolt.



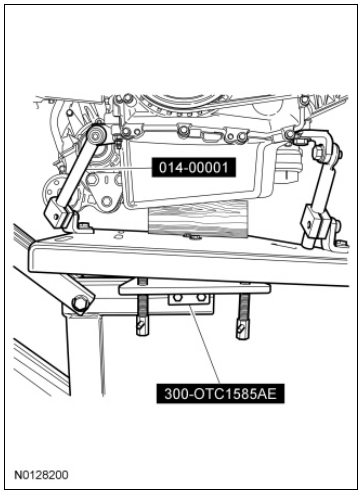
57. Remove the 2 oil pan-to-bellhousing bolts.



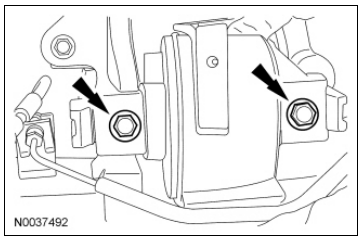
58. **NOTE:** Position a block of wood under the transaxle.

    Install the Powertrain Lift and Adjustable Grip Arm onto the engine.

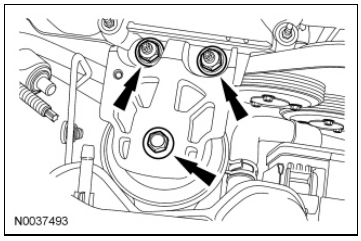
    - Raise the engine and transaxle 25.4 mm (1 in) to neutralize the engine and transaxle mounts.



59. Remove the 2 transaxle mount bolts.

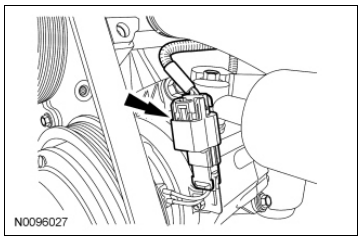


60. Remove the bolt, 2 nuts and the motor mount bracket.

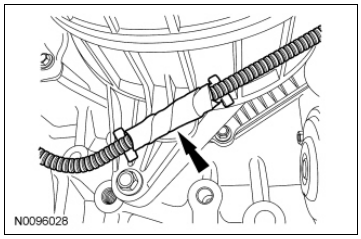


61. Lower the engine and transaxle from the vehicle.

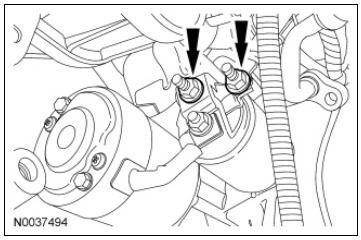
62. Disconnect the A/C compressor electrical connector.



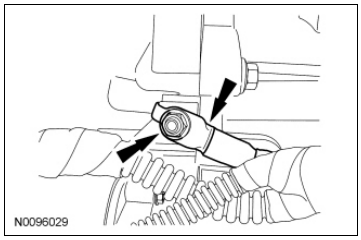
63. Detach the A/C compressor wiring harness pin-type retainer from the intake manifold.



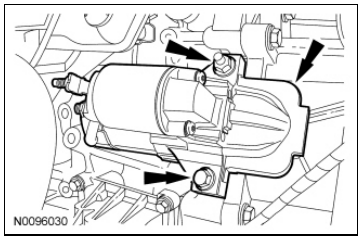
64. Remove the 2 nuts and disconnect the starter wires.



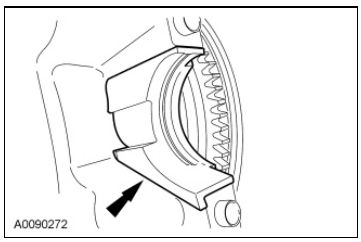
65. Remove the nut from the starter motor stud bolt.



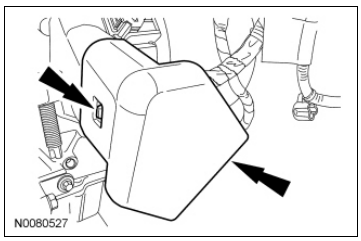
66. Remove the bolt, stud bolt and the starter.



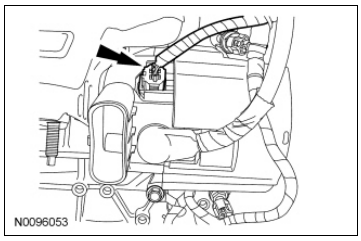
67. Remove the starter motor isolator.



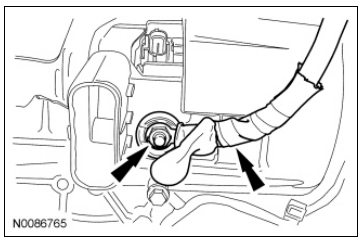
68. Press the locking tab to release the generator air duct and remove.



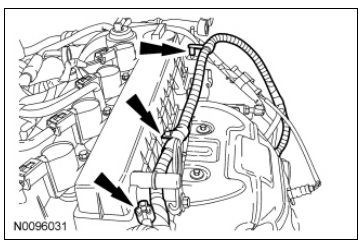
69. Disconnect the generator electrical connection.



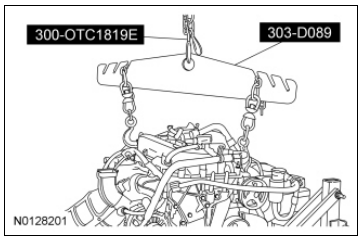
70. Remove the nut and the generator wiring harness.



71. Detach the 4 wiring harness retainers (3 shown) from the valve cover stud bolts.



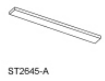
72. Install the Floor Crane and Spreader Bar and remove the engine and transaxle from the Powertrain Lift table.



73. Remove the bellhousing-to-engine retainers.
    - Separate the engine and transaxle.

Engine

Special Tool(s)

 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST1910-A	Engine Stand 014-00232 or equivalent
 ST3054-A	Holding Tool, Crankshaft Damper 303-1416
 ST1982-A	Installer, Connecting Rod 303-462 (T94P-6136-AH)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools, otherwise severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

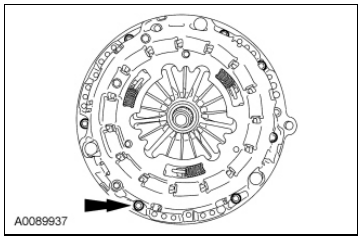
NOTE: For additional information, refer to the exploded views under the Engine Assembly procedure in this section.

Vehicles with manual transaxle

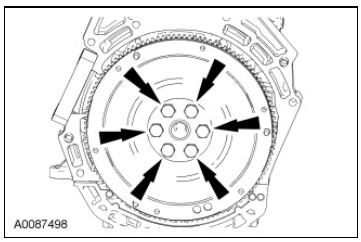
1. ⚠ **WARNING: The clutch disc and clutch pressure plate are heavy and may fall if not held when the bolts are removed. Failure to follow this instruction may result in serious personal injury.**

   NOTICE: **Loosen the 6 bolts evenly to prevent pressure plate damage.**

   Remove the 6 bolts, clutch pressure plate and clutch disc.

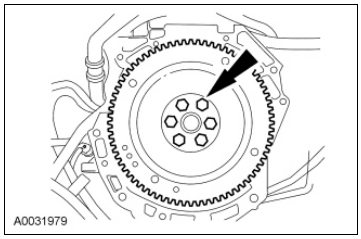


2. Remove the 6 bolts and the flywheel.



Vehicles with automatic transaxle

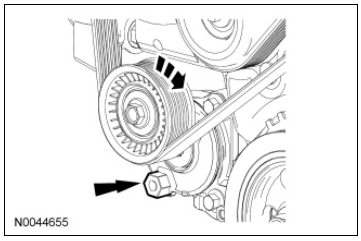
3. Remove the 6 bolts and the flexplate.



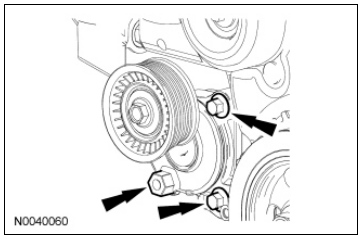
All vehicles

4. Mount the engine on a suitable Engine Stand.

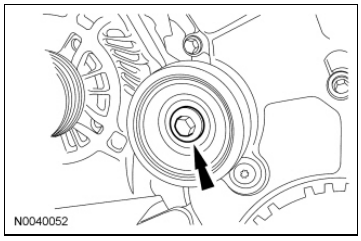
5. Using the hex feature, rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt from the engine.



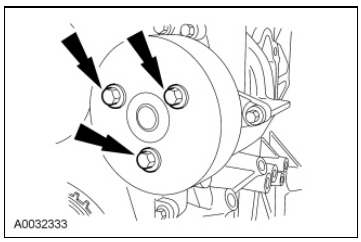
6. Remove the 2 bolts and the tensioner.



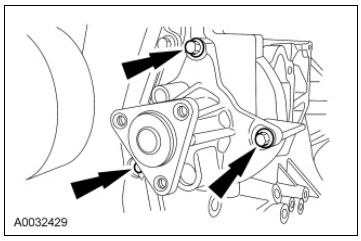
7. Remove the bolt and the accessory drive belt idler pulley.



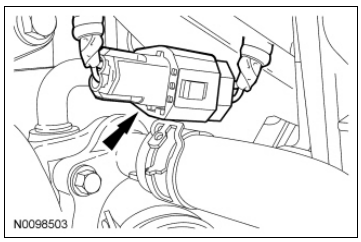
8. Remove the 3 bolts and the coolant pump pulley.



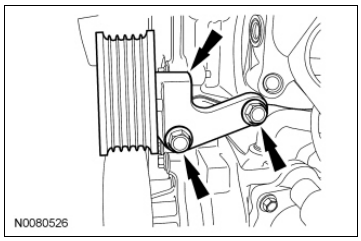
9. Remove the 3 bolts and the coolant pump.
    - Remove and discard the O-ring seal.



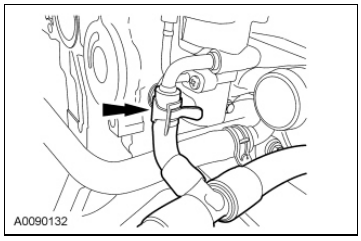
10. Disconnect the Knock Sensor (KS) electrical connector.



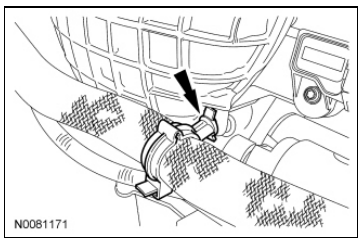
11. Remove the 2 bolts and the accessory drive belt idler pulley and bracket.



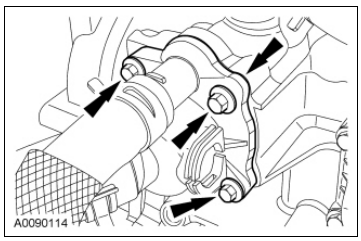
12. Disconnect the coolant hose from the EGR valve.



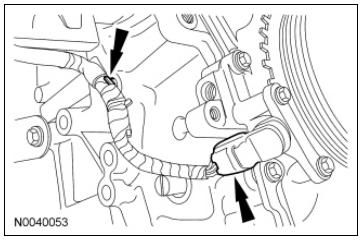
13. Remove the coolant tube retainer from the intake manifold.



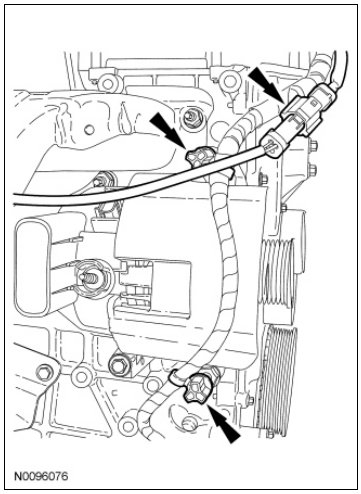
14. Remove the 3 bolts and the thermostat housing assembly.



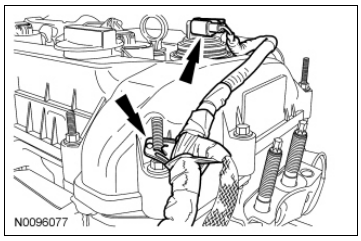
15. Disconnect the Crankshaft Position (CKP) sensor electrical connector and detach the wiring harness pin-type retainer.



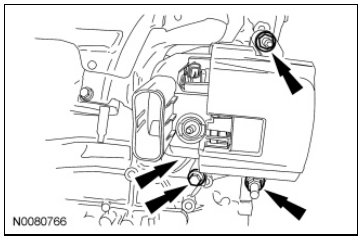
16. Disconnect the Heated Oxygen Sensor (HO2S) electrical connector and detach the 2 wiring harness retainers from the generator stud bolts.



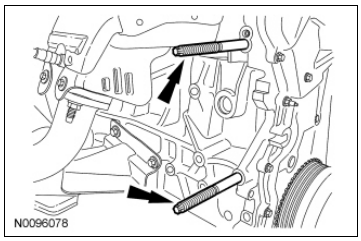
17. Disconnect the Variable Camshaft Timing (VCT) electrical connector and detach the wiring harness retainer from the valve cover stud bolt.



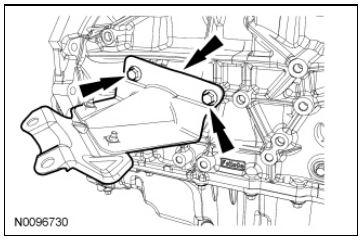
18. Remove the 2 nuts, 1 bolt and the generator.



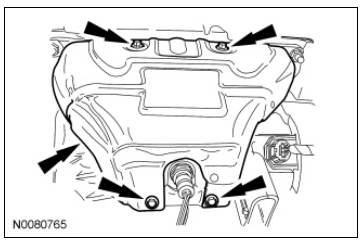
19. Remove the 2 generator studs.



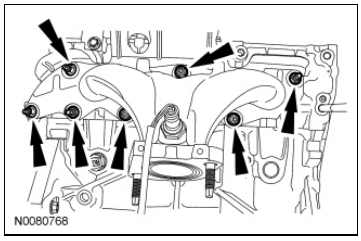
20. Remove the 2 bolts and the exhaust flexible pipe bracket.



21. Remove the 4 exhaust manifold heat shield bolts and the heat shield.



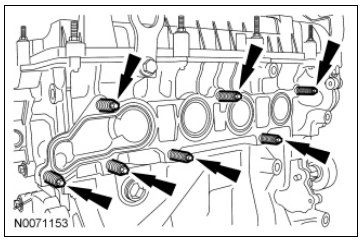
22. Remove and discard the 7 exhaust manifold nuts.



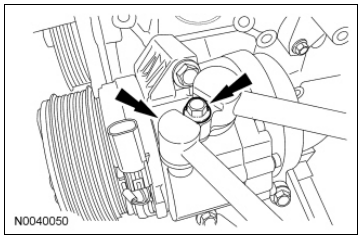
23. Remove the exhaust manifold and discard the exhaust manifold gasket.

24. Clean and inspect the exhaust manifold. For additional information, refer to Section 303-00 .

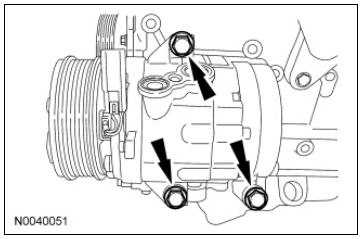
25. Remove and discard the 7 cylinder head studs.



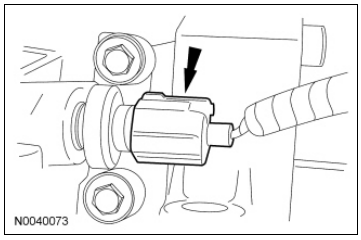
26. Remove the bolt and the A/C manifold tube.
    - Discard the 2 O-ring seals.



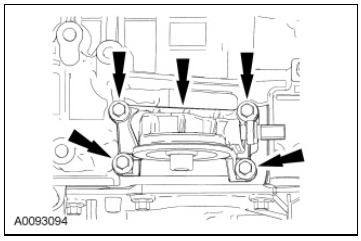
27. Remove the 3 bolts and the A/C compressor.



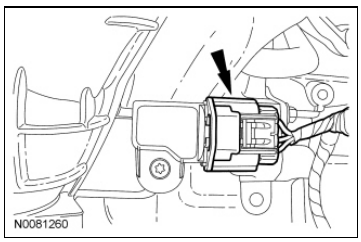
28. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.



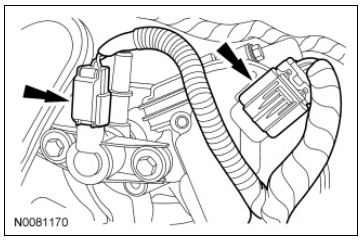
29. Remove the 4 bolts and the oil filter adapter.
    - Discard the gasket.



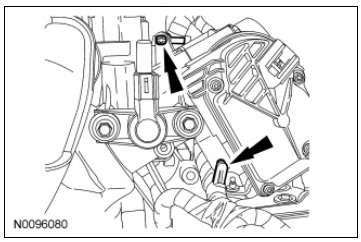
30. Disconnect the Manifold Absolute Pressure (MAP) sensor electrical connector.



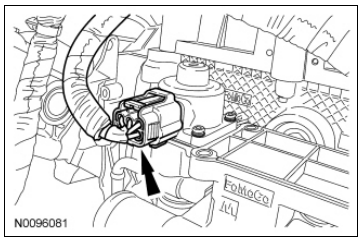
31. Disconnect the electronic throttle control and Evaporative Emission (EVAP) canister purge valve electrical connectors.



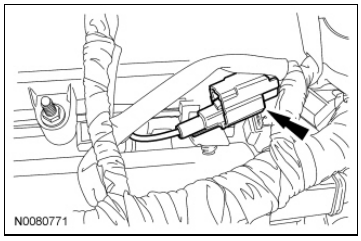
32. Detach the 2 wiring harness retainers from the intake manifold.



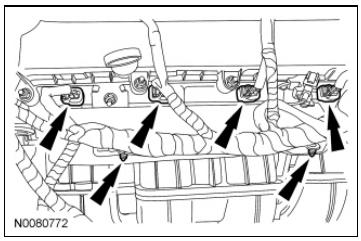
33. Disconnect the EGR valve electrical connector.



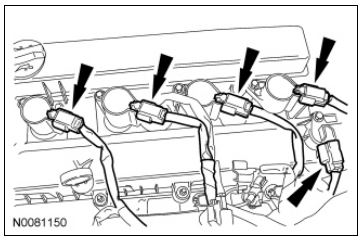
34. Disconnect the radio capacitor electrical connector.



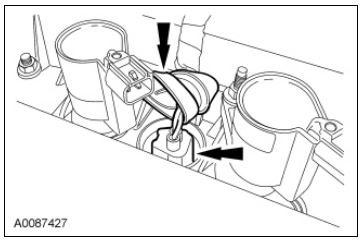
35. Disconnect the 4 fuel injector electrical connectors.
    - Detach the 2 wiring harness retainers and remove the wiring harness assembly.



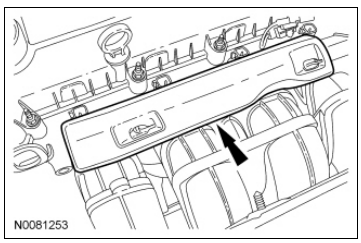
36. Disconnect the 4 ignition coil-on-plugs and Camshaft Position (CMP) sensor electrical connectors.



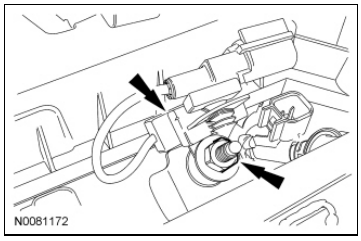
37. Position the rubber boot aside and disconnect the Cylinder Head Temperature (CHT) sensor electrical connector and remove the wiring harness.



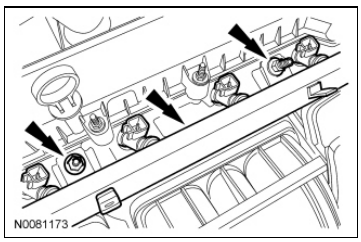
38. Remove the fuel rail insulator.



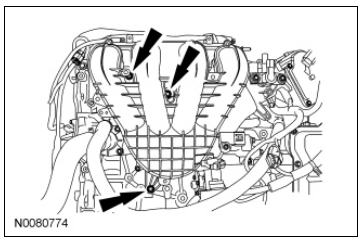
39. Remove the nut and the radio capacitor.



40. Remove the 2 stud bolts, fuel rail and fuel injectors as an assembly.

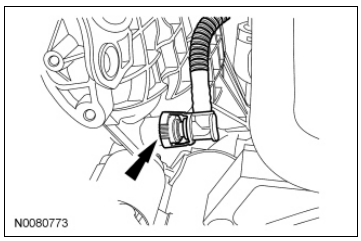


41. Remove the 7 bolts (3 shown) and position the intake manifold aside.

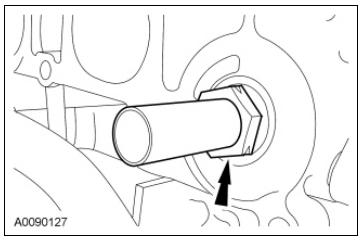


42. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

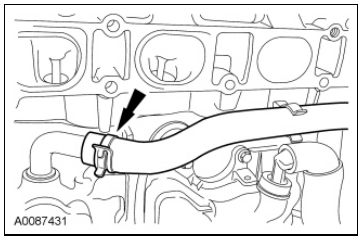
    Squeeze the 2 crankcase vent oil separator tube tabs and disconnect the tube from the intake manifold.



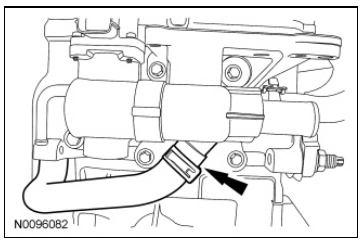
43. Remove the EGR tube.



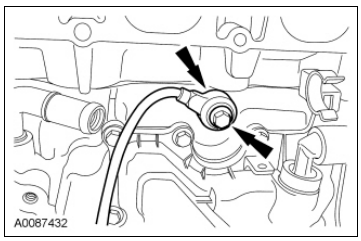
44. Disconnect the bypass hose.



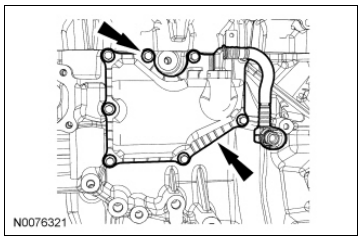
45. Remove the bypass hose from the coolant outlet.



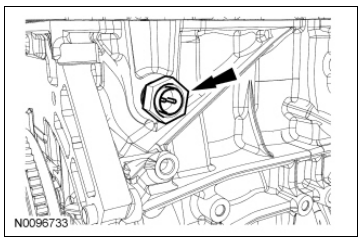
46. Remove the bolt and the KS .



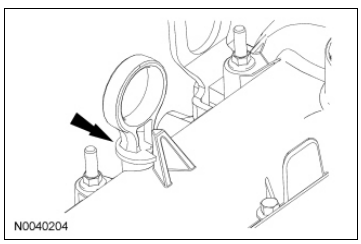
47. Remove the 8 bolts and the crankcase vent oil separator.



48. If equipped, remove the block heater.

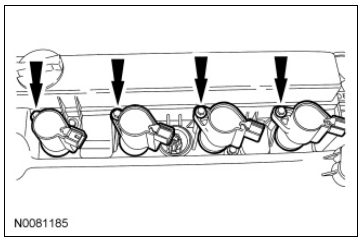


49. Remove the oil level indicator.

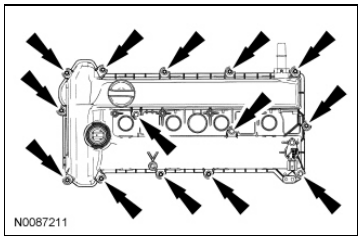


50. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

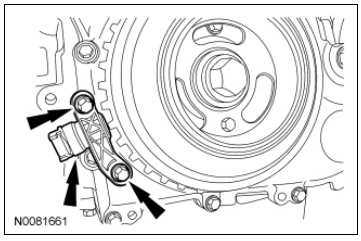
    Remove the 4 bolts and the 4 coil-on-plugs.



51. Remove the 14 retainers and the valve cover.



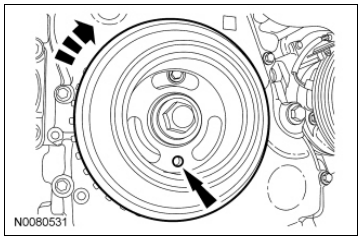
52. Remove the 2 bolts and the CKP sensor.



53. ***NOTICE:*** **Failure to position the No. 1 position at Top Dead Center (TDC) can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

    Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at Top Dead Center (TDC).

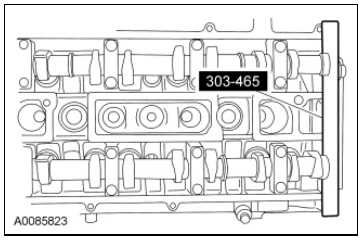
    - The hole in the crankshaft pulley should be in the 6 o'clock position.



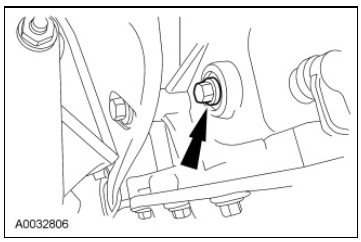
54. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this to prevent engine rotation can result in engine damage.**

    NOTE: The camshaft timing slots are offset. If the Camshaft Alignment Plate cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

    Install the Camshaft Alignment Plate in the slots on the rear of both camshafts.

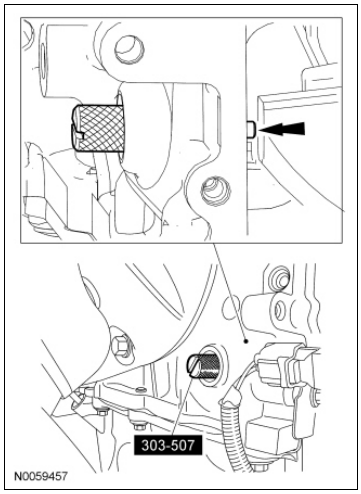


55. Remove the engine plug bolt.



56. **NOTE:** The Crankshaft TDC Timing Peg will contact the crankshaft and prevent it from turning past TDC . However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position during disassembly.

    Install the Crankshaft TDC Timing Peg.

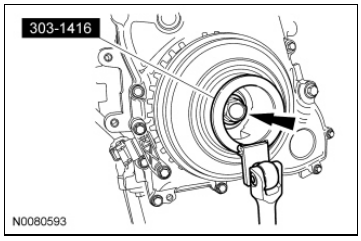


57. ***NOTICE:*** **The crankshaft must remain in the Top Dead Center (TDC) position during removal of the pulley bolt or damage to the engine can occur. Therefore, the crankshaft pulley must be held in place with the Crankshaft Damper Holding Tool and the bolt should be removed using an air impact wrench (1/2-in drive minimum).**

    NOTICE: **The crankshaft sprocket diamond washer may come off with the crankshaft pulley. The diamond washer must be replaced, remove and discard the diamond washer. If the diamond washer is not installed, engine damage may occur.**

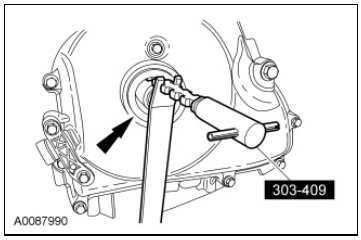
    Use the Crankshaft Damper Holding Tool and a suitable 1/2-in drive hand tool to hold the crankshaft pulley.
    Use an air impact wrench to remove the crankshaft pulley bolt.

    - Remove and discard the crankshaft pulley bolt and washer.
    - Remove the crankshaft pulley.
    - Remove the diamond washer and discard.

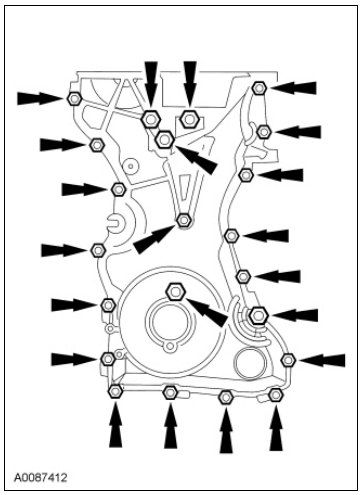


58. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

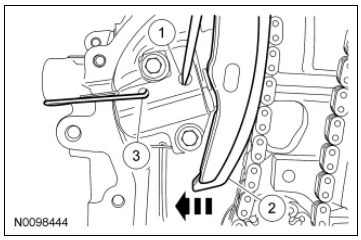
    Using the Oil Seal Remover, remove the crankshaft front oil seal.



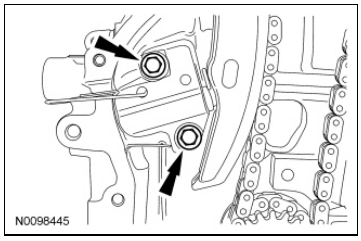
59. Remove the 22 bolts and the engine front cover.



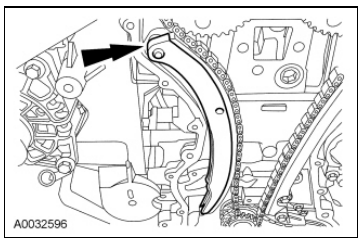
60. Compress the timing chain tensioner in the following sequence.
    1. Using a small pick, release and hold the ratchet mechanism.
    2. While holding the ratchet mechanism in the released position, compress the tensioner by pushing the timing chain arm toward the tensioner.
    3. Insert a paper clip into the hole to retain the tensioner.



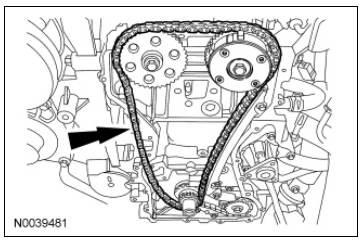
61. Remove the 2 bolts and timing chain tensioner.



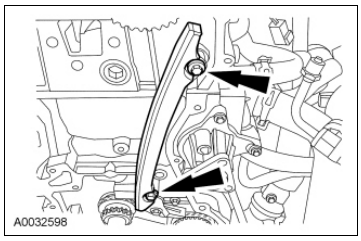
62. Remove the RH timing chain guide.



63. Remove the timing chain.

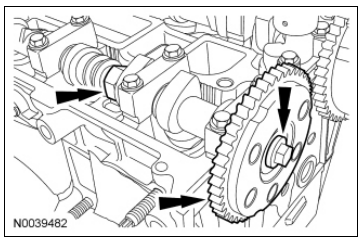


64. Remove the 2 bolts and the LH timing chain guide.



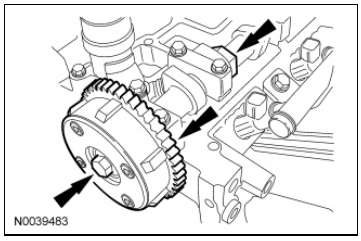
65. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

    Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the exhaust camshaft sprocket.

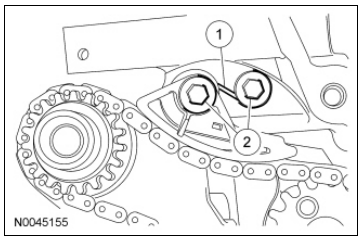


66. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

    Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the intake camshaft sprocket.



67. Remove the oil pump drive chain tensioner.
    1. Release the tension on the tensioner spring.
    2. Remove the tensioner and the 2 shoulder bolts.

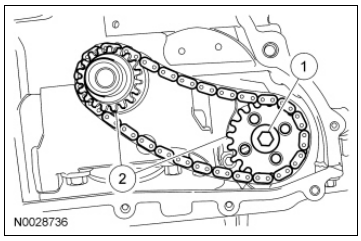


68. **NOTE:** Remove and discard the crankshaft sprocket diamond washer located behind the crankshaft sprocket.

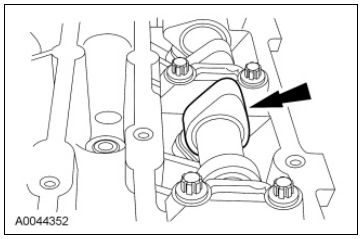
    NOTE: The oil pump chain sprocket must be held in place.

    Remove the oil pump chain and sprockets.

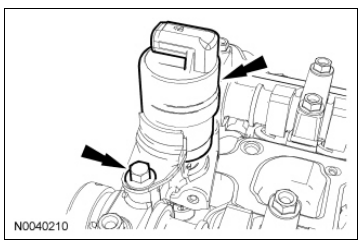
    1. Remove the bolt.
    2. Remove the chain and sprockets.



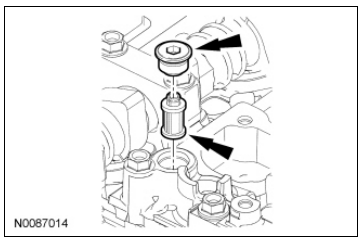
69. Mark the position of the camshaft lobes on the No. 1 cylinder for assembly reference.



70. Remove the bolt and the VCT solenoid.



71. Remove the plug and the VCT system oil filter from the intake camshaft thrust cap.

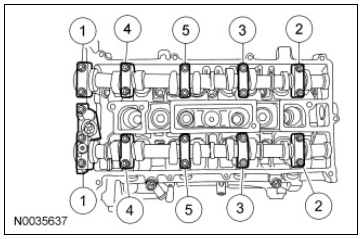


72. ***NOTICE:*** **Failure to follow the camshaft loosening procedure can result in damage to the camshafts.**

    NOTE: Mark the location and orientation of each camshaft bearing cap.

    Remove the camshafts from the engine.

    - Loosen the camshaft bearing cap bolts, in the sequence shown, one turn at a time until all tension is released from the camshaft bearing caps.
    - Remove the bolts and the camshaft bearing caps.
    - Remove the camshafts.

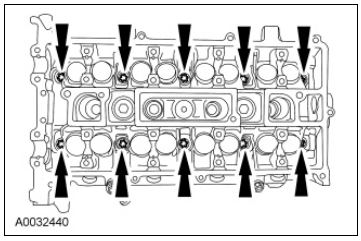


73. **NOTE:** If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

    NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

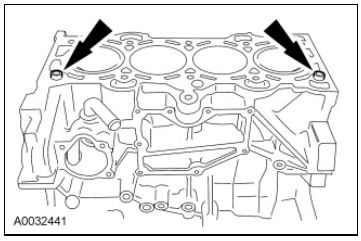
    Remove and inspect the valve tappets. For additional information, refer to Section 303-00 .

74. Remove the cylinder head.
    - Remove and discard the 10 cylinder head bolts.
    - Remove the cylinder head.
    - Remove and discard the cylinder head gasket.

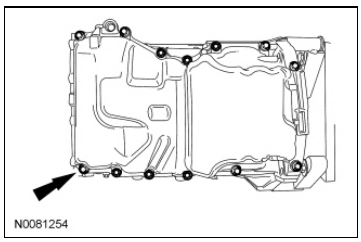


75. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

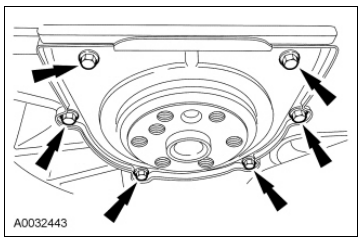
76. Remove the 2 cylinder head alignment dowels.



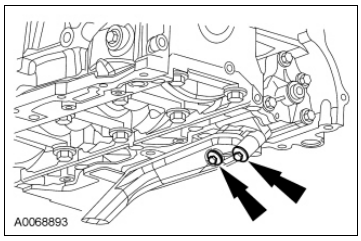
77. Remove the 13 bolts and the oil pan.



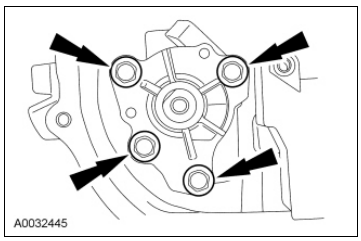
78. Remove the 6 bolts and the rear crankshaft seal.



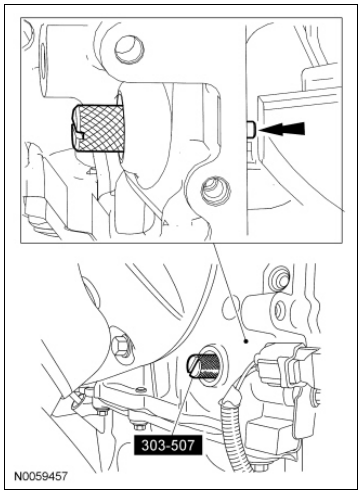
79. Remove the 2 bolts, oil pump pickup tube and gasket.



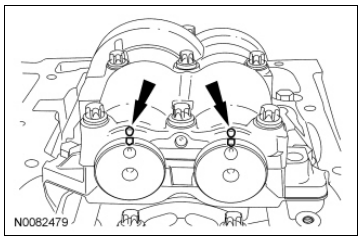
80. Remove the 4 bolts and the oil pump.



81. Make sure the Crankshaft TDC Timing Peg is still installed and the engine is still at Top Dead Center (TDC).
    - Rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg.

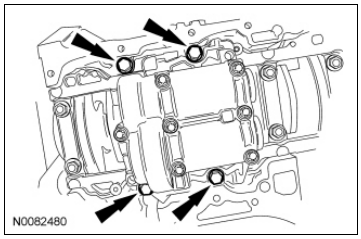


82. Mark the balancer unit and shafts on the top for reference that the balancer unit is at TDC .

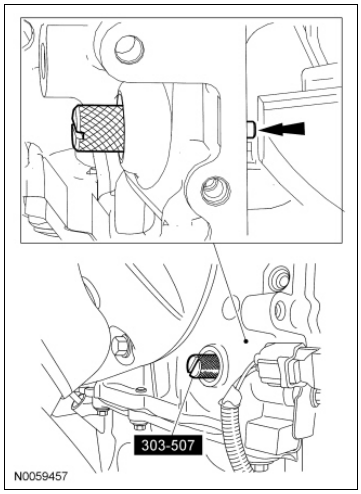


83. ***NOTICE:*** **Due to the precision interior construction of the balancer unit, it should not be disassembled.**

    Remove the 4 bolts and the balancer unit.



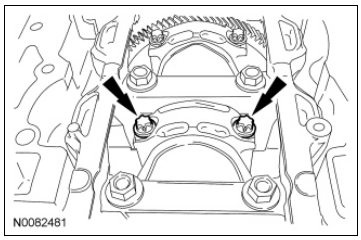
84. Remove the Crankshaft TDC Timing Peg.



85. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

86. **NOTE:** Clearly mark the connecting rods, connecting rod caps and connecting rod bearings in numerical order for correct orientation for reassembly.

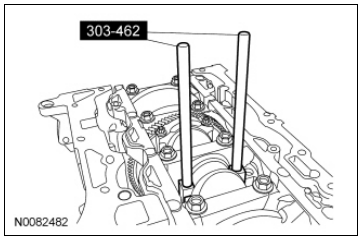
    Remove the connecting rod cap bolts and cap.



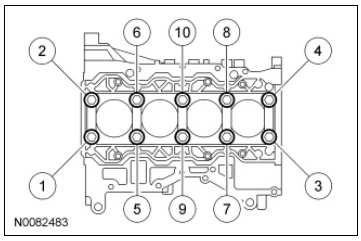
87. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

    Using the Connecting Rod Installer, remove the piston/rod assembly from the engine block.

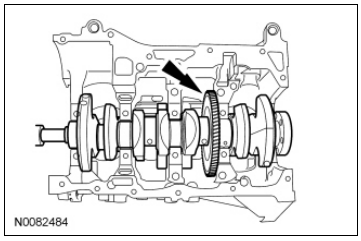
    - Repeat the previous 2 steps until all the piston/rod assemblies are removed from the engine block.



88. Remove the bolts in the sequence shown.
    - Remove the main bearing beam.
    - Discard the bolts.

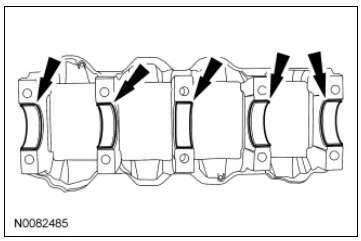


89. Remove the crankshaft from the engine block.



90. **NOTE:** If the main bearings are being reused, mark them in order for correct orientation and reassembly.

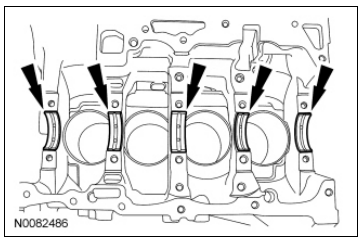
Remove the main bearings from the main bearing beam.



91. **NOTE:** If the main bearings are being reused, mark them in order for correct orientation and reassembly.

    NOTE: The center bulkhead has the thrust bearing.

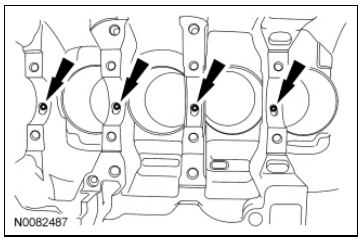
    Remove the main bearings from the cylinder block.



92. **NOTE:** If the oil squirters are being reused, mark them in order for correct location during reassembly.

    NOTE: The front bulkhead does not have an oil squirter.

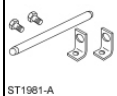
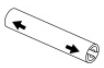
    Remove the 4 oil squirters.



93. Inspect the cylinder block, main bearing beam, pistons and connecting rods. For additional information, refer to Section 303-00 .

Cylinder Head

Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST1902-A	Compressor, Valve Spring 303-472 (T94P-6565-AH)
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)
 ST1904-A	Remover, Valve Stem Oil Seal 303-468 (T94P-6510-AH)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Multi-Purpose Grease Motorcraft® XL-5 (aerosol) and/or CRC® SL3151	

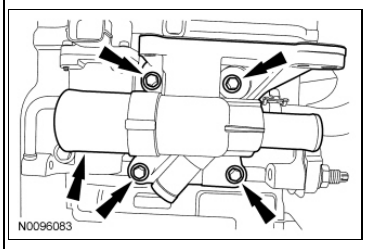
Item	Part Number	Description
1	W500015	Coolant outlet bolt (4 required)
2	8K556	Coolant outlet
3	-	Coolant outlet gasket (part of 8K556)
4	W500225	EGR valve bolt (2 required)
5	9D475	EGR valve
6	9D476	EGR valve gasket
7	6G004	Cylinder Head Temperature (CHT) sensor
8	12405	Spark plug (4 required)
9	6518	Valve collet (16 required)
10	6514	Valve spring retainer (16 required)
11	6513	Valve spring (16 required)
12	6517	Valve seal (16 required)
13	6505	Intake valve (8 required)
14	6507	Exhaust valve (8 required)
15	6049	Cylinder head

Disassembly

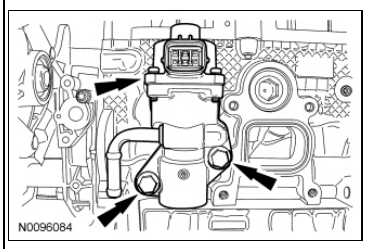
NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components removed for locations.

1. Remo the 4 bolts and the coolant outlet.

- Discard the gasket.



2. Remove the 2 bolts and the EGR valve.
   - Discard the gasket.



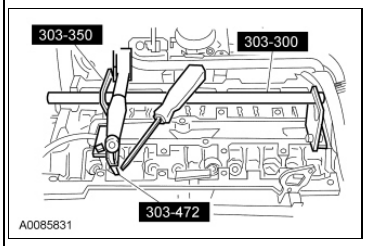
3. Remove the Cylinder Head Temperature (CHT) sensor.

4. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs, damage can occur to the cylinder head or spark plug.**

   Remove the spark plugs.

5. **NOTE:** Use a small screwdriver and grease to remove the valve collets.

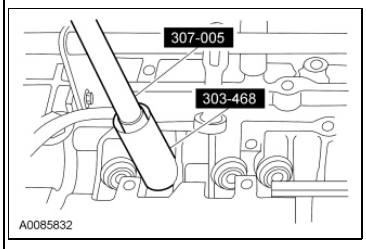
   Using the Valve Spring Compressors, compress the valve springs and remove the valve collets, valve spring retainers and the valve springs.



6. Inspect the components, if necessary. For additional information, refer to Section 303-00 .

7. Remove the valves.

8. Using the Valve Stem Oil Seal Remover and Slide Hammer, remove and discard the valve seals.



9. Inspect the valves. For additional information, refer to Section 303-00 . Install new parts, as necessary.

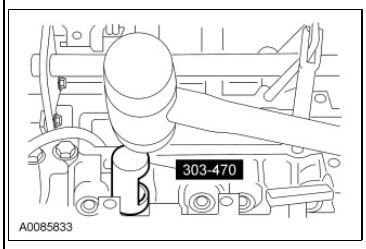
Assembly

1. **NOTE:** Coat the valve stems with clean engine oil.

   Install the valves.

2. **NOTE:** Use the protector provided with the replacement kit to prevent damage to the valve seals. Lubricate the valve stems and guides with clean engine oil.

   Using the Valve Stem Oil Seal Installer, install the valve seals.

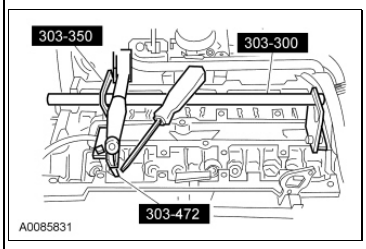


3. **NOTE:** Check the seating of the valve collets.

   Using the Valve Spring Compressors, install the valve springs.

   - Insert the valve springs and the valve spring retainers.

- Compress the valve springs and install the valve collets, using grease and a small screwdriver.



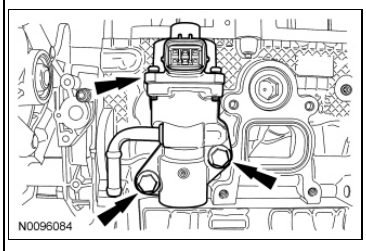
4. *NOTICE:* **Only use hand tools when removing or installing the spark plugs, damage can occur to the cylinder head or spark plug.**

   Install the spark plugs.

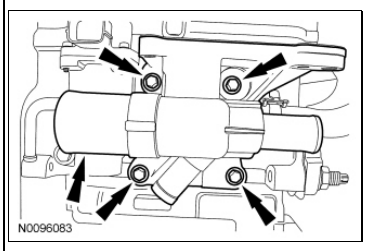
   - Tighten to 12 Nm (106 lb-in).

5. Install the CHT sensor.
   - Tighten to 12 Nm (106 lb-in).

6. Install the EGR valve, using a new gasket.
   - Tighten to 20 Nm (177 lb-in).



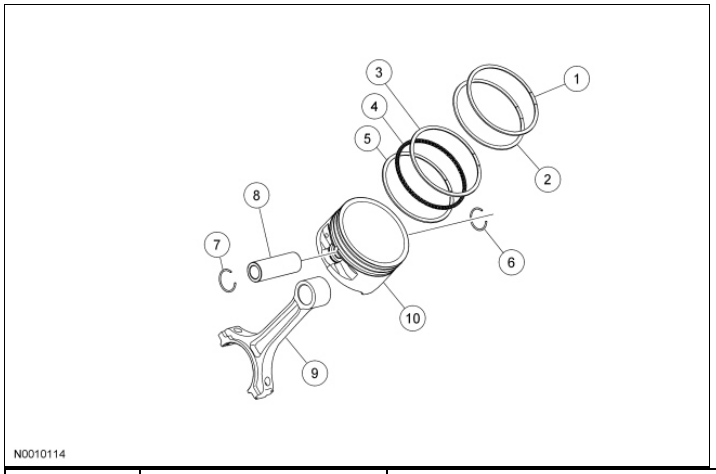
7. Using a new gasket, install the coolant outlet and bolts.
   - Tighten to 10 Nm (89 lb-in).



Piston

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	6150	Piston compression upper ring
2	6152	Piston compression lower ring
3	6159	Piston oil control upper segment ring
4	6161	Piston oil control spacer
5	6159	Piston oil control lower segment ring
6	6140	Piston pin retainer
7	6140	Piston pin retainer
8	6135	Piston pin
9	6200	Connecting rod
10	6110	Piston

Disassembly

1. Remove the piston rings from the piston.
   - Discard the piston rings.

2. Remove the 2 piston pin retainers and the piston pin.

3. **NOTE:** If the piston and connecting rod are to be reinstalled, they must be assembled in the same orientation. Mark the piston orientation to the connecting rod for reassembly.

   Separate the piston from the connecting rod.

4. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00 .

Assembly

1. **NOTE:** The arrow on the top of the piston points towards the front of the engine.

   Align the piston-to-connecting rod orientation marks, and position the connecting rod in the piston.

2. Lubricate the piston pin and pin bore with clean engine oil.

3. Install the piston pin in the piston and connecting rod assembly.

4. Install the piston pin retaining clips in the piston.

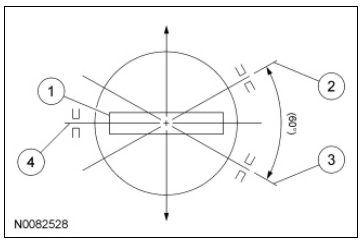
5. Lubricate the piston and the new piston rings with clean engine oil.

6. **NOTE:** The piston compression upper and lower ring should be installed with the paint mark on the outside diameter circumference of the ring to be positioned on the right side of the ring gap. The lower compression ring needs to be installed with the undercut side downward.

   NOTE: The upper and lower compression ring gaps are not controlled for installation.

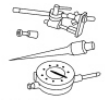
   Install the piston rings onto the piston as shown.

   1. Piston pin
   2. Upper oil control ring gap location
   3. Lower oil control ring gap location
   4. Center line of the piston pin bore and the expander gap



Engine

Special Tool(s)

 ST1751-A	Aligner, Clutch Disc 308-006 (T71P-7137-H)
 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST3055A	Aligner, Crankshaft Sens 303-1417
 ST1376-A	Compressor, Piston Ring 303-D032 (D81L-6002-C)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST3054-A	Holding Tool, Crankshaft Damper 303-1416
 ST1917-A	Installer, Camshaft Front Oil Seal 303-096 (T74P-6150-A)
 ST1982-A	Installer, Connecting Rod 303-462 (T94P-6136-AH)
 ST1506-A	Installer, Crankshaft Rear Main Oil Seal 303-328 (T88P-6701-B1)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

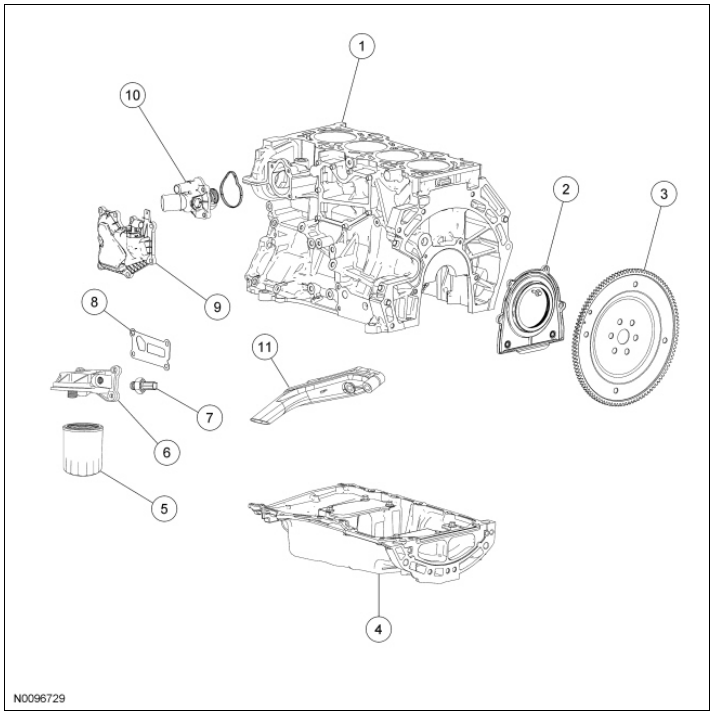
General Equipment

6 mm x 18 mm bolt

Material

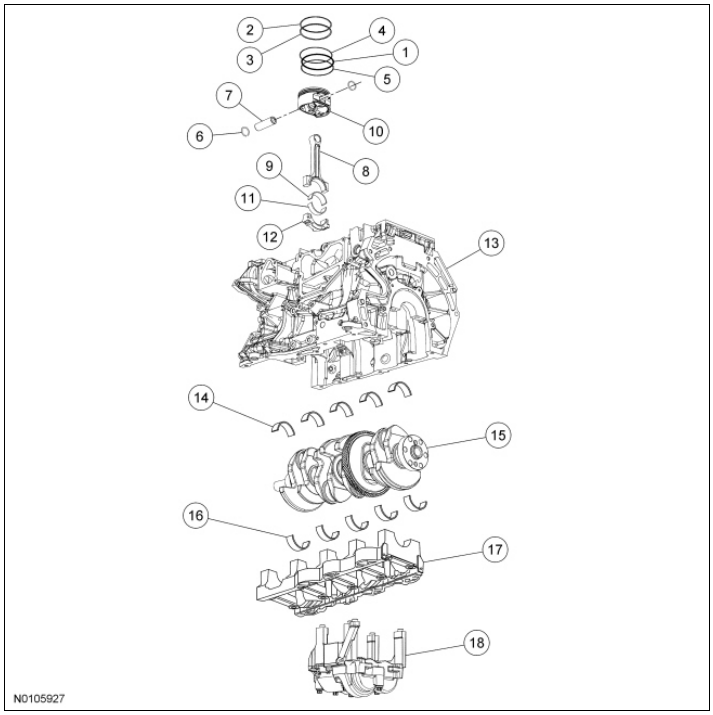
Item	Specification
High Temperature 4x4 Front Axle and Wheel Bearing Grease XG-11	WSS-M1C267-A1
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Motorcraft® Silicone Gasket Remover ZC-30	-

Lower Engine Block (View 1)



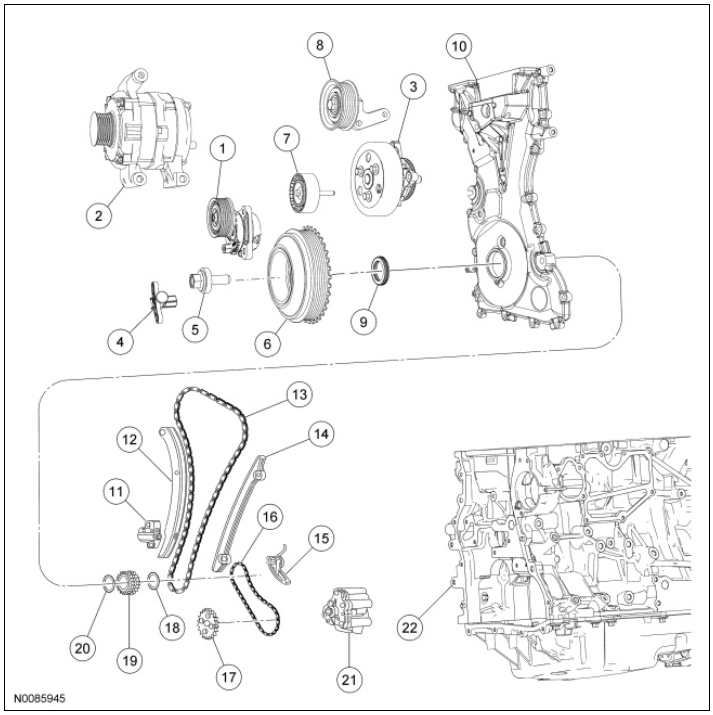
Item	Part Number	Description
1	6010	Cylinder block
2	6K318	Crankshaft rear oil seal and retainer
4	6675	Oil pan
5	6714	Engine oil filter
6	6884	Oil filter adapter
7	9278	Engine Oil Pressure (EOP) switch
8	6A636	Oil filter adapter gasket
9	6A785	Crankcase vent oil separator
10	8575	Thermostat assembly
11	6622	Oil pump screen and pickup tube

Lower Engine Block (View 2)



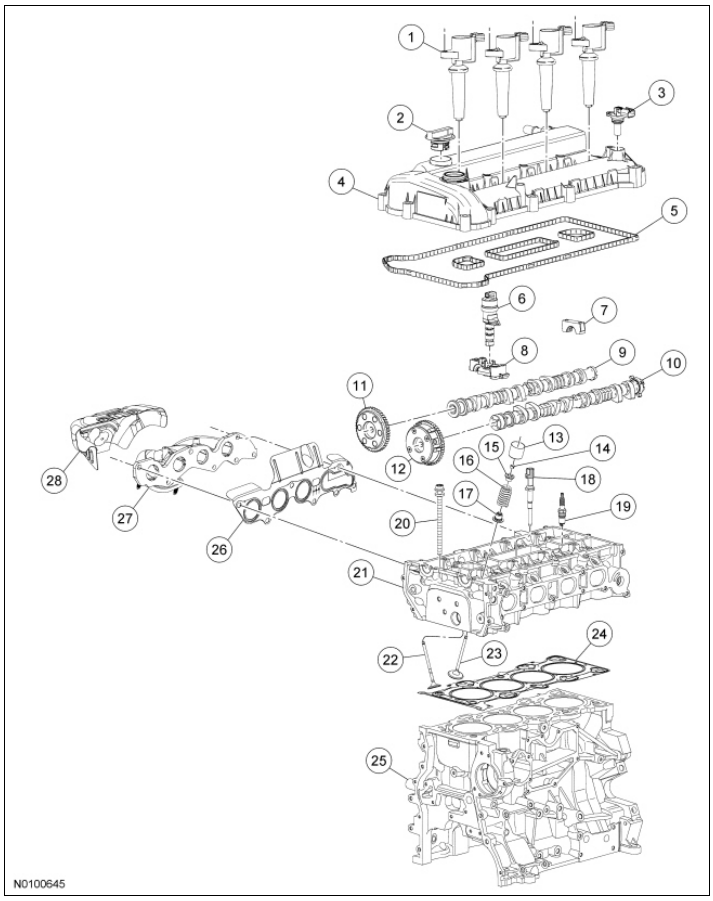
Item	Part Number	Description
1	6161	Piston oil control spacer (4 required)
2	6150	Piston compression upper ring (4 required)
3	6152	Piston compression lower ring (4 required)
4	6159	Piston oil control upper segment ring (4 required)
5	6159	Piston oil control lower segment ring (4 required)
6	6140	Piston pin retainer (8 required)
7	6135	Piston pin (4 required)
8	6200	Connecting rod (4 required)
9	6211	Connecting rod upper bearing (4 required)
10	6110	Piston (4 required)
11	6211	Connecting rod lower bearing (4 required)
12	6210	Connecting rod cap (4 required)
13	6010	Cylinder block
14	6333	Cylinder block crankshaft main bearing (5 required)
15	6303	Crankshaft
16	6333	Crankshaft main bearing beam bearing (5 required)
17	6F098	Main bearing beam
18	6K360	Balance shaft assembly

Front Engine Block



Item	Part Number	Description
1	6B209	Accessory drive belt tensioner
2	10300	Generator
3	8501	Coolant pump and pulley
4	6C315	Crankshaft Position (CKP) sensor
5	6A340	Crankshaft pulley bolt
6	6316	Crankshaft pulley
7	6C348	Smooth idler pulley
8	19A216	Idler pulley and bracket
9	6700	Crankshaft front seal
10	6019	Engine front cover
11	6K254	Timing chain tensioner
12	6K255	Timing chain tensioner arm
13	6268	Timing chain
14	6K297	Timing chain guide
15	6C271	Oil pump chain tensioner
16	6A895	Oil pump chain
17	6652	Oil pump drive gear
18	6378	Diamond washer
19	6306	Crankshaft sprocket
20	6378	Diamond washer
21	6600	Oil pump
22	6010	Cylinder block

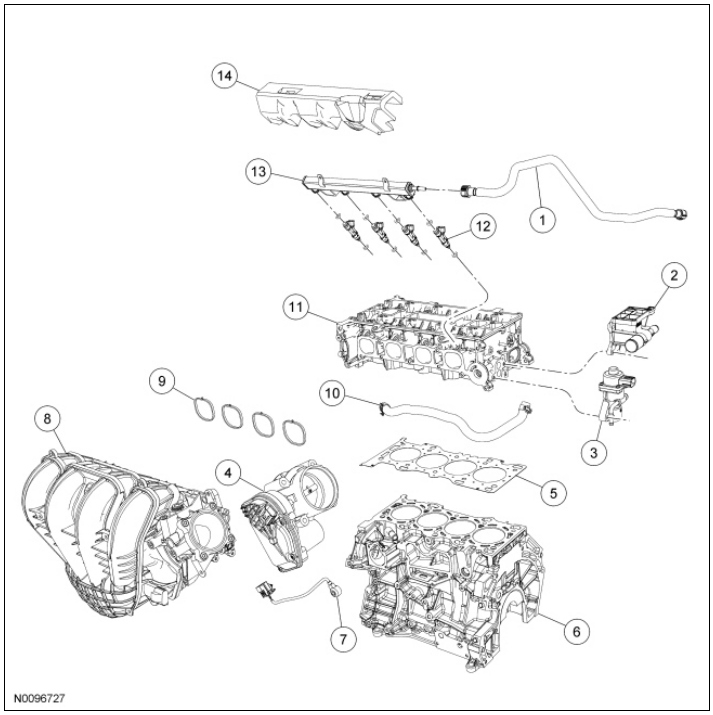
Cylinder Head



Item	Part Number	Description
1	12A366	Coil-on-plug assembly (4 required)
2	6766	Oil filler cap
3	12K073	Camshaft Position (CMP) sensor
4	6M293	Valve cover
5	6K260	Valve cover gasket
6	6M280	Variable Camshaft Timing (VCT) solenoid
7	6A284	Camshaft bearing cap (9 required)
8	6A258	Camshaft bearing cap
9	6A272	Camshaft (exhaust)
10	6A271	Camshaft (intake)
11	6C251	Camshaft sprocket
12	6C525	VCT actuator
13	6500	Valve tappet (16 required)
14	6518	Valve collet (16 required)
15	6514	Valve spring retainer (16 required)
16	6513	Valve spring (16 required)
17	6A517	Valve stem seal (16 required)
18	6G004	Cylinder Head Temperature (CHT) sensor
19	12405	Spark plug (4 required)
20	6065	Cylinder head bolt (10 required)

21	6049	Cylinder head
22	6505	Exhaust valve (8 required)
23	6507	Intake valve (8 required)
24	6051	Head gasket
25	6010	Cylinder block
26	9448	Exhaust manifold gasket
27	9430	Exhaust manifold
28	9N454	Exhaust manifold heat shield

Intake Manifold



Item	Part Number	Description
1	9288	Fuel supply tube
2	8K556	Coolant outlet
3	9D475	EGR valve
4	9F991	Throttle Body (TB)
5	6051	Cylinder head gasket
6	6010	Cylinder block
7	12A699	Knock Sensor (KS)
8	9424	Intake manifold
9	9439	Intake manifold gasket
10	8A582	Coolant bypass hose
11	6049	Cylinder head
12	9F593	Fuel injector (4 required)
13	9H487	Fuel rail
14	-	Fuel rail insulator

NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools, otherwise severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. All parts must be thoroughly cleaned and any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTE: Assembly of the engine requires various inspections/measurements of the engine components (engine block, crankshaft, connecting rods, pistons and piston rings). These inspections/measurements will aid in determining if the engine components will require replacement. For additional information, refer to Section 303-00 .

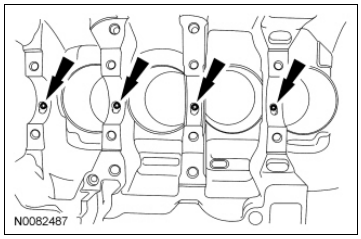
All vehicles

1. **NOTE:** If the oil squirters are being reused, they must be installed in the same location as marked during disassembly.

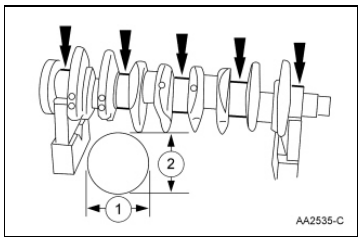
   NOTE: The front bulkhead does not have oil squirter.

   Install the 4 oil squirters.

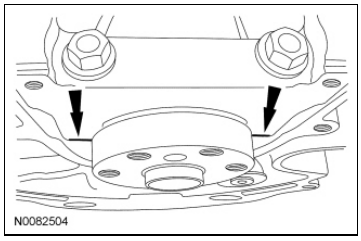
   - Tighten to 4 Nm (35 lb-in).



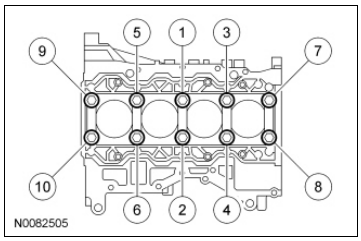
2. Measure each of the crankshaft main bearing journal diameters in at least 2 directions and record the smallest diameter for each journal.



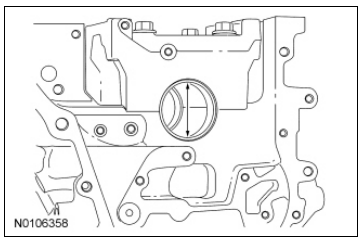
3. Position the main bearing beam in the engine block with the main bearing beam mounted flush with the rear face of the engine block.



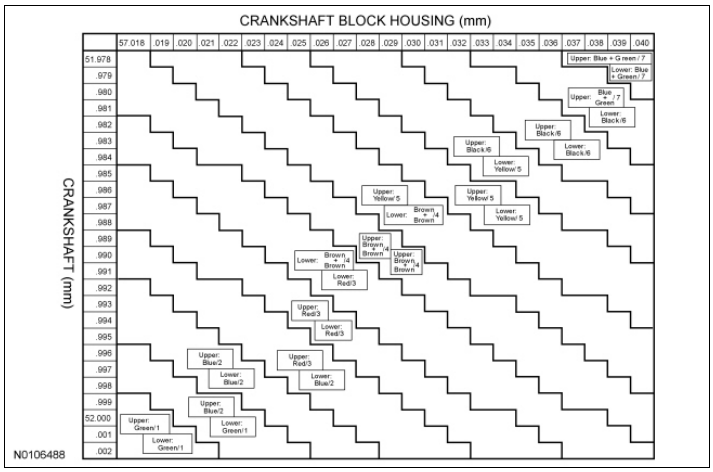
4. Using the original main bearing beam bolts, install and tighten the 10 main bearing beam bolts.
    - Tighten the bolts in the sequence shown in 3 stages.
    - Stage 1: Tighten to 5 Nm (44 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.



5. Measure each crankshaft block main bearing bore diameter.
    - Remove the bolts and the main bearing beam.
    - Discard the main bearing beam bolts.



6. Using the chart, select the crankshaft main bearings.



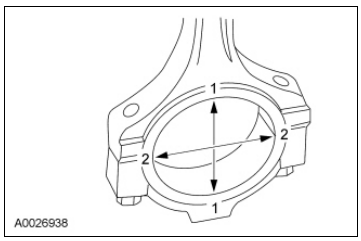
7. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

    Using the original connecting rod cap bolts, install the connecting caps and bolts.

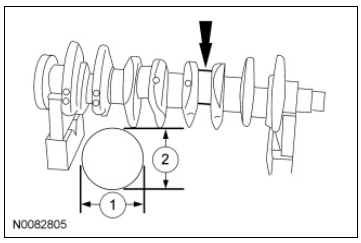
    - Tighten the bolts in 2 stages.

- Stage 1: Tighten to 29 Nm (21 lb-ft).
- Stage 2: Tighten an additional 90 degrees.

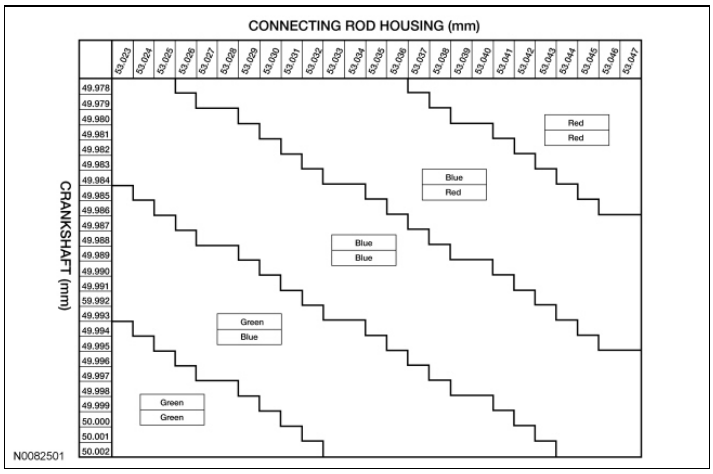
8. Measure the connecting rod large end bore in 2 directions. Record the smallest measurement for each connecting rod.
    - Remove the bolts and the connecting rod cap.
    - Discard the connecting rod cap bolts.



9. Measure each of the crankshaft connecting rod bearing journal diameters in at least 2 directions. Record the smallest measurement for each connecting rod journal.



10. Using the chart, select the correct connecting rod bearings for each crankshaft connecting rod journal.

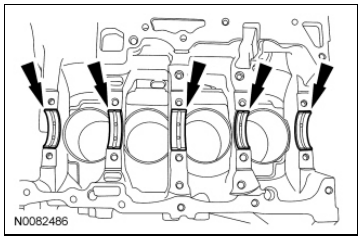


11. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

    NOTE: If reusing the crankshaft main bearings, install them in their original positions and orientation as noted during disassembly.

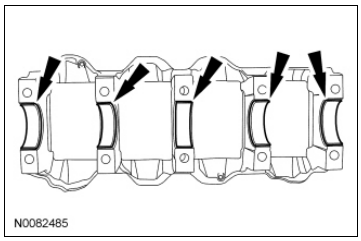
    NOTE: The center bulkhead is the thrust bearing.

    Lubricate the upper crankshaft main bearings with clean engine oil and install the 5 crankshaft main bearings in the cylinder block.



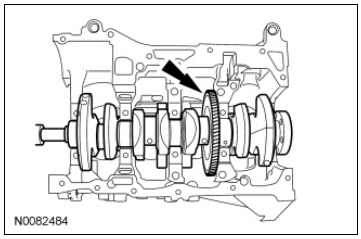
12. **NOTE:** If reusing the crankshaft main bearings, install them in their original positions and orientation as noted during disassembly.

    Lubricate the crankshaft main bearings with clean engine oil and install the 5 crankshaft main bearings in the main bearing beam.

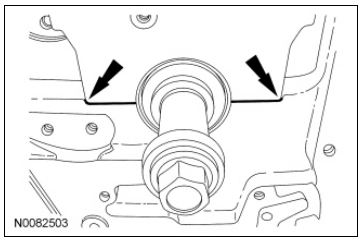


13. Lubricate journals on the crankshaft with clean engine oil.

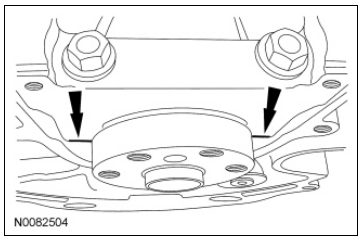
14. Position the crankshaft in the cylinder block.



15. Lubricate the 10 main bearing beam side fit surfaces (front 2 shown) with clean engine oil.



16. Lubricate the crankshaft bearing journals on the main bearing beam with clean engine oil. Then position the main bearing beam in the engine block with the main bearing beam mounted flush with the rear face of the engine block.

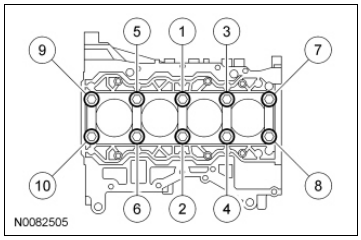


17. **NOTE:** Lubricate the main bearing beam bolts threads and under the bolt heads with clean engine oil.

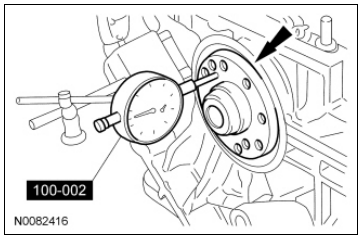
NOTE: Position the crankshaft to the rear of the cylinder block, then position the crankshaft to the front of the cylinder block before tightening the main bearing beam bolts.

Install and tighten the 10 new main bearing beam bolts.

- Tighten the bolts in the sequence shown in 3 stages.
- Stage 1: Tighten to 5 Nm (44 lb-in).
- Stage 2: Tighten to 25 Nm (18 lb-ft).
- Stage 3: Tighten an additional 90 degrees.



18. Using the Dial Indicator Gauge with Holding Fixture, measure crankshaft end play.
    - Position the crankshaft to the rear of the cylinder block.
    - Zero the Dial Indicator Gauge with Holding Fixture.
    - Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.
    - Acceptable crankshaft end play is 0.22-0.43 mm (0.008-0.016 in). If the crankshaft end play exceeds the specified range, install new parts as necessary.



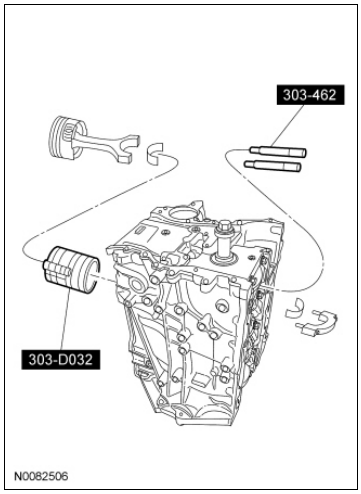
19. ***NOTICE:*** **Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.**

    NOTE: Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with clean engine oil.

    NOTE: Make sure the piston arrow on top is facing toward the front of the engine.

    Using the Piston Ring Compressor and the Connecting Rod Installer, install the piston and connecting rod assemblies.

    - When installing the pistons and connecting rod assemblies, the oil ring gaps must be positioned 60 degrees apart from each other and a minimum of 90 degrees from the expander gap.
    - The position of the upper and lower compression ring gaps are not controlled for installation.



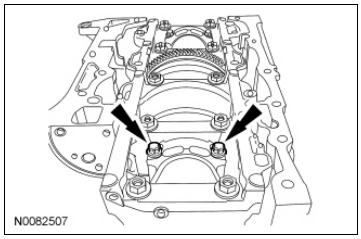
20. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

    NOTE: Install connecting rod caps and bolts on the connecting rods for cylinders 1 and 4 first and tighten. Then rotate crankshaft 180 degrees and install connecting rod caps and bolts on connecting rods for cylinders 2 and 3 and tighten.

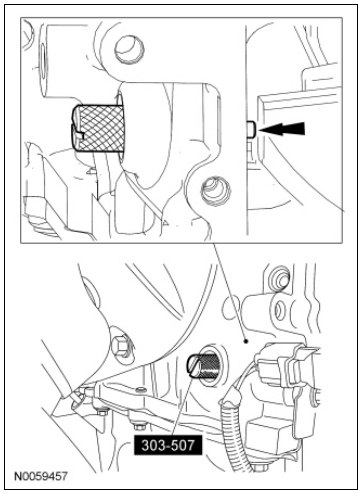
    NOTE: After installation of each connecting rod cap, rotate the crankshaft to verify smooth operation.

    Install the connecting rod caps and the new bolts.

    - Tighten the bolts in 2 stages.
    - Stage 1: Tighten to 29 Nm (21 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



21. Install the Crankshaft TDC Timing Peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg. The engine is now at Top Dead Center (TDC).



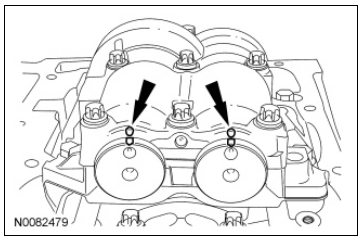
22. *NOTICE:* **Due to the precision interior construction of the balancer unit, it should not be disassembled.**

    NOTE: The original adjustment shims must be installed in their original position.

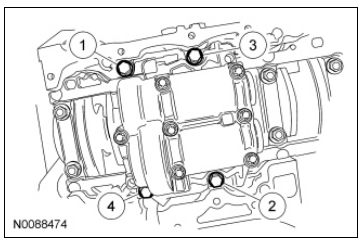
    NOTE: Confirm by visual inspection that there is no damage to the balancer unit gear and verify that the shaft turns smoothly. If there is any damage or malfunction, replace the balancer unit.

    Install the adjustment shims in their original position on the seat faces of the balancer unit.

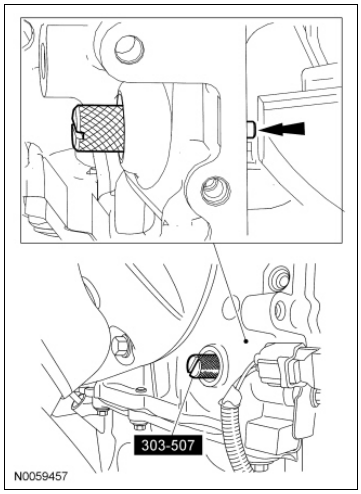
23. With the balancer unit shaft marks in the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.



24. Install the balancer unit bolts.
    - Tighten in the sequence shown in 2 stages.
        - ♦ Stage 1: Tighten to 25 Nm (18 lb-ft).
        - ♦ Stage 2: Tighten to 50 Nm (37 lb-ft).

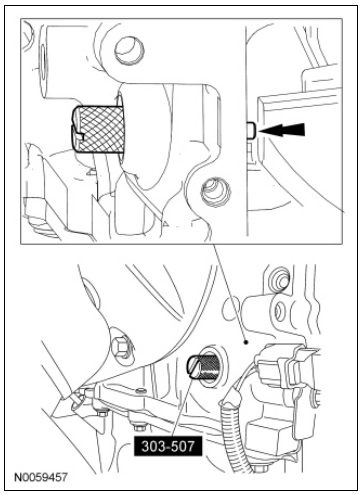


25. Remove the Crankshaft TDC Timing Peg.



26. Rotate the crankshaft to confirm that there are no meshing problems between the balancer unit gear and the crankshaft gear.

27. Install the Crankshaft TDC Timing Peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg.
    - Remove the Crankshaft TDC Timing Peg.



28. **NOTE:** Measure the backlash and verify that it is within specified range at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees. It will be necessary to reset the measuring equipment between measurements.

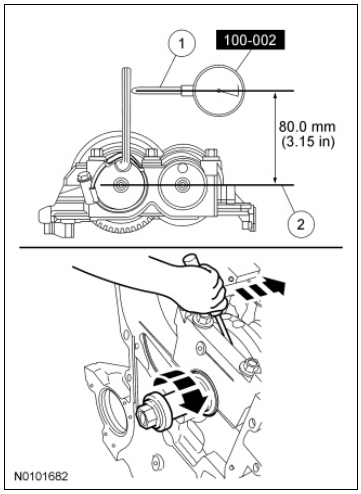
    NOTE: The measurement must be taken with the Dial Indicator Gauge with Holding Fixture, a 5-mm Allen wrench and worm clamp set up as shown. Mark the Allen wrench with a file 80 mm (3.149 in) above the driven gear shaft center. Make sure the worm clamp and Allen wrench are not touching the balance shaft housing.

    NOTE: For an accurate measurement while measuring the gear backlash, insert a screwdriver as shown into the crankshaft No. 1 crankweight area and set both the rotation and the thrust direction with the screwdriver, using a prying action as shown.

    Position the Dial Indicator Gauge with Holding Fixture as shown. Measure the gear backlash.

    - Position the Dial Indicator Gauge with Holding Fixture (1) on the Allen wrench 80 mm (3.149 in) above the driven gear shaft center (2) on the balancer unit.

- Rotate the crankshaft clockwise and measure the backlash at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees.
- Backlash specifications are 0.005 to 0.101 mm (0.00019 to 0.0039 in).
- If the backlash exceeds the specified range, carry out the balance shaft backlash procedure. For additional information, refer to the Balance Shaft Backlash procedure in this section.

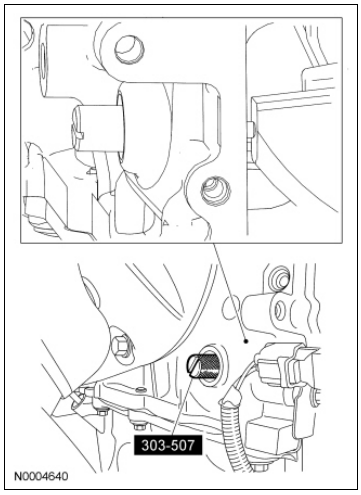


29. ***NOTICE:*** **Failure to position the No. 1 piston at Top Dead Center (TDC) can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

    Turn the crankshaft clockwise to position the No. 1 piston at Top Dead Center (TDC).

30. **NOTE:** The Crankshaft TDC Timing Peg will contact the crankshaft and prevent it from turning past TDC . However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position until the timing drive components and crankshaft pulley are installed.

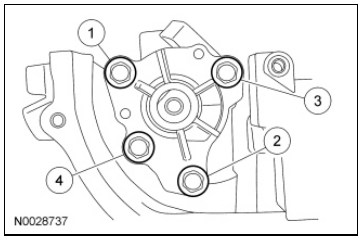
    Install the Crankshaft TDC Timing Peg.



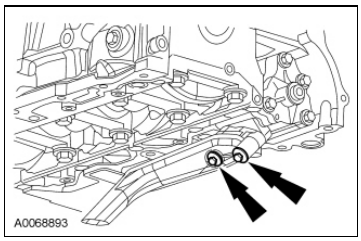
31. **NOTE:** Clean the oil pump and cylinder block mating surfaces with metal surface prep.

    Install the oil pump assembly. Tighten the 4 bolts in the sequence shown in 2 stages:

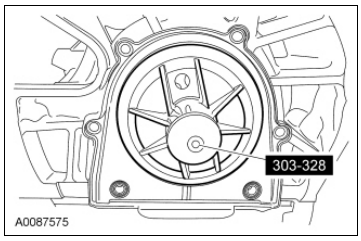
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten to 20 Nm (177 lb-in).



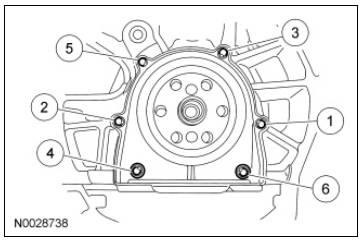
32. Install a new gasket, oil pump pickup tube and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



33. Using the Crankshaft Rear Main Oil Seal Installer, install the crankshaft rear main oil seal.



34. Tighten the 6 crankshaft rear main oil seal retainer plate bolts in the sequence shown.
    - To install, tighten to 10 Nm (89 lb-in).



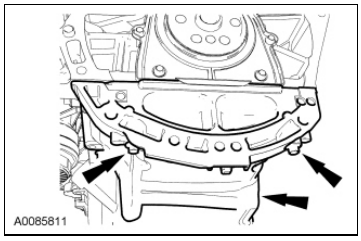
35. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.**

    Clean and inspect all mating surfaces.

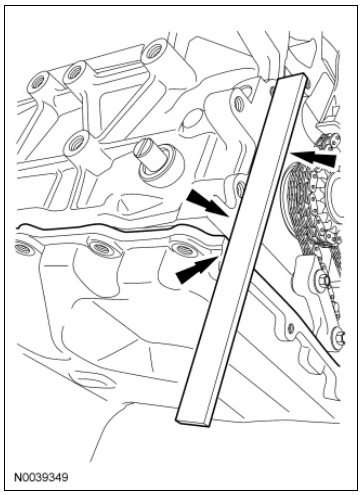
36. **NOTE:** If the oil pan is not secured within 4 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow these instructions can cause future oil leakage.

    Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the oil pan.

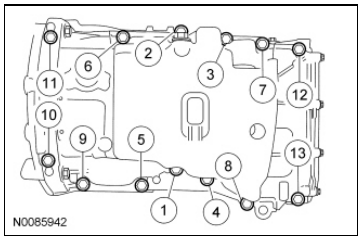
    - Position the oil pan onto the engine and install the 2 rear oil pan bolts finger-tight.



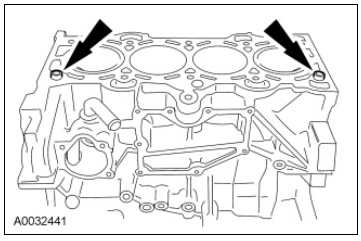
37. Using a suitable straight edge, align the front surface of the oil pan flush with the front surface of the engine block.



38. Install the remaining oil pan bolts.
    - Tighten in the sequence shown to 20 Nm (177 lb-in).



39. Install the 2 cylinder head alignment dowels. Dowels must be fully seated in the cylinder block.



40. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

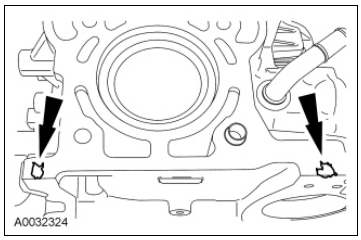
    NOTE: Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

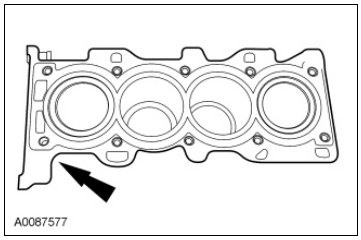
Clean the cylinder head-to-cylinder block mating surface of both the cylinder head and the cylinder block in the following sequence.

1. Remove any large deposits of silicone or gasket material with a plastic scraper.
2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply metal surface prep, following package directions, to remove any traces of oil or coolant, and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

41. Apply silicone gasket and sealant to the locations shown.



42. Install a new head gasket.

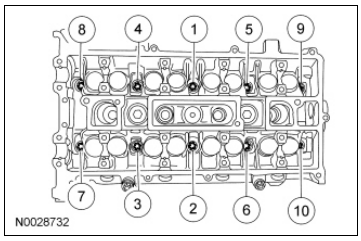


43. **NOTE:** The cylinder head bolts are a torque-to-yield design and must not be reused. New cylinder head bolts must be installed.

    NOTE: Lubricate the bolts with clean engine oil prior to installation.

    Install the cylinder head and 10 new bolts. Tighten the bolts in the sequence shown in 5 stages:

    - Stage 1: Tighten to 7 Nm (62 lb-in).
    - Stage 2: Tighten to 15 Nm (133 lb-in).
    - Stage 3: Tighten to 45 Nm (33 lb-ft).
    - Stage 4: Turn 90 degrees.
    - Stage 5: Turn an additional 90 degrees.



44. **NOTE:** Coat the valve tappets with clean engine oil prior to installation.

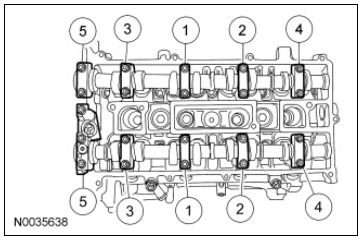
    Install the valve tappets.

45. ***NOTICE:*** **Install the camshafts with the alignment slots in the camshafts lined up so the Camshaft Alignment Plate can be installed without rotating the camshafts. Make sure the lobes on the No. 1 cylinder are in the same position as noted in the removal procedure. Rotating the camshafts when the timing chain is removed, or installing the camshafts 180 degrees out of position can cause severe damage to the valves and pistons.**

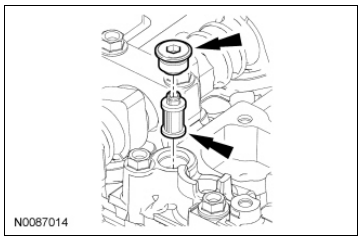
    NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

    Install the camshafts and bearing caps in their original locations and orientation. Tighten the bearing caps in the sequence shown in 3 stages:

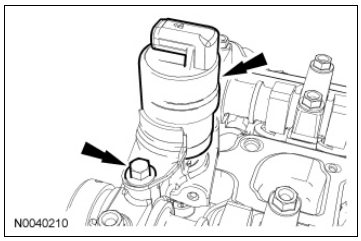
    - Stage 1: Tighten the camshaft bearing cap bolts until finger-tight.
    - Stage 2: Tighten to 7 Nm (62 lb-in).
    - Stage 3: Tighten to 16 Nm (142 lb-in).



46. Install the Variable Camshaft Timing (VCT) system oil filter and the plug in the intake camshaft thrust cap.
    - Tighten to 17 Nm (150 lb-in).



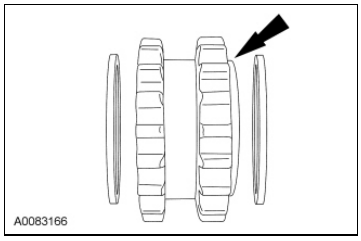
47. Install the Variable Camshaft Timing (VCT) solenoid and the bolt.
    - Tighten to 10 Nm (89 lb-in).



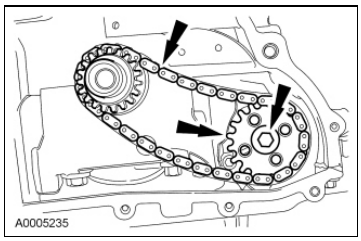
48. **NOTE:** Install a new crankshaft sprocket diamond washer on both sides of the crankshaft sprocket.

    Install the crankshaft sprocket and new crankshaft sprocket diamond washers.

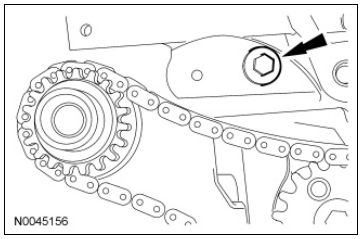
    - The crankshaft sprocket flange must be facing away from the engine block.



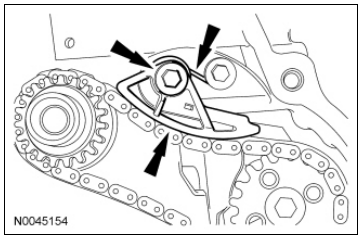
49. Install the oil pump drive chain, sprocket and bolt.
    - Tighten to 25 Nm (18 lb-ft).



50. Install the oil pump drive chain tensioner shoulder bolt.
    - Tighten to 10 Nm (89 lb-in).

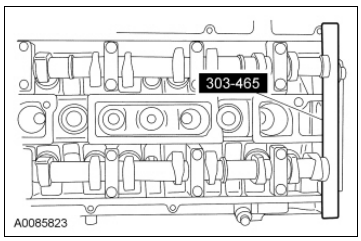


51. Install the oil pump drive chain tensioner and bolt. Hook the tensioner spring around the shoulder bolt.
    - Tighten to 10 Nm (89 lb-in).

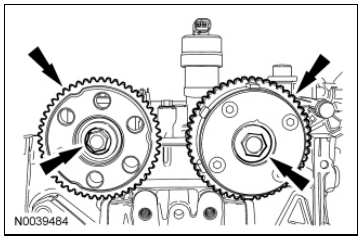


52. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

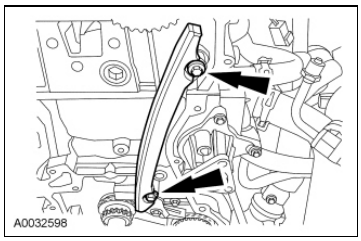
    Install the Camshaft Alignment Plate in the slots on the rear of both camshafts.



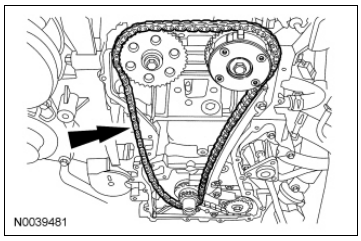
53. Install the camshaft sprockets and the bolts. Do not tighten the bolts at this time.



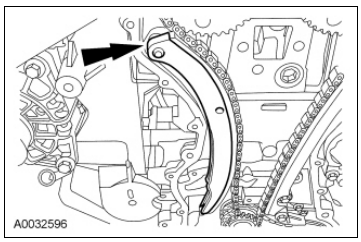
54. Install the timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



55. Install the timing chain.



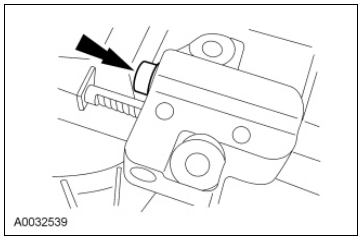
56. Install the timing chain tensioner arm.



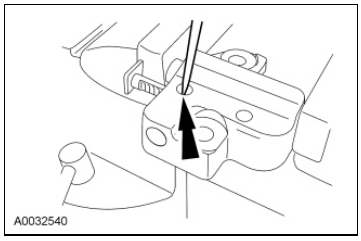
NOTE: If the timing chain tensioner plunger and ratchet assembly are not pinned in the compressed position, follow the next 4 steps.

57. ***NOTICE:*** **Do not compress the ratchet assembly. This will damage the ratchet assembly.**

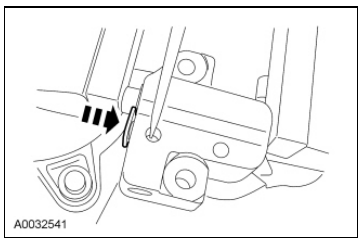
    Using the edge of a vise, compress the timing chain tensioner plunger.



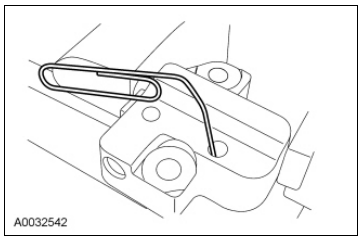
58. Using a small pick, push back and hold the ratchet mechanism.



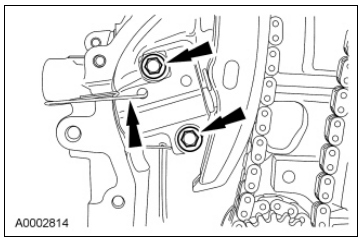
59. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.



60. Install a paper clip into the hole in the tensioner housing to hold the ratchet assembly and the plunger in during installation.



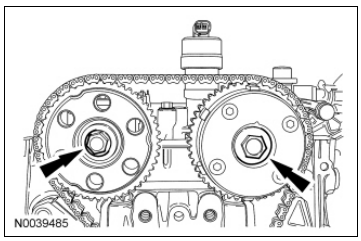
61. Install the timing chain tensioner and the 2 bolts. Remove the paper clip to release the piston.
    - Tighten to 10 Nm (89 lb-in).



62. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

    Using the flats on the camshafts to prevent camshaft rotation, tighten the camshaft sprocket bolts.

    - Tighten to 72 Nm (53 lb-ft).

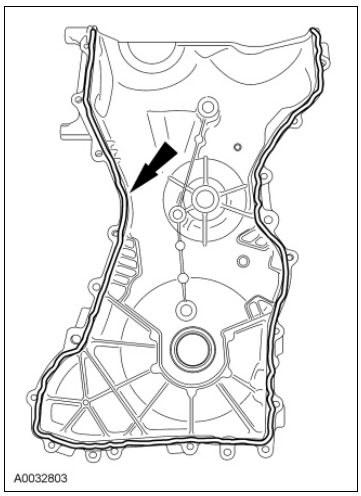


63. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean sealing surfaces. These tools cause scratches and gouges which make leak paths.**

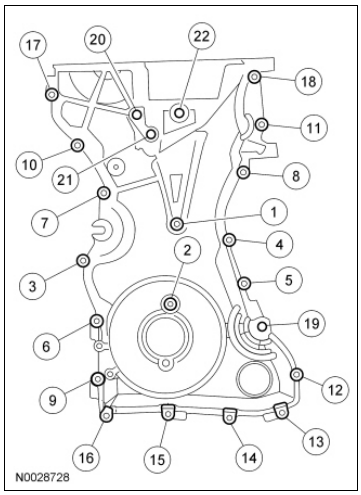
Clean and inspect the mounting surfaces of the engine and the front cover.

64. **NOTE:** The engine front cover must be installed and the bolts tightened within 4 minutes of applying the silicone gasket and sealant.

    Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the cylinder head and oil pan joint areas. Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the front cover.



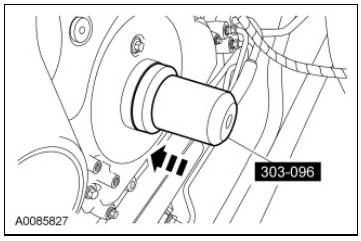
65. Install the engine front cover. Tighten the 22 bolts in the sequence shown, to the following specifications:
    - Tighten the 8-mm bolts to 10 Nm (89 lb-in).
    - Tighten the 13-mm bolts to 48 Nm (35 lb-ft).



66. **NOTE:** Remove the through bolt from the Camshaft Front Oil Seal Installer.

    NOTE: Lubricate the oil seal with clean engine oil.

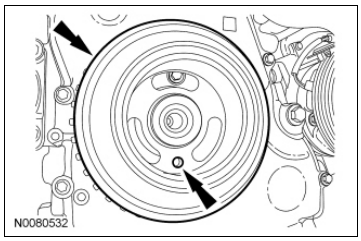
    Using the Camshaft Front Oil Seal Installer, install a new crankshaft front oil seal.



67. **NOTE:** Do not install the crankshaft pulley bolt at this time.

    NOTE: Apply clean engine oil on the seal area before installing.

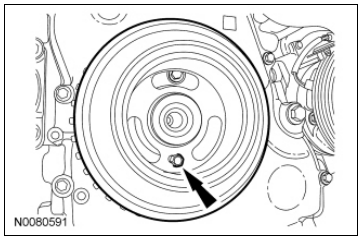
    Position the crankshaft pulley onto the crankshaft with the hole in the pulley at the 6 o'clock position.



68. ***NOTICE:*** **Only hand-tighten the 6 mm bolt or damage to the front cover can occur.**

    NOTE: This step will correctly align the crankshaft pulley to the crankshaft.

    Install a standard 6 mm x 18 mm bolt through the crankshaft pulley and thread it into the front cover.

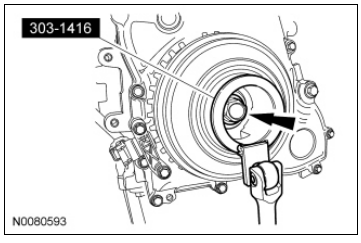


69. ***NOTICE:*** **The crankshaft must remain in the Top Dead Center (TDC) position during installation of the pulley bolt or damage to the engine can occur. Therefore, the crankshaft pulley must be held in place with the Crankshaft Damper Holding Tool and the bolt should be installed using hand tools only.**

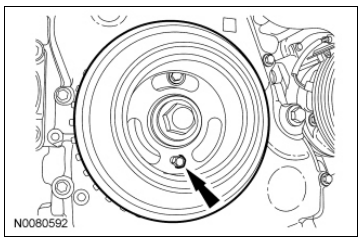
    NOTE: Do not reuse the crankshaft pulley bolt.

    Install a new crankshaft pulley bolt. Using the Crankshaft Damper Holding Tool to hold the crankshaft pulley in place, tighten the crankshaft pulley bolt in 2 stages:

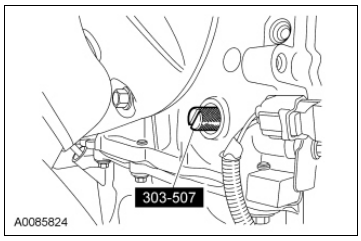
    - Stage 1: Tighten to 100 Nm (74 lb-ft).
    - Stage 2: Tighten an additional 90 degrees (one-fourth turn).



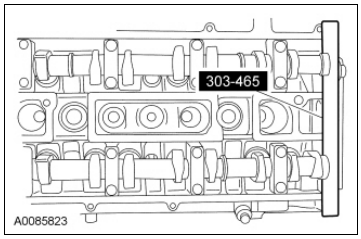
70. Remove the 6 mm x 18 mm bolt.



71. Remove the Crankshaft TDC Timing Peg.



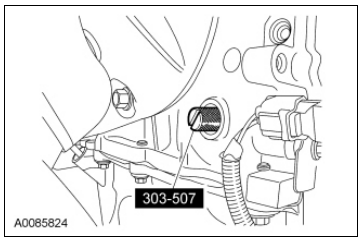
72. Remove the Camshaft Alignment Plate.



73. **NOTE:** Only turn the engine in the normal direction of rotation.

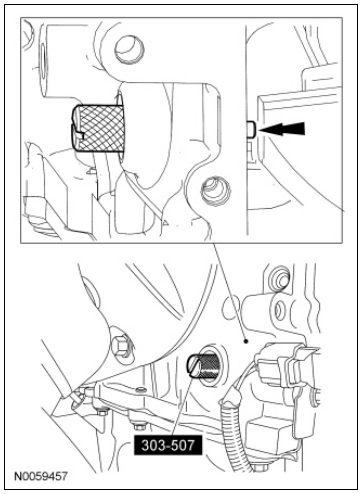
    Turn the crankshaft clockwise one and three-fourths turns.

74. Install the Crankshaft TDC Timing Peg.



75. **NOTE:** Only turn the engine in the normal direction of rotation.

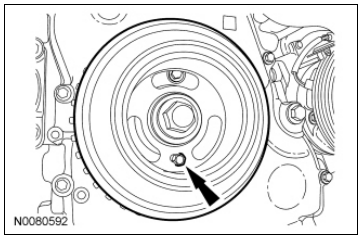
    Turn the crankshaft clockwise until the crankshaft contacts the Crankshaft TDC Timing Peg.



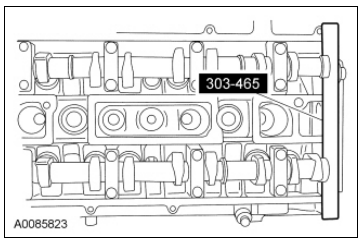
76. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

    Using the 6 mm x 18 mm bolt, check the position of the crankshaft pulley.

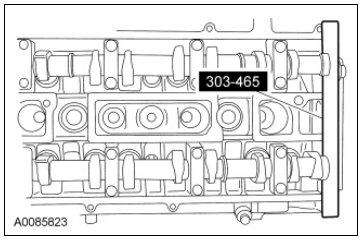
    - If it is not possible to install the bolt, the engine valve timing must be corrected.



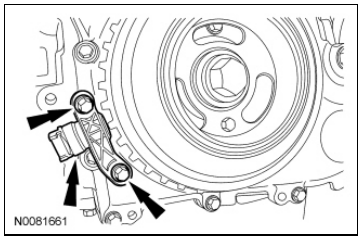
77. Install the Camshaft Alignment Plate to check the position of the camshafts.
    - If it is not possible to install the Camshaft Alignment Plate, the engine valve timing must be corrected.



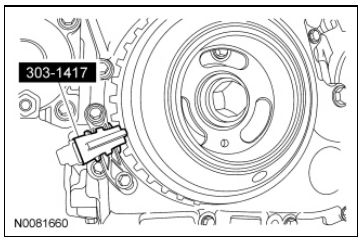
78. Remove the Camshaft Alignment Plate.



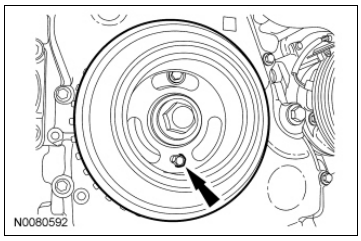
79. Install the Crankshaft Position (CKP) sensor and the 2 bolts.
    - Do not tighten the bolts at this time.



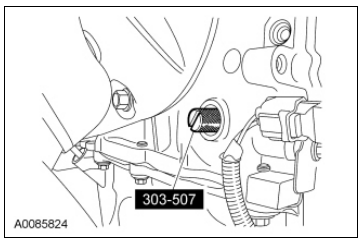
80. Using the Crankshaft Sensor Aligner, adjust the CKP sensor.
    - Tighten the 2 CKP bolts to 7 Nm (62 lb-in).



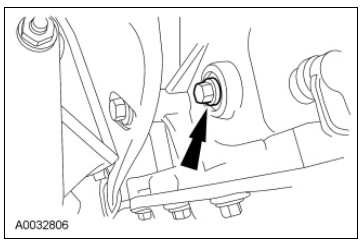
81. Remove the 6 mm x 18 mm bolt.



82. Remove the Crankshaft TDC Timing Peg.



83. Install the engine plug bolt.
    - Tighten to 20 Nm (177 lb-in).

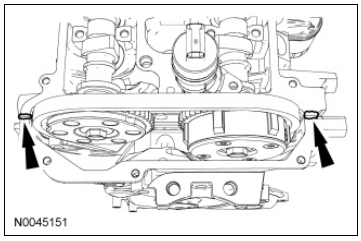


84. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.**

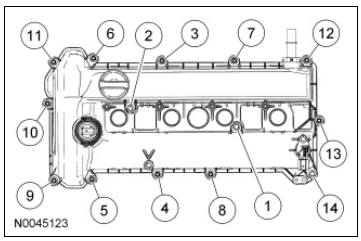
    Clean the valve cover gasket surface with metal surface prep.

85. **NOTE:** The valve cover must be secured within 4 minutes of silicone gasket application. If the valve cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep.

    Apply silicone gasket and sealant to the locations shown.



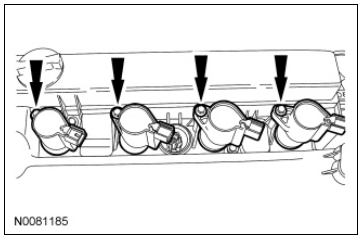
86. Install the valve cover.
    - Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).



87. **NOTE:** Apply dielectric compound to the inside of the coil-on-plug boots.

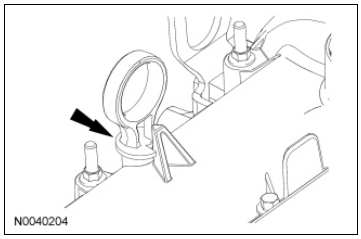
    Install the 4 coil-on-plugs and the 4 bolts.

    - Tighten to 8 Nm (71 lb-in).

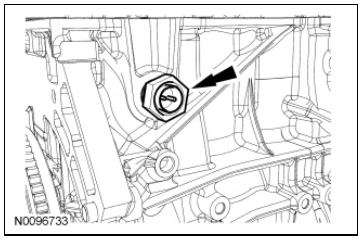


88. **NOTE:** Make sure the notch on the oil level indicator is aligned with the V-shaped boss on the valve cover and fully engaged into the valve cover.

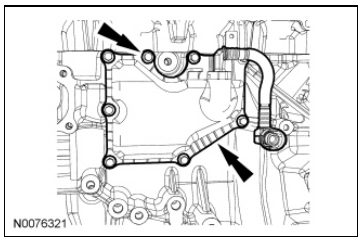
    Install the oil level indicator.



89. If equipped, install the block heater.
    - Tighten to 40 Nm (30 lb-ft).



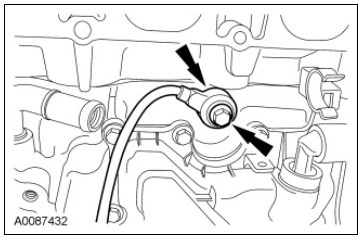
90. Install the crankcase vent oil separator and the 8 bolts.
    - Tighten to 10 Nm (89 lb-in).



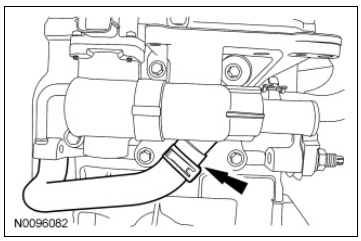
91. **NOTE:** The Knock Sensor (KS) must not touch the crankcase vent oil separator.

    Install the KS and the bolt.

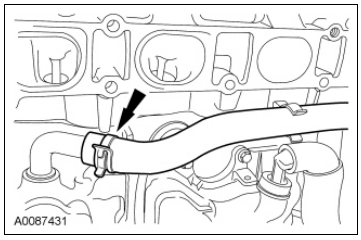
    - Tighten to 20 Nm (177 lb-in).



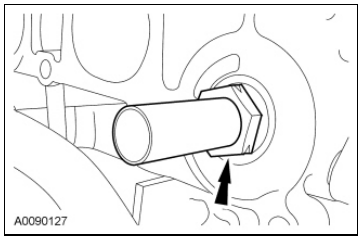
92. Install the coolant bypass hose on the coolant outlet.



93. Connect the coolant bypass hose.

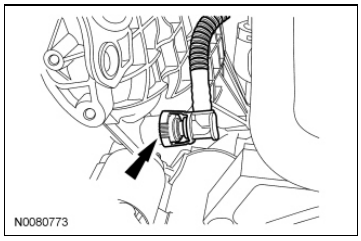


94. Install the EGR tube.
    - Tighten to 55 Nm (41 lb-ft).



95. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

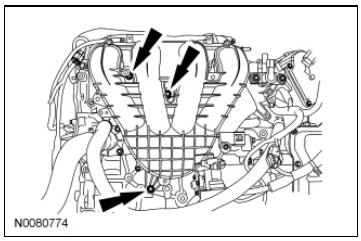
    Position the intake manifold and connect the crankcase vent oil separator tube.



96. **NOTE:** Inspect and install new intake manifold gaskets, if necessary.

    Install the intake manifold gaskets, intake manifold and the 7 bolts (3 shown).

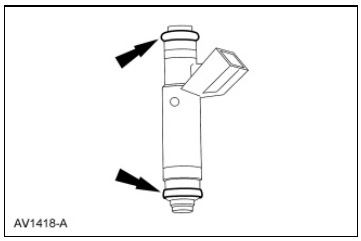
    - Tighten to 18 Nm (159 lb-in).



97. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. Use of ordinary O-rings can cause the fuel system to leak. Do not reuse the O-ring seals.**

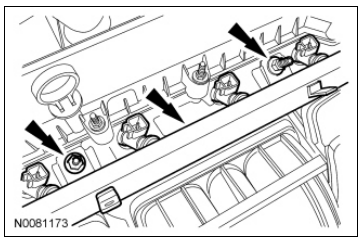
    Install new fuel injector O-rings.

    - Separate the fuel injectors from the fuel rail.
    - Remove and discard the fuel injector O-rings.
    - Install new O-rings and lubricate with clean engine oil.
    - Install the fuel injectors onto the fuel rail.

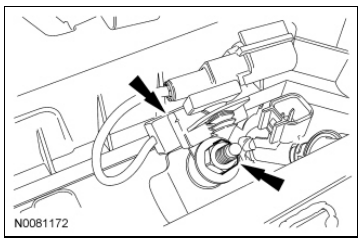


98. Install the fuel rail and injector assembly and the 2 stud bolts.

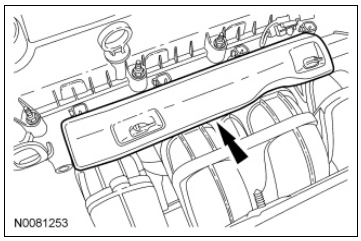
- Tighten to 23 Nm (17 lb-ft).



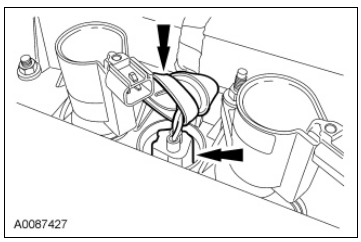
99. Install the radio capacitor and nut.
    - Tighten to 10 Nm (89 lb-in).



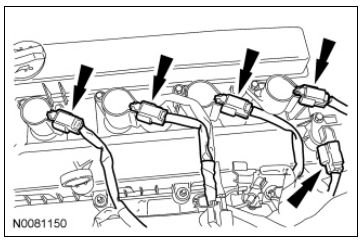
100. Install the fuel rail insulator.



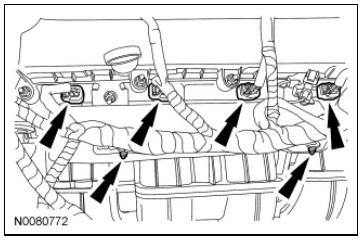
101. Position the engine control wiring harness on the engine and connect the CHT sensor and install the rubber boot.



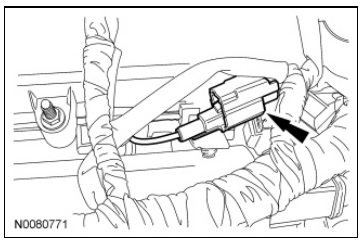
102. Connect the 4 ignition coil-on-plugs and Camshaft Position (CMP) sensor electrical connectors.



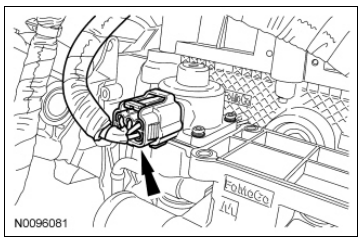
103. Connect the 4 fuel injector electrical connectors.
    - Attach the 2 wiring harness retainers.



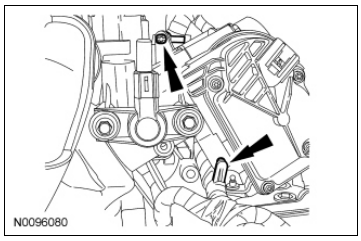
104. Connect the radio capacitor electrical connector.



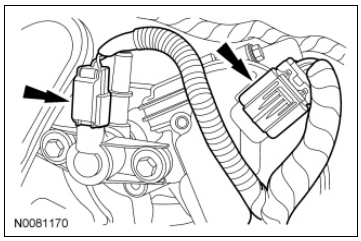
105. Connect the EGR valve electrical connector.



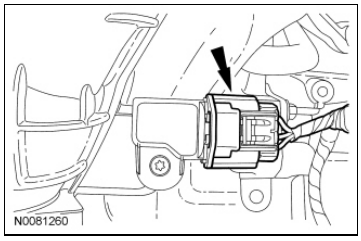
106. Attach the 2 wiring harness retainers to the intake manifold.



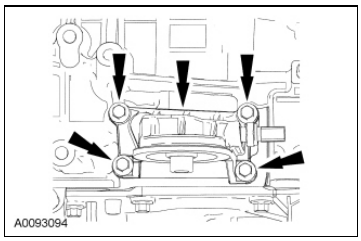
107. Connect the electronic throttle control and Evaporative Emission (EVAP) canister purge valve electrical connectors.



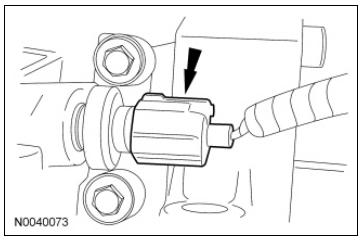
108. Connect the Manifold Absolute Pressure (MAP) sensor electrical connector.



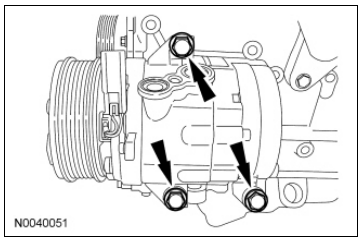
109. Using a new gasket install the oil filter adapter and the 4 bolts.
    - Tighten to 25 Nm (18 lb-ft).



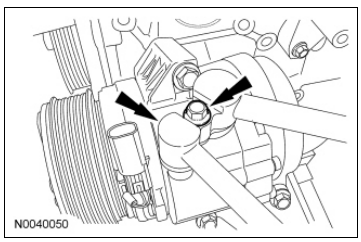
110. Connect the Engine Oil Pressure (EOP) switch electrical connector.



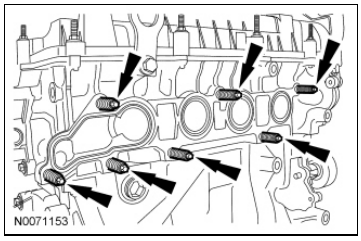
111. Install the A/C compressor and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



112. Using new O-ring seals, install the A/C manifold tube and the bolt.
    - Tighten to 25 Nm (18 lb-ft).



113. Install 7 new cylinder head studs.
    - Tighten to 17 Nm (150 lb-in).



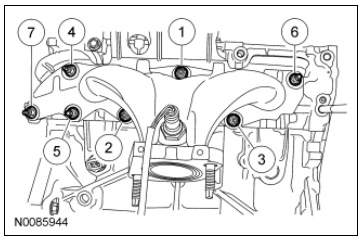
114. Install the new exhaust manifold gasket on the engine.

115. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

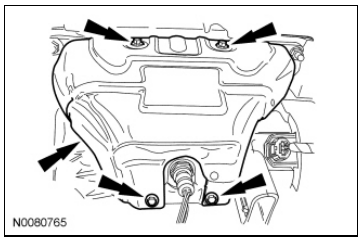
    NOTE: Make sure to tighten the nuts in the sequence in 2 stages.

    Position the exhaust manifold and tighten the 7 new exhaust manifold nuts in the sequence shown in 2 stages:

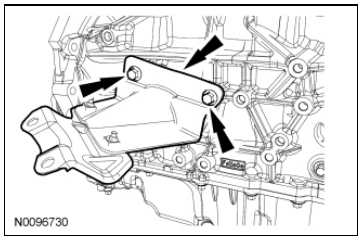
    - Stage 1: Tighten to 48 Nm (35 lb-ft).
    - Stage 2: Tighten to 48 Nm (35 lb-ft).



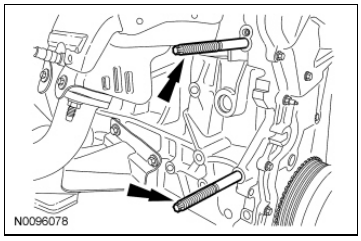
116. Install the exhaust manifold heat shield and the 4 bolts.
    - Tighten to 10 Nm (89 lb-in).



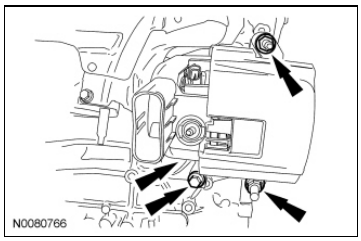
117. Install the exhaust flexible pipe bracket and the 2 bolts.
    - Tighten to 35 Nm (26 lb-ft).



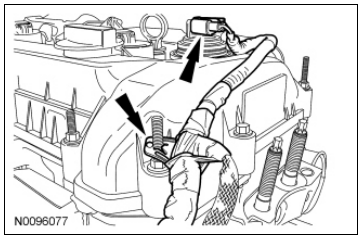
118. Install the 2 generator studs.
    - Tighten to 24 Nm (18 lb-ft).



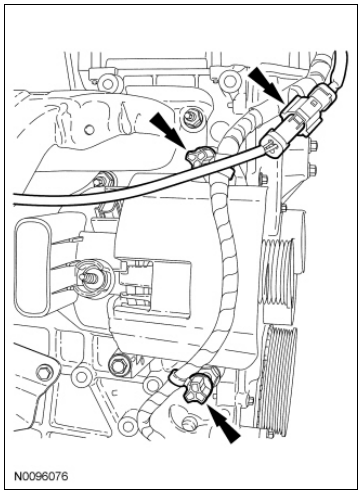
119. Install the generator, 2 nuts and 1 bolt.
    - Tighten to 47 Nm (35 lb-ft).



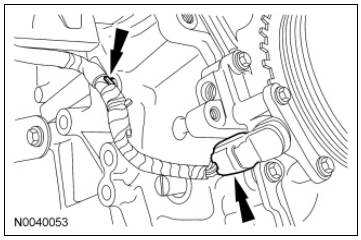
120. Connect the Variable Camshaft Timing (VCT) electrical connector and attach the wiring harness retainer to the valve cover stud bolt.



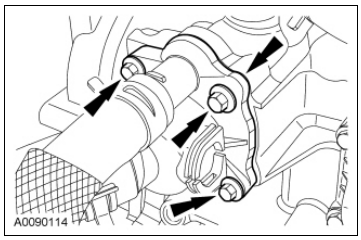
121. Connect the Heated Oxygen Sensor (HO2S) electrical connector and attach the 2 wiring harness retainers to the generator stud bolts.



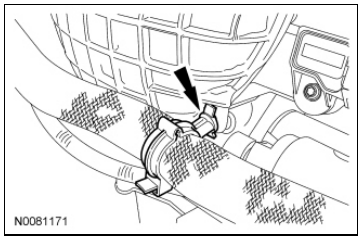
122. Connect the CKP sensor electrical connector and attach the wiring harness pin-type retainer.



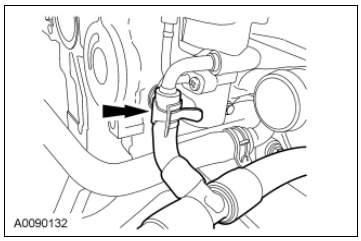
123. Install the thermostat housing and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



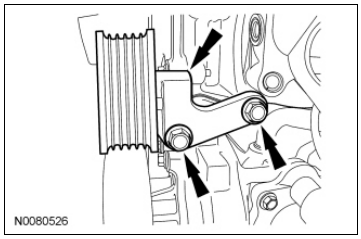
124. Install the coolant tube retainer to the intake manifold.



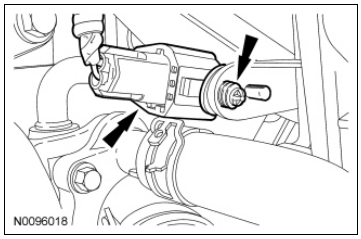
125. Connect the coolant hose to the EGR.



126. Install the accessory drive belt idler pulley and bracket and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).



127. Connect the KS electrical connector and attach the wiring harness pin-type retainer.



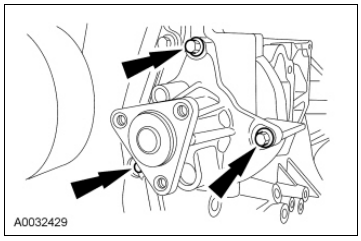
128. ***NOTICE:*** **Make sure the coolant pump is correctly seated to the engine block before installing and tightening the fasteners, or damage to the coolant pump may occur.**

    NOTE: Clean the coolant pump mating surface with metal surface prep.

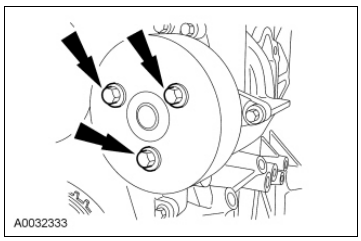
NOTE: Lubricate the new coolant pump O-ring with clean engine coolant.

Install the new O-ring, coolant pump and the 3 bolts.

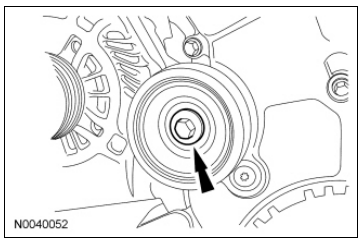
- Tighten to 10 Nm (89 lb-in).



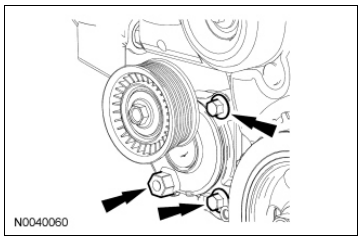
129. Install the coolant pump pulley and the 3 bolts.
    - Tighten to 20 Nm (177 lb-in).



130. Install the accessory drive belt idler pulley.
    - Tighten to 25 Nm (18 lb-ft).

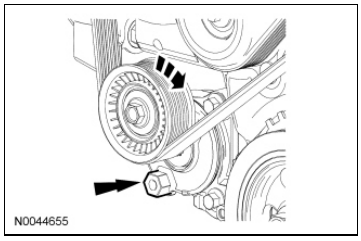


131. Install the accessory drive belt tensioner and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

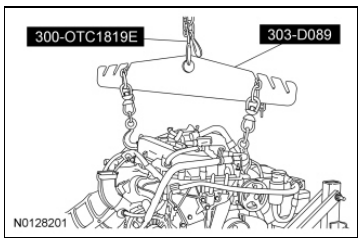


132. Position the accessory drive belt onto the tensioner and all of the accessory drive pulleys except the coolant pump pulley.

133. Using the hex feature, rotate the accessory drive belt tensioner clockwise and install the accessory drive belt onto the coolant pump pulley.

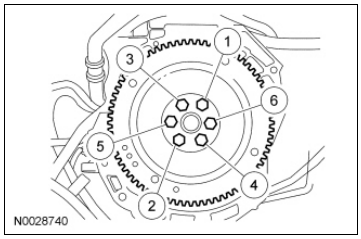


134. Using the Floor Crane and Spreader Bar, remove the engine from the engine stand.



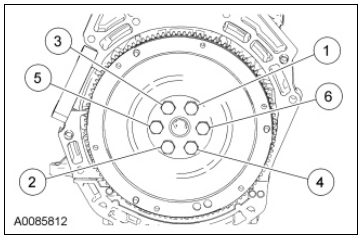
Vehicles with automatic transaxle

135. Install the flexplate and the 6 bolts. Tighten the 6 bolts in the sequence shown in 3 stages:
- Stage 1: Tighten to 50 Nm (37 lb-ft).
- Stage 2: Tighten to 80 Nm (59 lb-ft).
- Stage 3: Tighten to 112 Nm (83 lb-ft).

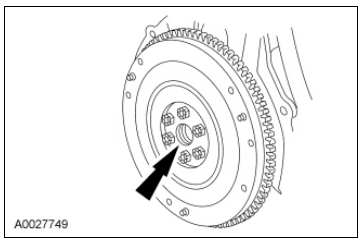


Vehicles with manual transaxle

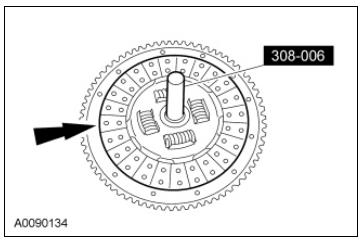
136. Install the flywheel and the 6 bolts. Tighten the 6 bolts in the sequence shown in 3 stages:
- Stage 1: Tighten to 50 Nm (37 lb-ft).
- Stage 2: Tighten to 80 Nm (59 lb-ft).
- Stage 3: Tighten to 112 Nm (83 lb-ft).



137. Lubricate the transaxle input shaft pilot bearing with front axle grease.



138. Using the Clutch Disc Aligner, position the clutch disc on the flywheel.



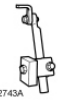
139. **NOTE:** If reusing the clutch pressure plate and flywheel, align the marks made during removal.

    Position the clutch pressure plate and install the 6 bolts.

    - Tighten to 29 Nm (21 lb-ft) in a star pattern sequence.

Engine - Automatic Transaxle

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2743A	Adjustable Grip Arm 014-00001 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

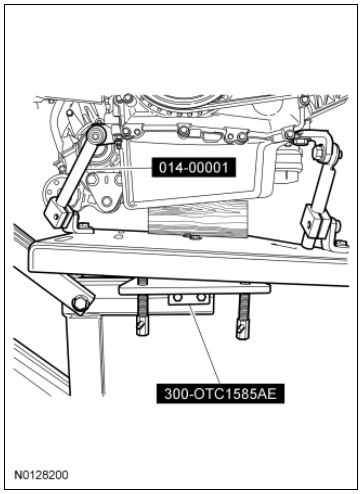
⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to flow these instructions may result in serious personal injury.

1. Using the Floor Crane and Spreader Bar, position the engine and transaxle together. Install the bellhousing-to-engine bolts.
   - Tighten to 48 Nm (35 lb-ft).

2. Using the Floor Crane and Spreader Bar, position the engine and transaxle onto the Powertrain Lift table.

3. **NOTE:** Position a suitable block of wood under the transaxle.

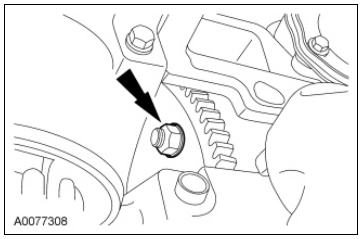
   Install the Powertrain Lift and Adjustable Grip Arm onto the engine.



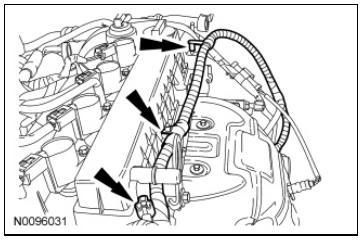
4. ***NOTICE:*** **Only rotate the engine in a clockwise direction or engine damage may occur.**

   Install the 4 new torque converter nuts.

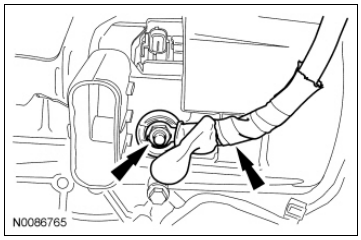
   - Tighten to 35 Nm (26 lb-ft).



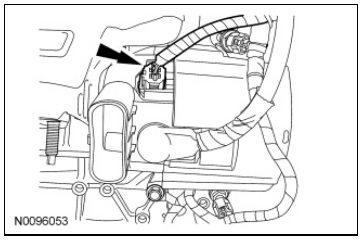
5. Position the generator wiring harness and attach the 4 wiring harness retainers (3 shown) to the valve cover stud bolts.



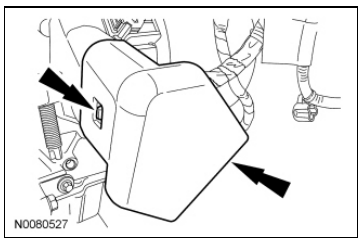
6. Connect the generator B+ wiring harness and install the nut.
   - Tighten to 12 Nm (106 lb-in).



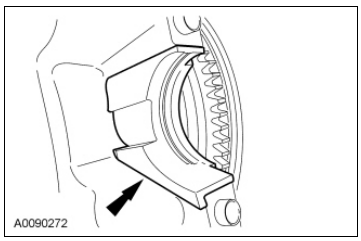
7. Connect the generator electrical connection.



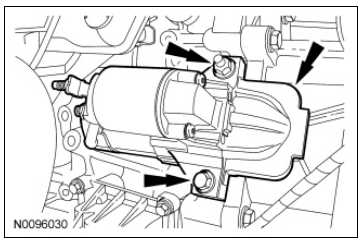
8. Install the generator air duct.



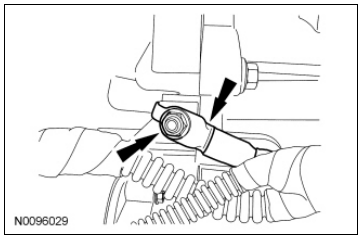
9. Install the starter motor isolator.



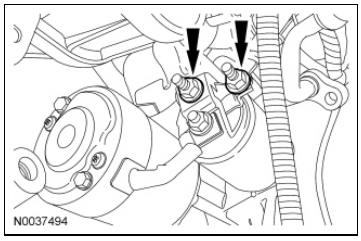
10. Install the starter, bolt and the stud bolt.
    - Tighten to 25 Nm (18 lb-ft).



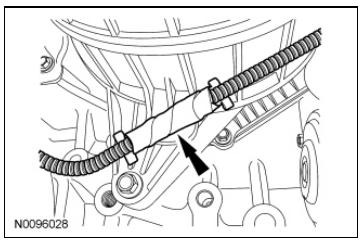
11. Position the wiring harness and install the ground wire to the starter motor stud bolt and install the nut.
    - Tighten to 18 Nm (159 lb-in).



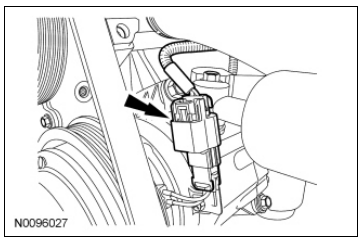
12. Connect the starter wires and install the 2 nuts.
    - Tighten the large starter motor B+ wire nut to 12 Nm (106 lb-in).
    - Tighten the small starter motor solenoid wire nut to 5 Nm (44 lb-in).



13. Attach the A/C compressor wiring harness pin-type retainer to the intake manifold.

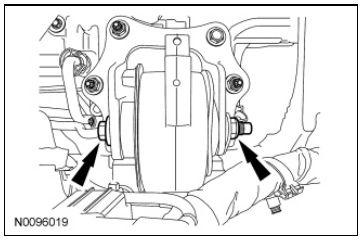


14. Connect the A/C compressor electrical connector.

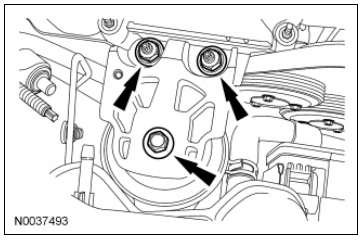


15. Raise the engine and transaxle into the vehicle.

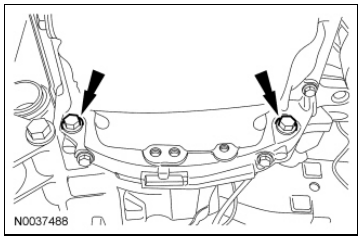
16. Install the transaxle mount through bolt and nut.
    - Tighten to 90 Nm (66 lb-ft).



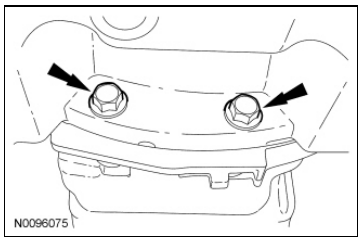
17. Install the engine mount bracket, 2 nuts and the bolt.
    - Tighten the nuts to 103 Nm (76 lb-ft).
    - Tighten the bolt to 115 Nm (85 lb-ft).



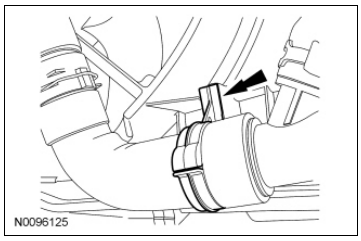
18. Install the 2 oil pan-to-bellhousing bolts.
    - Tighten to 48 Nm (35 lb-ft).



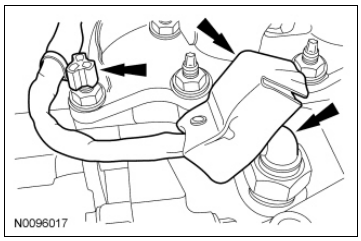
19. Install the 2 bellhousing-to-oil pan bolts.
    - Tighten to 48 Nm (35 lb-ft).



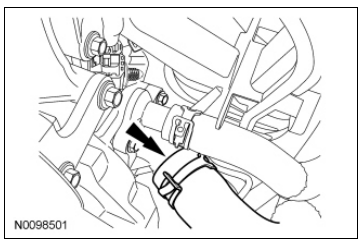
20. Attach the lower radiator hose pin-type retainer to the cooling fan shroud.



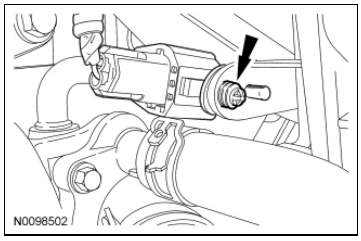
21. If equipped, connect the block heater electrical connector and position back the block heater shield.
    - Attach the 8 block heater wiring harness retainers (1 shown).



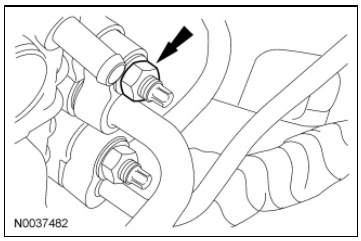
22. Install the lower radiator hose to the thermostat housing.



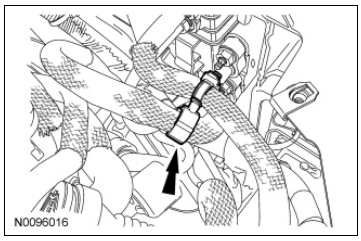
23. Attach the Knock Sensor (KS) electrical connector to the intake manifold.



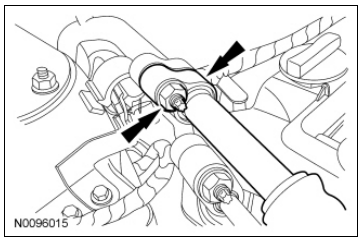
24. Install a new O-ring seal and connect the upper A/C tube to the condenser and install the nut.
    - Tighten to 8 Nm (71 lb-in).



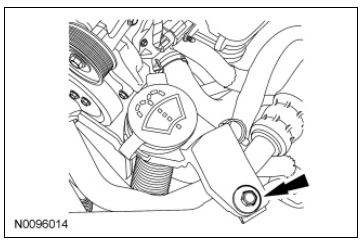
25. Attach the coolant vent hose retaining clip to the A/C tube.



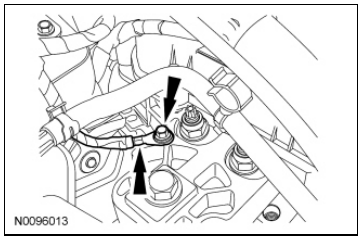
26. Install a new O-ring seal and connect the A/C tube and install the nut.
    - Tighten to 8 Nm (71 lb-in).



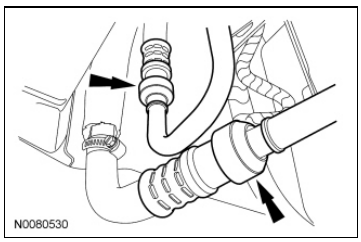
27. Install the windshield washer reservoir/A/C tube bracket bolt.
    - Tighten to 7 Nm (62 lb-in).



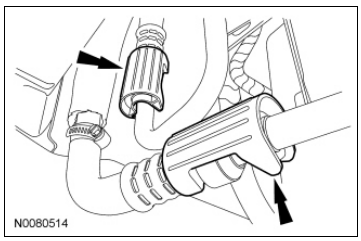
28. Install the ground wire on the engine mount and the bolt.
    - Tighten to 10 Nm (89 lb-in).



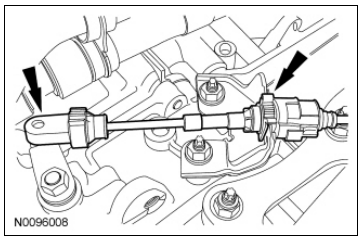
29. Connect the 2 transaxle fluid cooler tubes.



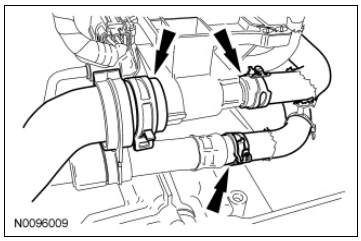
30. Install the 2 secondary latches to the transaxle fluid cooler tubes.



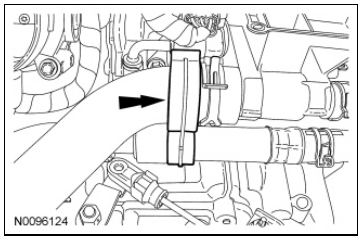
31. Connect the transaxle shift cable to the bracket and attach the shift cable to the transaxle manual lever.



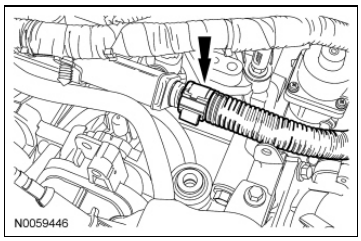
32. Connect the heater hose in-line connector and connect the upper radiator and heater hoses to the coolant outlet.



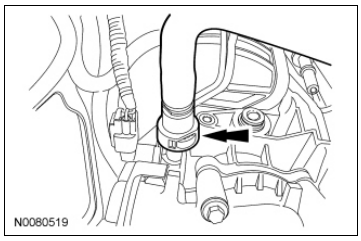
33. Attach the coolant hoses retainer.



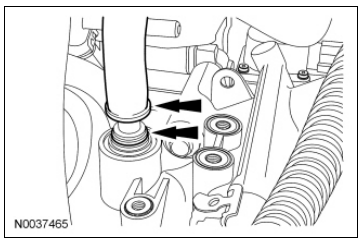
34. Connect the fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .



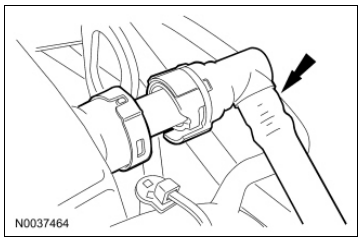
35. Connect the fuel vapor return tube.



36. Insert the brake booster vacuum supply tube into the locking ring on the intake manifold.



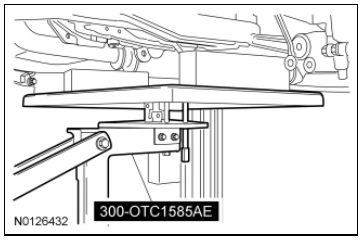
37. Connect the crankcase vent tube to the valve cover.



38. Install the exhaust flexible pipe. For additional information, refer to Section 309-00 .

39. Install the engine oil filter.
    - Lubricate the engine oil filter gasket with clean engine oil and tighten the oil filter three-fourths turn after the oil filter gasket makes contact with the oil filter adapter.

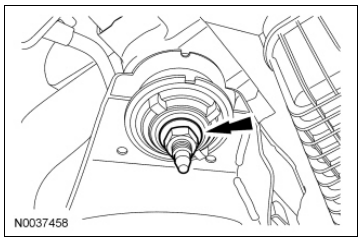
40. Place the subframe assembly on the Powertrain Lift and raise the subframe into the installed position.



41. **NOTE:** LH shown, RH similar.

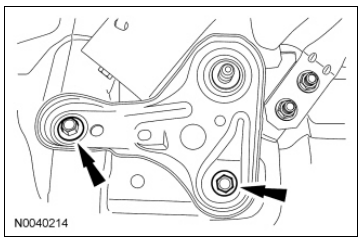
    Install the front subframe nuts.

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



42. **NOTE:** LH shown, RH similar.

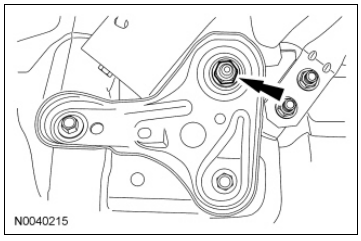
    Position the subframe brackets and install the bolts finger-tight.



43. **NOTE:** LH shown, RH similar.

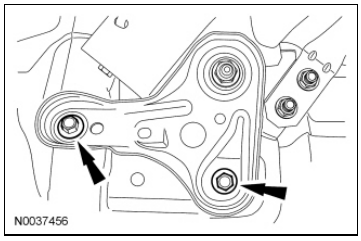
    Install the subframe nuts.

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



44. **NOTE:** LH shown, RH similar.

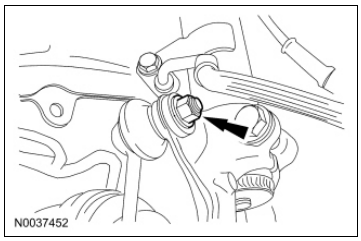
    Tighten the subframe bracket-to-body bolts to 103 Nm (76 lb-ft).



45. **NOTE:** LH shown, RH similar.

    Install the sway bar links and nuts to the struts.

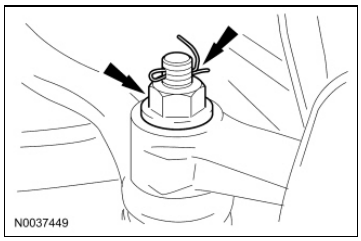
    - Tighten to 40 Nm (30 lb-ft).



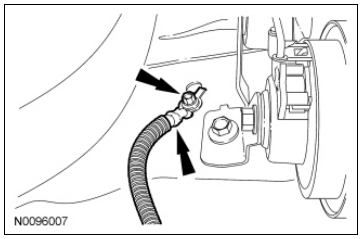
46. **NOTE:** LH shown, RH similar.

    Install tie-rod ends and nuts.

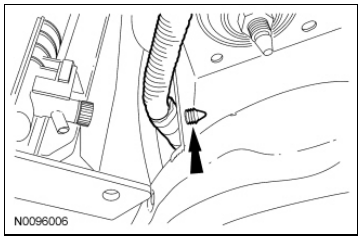
    - Tighten to 48 Nm (35 lb-ft).
    - Install the cotter pin.



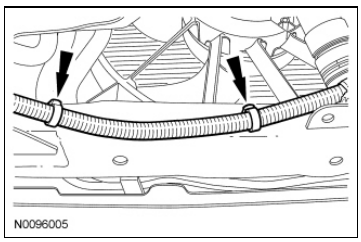
47. Install the Electronic Power Assist Steering (EPAS) system wiring harness ground and the bolt.
    - 12 Nm (106 lb-in).



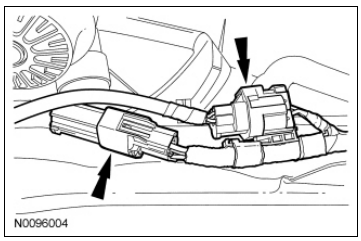
48. Attach the EPAS system wiring harness pin-type retainer to the subframe under the LH fender splash shield.



49. Attach the 2 EPAS system wiring harness pin-type retainers to the subframe.

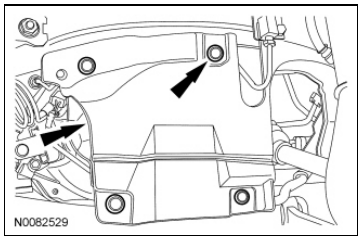


50. Connect the 2 EPAS system electrical connectors.

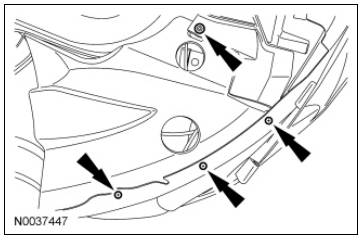


51. Install the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

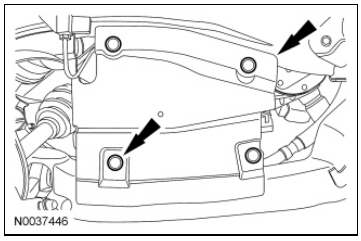
52. Install the LH splash shield and the 6 pin-type retainers (4 shown).



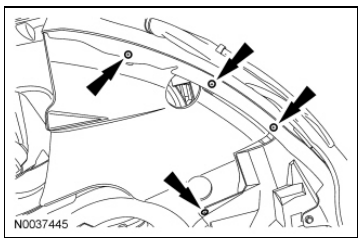
53. Position the LH fender splash shield and install the 4 screws.



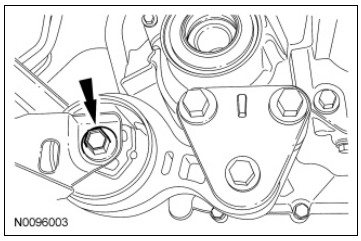
54. Install the RH splash shield and the 6 pin-type retainers (4 shown).



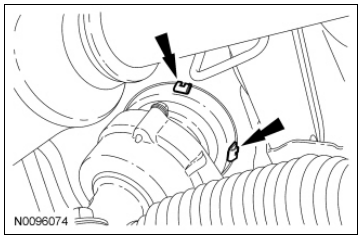
55. Position the RH fender splash shield and install the 4 screws.



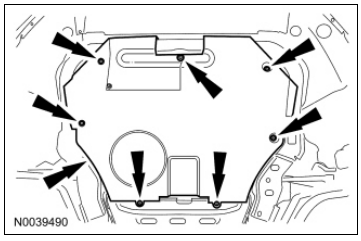
56. Install the engine roll restrictor bolt.
    - Tighten to 90 Nm (66 lb-ft).



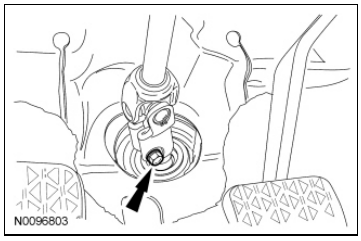
57. Slide the steering gear-to-dash seal onto the steering gear and engage the 4 retaining clips (2 shown) into the body.
    - From under the vehicle, verify that the seal is correctly installed on the steering gear and the retaining clips are fully engaged into the dash.



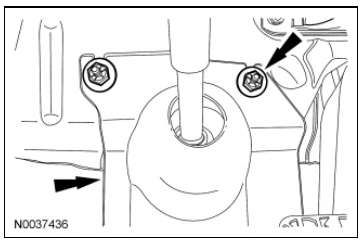
58. If equipped, install the 7 screws and the underbody cover.



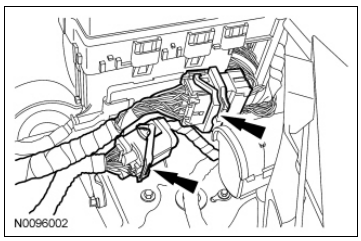
59. Install the steering column shaft onto the steering gear and install the bolt.
    - Tighten to 20 Nm (177 lb-in).



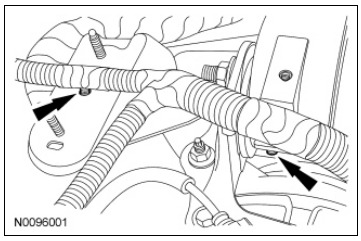
60. Install the steering joint cover and the 2 nuts.



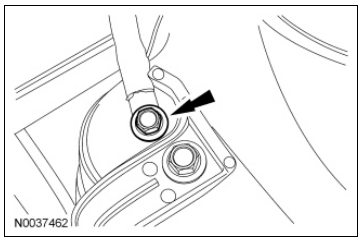
61. Connect the 2 engine harness electrical connectors.



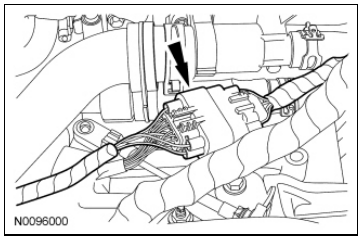
62. Attach the 2 negative battery cable pin-type retainers to the transaxle mount and battery tray bracket.



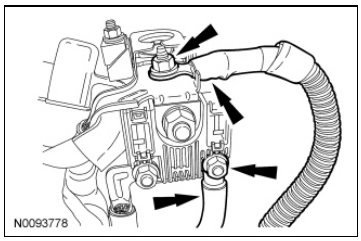
63. Install the ground wire-to-body and the bolt.
    - Tighten to 12 Nm (106 lb-in).



64. Connect the engine wiring harness electrical connector.



65. Install the 2 battery cables to the positive battery cable and the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



66. Install the battery tray. For additional information, refer to Section 414-01 .

67. Install the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to Section 303-12A .

68. Fill the engine with clean engine oil.

69. Fill and bleed the cooling system. For additional information, refer to Section 303-03A .

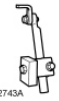
70. Fill the transaxle. For additional information, refer to Section 307-01A .

71. Recharge the A/C system. For additional information, refer to Section 412-00A .

72. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Engine - Manual Transaxle

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2743A	Adjustable Grip Arm, 1735A 014-00001 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

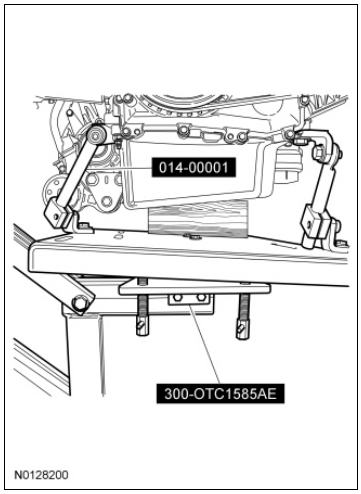
⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to llow these instructions may result in serious personal injury.

1. Using the Floor Crane and Spreader Bar, position the engine and transaxle together. Install the bellhousing-to-engine bolts.
   - Tighten to 48 Nm (35 lb-ft).

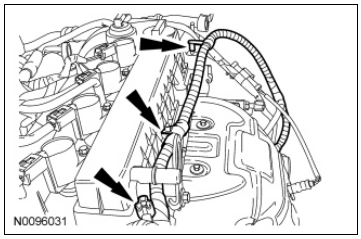
2. **NOTE:** Position a suitable block of wood under the transaxle.

   Using the Floor Crane and Spreader Bar, position the engine and transaxle onto the Powertrain Lift table.

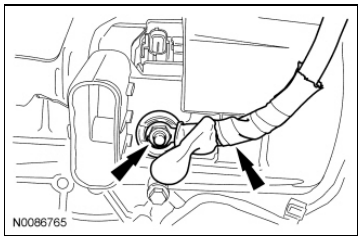
3. Install the Powertrain Lift and Adjustable Grip Arm onto the engine.



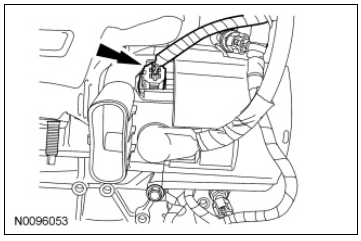
4. Position the generator wiring harness and attach the 4 wiring harness retainers (3 shown) to the valve cover stud bolts.



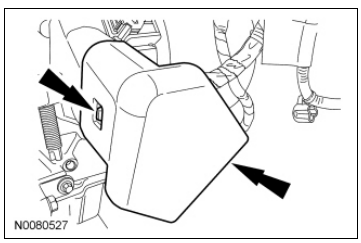
5. Connect the generator B+ wiring harness and install the nut.
   - Tighten to 12 Nm (106 lb-in).



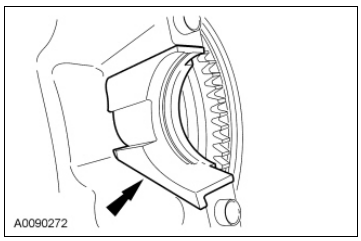
6. Connect the generator electrical connection.



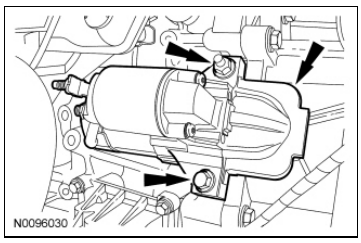
7. Install the generator air duct.



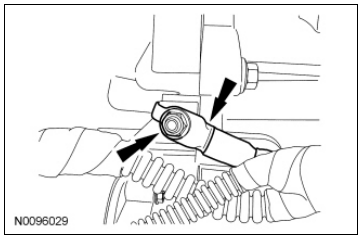
8. Install the starter motor isolator.



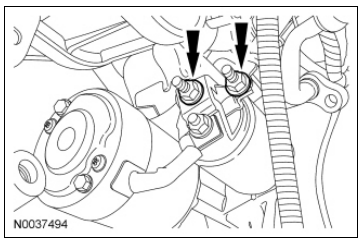
9. Install the starter, bolt and stud bolt.
   - Tighten to 25 Nm (18 lb-ft).



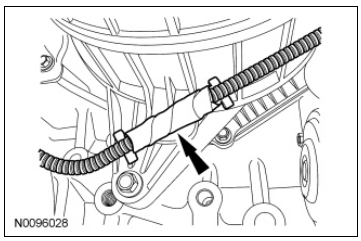
10. Position the wiring harness and install the ground wire to the starter motor stud bolt and install the nut.
    - Tighten to 18 Nm (159 lb-in).



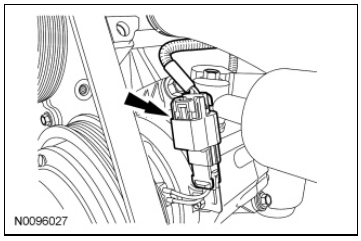
11. Connect the starter wires and install the 2 nuts.
    - Tighten the large starter motor B+ wire nut to 12 Nm (106 lb-in).
    - Tighten the small starter motor solenoid wire nut to 5 Nm (44 lb-in).



12. Attach the A/C compressor wiring harness pin-type retainer to the intake manifold.

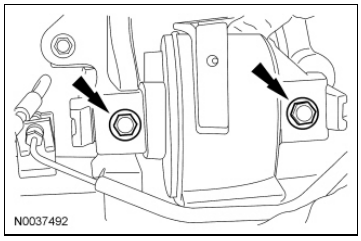


13. Connect the A/C compressor electrical connector.

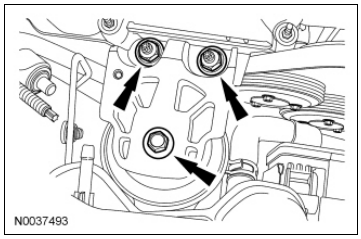


14. Raise the engine and transaxle into the vehicle.

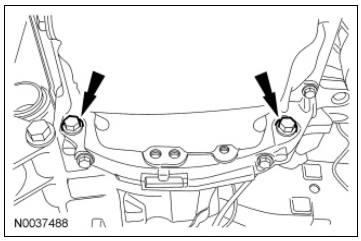
15. Install the 2 transaxle mount bolts.
    - Tighten to 90 Nm (66 lb-ft).



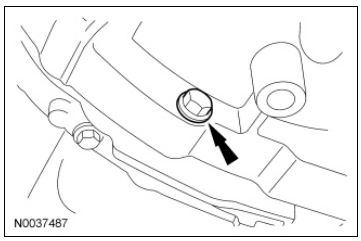
16. Install the engine mount bracket, 2 nuts and the bolt.
    - Tighten the nuts to 103 Nm (76 lb-ft).
    - Tighten the bolt to 115 Nm (85 lb-ft).



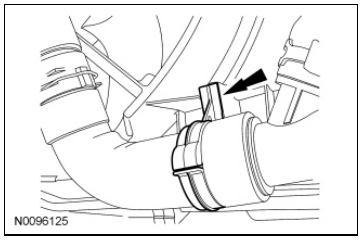
17. Install the 2 oil pan-to-bellhousing bolts.
    - Tighten to 48 Nm (35 lb-ft).



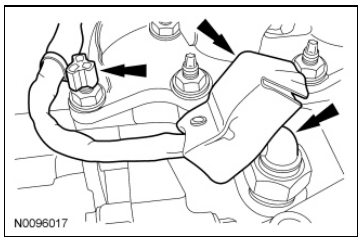
18. Install the bellhousing-to-oil pan bolt.
    - Tighten to 48 Nm (35 lb-ft).



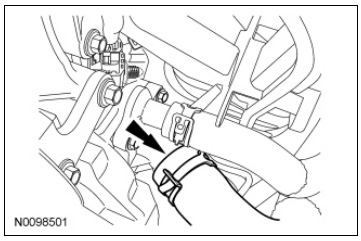
19. Attach the lower radiator hose pin-type retainer to the cooling fan shroud.



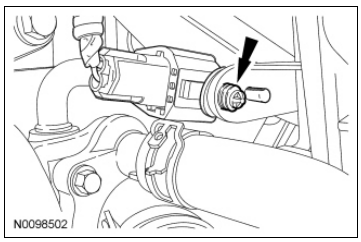
20. If equipped, connect the block heater electrical connector and position back the block heater shield.
    - Attach the 8 block heater wiring harness retainers (1 shown).



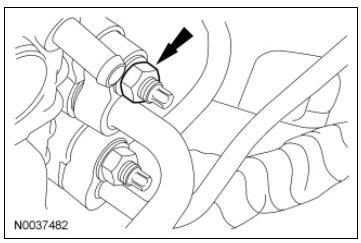
21. Install the lower radiator hose to the thermostat housing.



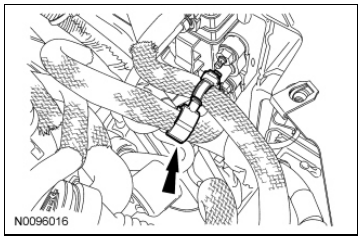
22. Attach the Knock Sensor (KS) electrical connector to the intake manifold.



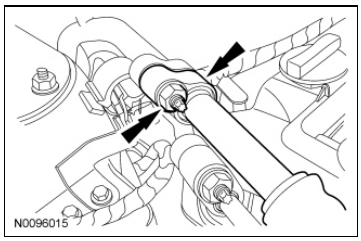
23. Install a new O-ring seal and connect the upper A/C tube to the condenser and install the nut.
    - Tighten to 8 Nm (71 lb-in).



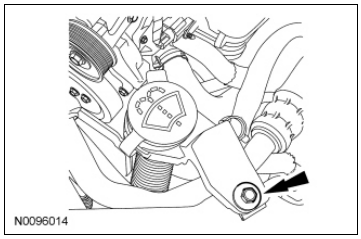
24. Attach the coolant vent hose retaining clip to the A/C tube.



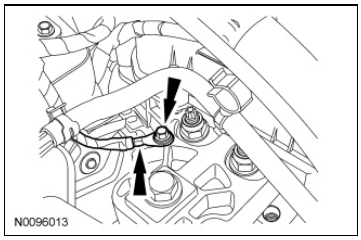
25. Install a new O-ring seal and connect the upper A/C tube and install the nut.
    - Tighten to 8 Nm (71 lb-in).



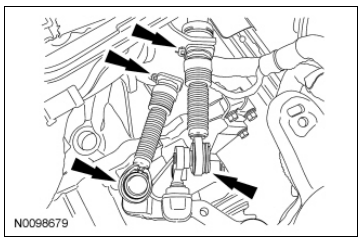
26. Install the A/C tube/windshield washer reservoir bracket bolt.
    - Tighten to 7 Nm (62 lb-in).



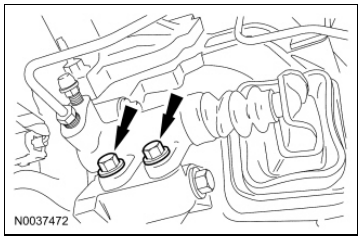
27. Install the ground wire on the engine mount and the bolt.
    - Tighten to 10 Nm (89 lb-in).



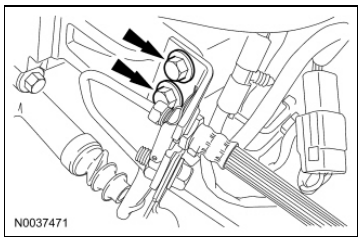
28. Attach the transaxle control cables to the bracket.
    - Connect the control cables to the control levers.



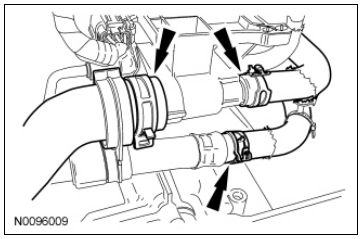
29. Install the clutch slave cylinder and the 2 bolts.
    - Tighten to 22 Nm (16 lb-ft).



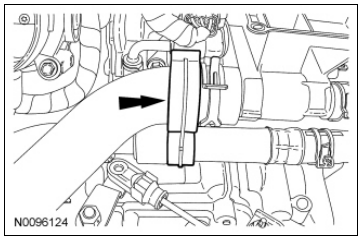
30. Install the 2 clutch tube bracket bolts.
    - Tighten to 22 Nm (16 lb-ft).



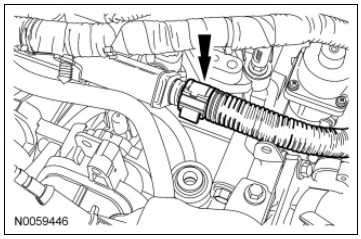
31. Connect the heater hose in-line connector and connect the upper radiator and heater hoses to the coolant outlet.



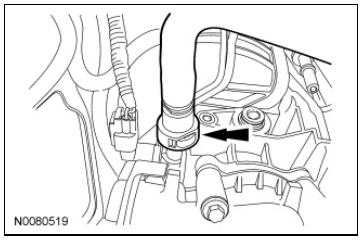
32. Attach the coolant hoses retainer.



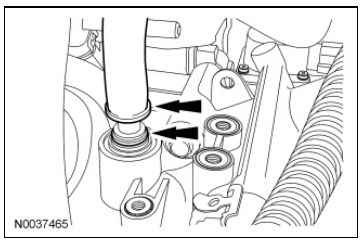
33. Connect the fuel supply tube quick connect coupling. For additional information, refer to Section 310-00 .



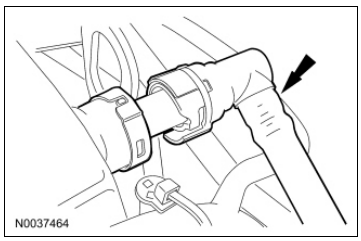
34. Connect the fuel vapor return tube.



35. Insert the brake booster vacuum supply tube into the locking ring on the intake manifold.



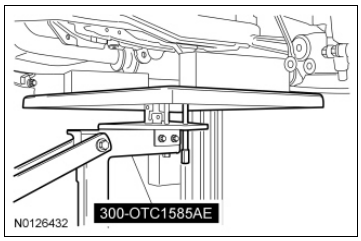
36. Connect the crankcase vent tube to the valve cover.



37. Install the exhaust flexible pipe. For additional information, refer to Section 309-00 .

38. Install the engine oil filter.
    - Lubricate the engine oil filter gasket with clean engine oil and tighten the oil filter three-fourths turn after the oil filter gasket makes contact with the oil filter adapter.

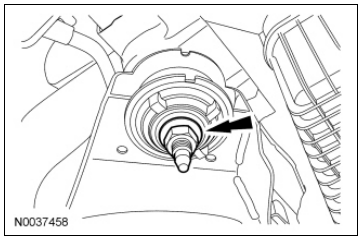
39. Place the subframe assembly on the Powertrain Lift and raise the subframe into the installed position.



40. **NOTE:** LH shown, RH similar.

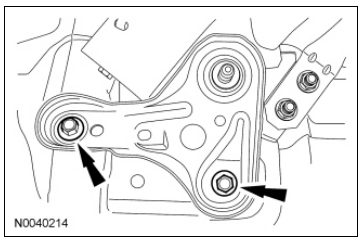
    Install the front subframe nuts.

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



41. **NOTE:** LH shown, RH similar.

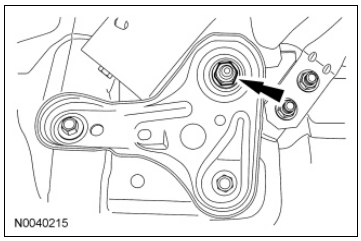
    Position the subframe brackets and install the bolts finger-tight.



42. **NOTE:** LH shown, RH similar.

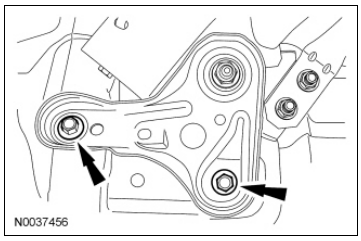
    Install the subframe nuts.

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



43. **NOTE:** LH shown, RH similar.

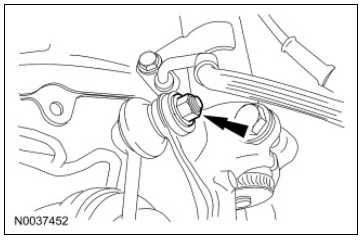
    Tighten the subframe bracket-to-body bolts to 103 Nm (76 lb-ft).



44. **NOTE:** LH shown, RH similar.

    Install the sway bar links and nuts to the struts.

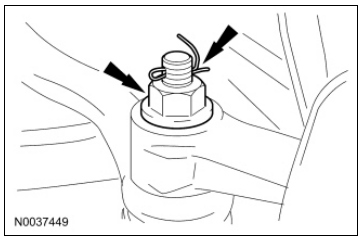
    - Tighten to 40 Nm (30 lb-ft).



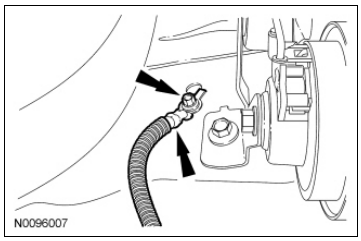
45. **NOTE:** LH shown, RH similar.

    Install tie-rod ends and nuts.

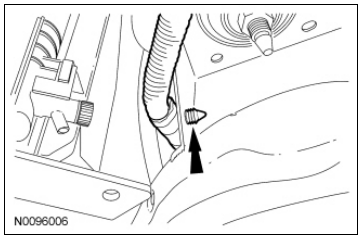
- Tighten to 48 Nm (35 lb-ft).
- Install the cotter pin.



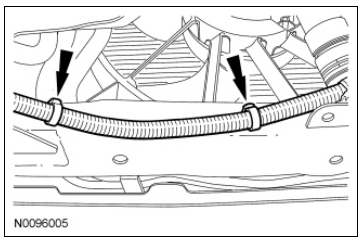
46. Install the Electronic Power Assist Steering (EPAS) system wiring harness ground and the bolt.
    - Tighten to 12 Nm (106 lb-in).



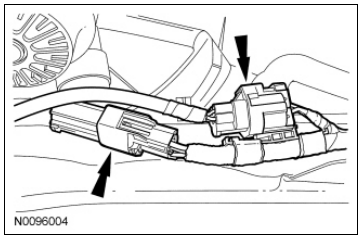
47. Attach the EPAS system wiring harness pin-type retainer to the subframe under the LH fender splash shield.



48. Attach the 2 EPAS system wiring harness pin-type retainers to the subframe.

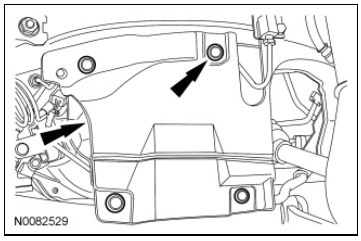


49. Connect the 2 EPAS system electrical connectors.

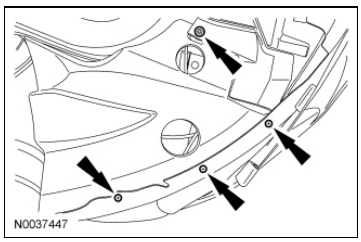


50. Install the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

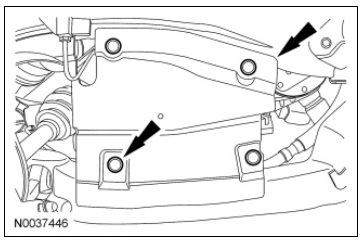
51. Install the LH splash shield and the 6 pin-type retainers (4 shown).



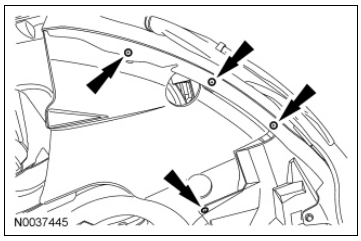
52. Position the LH fender splash shield and install the 4 screws.



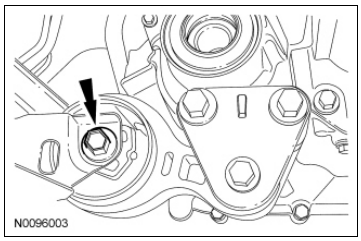
53. Install the RH splash shield and the 6 pin-type retainers (4 shown).



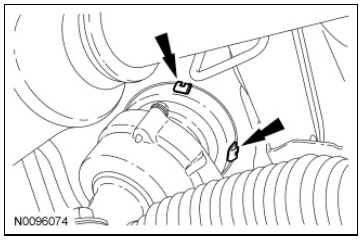
54. Position the RH fender splash shield and install the 4 screws.



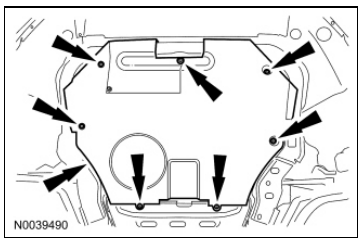
55. Install the engine roll restrictor bolt.
    - Tighten to 90 Nm (66 lb-ft).



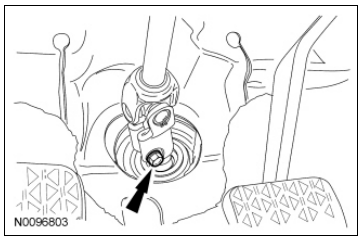
56. Slide the steering gear-to-dash seal onto the steering gear and engage the 4 retaining clips (2 shown) into the body.
    - From under the vehicle, verify that the seal is correctly installed on the steering gear and the retaining clips are fully engaged into the dash.



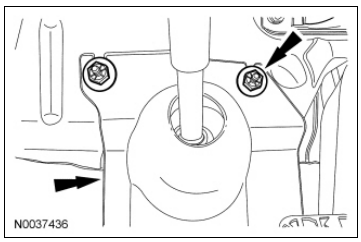
57. If equipped, install the 7 screws and the underbody cover.



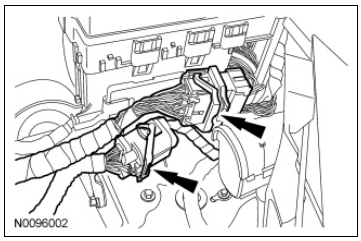
58. Install the steering column shaft onto the steering gear and install the bolt.
    - Tighten to 20 Nm (177 lb-in).



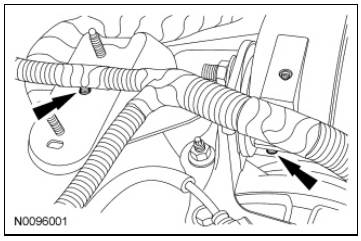
59. Install the steering joint cover and the 2 nuts.



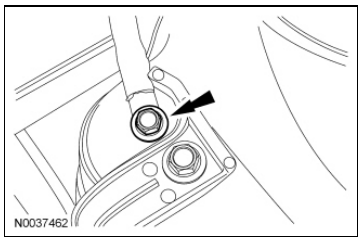
60. Connect the 2 engine harness electrical connectors.



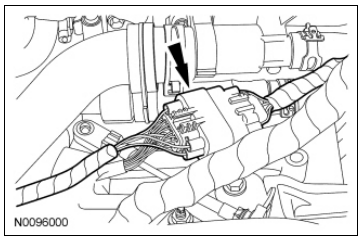
61. Attach the 2 negative battery cable pin-type retainers to the transaxle mount and battery tray bracket.



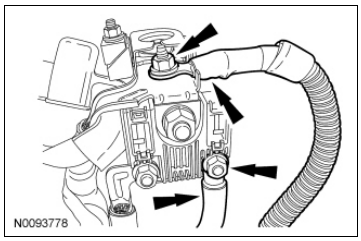
62. Install the ground wire-to-body and the bolt.
    - Tighten to 12 Nm (106 lb-in).



63. Connect the engine wiring harness electrical connector.



64. Install the 2 battery cables to the positive battery cable and the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



65. Install the battery tray. For additional information, refer to Section 414-01 .

66. Install the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to Section 303-12A .

67. Fill the engine with clean engine oil.

68. Fill and bleed the cooling system. For additional information, refer to Section 303-03A .

69. Recharge the A/C system. For additional information, refer to Section 412-00A .

70. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Material

Item	Specification	Fill Capacity
Motorcraft® Metal Surface Prep ZC-31-A	-	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	5.7L (6.0 qt) includes filter change
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	-
Thread Sealant with PTFE TA-24	WSK-M2G350-A2	-

General Specifications

Item	Specification
Engine	
Bore/stroke	89.0 x 79.5 mm (3.12 in)
Compression ratio	10.3:1
Displacement	3.0L (4V) (182 Cubic Inch Displacement (CID))
Engine and transaxle assembly weight (without accessory drive components)	234 kg (516 lb)
Engine weight (without accessory drive components and flexplate)	146 kg (322 lb)
Fire order	1-4-2-5-3-6
No. cylinders	6
Oil pressure (Minimum at 1,500 rpm with engine warmed up after 10 minutes of idling)	172 kPa (25 psi)
Spark plug	CGSF-22F Gap = 1.15-1.25 mm (0.045-0.049 in)
Cylinder Head and Valve Train	

Combustion chamber volume	51.2 cc +/- 1.5 cc
Cylinder head gasket surface flatness	0.025 mm (0.001 in) in any 25 mm (1 in) X 25 mm (1 in) area, 0.05 mm (0.002 in) in any 150 mm (6 in) area, 0.15 mm (0.005 in) overall
Roller follower ratio @ max. lift	2.0:1
Valve arrangement (front to rear)	LH intake I-I-I-I-I-I LH exhaust E-E-E-E-E-E RH intake I-I-I-I-I-I RH exhaust E-E-E-E-E-E
Valve face angle	45.5 degrees
Valve face runout	0.04 mm (0.001 in)
Valve guide bore diameter	6.015-6.044 mm (0.236-0.237 in)
Valve head diameter - exhaust	30 mm (1.18 in)
Valve head diameter - intake	35 mm (1.38 in)
Valve head diameter (exhaust) - gauge diameter	28.0 mm (1.10236 in)
Valve head diameter (intake) - gauge diameter	33.5 mm (1.3189 in)
Valve seat angle	44.75 degrees
Valve seat runout	0.04 mm (0.001 in)
Valve seat width - exhaust	1.4-1.7 mm (0.055-0.066 in)
Valve seat width - intake	1.1-1.4 mm (0.043-0.055 in)
Valve spring compression pressure (Nm @ spec. length)	780 Nm @ 32.29 mm (575 lb @ 1.27 in)
Valve spring free length (approx.)	50.52 mm (1.988 in)
Valve spring installed height (Nm @ spec. length)	42.61 mm (1.677 in)
Valve spring installed pressure	280 Nm @ 42.61 mm (206 lb @ 1.677 in)
Valve spring installed pressure - service limit	5% force loss @ specified height
Valve spring squareness	1.2 mm (0.047 in) from ID
Valve stem diameter - exhaust	5.950-5.970 mm (0.2343-0.2350 in)
Valve stem diameter - intake	5.975-5.995 mm (0.2350-0.2358 in)
Valve stem-to-guide clearance - exhaust	0.045-0.094 mm (0.0017-0.037 in)
Valve stem-to-guide clearance - intake	0.019-0.069 mm (0.0007-0.0027 in)
Hydraulic Lash Adjuster	
Clearance to bore	0.018-0.069 mm (0.0007-0.0027 in)
Collapsed lash adjuster gap	0.50-1.11 mm (0.019-0.043 in)

Diameter (standard)	15.988-16.000 mm (0.6294-0.6299 in)
Hydraulic leakdown rate	5-25 seconds
Camshaft	
Camshaft journal bore inside diameter	26.987-27.012 mm (1.062-1.063 in)
Camshaft journal-to-bearing clearance - service limit 0.121 mm (0.0047 in)	
Camshaft journal-to-bearing clearance - standard	0.025-0.076 mm (0.001-0.0029 in)
End play - service limit	0.241 mm (0.009 in)
Journal diameter (all)	26.936-26.962 mm (1.060-1.061 in)
Lobe lift (intake)	5.084 mm (0.2 in)
Lobe lift (exhaust)	5.084 mm (0.2 in)
Runout	-
Theoretical valve lift @ 0 lash	10.38 mm (0.408 in)
Cylinder Block	
Cylinder bore diameter - grade 1	89.000-89.010 mm (3.50393-3.504323 in)
Cylinder bore diameter - grade 2	89.011-89.020 mm (3.50437-3.50472 in)
Cylinder bore diameter - grade 3	89.021-82.030 mm (3.50476-3.50511 in)
Cylinder bore maximum out-of-round	0.015 mm (0.0005 in)
Cylinder bore maximum out-of-round - service limit	0.020 mm (0.0007 in)
Cylinder bore maximum taper	0.020 mm (0.0008 in)
Head gasket surface flatness	0.025 mm any 25 mm (1 in) X 25 mm (1 in) area, 0.05 mm (0.002 in) in any 150 mm (6 in) area, 0.15 mm (0.005 in) overall
Main bearing bore inside diameter	67.998-68.022 mm (2.677-2.6780 in)
Crankshaft	
Connecting rod journal diameter	49.969-49.991 mm (1.967-1.968 in)
Connecting rod journal maximum out-of-round	0.006 mm (0.0002 in)
Connecting rod journal maximum taper	0.008 mm (0.0003 in)
Crankshaft end play	0.100-0.255 mm (0.003-0.010 in)
Main bearing journal diameter	62.968-62.992 mm (2.467-2.479 in)
Main bearing journal maximum out-of-round	0.006 mm (0.0002 in)
Main bearing journal maximum taper	0.008 mm (0.0003 in)
Main bearing journal-to-cylinder block clearance	0.024-0.046 mm (0.0009-0.0018 in) (select fit bearings)
Piston and Connecting Rod	
Connecting rod bearing bore diameter	53.015-53.035 mm (2.0872-2.0879 in)
Connecting rod bearing-to-crankshaft clearance	0.028-0.066 mm (0.001-0.0025 in)
Connecting rod length (center-to-center)	138.06-138.14 mm (5.435-5.38 in)

Connecting rod maximum allowed bend	0.038 mm per 25 (0.0014 per 0.984 in)	
Connecting rod maximum allowed twist	0.050 mm per 25 (0.0019 per 0.984 in)	
Connecting rod pin bore diameter	21.017-21.031 mm (0.827-0.828 in)	
Connecting rod side clearance	0.100-0.30 mm (0.0039-0.0118 in)	
Connecting rod-to-pin clearance - service limit	0.035 mm (0.0013 in)	
Connecting rod-to-pin clearance - standard	0.004-0.02 mm (0.0001-0.0007 in)	
Piston diameter - coated, grade 1	88.980-88.995 mm (3.5031-3.5037 in)	
Piston diameter - coated, grade 2	88.78-89.007 mm (3.4952-3.5042 in)	
Piston diameter - coated, grade 3	89.00-89.015 mm (3.5039-3.5045 in)	
Piston diameter - uncoated, grade 1	88.970-88.980 mm (3.50275-3.50314 in)	
Piston diameter - uncoated, grade 2	88.978-88.992 mm (3.50306-3.50362 in)	
Piston diameter - uncoated, grade 3	88.990-89.000 mm (3.5035-3.5039 in)	
Piston pin bore diameter	21..8273-0.8275 in)	
Piston pin diameter	21.011-21.013 mm (0.8271-0.8273 in)	
Piston pin length	60.08-60.51 mm (2.365-2.382 in)	
Piston ring end gap - compression (bottom, gauge diameter)	0.27-0.42 mm (0.0106-0.0165 in)	
Piston ring end gap - compression (bottom, service limit)	0.65 mm (0.0255 in) max	
Piston ring end gap - compression (top, gauge diameter) [a]	0.100-0.250 mm (0.0039-0.0098 in)	
Piston ring end gap - compression (top, service limit)	0.50 mm (0.0196 in) max	
Piston ring end gap - oil ring (steel rail, gauge diameter)	0.15-0.65 mm (0.0059-0.0255 in)	
Piston ring end gap - oil ring (steel rail, service limit)	0.90 mm (0.0354 in) max	
Piston ring groove width - compression (bottom)	1.530-1.555 mm (0.0602-0.0612 in)	
Piston ring groove width - compression (top)	1.230-1.255 mm (0.0484-0.0494 in)	
Piston ring groove width - oil ring	2.53-2.555 mm (0.0996-0.1005 in)	
Piston ring-to-groove clearance	-	
Piston ring width	-	0.002 to 0.009 mm (0.00007-0.0003 in)
Piston-to-connecting rod clearance	-	
Piston-to-cylinder bore clearance (coated)	0.003 to 0.032 mm (0.0001-0.0012 in)	
Piston-to-cylinder bore clearance (uncoated)	0.012 to 0.022 mm (0.0005-0.0009 in)	

[a] Specification 82.4 mm (3.2441 in) diameter gauge.

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolts	25	18	-
A/C compressor bracket bolts	25	18	-
A/C manifold bolt	15	-	133
A/C tube nut	8	-	71
A/C tube/windshield washer bottle bracket bolt	10	-	89
Accessory drive belt tensioner bolts	25	18	-
Battery terminal power feed wire nuts	6	-	53
Block heater	21	15	-
Camshaft bearing cap bolts [a]	-	-	-
Camshaft phaser and sprocket bolts	18	-	159
Camshaft oil seal retainer bolts	10	-	89
Catalytic converter nuts - LH	-	-	-
Catalytic converter nuts - RH All-Wheel Drive (AWD)	40	30	-
Catalytic converter studs	12	-	106
Connecting rod cap bolts [a]	-	-	-
Coolant pump housing bolts	-	89	
Coolant pump housing hose clamps	7	-	62
Crankshaft pulley bolt [a]	-	-	-
Cylinder head bolts [a]	-	-	-
EGR tube fittings	40	30	-
Electronic Power Assist Steering (EPAS) ground wire bolt	10	-	89
Engine front cover bolts [a]	-	-	-
Engine support insulator bracket bolt	115	85	-
Engine support insulator bracket nuts	63	46	-
Engine mount damper bolt	23	17	-
Engine mount bolts and nuts	55	-	
Engine oil filter [a]	-	-	-
Engine Oil Pressure (EOP) switch	14	-	124
Engine roll-restrictor bolts	90	66	-
Exhaust heat shield - LH and RH	10	-	89
Exhaust heat shield bracket bolts (inboard half)	40	30	-
Exhaust heat shield bracket nuts (outboard half)	20	-	177
Exhaust manifold nuts [a]	-	-	-
Exhaust manifold studs	12	-	106
Flexplate bolts	80	59	-
Fuel rail and injectors assembly bolts	10	-	p" align="left">Generator B+ terminal 8 - 71

			nut
Generator nuts and bolt	47	35	-
Generator studs	8	-	71
Ground wire-to-engine mount bracket	10	-	89
Ground wire-to-strut tower bolt	10	-	89
Heated Oxygen Sensor (HO2S) [a]	-	-	-
Ignition coil-on-plug bolts	6	-	53
Intermediate steering shaft bolt	20	-	177
Lower cylinder block bolts [a]	-	-	-
Lower intake manifold bolts [a]	-	-	-
Oil level indicaton="top" align="center">9	-	80	
Oil pan baffle nuts [a]	-	-	-
Oil pan bolts [a]	-	-	-
Oil pan drain plug	26	19	-
Oil pan-to-front cover bolts	25	18	-
Oil pan-to-transaxle bolts	40	30	-
Oil pump bolts [a]	-	-	-
Oil pump screen and pickup tube bolts	10	-	89
Oil separator cover bolts	10	-	89
PCM ground wire bolt	10	-	89
Power Transfer Unit (PTU) bracket bolts	55	-	
PTU -to-transaxle bolts	90	66	-
Radio frequency interference capacitor nut	6	-	53
Rear driveshaft-to- PTU flange bolts	70	52	-
Spark plugs	15	-	133
Stabilizer bar link nuts	40	30	-
Starter motor bolts	27	20	-
Starter (large) terminal nut	12	-	106
Starter (small) terminal nut	5	-	44
Starter ground wire nut	18	-	
Subframe bracket-to-body bolts	103	76	-
Subframe nuts	150	111	-
Tie-rod end nuts	48	35	-
Timing chain guide bolts	25	18	-
Timing chain tensioner bolts	25	18	-
Torque converter-to-flexplate nuts	40	30	-
Transaxle control cable bracket bolts	23	17	-
Transaxle support through bolt	103	76	-
Transaxle-to-engine bolts	48	35	-
Upper intake manifold bolts [a]	-	-	-
Upper intake manifold	10	-	89
Valve cover bolts and stud bolts [a]	-	-	-
Variable Camshaft Timing (VCT) assembly bolts	10	-	89

[a] Refer to the procedure in this section.

Engine

The 3.0L (4V) is a V-6 engine with the following features:

- Dual overhead camshafts
- Four valves per cylinder
- Sequential Multi-Port Fuel Injection (SFI)
- A composite lower intake manifold and a composite upper intake manifold
- Aluminum cylinder heads
- Two-piece design aluminum cylinder block
- Variable Camshaft Timing (VCT) system
- Electronic ignition system with 6 ignition coils

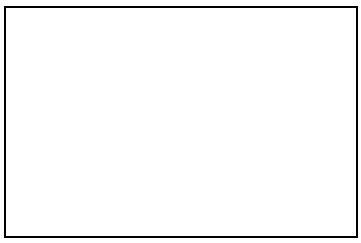
Engine Identification

For quick identification, refer to the safety certification decal.

- The decal is located on the LH front door lock face panel.

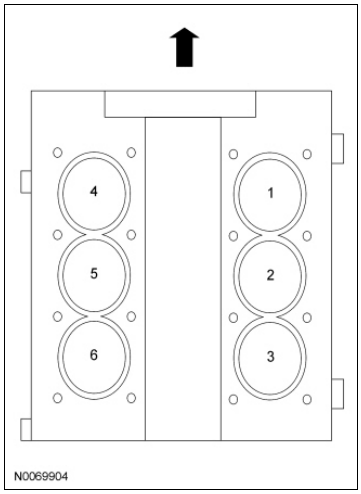
Engine Code Information Label

The engine code information label, located on the front side of the valve cover, contains the following:



Item	Description
1	Engine part number
2	Cleveland engine plant 2
3	Engine displacement
4	Bar code
5	Running number
6	Engine build date (DDMMYY)
7	Plant shift line
8	Bar code

Engine Cylinder Identification



Exhaust Emission Control System

Operation and required maintenance of the exhaust emission control devices used on this engine are covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The SFI provides the fuel/air mixture needed for combustion in the cylinders. The 6 solenoid-operated fuel injectors:

- are mounted between the fuel rail and the intake manifold.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.

Valve Train

The camshafts are mounted in the cylinder heads and act against a roller follower to open and close the valves. A hydraulic lash adjuster is located on one side of the roller follower and the valve tip on the opposite end. The camshafts are driven off the front of each cylinder head by 2 chains (one each side). Both of the chains are driven by sprockets that are located on the crankshaft, just in front of the oil pump.

Variable Camshaft Timing (VCT) System

The VCT system changes intake camshaft timing dependent on engine speed, load and oil temperature. Oil pressure advances and retards camshaft timing to improve low-speed and high-speed engine performance, engine idle quality and exhaust emissions.

PCV System

All engines are equipped with a closed-type positive crankcase ventilation system recycling the crankcase vapors to the upper intake manifold.

Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rod bearings and timing chain tensioners. The flow of oil to the valve tappets and valve train is controlled by a restricting orifice located in the head gaskets.

Oil Pump

The lubrication system is designed to provide optimum oil flow to critical components of the engine through its entire operating range.

The heart of the system is a positive displacement internal gear oil pump.

Generically this design is known as a gerotor pump, which operates as follows:

- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.
- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to make sure of correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Cooling System

The engine cooling system includes the following components:

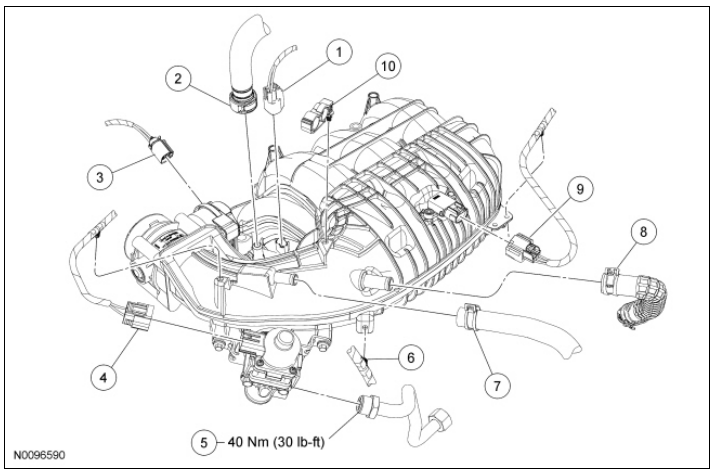
- Radiator
- Electric cooling fan motor
- Degas bottle (aids in maintaining the correct volume of engine coolant)
- Coolant thermostat
- Coolant hoses
- Coolant pump housing

Engine

For basic engine mechanical concerns, refer to Section 303-00 . For driveability concerns, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

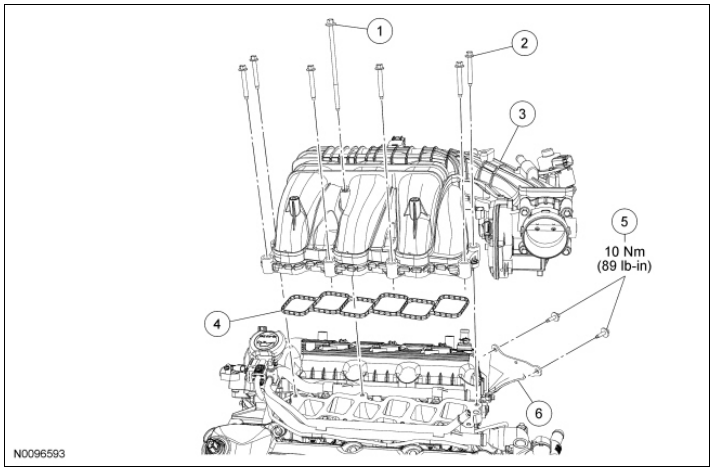
Upper Intake Manifold

Upper Intake Manifold (View 1 of 2)



Item	Part Number	Description
1	14A464	Evaporative Emission (EVAP) canister purge valve electrical connector (part of 12C508)
2	9D289	EVAP tube-to- EVAP canister purge valve quick connect coupling
3/td>	14A464	Electronic throttle control electrical connector (part of 12C508)
4	14A464	EGR valve electrical connector (part of 12C508)
5	-	EGR tube fitting (part of 9D477)
6	W700497	Engine control wiring harness retainer (part of 12C508)
7	-	Brake booster vacuum tube
8	6K817	PCV tube
9	14A464	Manifold Absolute Pressure (MAP) sensor electrical connector (part of 12C508)
10	-	Fuel tube and EVAP tube-to- EVAP canister purge valve tube retainer

Upper Intake Manifold (View 2 of 2)



Item	Part Number	Description
1	W713391	Upper intake manifold bolt
2	9Y450	Upper intake manifold bolt (6 required)
3	9424	Upper intake manifold
4	-	Upper intaold gasket
5	W701775	Upper intake manifold support bracket bolts (2 required)
6	9J444	Upper intake manifold support bracket

Removal

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12B .
2. Remove the battery. For additional information, refer to Section 414-01 .
3. Remove the EGR tube fitting from the EGR valve.
4. Disconnect the electronic throttle control electrical connector.
5. Disconnect the Evaporative Emission (EVAP) canister purge valve electrical connector.
6. Disconnect the EGR valve electrical connector and detach the wiring retainer.
7. Disconnect the EVAP tube-to- EVAP canister purge valve quick connect coupling and the brake booster vacuum tube from the upper intake manifold.
    - Detach the fuel tube and EVAP tube-to- EVAP canister purge valve tube retainer from the upper intake manifold.
8. Detach the engine control wiring harness retainer from the upper intake manifold.
9. Disconnect the PCV tube from the upper intake manifold.
10. Disconnect the Manifold Absolute Pressure (MAP) sensor electrical connector and detach the wiring retainer.
11. Remove the 2 upper intake manifold support bracket bolts from the upper intake manifold.
12. Remove the 7 bolts and the upper intake manifold.
    - Remove and discard the gaskets.

Installation

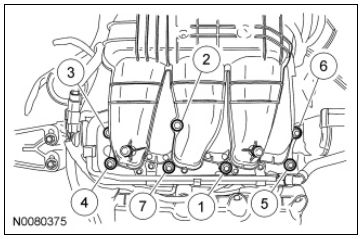
1. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

   Clean and inspect all of the sealing surfaces of the upper intake manifold.

2. **NOTE:** Install new upper intake manifold gaskets.

   Position the upper intake manifold and install the 7 bolts.

   - Tighten the bolts in 2 stages in the sequence shown.
     - ♦ Stage 1: Tighten to 10 Nm (89 lb-in).
     - ♦ Stage 2: Tighten an additional 45 degrees.



3. Install the 2 upper intake manifold support bracket bolts.
   - Tighten to 10 Nm (89 lb-in).

4. Connect the MAP sensor electrical connector and attach the wiring retainer.

5. Connect the PCV tube to the upper intake manifold.

6. Attach the engine control wiring harness retainer to the upper intake manifold.

7. Connect the EVAP tube-to- EVAP canister purge valve quick connect coupling and the brake booster vacuum tube to the upper intake manifold.
   - Attach the fuel tube and EVAP tube-to- EVAP canister purge valve tube retainer to the upper intake manifold.

8. Connect the EGR valve electrical connector and attach the wiring retainer.

9. Connect the EVAP canister purge valve electrical connector.

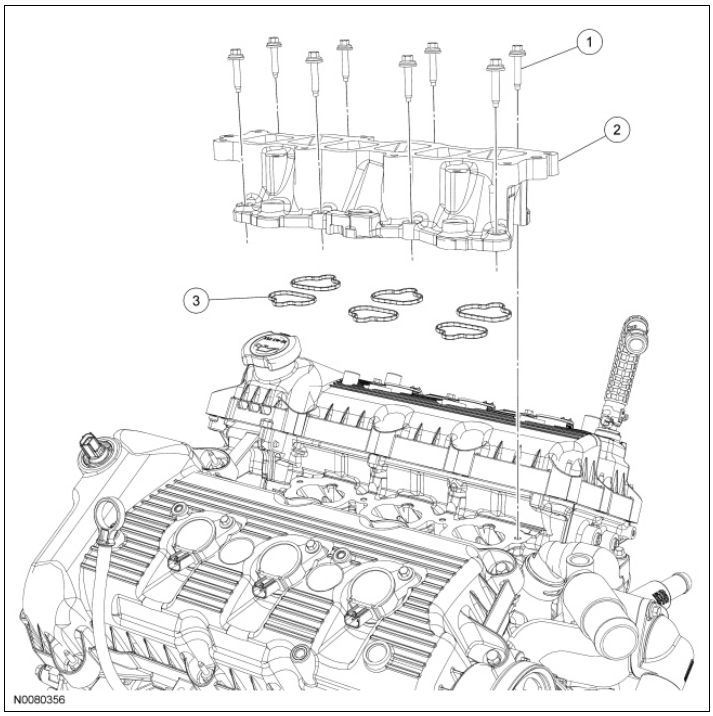
10. Connect the electronic throttle control electrical connector.

11. Install the EGR tube fitting to the EGR valve.
    - Tighten to 40 Nm (30 lb-ft).

12. Install the battery. For additional information, refer to Section 414-01 .

13. Install the ACL outlet pipe. For additional information, refer to Section 303-12B .

Lower Intake Manifold



Item	Part Number	Description
1	W503279	Lower intake manifold bolt (8 required)
2	9K461	Lower intake manifold
3	9439	Lower intake manifold gasket (6 required)

Removal

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the fuel rail. For additional information, refer to Section 303-04B .
4. Remove the 8 lower intake manifold bolts and the lower intake manifold.
   - Remove and discard the gaskets.

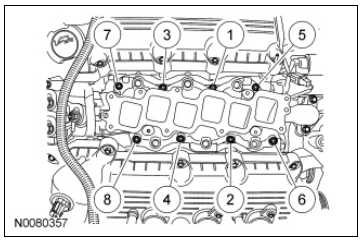
Installation

1. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

   NOTE: Clean and inspect all sealing surfaces. Install new gaskets.

   Position the lower intake manifold and install the 8 bolts.

   - Tighten in the sequence shown to 10 Nm (89 lb-in).



2. Install the fuel rail. For additional information, refer to Section 303-04B .

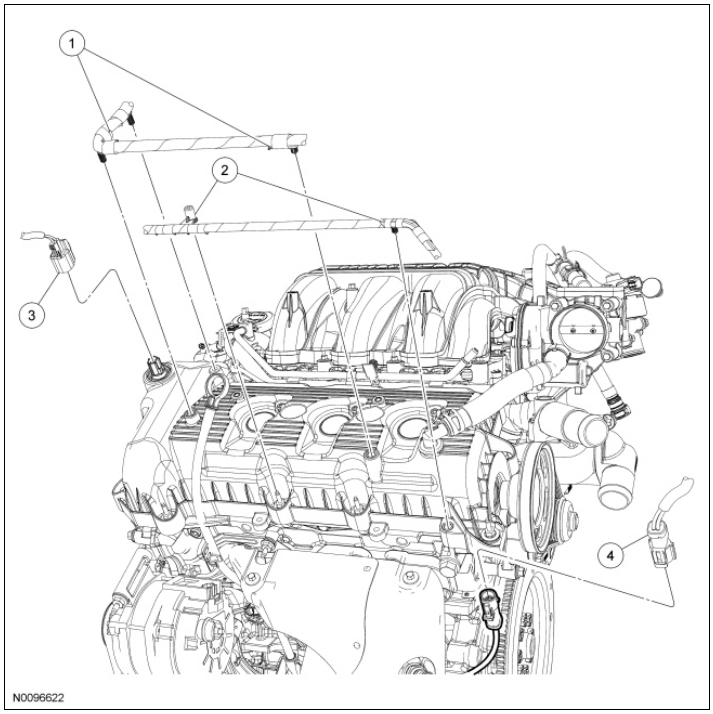
3. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Valve Cover - LH

Material

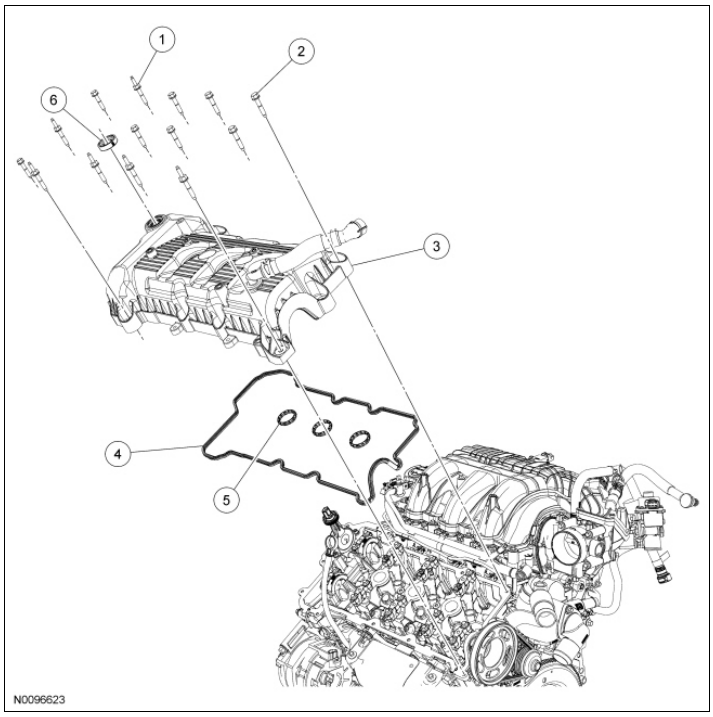
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

LH Valve Cover (View 1 of 2)



Item	Part Number	Description
1	-	Valve cover wiring retainers (part of 12A581)
2	-	B+ cable valve cover stud bolt wiring retainers (part of 14tr>
3	14A464	Variable Camshaft Timing (VCT) electrical connector (part of 12A581)
4	14A464	LH Heated Oxygen Sensor (HO2S) electrical connector (part of 12A581)

LH Valve Cover (View 2 of 2)



Item	Part Number	Description
1	6C519	Valve cover stud bolt (6 required)
2	6C519	Valve cover bolt (8 required)
3	6A505	Valve cover
4	6A559	Valve cover gasket
5	6C527	Valve cover spark plug gasket (3 required)
6	6C535	Variable Camshaft Timing (VCT) valve cover seal

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

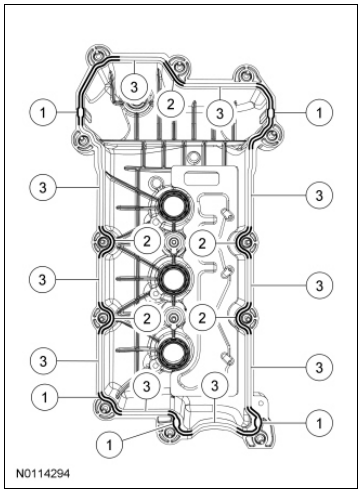
1. Remove the LH ignition coil-on-plugs. For additional information, refer to Section 303-07B .
2. Detach the 3 wiring retainers from the valve cover.
3. Detach the wiring retainer from the valve cover stud bolt and 1 retainer from the valve cover.
4. Disconnect the Variable Camshaft Timing (VCT) electrical connector.
5. Disconnect the Heated Oxygen Sensor (HO2S) electrical connector.
6. **NOTE:** Inspect the crankcase ventilation tube and valve cover sealing area. If either a new valve cover or crankcase ventilation tube is required, both components must be installed new.

   Remove the 9 bolts, 5 stud bolts and the valve cover.

   - Remove and discard the gasket.

Installation

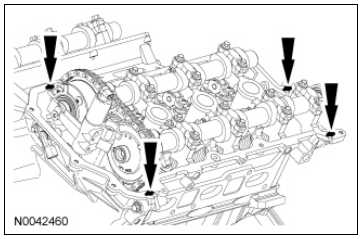
1. Install the new gasket in the valve cover in the following sequence.
    1. Install the gasket at waffle pads and then the corners.
    2. Install the gasket around bolt holes.
    3. Install the remaining part of the gasket.



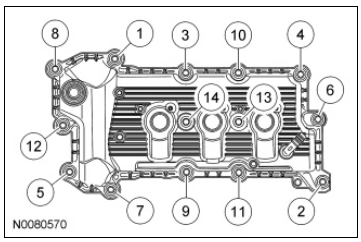
2. **NOTE:** The valve cover must be installed and the bolts and studs tightened within 4 minutes of sealant application.

   NOTE: Clean cylinder head and front cover surface and the cam seal retainer-to-cylinder head surface using metal surface prep before applying silicone gasket and sealant.

   Apply an 8 mm (0.31 in) dot of silicone gasket and sealant at the cylinder block to front cover mating surface and the cam seal retainer-to-cylinder head joints.



3. Position the valve cover and install the bolts and stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



4. Position the wire harness and connect the HO2S electrical connector.

5. Connect the VCT electrical connector.

6. Attach the wiring retainer to the valve cover stud bolt and attach the pin-type wiring retainer to the valve cover.

7. Attach the 3 wiring retainers to the valve cover.

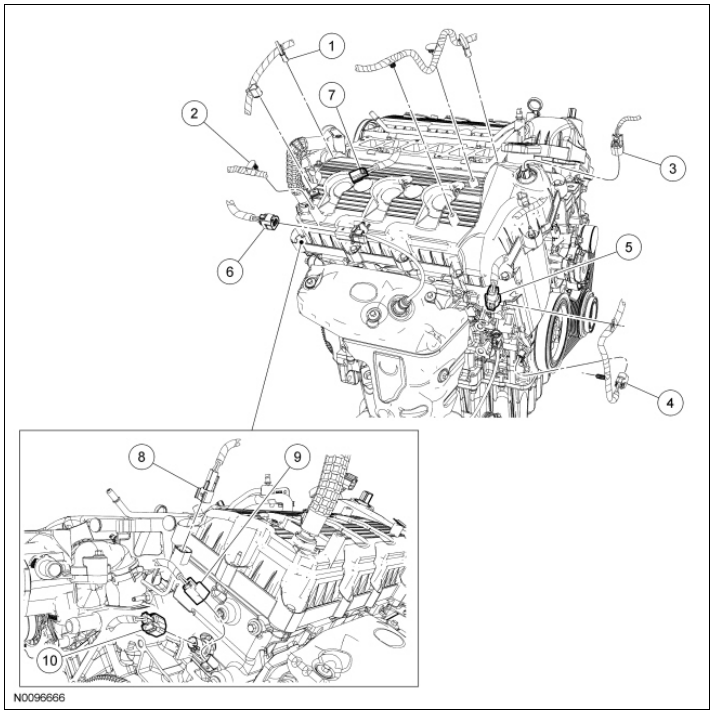
8. Install the LH ignition coil-on-plugs. For additional information, refer to Section 303-07B .

Valve Cover - RH

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

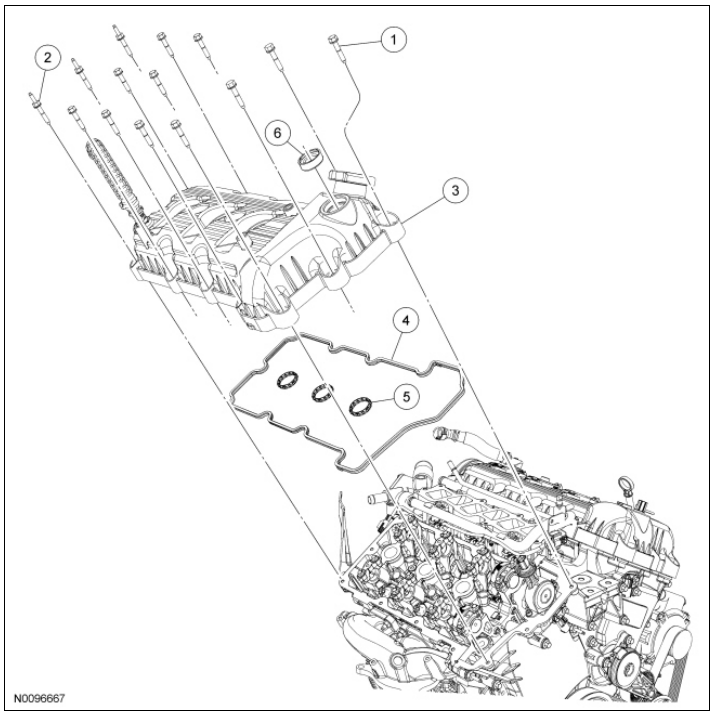
RH Valve Cover (View 1 of 2)



Item	Part Number	Description
1	-	Main engine control wiring harness valve cover stud bolt retainer (part of 12A581) (4 required)
2	-	Main enging harness valve cover retainer (part of 12A581) (3 required)
3	14A464	Variable Camshaft Timing (VCT) electrical connector (part of 12A581)
4	-	Crankshaft Position (CKP) electrical connector and wiring harness retainer (part of 12A581)
5	-	Catalyst Monitor Sensor (CMS) electrical connector (part of 12A581)

6	-	Heated Oxygen Sensor (HO2S) electrical connector (part of 12A581)
7	-	Heated PCV electrical connector (part of 12A581)
8	-	Cylinder head Knock Sensor (KS) electrical connector (part of 12A581)
9	-	Cylinder block KS electrical connector (part of 12A581)
10	-	Cylinder Head Temperature (CHT) electrical connector (part of 12A581)

RH Valve Cover (View 2 of 2)



Item	Part Number	Description
1	6C519	Valve cover stud bolt (11 required)
2	6C519	Valve cover bolt (3 required)
3	6582	Valve covertr valign="top">
4	6584	Valve cover gasket
5	6C527	Valve cover spark plug gasket (3 required)
6	6C535	Variable Camshaft Timing (VCT) valve cover seal

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

1. Remove the RH ignition coil-on-plugs. For additional information, refer to Section 303-07B .

2. Detach the 3 main engine control wiring harness retainers from the valve cover and 4 retainers from the valve cover stud bolts.

3. Disconnect the Variable Camshaft Timing (VCT) electrical connector.

4. Disconnect the Heated Oxygen Sensor (HO2S) electrical connector.

5. Disconnect the Crankshaft Position (CKP) electrical connector and detach the 2 wiring harness retainers.

6. Disconnect the Catalyst Monitor Sensor (CMS) electrical connector.

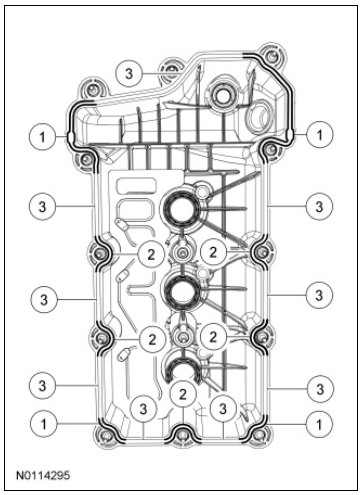
7. Disconnect the heated PCV electrical connector.

8. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector and the cylinder head and cylinder block Knock Sensor (KS) electrical connectors.

9. Remove the 11 bolts, 3 stud bolts and the valve cover.
    - Remove and discard the gasket.

Installation

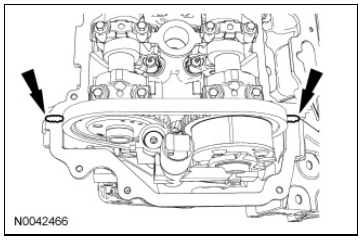
1. Install the new gasket in the valve cover in the following sequence.
    1. Install the gasket at waffle pads and then corners.
    2. Install the gasket around bolt holes.
    3. Install the remaining part of the gasket.



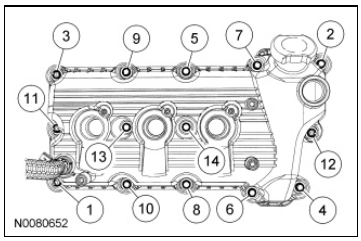
2. **NOTE:** The valve cover must be installed and the bolts and stud bolts tightened within 4 minutes of sealant application.

   NOTE: Clean cylinder head and front cover surface using metal surface prep before applying silicone gasket and sealant.

   Apply an 8 mm (0.31 in) dot of silicone gasket sealant to the front cover-to-cylinder head joints.



3. Position the valve cover and install the bolts and stud bolts.
   - Tighten in the sequence shown to 10 Nm (89 lb-in).



4. Connect the CHT sensor electrical connector and the cylinder head and cylinder block KS electrical connectors.

5. Connect the heated PCV electrical connector.

6. Connect the CMS electrical connector.

7. Connect the CKP electrical connector and attach the wiring harness retainer.

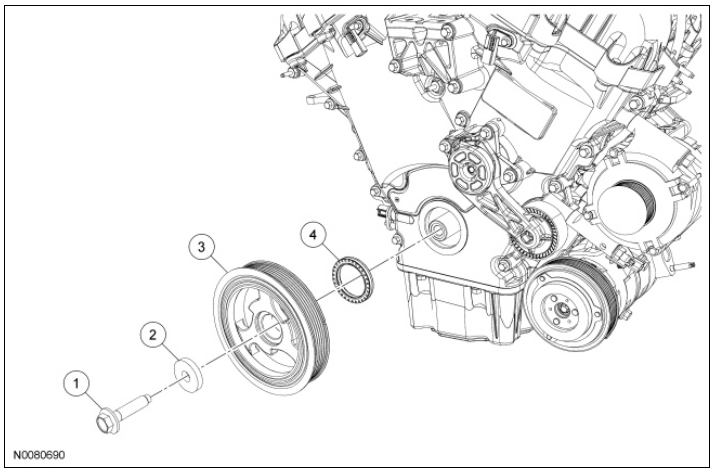
8. Connect the HO2S electrical connector.

9. Connect the VCT electrical connector.

10. Attach the 3 main engine control wiring harness retainers to the valve cover and the 4 retainers to the valve cover stud bolts.

11. Install the RH ignition coil-on-plugs. For additional information, refer to Section 303-07B .

Crankshaft Pulley and Crankshaft Front Seal - Exploded View



Item	Part Number	Description
1	W701512	Crankshaft pulley bolt
2	N806165	Washer
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal

1. For additional information, refer to the procedures in this section.

Crankshaft Pulley

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 (or equivalent)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

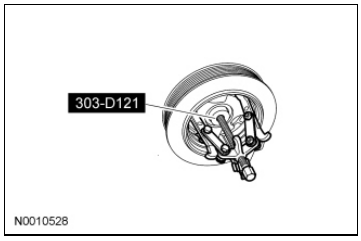
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the accessory drive belt. For additional information, refer to Section 303-05B .

3. Remove the crankshaft pulley bolt and washer.
   - Discard the crankshaft pulley bolt.

4. Using the 3 Jaw Puller, remove the crankshaft pulley.



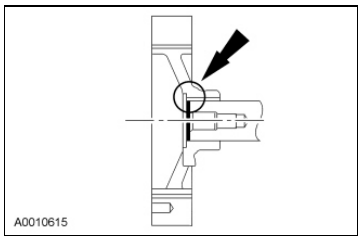
Installation

1. Lubricate the crankshaft front seal inner lip with clean engine oil.

2. **NOTE:** Clean the keyway and slot using metal surface prep before applying silicone gasket and sealant.

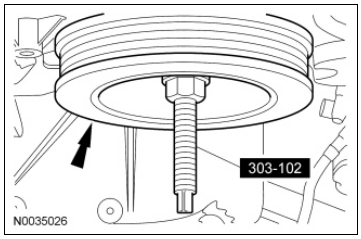
   NOTE: The crankshaft pulley must be installed and the bolt tightened within 4 minutes of applying the silicone gasket and sealant.

   Apply silicone gasket and sealant to the end of the keyway slot.



3. **NOTE:** Lubricate the outside diameter sealing surface with clean engine oil.

   Using the Crankshaft Vibration Damper Installer, install the crankshaft pulley.



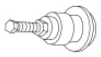
4. Install the bolt and washer. Tighten the bolt in 4 stages:
   - Stage 1: Tighten to 120 Nm (89 lb-ft).
   - Stage 2: Loosen one full turn.
   - Stage 3: Tighten to 50 Nm (37 lb-ft).
   - Stage 4: Tighten an additional 90 degrees.

5. Install the accessory drive belt. For additional information, refer to Section 303-05B .

6. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Crankshaft Front Seal

Special Tool(s)

 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST1328-A	
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

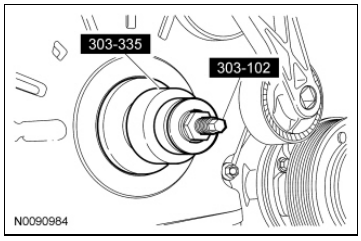
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
3. Using the Oil Seal Remover, remove and discard the crankshaft front seal.

Installation

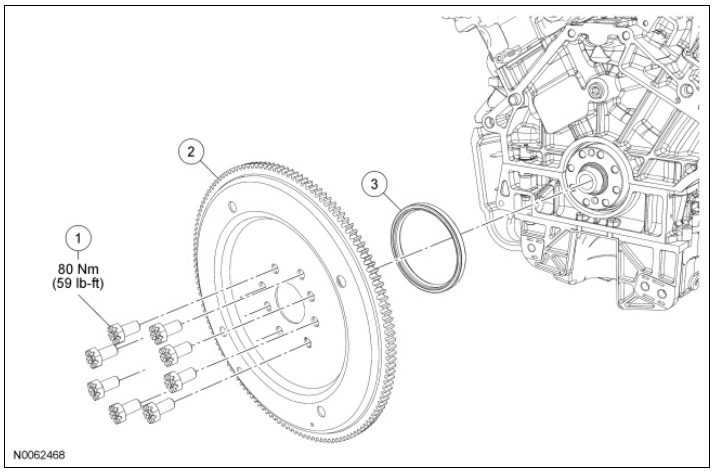
1. **NOTE:** Clean all sealing surfaces with metal surface prep.

   Apply clean engine oil to the seal lip and seal bore before installing the seal.
2. Using the Front Cover Oil Seal Installer and the Crankshaft Vibration Damper Installer, install a new crankshaft front seal.



3. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

Flexplate or Flywheel and Crankshaft Rear Seal - Exploded View



Item	Part Number	Description
1	W701559	Flexplate bolt (8 required)
2	6375	Flexplate
3	6701	Crankshaft rear oil seal

1. For additional information, refer to the procedures in this section.

Flexplate

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the transaxle. For additional information, refer to Section 307-01B .

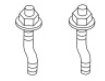
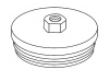
3. Remove the bolts and the flexplate.
   - To install, tighten to 80 Nm (59 lb-ft).

4. To install, reverse the removal procedure.

5. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Crankshaft Rear Seal

Special Tool(s)

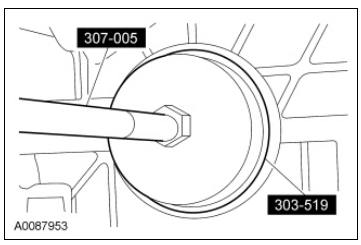
 ST1333-A	Inser Bolts, Crankshaft Rear Main Oil Seal 303-384 (T91P-6701-A)
 ST1327-A	Installer, Crankshaft Rear Main Oil Seal 303-178 (T82L-6701-A)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the flexplate. For additional information, refer to Flexplate in this section.
3. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove and discard the crankshaft rear oil seal.

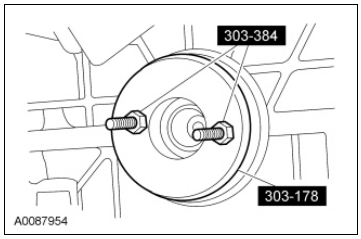


Installation

1. **NOTE:** Clean all sealing surfaces with metal surface prep.

   NOTE: Apply clean engine oil to the seal lip and seal bore before installing the seal.

   Using the Crankshaft Rear Main Oil Seal Installer Bolts and the Crankshaft Rear Main Oil Seal Installer, install the crankshaft rear oil seal.



2. Install the flexplate. For additional information, refer to Flexplate in this section.

Engine Front Cover

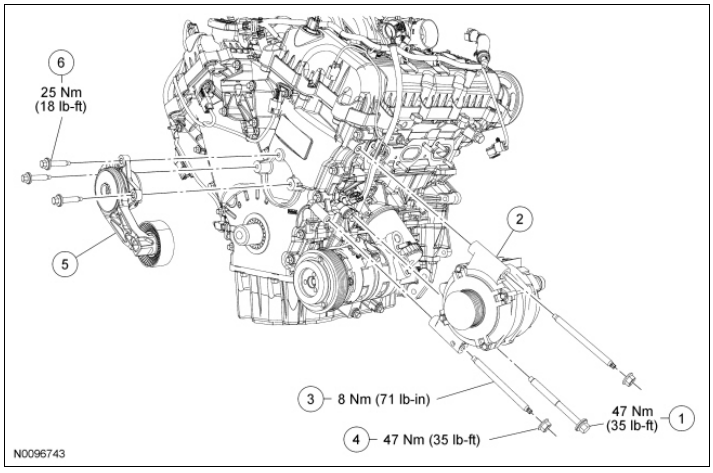
Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G3td>

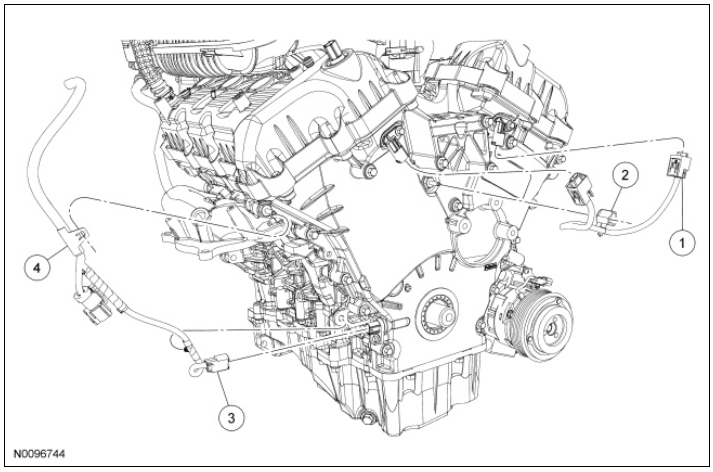
Engine Front Cover (View 1 of 3)



Item	Part Number	Description
1	W709986	Generator bolt
2	10300	Generator
3	W710416	Generator stud
4	W520414	Generator stud nut (2 required)

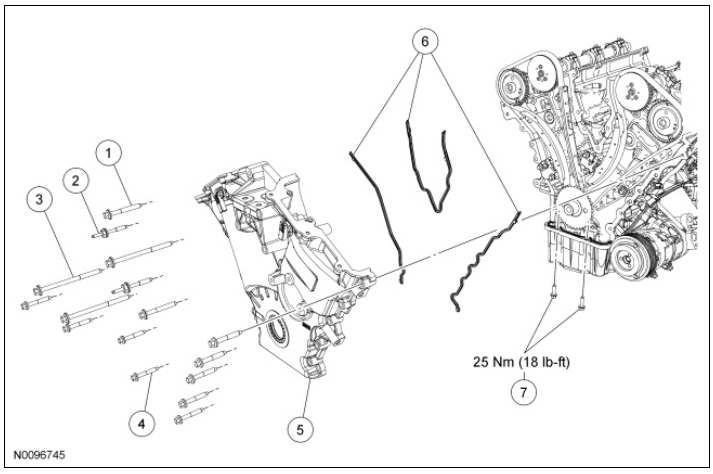
5	6B209	Accessory drive belt tensioner
6	W503297	Accessory drive belt tensioner bolt (3 required)

Engine Front Cover (View 2 of 3)



Item	Part Number	Description
1	14A464	Camshaft Position (CMP) sensor electrical connector (part of 12A581) (2 required)
2	-	CMP sensor wiring harness retainer (part of 1281)
3	14A464	Crankshaft Position (CKP) electrical connector (part of 12A581)
4	-	CKP wiring harness retainer (part of 12A581)

Engine Front Cover (View 3 of 3)



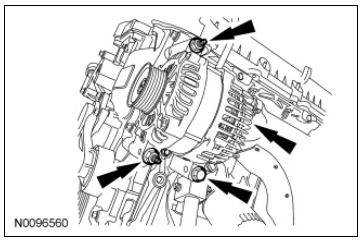
Item	Part Number	Description
1	W708222	Engine front cover bolt (2 required)
2	W710030	Engine front cover stud bolt (2 required)
3	W708221	Engine front cover bolt (2 required)

4	W701525	Engine front cover bolt (10 required)
5	6019	Engine front cover
6	6D081	Engine front cover gaskets
7	W709678	Oil pan-to-front cover bolts

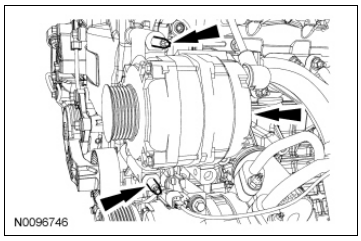
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

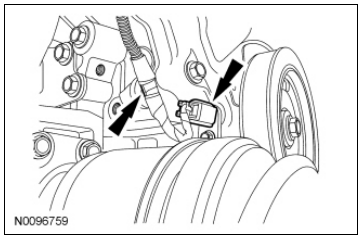
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refeto Section 100-02 .
2. Release the fuel system pressure. For additional information, refer to Section 310-00 .
3. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
4. Remove the crankshaft front seal. For additional information, refer to Crankshaft Pulley and Crankshaft Front Seal - Exploded View and Crankshaft Front Se in this section.
5. Remove the generator bolt and the 2 nuts.



6. Remove the 2 studs and position the generator away from the engine.



7. Remove the 3 bolts and the accessory drive belt tensioner.
8. Detach the wiring harness retainer from the engine front cover stud bolt.
9. Disconnect the Crankshaft Position (CKP) electrical connector and detach the wiring harness retainer.



10. Disconnect the 2 Camshaft Position (CMP) sensor electrical connectors and detach the wiring harness retainer from the engine front cover stud bolt.

11. Remove the LH and RH Variable Camshaft Timing (VCT) oil control solenoids. For additional information, refer to Section 303-14B .

12. Remove the engine mount. For additional information, refer to Engine Mount in this section.

13. Remove the 2 oil pan-to-front cover bolts.

14. Remove the 14 bolts, 2 stud bolts and the engine front cover.
    - Remove and discard the gaskets.

Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.**

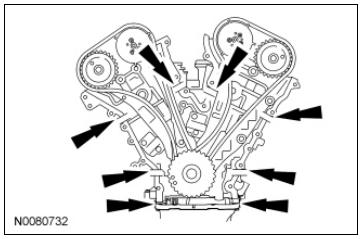
   NOTICE: **Do not damage the oil pan gasket while cleaning the sealant from the lower cylinder block-to-oil pan joint.**

   Use a plastic scraping tool to remove all traces of sealant.

   - Clean all sealing surfaces with metal surface prep and install new gaskets.

2. **NOTE:** The engine front cover must be installed and the bolts tightened within 4 minutes of applying sealant.

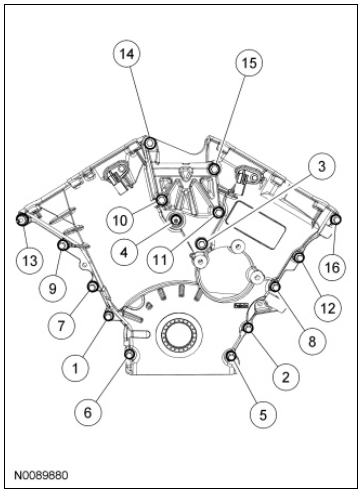
   Apply a 6 mm (0.23 in) diameter dot of silicone gasket and sealant to the cylinder block, lower cylinder block, cylinder head and oil pan mating surfaces.



3. Position the engine front cover and install the bolts. Tighten in the sequence shown to 25 Nm (18 lb-ft).

Item	Part Number	Description
1	W701525	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 47.5
2	W701525	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 47.5
3	W708222	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 64
4	W710030	Stud, Hex Flange Head Pilot, M6 x 1 x 20 / M8 x 1.25 x 47.5
5	W701525	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 47.5
6	W701525	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 47.5
7	W701525	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 47.5
8	W701525	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 47.5

9	W701525	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 47.5
10	W708221	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 118
11	W708221	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 118
12	W701525	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 47.5
13	W710030	Stud, Hex Flange Head Pilot, M6 x 1 x 20 / M8 x 1.25 x 47.5
14	W708222	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 64
15	W701525	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 118
16	W701525	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 47.5



4. Install the 2 oil pan-to-front cover bolts.
   - Tighten to 25 Nm (18 lb-ft).

5. Remove the oil pan drain plug and drain the engine oil.
   - Install the plug and tighten to 26 Nm (19 lb-ft).

6. Install the engine mount. For additional information, refer to Engine Mount in this section.

7. Install the LH and RH VCT oil control solenoids. For additional information, refer to Section 303-14B .

8. Connect the 2 CMP sensor electrical connectors and attach the wiring harness retainer to the engine front cover stud bolt.

9. Connect the Crankshaft Position (CKP) electrical connector and attach the wiring harness retainer.

10. Attach the wiring harness retainer to the engine front cover stud bolt.

11. Install the accessory drive belt tensioner and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

12. Position the generator and install the 2 studs.
    - Tighten to 8 Nm (71 lb-in).

13. Install the generator bolt and 2 nuts.
    - Tighten to 47 Nm (35 lb-ft).

14. Install the crankshaft front seal. For additional information, refer to Crankshaft Pulley and Crankshaft Front Seal - Exploded View and Crankshaft Front Seal in this section.

15. Fill the engine with clean engine oil.

16. Connect the battery ground cable. For additional information, refer to Section 414-01 .

17. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Timing Drive Components

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

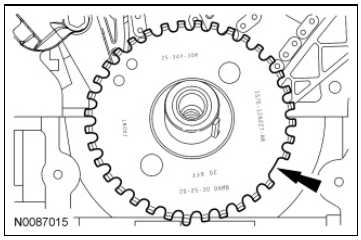
NOTICE: **Failure to verify correct timing drive component alignment will result in severe engine damage.**

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

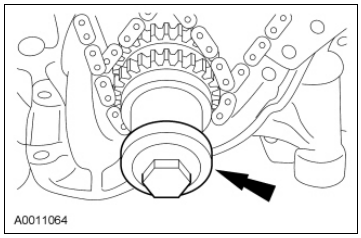
Section 303-07B .

3. **NOTE:** This pulse wheel is used in several different engines. Install the pulse wheel with the keyway in the slot stamped "30RFF" (orange in color).

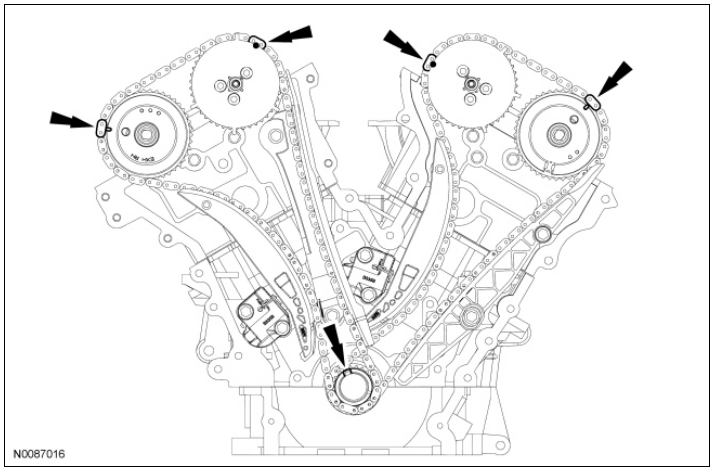
   Remove the ignition pulse wheel.



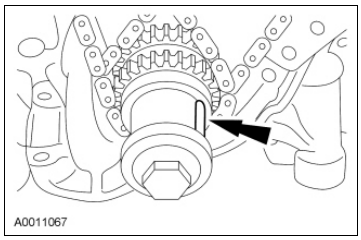
4. Install the crankshaft pulley bolt and washer.



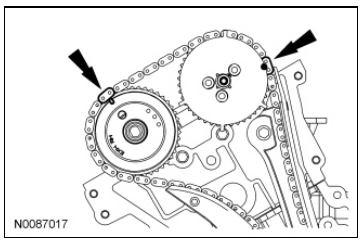
5. Rotate the crankshaft clockwise to position the crankshaft keyway in the 11 o'clock position and position the camshafts in the correct position. This will position the No. 1 cylinder at Top Dead Center (TDC).
   - Verify that the camshafts are correctly located. If not, rotate the crankshaft one additional turn and recheck.



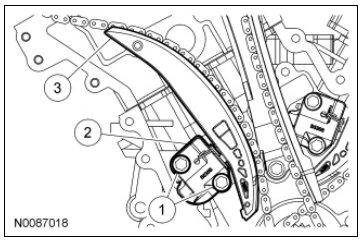
6. Rotate the crankshaft clockwise 120 degrees to the 3 o'clock position to position the RH camshafts in the neutral position.



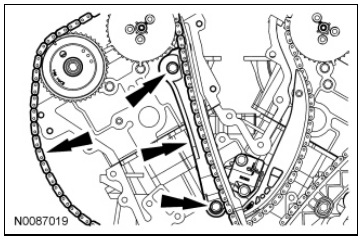
7. Verify that the RH camshafts are in the neutral position.



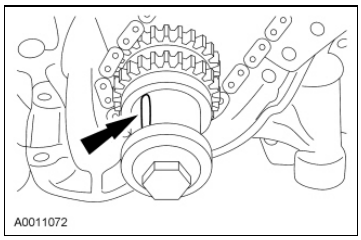
8. Remove the RH timing chain tensioner arm.
    1. Remove the 2 bolts.
    2. Remove the tensioner.
    3. Remove the tensioner arm.



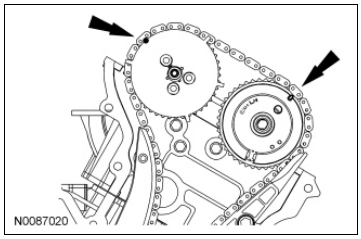
9. Remove the 2 bolts and the RH timing chain guide.
    - Remove the RH timing chain from the engine.



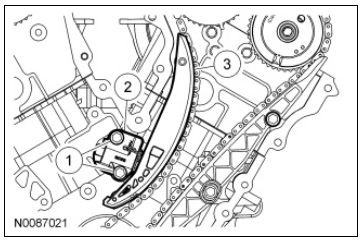
10. Rotate the crankcase clockwise 600 degrees (one and two-third turns) to position the crankcase keyway in the 11 o'clock position. This will position the LH camshafts in the neutral position.



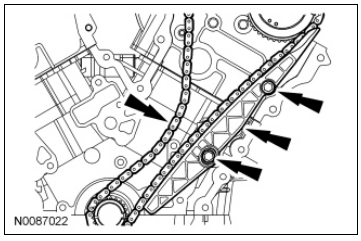
11. Verify the LH camshafts are in the neutral position.



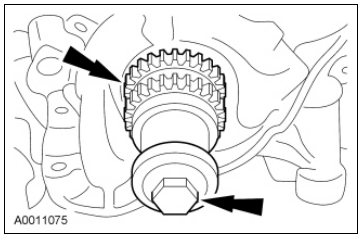
12. Remove the LH timing chain and tensioner arm.
    1. Remove the 2 bolts.
    2. Remove the tensioner.
    3. Remove the tensioner arm.



13. Remove the 2 bolts and the LH timing chain guide.
    - Remove the LH timing chain from the engine.



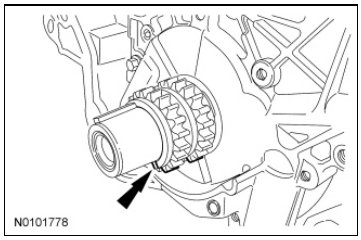
14. Remove the crankshaft pulley bolt and the crankshaft sprocket.



Installation

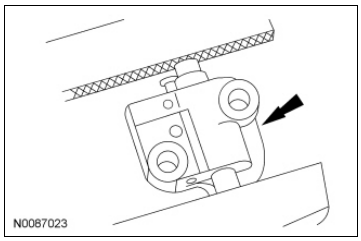
1. ***NOTICE:*** **Failure to verify correct timing drive component alignment will result in severe engine damage.**

   Install the crankshaft sprocket with the timing mark facing out. The timing mark on the LH and RH timing chains will be aligned to this mark during assembly.



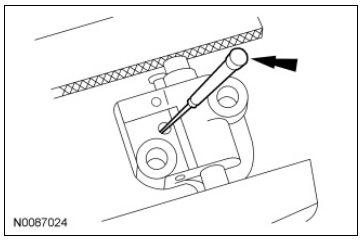
2. **NOTE:** LH shown, RH similar.

   Position the chain tensioner in a soft-jawed vise.



3. **NOTE:** LH shown, RH similar.

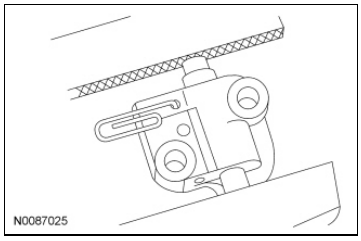
   Hold the chain tensioner ratchet lock mechanism away from the ratchet stem with a small pick.



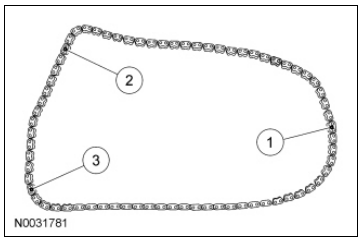
4. ***NOTICE:*** **During tensioner compression, do not release the ratchet stem until the tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.**

   Slowly compress the timing chain tensioner.

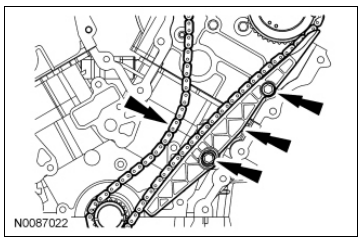
5. Retain the tensioner piston with a 1.5 mm (0.06 in) diameter wire or paper clip.



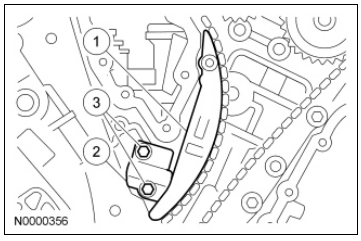
6. If timing marks in the timing chains are not evident, use a permanent-type marker to mark the crankshaft and camshaft timing marks on the LH and RH timing chains.
    1. Mark any link to use as the crankshaft timing mark.
    2. Starting with the crankshaft timing mark, count 29 links and mark the link.
    3. Continue counting to link 42 and mark the link.



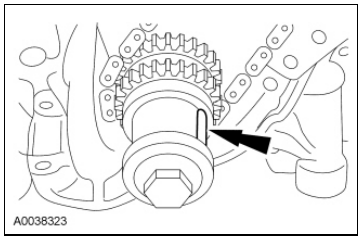
7. Position the LH timing chain and guide and install the bolts.
    - Tighten to 25 Nm (18 lb-ft).
    - Align the marks on the timing chain with the marks on the camshaft and crankshaft sprockets.



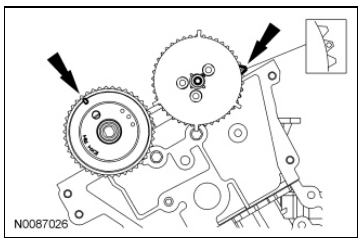
8. Install the LH timing chain tensioner arm and the LH timing chain tensioner.
    1. Install the tensioner arm.
    2. Position the tensioner.
    3. Install the bolts.
        - Tighten to 25 Nm (18 lb-ft).



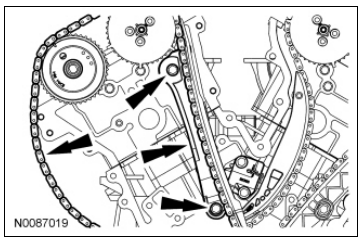
9. Install the crankshaft pulley bolt and rotate the crankshaft clockwise 120 degrees until the crankshaft keyway is in the 3 o'clock position.



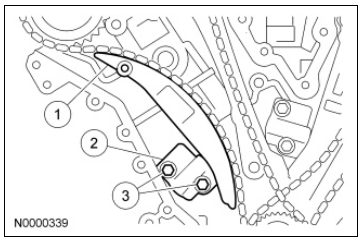
10. Verify that the RH camshafts are correctly positioned.



11. Install the RH timing chain and chain guide and install the bolts.
    - Tighten to 25 Nm (18 lb-ft).
    - Align the marks on the timing chain with the marks on the camshaft and crankshaft sprockets.



12. Install the RH timing chain tensioner and tensioner arm.
    1. Install the tensioner arm.
    2. Position the tensioner.
    3. Install the bolts.
    - Tighten to 25 Nm (18 lb-ft).



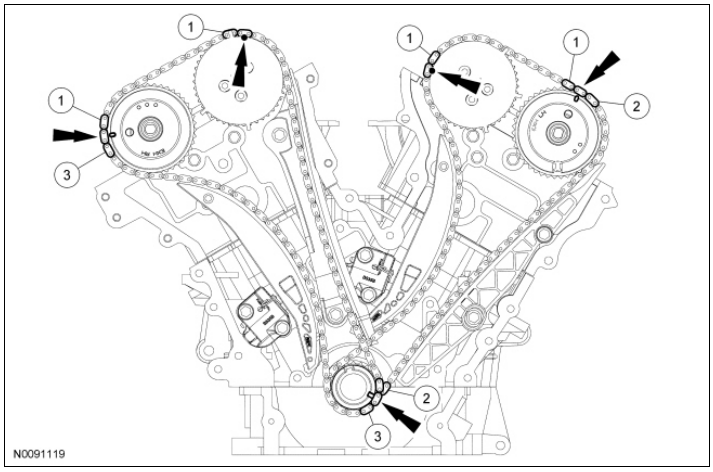
13. Remove the LH and RH timing chain tensioner piston retaining wires.

14. Rotate the crankshaft counterclockwise 120 degrees to TDC .

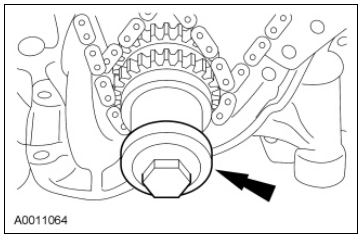
15. ***NOTICE:*** **Failure to verify correct timing drive component alignment will result in severe engine damage.**

    Verify the timing with the following steps.

    1. There should be 12 chain links between the camshaft timing marks.
    2. There should be 27 chain links between the camshaft and the crankshaft timing marks.
    3. There should be 30 chain links between the camshaft and the crankshaft timing marks.

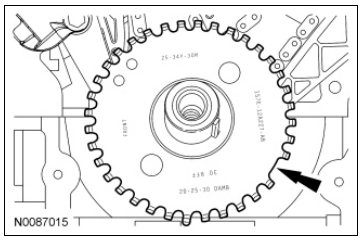


16. Remove the crankshaft pulley bolt and washer.



17. **NOTE:** This pulse wheel is used in several different engines. Install the pulse wheel with the keyway in the slot stamped "30RFF" only (orange in color).

    Install the ignition pulse wheel.

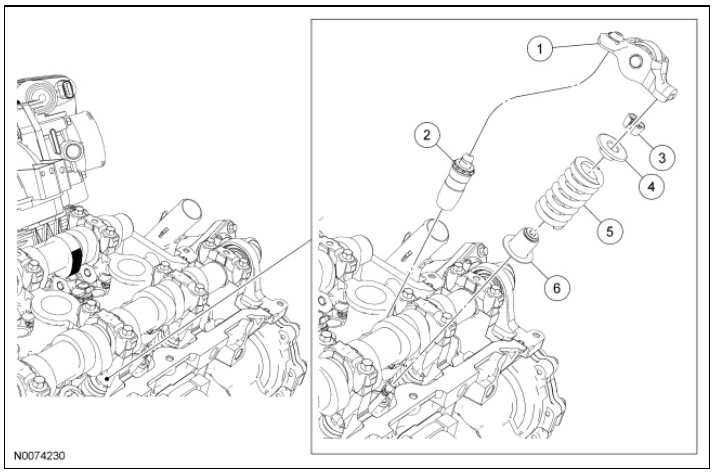


18. Install the LH and RH spark plugs. For additional information, refer to Section 303-07B .

19. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

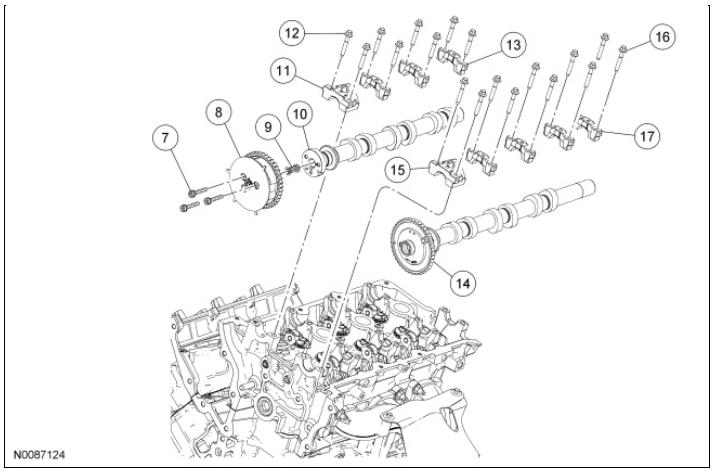
Valve Train Components - Exploded View

LH Side Roller Follower, Hydraulic Lash Adjuster and Valve Spring



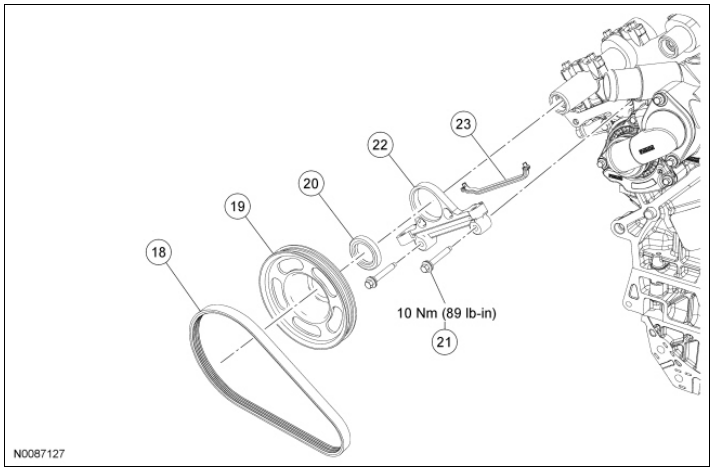
Item	Part Number	Description
1	6529	Roller follower (12 required)
2	6C501	Hydraulic lash adjuster (12 required)
3	Valve spring retainer key (24 required)	
4	6514	Valve spring retainer (12 required)
5	6513	Valve spring (12 required)
6	6A517	Valve stem seal (12 required)

LH Side Intake and Exhaust Camshafts



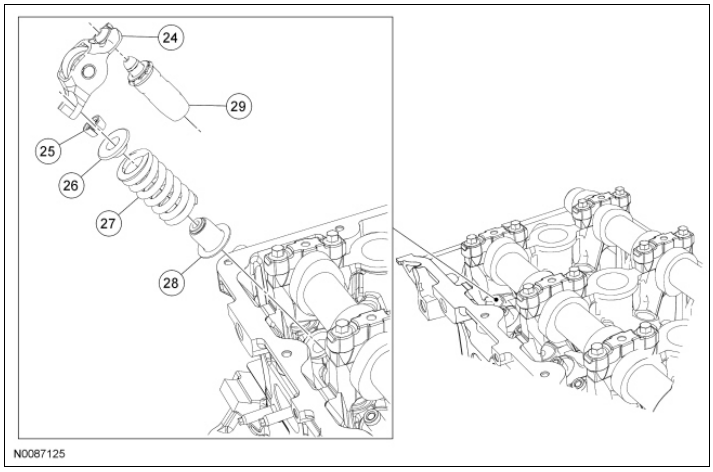
Item	Part Number	Description
7	W713106	Camshaft phaser and sprocket bolt (3 required)
8	6C524	Camshaft phaser and sprocket
9	6C683	Variable Camshaft Timing (VCT) system oil filter
10	6250	LH intake camshaft
11	6B280	Intake camshaft thrust bearing cap
12	W710702	Intake camshaft bearing cap bolt (8 required)
13	6B280	Intake camshaft bearing cap (3 required)
14	6250	LH exhaust camshaft
15	6B280	Exhaust camshaft thrust bearing cap
16	W710702	Exhaust camshaft bearing cap bolt (10 required)
17	6B280	Exhaust camshaft bearing cap (4 required)

Coolant Pump Belt and Pulley



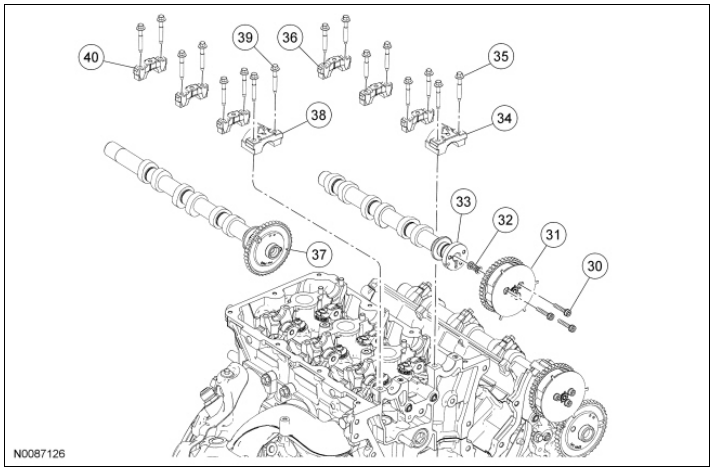
Item	Part Number	Description
18	8K543	Coolant pump drive belt
19	6A359	Coolant pump drive pulley
20	-	Camshaft oil seal
21	W701242	Camshaft oil seal retainer bolt (2 required)
22	6B293	Camshaft oil seal retainer
23	6B295	Camshaft oil seal retainer gasket

RH Side Roller Follower, Hydraulic Lash Adjuster and Valve Spring



Item	Part Number	Description
24	6529	Roller follower (12 required)
25	6518	Valve spring retainer key (24 required)
27	6513	Valve spring (12 required)
28	6A517	Valve stem seal (12 required)
29	6C501	Hydraulic lash adjuster (12 required)

RH Side Intake and Exhaust Camshaft



Item	Part Number	Description
30	W713106	Camshaft phaser and sprocket bolt (3 required)
31	6C524	Camshaft phaser and sprocket
32	6C683	VCT system oil filter
33	6250	LH intake camshaft
34	6B280	Intake camshaft thrust bearing cap
35	W710702	Intake camshaft bearing cap bolt (8 required)
36	6B280	Intake camshaft bearing cap (3 required)
37	6250	LH exhaust camshaft
38	6B280	Exhaust camshaft thrust bearing cap
39	W710702	Exhaust camshaft bearing cap bolt (10 required)

40	6B280	Exhaust camshaft bearing cap (3 required)

1. For additional information, refer to the procedures in this section.

Camshaft Phaser and Sprocket

Special Tool(s)

 ST2969-A	Locking Tool, Timing Chain 303-1175

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

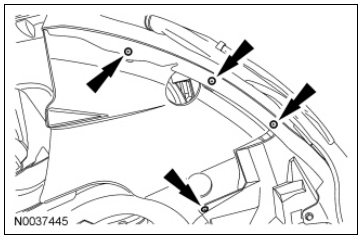
LH camshaft phaser and sprocket

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 . Click here to view a video version of this procedure.

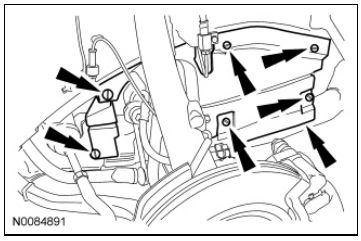
2. Remove the LH Variable Camshaft Timing (VCT) oil control solenoid. For additional information, refer to Section 303-14B .

3. Remove the LH Camshaft Position (CMP) sensor. For additional information, refer to Section 303-14B .

4. Remove the 4 screws and position the RH fender splash shield aside.


N0037445

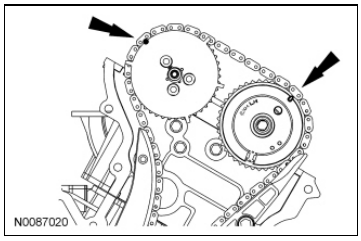
5. Remove the 6 pin-type retainers and the RH splash shield.



6. ***NOTICE:*** **The camshafts must be in the neutral position before removing the bearing caps or damage to the engine may occur.**

   NOTE: The engine front cover is removed for clarity.

   Rotate the crankshaft until the LH camshafts are in the neutral position as shown.

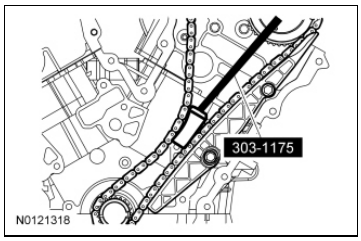


7. ***NOTICE:*** **The Timing Chain Locking Tool must be installed square to the timing chain and the engine block or damage may result.**

   NOTE: The Timing Chain Locking Tool will lock the timing chain in place.

   NOTE: The engine front cover is removed for clarity.

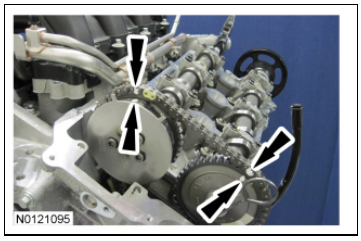
   Install the Timing Chain Locking Tool in the LH timing chain as shown.



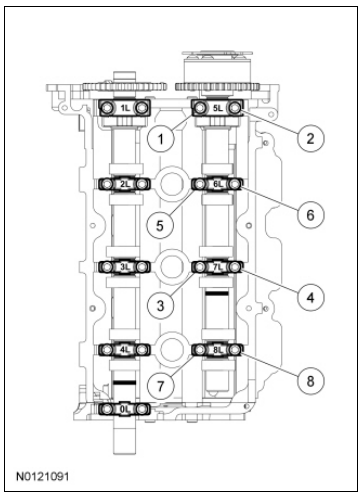
8. ***NOTICE:*** **Do not remove the Timing Chain Locking Tool at any time during assembly. If the Timing Chain Locking Tool is removed or out of placement, the engine front cover must be removed and the engine must be retimed. For additional information, refer to Timing Drive Components in this section.**

   NOTICE: **The timing chain must be installed in its original position onto the camshaft phaser and sprocket and exhaust camshaft using the marks, or damage to valves and pistons will result.**

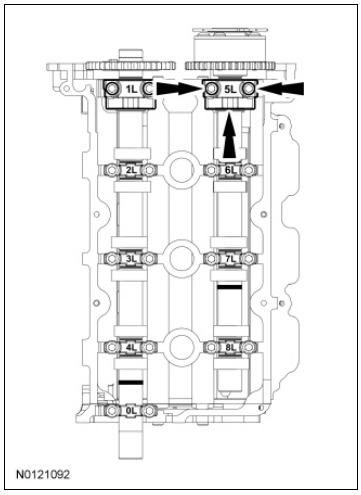
   Mark the timing chain links and LH camshaft phaser and sprocket and exhaust camshaft gear as shown for installation.



9. Loosen the intake camshaft bolts evenly in the sequence shown.



10. Remove the 2 bolts and the intake camshaft bearing thrust cap.



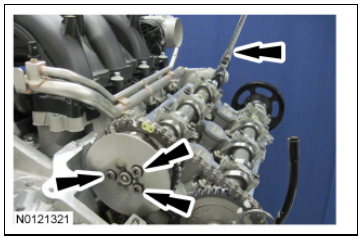
11. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while removing the camshaft phaser and sprocket or damage to the engine may occur.**

    NOTICE: **Only use hand tools to remove the camshaft phaser and sprocket bolts or damage may occur to the camshaft or camshaft phaser and sprocket.**

    NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the LH intake camshaft to hold the camshaft in place for removal of the camshaft phaser and sprocket bolts.

    Loosen the 3 bolts for the LH camshaft phaser and sprocket.

    - Tighten to 18 Nm (159 lb-in).

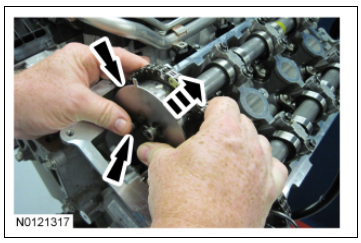


12. *NOTICE:* **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

    NOTE: The camshaft will move and needs to be positioned towards the rear of the engine.

    Using your hands, press the LH camshaft phaser and sprocket bolts towards the rear of the engine while using a rocking motion to release the LH camshaft phaser and sprocket from the camshaft.

    - Once the LH camshaft phaser and sprocket has separated from the camshaft, remove the timing chain from the LH camshaft phaser and sprocket and remove.

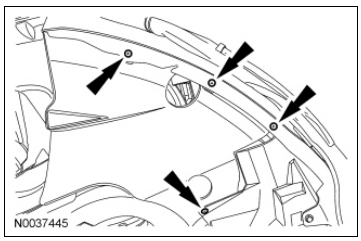


RH camshaft phaser and sprocket

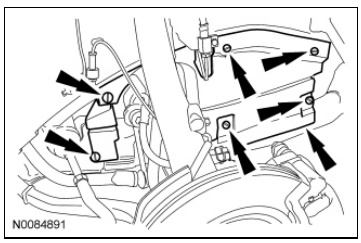
13. Remove the RH VCT oil control solenoid. For additional information, refer to Section 303-14B .

14. Remove the RH CMP sensor. For additional information, refer to Section 303-14B .

15. Remove the 4 screws and position the RH fender splash shield aside.



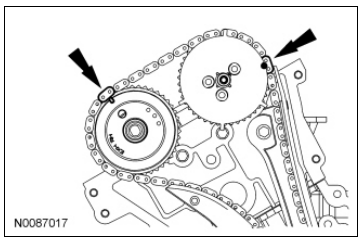
16. Remove the 6 pin-type retainers and the RH splash shield.



17. *NOTICE:* **The camshafts must be in the neutral position before removing the bearing caps or damage to the engine may occur.**

NOTE: The engine front cover is removed for clarity.

Rotate the crankshaft until the RH camshafts are in the neutral position as shown.

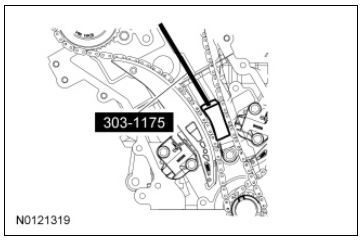


18. ***NOTICE:*** **The Timing Chain Locking Tool must be installed square to the timing chain and the engine block or damage may result.**

    NOTE: The Timing Chain Locking Tool will lock the timing chain in place.

    NOTE: The engine front cover is removed for clarity.

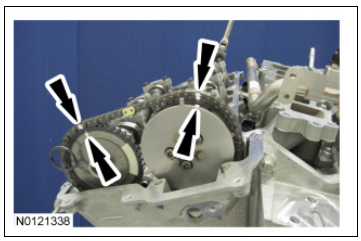
    Install the Timing Chain Locking Tool in the RH timing chain as shown.



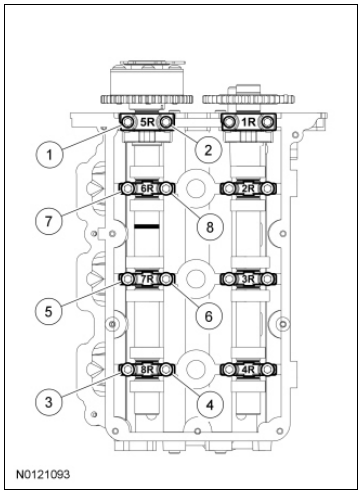
19. ***NOTICE:*** **Do not remove the Timing Chain Locking Tool at any time. If the Timing Chain Locking Tool is removed or out of placement, the engine front cover must be removed and the engine must be retimed. For additional information, refer to Timing Drive Components in this section.**

    NOTICE: **The timing chain must be installed in its original position onto the camshaft phaser and sprocket and exhaust camshaft gear using the marks, or damage to valves and pistons will result.**

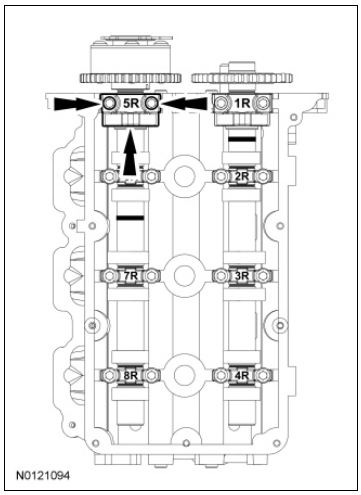
    Mark the timing chain links and RH camshaft phaser and sprocket and exhaust camshaft gear as shown for installation.



20. Loosen the intake camshaft bolts evenly in the sequence shown.



21. Remove the 2 bolts and the intake camshaft bearing thrust cap.



22. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while removing the camshaft phaser and sprocket or damage to the engine may occur.**

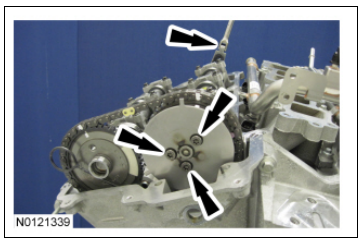
    NOTICE: **Only use hand tools to remove the camshaft phaser and sprocket bolt or damage may occur to the camshaft or camshaft phaser and sprocket.**

    NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the RH intake camshaft to hold the camshaft in place for removal of the camshaft phaser and sprocket bolts.

    NOTE: The engine front cover is removed for clarity.

    Loosen the 3 bolts for the RH camshaft phaser and sprocket.

    - Tighten to 18 Nm (159 lb-in).

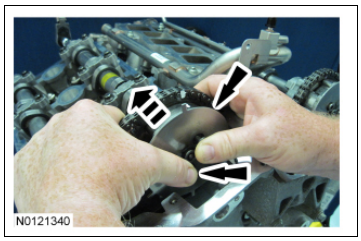


23. ***NOTICE:*** **Damage to the camshaft phaser and sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

    NOTE: The camshaft will move and needs to be positioned towards the rear of the engine.

    Using your hands, press the RH camshaft phaser and sprocket bolts towards the rear of the engine while using a rocking motion to release the RH camshaft phaser and sprocket from the camshaft.

    - Once the RH camshaft phaser and sprocket has separated from the camshaft, remove the timing chain from the RH camshaft phaser and sprocket and remove.



Installation

RH camshaft phaser and sprocket

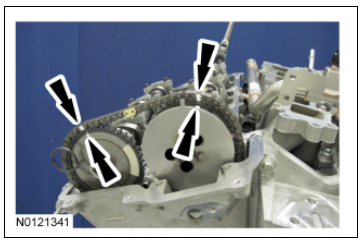
1. ***NOTICE:*** **Do not remove the Timing Chain Locking Tool at any time during installation. If the Timing Chain Locking Tool is removed or out of placement, the engine front cover must be removed and the engine must be retimed. For additional information, refer to Timing Drive Components in this section.**

   NOTICE: **The timing chain must be installed in its original position onto the camshaft phaser and sprocket using the marks, or damage to valves and pistons will result.**

   NOTE: If replacement of the camshaft phaser and sprocket is necessary, transfer the mark to the new camshaft phaser and sprocket.

   Position the RH camshaft phaser and sprocket into the timing chain with the alignment marks.

   - Make sure the timing chain mark is in alignment with the exhaust camshaft gear mark.

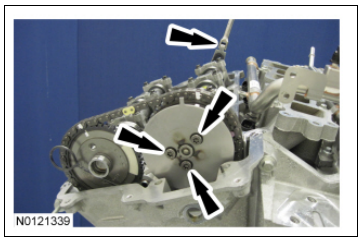


2. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while installing the camshaft phaser and sprocket or damage to the engine may occur.**

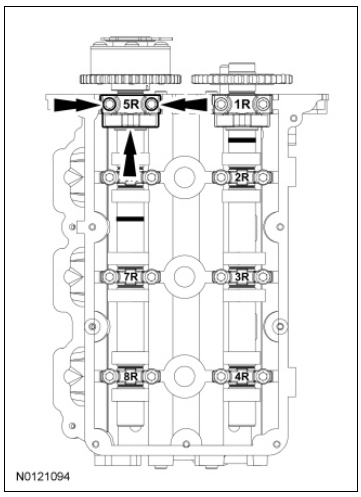
   NOTICE: **Only use hand tools to install the camshaft phaser and sprocket bolts or damage may occur to the camshaft or camshaft phaser and sprocket.**

   Using the 3/8-in ratchet and extension into the D-slot on the rear of the RH intake camshaft, align the RH camshaft phaser and sprocket with the camshaft and install the 3 bolts.

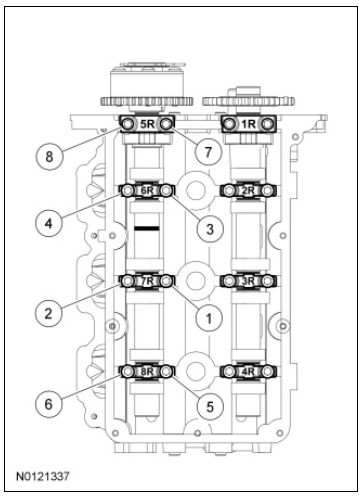
- Tighten the 3 bolts in a clockwise pattern until the RH camshaft phaser and sprocket is seated on the camshaft.
- Torque the 3 bolts to 18 Nm (159 lb-in), using the 3/8-in ratchet and extension to hold camshaft from turning.



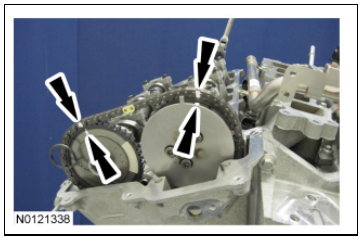
3. Lubricate the bearing surface of the RH intake camshaft bearing thrust cap with clean engine oil and install the camshaft bearing thrust cap and the 2 bolts.
    - Do not torque at this time.



4. Tighten the RH intake camshaft bearing cap bolts in the sequence shown in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Individually loosen and then tighten each camshaft bearing cap to 10 Nm (89 lb-in).

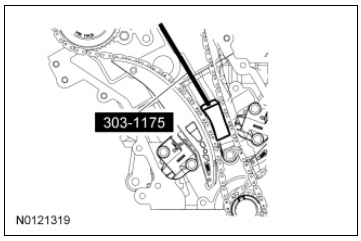


5. Verify the timing chain links and RH camshaft phaser and sprocket and exhaust camshaft gear are in alignment.

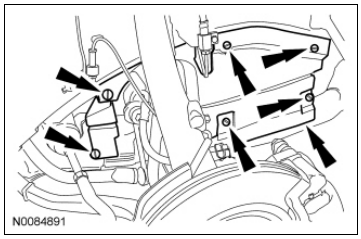


6. **NOTE:** The engine front cover is removed for clarity.

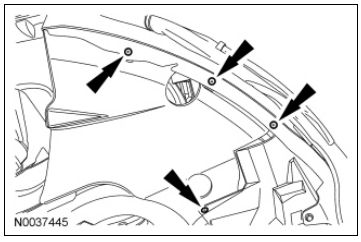
   Remove the Timing Chain Locking Tool from the RH timing chain.



7. Install the RH splash shield and the 6 pin-type retainers.



8. Position the RH fender splash shield and install the 4 screws.



9. Install the RH CMP sensor. For additional information, refer to Section 303-14B .

10. Install the RH VCT oil control solenoid. For additional information, refer to Section 303-14B .

LH camshaft phaser and sprocket

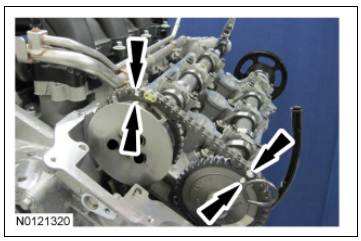
11. ***NOTICE:*** **Do not remove the Timing Chain Locking Tool at any time during installation. If the Timing Chain Locking Tool is removed or out of placement, the engine front cover must be removed and the engine must be retimed. For additional information, refer to Timing Drive Components in this section.**

    NOTICE: **The timing chain must be installed in its original position onto the camshaft phaser and sprocket using the marks, or damage to valves and pistons will result.**

    NOTE: If replacement of the camshaft phaser and sprocket is necessary, transfer the mark to the new camshaft phaser and sprocket.

Position the LH camshaft phaser and sprocket into the timing chain with the alignment marks.

- Make sure the timing chain mark is in alignment with the exhaust camshaft gear mark.

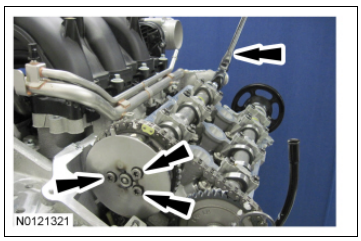


12. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while installing the camshaft phaser and sprocket or damage to the engine may occur.**

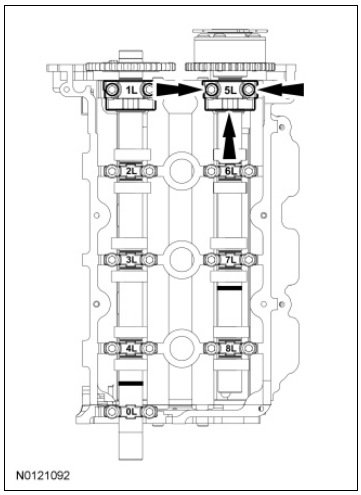
    NOTICE: **Only use hand tools to install the camshaft phaser and sprocket bolts or damage may occur to the camshaft or camshaft phaser and sprocket.**

    Using the 3/8-in ratchet and extension into the D-slot on the rear of the LH intake camshaft, align the LH camshaft phaser and sprocket with the camshaft and install the 3 bolts.

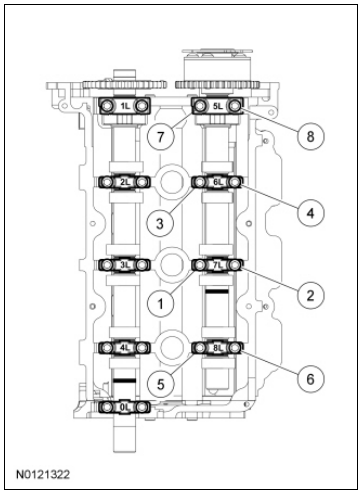
    - Tighten the 3 bolts in a clockwise pattern until the LH camshaft phaser and sprocket is seated on the camshaft.
    - Torque the 3 bolts to 18 Nm (159 lb-in), using the 3/8-in ratchet and extension to hold camshaft from turning.



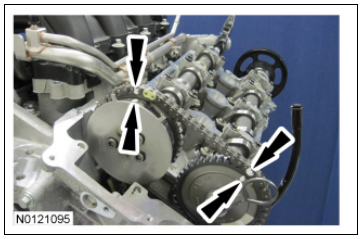
13. Lubricate the bearing surface of the LH intake camshaft bearing thrust cap with clean engine oil and install the camshaft bearing thrust cap and the 2 bolts.
    - Do not torque at this time.



14. Tighten the LH intake camshaft bearing cap bolts in the sequence shown in 2 stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Individually loosen and then tighten each camshaft bearing cap to 10 Nm (89 lb-in).

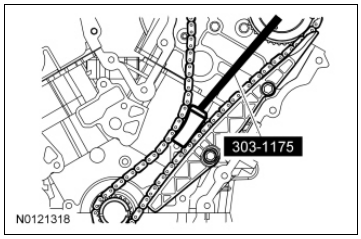


15. Verify the timing chain links and LH camshaft phaser and sprocket and exhaust camshaft gear are in alignment.

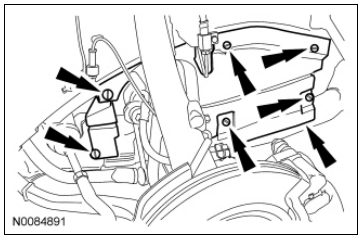


16. **NOTE:** The engine front cover is removed for clarity.

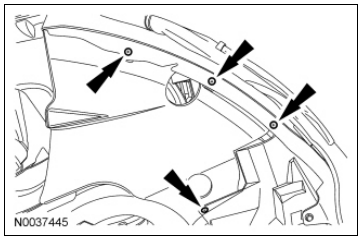
    Remove the Timing Chain Locking Tool from the LH timing chain.



17. Install the RH splash shield and the 6 pin-type retainers.



18. Position the RH fender splash shield and install the 4 screws.



19. Install the LH CMP sensor. For additional information, refer to Section 303-14B .
20. Install the LH VCT oil control solenoid. For additional information, refer to Section 303-14B .

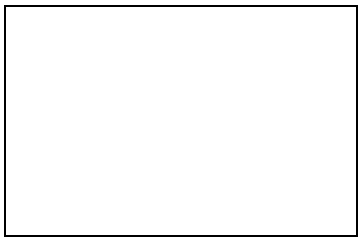
Variable Camshaft Timing (VCT) System Oil Filter

Removal

1. Remove the camshaft phaser and sprocket. For additional information, refer to Camshaft Phaser and Sprocket in this section.

2. **NOTE:** RH Variable Camshaft Timing (VCT) system oil filter shown, LH similar.

   Remove and discard the VCT system oil filter from the camshaft.



Installation

1. **NOTE:** RH VCT system oil filter shown, LH similar.

   Install the new VCT system oil filter in the camshaft.

2. Install the camshaft phaser and sprocket. For additional information, refer to Camshaft Phaser and Sprocket in this section.

Camshafts - LH

Special Tool(s)

 ST1970-A	Installer, Camshaft Oil Seal 303-464 (T94P-6256-BH)
 ST3042-A	Installer, Camshaft Pulley 303-458 (T94P-6312-AH3), part of 303-S455
 ST1586-A	Installer, Power Steering Pump Pulley 211-185 (T91P-3A733-A)
 ST3044-A	Plate, Water Pump Pulley 303-456 (T94P-6312-AH1), part of 303-S455
 ST2060-A	Protector, Camshaft Oil Seal 303-463 (T94P-6256-AH)
 ST3045-A	Protector, Water Pump Shaft 303-457 (T94P-6312-AH2), part of 303-S455
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST3043-A	Spacer, Water Pump Pulley 303-459 (T94P-6312-AH4), part of 303-S455

Material

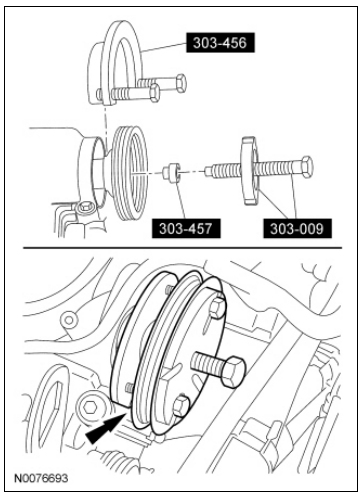
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

1. Remove the coolant pump belt. For additional information, refer to Section 303-05B .

2. ***NOTICE:*** **Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.**

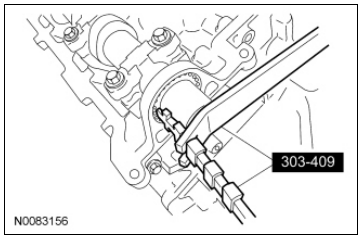
   Using the Water Pumpey Plate, Water Pump Shaft Protector and the Crankshaft Vibration Damper Remover, remove the coolant pump pulley.



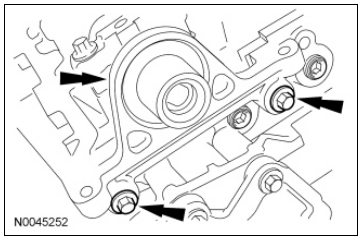
3. Remove the LH camshaft phaser and socket. For additional information, refer to Camshaft Phaser and Sprocket in this section.

4. ***NOTICE:*** **Do not scratch the camshaft sealing surface while removing the camshaft oil seal. If scratched, camshaft oil seal leakage may occur.**

   Using the Oil Seal Remover, remove and discard the camshaft oil seal.

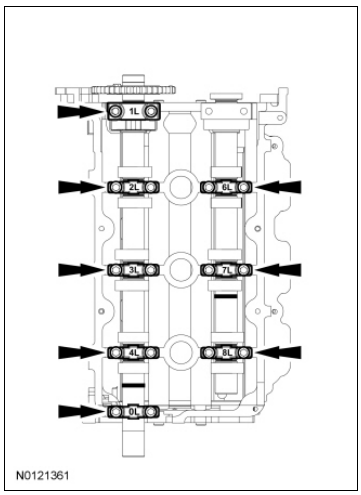


5. Remove the 2 bolts and the camshaft oil seal retainer.
   - Discard the press-in-place gasket.

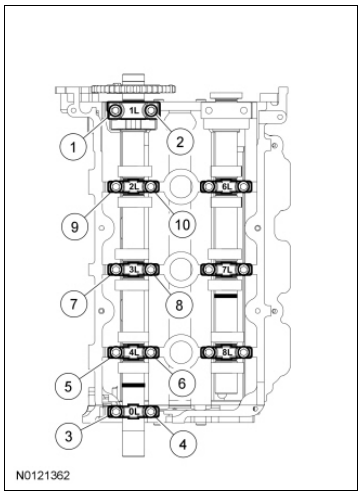


6. ***NOTICE:*** **Cylinder head camshaft bearing caps must be assembled in their original positions. Some engines have factory markings on the camshaft bearing caps (as shown in illustration). Engines that do not have the factory markings must be marked for correct position and orientation prior to removal. Failure to install the camshaft bearing caps in their original positions may result in severe engine damage.**

If necessary, mark the camshaft bearing cap position and orientation as shown in the illustration.



7. Loosen the bolts evenly in the sequence shown.

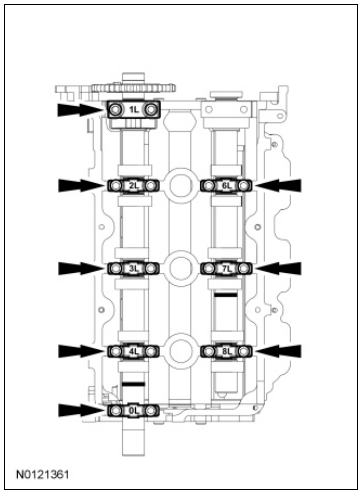


8. ***NOTICE:*** **After loosening the camshaft bearing cap bolts, remove the camshaft bearing thrust cap (1L) first, or damage to the thrust cap may occur.**

   NOTE: Make sure the camshaft bearing caps are marked as instructed in the previous step.

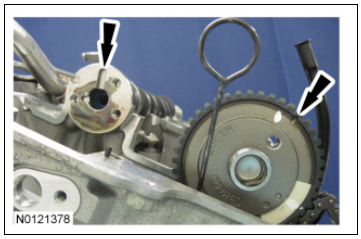
   Remove the camshaft cap bolts.

   1. Remove the camshaft bearing thrust cap (1L).
   2. Remove the remaining camshaft bearing caps.
   3. Remove the camshafts from the cylinder head.



Installation

1. Lubricate the LH camshafts with clean engine oil and carefully position the camshafts onto the cylinder head.
    - Align the LH camshafts as shown.

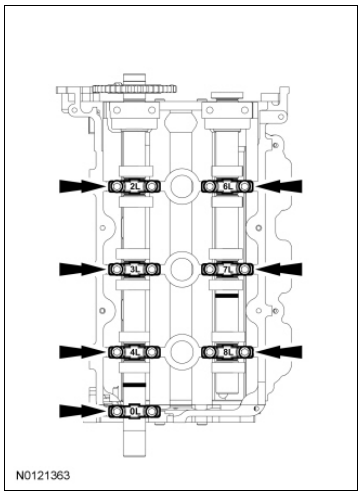


2. ***NOTICE:*** **Cylinder head camshaft journal caps and cylinder heads are numbered to verify that they are assembled in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

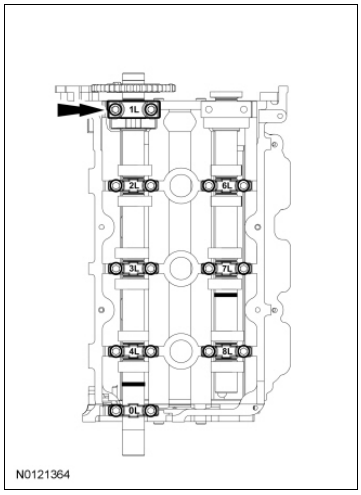
   NOTICE: **Do not install the camshaft journal thrust cap until all of the camshaft bearing caps have been installed or damage to the thrust cap can occur.**

   Lubricate the bearing surfaces of the LH camshaft bearing caps with clean engine oil and install the bearing caps.

    - Loosely install the bolts.



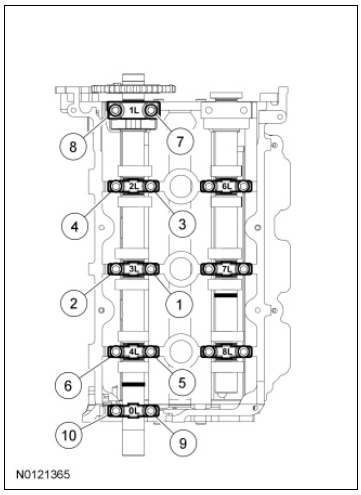
3. Lubricate the bearing surface of the LH exhaust camshaft bearing thrust cap with clean engine oil and install the bearing thrust cap.
    - Loosely install the bolts.



4. **NOTE:** Make sure to tighten the camshaft bearing cap bolts in sequence in 2 stages.

    Tighten the LH exhaust camshaft bearing cap bolts in the sequence shown in 2 stages.

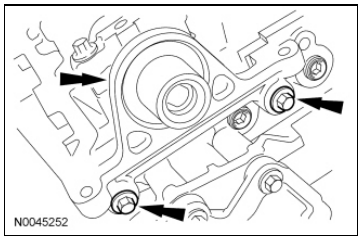
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Individually loosen and then tighten each camshaft bearing cap to 10 Nm (89 lb-in).



5. **NOTE:** Clean the sealing surfaces with metal surface prep before installing a new press-in-place gasket.

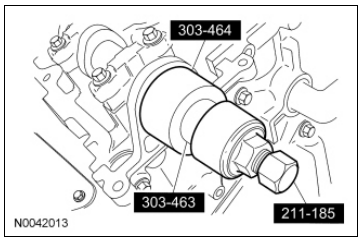
    Install the camshaft oil seal retainer and the 2 bolts.

    - Tighten to 10 Nm (89 lb-in).



6. **NOTE:** Lubricate the camshaft oil seal with clean engine oil.

   Using the Camshaft Oil Seal Installer, Camshaft Oil Seal Protector and the Power Steering Pump Pulley Installer, install the camshaft oil seal.

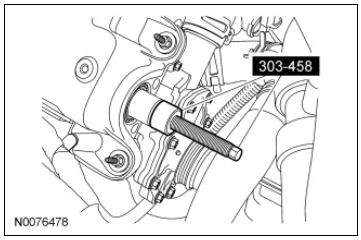


7. Install the LH camshaft phaser and socket. For additional information, refer to Camshaft Phaser and Sprocket in this section.

8. ***NOTICE:*** **Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.**

   Install the Camshaft Pulley Installer in the camshaft as shown in the illustration.

   - Adjust the collar on the Camshaft Pulley Installer screw to get the best thread engagement in the rear of the camshaft.

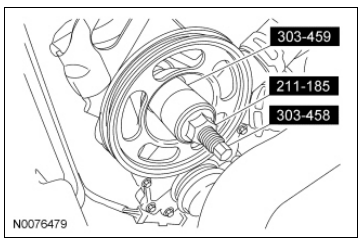


9. ***NOTICE:*** **Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.**

   NOTE: Only the roller collared nut from the Power Steering Pump Pulley Installer (211-185) is used on Camshaft Pulley Installer (303-458).

   Position the coolant pump pulley over the previously installed Camshaft Pulley Installer and on the end of the camshaft. Install the Camshaft Pulley Installer, Power Steering Pump Pulley Installer and the Water Pump Pulley Spacer as shown in the illustration.

   - Using the Camshaft Pulley Installer, Power Steering Pump Pulley Installer and the Water Pump Pulley Spacer, install a new service coolant pump pulley flush with the end of the camshaft.



10. Install the coolant pump belt. For additional information, refer to Section 303-05B .

Camshafts - RH

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

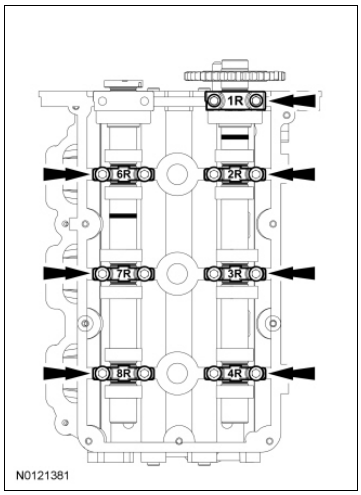
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

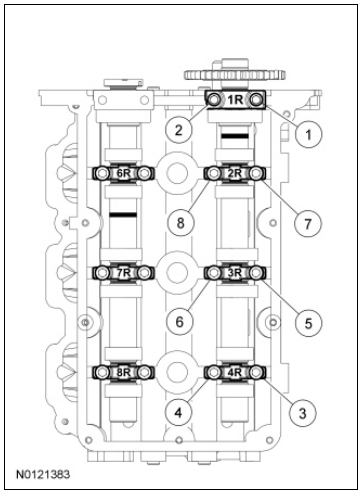
2. Remove the RH camshaft phaser and socket. For additional information, refer to Camshaft Phaser and Sprocket in this section.

3. ***NOTICE:*** **Cylinder head camshaft bearing caps must be assembled in their original positions. Some engines have factory markings on the camshaft bearing caps (as shown in illustration). Engines that do not have the factory markings must be marked for correct position and orientation prior to removal. Failure to install the camshaft bearing caps in their original positions may result in severe engine damage.**

   If necessary, mark the camshaft bearing cap position and orientation as shown in the illustration.



4. Loosen the bolts evenly in the sequence shown.

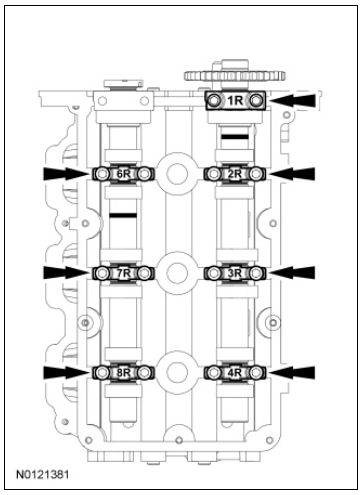


5. ***NOTICE:*** **After loosening the camshaft bearing cap bolts, remove the camshaft bearing thrust cap (1R) first, or damage to the thrust cap may occur.**

   NOTE: Make sure the camshaft bearing caps are marked as instructed in the previous step.

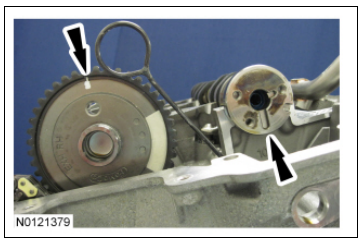
   Remove the camshaft cap bolts.

   1. Remove the camshaft bearing thrust cap (1R).
   2. Remove the remaining camshaft bearing caps.
   3. Remove the camshafts from the cylinder head.



Installation

1. Lubricate the RH camshafts with clean engine oil and carefully position the camshafts onto the cylinder head.
   - Align the RH camshafts as shown.

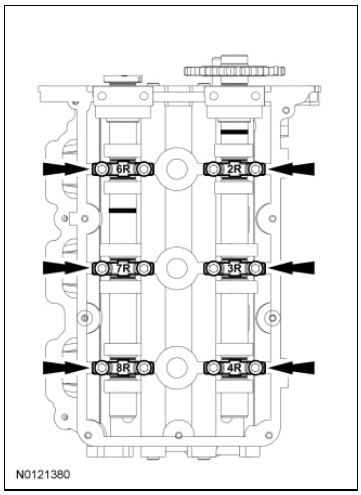


2. ***NOTICE:*** **Cylinder head camshaft journal caps and cylinder heads are numbered to verify that they are assembled in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

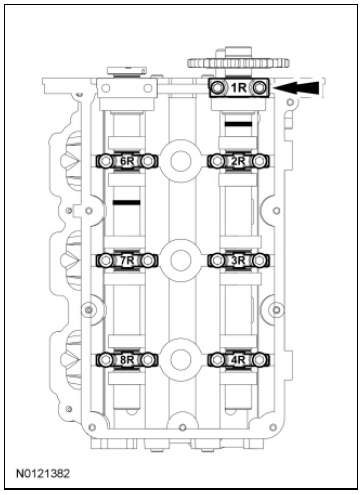
   NOTICE: **Do not install the camshaft journal thrust cap until all of the camshaft bearing caps have been installed or damage to the thrust cap can occur.**

   Lubricate the bearing surfaces of the RH camshaft bearing caps with clean engine oil and install the bearing caps.

   - Loosely install the bolts.



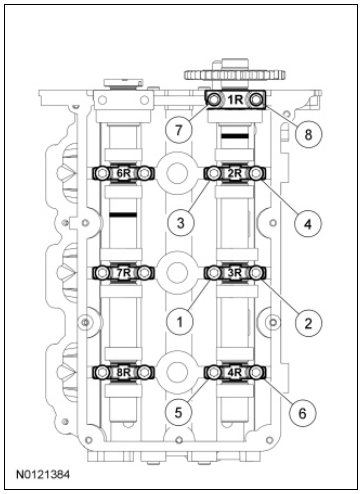
3. Lubricate the bearing surface of the RH exhaust camshaft bearing thrust cap with clean engine oil and install the bearing thrust cap.
   - Loosely install the bolts.



4. **NOTE:** Make sure to tighten the camshaft bearing cap bolts in sequence in 2 stages.

   Tighten the RH camshaft bearing cap bolts in the sequence shown in 2 stages.

   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Individually loosen and then tighten each camshaft bearing cap to 10 Nm (89 lb-in).



5. Install the RH camshaft phaser and socket. For additional information, refer to Camshaft Phaser and Sprocket in this section.

Camshaft Roller Follower

Special Tool(s)

 ST1975-A	Compressor, Valve Spring 303-473 (T94P-6565-BH)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXOLSP12 (Canada)	WSS-M2C945-A

Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

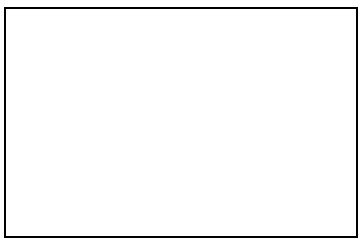
2. Remove the LH and RH valve covers. For additional information, refer to Valve Cover - LH and Valve Cover - RH in this section.

3. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.**

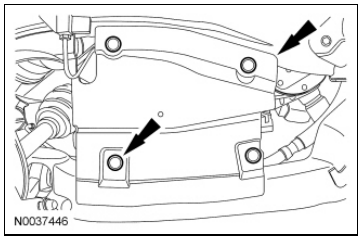
   Remove the 6 spark plugs.

   - To install, tighten to 15 Nm (133 lb-in).

4. Remove the 4 screws and position the RH fender splash shield aside.



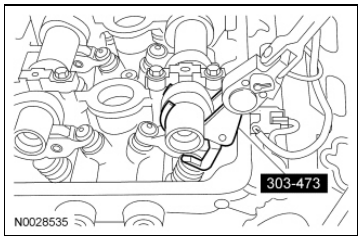
5. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



6. Rotate the crankshaft until the camshaft lobe is pointing directly away from the roller follower.

7. **NOTE:** Mark the positions of the roller followers to make sure they are assembled in their original positions.

   Using the Valve Spring Compressor, remove the roller followers.



8. **NOTE:** Lubricate the roller followers with clean engine oil.

   To install, reverse the removal procedure.

Hydraulic Lash Adjuster

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

1. Remove the camshaft roller followers. For additional information, refer to Camshaft Roller Follower in this section.

2. **NOTE:** Mark the positions of the hydraulic lash adjusters to make sure they are assembled in their original positions.

   Remove the hydraulic lash adjusters.

3. **NOTE:** Inspect the hydraulic lash adjusters for scoring marks and uneven wear in the bore. Install new lash adjusters if necessary.

   To install, reverse the removal procedure.

   - Lubricate the hydraulic lash adjusters with clean engine oil.

Valve Spring, Retainer, and Seal

Special Tool(s)

 ST1975-A	Compressor, Valve Spring 303-473 (T94P-6565-BH)
 ST1977-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

1. Remove the camshaft roller followers. For additional information, refer to Camshaft Roller Follower in this section.

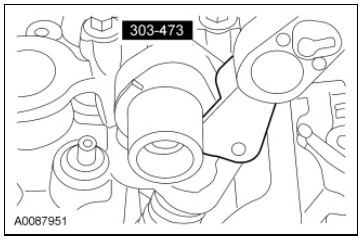
2. ***NOTICE:*** **If the components are to be reinstalled, they must be installed in their original positions or damage to the engine may occur. Mark the components for installation into their original locations.**

   NOTE: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this from happening.

   NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer Cylinder Head - RH or Cylinder Head - LH in this section.

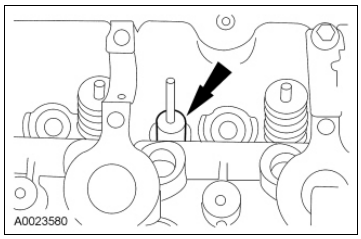
   Pressurize the cylinder using compressed air.

3. Using the Valve Spring Compressor, remove the key, retainer and the valve spring.



4. **NOTE:** Camshaft removed for clarity.

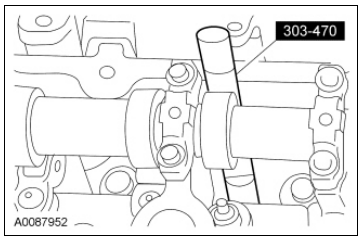
   Remove and discard the valve seal.



Installation

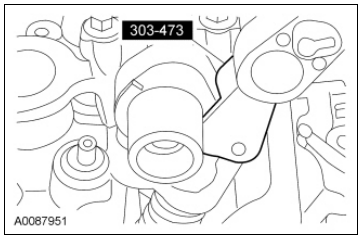
1. **NOTE:** Lubricate the valve guide with clean engine oil.

   Using the Valve Stem Oil Seal Installer, install the new valve seal.



2. ***NOTICE:*** **If the components are to be reinstalled, they must be installed in their original positions or damage to the engine may occur.**

   Using the Valve Spring Compressor, install the valve spring, retainer and key.

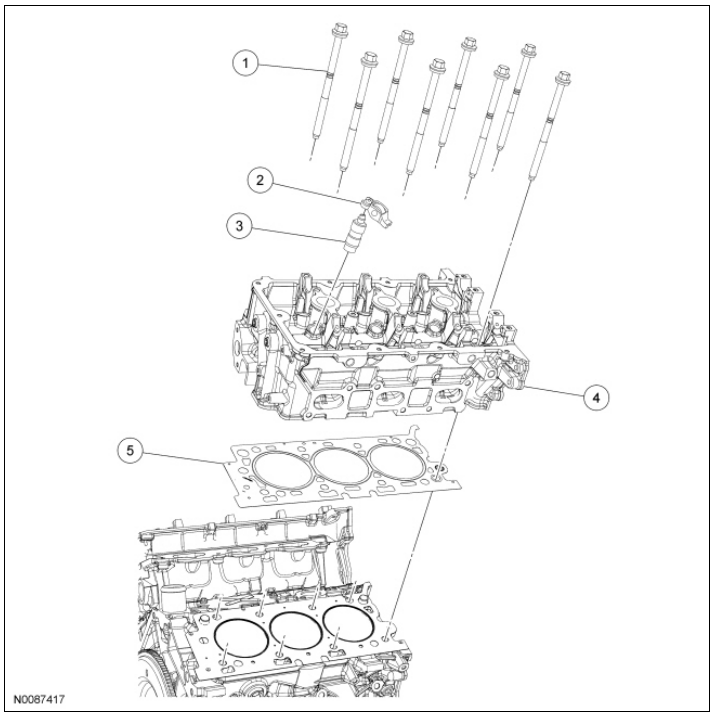


3. Install the camshaft roller followers. For additional information, refer to Camshaft Roller Follower in this section.

Cylinder Head - RH

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Part Number	Description	
1	6065	Cylinder head bolt (8 required)
2	6529	Camshaft roller follower (12 required)
3	6C501	Hydraulic lash adjuster (12 required)
4	6049	Cylinder head
5	6051	Cylinder head gasket

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.

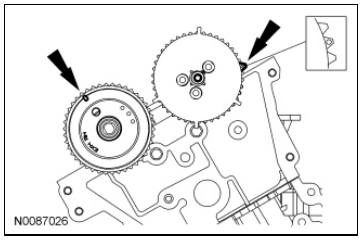
3. Remove the RH exhaust manifold. For additional information, refer to Exhaust Manifold - RH in this section.

4. Remove the coolant pump housing. For additional information, refer to Section 303-03A .

5. Remove the timing drive components. For additional information, refer to Timing Drive Components in this section.

6. ***NOTICE:*** **The camshafts must be in the neutral position before removing the bearing caps or damage to the engine may occur.**

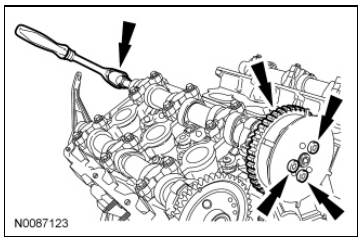
   Verify the RH camshafts are in the neutral position.



7. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while removing the camshaft phaser and sprocket or damage to the engine may occur.**

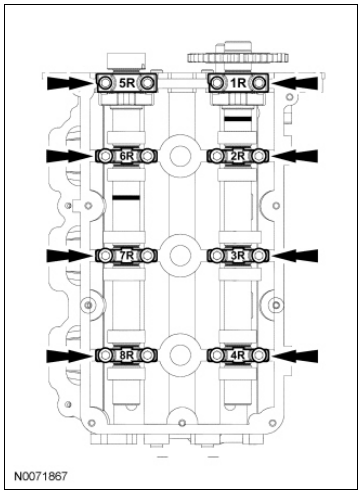
   NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for removal of the camshaft phasernd sprocket bolts.

   Remove the 3 bolts and the RH camshaft phaser and sprocket.



8. ***NOTICE:*** **Cylinder head camshaft bearing caps must be assembled in their original positions. Some engines have factory markings on the camshaft bearing caps (as shown in illustration). Engines that do not have the factory markings must be marked for correct position and orientation prior to removal. Failure to install the camshaft bearing caps in their original positions may result in severe engine damage.**

   If necessary, mark the camshaft bearing cap position and orientation as shown in the illustration.

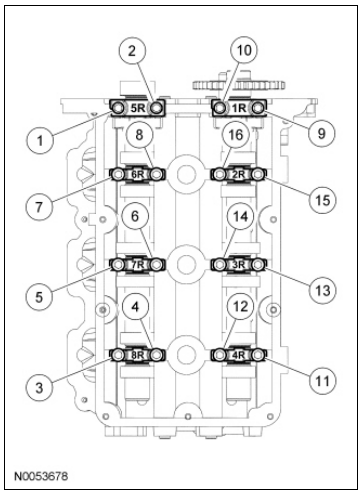


9. *NOTICE:* **After loosening all of the camshaft bearing cap bolts, remove the camshaft bearing thrust caps (5R and 1R) first, or damage to the thrust caps may occur.**

   NOTE: Make sure the camshaft bearing caps are marked as instructed in the previous step.

   Loosen the bolts evenly in the sequence shown.

   1. Remove the camshaft bearing thrust caps (5R and 1R).
   2. Remove the remaining camshaft bearing caps.
   3. Remove the camshafts from the cylinder head.



10. *NOTICE:* **The camshaft roller followers must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

    Remove the camshaft roller followers.

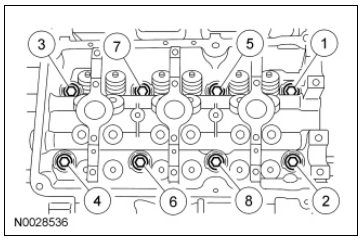
11. *NOTICE:* **The hydraulic lash adjusters must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

    Remove the hydraulic lash adjusters.

12. **NOTE:** New cylinder head bolts must be installed. They are a torque-to-yield design and cannot be reused.

    Remove the bolts in the sequence shown.

- Remove the cylinder head.
- Discard the bolts and gasket.



13. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.**

   Use a plastic scraping tool to remove all traces of the head gasket.

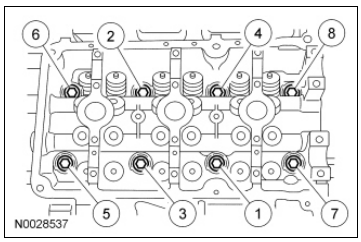
   - Clean all surfaces with metal surface prep.

2. Position a new gasket and the cylinder head.

3. **NOTE:** New cylinder head bolts must be installed. They are a torque-to-yield design and cannot be reused.

   Install the bolts and tighten in 6 stages in the sequence shown.

   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Stage 2: Tighten 90 degrees.
   - Stage 3: Loosen one full turn.
   - Stage 4: Tighten to 40 Nm (30 lb-ft).
   - Stage 5: Tighten 90 degrees.
   - Stage 6: Tighten 90 degrees.



4. ***NOTICE:*** **The hydraulic lash adjusters must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

   Install the hydraulic lash adjusters.

   - Lubricate the hydraulic lash adjusters with clean engine oil.

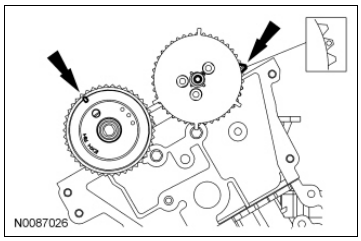
5. ***NOTICE:*** **The camshaft roller followers must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

Install the camshaft roller followers.

- Lubricate the camshaft roller followers with clean engine oil.

6. Position the RH camshaft phaser and sprocket onto the intake camshaft.
   - Install the 3 bolts finger-tight.

7. Lubricate the RH camshafts with clean engine oil and carefully position the camshafts onto the cylinder head.
   - Align the RH camshafts as shown.



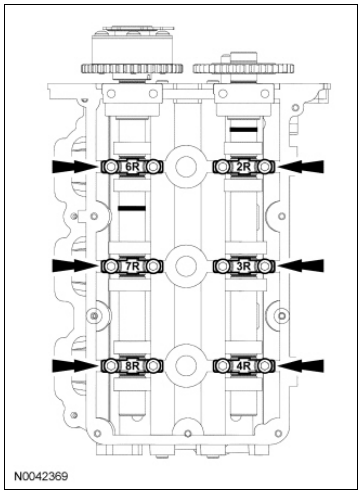
8. *NOTICE:* **Cylinder head camshaft journal caps and cylinder heads are numbered to verify that they are assembled in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

   NOTICE: **Do not install the camshaft journal thrust caps until all of the camshaft bearing caps have been installed or damage to the thrust caps can occur.**

   NOTE: Lubricate the bearing surfaces of the RH camshaft bearing caps with clean engine oil.

   Install the camshaft bearing caps.

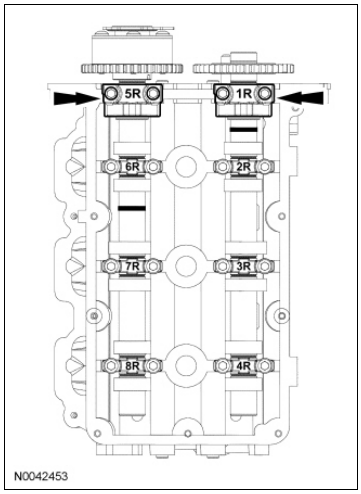
   - Loosely install the bolts.



9. **NOTE:** Lubricate the bearing surfaces of the RH camshaft bearing thrust caps with clean engine oil.

   Install the camshaft bearing thrust caps.

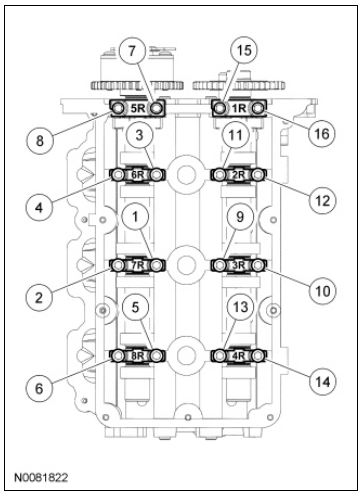
   - Loosely install the bolts.



10. **NOTE:** Make sure to tighten the camshaft bearing cap bolts in sequence in 2 stages.

    Tighten the RH camshaft bearing cap bolts in the sequence shown in 2 stages.

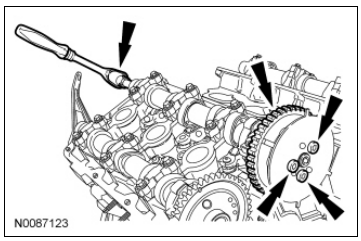
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Individually loosen and then tighten each camshaft bearing cap to 10 Nm (89 lb-in).



11. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while tightening the camshaft phaser and sprocket bolts or damage to the engine may occur.**

    NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for tightening of the camshaft phaser and sprocket bolts.

    Tighten the 3 RH camshaft phaser and sprocket bolts to 18 Nm (159 lb-in).

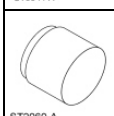
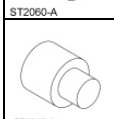
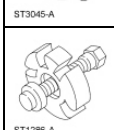
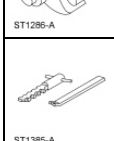
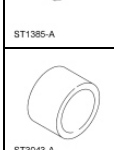


12. Install the timing drive components. For additional information, refer to Timing Drive Components in this section.

13. Install the coolant pump housing. For additional information, refer to Section 303-03A .
14. Install the RH exhaust manifold. For additional information, refer to Exhaust Manifold - RH in this section.
15. Install the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.

Cylinder Head - LH

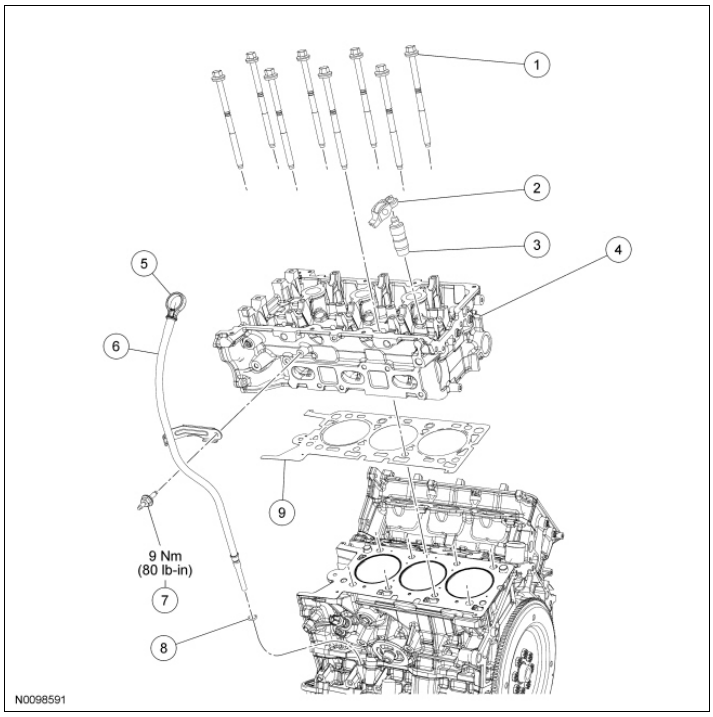
Special Tool(s)

 ST1970-A	Installer, Camshaft Oil Seal 303-464 (T94P-6256-BH)
 ST3042-A	Installer, Camshaft Pulley 303-458 (T94P-6312-AH3), part of 303-S455
 ST1586-A	Installer, Power Steering Pump Pulley 211-185 (T91P-3A733-A)
 ST3044-A	Plate, Water Pump Pulley 303-456 (T94P-6312-AH1), part of 303-S455
 ST2060-A	Protector, Camshaft Oil Seal 303-463 (T94P-6256-AH)
 ST3045-A	Protector, Water Pump Shaft 303-457 (T94P-6312-AH2), part of 303-S455
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST3043-A	Spacer, Water Pump Pulley 303-459 (T94P-6312-AH4), part of 303-S455

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

LH Cylinder Head



Item	Part Number	Description
1	6065	Cylinder head bolt (8 required)
2	6529	Camshaft rollerower (12 required)
3	6C501	Hydraulic lash adjuster (12 required)
4	6050	Cylinder head
5	6750	Oil level indicator
6	6754	Oil level indicator tube
7	W701822	Oil level indicator tube stud bolt
8	110282	Oil level indicator tube O-ring
9	6083	Cylinder head gasket

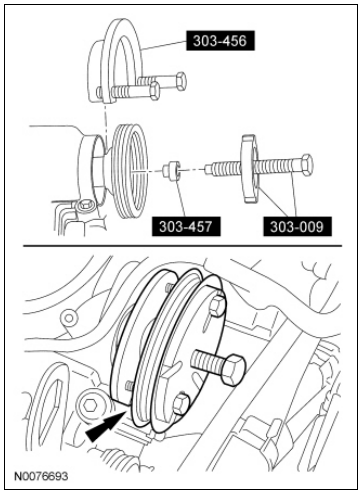
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.
3. Remove the LH catalytic converter. For additional information, refer to Section 309-00 .
4. Remove the coolant pump housing. For additional information, refer to Section 303-03A .
5. Remove the timing drive components. For additional information, refer to Timing Drive Components in this section.

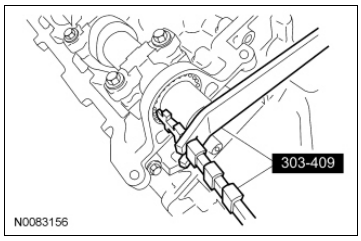
6. ***NOTICE:*** **Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.**

   Using the Water Pump Pulley Plate, Water Pump Shaft Protector and the Crankshaft Vibration Damper Remover, remove the coolant pump pulley.

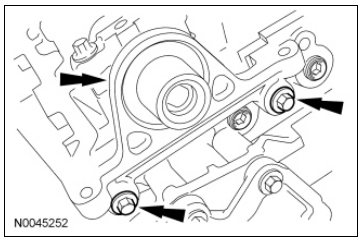


7. ***NOTICE:*** **Do not scratch the camshaft sealing surface while removing the camshaft oil seal. If scratched, camshaft oil seal leakage may occur.**

   Using the Oil Seal Remover, remove and discard the camshaft oil seal.

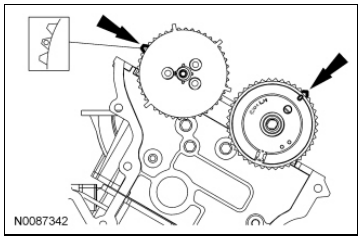


8. Remove the 2 bolts and the camshaft oil seal retainer.
   - Discard the press-in-place gasket.



9. ***NOTICE:*** **The camshafts must be in the neutral position before removing the bearing caps or damage to the engine may occur.**

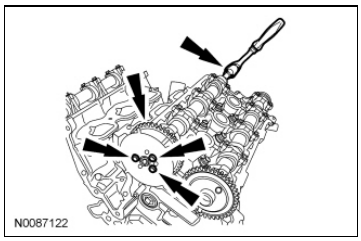
   Verify the LH camshafts are in the neutral position.



10. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while removing the camshaft phaser and sprocket or damage to the engine may occur.**

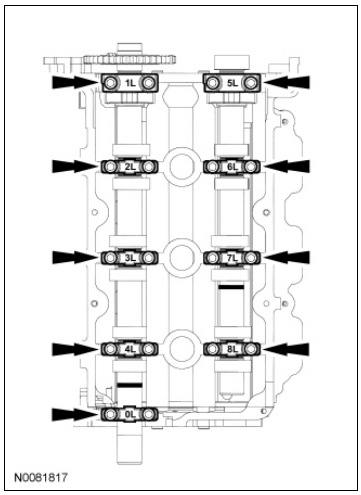
    NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for removal of the camshaft phaser and sprocket bolts.

    Remove the 3 bolts and the LH camshaft phaser and sprocket.



11. ***NOTICE:*** **Cylinder head camshaft bearing caps must be assembled in their original positions. Some engines have factory markings on the camshaft bearing caps (as shown in illustration). Engines that do not have the factory markings must be marked for correct position and orientation prior to removal. Failure to install the camshaft bearing caps in their original positions may result in severe engine damage.**

    If necessary, mark the camshaft bearing cap position and orientation as shown in the illustration.



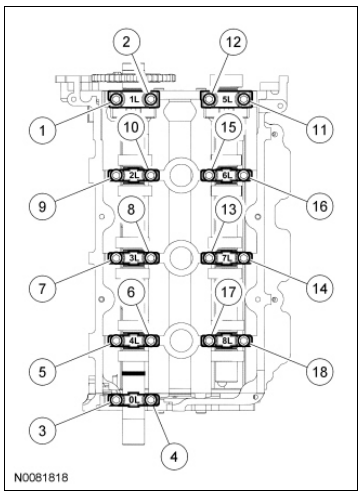
12. ***NOTICE:*** **After loosening all of the camshaft bearing cap bolts, remove the camshaft bearing thrust caps (1L and 5L) first, or damage to the thrust caps may occur.**

    NOTE: Make sure the camshaft bearing caps are marked as instructed in the previous step.

    Loosen the bolts evenly in the sequence shown.

    1. Remove the camshaft bearing thrust caps (1L and 5L).
    2. Remove the remaining camshaft bearing caps.

3. Remove the camshafts from the cylinder head.



13. ***NOTICE:*** **The camshaft roller followers must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

    Remove the camshaft roller followers.

14. ***NOTICE:*** **The hydraulic lash adjusters must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

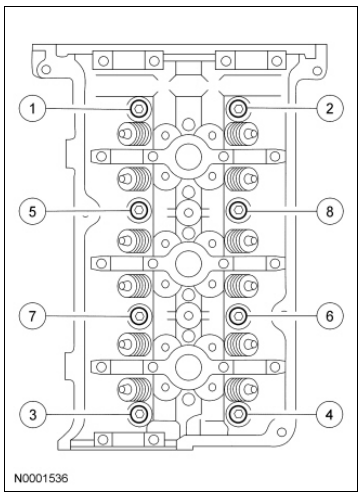
    Remove the hydraulic lash adjusters.

15. Remove the oil level indicator.

16. Remove the stud bolt and then remove the oil level indicator tube.
    - Remove and discard the O-ring seal.

17. **NOTE:** New cylinder head bolts must be installed. They are a torque-to-yield design and cannot be reused.

    Remove the bolts in the sequence shown.



18. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.**

   Use a plastic scraping tool to remove all traces of the head gasket.

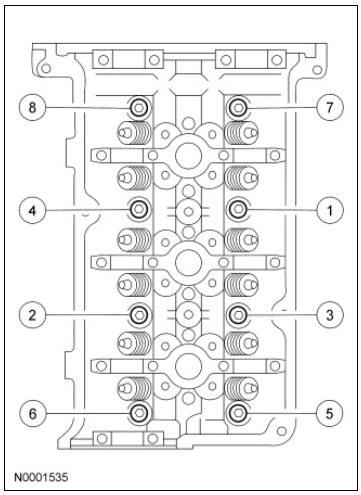
   - Clean all surfaces with metal surface prep.

2. Position a new gasket and the cylinder head.

3. **NOTE:** New cylinder head bolts must be installed. They are a torque-to-yield design and cannot be reused.

   Install the bolts and tighten in 6 stages in the sequence shown.

   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Stage 2: Tighten 90 degrees.
   - Stage 3: Loosen one full turn.
   - Stage 4: Tighten to 40 Nm (30 lb-ft).
   - Stage 5: Tighten 90 degrees.
   - Stage 6: Tighten 90 degrees.



4. **NOTE:** Installation of the oil level indicator may require the assistance of a second technician to align the tube with the orifice.

   NOTE: Install a new O-ring seal and lubricate with clean engine oil.

   Install the oil level indicator tube and install the stud bolt.

   - To install, tighten to 9 Nm (80 lb-in).

5. Install the oil level indicator.

6. ***NOTICE:*** **The hydraulic lash adjusters must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

   Install the hydraulic lash adjusters.

- Lubricate the hydraulic lash adjusters with clean engine oil.

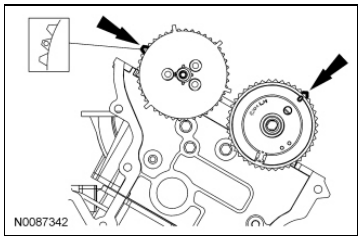
7. ***NOTICE:*** **The camshaft roller followers must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

   Install the camshaft roller followers.

   - Lubricate the camshaft roller followers with clean engine oil.

8. Position the camshaft phaser and sprocket onto the intake camshaft.
   - Install the 3 bolts finger-tight.

9. Lubricate the LH camshafts with clean engine oil and carefully position the camshafts onto the cylinder head.
   - Align the LH camshafts as shown.

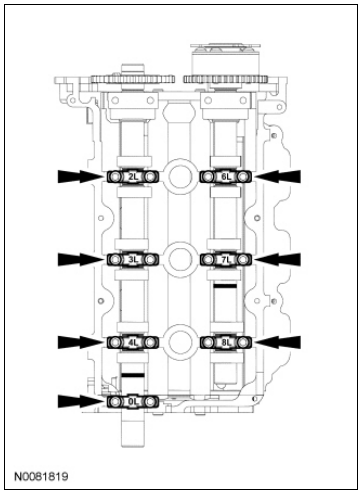


10. ***NOTICE:*** **Cylinder head camshaft journal caps and cylinder heads are numbered to verify that they are assembled in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

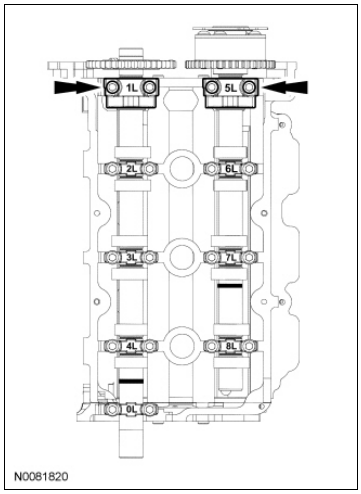
    NOTICE: **Do not install the camshaft journal thrust caps until all of the camshaft bearing caps have been installed or damage to the thrust caps can occur.**

    Lubricate the bearing surfaces of the LH camshaft bearing caps with clean engine oil and install the bearing caps.

    - Loosely install the bolts.



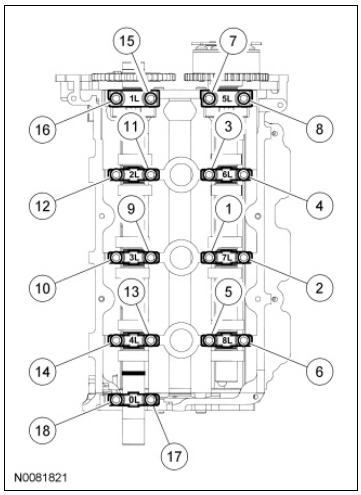
11. Lubricate the bearing surfaces of the LH camshaft bearing thrust caps with clean engine oil and install the bearing thrust caps.
    - Loosely install the bolts.



12. **NOTE:** Make sure to tighten the camshaft bearing cap bolts in sequence in 2 stages.

    Tighten the LH camshaft bearing cap bolts in the sequence shown in 2 stages.

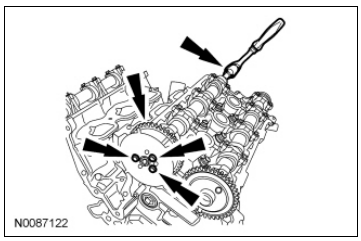
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Individually loosen and then tighten each camshaft bearing cap to 10 Nm (89 lb-in).



13. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while tightening the camshaft phaser and sprocket bolts or damage to the engine may occur.**

    NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for tightening of the camshaft phaser and sprocket bolts.

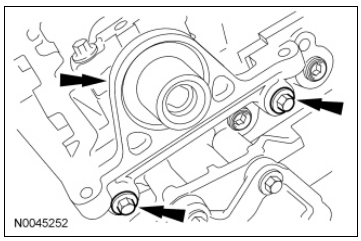
    Tighten the 3 LH camshaft phaser and sprocket bolts to 18 Nm (159 lb-in).



14. **NOTE:** Clean the sealing surfaces with metal surface prep before installing a new press-in-place gasket.

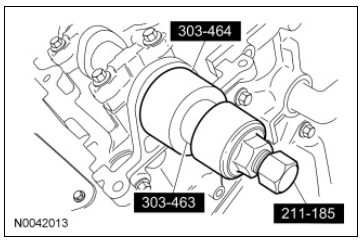
Install the camshaft oil seal retainer and the 2 bolts.

- Tighten to 10 Nm (89 lb-in).



15. **NOTE:** Lubricate the camshaft oil seal with clean engine oil.

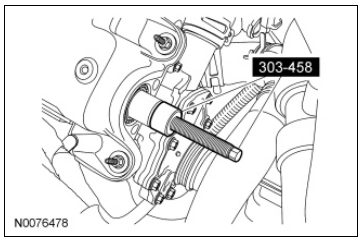
    Using the Camshaft Oil Seal Installer, Camshaft Oil Seal Protector and the Power Steering Pump Pulley Installer, install the camshaft oil seal.



16. ***NOTICE:*** **Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.**

    Install the Camshaft Pulley Installer in the camshaft as shown in the illustration.

    - Adjust the collar on the Camshaft Pulley Installer screw to get the best thread engagement in the rear of the camshaft.

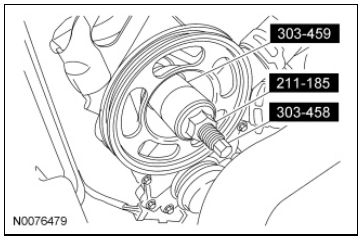


17. ***NOTICE:*** **Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.**

    NOTE: Only the roller collared nut from the Power Steering Pump Pulley Installer (211-185) is used on Camshaft Pulley Installer (303-458).

    Position the coolant pump pulley over the previously installed Camshaft Pulley Installer and on the end of the camshaft. Install the Camshaft Pulley Installer, Power Steering Pump Pulley Installer and the Water Pump Pulley Spacer as shown in the illustration.

    - Using the Camshaft Pulley Installer, Power Steering Pump Pulley Installer and the Water Pump Pulley Spacer, install a new service coolant pump pulley flush with the end of the camshaft.



18. Install the timing drive components. For additional information, refer to Timing Drive Components in this section.

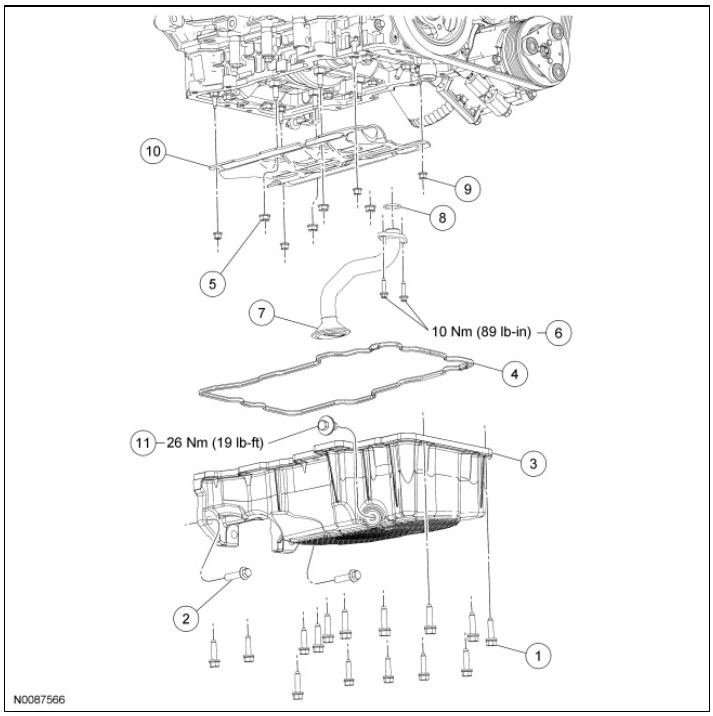
19. Install the coolant pump housing. For additional information, refer to Section 303-03A .

20. Install the LH catalytic converter. For additional information, refer to Section 309-00 .

21. Install the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.

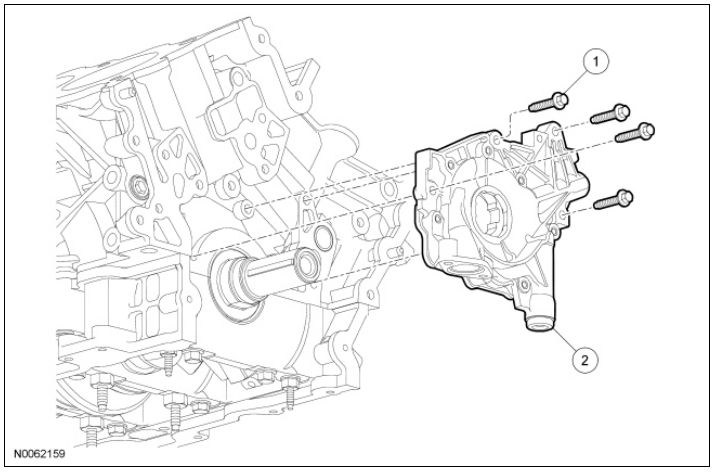
Engine Lubrication Components - Exploded View

Oil Pan, Oil Pan Baffle and Oil Pump Screen and Pickup Tube



Item	Part Number	Description
1	W709678	Oil pan-to-engine bolt (15 required)
2	W500120	Oil pan-to-transaxle bolt (2 required)
3	6675	Oil pan
4	6710	Oil pan gasket
5	W701582	Oil pan baffle nut (4 required)
6	W700005	Oil pump screen and pickup tube bolts (2 required)
7	6622	Oil pump screen and pickup tube
8	6625	Oil pump screen and pickup tube O-ring seal
9	W701542	Oil pan baffle nut (4 required)
10	6687	Oil pan baffle
11	6730	Oil pan drain plug

Oil Pump



Item	Part Number	Description
1	W500300	Oil pump bolt (4 required)
2	6621	Oil pump

1. For additional information, refer to the procedures in this section.

Oil Pan

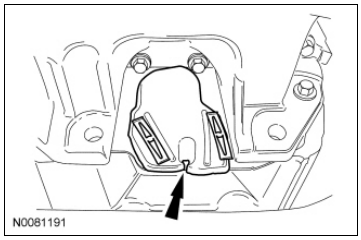
Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the LH catalytic converter manifold. For additional information, refer to Section 309-00 .
3. Drain the engine oil and install the drain plug.
   - Tighten to 26 Nm (19 lb-ft).
4. Remove and discard the oil filter.
5. Remove the access cover.



6. Remove the 2 oil pan-to-transaxle bolts.
7. Remove the 15 bolts and the oil pan.
   - Remove and discard the oil pan gasket.

Installation

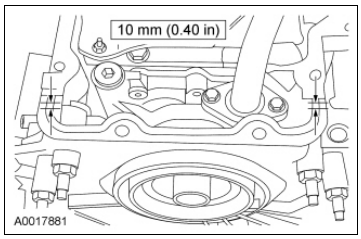
1. *NOTICE:* **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.**

   Use a plastic scraping tool to remove all traces of the oil pan gasket.

   - Clean all sealing surfaces with metal surface prep and install a new oil pan gasket.

2. **NOTE:** The oil pan must be installed and the bolts tightened within 4 minutes of sealant application.

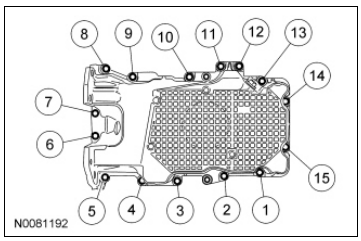
   Apply a 10 mm (0.40 in) diameter dot of silicone sealant to the areas indicated.



3. Position the oil pan and loosely install the bolts.

4. Install the 2 oil pan-to-transaxle bolts.
   - Tighten to 40 Nm (30 lb-ft).

5. Tighten the oil pan-to-engine bolts in the sequence shown to 25 Nm (18 lb-ft).



6. Install the access cover.

7. **NOTE:** Lubricate the engine oil filter gasket with clean engine oil prior to installing.

   Install a new oil filter.

   - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

8. Install the LH catalytic converter manifold. For additional information, refer to Section 309-00 .

9. Fill the engine with clean engine oil.

Oil Pump Screen and Pickup Tube

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

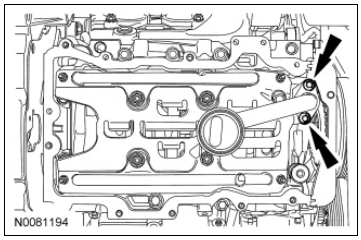
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the oil pan. For additional information, refer to Engine Lubrication Components - Exploded View and Oil Pan in this section.

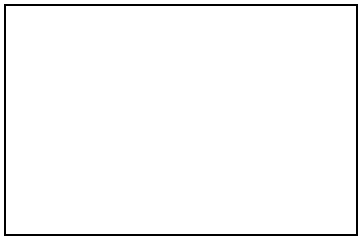
3. Remove the bolts the oil pump screen and pickup tube.
   - Remove and discard the O-ring seal.



Installation

1. Install a new O-ring seal on the oil pump screen and pickup tube.
   - Lubricate the O-ring seal with clean engine oil.

2. Install the oil pump screen and pickup tube.
   1. Position the oil pump screen and pickup tube.
   2. Install the bolts and tighten to 10 Nm (89 lb-in).



3. Install the oil pan. For additional information, refer to Oil Pan in this section.

Oil Pan Baffle

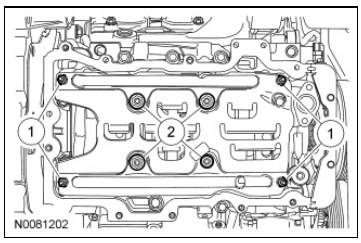
Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the oil pump screen and pickup tube. For additional information, refer to Engine Lubrication Components - Exploded View and Oil Pump Screen and Pickup Tube in this section.

3. Remove the 8 nuts and the oil pan baffle in the following sequence.
    1. To install, tighten the 4 M6 oil pan baffle nuts in 2 stages.
        - Stage 1: Tighten to 5 Nm (44 lb-in).
        - Stage 2: Tighten an additional 45 degrees.
    2. Then install and tighten the 4 M8 oil pan baffle nuts in 2 stages.
        - Stage 1: Tighten to 15 Nm (133 lb-in).
        - Stage 2: Tighten an additional 45 degrees.



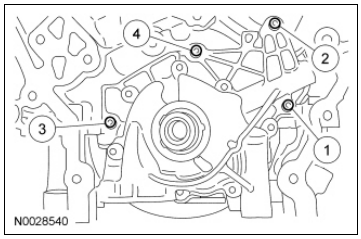
4. To install, reverse the removal procedure.

Oil Pump

Removal

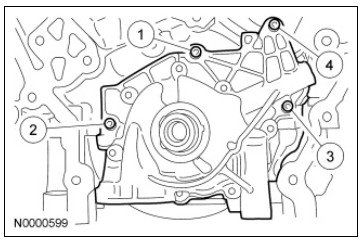
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the timing drive components. For additional information, refer to Timing Drive Components in this section.
3. Remove the oil pump screen and pickup tube. For additional information, refer to Engine Lubrication Components - Exploded View and Oil Pump Screen and Pickup Tube in this section.
4. Remove the bolts in the sequence shown.



Installation

1. Position the oil pump aninstall the bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

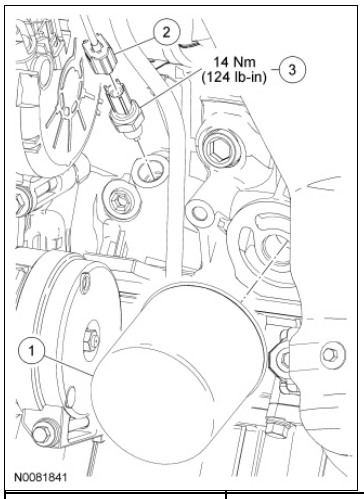


2. Install the oil pump screen and pickup tube. For additional information, refer to Engine Lubrication Components - Exploded View and Oil Pump Screen and Pickup Tube in this section.
3. Install the timing drive components. For additional information, refer to Timing Drive Components in this section.

Engine Oil Pressure (EOP) Switch

Material

Item	Specification
Thread Sealant with PTFE TA-24	WSK-M2G350-A2



Item	Part Number	Description
1	6714	Engine oil filter
2	14A464	
3	9278	EOP

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** Lubricate the engine oil filter gasket with clean engine oil prior to installing.

   Remove the engine oil filter.

   - To install, tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

3. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

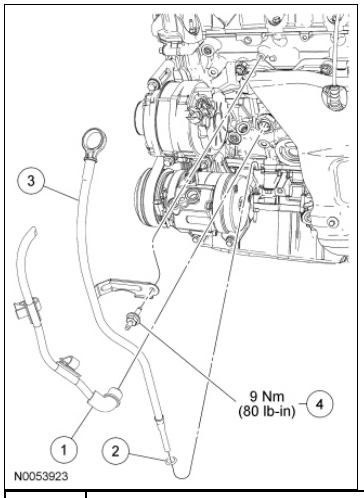
4. Remove the EOP switch.
   - To install, tighten to 14 Nm (124 lb-in).

5. To install, reverse the removal procedure.
   - Apply thread sealant with PTFE to the EOP switch threads.

Oil Level Indicator and Tube

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	-	Block heater wiring harness (if equipped)
2	110282	Oil level indicator O-ring seal
6754	Oil level indicator tube	
4	W701822	Oil level indicator tube stud bolt

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the oil level indicator.

3. If equipped, disconnect the block heater electrical connector and wiring harness retainers.

4. Remove the stud bolt and the oil level indicator tube.
   - Discard the O-ring seal.
   - To install, tighten to 9 Nm (80 lb-in).

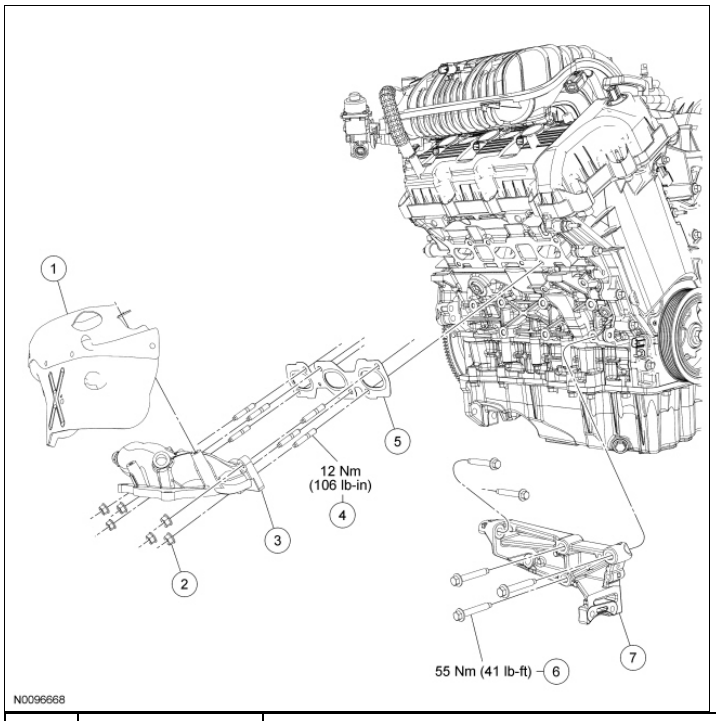
5. **NOTE:** Install a new O-ring seal and lubricate with clean engine oil.

   To install, reverse the removal procedure.

Exhaust Manifold - RH

Material

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



Item	Part Number	Description
1	5E258	RH catalytic converter heat shield
2	W701706	RH exhaust manifold nut (6 required)
3	9430	RH exhaust manifold
4	W701732	RH exhaust manifold sired)
5	9448	RH exhaust manifold gasket
6	W500724	Power Transfer Unit (PTU) bracket bolt (5 required)
7	7A444	PTU bracket

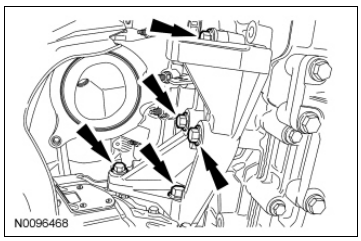
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the EGR tube. For additional information, refer to Section 303-08B .
3. Remove the RH catalytic converter. For additional information, refer to Section 309-00 .

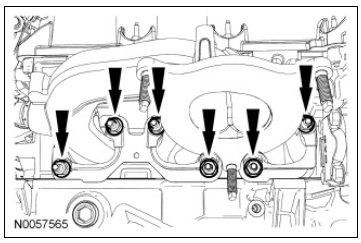
4. **NOTE:** The heat shield that was unbolted from the exhaust manifold during removal of the RH catalytic converter cannot be removed from the vehicle until the Power Transfer Unit (PTU) bracket is removed.

   Remove the 5 bolts and the PTU bracket.

   - Remove the catalytic converter heat shield from the vehicle.

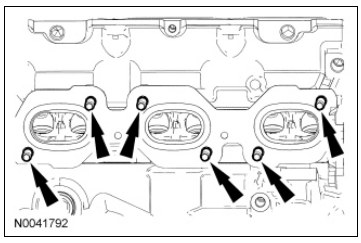


5. Remove the 6 nuts and the RH exhaust manifold.
   - Discard the gasket and nuts.



6. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .

7. Remove and discard the 6 RH exhaust manifold studs.

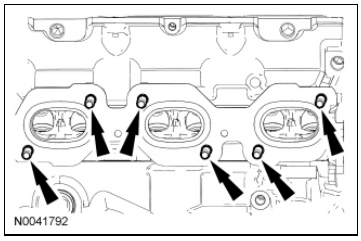


8. *NOTICE:* **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

   Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

Installation

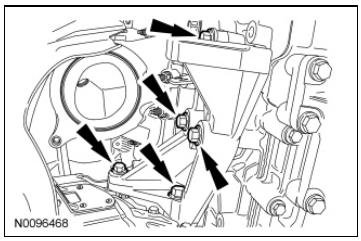
1. Install 6 new RH exhaust manifold studs.
   - Tighten to 12 Nm (106 lb-in).



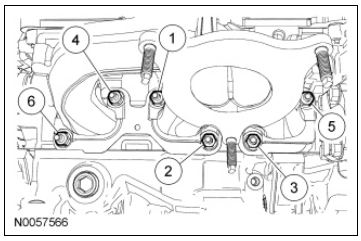
2. **NOTE:** The catalytic converter heat shield must be positioned up into the engine compartment prior to installing the PTU bracket.

   Position the catalytic converter heat shield into the engine compartment.

3. Install the PTU bracket and the 5 bolts.
   - Tighten to 55 Nm (41 lb-in).



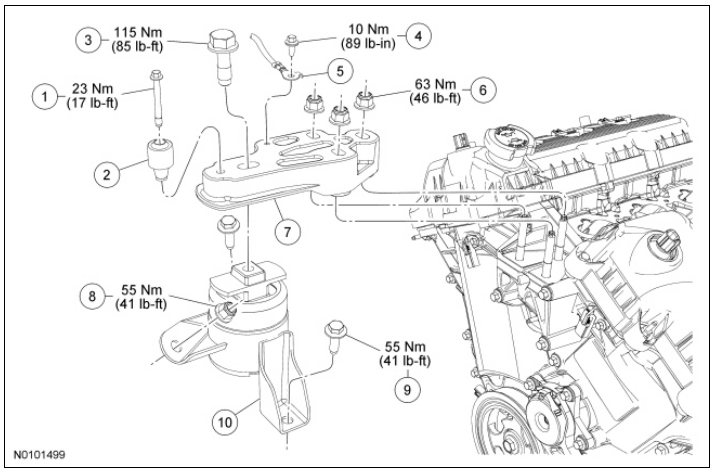
4. Install a new gasket, the RH exhaust manifold and 6 new nuts.
   - Tighten to 20 Nm (177 lb-in) in the sequence shown.



5. Install the RH catalytic converter. For additional information, refer to Section 309-00 .

6. Install the EGR tube. For additional information, refer to Section 303-08B .

Engine Mount



Item	Part Number	Description
1	W711879	Damper bolt
2	7458	Damper
3	W711684	Engine mount bracket bolt
4	W705936	Ground wire bolt
5	19A095	Ground wire
6	W712334	Engine support insulator bracket nut (3 required)
7	6061	Engine mount bracket
8	W711578	Engine mount nut td>
9	W706496	Engine mount bolt (2 required)
10	6038	Engine mount

Removal and Installation

1. Remove the engine coolant degas bottle. For additional information, refer to Section 303-03A .

2. Remove the bolt and position aside the ground wire.
   - To install, tighten to 10 Nm (89 lb-in).

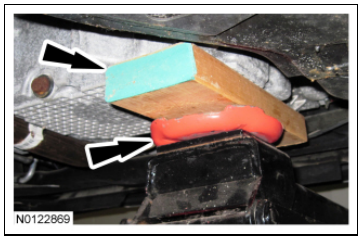
3. Remove the bolt and damper.
   - To install, tighten to 23 Nm (17 lb-ft).

4. Remove the engine support insulator bracket bolt.
   - To install, tighten to 115 Nm (85 lb-ft).

5. **NOTE:** Failure to position the wood block and floor jack as illustrated can result in damage to the oil pan.

   Position a floor jack with a block of wood under the front of the oil pan.

   - Using the floor jack, lift the engine 12 mm (0.47 in).



6. Remove the 3 nuts and the engine support insulator bracket.
    - To install, tighten to 63 Nm (46 lb-ft).

7. Remove the nut, 2 bolts and the engine mount.
    - To install, tighten to 55 Nm (41 lb-ft).

8. **NOTE:** If the engine mount bracket is to be removed, the engine must be lowered to avoid contact between the A/C tubes and the engine mount bracket.

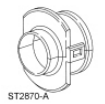
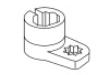
   Use the floor jack to lower the engine 25 mm (0.98 in).

    - Remove the engine mount bracket.

9. To install, reverse the removal procedure.

Engine

Special Tool(s)

 ST2870-A	Disconnect Tool, Transmission Cooler Line 307-569
 ST2873-A	Engine Lifting Bracket Set 303-1140
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST2793-A	Lifting Bracket, Engine 303-050 (T70P-6000)
 ST2463-A	Lifting Brackets, Engine 134-00243 or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent
 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST1408-A	Tie-Rod End Remover 211-105 (T85M-3395-A)
 ST2743A	Adjustable Grip Arm, 1735A 014-00001 or equivalent

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

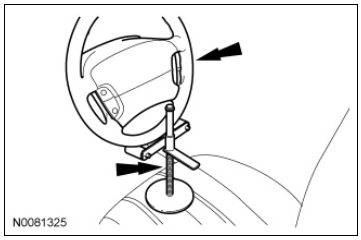
All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

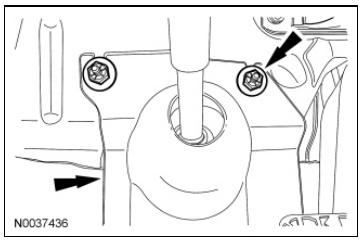
2. Release the fuel system pressure. For additional information, refer to Section 310-00 .

3. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
4. Recover the A/C system. For additional information, refer to Section 412-00A .
5. Place the steering wheel in the straight-ahead position and the ignition key in the OFF position.
6. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.

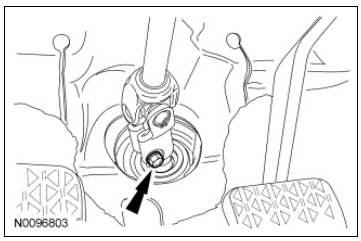


7. Remove the 2 nuts and the steering joint cover.

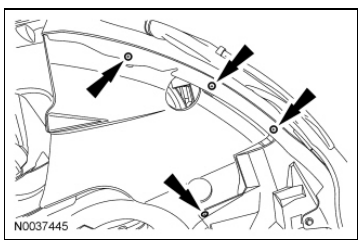


8. ***NOTICE:*** **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

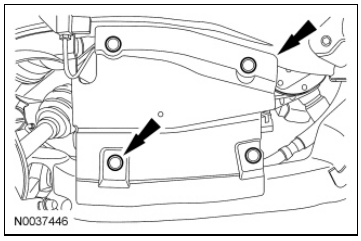
   Remove the bolt and disconnect the steering column shaft from the steering gear.



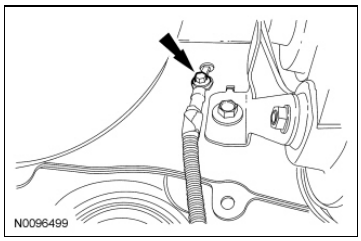
9. Drain the cooling system. For additional information, refer to Section 303-03A .
10. Remove the 4 screws and position the RH fender splash shield aside.



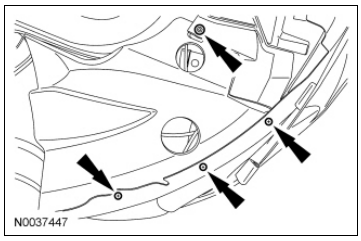
11. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



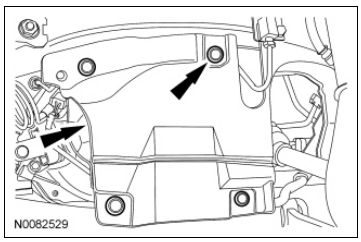
12. Remove the bolt and the Electronic Power Assist Steering (EPAS) wiring ground wire from in the RH front wheel well.



13. Remove the 4 screws and position the LH fender splash shield aside.



14. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.

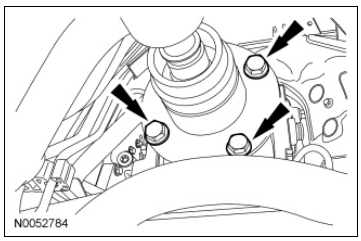


15. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .

All-Wheel Drive (AWD) vehicles

16. **NOTE:** Index-mark the driveshaft for installation.

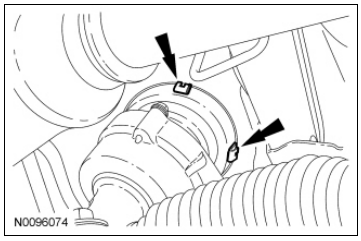
    Remove the 4 bolts (3 shown) and support the driveshaft with a length of mechanic's wire.



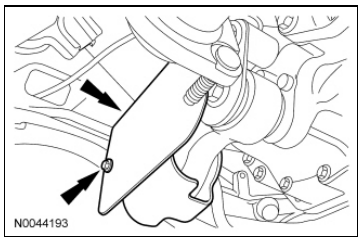
All vehicles

17. *NOTICE:* **The steering gear-to-dash seal must be removed or it will be damaged when lowering the subframe.**

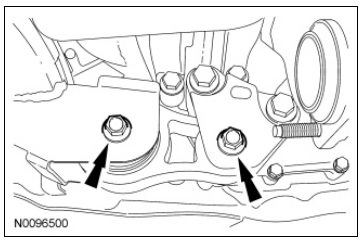
    Release the 4 clips (2 shown) and slide the steering gear-to-dash seal off of the steering gear and into the passenger compartment.



18. If equipped, remove the 2 bolts and the heat shield.

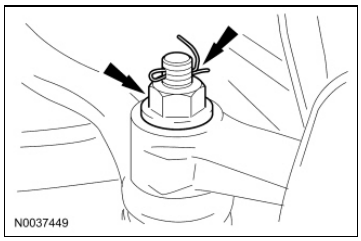


19. Remove the 2 bolts and the engine roll restrictor.



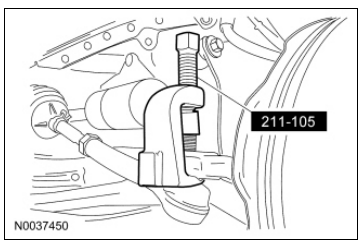
20. **NOTE:** RH shown, LH similar.

    Remove the cotter pins and nuts from the tie-rod ends.



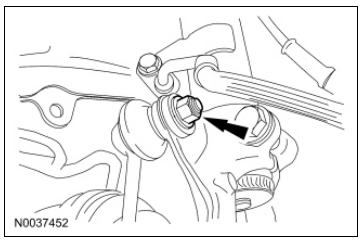
21. **NOTE:** LH shown, RH similar.

    Using the Tie-Rod End Remover, separate the tie-rod ends from the steering knuckles.



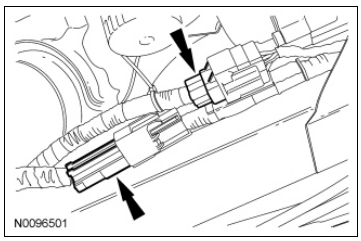
22. **NOTE:** RH shown, LH similar.

    Remove the nuts and separate the stabilizer bar links from the struts.

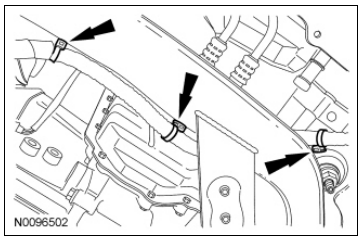


23. Remove the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

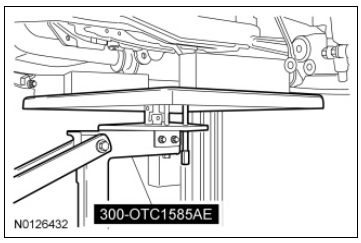
24. Disconnect the 2 EPAS electrical connectors near the front of the subframe.



25. Detach the 3 wiring harness retainers from the LH front of the subframe.

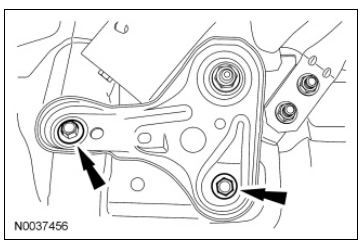


26. Position the Powertrain Lift under the subframe assembly.



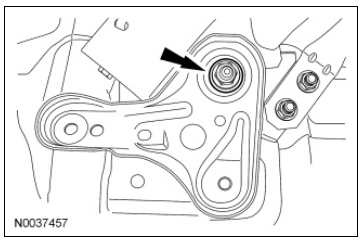
27. **NOTE:** LH shown, RH similar.

    Remove the subframe bracket-to-body bolts.



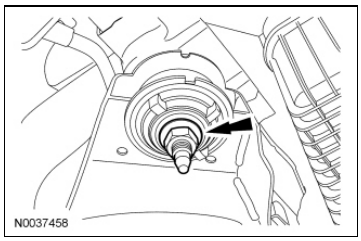
28. **NOTE:** LH shown, RH similar.

    Remove the subframe nuts and the subframe brackets.



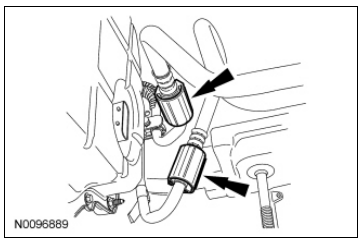
29. **NOTE:** LH shown, RH similar.

    Remove the front subframe nuts.

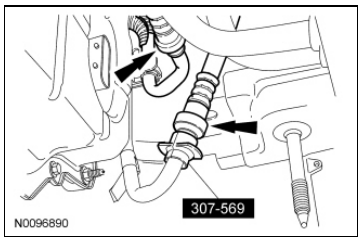


30. Lower the subframe assembly from the vehicle.

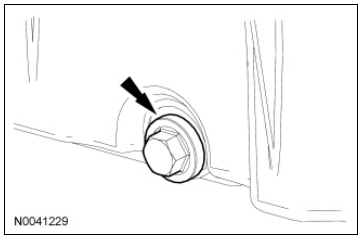
31. Remove the 2 transaxle fluid cooler tube secondary latches.



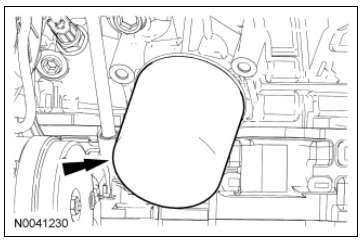
32. Using the Transmission Cooler Line Disconnect Tool, disconnect the 2 transaxle fluid cooler tubes.



33. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 26 Nm (19 lb-ft).



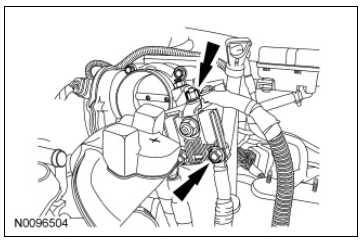
34. Remove and discard the engine oil filter.



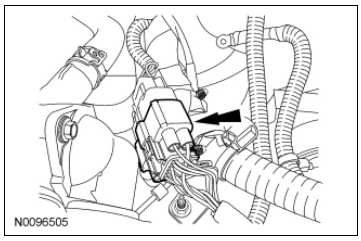
35. Remove the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to Section 303-12B .

36. Remove the battery tray. For additional information, refer to Section 414-01 .

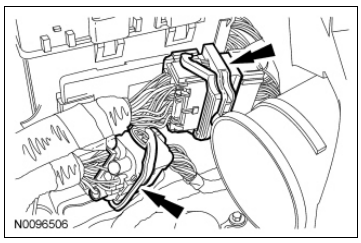
37. Remove the 2 nuts and disconnect the power feed wires from the battery terminal.



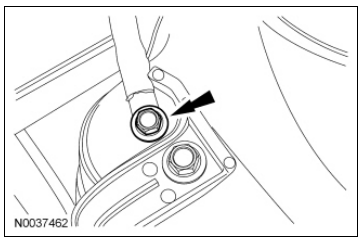
38. Disconnect the engine wiring harness electrical connector.



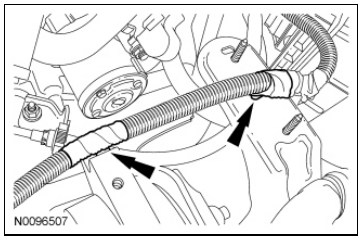
39. Disconnect the 2 engine wiring harness electrical connectors.



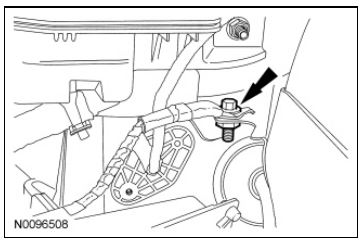
40. Remove the bolt and position aside the ground wire.



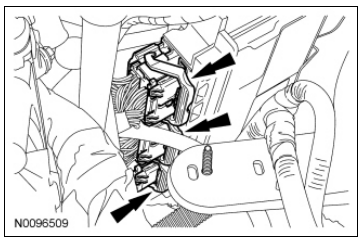
41. Detach the 2 wiring harness retainers from the battery tray bracket and transaxle mount.



42. Remove the PCM ground bolt and position aside the ground wire.

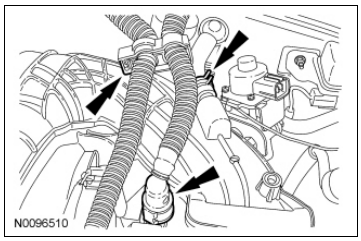


43. Disconnect the 3 PCM electrical connectors.

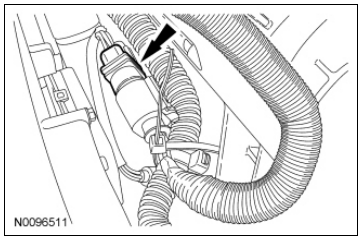


44. Disconnect the fuel supply tube from the fuel rail. For additional information, refer to Section 310-00 .

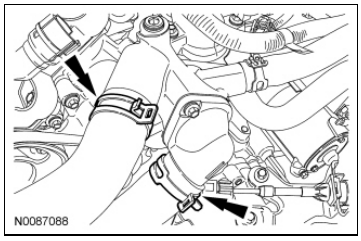
45. Disconnect the EVAP tube-to- EVAP canister purge valve quick connect coupling and the brake booster vacuum tube from the upper intake manifold.
    - Detach the fuel tube and EVAP tube-to- EVAP canister purge valve tube retainer from the upper intake manifold.



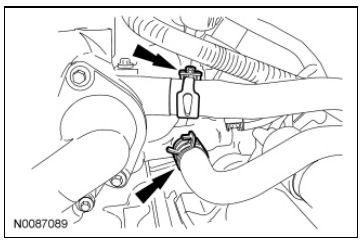
46. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector.



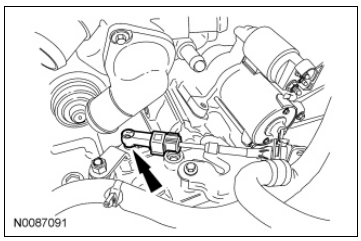
47. Disconnect the upper and lower radiator hoses.



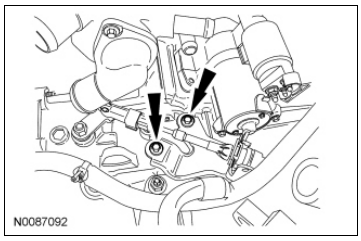
48. Disconnect the 2 heater hoses.



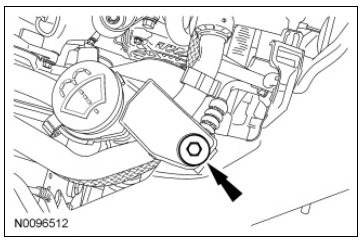
49. Disconnect the gearshift cable from the transaxle.



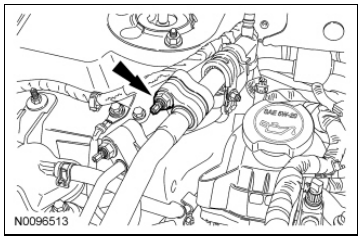
50. Remove the 2 shift cable bracket bolts, and position the cable and bracket aside.



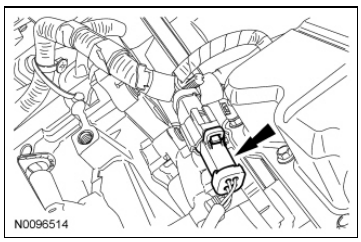
51. Remove the A/C tube/windshield washer bottle bracket bolt.



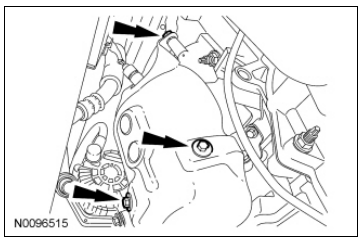
52. Remove the nut and disconnect the A/C tube.
    - Discard the gasket.



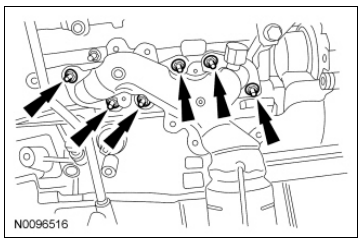
53. Disconnect the LH Catalyst Monitor Sensor (CMS) electrical connector.



54. Remove the 4 bolts (3 shown) and the LH catalytic converter heat shield.

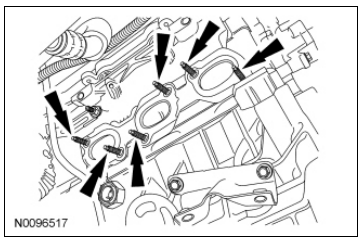


55. Remove the 6 nuts and the LH catalytic converter manifold.
    - Discard the 6 LH catalytic converter manifold nuts and gasket.

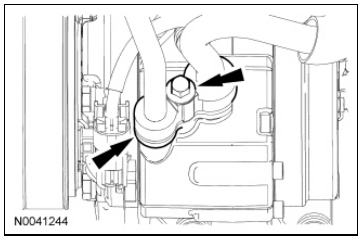


56. Clean and inspect the LH catalytic converter manifold. For additional information, refer to Section 303-00 .

57. Remove and discard the 6 LH catalytic converter manifold studs.

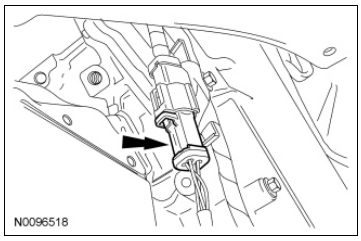


58. Remove the bolt and separate the A/C manifold from the A/C compressor.
    - Discard the gasket.

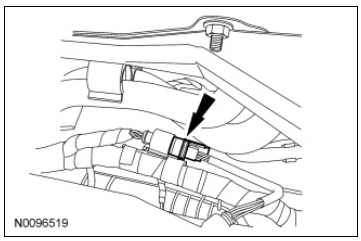


AWD vehicles

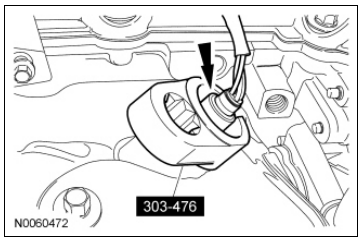
59. Disconnect the RH CMS electrical connector.



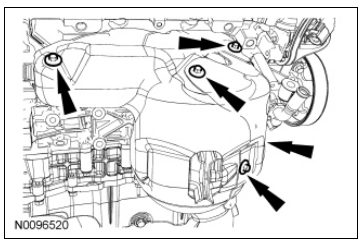
60. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.



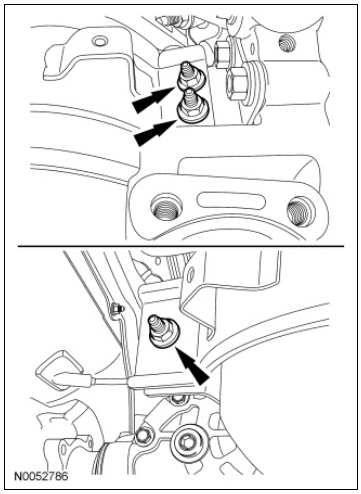
61. Using the Exhaust Gas Oxygen Sensor Socket, remove the RH HO2S .



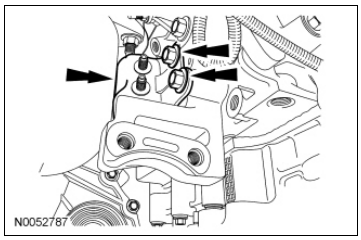
62. Remove the 5 bolts and the RH exhaust heat shield.



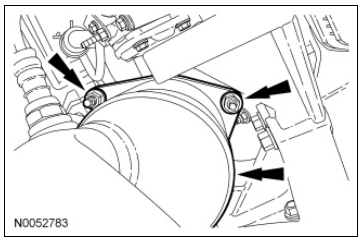
63. Remove the 3 nuts and the RH exhaust heat shield bracket (outboard half).



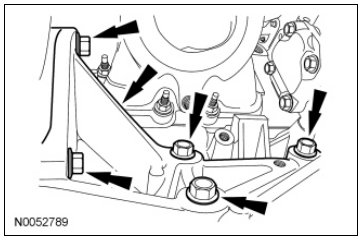
64. Remove the 2 bolts and the RH exhaust heat shield bracket (inboard half).



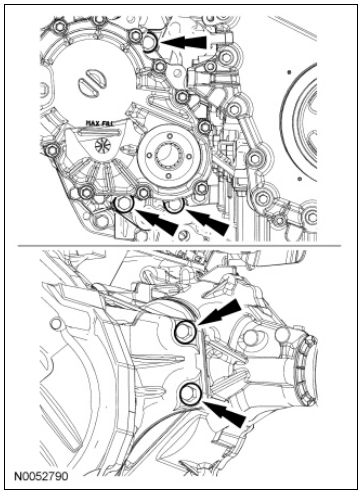
65. Remove the 3 nuts (2 shown) and the RH catalytic converter.
    - Discard the nuts and gasket.



66. Remove the 5 bolts and the PTU support bracket.

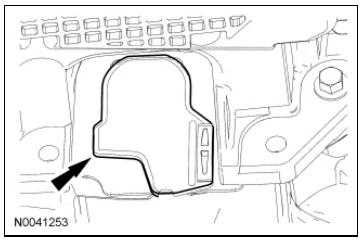


67. Remove the 5 bolts and the PTU .

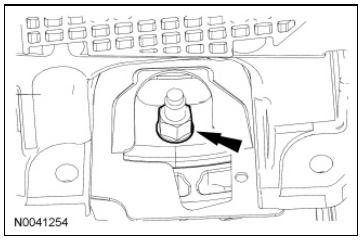


All vehicles

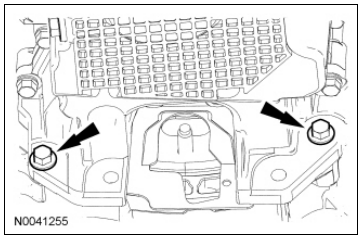
68. Remove the torque converter nut access plug.



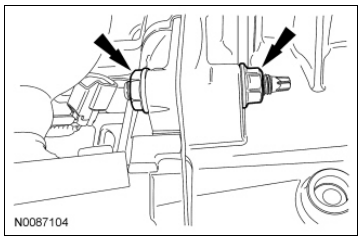
69. Remove the 4 torque converter nuts.



70. Remove the 2 oil pan-to-transaxle bolts.



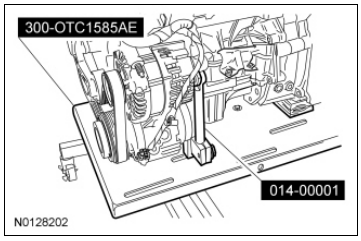
71. Remove the 2 nuts and the transaxle-to-engine stud.



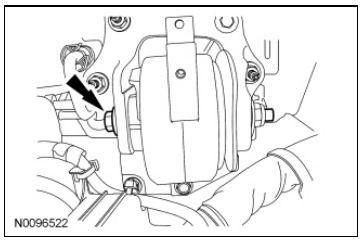
72. **NOTE:** Position a suitable block of wood under the transaxle.

    Install the Powertrain Lift and the Adjustable Grip Arm onto the engine.

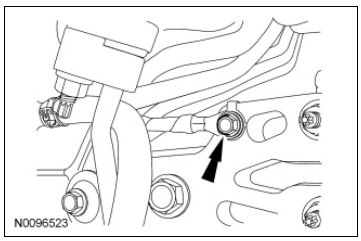
    - Raise the engine and transaxle 25.4 mm (1 in) to neutralize the engine and transaxle mounts.



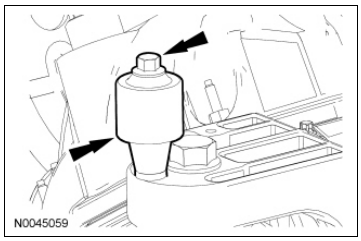
73. Remove the rear transaxle support through bolt.



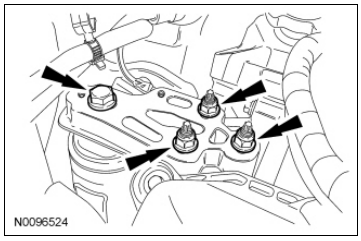
74. Remove the bolt and ground strap from the engine mount bracket.



75. Remove the bolt and damper.

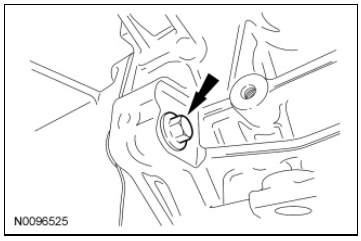


76. Remove the bolt, 3 nuts and the engine mount bracket.

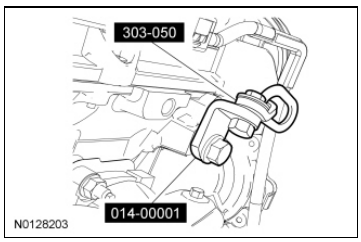


77. Lower the engine and transaxle from the vehicle.

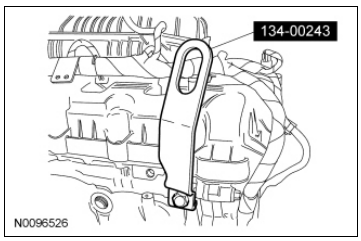
78. Remove the transaxle-to-engine bolt.



79. Install the Adjustable Grip Arm and the Engine Lifting Bracket.

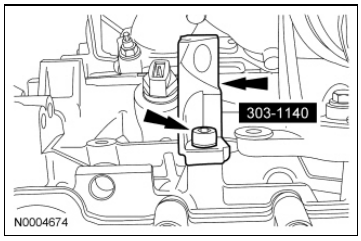


80. Install the Engine Lifting Bracket.

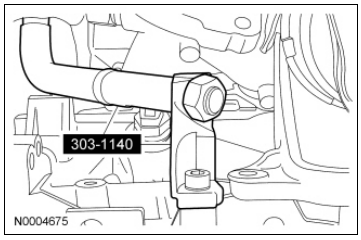


81. **NOTE:** When installing the lower half of the lifting bracket it will be easier to loosely install the upper bolt first then install the lower bolt.

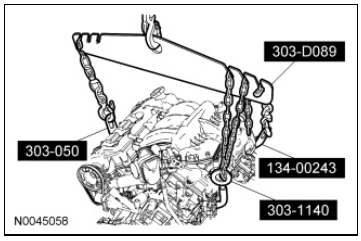
    Install the lower half of the Engine Lifting Bracket Set.



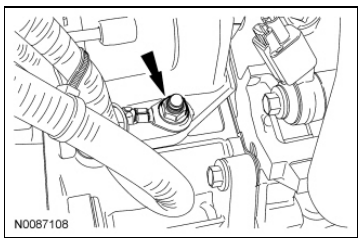
82. Install the upper half of the Engine Lifting Bracket Set.



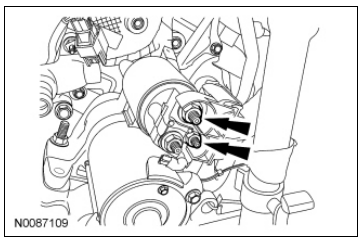
83. Using the Spreader Bar, Engine Lifting Brackets, Engine Lifting Bracket Set and a suitable engine crane, remove the engine and transaxle from the lift table.



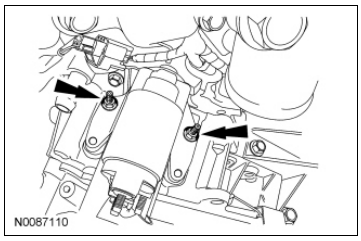
84. Remove the nut and the starter wiring ground.



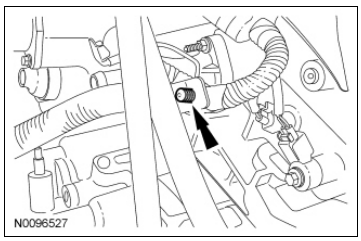
85. Remove the 2 nuts and the starter wiring.



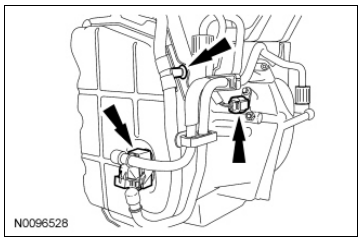
86. Remove the 2 stud bolts and the starter.



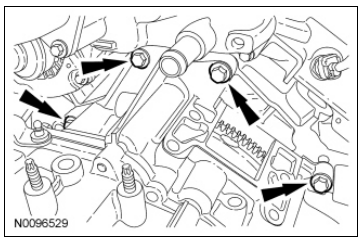
87. Detach the wiring harness retainer from the transmission indicator tube.



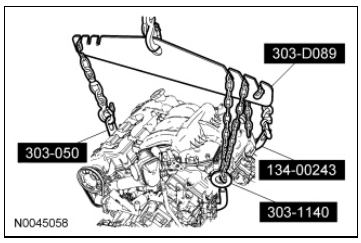
88. Disconnect the 2 transmission electrical connectors and detach the wiring retainer from the stud bolt.



89. Remove the 4 remaining transaxle-to-engine bolts.

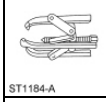


90. Using the Spreader Bar, Engine Lifting Brackets, Engine Lifting Bracket Set and the Heavy Duty Floor Crane, separate the engine and transaxle.



Engine

Special Tool(s)

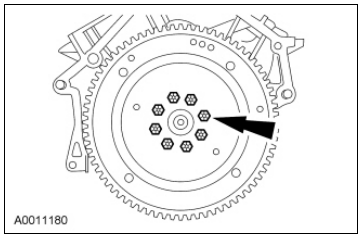
 ST1184-A	3 Jaw Puller 303-D121
 ST1982-A	Installer, Connecting Rod 303-462 (T94P-6136-AH)
 ST3044-A	Plate, Water Pump Pulley 303-456 (T94P-6312-AH1), part of 303-S455
 ST3045-A	Protector, Water Pump Shaft 303-457 (T94P-6312-AH2), part of 303-S455
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)
 ST3085-A	Remover, Stretchy Belt 303-1419
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

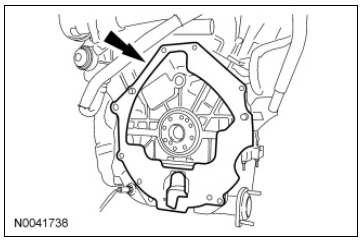
NOTE: For additional information, refer to the exploded view under the Assembly procedure in this section.

All engines

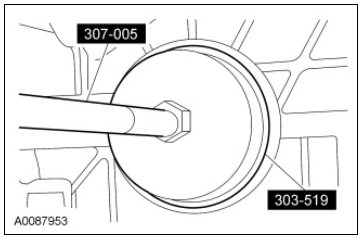
1. Remove the 8 bolts and the flexplate.



2. Remove the engine-to-transaxle separator plate.

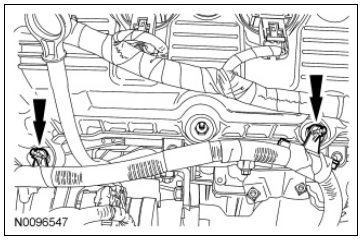


3. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove and discard the crankshaft rear oil seal.

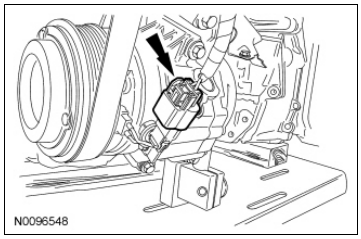


4. Mount the engine on a suitable stand.

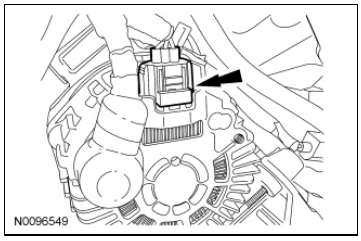
5. Detach the 2 B+ wiring harness retainers from the valve cover stud bolts.



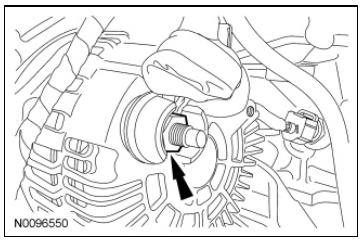
6. Disconnect the A/C compressor clutch electrical connector.



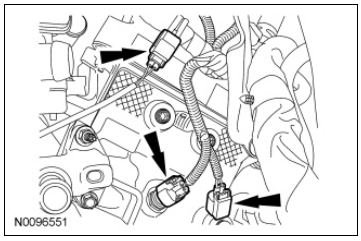
7. Disconnect the generator electrical connector.



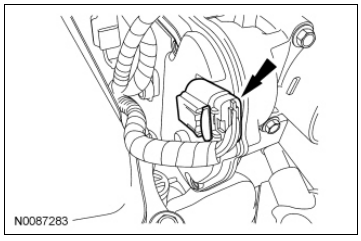
8. Remove the nut and the B+ wire from the generator.
    - Remove the B+ harness from the engine.



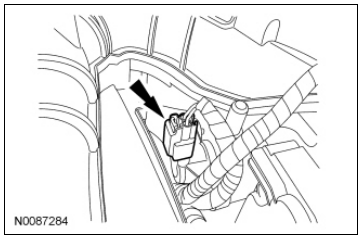
9. Disconnect the 3 engine wiring connectors.
    - Disconnect the engine block Knock Sensor (KS) electrical connector.
    - Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.
    - Disconnect the cylinder head KS electrical connector.



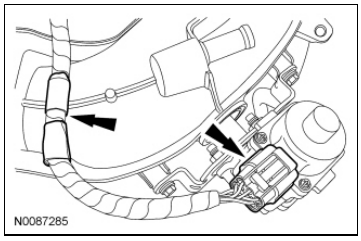
10. Disconnect the electronic throttle control electrical connector.



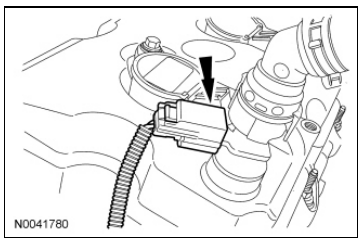
11. Disconnect the Evaporative Emission (EVAP) canister purge valve electrical connector.



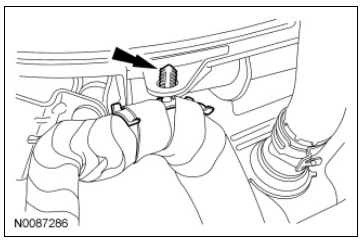
12. Disconnect the EGR regulator electrical connector and detach the wiring retainer.



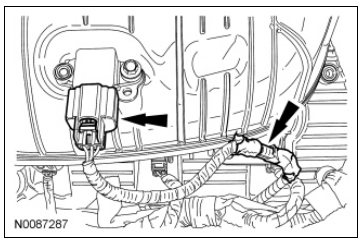
13. Disconnect the PCV valve electrical connector.



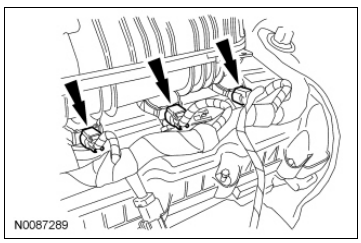
14. Detach the wiring harness retainer from the upper intake manifold.



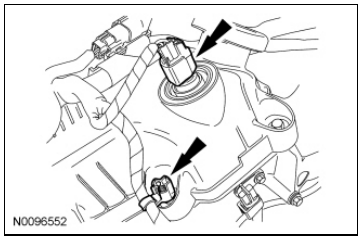
15. Disconnect the Manifold Absolute Pressure (MAP) electrical connector and detach the wiring retainer.



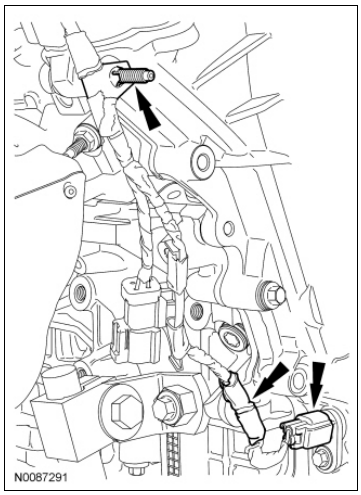
16. Disconnect the RH coil-on-plug electrical connectors.
    - Detach the 2 wiring harness retainers.



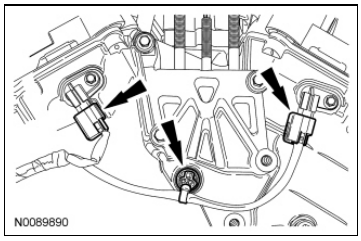
17. Disconnect the RH Variable Camshaft Timing (VCT) electrical connector and detach the wiring harness retainer from the valve cover stud bolt.



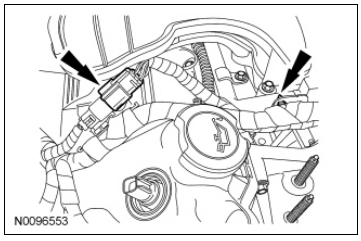
18. Disconnect the Crankshaft Position (CKP) sensor electrical connector and detach the 2 wiring harness retainers.



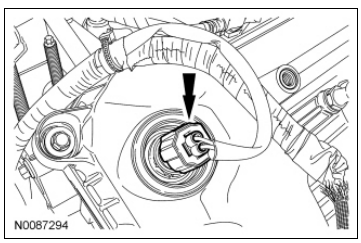
19. Disconnect the 2 Camshaft Position (CMP) sensor electrical connectors and detach the wiring harness retainer from the engine front cover stud bolt.



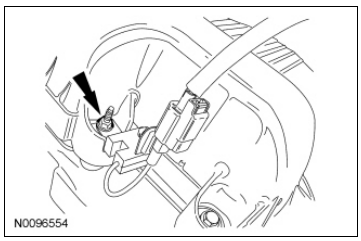
20. Disconnect the fuel injector wiring harness electrical connector and detach the wiring harness retainer.



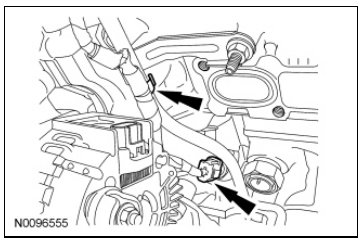
21. Disconnect the LH VCT electrical connector.



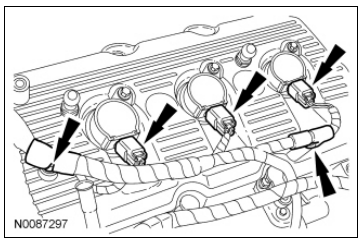
22. Remove the nut and the radio frequency interference capacitor.



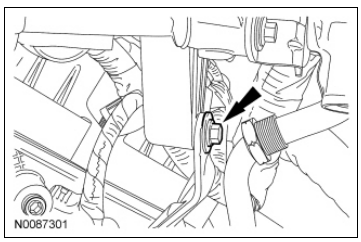
23. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and detach the wiring retainer from the oil indicator tube.



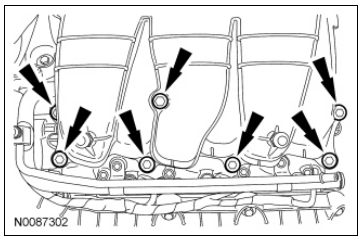
24. Disconnect the 3 LH coil-on-plug electrical connectors.
    - Detach the 2 wiring harness retainers.



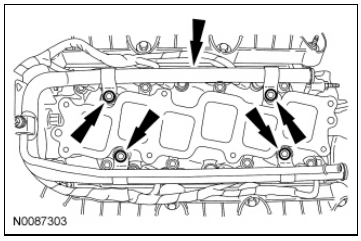
25. Remove the 2 upper intake manifold bracket bolts (1 shown).



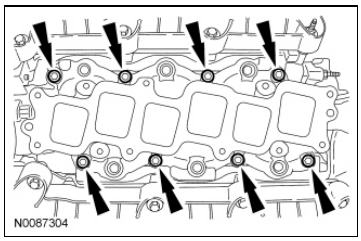
26. Remove the 7 bolts and the upper intake manifold.
    - Remove and discard the gaskets.



27. Remove the 4 bolts and the fuel rail and injectors as an assembly.

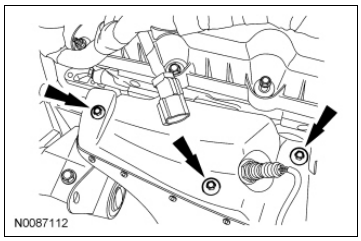


28. Remove the 8 lower intake manifold bolts and the lower intake manifold.
    - Remove and discard the gaskets.

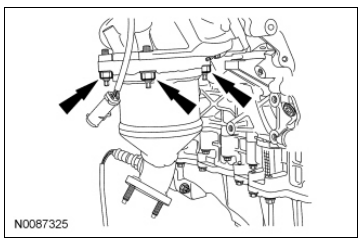


FWD vehicles

29. Remove the 3 bolts and the RH heat shield.

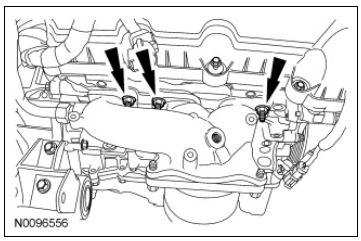


30. Remove the 3 nuts and the RH catalytic converter.
    - Discard the nuts and gasket.



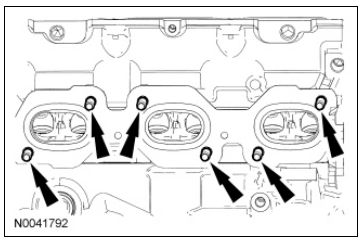
All engines

31. Remove the 6 RH exhaust manifold nuts and the manifold.
    - Discard the nuts and gasket.

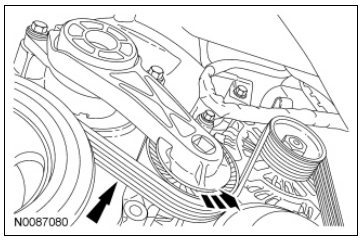


32. Clean and inspect the RH catalytic converter manifold. For additional information, refer to Section 303-00 .

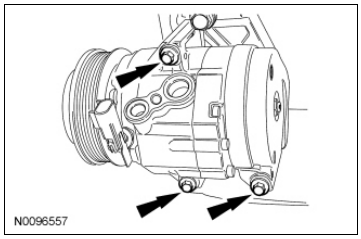
33. Remove and discard the 6 RH catalytic converter manifold studs.



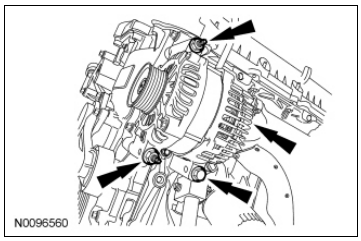
34. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.



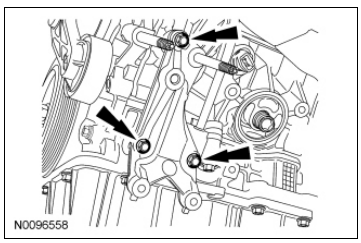
35. Remove the 3 bolts and the A/C compressor.



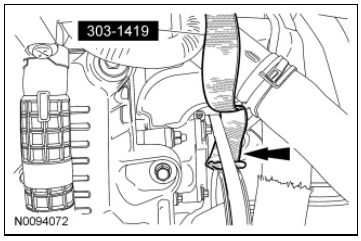
36. Remove the bolt, 2 nuts and the generator.



37. Remove the 3 bolts and the A/C compressor bracket.

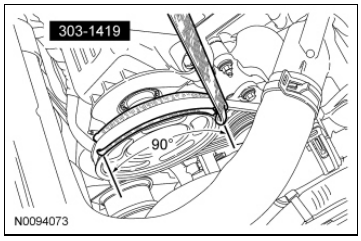


38. Position the Stretchy Belt Remover under the coolant pump belt as shown.

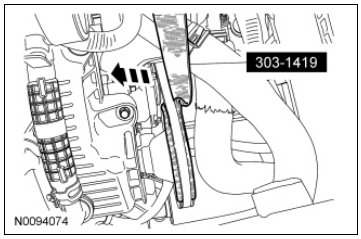


39. **NOTE:** Feed the Stretchy Belt Remover on to the camshaft coolant pump pulley 90 degrees.

    Turn the crankshaft clockwise and feed the Stretchy Belt Remover evenly on the camshaft coolant pump pulley as shown.

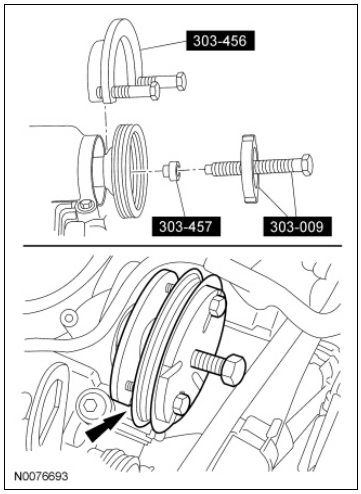


40. Remove the coolant pump belt.
    - Fold the Stretchy Belt Remover over the top of the coolant pump belt.
    - In one quick motion, pull the Stretchy Belt Remover up and toward the front of the engine removing the coolant pump belt.

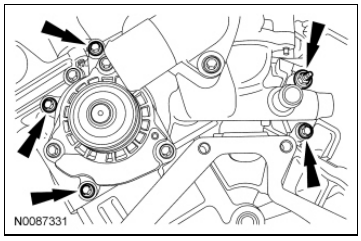


41. ***NOTICE:*** **Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.**

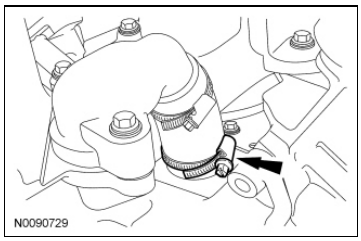
    Using the Water Pump Pulley Plate, Water Pump Shaft Protector and the Crankshaft Vibration Damper Remover, remove the coolant pump pulley.



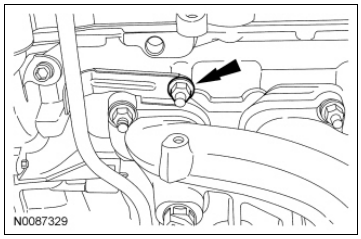
42. Remove the 5 coolant pump housing bolts.



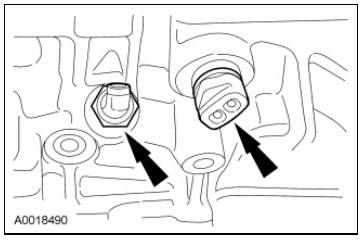
43. Loosen the clamp and detach the coolant hose.
    - Remove the coolant pump housing.



44. Remove the stud bolt and the oil level indicator and tube.
    - Remove and discard the O-ring seal.

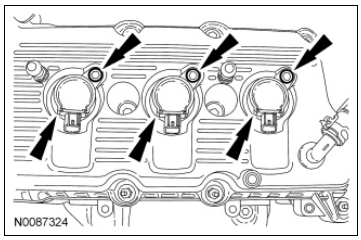


45. Remove the EOP switch and, if equipped, the block heater.

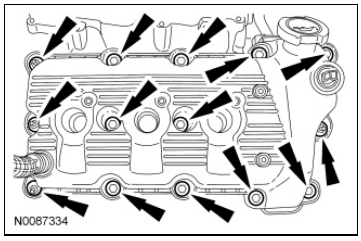


46. **NOTE:** LH shown, RH similar.

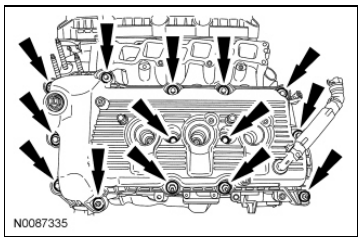
    Remove the bolts and the 6 coil-on-plugs.



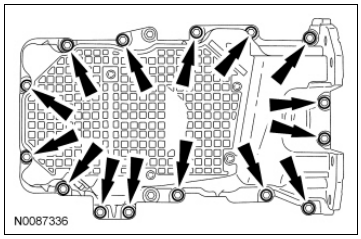
47. Remove the bolts and the RH valve cover.
    - Discard the gasket.



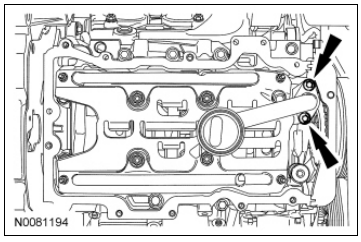
48. Remove the bolts and the LH valve cover.
    - Discard the gasket.



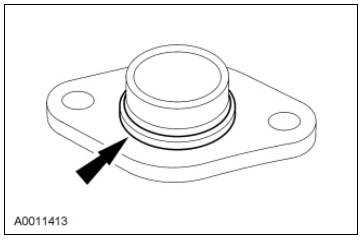
49. Remove the 15 bolts and the oil pan.
    - Discard the gasket.



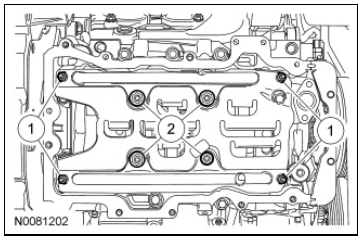
50. Remove the 2 bolts and the oil pump screen and pickup tube.



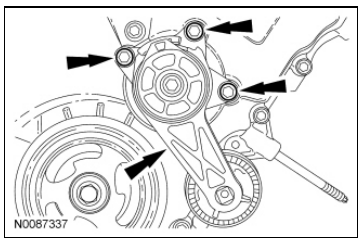
51. Remove and discard the O-ring seal.



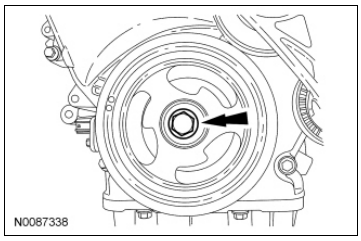
52. Remove the oil pan baffle.
    1. Remove the 4 M6 oil pan baffle nuts.
    2. Remove the 4 M8 oil pan baffle nuts.



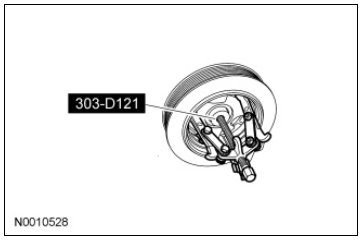
53. Remove the 3 bolts and the accessory drive belt tensioner.



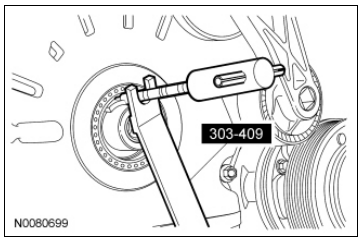
54. Remove the crankshaft pulley bolt and washer.
    - Discard the crankshaft pulley bolt.



55. Using the 3 Jaw Puller, remove the crankshaft pulley.

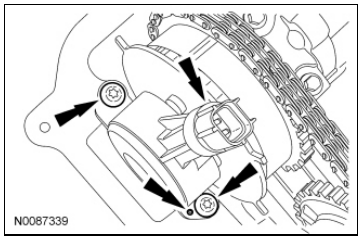


56. Using the Oil Seal Remover, remove and discard the crankshaft front seal.



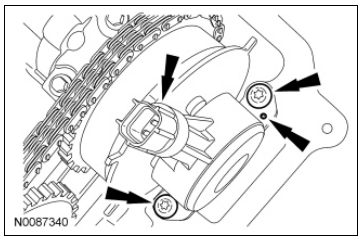
57. **NOTE:** Note the position of the alignment dowel on the engine front cover.

    Remove the 2 bolts and the LH VCT .



58. **NOTE:** Note the position of the alignment dowel on the engine front cover.

    Remove the 2 bolts and the RH VCT .

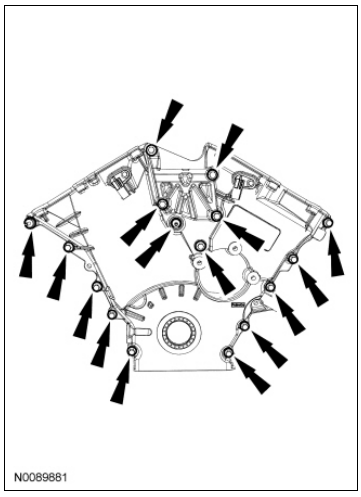


59. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surface. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of sealant.**

    NOTE: Note the location of all bolts and stud bolts for installation.

    Remove the 14 bolts, 2 stud bolts and the engine front cover.

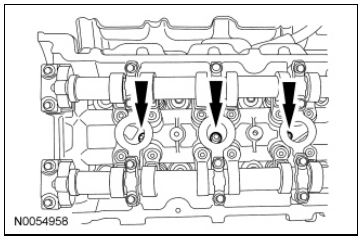
    - Discard the gaskets.



60. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.**

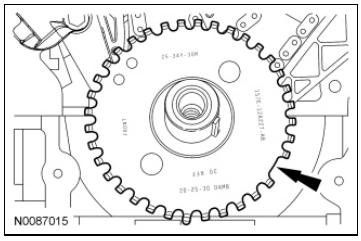
    NOTE: LH shown, RH similar.

    Remove the LH and RH spark plugs.

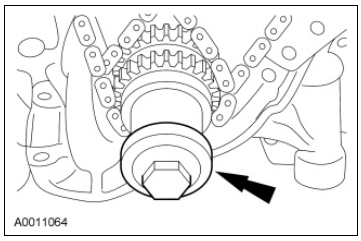


61. **NOTE:** This pulse wheel is used in several different engines. Install the pulse wheel with the keyway in the slot stamped "30RFF" (orange in color).

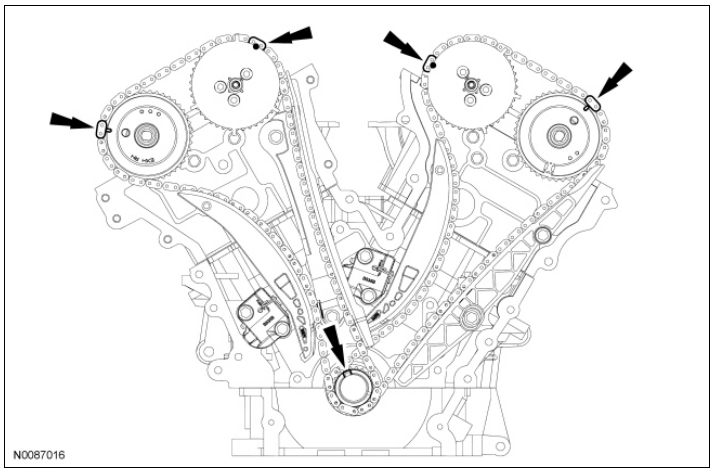
    Remove the ignition pulse wheel.



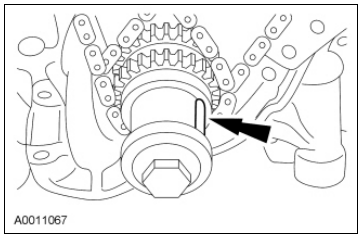
62. Install the crankshaft pulley bolt and washer.



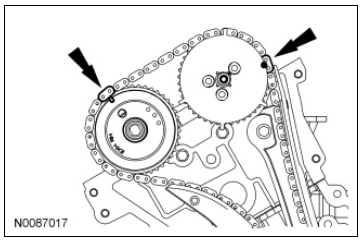
63. Rotate the crankshaft clockwise to position the crankshaft keyway in the 11 o'clock position and position the camshafts in the correct position. This will position the No. 1 cylinder at Top Dead Center (TDC).
    - Verify that the camshafts are correctly located. If not, rotate the crankshaft one additional turn and recheck.



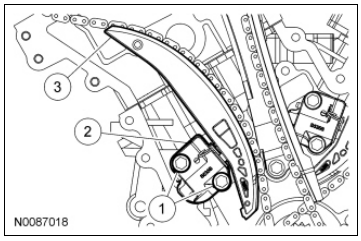
64. Rotate the crankshaft clockwise 120 degrees to the 3 o'clock position to position the RH camshafts in the neutral position.



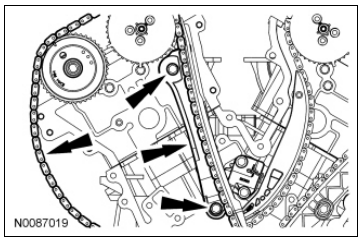
65. Verify that the RH camshafts are in the neutral position.



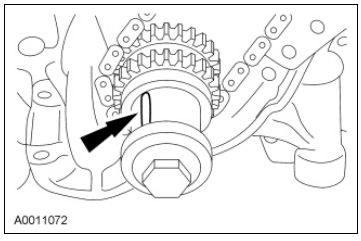
66. Remove the RH timing chain tensioner arm.
    1. Remove the 2 bolts.
    2. Remove the tensioner.
    3. Remove the tensioner arm.



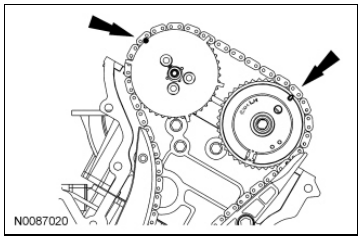
67. Remove the 2 bolts and the RH timing chain guide.
    - Remove the RH timing chain from the engine.



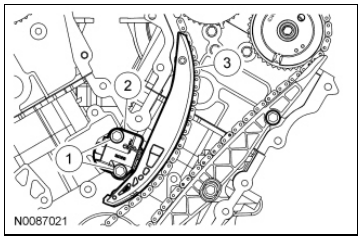
68. Rotate the crankcase clockwise 600 degrees (one and two-thirds turns) to position the crankcase keyway in the 11 o'clock position. This will position the LH camshafts in the neutral position.



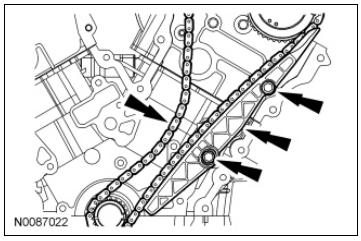
69. Verify the LH camshafts are in the neutral position.



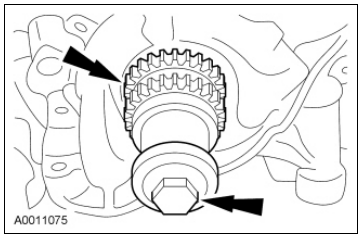
70. Remove the LH timing chain and tensioner arm.
    1. Remove the 2 bolts.
    2. Remove the tensioner.
    3. Remove the tensioner arm.



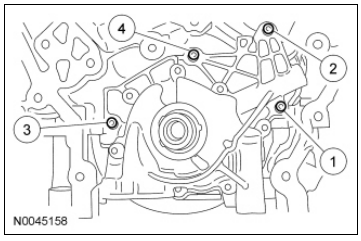
71. Remove the 2 bolts and the LH timing chain guide.
    - Remove the LH timing chain from the engine.



72. Remove the crankshaft pulley bolt and the crankshaft sprocket.

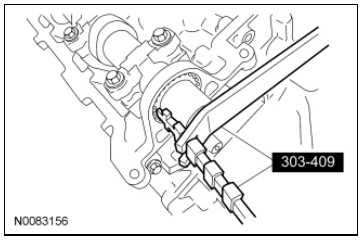


73. Remove the 4 bolts in the sequence shown.
    - Remove the oil pump.

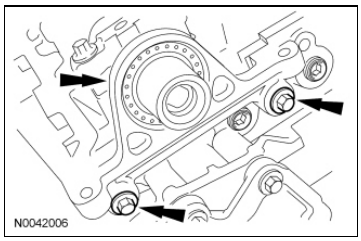


74. ***NOTICE:*** **Do not scratch the camshaft sealing surface while removing the camshaft oil seal. If scratched, camshaft oil seal leakage may occur.**

    Using the Oil Seal Remover, remove the camshaft oil seal and discard.

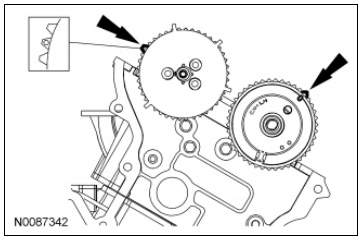


75. Remove the 2 bolts and the camshaft oil seal retainer.
    - Discard the press-in-place gasket.



76. ***NOTICE:*** **The camshafts must be in the neutral position before removing the bearing caps or damage to the engine may occur.**

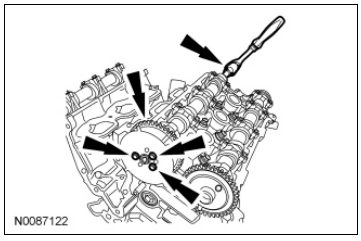
    Verify the LH camshafts are in the neutral position.



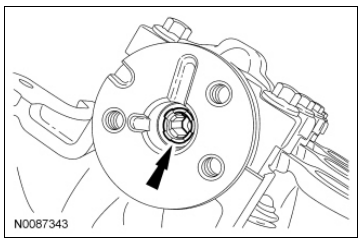
77. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while removing the camshaft phaser and sprocket or damage to the engine may occur.**

    NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for removal of the camshaft phaser and sprocket bolts.

    Remove the 3 bolts and the LH camshaft phaser and sprocket.

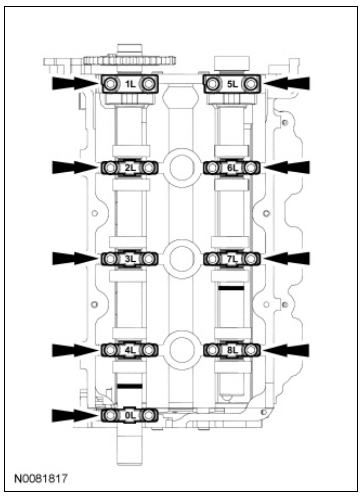


78. Remove and discard the VCT system oil filter screen from the LH camshaft.



79. ***NOTICE:*** **Cylinder head camshaft bearing caps must be assembled in their original positions. Some engines have factory markings on the camshaft bearing caps (as shown in illustration). Engines that do not have the factory markings must be marked for correct position and orientation prior to removal. Failure to install the camshaft bearing caps in their original positions may result in severe engine damage.**

    If necessary, mark the camshaft bearing cap position and orientation as shown in the illustration.

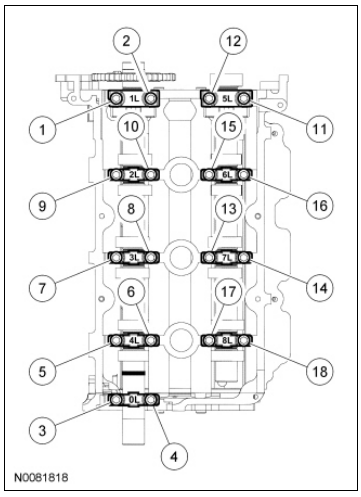


80. ***NOTICE:*** **After loosening all of the camshaft bearing cap bolts, remove the camshaft bearing thrust caps (1L and 5L) first, or damage to the thrust caps may occur.**

    NOTE: Make sure the camshaft bearing caps are marked as instructed in the previous step.

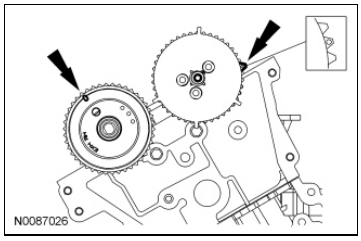
    Loosen the bolts evenly in the sequence shown.

    1. Remove the camshaft bearing thrust caps (1L and 5L).
    2. Remove the remaining camshaft bearing caps.
    3. Remove the camshafts from the cylinder head.



81. ***NOTICE:*** **The camshafts must be in the neutral position before removing the bearing caps or damage to the engine may occur.**

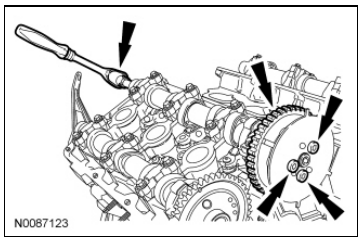
    Verify the RH camshafts are in the neutral position.



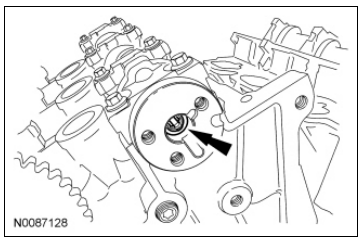
82. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while removing the camshaft phaser and sprocket or damage to the engine may occur.**

    NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for removal of the camshaft phaser and sprocket bolts.

    Remove the 3 bolts and the RH camshaft phaser and sprocket.

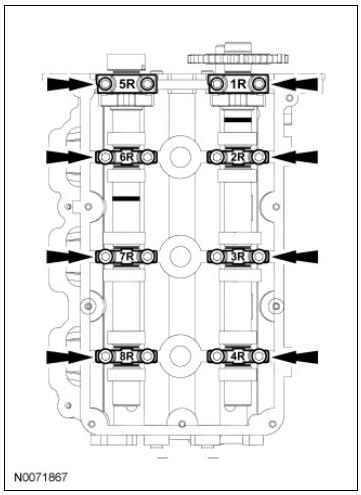


83. Remove and discard the VCT system oil filter screen from the RH camshaft.



84. ***NOTICE:*** **Cylinder head camshaft bearing caps must be assembled in their original positions. Some engines have factory markings on the camshaft bearing caps (as shown in illustration). Engines that do not have the factory markings must be marked for correct position and orientation prior to removal. Failure to install the camshaft bearing caps in their original positions may result in severe engine damage.**

    If necessary, mark the camshaft bearing cap position and orientation as shown in the illustration.

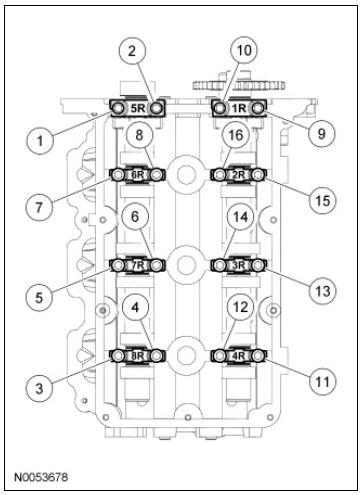


85. ***NOTICE:*** **After loosening all of the camshaft bearing cap bolts, remove the camshaft bearing thrust caps (5R and 1R) first, or damage to the thrust caps may occur.**

    NOTE: Make sure the camshaft bearing caps are marked as instructed in the previous step.

    Loosen the bolts evenly in the sequence shown.

    1. Remove the camshaft bearing thrust caps (5R and 1R).
    2. Remove the remaining camshaft bearing caps.
    3. Remove the camshafts from the cylinder head.

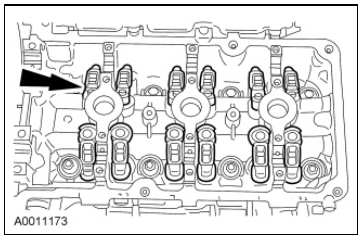


86. ***NOTICE:*** **The camshaft roller followers must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

    NOTE: RH shown, LH similar.

    Remove the LH and RH camshaft roller followers.

    - Mark the location of the roller followers, using a permanent-type marker.



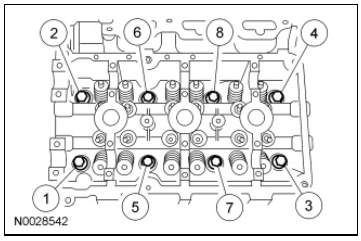
87. ***NOTICE:*** **The hydraulic lash adjusters must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

    Remove the hydraulic lash adjusters.

88. **NOTE:** RH shown, LH similar.

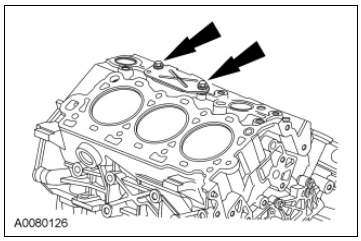
    Loosen the bolts in the indicated sequence and remove the LH and RH cylinder heads.

    - Discard the bolts and the gaskets.

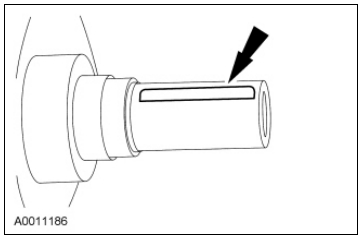


89. Support the cylinder heads on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

90. Remove the bolts and the oil separator cover.
    - Discard the gasket.



91. Remove the crankshaft key.

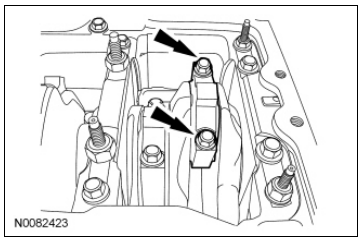


92. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

93. **NOTE:** Clearly mark the position and orientation of the pistons, connecting rods, connecting rod caps and connecting rod bearings for reassembly.

    Remove the connecting rod cap bolts and cap.

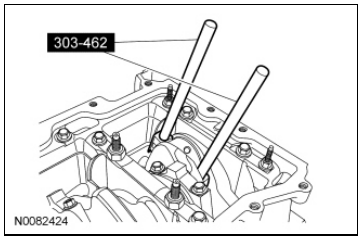
    - Discard the connecting rod cap bolts.



94. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

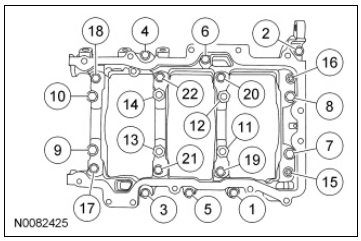
    Using the Connecting Rod Installer, remove the piston/rod assembly from the engine block.

    - Repeat these 2 steps until all the piston/rod assemblies are removed from the engine block.

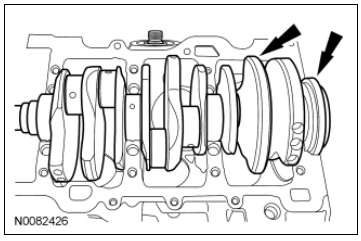


95. Remove the engine block from the stand and place on a workbench.

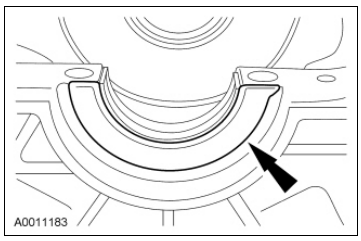
96. Remove the bolts and studs in the indicated sequence.
    - Discard the lower cylinder block bolts.
    - Remove the lower cylinder block.



97. Remove the crankshaft rear main seal.
    - Remove the crankshaft.

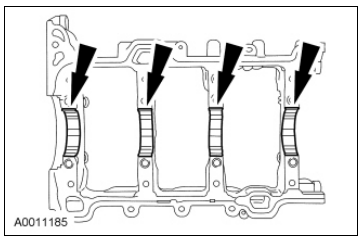


98. Remove the crankshaft thrust bearing from the cylinder block.



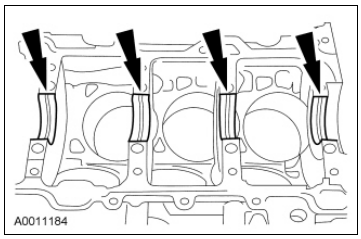
99. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

    Remove the bearings from the lower cylinder block.



100. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

     Remove the crankshaft main bearings from the cylinder block.



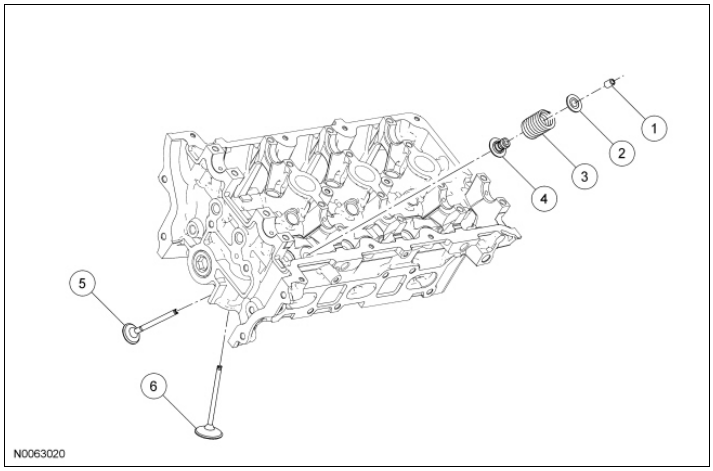
101. Inspect the cylinder block, lower cylinder block, pistons and connecting rods. For additional information, refer to Section 303-00 .

Cylinder Head

Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST1902-A	Compressor, Valve Spring 303-1418
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)

Cylinder Head

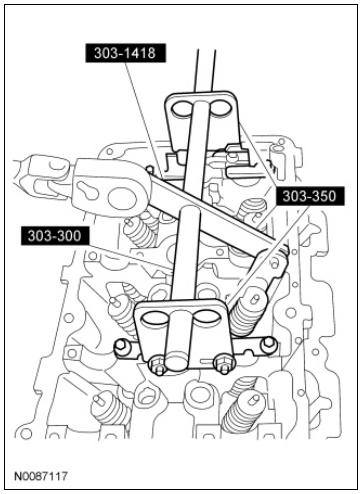


Item	Part Number	Description
1	6518	Valve spring retainer key (24 required)
2	6514	Valve spring retainer (12 required)
3	6513	Valve spring (12 required)
4	6A517	Valve stem seal (12 required)
5	6505	Intake valve (6 required)
6	6507	Exhaust valve (6 required)

Disassembly

NOTICE: **If the components are to be reinstalled, they must be installed in the same positions. Mark the components removed for locations. If not reassembled in their original positions, severe engine damage may occur.**

1. Using the Valve Spring Compressors, remove the keys, retainer and spring.

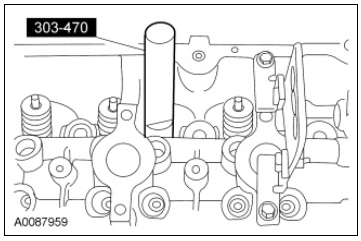


2. Remove the valve from the cylinder head.

3. Remove the valve stem seal.

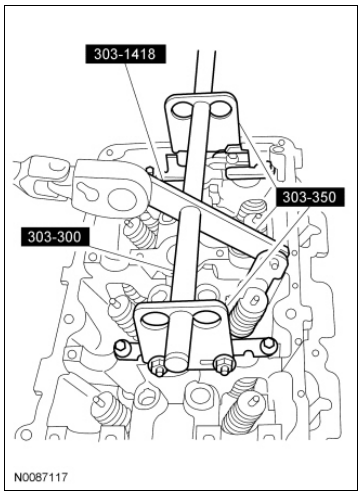
Assembly

1. Using the Valve Stem Oil Seal Installer, install the valve stem seal.



2. Install the valve.

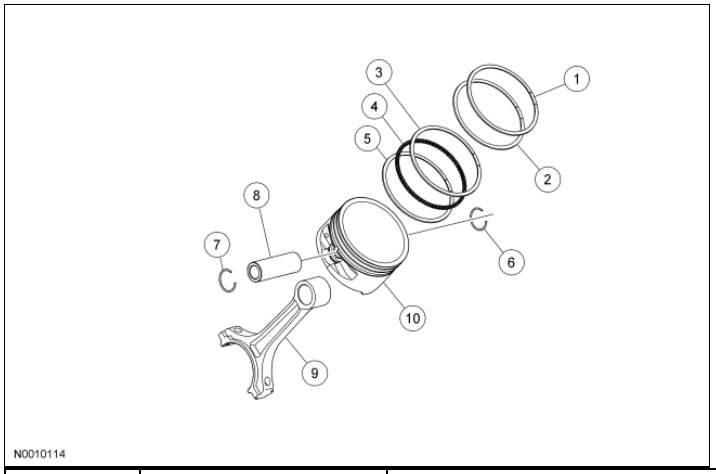
3. Using the Valve Spring Compressors, install the valve spring, retainer and keys.



Piston

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canadr>XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	6150	Piston compression upper ring
2	6152	Piston compression lower ring
3	6159	Piston oil control upper segment ring
4	6161	Piston oil control spacer
5	6159	Piston oil control lower segment ring
6	6140	Piston pin retainer
7	6140	Piston pin retainer
8	6135	Piston pin
9	6200	Connecting rod
10	6110	Piston

Disassembly

1. Remove the piston rings from the piston.
   - Discard the piston rings.

2. Remove the 2 piston pin retainers and the piston pin.

3. **NOTE:** If the piston and connecting rod are to be reinstalled, they must be assembled in the same orientation. Mark the piston orientation to the connecting rod for reassembly.

   Separate the piston from the connecting rod.

4. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00 .

Assembly

1. Align the piston-to-connecting rod orientation marks and position the connecting rod in the piston.

2. Lubricate the piston pin and pin bore with clean engine oil.

3. Install the piston pin in the piston and connecting rod assembly.

4. Install the piston pin retaining clips in the piston.

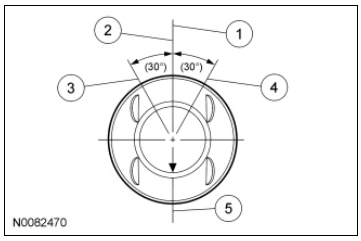
5. Lubricate the piston and the new piston rings with clean engine oil.

6. **NOTE:** The piston compression lower ring should be installed with the "O" mark on the ring face pointing up toward the top of the piston.

   NOTE: When installing the piston oil control spacer, orient the gap such that the cut ends are pointed toward the top of the piston.

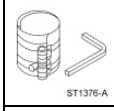
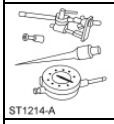
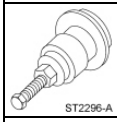
   Install the piston rings onto the piston as shown.

   1. Center line of the piston parallel to the wrist pin bore
   2. Upper compression ring gap location
   3. Upper oil control segment ring gap location
   4. Lower oil control segment ring gap location
   5. Expander ring and lower compression ring gap location



Engine

Special Tool(s)

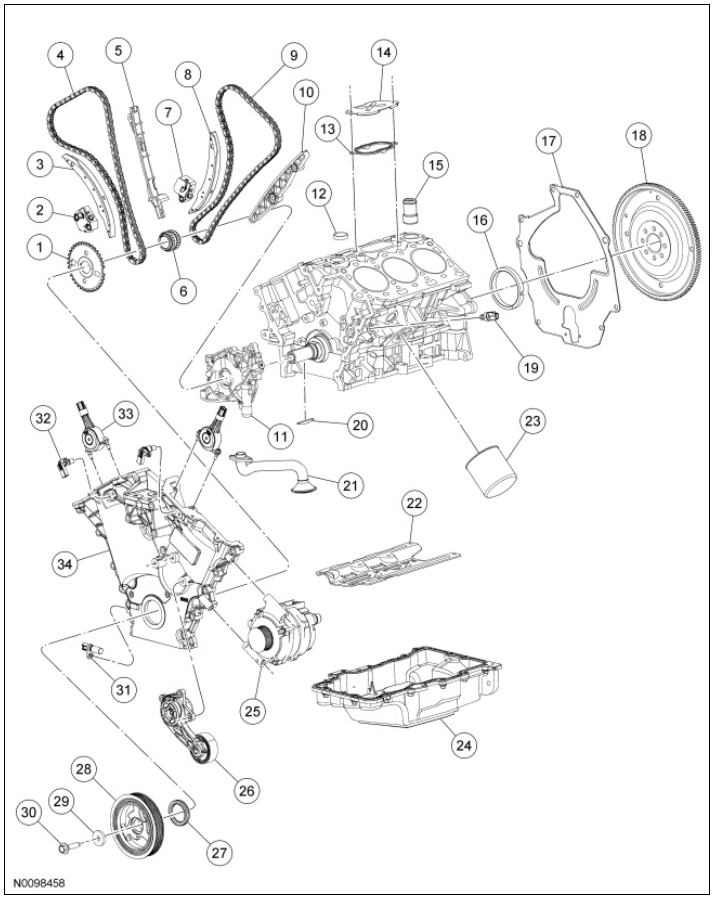
 ST1376-A	Compressor, Piston Ring 303-D032 (D81L-6002-C)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST2673-A	Engine Lifting Bracket Set 303-1140
 ST1979-A	Installer, Camshaft Oil Seal 303-464 (T94P-6256-BH)
 ST3042-A	Installer, Camshaft Pulley 303-458 (T94P-6312-AH3), part of 303-S455
 ST1982-A	Installer, Connecting Rod 303-462 (T94P-6136-AH)
 ST1327-A	Installer, Crankshaft Rear Main Oil Seal 303-178 (T82L-6701-A)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2296-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1586-A	Installer, Power Steering Pump Pulley 211-185 (T91P-3A733-A)
 ST1333-A	Installer Bolts, Crankshaft Rear Main Oil Seal 303-384 (T91P-6701-A)
 ST2463-A	Lifting Brackets, Engine 134-00243 or equivalent
 ST1595-A	Lifting Brackets, Engine 303-050 (T70P-6000)

 ST2060-A	Protector, Camshaft Oil Seal 303-463 (T91P-6256-AH)
 ST3043-A	Spacer, Water Pump Pulley 303-459 (T94P-6312-AH4), part of 303-S455
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2743A	Universal Adapter Brackets 014-0001

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Thread Sealant with PTFE TA-24	WSK-M2G350-A2

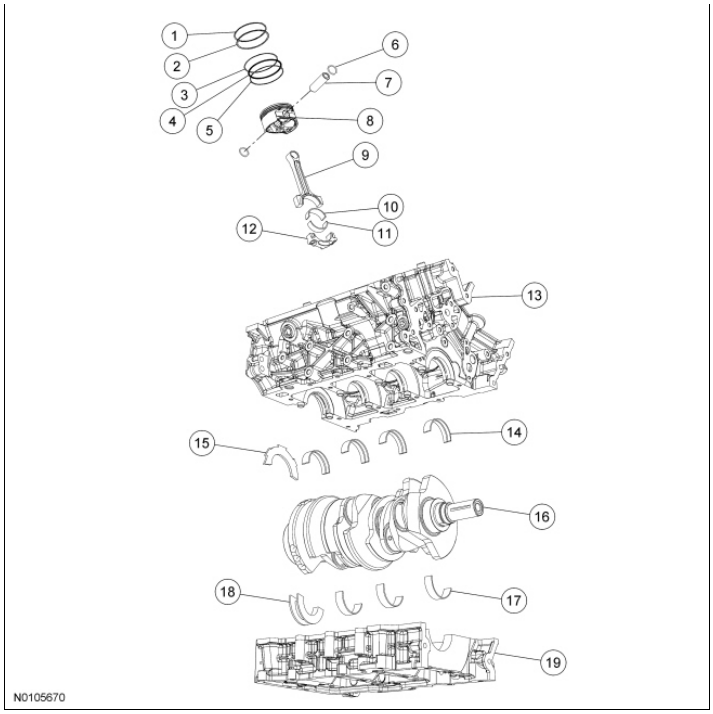
Lower Engine Block (View 1)



Item	Part Number	Description
1	12A227	Ignition pulse wheel
2	6L266	RH timing chain tensioner
3	6K255	RH timing chain tensioner arm
4	6268	RH timing chain
5	6M256	RH timing chain guide
6	6306	Crant sprocket
7	6L266	LH timing chain tensioner
8	6K255	LH timing chain tensioner arm
9	6268	LH timing chain
10	6B297	LH timing chain guide
11	6621	Oil pump
12	W701923	Cup plug
13	6B752	Oil separator gasket
14	6869	Oil separator cover
15	8A505	Water inlet tube
16	6701	Crankshaft rear oil seal
17	6A373	Spacer plate
18	6375	Flexplate
19	9278	Engine Oil Pressure (EOP) switch
20	W701528	Woodruff key
21	6622	Oil pickup tube and screen
22	6687	Oil pan baffle

23	6714	Oil filter
24	6675	Oil pan
25	10300	Generator
26	6B209	Accessory drive belt tensioner
27	6700	Crankshaft front seal
28	6316	Crankshaft vibration damper
29	N806165	Crankshaft vibration damper washer
30	W701512	Crankshaft vibration damper bolt
31	6C315	Crankshaft Position (CKP) sensor
32	12K073	Camshaft Position (CMP) sensor (2 required)
33	6M280	Variable Camshaft Timing (VCT) solenoid (2 required)
34	6019	Front cover

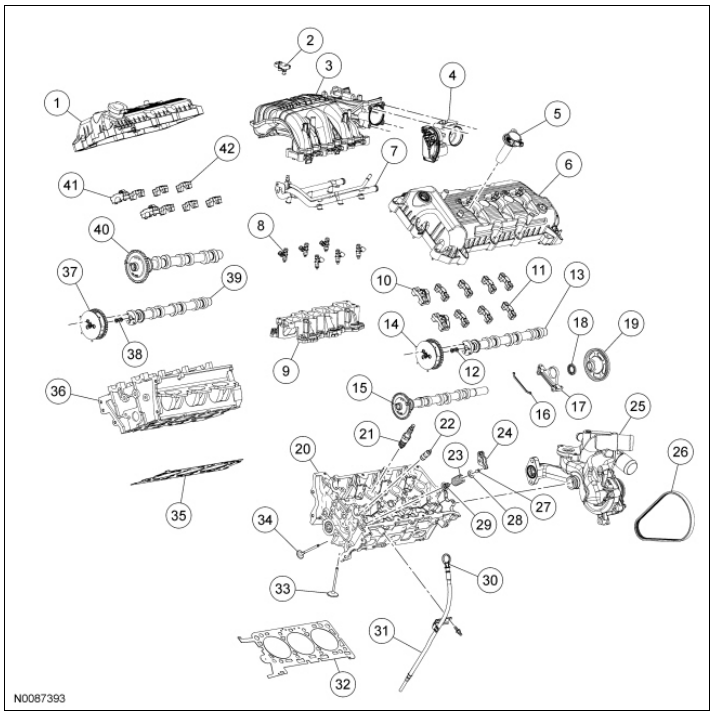
Lower Engine Block (View 2)



Item	Part Number	Description
1	6150	Piston compression upper ring (6 required)
2	6152	Piston compression lower ring (6 required)
3	6159	Piston oil control upper segment ring (6 required)
4	6161	Piston oil control spacer (6 required)
5	6159	Piston oil control lower segment ring (6 required)
6	6140	Piston pin retainer (12 required)
7	6135	Piston pin (6 required)
8	6110	Piston (6 required)

9	6200	Connecting rod (6 required)
10	6211	Connecting rod upper bearing (6 required)
11	6211	Connecting rod lower bearing (6 required)
12	6210	Connecting rod cap (6 required)
13	6010	Cylinder block
14	6333	Cylinder block crankshaft main bearing (4 required)
15	6A341	Crankshaft upper thrust bearing
16	6303	Crankshaft
17	6333	Lower cylinder block crankshaft main bearings (3 required)
18	6337	Lower cylinder block crankshaft main thrust bearing
19	6F095	Lower cylinder block

Cylinder Heads and Intake Manifolds



Item	Part Number	Description
1	6582	RH valve cover
2	9F479	Mass Air Flow (MAF) sensor
3	9424	Upper intake manifold
4	9F991	Throttle Body (TB)
5	12029	Coil-on-plug (6 required)
6	6A505	LH valve cover
7	9F792	Fuel rail
8	9F593	Fuel injector (6 required)
9	9424	Lower intake manifold
10	6B280	Camshaft thrust bearing cap

11	6B280	Camshaft bearing cap
12	6C683	LH Variable Camshaft Timing (VCT) system oil filter
13	6A267	LH intake camshaft
14	6C524	LH camshaft phaser and sprocket
15	6A269	LH exhaust camshaft
16	6B295	Camshaft oil seal retainer gasket
17	6B293	Camshaft oil seal retainer
18	-	Camshaft oil seal
19	6A359	Coolant pump drive pulley
20	6050	LH cylinder head
21	12405	Spark plug (6 required)
22	6C501	Hydraulic lash adjuster (24 required)
23	6513	Valve spring (24 required)
24	6529	Camshaft roller follower (24 required)
25	8501	Coolant pump housing
26	8K453	Coolant pump belt
27	6518	Valve spring retainer key (48 required)
28	6514	Valve spring retainer (24 required)
29	6A517	Valve stem seal (24 required)
30	-	Oil level indicator
31	6754	Oil leindicator tube
32	6083	LH cylinder head gasket
33	6507	Intake valve (24 required)
34	6505	Exhaust valve (24 required)
35	6051	RH cylinder head gasket
36	6050	RH cylinder head
37	6C524	RH camshaft phaser and sprocket
38	6C683	RH VCT system oil filter
39	6A266	RH intake camshaft
40	6A268	RH exhaust camshaft
41	6A268	Camshaft thrust bearing cap
42	6A258	Camshaft bearing cap

NOTICE: **During engine repair procedures, cleanliness is extremely important. All parts must be thoroughly cleaned and any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTICE: **If the oil pan was removed during engine disassembly, it must be installed after the engine and transaxle are assembled and the transaxle-to-engine bolts are installed. Failure to follow this assembly sequence can result in engine oil leaks.**

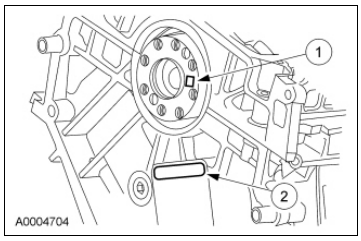
NOTE: Assembly of the engine requires various inspections/measurements of the engine components (engine block, crankshaft, connecting rods, pistons and piston rings). These inspections/measurements will aid in determining if the engine components will require replacement. For additional information, refer to Section 303-00 .

All engines

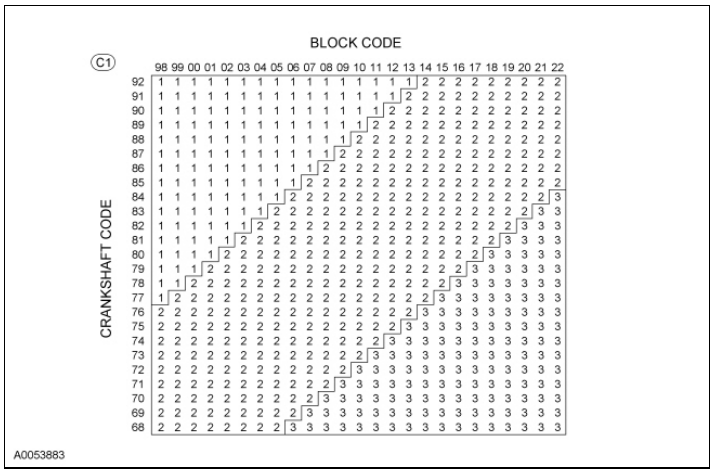
1. **NOTE:** This procedure is for selecting bearings using a new crankshaft.

   Select the crankshaft main bearings for each crankshaft journal.

   1. Read the code on the crankshaft flange.
   2. Read the code on the cylinder block rear face.
      - The first 2 numbers after the asterisk make up the code for main No. 1 and the next 2 numbers for main No. 2.
      - The first 2 numbers after the second asterisk make up the code for main No. 3 and the last 2 numbers for main No. 4.

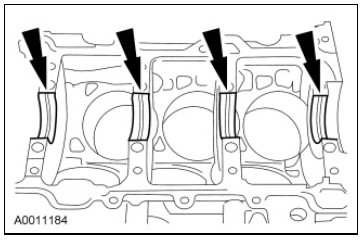


2. Using the chart, choose a bearing for each main. Match the block and crankshaft code with its corresponding column or row, by reading across the "crankshaft" row and down the "block" column.
   - For example: If the block code is *0609*0711* and the crankshaft code is *8580*8082*, main No. 1 should use grade 1 bearings, as determined by the intersection of the 06 block column and the 85 crankshaft row. Mains 2, 3 and 4 should all be grade 2.

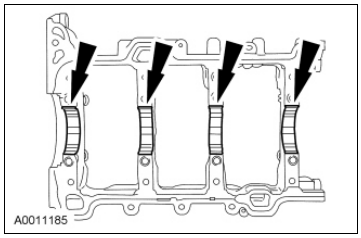


3. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

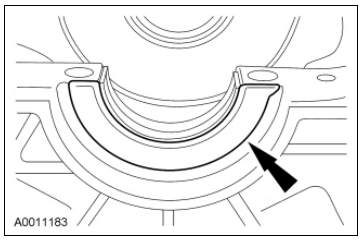
   Lubricate the upper crankshaft main bearings with clean engine oil and install the 4 crankshaft main bearings in the cylinder block.



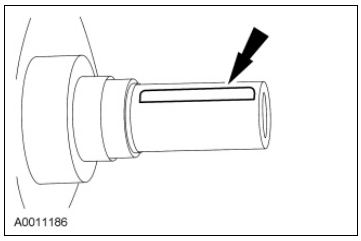
4. Lubricate the lower crankshaft main bearings with clean engine oil and install the 4 crankshaft main bearings in the lower cylinder block.



5. Lubricate the crankshaft thrust bearing with clean engine oil and install in the cylinder block.

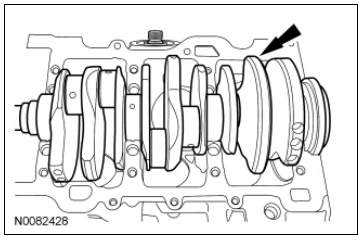


6. Install the crankshaft key.



7. Apply clean engine oil to the crankshaft main and rod bearing journals.

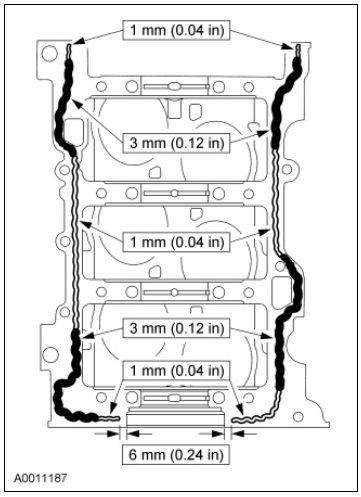
8. Position the crankshaft in the cylinder block.



9. ***NOTICE:*** **The lower cylinder block must be installed and the bolts tightened within 4 minutes of applying the sealant.**

   NOTE: Clean and degrease both surfaces using metal surface prep before applying sealant.

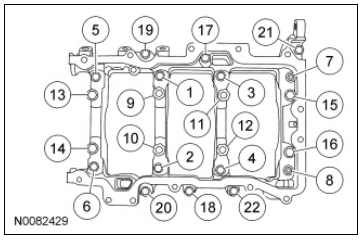
   Apply gasket and sealant to the cylinder block as shown.



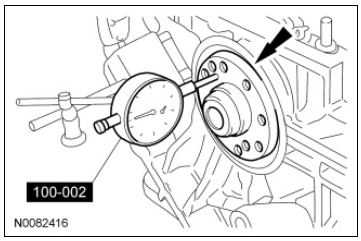
10. ***NOTICE:*** **Fasteners No. 5 through 8 are studs. Fasteners No. 18 through 22 are M8 x 1.25 mm x 79.3 mm (0.05 in x 3.12 in) bolts. Fasteners No. 1 through 4, 17 are M8 x 1.25 mm x 96 mm (0.05 in x 3.75 in) bolts. Fasteners 9 through 12 are M10 x 1.5 mm x 106.8 mm (0.06 in x 4.20 in) /M8 x 1.25 mm x 21.5 mm (0.05 in x 0.84 in) studs. Fasteners 13 through 16 are M10 x 1.5 mm x 106.5 mm (0.06 in x 4.17 in) bolts. The bolts and studs must be installed in the correct position or engine damage can result.**

    Position the lower cylinder block and install the new bolts and new studs.

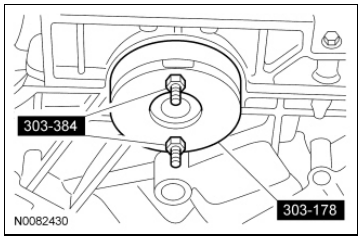
    - Tighten the bolts and studs in the sequence shown in 4 stages.
    - Stage 1: Tighten fasteners 1 through 8 to 25 Nm (18 lb-ft).
    - Stage 2: Tighten fasteners 9 through 16 to 40 Nm (30 lb-ft).
    - Stage 3: Tighten fasteners 1 through 16 an additional 90 degrees.
    - Stage 4: Tighten fasteners 17 through 22 to 25 Nm (18 lb-ft).



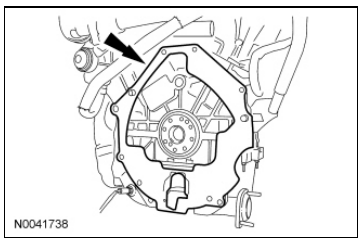
11. Using the Dial Indicator Gauge with Holding Fixture, measure crankshaft end play.
    - Position the crankshaft to the rear of the cylinder block.
    - Zero the Dial Indicator Gauge with Holding Fixture.
    - Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.
    - Acceptable crankshaft end play is 0.100-0.255 mm (0.003-0.010 in). If the crankshaft end play exceeds the specified range, install new parts as necessary.



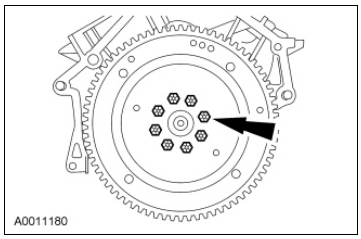
12. Using the Crankshaft Rear Main Oil Seal Installer and the Crankshaft Rear Main Oil Seal Installer Bolts, install the crankshaft rear oil seal.



13. Install the engine-to-transaxle separator plate.



14. Position the flexplate and install the bolts.
    - Tighten to 80 Nm (59 lb-ft).



15. Mount the engine on an engine stand.

16. Using the chart, select the correct piston grade size for the cylinder bores.
    - Measure the cylinder block bore diameter.
    - Mark the outside of the block with the appropriate number(s) to identify bore grade size.
    - Choose the correct piston grade size for the cylinder bore.

LITER	GRADE	CYLINDER BLOCK BORE DIAMETER	PISTON DIAMETER UNCOATED	PISTON DIAMETER COATED
3.0L	1	89.000-89.010	88.970-88.980	88.990-89.010
3.0L	2	89.010-89.020	88.978-88.992	88.998-89.022
3.0L	3	89.020-89.030	88.990-89.000	89.010-89.030
3.0L	1A	89.000-89.010	88.970-89.980	88.990-89.010
3.0L	2A	89.010-89.020	88.978-89.992	88.998-89.022
3.0L	3A	89.020-89.030	88.990-89.000	89.010-89.030

N0091569

17. ***NOTICE:*** **Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.**

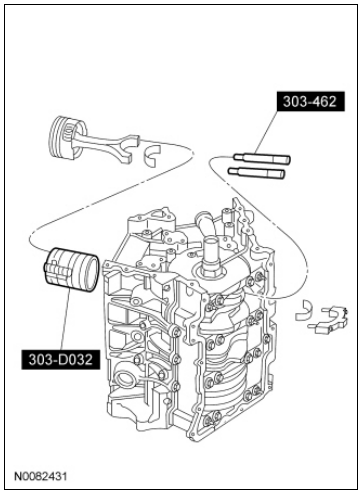
    NOTE: Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with clean engine oil.

    NOTE: Make sure the piston rings are positioned to specifications for installation. For additional information, refer to Disassembly and Assembly of Subassemblies - Piston in this section.

    NOTE: Make sure the piston arrow on top is facing toward the front of the engine.

NOTE: After installation of each piston and connecting rod, rotate the crankshaft to verify smooth operation.

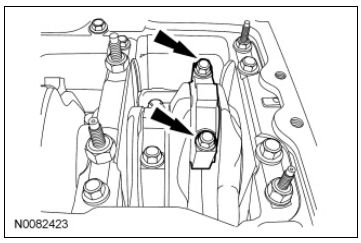
Using the Piston Ring Compressor and the Connecting Rod Installer, install the piston and connecting rod assemblies.



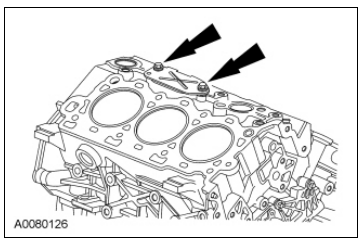
18. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

    Install the connecting rod caps and the new bolts.

    - Tighten the bolts in 2 stages.
    - Stage 1: Tighten to 23 Nm (17 lb-ft).
    - Stage 2: Tighten to 43 Nm (32 lb-ft).



19. Install the oil separator cover, a new gasket and the bolts.
    - Tighten to 10 Nm (89 lb-in).

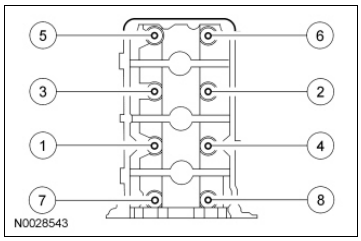


20. **NOTE:** LH shown, RH similar.

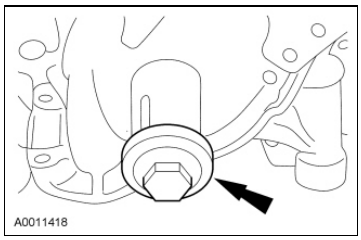
    Position the new LH and RH cylinder heads and gaskets. Install new bolts and tighten in the sequence shown in 6 stages.

    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Tighten 90 degrees.

- Stage 3: Loosen one full turn.
- Stage 4: Tighten to 40 Nm (30 lb-ft).
- Stage 5: Tighten 90 degrees.
- Stage 6: Tighten 90 degrees.



21. Install the crankshaft pulley bolt and rotate the crankshaft keyway to the 11 o'clock position to locate Top Dead Center (TDC).



22. ***NOTICE:*** **The hydraulic lash adjusters must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

    Install the hydraulic lash adjusters.

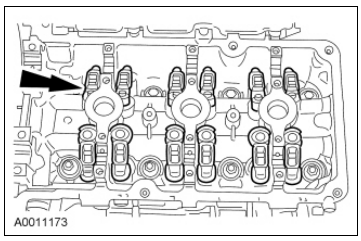
    - Lubricate the hydraulic lash adjusters with clean engine oil.

23. Apply clean engine oil to the LH and RH camshaft roller followers.

24. ***NOTICE:*** **The camshaft roller followers must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

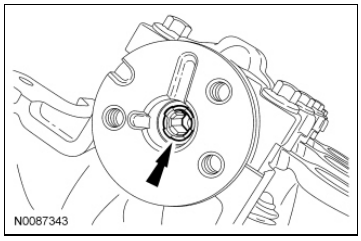
    NOTE: RH shown, LH similar.

    Install the LH and RH camshaft roller followers.



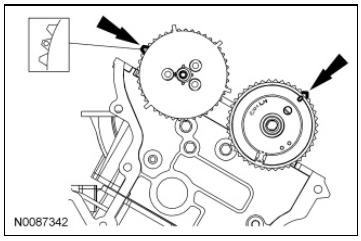
25. **NOTE:** LH shown, RH similar.

    Install the new LH and RH oil filter screens in the intake camshafts.



26. Position the camshaft phaser and sprockets onto the intake camshafts.
    - Install the 3 bolts finger-tight.

27. Lubricate the LH camshafts with clean engine oil and carefully position the camshafts onto the cylinder head.
    - Align the LH camshafts as shown.

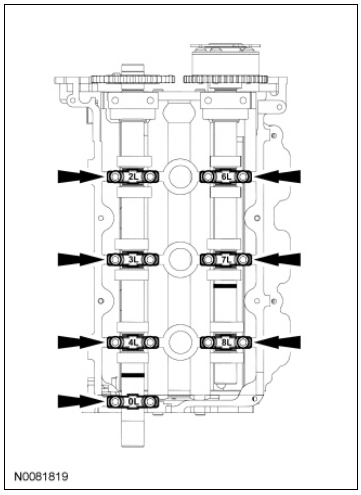


28. ***NOTICE:*** **Cylinder head camshaft journal caps and cylinder heads are numbered to verify that they are assembled in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

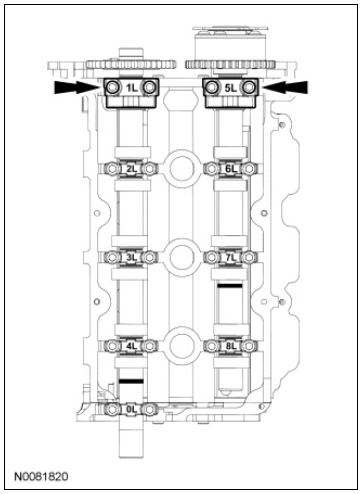
    NOTICE: **Do not install the camshaft journal thrust caps until all of the camshaft bearing caps have been installed, or damage to the thrust caps can occur.**

    Lubricate the bearing surfaces of the LH camshaft bearing caps with clean engine oil and install the bearing caps.

    - Loosely install the bolts.



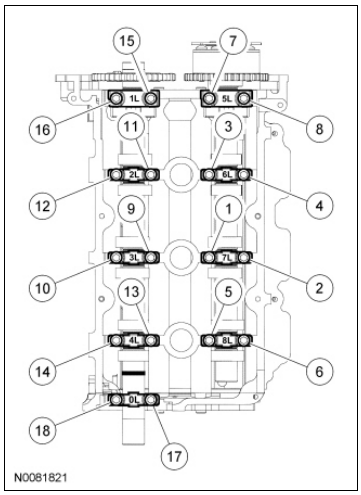
29. Lubricate the bearing surfaces of the LH camshaft bearing thrust caps with clean engine oil and install the bearing thrust caps.
    - Loosely install the bolts.



30. **NOTE:** Make sure to tighten the camshaft bearing cap bolts in sequence in 2 stages.

    Tighten the LH camshaft bearing cap bolts in the sequence shown in 2 stages.

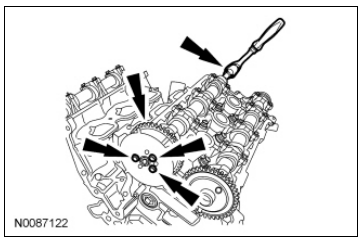
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Individually loosen and then tighten each camshaft bearing cap to 10 Nm (89 lb-in).



31. ***NOTICE:*** **Do not allow the camshaft to rotate from the neutral position while tightening the camshaft phaser and sprocket bolts or damage to the engine may occur.**

    NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for tightening of the camshaft phaser and sprocket bolts.

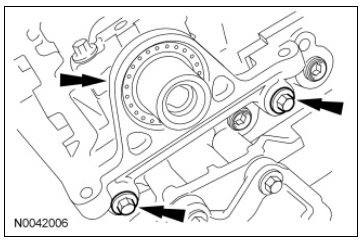
    Tighten the 3 LH camshaft phaser and sprocket bolts to 18 Nm (159 lb-in).



32. **NOTE:** Clean the sealing surface with metal surface prep before installing a new press-in-place gasket.

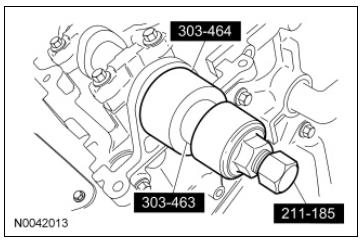
Install the camshaft oil seal retainer and the 2 bolts.

- Tighten to 10 Nm (89 lb-in).

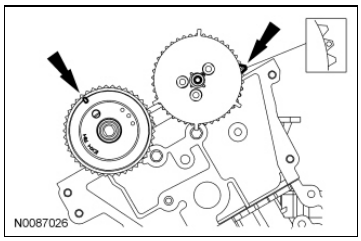


33. **NOTE:** Apply clean engine oil to the seal lip and seal bore before installing the seal.

    Using the Power Steering Pump Pulley Installer, Camshaft Oil Seal Installer and the Camshaft Oil Seal Protector, install a new camshaft oil seal.



34. Lubricate the RH camshafts with clean engine oil and carefully position the camshafts onto the cylinder head.
    - Align the RH camshafts as shown.



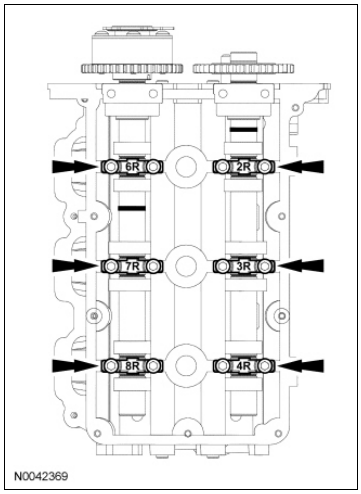
35. ***NOTICE:*** **Cylinder head camshaft journal caps and cylinder heads are numbered to verify that they are assembled in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

    NOTICE: **Do not install the camshaft journal thrust caps until all of the camshaft bearing caps have been installed or damage to the thrust caps can occur.**

    NOTE: Lubricate the bearing surfaces of the RH camshaft bearing caps with clean engine oil.

    Install the camshaft bearing caps.

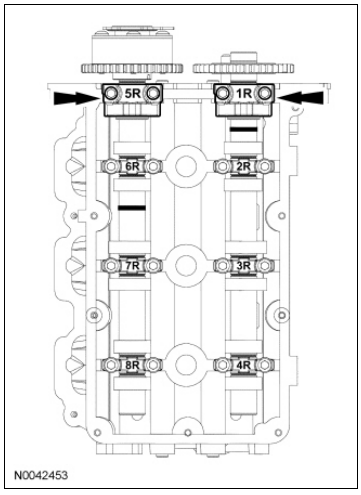
    - Loosely install the bolts.



36. **NOTE:** Lubricate the bearing surfaces of the RH camshaft bearing thrust caps with clean engine oil.

    Install the camshaft bearing thrust caps.

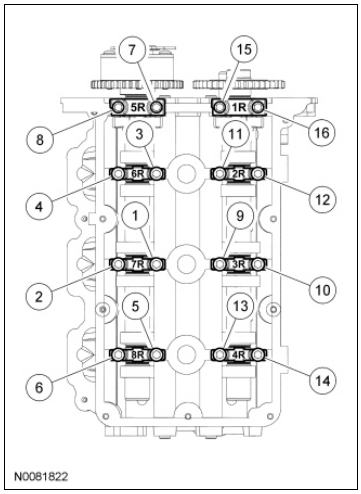
    - Loosely install the bolts.



37. **NOTE:** Make sure to tighten the camshaft bearing cap bolts in sequence in 2 stages.

    Tighten the RH camshaft bearing cap bolts in the sequence shown in 2 stages.

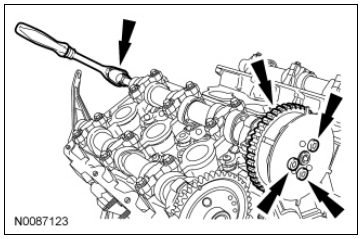
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Individually loosen and then tighten each camshaft bearing cap to 10 Nm (89 lb-in).



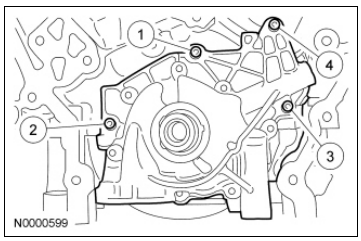
38. *NOTICE:* **Do not allow the camshaft to rotate from the neutral position while tightening the camshaft phaser and sprocket bolts or damage to the engine may occur.**

    NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for tightening of the camshaft phaser and sprocket bolts.

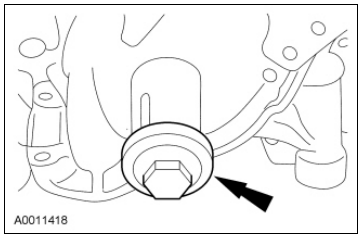
    Tighten the 3 RH camshaft phaser and sprocket bolts to 18 Nm (159 lb-in).



39. Position the oil pump and install the bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

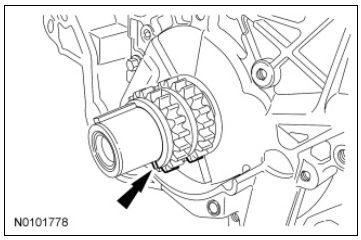


40. Remove the crankshaft pulley bolt.



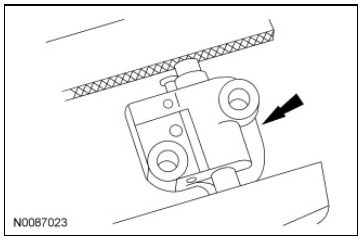
41. *NOTICE:* **Failure to verify correct timing drive component alignment will result in severe engine damage.**

Install the crankshaft sprockets with the timing marks facing out. The timing mark on the LH and RH timing chains will be aligned to this mark during assembly.



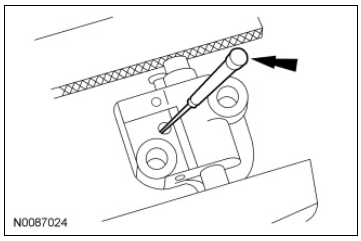
42. **NOTE:** LH shown, RH similar.

    Position the chain tensioner in a soft-jawed vise.



43. **NOTE:** LH shown, RH similar.

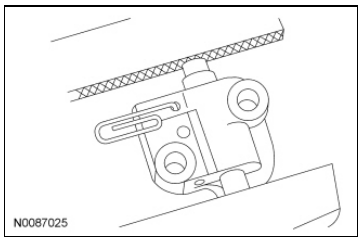
    Hold the chain tensioner ratchet lock mechanism away from the ratchet stem with a small pick.



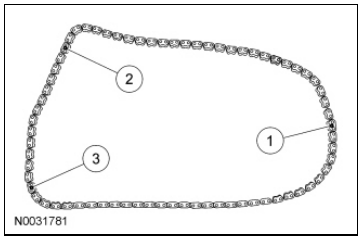
44. ***NOTICE:*** **During tensioner compression, do not release the ratchet stem until the tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.**

    Slowly compress the timing chain tensioner.

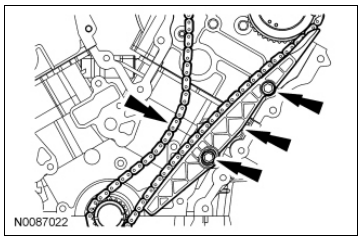
45. Retain the tensioner piston with a 1.5 mm (0.06 in) diameter wire or paper clip.



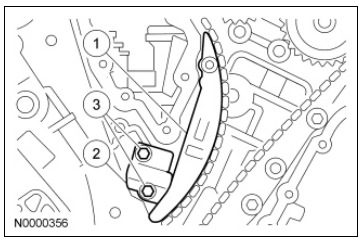
46. If timing marks in the timing chains are not evident, use a permanent-type marker to mark the crankshaft and camshaft timing marks on the LH and RH timing chains.
    1. Mark any link to use as the crankshaft timing mark.
    2. Starting with the crankshaft timing mark, count 29 links and mark the link.
    3. Continue counting to link 42 and mark the link.



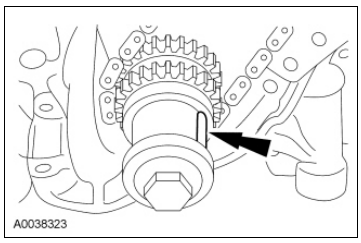
47. Position the LH timing chain and guide and install the bolts.
    - Tighten to 25 Nm (18 lb-ft).
    - Align the marks on the timing chain with the marks on the camshaft and crankshaft sprockets.



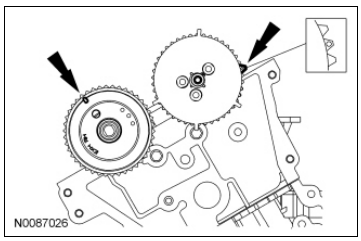
48. Install the LH timing chain tensioner arm and the LH timing chain tensioner.
    1. Install the tensioner arm.
    2. Position the tensioner.
    3. Install the bolts.
    - Tighten to 25 Nm (18 lb-ft).



49. Install the crankshaft pulley bolt and rotate the crankshaft clockwise 120 degrees until the crankshaft keyway is in the 3 o'clock position.

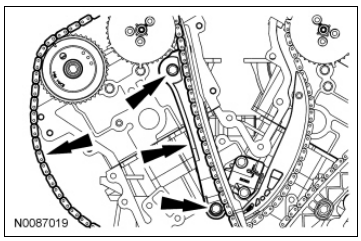


50. Verify that the RH camshafts are correctly positioned.

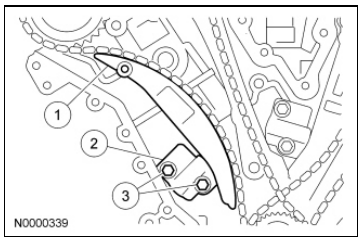


51. Install the RH timing chain and chain guide and install the bolts.
    - Tighten to 25 Nm (18 lb-ft).

- Align the marks on the timing chain with the marks on the camshaft and crankshaft sprockets.



52. Install the RH timing chain tensioner and tensioner arm.
    1. Install the tensioner arm.
    2. Position the tensioner.
    3. Install the bolts.
    - Tighten to 25 Nm (18 lb-ft).



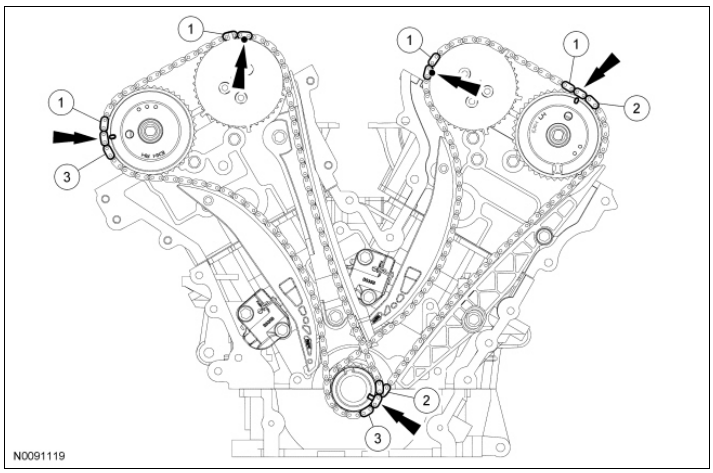
53. Remove the LH and RH timing chain tensioner piston retaining wires.

54. Rotate the crankshaft counterclockwise 120 degrees to TDC .

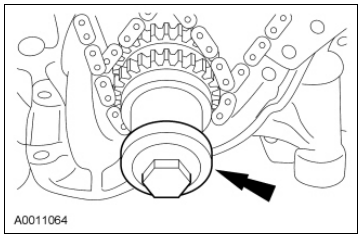
55. ***NOTICE:*** **Failure to verify correct timing drive component alignment will result in severe engine damage.**

    Verify the timing with the following steps.

    1. There should be 12 chain links between the camshaft timing marks.
    2. There should be 27 chain links between the camshaft and the crankshaft timing marks.
    3. There should be 30 chain links between the camshaft and the crankshaft timing marks.

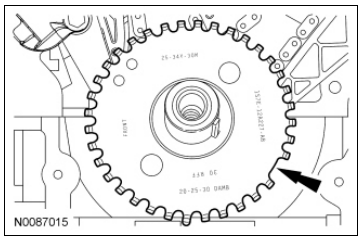


56. Remove the crankshaft pulley bolt and washer.



57. **NOTE:** This pulse wheel is used in several different engines. Install the pulse wheel with the keyway in the slot stamped "30RFF" only (orange in color).

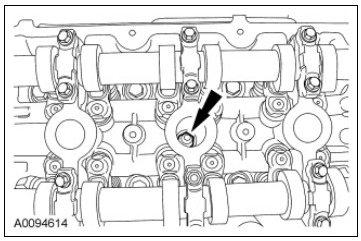
    Install the ignition pulse wheel.



58. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs, damage can occur to the cylinder head or spark plug.**

    Install the LH and RH spark plugs.

    - Tighten to 15 Nm (133 lb-in).



59. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.**

    NOTICE: **Do not damage the oil pan gasket while cleaning the sealant from the lower cylinder block-to-oil pan joint.**

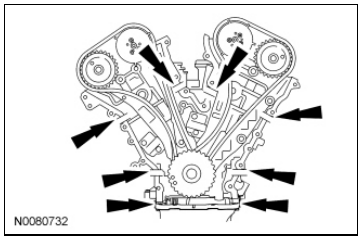
    Use a plastic scraping tool to remove all traces of sealant.

    - Clean all sealing surfaces with metal surface prep and install new gaskets.

60. **NOTE:** Clean and degrease the sealing surfaces with metal surface prep before applying gasket and sealant.

    NOTE: The front cover must be installed and the bolts tightened within 4 minutes of sealant application.

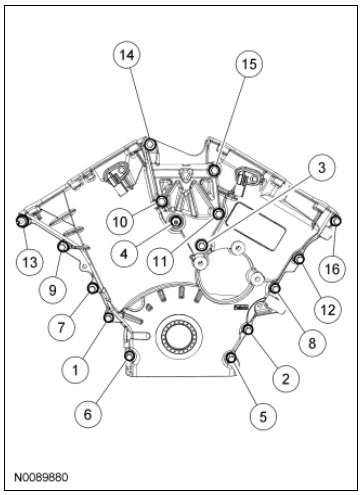
    Apply a 6 mm (0.24 in) dot of silicone gasket and sealant to the cylinder block to lower cylinder block and cylinder head mating surfaces.



61. **NOTE:** Fasteners 4 and 13 are stud bolts.

    Position the front cover and install the bolts and stud bolts.

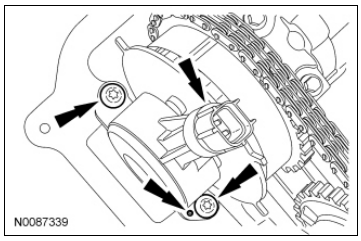
    - Tighten in the sequence shown to 25 Nm (18 lb-ft).



62. **NOTE:** Note the position of the alignment dowel on the engine front cover.

    Install the 2 bolts and the LH Variable Camshaft Timing (VCT) solenoid.

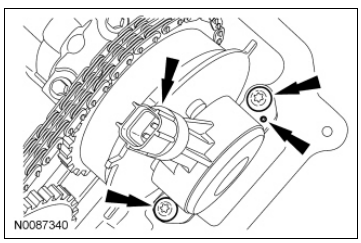
    - Tighten to 10 Nm (89 lb-in).



63. **NOTE:** Note the position of the alignment dowel on the engine front cover.

    Install the 2 bolts and the RH VCT solenoid.

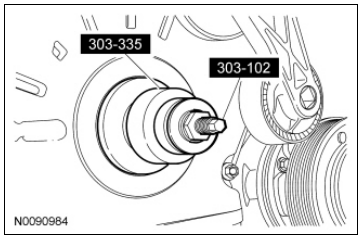
    - Tighten to 10 Nm (89 lb-in).



64. **NOTE:** Clean all sealing surfaces with metal surface prep.

    Apply clean engine oil to the seal lip and seal bore before installing the seal.

65. Using the Front Cover Oil Seal Installer and the Crankshaft Vibration Damper Installer, install a new crankshaft front seal.

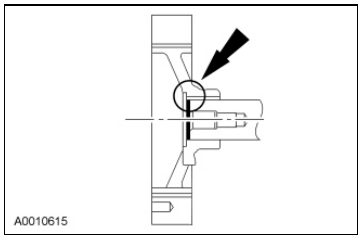


66. **NOTE:** Clean the keyway and slot using metal surface prep before applying silicone gasket and sealant.

    NOTE: Sealing surfaces must be free of dirt and oil.

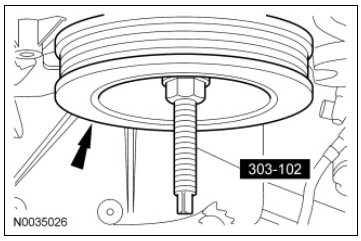
    NOTE: The crankshaft pulley must be installed and the bolt tightened within 4 minutes of sealant application.

    Apply silicone gasket and sealant to the end of the crankshaft pulley keyway slot.

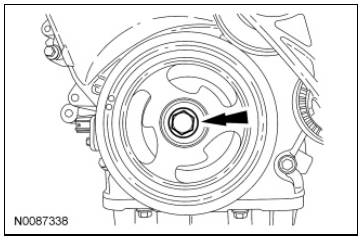


67. **NOTE:** Lubricate the outside diameter sealing surface with clean engine oil.

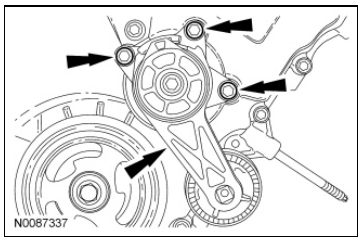
    Using the Crankshaft Vibration Damper Installer, install the crankshaft pulley.



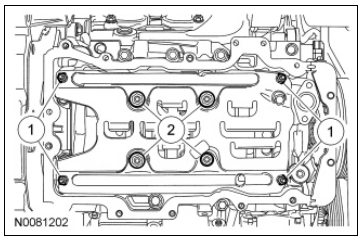
68. Install the bolt and washer. Tighten the bolt in 4 stages:
    - Stage 1: Tighten to 120 Nm (89 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.



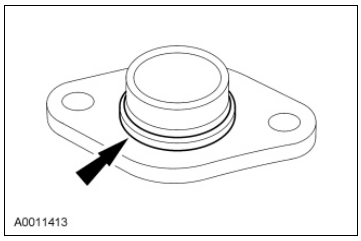
69. Install the belt tensioner and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



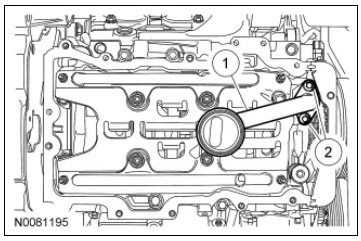
70. Install the 8 nuts and the oil pan baffle.
    1. Tighten the 4 M6 oil pan baffle nuts in 2 stages.
        - ♦ Stage 1: Tighten to 5 Nm (44 lb-in).
        - ♦ Stage 2: Tighten an additional 45 degrees.
    2. Then install and tighten the 4 M8 oil pan baffle nuts in 2 stages.
        - ♦ Stage 1: Tighten to 15 Nm (133 lb-in).
        - ♦ Stage 2: Tighten an additional 45 degrees.



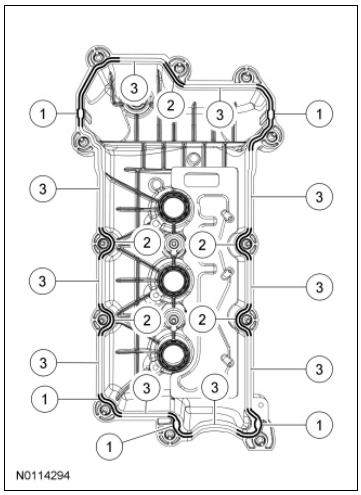
71. Install a new O-ring seal on the oil pump screen and pickup tube.
    - Lubricate the O-ring seal with clean engine oil.



72. Install the oil pump screen and pickup tube.
    1. Position the oil pump screen and pickup tube.
    2. Install the 2 bolts and tighten to 10 Nm (89 lb-in).



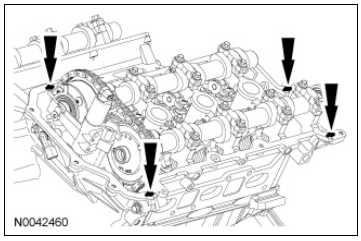
73. Install the new gasket in the LH valve cover in the following sequence.
    1. Install the gasket at waffle pads and then the corners.
    2. Install the gasket around bolt holes.
    3. Install the remaining part of the gasket.



74. **NOTE:** The valve cover must be installed and the bolts and studs tightened within 4 minutes of sealant application.

    NOTE: Clean cylinder head and front cover surface and the cam seal retainer-to-cylinder head surface using metal surface prep before applying silicone gasket and sealant.

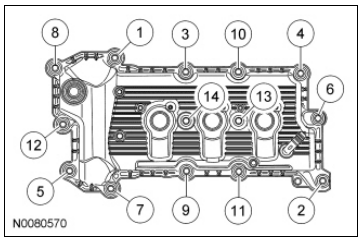
    Apply an 8 mm (0.31 in) dot of silicone gasket and sealant at the cylinder block to front cover mating surface and the cam seal retainer-to-cylinder head joints.



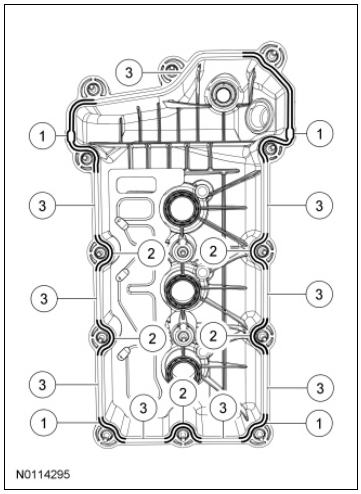
75. **NOTE:** Install a new valve cover gasket.

    Position the LH valve cover and install the bolts and stud bolts.

    - Tighten in the sequence shown to 10 Nm (89 lb-in).



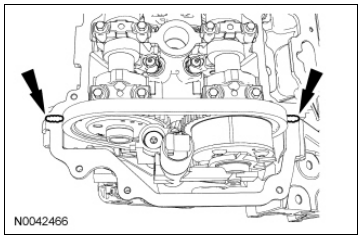
76. Install the new gasket in the RH valve cover in the following sequence.
    1. Install the gasket at waffle pads and then the corners.
    2. Install the gasket around bolt holes.
    3. Install the remaining part of the gasket.



77. **NOTE:** The valve cover must be installed and the bolts and stud bolts tightened within 4 minutes of sealant application.

    NOTE: Clean cylinder head and front cover surface using metal surface prep before applying silicone gasket and sealant.

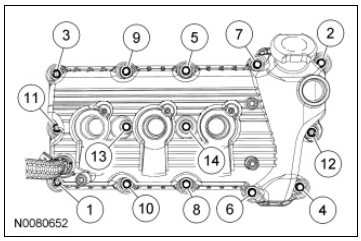
    Apply an 8 mm (0.31 in) dot of silicone gasket sealant to the front cover-to-cylinder head joints.



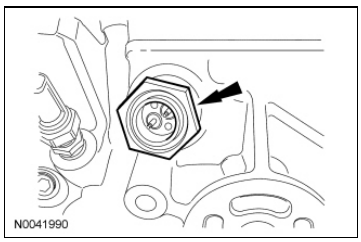
78. **NOTE:** Install a new valve cover gasket.

    Position the RH valve cover and install the bolts and stud bolts.

    - Tighten in the sequence shown to 10 Nm (89 lb-in).



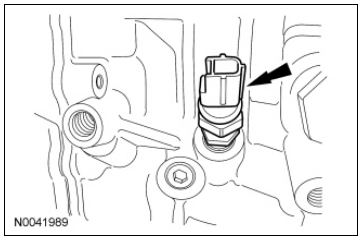
79. If equipped, install the block heater.
    - Tighten to 21 Nm (15 lb-ft).



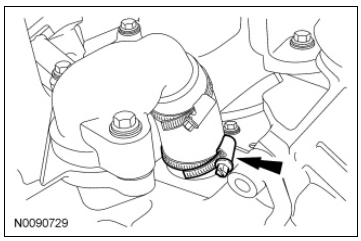
80. **NOTE:** Apply thread sealant with PTFE to the Engine Oil Pressure (EOP) switch threads.

    Install the EOP switch.

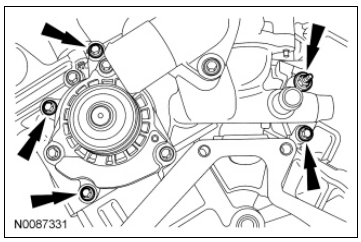
    - Tighten to 14 Nm (124 lb-in).



81. Position the coolant pump housing and attach the coolant hose.
    - Tighten the clamp to 7 Nm (62 lb-in).



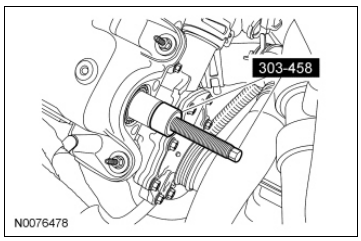
82. Install the 5 coolant pump housing bolts.
    - Tighten to 10 Nm (89 lb-in).



83. ***NOTICE:*** **Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.**

    Install the Camshaft Pulley Installer in the camshaft as shown in the illustration.

    - Adjust the collar on the Camshaft Pulley Installer screw to get the best thread engagement in the rear of the camshaft.

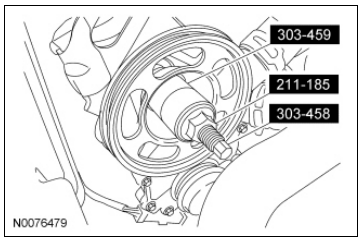


84. ***NOTICE:*** **Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.**

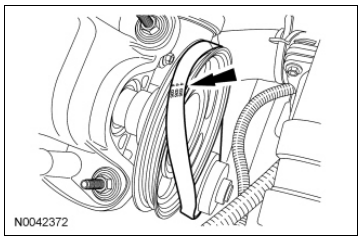
NOTE: Only the roller collared nut from the Power Steering Pump Pulley Installer (211-185) is used on Camshaft Pulley Installer (303-485).

Position the coolant pump pulley over the previously installed Camshaft Pulley Installer and on the end of the camshaft. Install the Camshaft Pulley Installer, Power Steering Pump Pulley Installer and the Water Pump Pulley Spacer as shown in the illustration.

- Using the Camshaft Pulley Installer, Power Steering Pump Pulley Installer and the Water Pump Pulley Spacer, install a new service coolant pump pulley flush with the end of the camshaft.



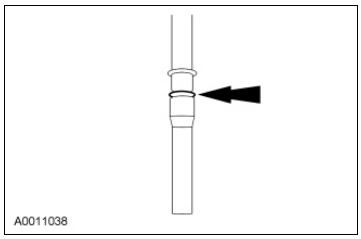
85. Install the coolant pump belt on the coolant pump pulley and position it on the camshaft pulley.



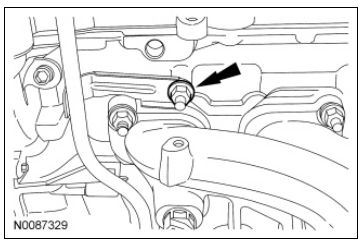
86. ***NOTICE:*** **Do not use any screwdrivers, pliers or other metal objects that could cause damage to the belt or camshaft pulley while installing the belt.**

    Rotate the crankshaft clockwise to seat the water pump belt on the camshaft pulley.

87. Install a new O-ring on the oil level indicator tube. Apply clean engine oil to the O-ring.

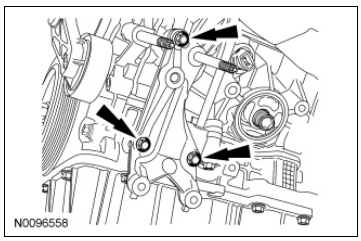


88. Position the oil level indicator and tube and install the stud bolt.
    - Tighten to 9 Nm (80 lb-in).

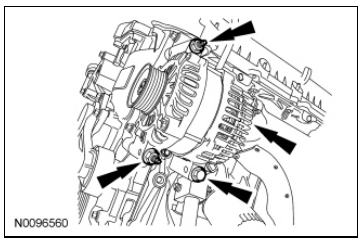


89. Install the 3 bolts and the A/C compressor bracket.

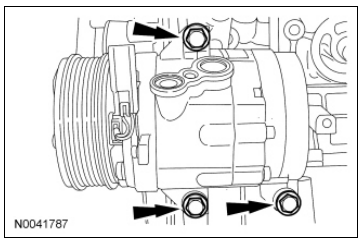
- Tighten to 25 Nm (18 lb-ft).



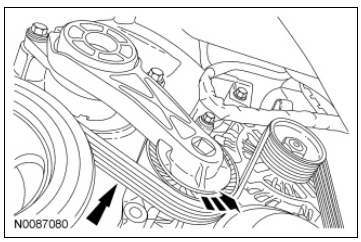
90. Position the generator and install the bolt and 2 nuts.
    - Tighten to 47 Nm (35 lb-ft).



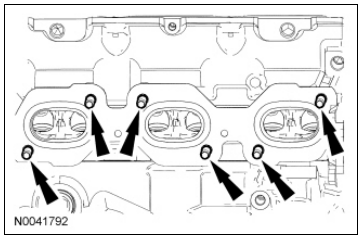
91. Install the A/C compressor and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



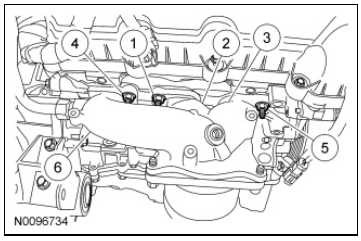
92. Rotate the accessory drive belt tensioner counterclockwise and install the accessory drive belt.



93. Install 6 new RH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).

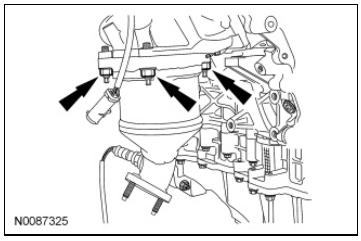


94. Install a new gasket and the RH exhaust manifold and new nuts.
    - Tighten the nuts in 2 stages in the sequence shown.
        - ♦ Stage 1: Tighten to 20 Nm (177 lb-in).
        - ♦ Stage 2: Tighten to 20 Nm (177 lb-in).

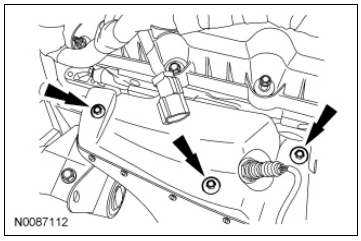


Front Wheel Drive (FWD)

95. Install a new gasket and the RH catalytic converter and the 3 new nuts.
    - Tighten to 40 Nm (30 lb-ft).



96. Install the 3 bolts and the RH heat shield.
    - Tighten to 10 Nm (89 lb-in).



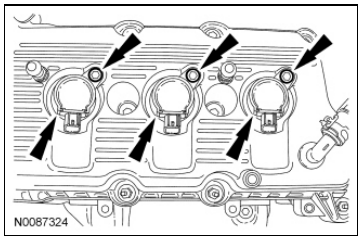
All engines

97. **NOTE:** LH shown, RH similar.

    Apply a light film of silicone brake caliper grease and dielectric compound to the interior of the spark plug boot prior to installation.

    Install the 6 coil-on-plugs and the bolts.

    - Tighten to 6 Nm (53 lb-in).

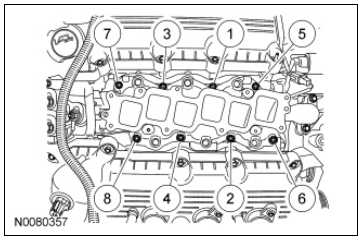


98. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

NOTE: Clean and inspect all sealing surfaces. Install new gaskets.

Position the lower intake manifold and install the 8 bolts.

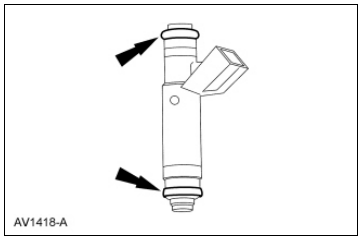
- Tighten in the sequence shown to 10 Nm (89 lb-in).



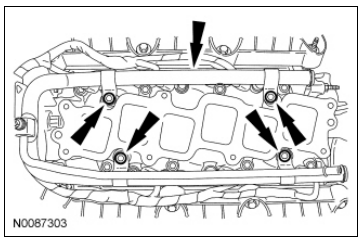
99. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. Use of ordinary O-rings can cause the fuel system to leak. Do not reuse the O-ring seals.**

    Install new fuel injector O-rings.

    - Separate the fuel injectors from the fuel rail.
    - Remove and discard the fuel injector O-rings.
    - Install new O-rings and lubricate with clean engine oil.
    - Install the fuel injectors onto the fuel rail.



100. Install the 4 bolts and the fuel rail and injectors assembly.
    - Tighten to 10 Nm (89 lb-in).

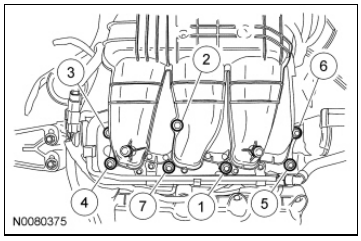


101. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

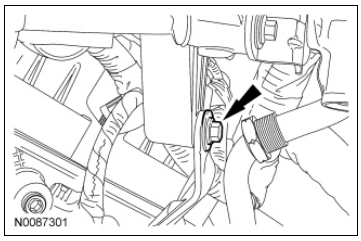
    NOTE: Clean and inspect all sealing surfaces. Install new gaskets.

    Position the upper intake manifold and install the 7 bolts.

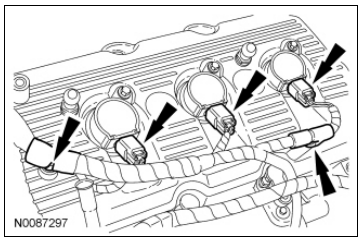
    - Tighten the bolts in 2 stages in the sequence shown.
        - ♦ Stage 1: Tighten to 10 Nm (89 lb-in).
        - ♦ Stage 2: Tighten an additional 45 degrees.



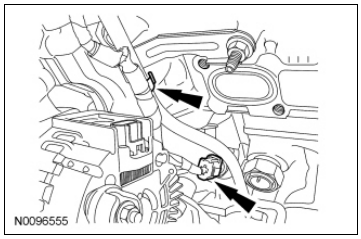
102. Loosen the upper intake manifold bracket lower bolt. Install the upper bolts (1 shown), then tighten all the bolts.
    - Tighten to 10 Nm (89 lb-in).



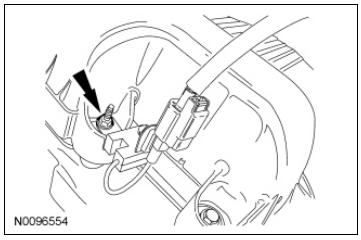
103. Connect the 3 LH coil-on-plug electrical connectors.
    - Attach the 2 wiring harness retainers.



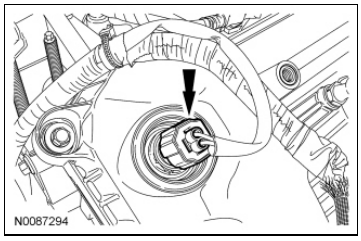
104. Connect the Engine Oil Pressure (EOP) switch electrical connector and attach the wiring retainer to the oil indicator tube.



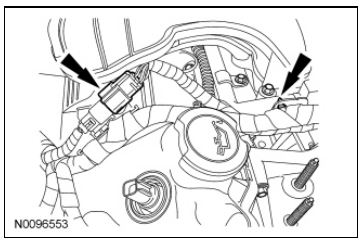
105. Install the radio interference capacitor and the nut.
    - Tighten to 6 Nm (53 lb-in).



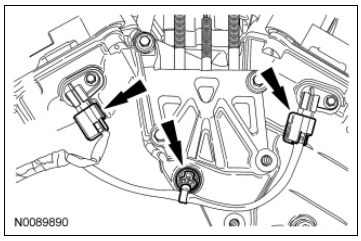
106. Connect the LH VCT electrical connector.



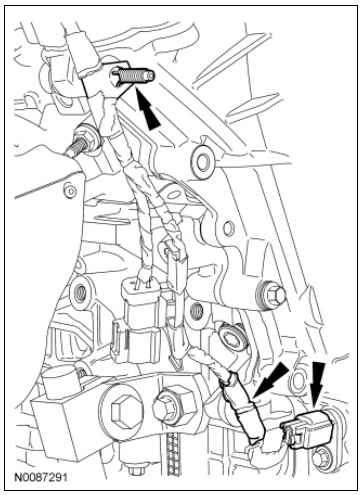
107. Connect the fuel injector wiring harness electrical connector and attach the wiring harness retainer.



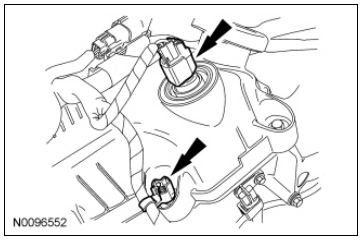
108. Connect the 2 Camshaft Position (CMP) sensor electrical connectors and attach the wiring harness retainer from the engine front cover stud bolt.



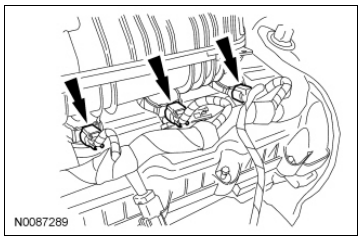
109. Connect the Crankshaft Position (CKP) sensor electrical connector and attach the 2 wiring harness retainers.



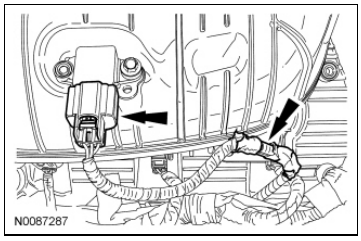
110. Connect the RH VCT electrical connector and attach the wiring harness retainer to the valve cover stud bolt.



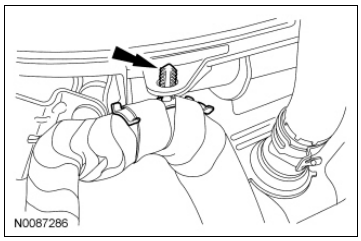
111. Connect the RH coil-on-plug electrical connectors.
    - Attach the 2 wiring harness retainers.



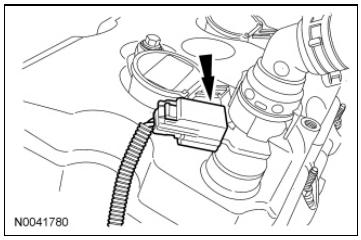
112. Connect the Manifold Absolute Pressure (MAP) electrical connector and attach the wiring retainer.



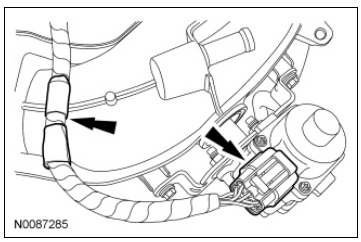
113. Attach the wiring harness retainer to the upper intake manifold.



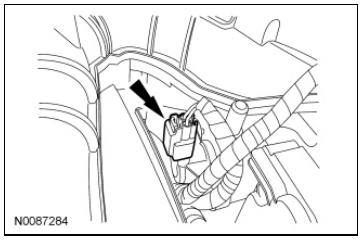
114. Connect the PCV valve electrical connector.



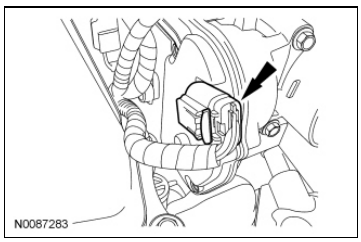
115. Connect the EGR regulator electrical connector and attach the wiring retainer.



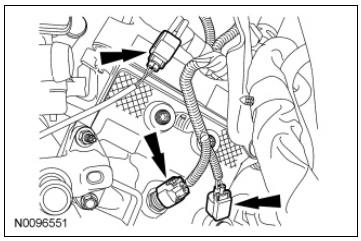
116. Connect the Evaporative Emission (EVAP) canister purge valve electrical connector.



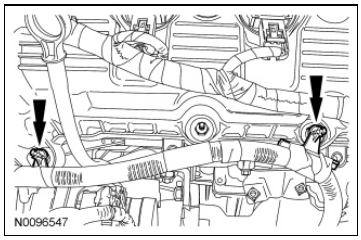
117. Connect the electronic throttle control electrical connector.



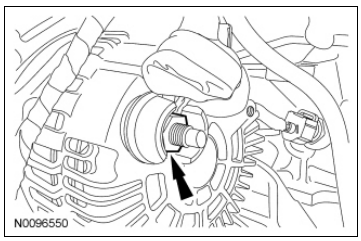
118. Connect the 3 engine wiring connectors.
    - Connect the engine block Knock Sensor (KS) electrical connector.
    - Connect the Cylinder Head Temperature (CHT) sensor electrical connector.
    - Connect the cylinder head KS electrical connector.



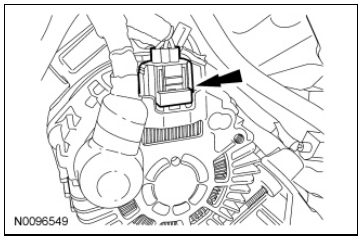
119. Position the B+ wiring harness and attach the 2 harness retainers to the valve cover stud bolts.



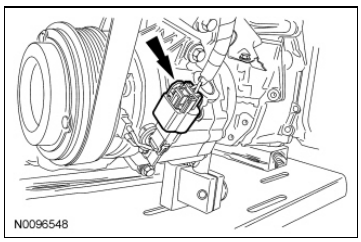
120. Install the B+ wire and nut on the generator.
    - Tighten to 8 Nm (71 lb-in).



121. Connect the generator electrical connector.

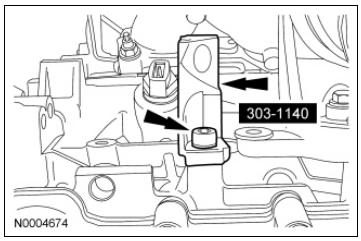


122. Connect the A/C compressor clutch electrical connector.

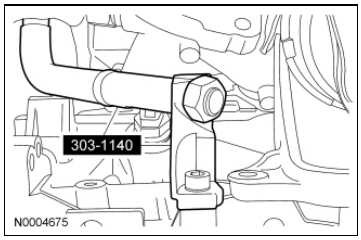


123. **NOTE:** When installing the lower half of the lifting bracket it will be easier to loosely install the upper bolt first then install the lower bolt.

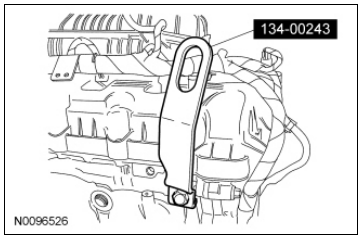
    Install the lower half of the Engine Lifting Bracket Set.



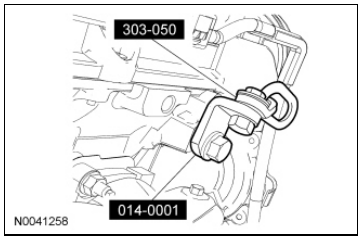
124. Install the upper half of the Engine Lifting Bracket Set.



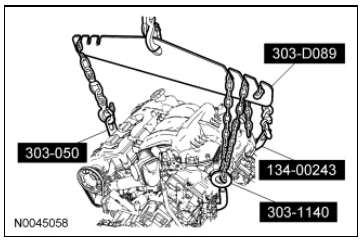
125. Install the Engine Lifting Bracket.



126. Install the Engine Lifting Bracket and the Universal Adapter Bracket.

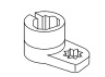


127. Using the Spreader Bar, Engine Lifting Brackets, Engine Lifting Bracket Set and a suitable engine crane, remove the engine from the engine stand.



Engine

Special Tool(s)

 ST2873-A	Engine Lifting Bracket Set 303-1140
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST2793-A	Lifting Bracket, Engine 303-050 (T70P-6000)
 ST2463-A	Lifting Brackets, Engine 134-00243 or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent
 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2743A	Adjustable Grip Arm, 1735A 014-00001 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

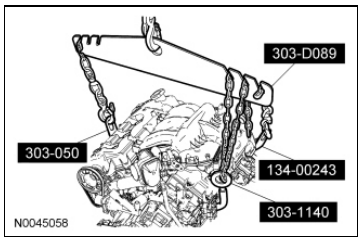
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Installation

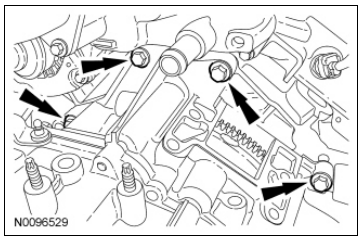
NOTICE: **If the oil pan was removed during engine disassembly, it must be installed after engine and transaxle are assembled and the transaxle-to-engine bolts are installed. Failure to follow this assembly sequence can result in engine oil leaks.**

All vehicles

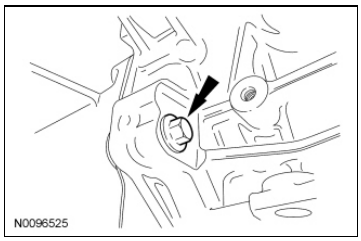
1. Using the Spreader Bar, Engine Lifting Brackets, Engine Lifting Bracket Set and a suitable engine crane, align the transaxle to the engine.



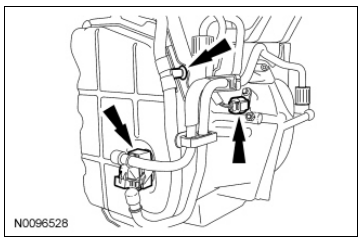
2. Install the 4 transaxle-to-engine bolts.
   - Tighten to 48 Nm (35 lb-ft).



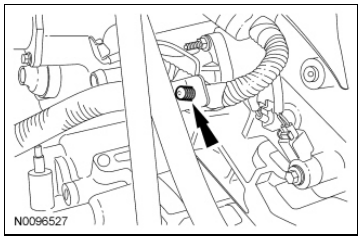
3. Install the transaxle-to-engine bolt.
   - Tighten to 48 Nm (35 lb-ft).



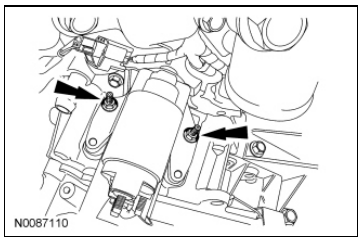
4. Connect the 2 transmission electrical connectors and attach the wiring harness retainer to the stud bolt.



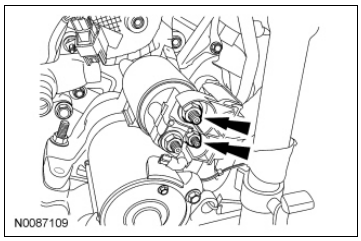
5. Attach the wiring harness retainer to the transmission indicator tube.



6. Install the starter and the 2 stud bolts.
    - Tighten to 27 Nm (20 lb-ft).



7. Install the starter wiring and the 2 nuts.
    - Tighten the small starter motor solenoid wire nut to 5 Nm (44 lb-in).
    - Tighten the large starter motor solenoid battery cable nut to 12 Nm (106 lb-in).

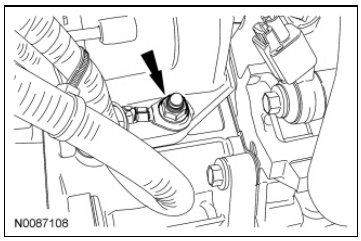


8. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.**

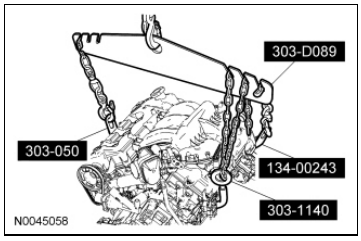
    Use a plastic scraping tool to remove all traces of the oil pan gasket.

    - Clean all sealing surfaces with metal surface prep and install a new oil pan gasket.

9. Install the starter wiring ground wire and nut.
    - Tighten to 18 Nm (159 lb-in).

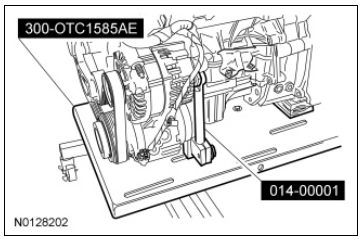


10. Using the Spreader Bar, Engine Lifting Brackets, Engine Lifting Bracket Set and a suitable engine crane, position the engine and transaxle onto the lift table.



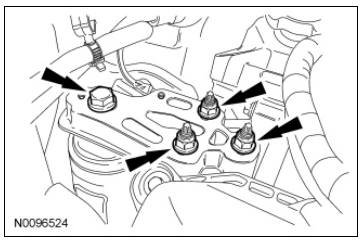
11. **NOTE:** Position a suitable block of wood under the transaxle.

    Install the Adjustable Grip Arm and the Powertrain Lift to the engine.

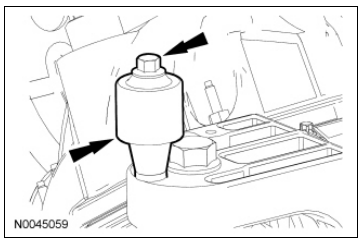


12. Raise the engine and transaxle up into the vehicle.

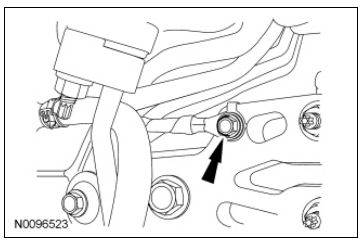
13. Install the engine support insulator bracket, 3 nuts and the bolt.
    - Tighten the nuts to 63 Nm (46 lb-ft).
    - Tighten the bolt to 115 Nm (85 lb-ft).



14. Install the damper and bolt.
    - Tighten to 23 Nm (17 lb-ft).

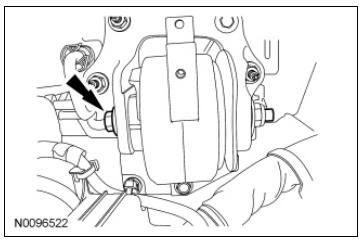


15. Install the ground strap and bolt on the engine mount bracket.
    - Tighten to 10 Nm (89 lb-in).

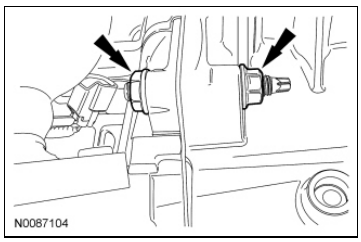


16. Install the rear transaxle support through bolt.

- Tighten to 103 Nm (76 lb-ft).



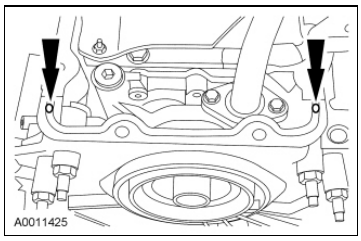
17. Install the transaxle-to-engine stud and 2 nuts.
    - Tighten to 48 Nm (35 lb-ft).



18. **NOTE:** Clean and degrease all sealing surfaces with metal surface prep.

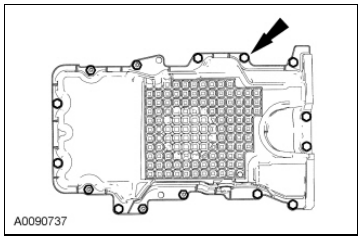
    NOTE: The oil pan must be installed and the bolts tightened within 4 minutes of the sealant application.

    Apply a 10 mm (0.39 in) dot of silicone gasket and sealant to the front cover-to-cylinder block sealing surface.

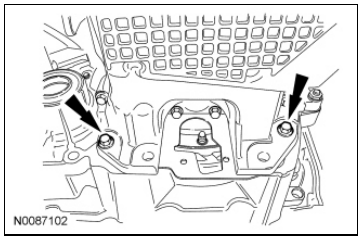


19. **NOTE:** Install a new oil pan gasket.

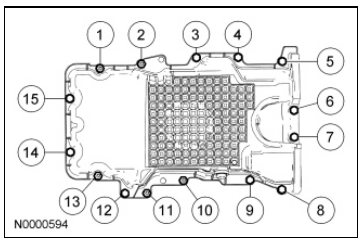
    Position the oil pan and gasket and loosely install the bolts and stud bolts.



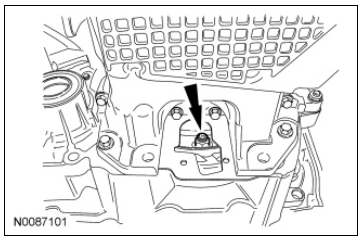
20. Install the 2 oil pan-to-transaxle bolts.
    - Tighten to 40 Nm (30 lb-ft).



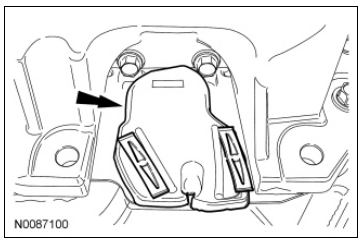
21. Tighten the oil pan bolts in the sequence shown to 25 Nm (18 lb-ft).



22. Install the 4 torque converter nuts.
    - Tighten to 40 Nm (30 lb-ft).

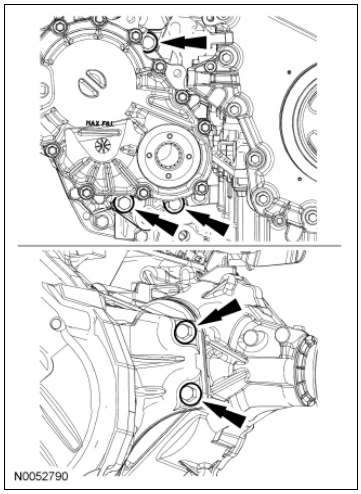


23. Install the access cover.

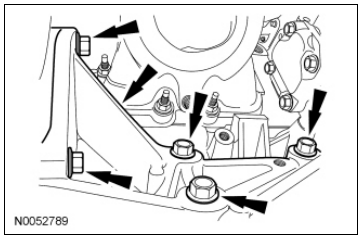


All-Wheel Drive (AWD) vehicles

24. Install the Power Transfer Unit (PTU) and the 5 bolts.
    - Tighten to 90 Nm (66 lb-ft).



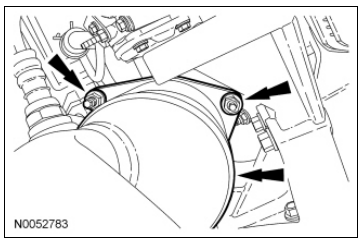
25. Install the PTU support bracket and the 5 bolts.
    - Tighten to 55 Nm (41 lb-ft).



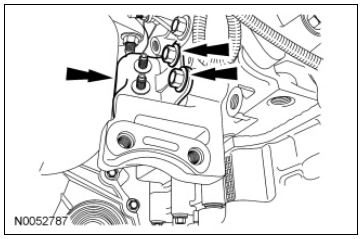
26. **NOTE:** A new PTU seal must be installed whenever the intermediate shaft is removed.

    Install a new PTU seal. For additional information, refer to Section 308-07B .

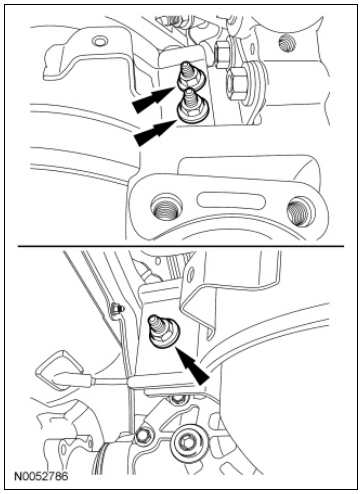
27. Using a new gasket, install the RH catalytic converter and 3 new nuts.
    - Tighten to 40 Nm (30 lb-ft).



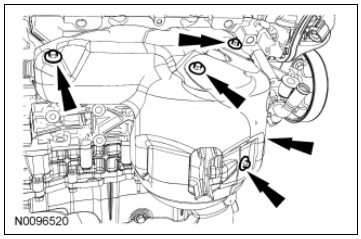
28. Install the RH exhaust heat shield bracket (inboard half) and the 2 bolts.
    - Tighten to 40 Nm (30 lb-ft).



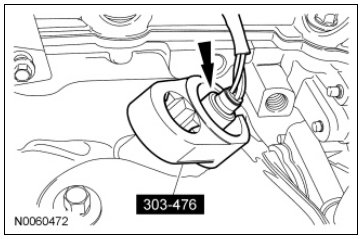
29. Install the RH exhaust heat shield bracket (outboard half) and the 3 nuts.
    - Tighten to 20 Nm (177 lb-in).



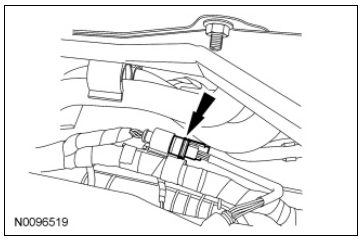
30. Install the RH exhaust heat shield and the 6 bolts.
    - Tighten to 10 Nm (89 lb-in).



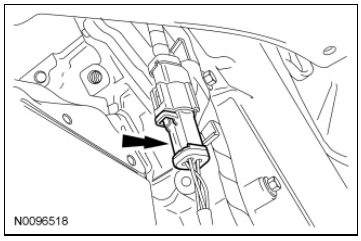
31. Using the Exhaust Gas Oxygen Sensor Socket, install the RH Heated Oxygen Sensor (HO2S).
    - Calculate the correct torque wrench setting for the following torque. Refer to the Torque Wrench Adapter Formulas in the Appendix.
    - To install, tighten to 48 Nm (35 lb-ft).



32. Connect the RH HO2S electrical connector.

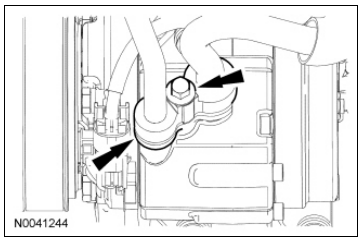


33. Connect the RH Catalyst Monitor Sensor (CMS) electrical connector.

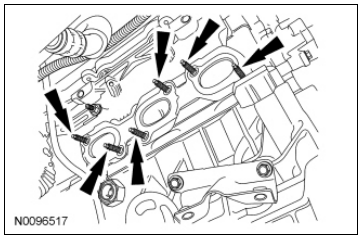


All vehicles

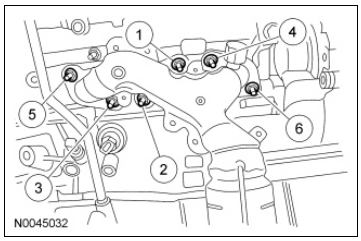
34. Position the A/C manifold onto the A/C compressor and install the bolt.
    - Install a new gasket.
    - Tighten to 15 Nm (133 lb-in).



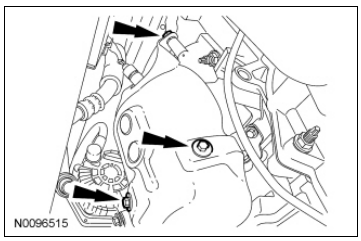
35. Install 6 new LH catalytic converter studs.
    - Tighten to 12 Nm (106 lb-in).



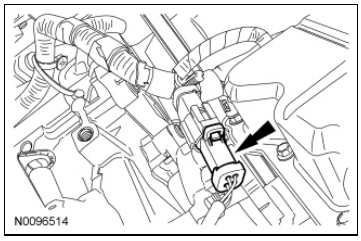
36. Install a new gasket, the LH catalytic converter and 6 new nuts.
    - Tighten to 20 Nm (177 lb-in) in the sequence shown.



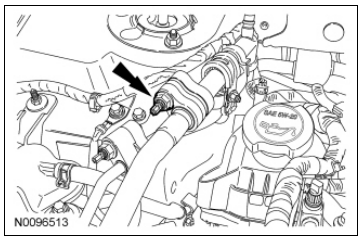
37. Install the heat shield and the 4 bolts (3 shown).
    - Tighten to 10 Nm (89 lb-in).



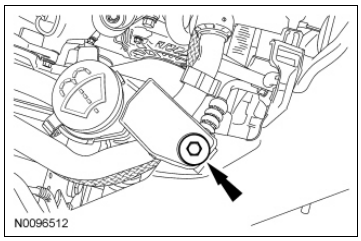
38. Connect the LH CMS electrical connector.



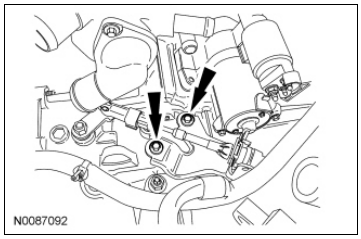
39. Connect the A/C tube and install the nut.
    - Install a new gasket.
    - Tighten to 8 Nm (71 lb-in).



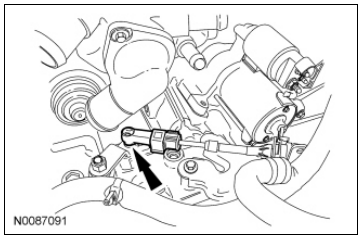
40. Install the A/C tube/windshield washer bottle bracket bolt.
    - Tighten to 10 Nm (89 lb-in).



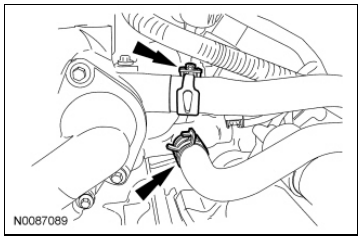
41. Position the transaxle control cable bracket in place, install the 2 bolts.
    - Tighten to 23 Nm (17 lb-ft).



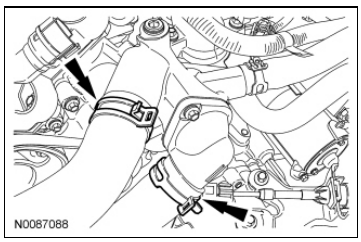
42. Connect the gearshift cable to the transaxle.



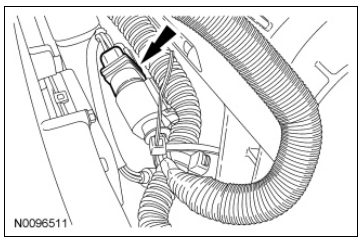
43. Connect the 2 heater hoses.



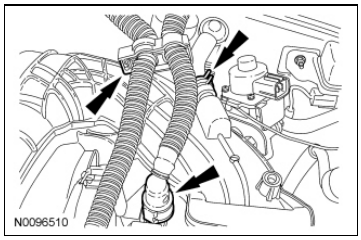
44. Connect the upper and lower radiator hoses.



45. Connect the LH HO2S electrical connector.



46. Connect the Evaporative Emission (EVAP) tube-to- EVAP canister purge valve quick connect coupling and the brake booster vacuum tube to the upper intake manifold.
    - Attach the fuel tube and EVAP tube-to- EVAP canister purge valve tube retainer to the upper intake manifold.

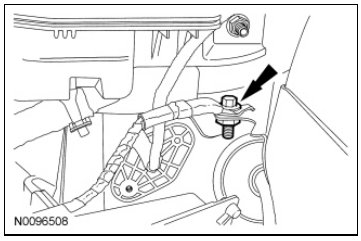


47. Connect the fuel supply tube to the fuel rail. For additional information, refer to Section 310-00 .

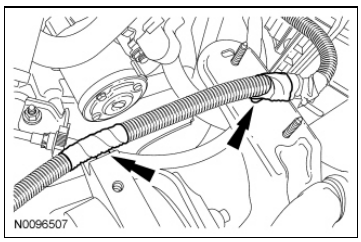
48. Connect the 3 PCM electrical connectors.



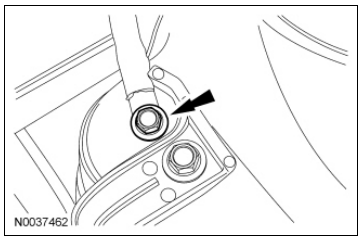
49. Position the PCM ground wire and install the bolt.
    - Tighten to 10 Nm (89 lb-in).



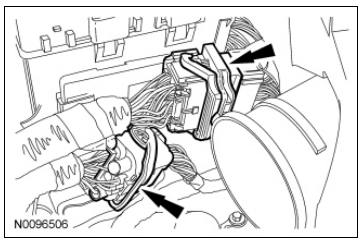
50. Attach the 2 wiring harness retainers to the battery tray bracket and transaxle mount.



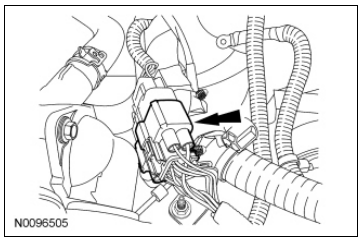
51. Install the ground wire-to-inner fender and bolt.
    - Tighten to 10 Nm (89 lb-in).



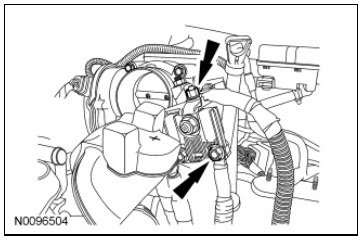
52. Connect the 2 engine wiring harness electrical connectors.



53. Connect the engine wiring harness electrical connector.



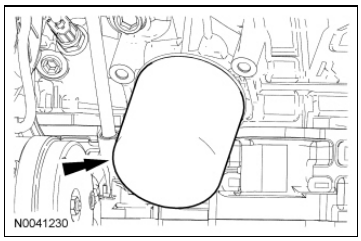
54. Connect the power feed wires to the battery terminal and install the 2 nuts.
    - Tighten to 6 Nm (53 lb-in).



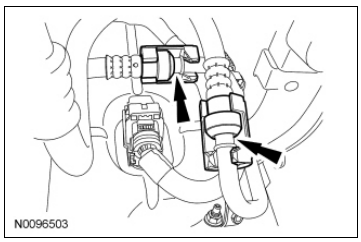
55. Install the battery tray. For additional information, refer to Section 414-01 .

56. Install the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to Section 303-12B .

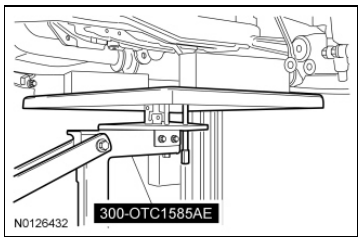
57. Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.



58. Position the transmission fluid cooler tubes in place. Install the transmission fluid cooler tubes in the transaxle by inserting the tube into the fitting until a click is heard/felt. Pull back to confirm connection is secure and install the secondary latches.



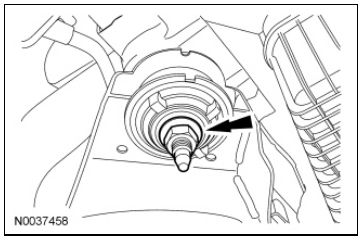
59. Place the subframe assembly on the Powertrain Lift and raise the subframe into the installed position.



60. **NOTE:** LH shown, RH similar.

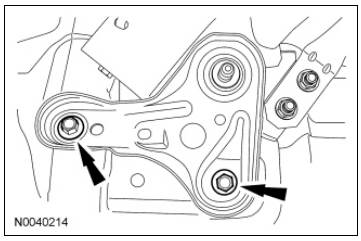
    Install the front subframe nuts.

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



61. **NOTE:** LH shown, RH similar.

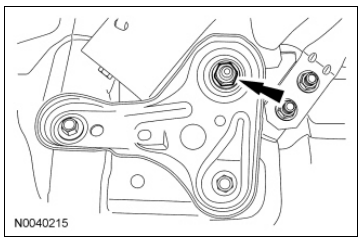
    Position the subframe brackets and install the bolts finger-tight.



62. **NOTE:** LH shown, RH similar.

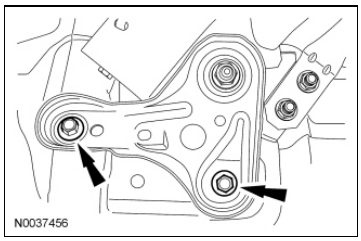
    Install the subframe nuts.

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

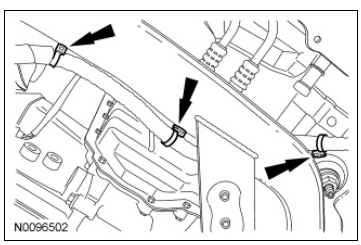


63. **NOTE:** LH shown, RH similar.

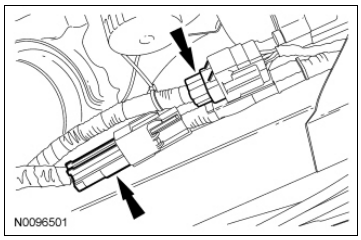
    Tighten the subframe bracket-to-body bolts to 103 Nm (76 lb-ft).



64. Attach the 3 wiring harness retainers to the LH front of the subframe.



65. Connect the 2 Electronic Power Assist Steering (EPAS) electrical connector on the front of the subframe.

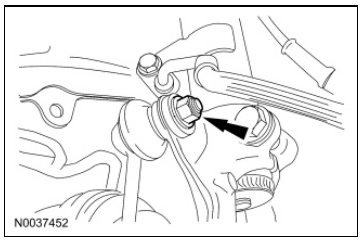


66. Install the intermediate shaft and the LH halfshaft. For additional information, refer to Section 205-04 .

67. **NOTE:** LH shown, RH similar.

    Install the stabilizer bar links and nuts to the struts.

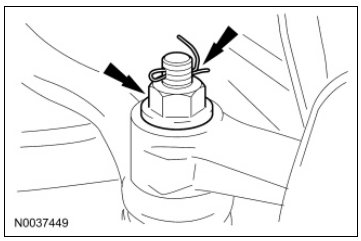
    - Tighten to 40 Nm (30 lb-ft).



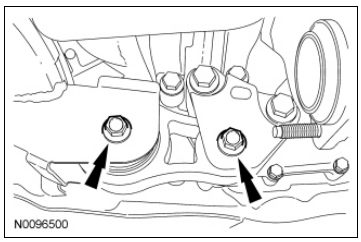
68. **NOTE:** LH shown, RH similar.

    Install the tie-rod ends and nuts.

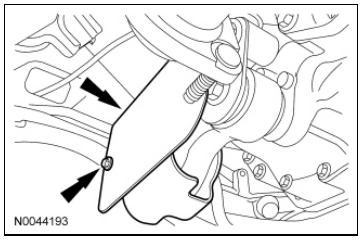
    - Tighten to 48 Nm (35 lb-ft).
    - Install the cotter pin.



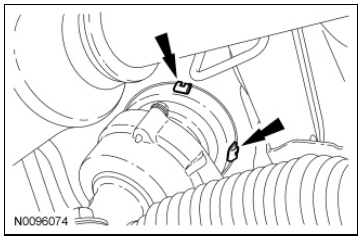
69. Install the engine roll restrictor and the 2 bolts.
    - Tighten to 90 Nm (66 lb-ft).



70. If equipped, install the heat shield and the 2 bolts.

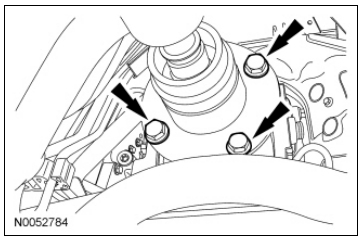


71. Slide the steering gear-to-dash seal onto the steering gear and engage the 4 retaining clips (2 shown) into the body.
    - From under the vehicle, verify that the seal is properly installed on the steering gear and the retaining clips are fully engaged into the body.



AWD vehicles

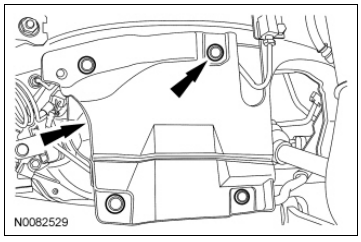
72. Line up the index marks on the rear driveshaft to the index marks on the PTU flange made during removal and install the 4 bolts (3 shown).
    - Tighten to 70 Nm (52 lb-ft).



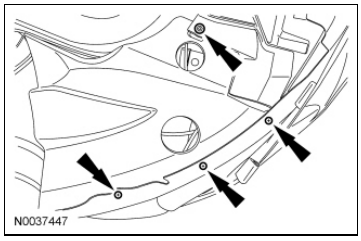
All vehicles

73. Install the exhaust flexible pipe. For additional information, refer to Section 309-00 .

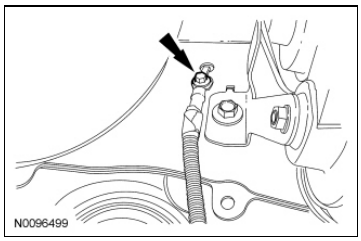
74. Install the LH splash shield and the 6 pin-type retainers (4 shown).



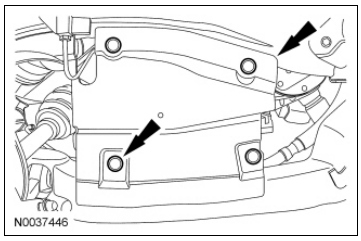
75. Position the LH fender splash shield and install the 4 screws.



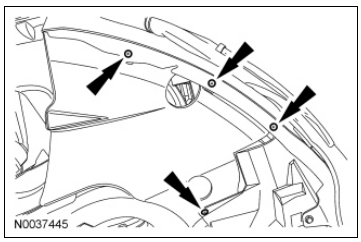
76. Install the EPAS ground wire and bolt in the RH front wheel well.
    - Tighten to 10 Nm (89 lb-in).



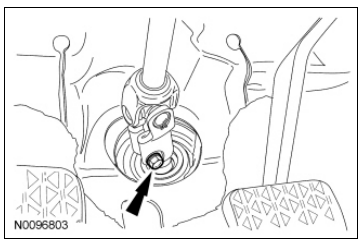
77. Install the RH splash shield and the 6 pin-type retainers (4 shown).



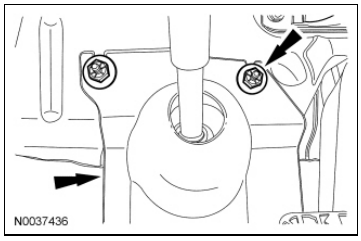
78. Position the RH fender splash shield and install the 4 screws.



79. Install the steering intermediate shaft onto the steering gear and install the bolt.
    - Tighten to 20 Nm (177 lb-in).



80. Install the steering joint cover and the 2 nuts.



81. Fill the engine with clean engine oil.

82. Connect the battery ground cable. For additional information, refer to Section 414-01 .

83. Fill and bleed the cooling system. For additional information, refer to Section 303-03A .

84. Check the transaxle fluid and add fluid if necessary. For additional information, refer to the transmission fluid drain and refill procedure in Section 307-01A .

85. Recharge the A/C system. For additional information, refer to Section 412-00A .

86. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Material

Item	Specification	Fill Capacity
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6	-
Motorcraft® Metal Surface Prep ZC-31-A	-	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	5.2L (5.5 qt) includes filter change
Motorcraft® Silicone Gasket Remover ZC-30	-	-
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A	[a]
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D	[a]
Thread Sealant with PTFE TA-24	WSK-M2G350-A2	-
Threadlock and Sealer TA-25	WSK-M2G351-A5	-

[a] Early build vehicle cooling systems are filled with Motorcraft® Specialty Green Engine Coolant and late build vehicle cooling systems are filled with Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.

General Specifications

Item	Specification
Engine	
Displacement	3.5L (4V) (214 CID)
No. cylinders	6
Bore/stroke	92.5/86.7 mm (3.641/3.413 in)
Fire order	1-4-2-5-3-6
Oil pressure	Minimum 30 psi @ 1,500 rpm with engine at normal operating temperature
Spark plug	AYSF-22FM Gap = 1.29-1.45 mm (0.051-0.057 in)
Compression ratio	10.3:1
Engine weight (without accessory drive components)	161 kg (355 lb)
Engine and transaxle weight (without accessory drive components)	260.8 kg (575 lb)
Cylinder head gasket surface flatness [a]	Flat within 0.08 mm (0.003 in) length end to end, area 150 mm (5.9 in) X 150 mm (5.9 in) (or full width) should be less than 0.05 mm (0.002 in)
Combustion chamber volume	55.84 cc (3.41 CI)
Valve tappet clearance intake	0.15-0.25 mm (0.006-0.01 in)
Valve tappet clearance - exhaust	0.360-0.460 mm (0.0142-0.0181 in) Engine must be at room temperature before measuring
Valve guide bore inner diameter	5.519-5.549 mm (0.217-0.218 in)
Valve stem diameter - intake	5.479-5.497 mm (0.2157-0.2164 in)
Valve stem diameter - exhaust	5.466-5.484 mm (0.2151-0.2159 in)
Valve stem-to-guide clearance - intake	0.022-0.070 mm (0.0008-0.0027 in)
Valve stem-to-guide clearance - exhaust	0.035-0.083 mm (0.0013-0.032 in)
Valve head diameter - intake	36.82-37.18 mm (1.44-1.46 in)

Valve head diameter - exhaust	30.82-31.18 mm (1.21-1.22 in)
Valve	0.05 mm (0.0001 in)
Valve face angle	44.5-45.5 degrees
Valve seat width - intake	1.3-1.5 mm (0.051-0.059 in)
Valve seat width - exhaust	1.7-2.0 mm (0.067-0.079 in)
Valve seat runout	0.04 mm (0.0001 in) MAX
Valve seat angle	44.5-45.5 degrees
Valve spring free length (approx.)	48.0 mm (1.889 in)
Valve spring compression pressure (N @ spec. length)	525 N @ 27.0 mm (114.7 lb @ 1.06 in)
Valve spring installed height	37.0 mm (1.45 in)
Valve spring installed height pressure (N @ spec. length)	235 N @ 37.0 mm (53 lb @ 1.45 in)
Valve spring installed pressure - service limit	10% force loss @ specified height
Camshaft	
Theoretical valve lift @ 0 lash	9.6798 mm (0.38 in)
Lobe lift - intake	9.6798 mm (0.38 in)
Lobe lift - exhaust	9.6798 mm (0.38 in)
Allowaift loss	0.062 mm (0.0024 in)
Camshaft journal bore inside diameter - 1st journal	31.0375-31.0625 mm (1.221-1.222 in)
Camshaft journal bore inside diameter - intermediate journals	25.9875-26.0125 mm (1.023-1.024 in)
Camshaft bearing outside diameter - 1st journal	30.993-31.013 mm (1.2202-1.2209 in)
Camshaft bearing outside diameter - intermediate journals	25.937-25.963 mm (1.021-1.022 in)
Camshaft journal-to-bearing clearance, 1st journal - service limit	0.0725 mm (0.0029 in) MAX
Camshaft journal-to-bearing clearance, intermediate journals - service limit	0.0755 mm (0.0029 in) MAX
Runout	0.040 mm (0.0015 in) MAX
End play - standard	0.032-0.170 mm

	(0.0012-0.0066 in)
End play - service limit	0.190 mm (0.00748 in) MAX
Cylinder Block	
Cylinder bore diameter - grade 1	92.500-92.520 mm (3.641-3.642 in)
Cylinder bore roundness	0.013 mm (0.0005 in)
Cylinder bore taper	
Block main bore roundness	0.008 mm (0.0003 in)
Main bearing bore inside diameter	72.400-72.424 mm (2.8503-2.8513 in)
Head gasket surface flatness	Flat within 0.150 mm (0.005 in) overall 0.050 mm (0.001 in) per 150 mm (5.905 in) x 150 mm (5.905 in) 0.025 mm (0.0009 in) per 25 mm (0.98 in) x 25 mm (0.98 in)
Crankshaft	
Main bearing journal diameter	67.5 mm (2.657 in)
Main bearing journal maximum taper	0.004 mm (0.00015 in)
Main bearing journal maximum out-of-round	0.006 mm (0.00023 in)
Main bearing journal-to-cylinder block clearance	0.026-0.041 mm (0.0010-0.0016 in)
Connecting rod journal diameter	55.983-56.003 mm (2.204-2.205 in)
Connecting rod journal maximum taper	0.004 mm (0.00015 in)
Connecting rod journal maximum out-of-round	0.006 mm (0.00023 in)
Crankshaft maximum end play	0.101-0.291 mm (0.0039-0.0114 in)
Piston and Connecting Rod	
Piston diameter - single grade	92.476-92.490 mm (3.6407-3.6413 in)
Piston-to-cylinder bore clearance	0.010 to 0.044 mm (0.0003-0.0017 in)
Piston ring end gap - compression (top, gauge diameter)	0.15-0.25 mm (0.0059-0.0098 in)
Piston ring end gap - compression (bottom, gauge diameter)	0.30-0.55 mm (0.0118-0.0216 in)
Piston ring end gap - oil ring (steel rail, gauge diameter)	0.15-0.45 mm (0.0059-0.0177 in)
Piston ring groove width - compression (top)	1.230-1.25 mm (0.0484-0.0492 in)
Piston ring groove width - compression (bottom)	1.530-1.55 mm (0.0602-0.0610 in)
Piston ring groove width - oil ring	2.53-2.55 mm

	(0.0996-0.1003 in)
Piston ring width - upper comp ring	1.17-1.19 mm (0.0460-0.0468 in)
Piston ring width - lower comp ring	1.47-1.49 mm (0.0578-0.0586 in)
Piston ring-to-groove clearance (upper and lower compression rings)	0.040-0.080 mm (0.0015-0.0031 in)
Piston pin bore diameter	23.004-23.008 mm (0.9056-0.9058 in)
Piston pin diameter 22.997-23.000 mm (0.9053-0.9055 in)	
Piston pin length	55.975 mm (2.203 in)
Piston pin-to-piston fit	0.004 to 0.011 mm (0.00015-0.00043 in)
Piston-to-connecting rod clearance	2.7 mm (0.1 in)
Connecting rod-to-pin clearance - standard	0.007-0.022 mm (0.0002-0.0009 in)
Connecting rod pin bore diameter	23.007-23.019 mm (0.905-0.906 in)
Connecting rod length (center-to-center)	152.68 mm (6.01 in)
Connecting rod maximum allowed bend	0.038 mm (0.0014 in)
Connecting rod maximum allowed twist	0.050 mm (0.0019 in)
Connecting rod bearing bore diameter - grade 1	59.866-59.872 mm (2.3569-2.3571 in)
Connecting rod bearing bore diameter - grade 2	59.873-59.879 mm (2.3572-2.3574 in)
Connecting rod bearing bore diameter - grade 3	59.880-59.886 mm (2.3574-2.3577 in)
Connecting rod bearing-to-crankshaft clearance	0.020-0.054 mm (0.0007-0.0021 in)
Connecting rod side clearance (assembled to crank) - s/TD>	0.175-0.425 mm (0.0068-0.0167 in)
Connecting rod side clearance (assembled to crank) - service limit	0.175-0.425 mm (0.0068-0.0167 in)

[a] Refer to the procedure in this section.

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolts and nut	25	18	-
A/C compressor stud	9	-	80
A/C manifold bolt	25	18	-
A/C tube bracket bolts	10	-	89
A/C tube fitting bolts and nuts	8	-	71
A/C tube retaining clamp bolt	8	-	71
A/C tube retaining clamp bolts and nut	10	-	89 Accessory drive belt tensioner bolts 11 - 97
Block coolant drain plug - RH [a]	-	-	-
Block coolant drain plug - LH [b]	-	-	-
Block heater	40	30	-
Block oil galley plug - LH	48	35	-
Block oil galley plug - rear	85	63	-
Block oil galley plug - RH	32	24	-
Camshaft cap bolts [c]	-	-	-
Camshaft Position (CMP) sensor bolts	10	-	89
Camshaft sprocket bolts [c]	-	-	-
40	30	-	
Catalytic converter bracket-to-engine bolts and nuts	40	30	-
Catalytic converter bracket-to-converter bolts	20	-	177
Connecting rod cap bolts [c]	-	-	-
Coolant pump bolts [c]	-	-	-
Crankshaft Position (CKP) sensor bolt	10	-	89
Crankshaft pulley bolt [c]	-	-	-
Crankcase rear seal retainer plate bolts [c]	-	-	-
Cylinder head bolts [c]	-	-	-
Cylinder Head Temperature (CHT) sensor	10	-	89
	9	-	80
Engine front cover bolts [c]	-	-	-
Engine lifting eye bolts	24	18	-
Engine mount brace bolts	25	18	-
Engine mount bracket bolts [c]	-	-	-
Engine mount studs [c]	-	-	-
Engine mount-to-engine nuts [c]	-	-	-
Engine mount-to-frame bolts	55	41	-
Engine mount-to-frame nut	63	46	-
Engine oil filter [d]	-	-	-
Engine Oil Pressure (EOP) switch <="center">-	-	-	
Engine roll-restrictor bolt	90	66	-
Engine-to-transaxle bolts	48	35	-
Exhaust manifold heat shield bolts	10	-	89
Exhaust manifold nuts [c]	-	-	-

Exhaust manifold studs	12	-	106
Exhaust Y-pipe nuts	40	30	-
Flexplate bolts	80	59	-
Fuel rail bolts	10	-	89
Generator bolt and nut	48	35	-
Generator B+ terminal nut	12	-	106
Ground wire-to-engine mount bolt	10	-	89
Ground wire-to-transaxle bolt	12	-	106
Heat shield nut and bolt	10	-	89
Ignition coil-on-plug bolts	7	-	62
Intermediate steering shaft bolt	25	18	-
Knock Sensor (KS) bolts	20	-	177
Lower intake manifold bolts [c]	-	-	-
Main bearing bolts [c]	-	-	-
Main bearing cap support brace bolts [c]	-	-	-
Oil filter adapteralign="top" align="center">-	-	-	
Oil pan bolts [c]	-	-	-
Oil pan-to-transaxle bolts	48	35	-
Oil pan drain plug	27	20	-
Oil pump bolts	10	-	89
Oil pump screen and pickup tube bolts	10	-	89
Positive battery cable nuts	9	-	80
Power Steering Pressure (PSP) hose bracket and nut	9	-	80
PSP tube banjo bolt	37	27	-
PSP tube bracketTD>	10	-	89
Power steering pump bolts	25	18	-
Power Transfer Unit (PTU)	90	66	-
PTU bracket bolts	70	52	-
Rear drive shaft-to- PTU flange bolts	70	52	-
Stabilizer bar link nuts	40	30	-
Starter bolts	26	19	-
Starter B+ terminal nut	12	-	106
Starter S-terminal nut	5	-	44
Subframe bracket bolts		76	-
Subframe nuts	150	111	-
Thermostat housing bolts	10	-	89
Tie-rod end nuts	48	35	-
Timing chain guide bolts	10	-	89
Timing chain guide pin [c]	-	-	-
Timing chain tensioner arm pin [c]	-	-	-
Timing chain tensioner bolts	10	-	89
Torque converter-to-flexplate nuts	36	27	-
Transaxle control cable bracket bolts and nut	12	-	106

12	-	106

Transaxle support insulator bracket bolt and nut	80	-	
Transaxle support insulator through bolt and nut	90	66	-
Transaxle-to-engine bolts	48	35	-
Upper intake manifold bolts [c]	-	-	-
Upper intake manifold support bracket bolt	10	-	89
Variable Camshaft Timing (VCT) assembly bolts [c]	-	-	-
VCT housing bolts [c]	-	-	-
Valve cover bolts and stud bolts [c]	-	-	-
Wiring harness retainer bolt and stud bolt	10	-	89
Wiring harness retainer bracket nuts	4	-	

[a] Tighten to 10 Nm (89 lb-in) plus an additional 720 degrees.
[b] Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.
[c] Refer to the procedure in this section.
[d] Tighten to 5 Nm (44 lb-in) plus an additional 180 degrees.

Engine

The 3.5L (4V) is a V-6 engine with the following features:

- Dual overhead camshafts
- Four valves per cylinder
- Sequential Multi-Port Fuel Injection (SFI)
- An aluminum lower intake manifold and a composite upper intake manifold
- Aluminum cylinder heads
- An aluminum, 60-degree V-cylinder block
- Timing chain driven coolant pump
- Variable Camshaft Timing (VCT) system
- The electronic ignition system with 6 ignition coils

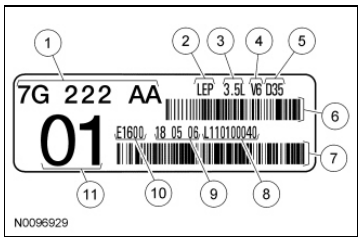
Engine Identification

For quick identification, refer to the safety certification decal.

- The decal is located on the LH front door lock face panel.

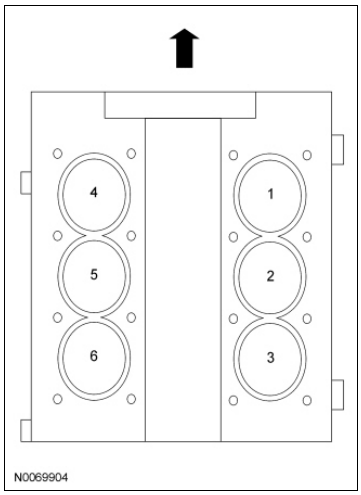
Engine Code Information Label

The engine code information label, located on the front side of the valve cover, contains the following:



Item	Description
1	Engine part number
2	Engine plant (Lima)
3	Engine displacement
4	Engine configuration
5	Duratech 3.5L
6	Bar code
7	Bar code
8	Running number
9	Engine build date (DDMMYY)
10	Plant shift line
11	Derivative code

Engine Cylinder Identification



Exhaust Emission Control System

Operation and required maintenance of the exhaust emission control devices used on this engine is covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The SFI provides the fuel/air mixture needed for combustion in the cylinders. The 6 solenoid-operated fuel injectors:

- are mounted between the fuel rail and the intake manifold.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.

Valve Train

The valve train uses Direct Acting Mechanical Buckets (DAMB). The camshaft lobes are positioned directly above mechanical buckets which are positioned on top of the valves.

Variable Camshaft Timing (VCT) System

The VCT system changes intake camshaft timing dependent on engine speed, load and oil temperature. Oil pressure advances and retards camshaft timing to improve low-speed and high-speed engine performance, engine idle quality and exhaust emissions.

PCV System

All engines are equipped with a closed-type PCV system recycling the crankcase vapors to the upper intake manifold.

Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rod bearings, timing chain tensioners and VCT solenoids. The flow of oil to the valve tappets and valve train is controlled by a restricting orifice located in the cylinder head, front camshaft cap.

Oil Pump

The lubrication system is designed to provide optimum oil flow to critical components of the engine through its entire operating range.

The heart of the system is a positive displacement internal gear oil pump.

Generically, this design is known as a gerotor pump, which operates as follows:

- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.
- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to make sure of correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high-viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Cooling System

NOTICE: **Early build vehicle cooling systems are filled with Motorcraft® Specialty Green Engine Coolant and late build vehicle cooling systems are filled with Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

NOTE: ring normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

The engine cooling system includes the following:

- Radiator
- Timing chain driven coolant pump
- Electric fan assembly(s)
- Degas bottle (aids in maintaining the correct volume of engine coolant)
- Coolant thermostat
- Coolant hoses

Engine

For basic engine mechanical concerns, refer to Section 303-00 . For driveability concerns, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

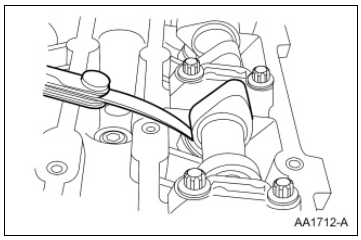
Valve Clearance Check

1. Remove the valve covers. For additional information, refer to Valve Cover - LH and Valve Cover - RH in this section.

2. **NOTE:** Engine must be at room temperature before measuring. The valve clearance must be measured with the camshaft at base circle. The engine will have to be rotated with the crankshaft pulley bolt to bring each valve to base circle.

   Use a feeler gauge to measure the clearance of each valve and record its location. A midrange clearance is thesirable:

   - Intake: 0.15-0.25 mm (0.006-0.01 in)
   - Exhaust: 0.360-0.460 mm (0.0142-0.0181 in)



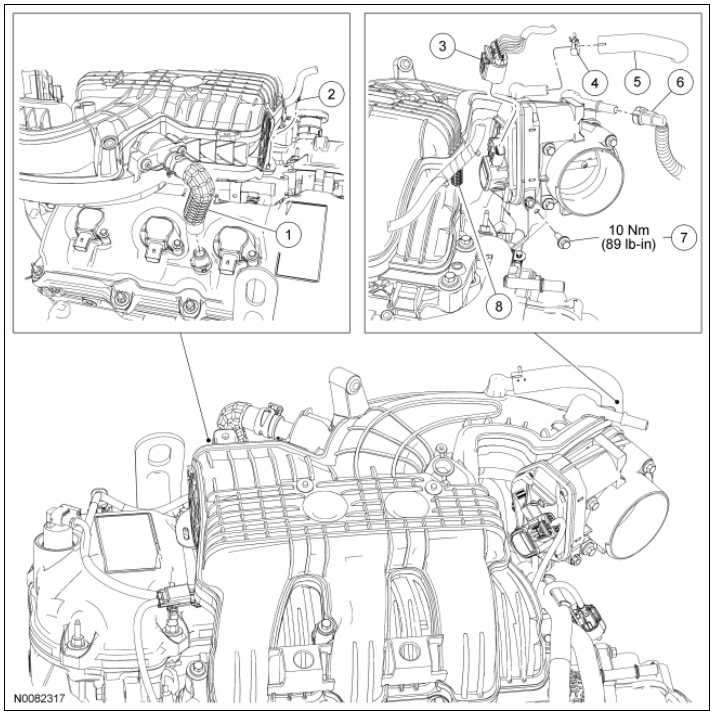
3. **NOTE:** The number on the valve tappet reflects the thickness of the valve tappet. For example, a tappet with the number 3.310 has the thickness of 3.31 mm (0.13 in).

   If any of the valve clearances are out of specification, select new tappets using this formula: tappet thickness = measured clearance + the base tappet thickness - most desirable thickness.
   Select the tappets and mark the installation location.

4. If required, install the new selected valve tappets in the marked locations. For additional information, refer to Valve Tappets in this section.

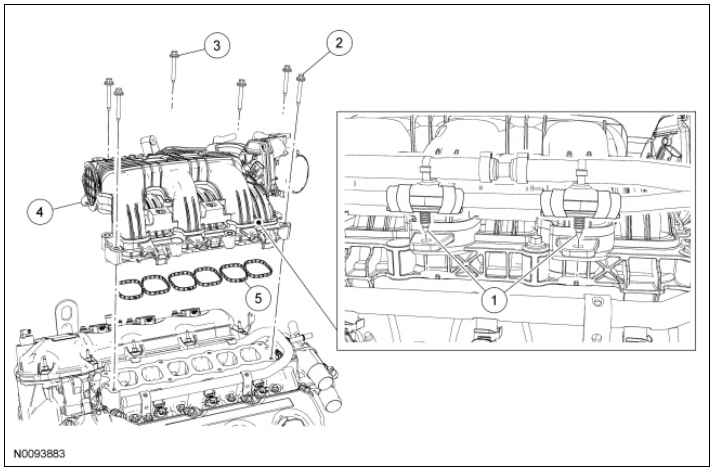
Upper Intake Manifold

Upper Intake Manifold (View 1 of 2)



Item	Part Number	Description
1	6K817	PCV hose
2	13A506	Block heater wiring harness retainer (part of 6B018)
3	14A464	Throttle Body (TB) electrical connector (part of 12C508)
4	CS16140	Brake booster-to-intake manifold vacuum hose clamp
5	6K817	Brake booster-to-intake manifold vacuum hose
6	9D661	Evaporative Emission (EVAP)-to-intake manifold tube
7	W503274	Upper intake manifold support bracket bolt
8	-	Engine control wiring harness retainer (part of 12C508)

Upper Intake Manifold (View 2 of 2)



Item	Part Number	Description
1	13A506	Wire harness pin-type retainers (part of 14B060)
2	W503282	Upper intake manifold bolt (5 required)
3	W707083	Upper intake manifold bolt
4	9S455	Upper intake manifold
5	9H486	Upper intake manifold gasket (3 required)

Removal

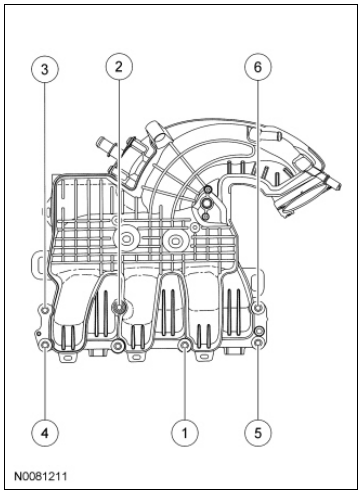
1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12C .
2. Disconnect the Throttle Body (TB) electrical connector.
3. Disconnect the Evaporative Emission (EVAP)ube from the intake manifold. For additional information, refer to Section 310-00 .
4. Disconnect the brake booster vacuum hose from the intake manifold.
5. Disconnect the PCV tube from the PCV valve.
6. Detach all the wiring harness retainers from the upper intake manifold.
7. If equipped, detach the cylinder block heater wiring harness retainer from the upper intake manifold.
8. Remove the upper intake manifold support bracket bolt.
9. Remove the 6 bolts and the upper intake manifold.
    - Remove and discard the gaskets.
    - Clean and inspect all of the sealing surfaces of the upper and lower intake manifold.

Installation

1. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

   Using new gaskets, install the upper intake manifold and the 6 bolts.

    - Tighten in the sequence shown to 10 Nm (89 lb-in).



2. Install the upper intake manifold support bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

3. If equipped, attach the cylinder block heater wiring harness retainer to the upper intake manifold.

4. Attach all the wiring harness retainers to the upper intake manifold.

5. Connect the PCV tube to the PCV valve.

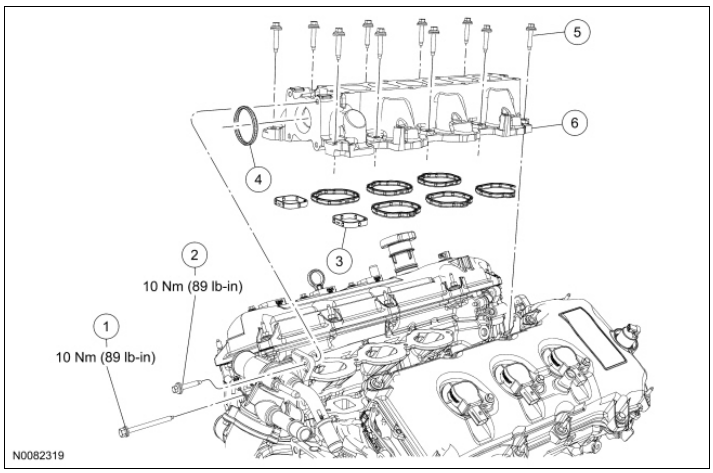
6. Connect the brake booster vacuum hose to the intake manifold.

7. Connect the EVAP tube to the intake manifold. For additional information, refer to Section 310-00 .

8. Connect the TB electrical connector.

9. Install the ACL outlet pipe. For additional information, refer to Section 303-12C .

Lower Intake Manifold



Item	Part Number	Description
1	W708607	Thermostat housing-to-lower intake manifold bolt
2	W503279	Thermostat housing-to-lower intake manifold bolt
3	9439	Lower intake manifold gasket (8 required)
4	8A571	Thermostat housing gasket
5	W503279	Lower intake manifold bolt (10 required)
6	9K461	Lower ke manifold

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

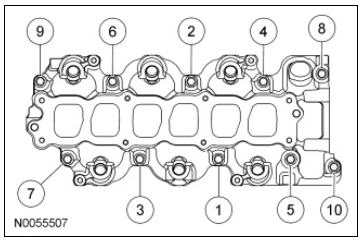
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the fuel rail. For additional information, refer to Section 303-04C .
3. Drain the cooling system. For additional information, refer to Section 303-03A .
4. Remove the 2 thermostat housing-to-lower intake manifold bolts.
5. Remove the 10 bolts and the lower intake manifold.
   - Remove and discard the intake manifold and thermostat housing gaskets.
   - Clean and inspect all sealing surfaces.

Installation

1. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

Using new intake manifold and thermostat housing gaskets, install the lower intake manifold and the 10 bolts.

- Tighten in the sequence shown to 10 Nm (89 lb-in).



2. Install the 2 thermostat housing-to-lower intake manifold bolts.
   - Tighten to 10 Nm (89 lb-in).

3. Install the fuel rail. For additional information, refer to Section 303-04C .

4. Fill and bleed the cooling system. For additional information, refer to Section 303-03A .

Valve Cover - LH

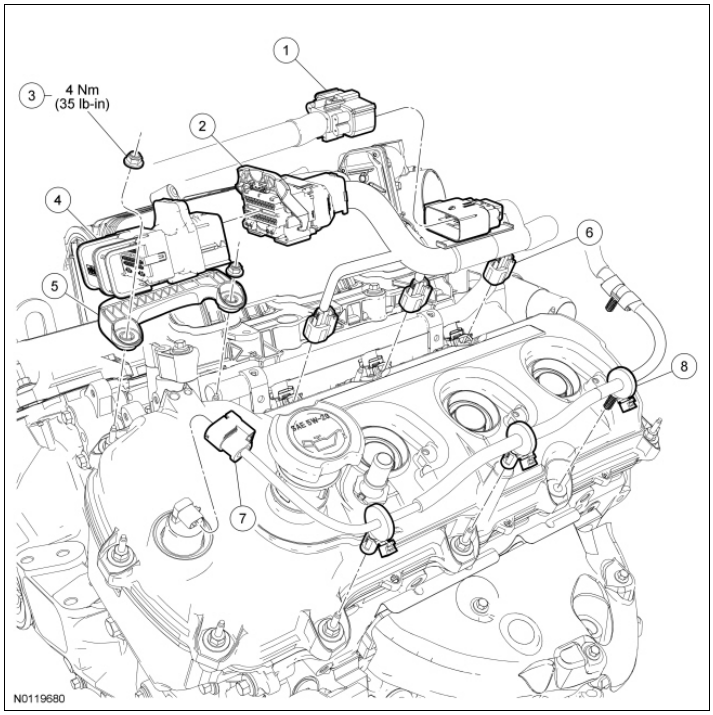
Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2983-A	Installer, VCT Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, VCT Spark Plug Tube Seal 303-1247/1

Material

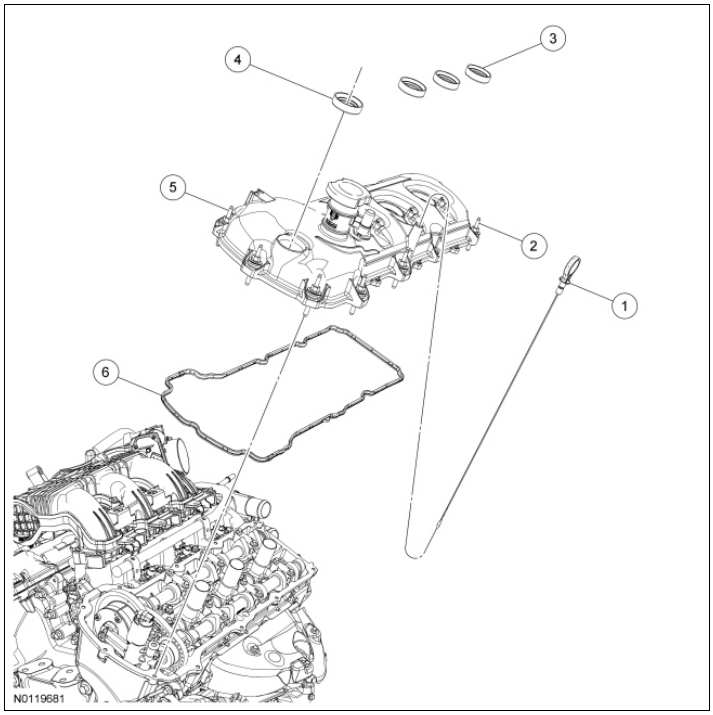
Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

Valve Cover - LH (View 1 of 2)



Item	Part Number	Description
1	-	Engine control wiring harness electrical connector (part of 12C508)
2	-	Engine control wiring harness electrical connector (part of 12C508)
3	W520100	Wiring harness retaining bracket nut (2 required)
4	-	Engine control wiring harness electrical connector (part of 12C508)
5	-	Wiring harness retaining bracket (part of 12C508)
6	-	LH fuel injector electrical connector (3 required) (part of 12C508)
7	-	LH Variable Camshaft Timing (VCT) electrical connector (part of 12 valign="top">
8	W700497	Engine control wiring harness retainer (part of 12C508)

Valve Cover - LH (View 2 of 2)

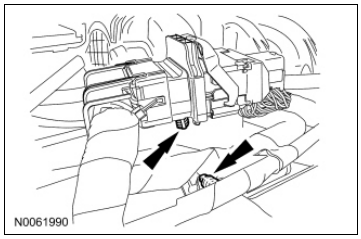


Item	Part Number	Description
1	6750	Oil level indicator
2	6C519	Valve cover stud bolt (9 required)
3	6C535	Spark plug tube seal (3 required)
4	6C535	Variable Camshaft Timing (VCT) solenoid seal
5	6A505	LH valve cover
6	6A559	LH valve cover gasket

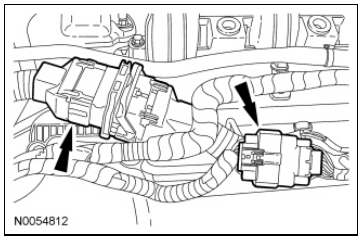
Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

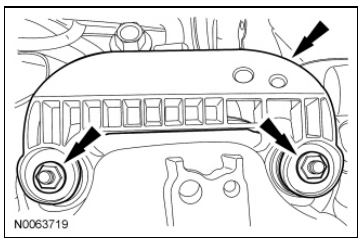
1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12C .
2. Remove the LH ignition coils.or additional information, refer to Section 303-07C .
3. Remove the oil level indicator.
4. Disconnect the LH Variable Camshaft Timing (VCT) solenoid electrical connector.
5. Detach the 2 wiring harness retainers.



6. Disconnect the 2 engine control wiring harness electrical connectors.



7. Remove the 2 nuts and the wiring harness retaining bracket.



8. Detach all of the wiring harness retainers from the valve cover and the stud bolts.

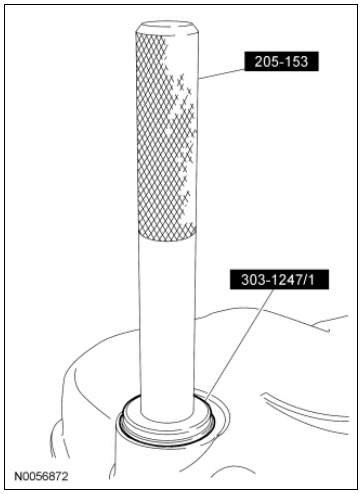
9. Disconnect the 3 LH fuel injector electrical connectors.

10. Loosen the 9 stud bolts and remove the LH valve cover.
    - Discard the gasket.

11. **NOTE:** VCT solenoid seal removal shown, spark plug tube seal removal similar.

    Inspect the VCT solenoid seals and the spark plug tube seals. Remove any damaged seals.

    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



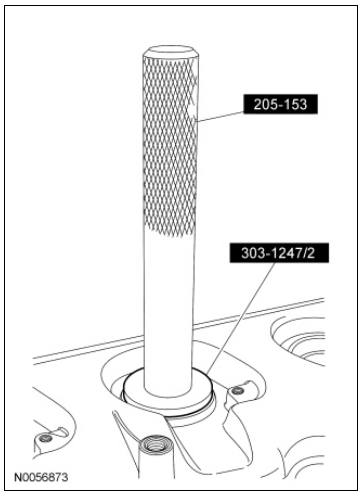
12. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

Installation

1. **NOTE:** Installation of new seals is only required if damaged seals were removed during disassembly of the engine.

   NOTE: Spark plug tube seal installation shown, VCT solenoid seal installation similar.

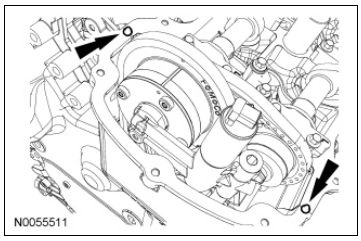
Using the VCT Spark Plug Tube Seal Installer and Handle, install new VCT solenoid and/or spark plug tube seals.



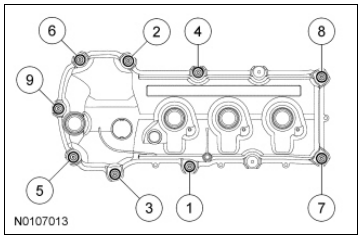
2. *NOTICE:* **Failure to use Motorcraft High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

   Apply an 8 mm (0.31 in) bead of Motorcraft High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.



3. Using a new gasket, install the LH valve cover and tighten the 9 stud bolts.
   - Tighten in the sequence shown to 10 Nm (89 lb-in).



4. Connect the 3 LH fuel injector electrical connectors.

5. Attach all of the wiring harness retainers to the valve cover and the stud bolts.

6. Install the wiring harness retaining bracket and the 2 nuts.
   - Tighten to 4 Nm (35 lb-in).

7. Connect the 2 engine control wiring harness electrical connectors.

8. Attach the 2 wiring harness retainers.
9. Connect the LH VCT solenoid electrical connector.
10. Install the oil level indicator.
11. Install the LH ignition coils. For additional information, refer to Section 303-07C .
12. Install the ACL outlet pipe. For additional information, refer to Section 303-12C .

Valve Cover - RH

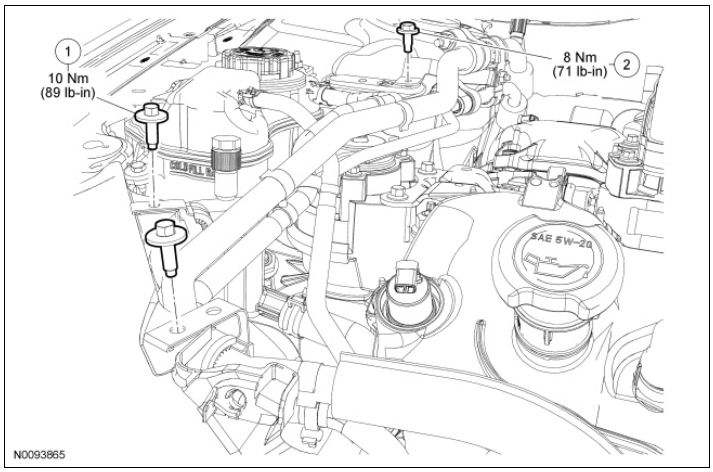
Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2983-A	Installer, VCT Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, VCT Spark Plug Tube Seal 303-1247/1

Material

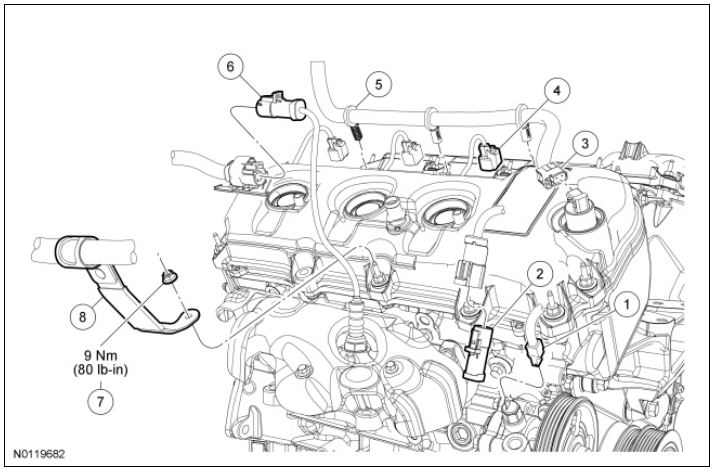
Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

Valve Cover - RH (View 1 of 3)



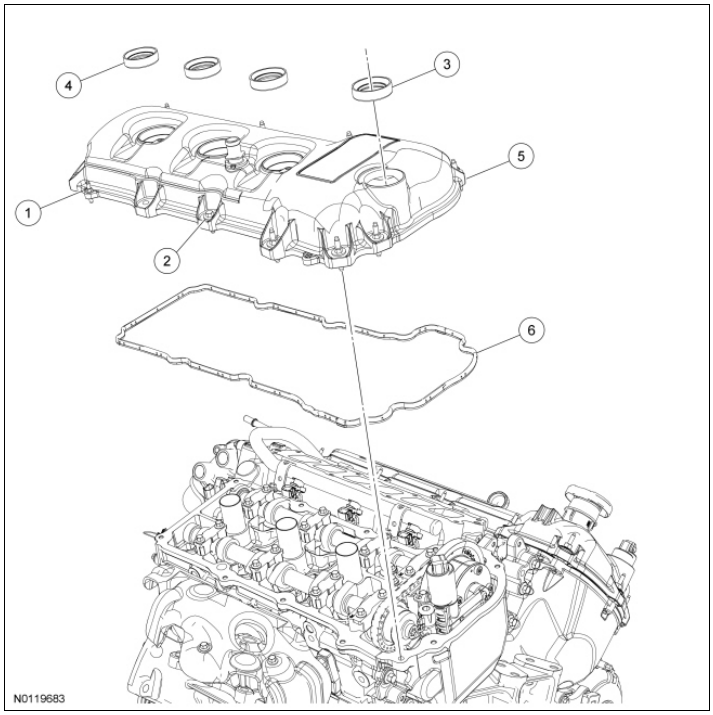
Item	Part Number	Description
1	W503924	A/C tube retaining clamp bolt (2 required)
2	W505422	A/C tube retaining clamp bolt

Valve Cover - RH (View 2 of 3)



Item	Part Number	Description
1	-	Power Steering Pressure (PSP) switcconnector (part of 12C508)
2	-	RH Catalyst Monitor Sensor (CMS) electrical connector (part of 12C508)
3	-	RH Variable Camshaft Timing (VCT) electrical connector (part of 12C508)
4	-	RH fuel injector electrical connector (3 required) (part of 12C508)
5	W700497	Engine control wiring harness retainer (part of 12C508)
6	-	RH Heated Oxygen Sensor (HO2S) electrical connector (part of 12C508)
7	W520100	PSP hose bracket nut
8	3A719	PSP hose bracket

Valve Cover - RH (View 3 of 3)

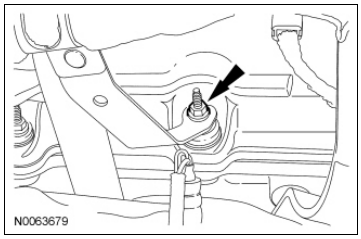


Item	Part Number	Description
1	6C519	Valve cover stud bolt (8 required)
2	6C520	Valve cover bolt
3	6C535	Variable Camshaft Timing (VCT) solenoid seal
4	6C535	Spark plug t3 required)
5	6582	RH valve cover
6	6584	RH valve cover gasket

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the RH ignition coils. For additional information, refer to Section 303-07C .
2. Remove the power steering fluid reservoir. For additional information, refer to Section 211-02 .
3. Disconnect the Power Steering Pressure (PSP) switch electrical connector.
4. Disconnect the RH Catalyst Monitor Sensor (CMS) electrical connector and retainer.
5. Remove the PSP hose bracket nut from the valve cover stud bolt and position the bracket aside.



6. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.

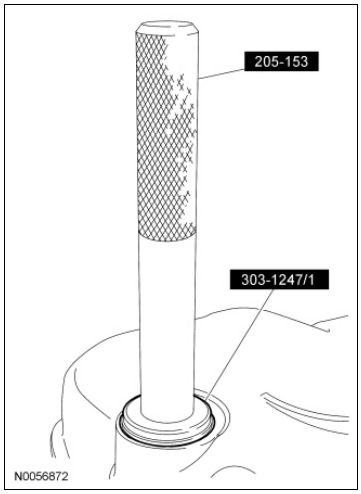
7. Disconnect the RH Variable Camshaft Timing (VCT) electrical connector.
8. Disconnect the 3 RH fuel injector electrical connectors.
9. Detach all of the wiring harness retainers from the valve cover and the stud bolts.
10. Remove the A/C tube retaining clamp bolt.
11. Remove the 2 A/C tube retaining clamp bolts.
12. **NOTE:** It is necessary to reposition the A/C tubes to remove the valve cover.

    Loosen the bolt and the 8 stud bolts and remove the RH valve cover.

    - Discard the gasket.
13. **NOTE:** VCT solenoid seal removal shown, spark plug tube seal removal similar.

    Inspect the VCT solenoid seals and the spark plug tube seals. Remove any damaged seals.

    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



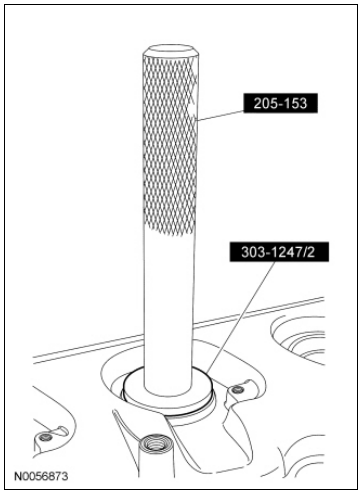
14. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

Installation

1. **NOTE:** Installation of new seals is only required if damaged seals were removed during disassembly of the engine.

   NOTE: Spark plug tube seal installation shown, VCT solenoid seal installation similar.

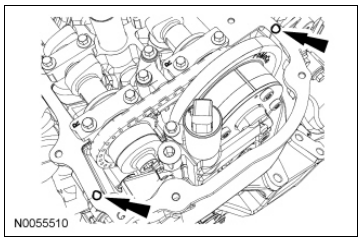
   Using the VCT Spark Plug Tube Seal Installer and Handle, install new VCT solenoid and/or spark plug tube seals.



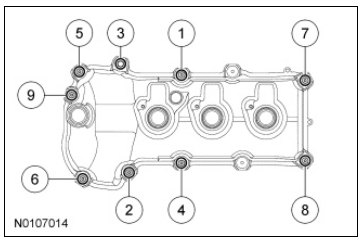
2. *NOTICE:* **Failure to use Motorcraft High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

   Apply an 8 mm (0.31 in) bead of Motorcraft High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.



3. Using a new gasket, install the RH valve cover, bolt and the 8 stud bolts.
   - Tighten in the sequence shown to 10 Nm (89 lb-in).



4. Position the A/C tubes and install the 2 retaining clamp bolts.
   - Tighten to 10 Nm (89 lb-in).

5. Install the A/C tube retaining clamp bolt.
   - Tighten to 8 Nm (71 lb-in).

6. Attach all of the wiring harness retainers to the valve cover and the stud bolts.

7. Connect the 3 LH fuel injector electrical connectors.

8. Connect the LH VCT electrical connector.

9. Connect the RH HO2S electrical connector.

10. Install the PSP hose bracket and nut.
    - Tighten to 9 Nm (80 lb-in).

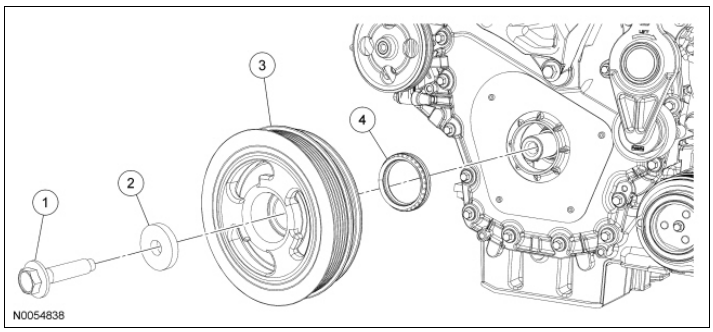
11. Connect the RH CMS electrical connector and retainer.

12. Connect the PSP switch electrical connector.

13. Install the power steering fluid reservoir. For additional information, refer to Section 211-02 .

14. Install the RH ignition coils. For additional information, refer to Section 303-07C .

Crankshaft Pulley and Crankshaft Front Seal - Exploded View

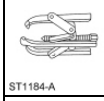
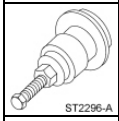


Item	Part Number	Description
1	W701512	Crankshaft pulley bolt
2	N806165	Washer
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal

1. For additional information, refer to the procedures in this section.

Crankshaft Pulley

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2296-A	Installer, Front Cover Oil Seal 303-335
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

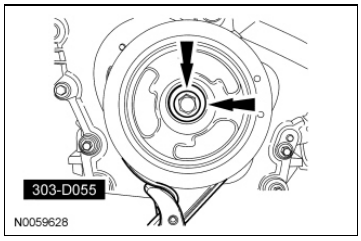
Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

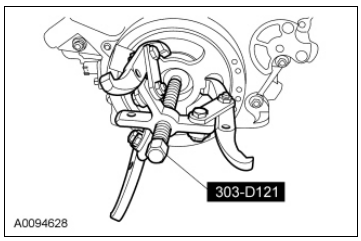
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the accessory drive belt and the powesteering belt. For additional information, refer to Section 303-05C .

3. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
   - Discard the bolt.



4. Using the 3 Jaw Puller, remove the crankshaft pulley.

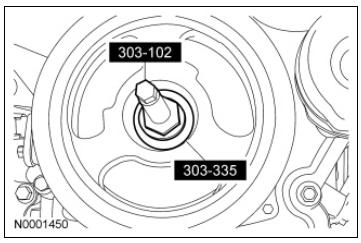


Installation

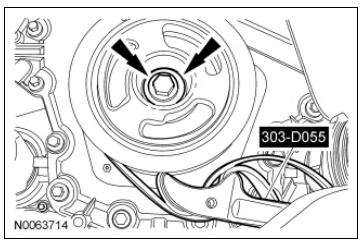
1. Lubricate the crankshaft front seal inner lip with clean engine oil.

2. **NOTE:** Lubricate the outside diameter sealing surfaces with clean engine oil.

   Using the Front Cover Oil Seal Installer and Crankshaft Vibration Damper Installer, install the crankshaft pulley.



3. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
   - Stage 1: Tighten to 120 Nm (89 lb-ft).
   - Stage 2: Loosen one full turn.
   - Stage 3: Tighten to 50 Nm (37 lb-ft).
   - Stage 4: Tighten an additional 90 degrees.

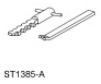


4. Install the accessory drive belt and the power steering belt. For additional information, refer to Section 303-05C .

5. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Crankshaft Front Seal

Special Tool(s)

 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)

Material

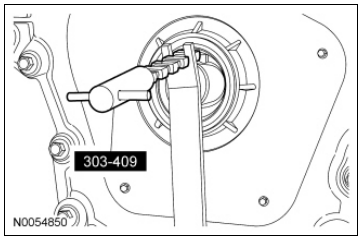
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

3. Using the Oil Seal Remover, remove and discard the crankshaft front seal.
   - Clean all sealing surfaces with metal surface prep.



Installation

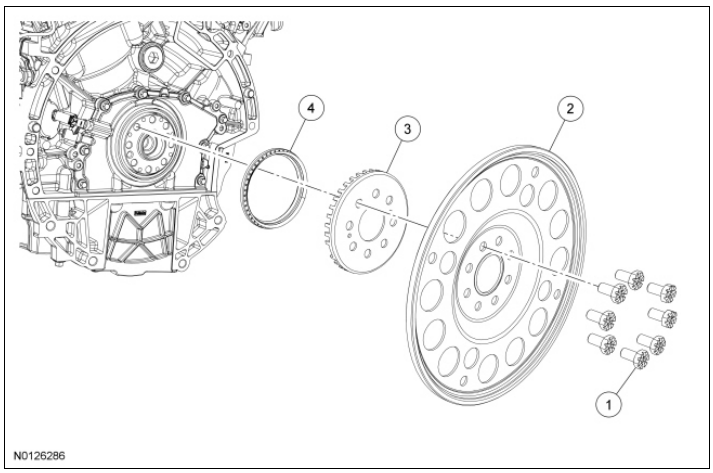
1. **NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

Using the Front Crankshaft Seal Installer and Crankshaft Vibration Damper Installer, install a new crankshaft front seal.

src="SCS~us~en~file=N0056874.jpg~gen~ref.jpg" height="211" width="325" border="1">

2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

Flexplate or Flywheel and Crankshaft Rear Seal - Exploded View



Item	Part Number	Description
1	W701559	Flexplate bolt (8 required)
2	6375	Flexplate
3	12A227	Crankshaft sensor ring
4	6701	Crankshaft rear seal

1. For additional information, refer to the procedures in this section.

Flexplate

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Removal

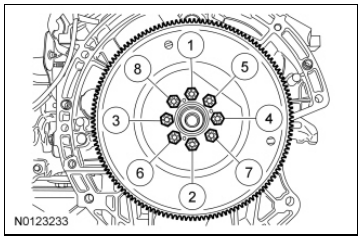
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the transaxle. For additional information, refer to Section 307-01A .
3. Remove the 8 bolts and the flexplate.

Installation

1. **NOTE:** One of the 8 flexplate holes are offset so the flexplate can only be installed in one position.

   Install the flexplate and the 8 bolts.

   - Tighten in the sequence shown to 80 Nm (59 lb-ft).



2. Install the transaxle. For additional information, refer to Section 307-01A .
3. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

Crankshaft Rear Seal

Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2980-A	Installer, Rear Main Seal 303-1250
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

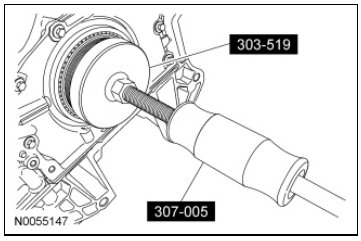
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the flexplate. For additional information, refer to Flexplate in this section.

start="3">
- Remove the crankshaft sensor ring.

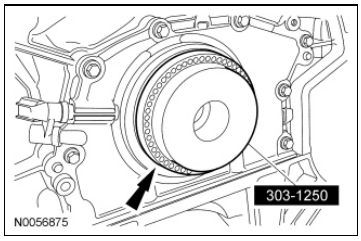
4. Using the Crankshaft Rear Oil Seal Remover and Slide Hammer, remove and discard the crankshaft rear seal.
    - Clean all sealing surfaces with metal surface prep.



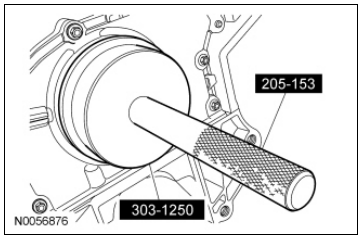
Installation

1. **NOTE:** Lubricate the seal lips and bore with clean engine oil prior to installation.

   Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.



2. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.

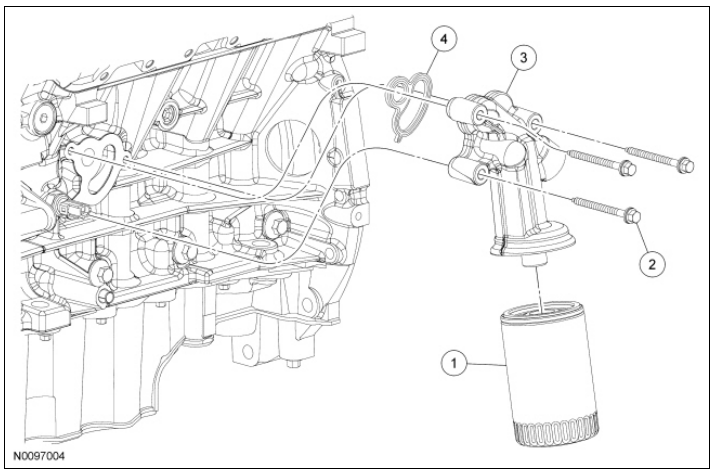


3. Install the crankshaft sensor ring.

4. Install the flexplate. For additional information, refer to Flexplate in this section.

5. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

Oil Filter Adapter

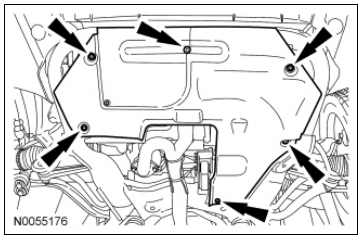


Item	Part Number	Description
1	6714	Engine oil filter
2	W503283	Oil filter adapter bolt (3 required)
3	6881	Oil filter adapter
4	6840	Oil filter adapter gasket

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. If equipped, remove the 6 screws and the underbody shield.



3. Remove and discard the engine oil filter.

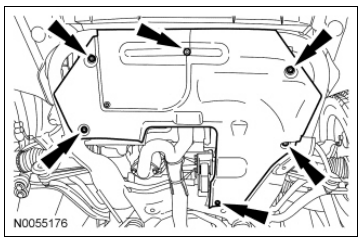
4. Remove the 3 bolts and the oil filter adapter.
   - Discard the gasket.
   - Clean and inspect all sealing surfaces.

Installation

1. Using a new gasket, install the oil filter adapter and the 3 bolts.
   - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.

2. Install a new engine oil filter.
   - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

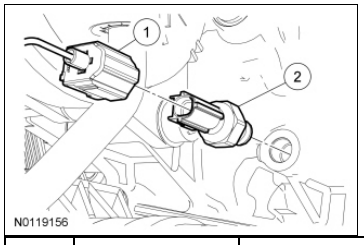
3. If equipped, install the 6 screws and the underbody shield.



Engine Oil Pressure (EOP) Switch

Material

Item	Specification
Thread Sealant with PTFE TA-24	WSK-M2G350-A2

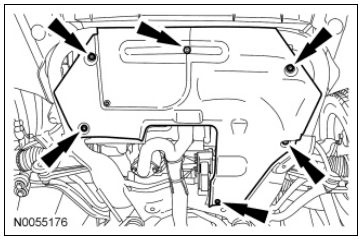


Item	Part Number	Description
1	14A464	Engine Oil Pressure (EOP) switch electrical connector (part of 12C508)
2	9278	EOP switch

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. If equipped, remove the 6 screws and the underbody shield.



3. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

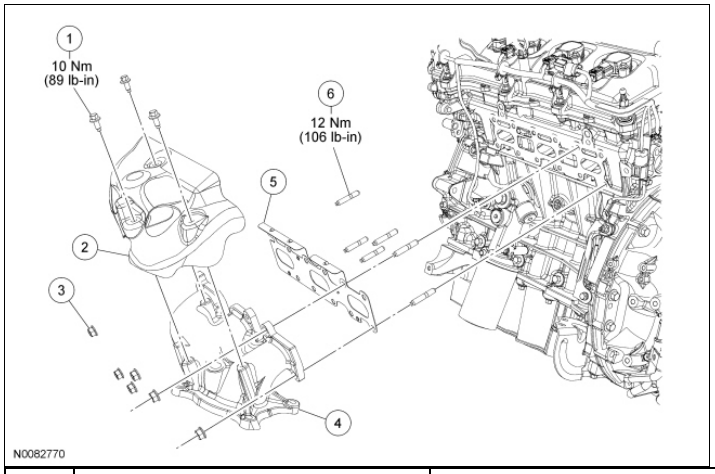
4. Remove the EOP switch.
   - To install, tighten to 14 Nm (124 lb-in) plus an additional 180 degrees.

5. To install, reverse the removal procedure.
   - Apply thread sealant with PTFE to the EOP switch threads prior to installation.

Exhaust Manifold - LH

Material

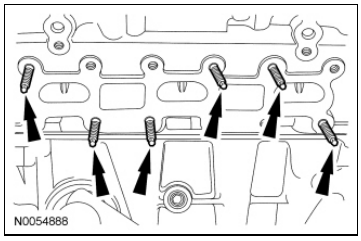
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-



Item	Part Number	Description
1	W713299	LH exhaust manifold heat shield bolt (3 required)
2	9Y427 exhaust manifold heat shield	
3	W701706	LH exhaust manifold nut (6 required)
4	9431	LH exhaust manifold
5	9448	LH exhaust manifold gasket
6	W701732	LH exhaust manifold stud (6 required)

Removal

1. Remove the LH catalytic converter. For additional information, refer to Section 309-00 .
2. Remove the LH Heated Oxygen Sensor (HO2S). For additional information, refer to Section 303-14C .
3. Remove the 3 bolts and the LH exhaust manifold heat shield.
4. Remove the 6 nuts and the LH exhaust manifold.
   - Discard the nuts and gasket.
5. Clean and inspect the LH exhaust manifold. For additional information, refer to Section 303-00 .
6. Remove and discard the 6 LH exhaust manifold studs.



7. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

   Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

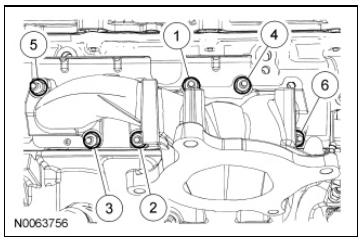
Installation

1. Install 6 new LH exhaust manifold studs.
   - Tighten to 12 Nm (106 lb-in).

2. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

   Using a new gasket, install the LH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:

   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten to 25 Nm (18 lb-ft).



3. Install the LH exhaust manifold heat shield and the 3 bolts.
   - Tighten to 10 Nm (89 lb-in).

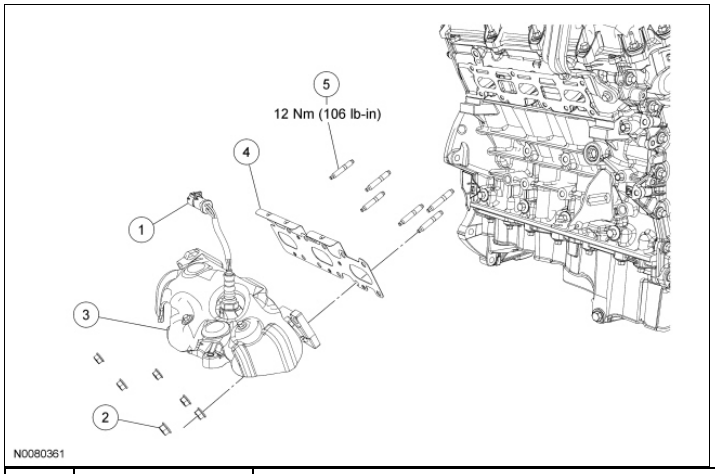
4. Install the LH HO2S . For additional information, refer to Section 303-14C .

5. Install the LH catalytic converter. For additional information, refer to Section 309-00 .

Exhaust Manifold - RH

Material

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



Item	Part Number	Description
1	14A464	RH Heated Oxygen Sensor (HO2S) electrical connector
2	W701706	RH exhaust manifold nut (6 required)
3	9430	RH exhaust manifold
5	W701732	RH exhaust manifold stud (6 required)

Removal

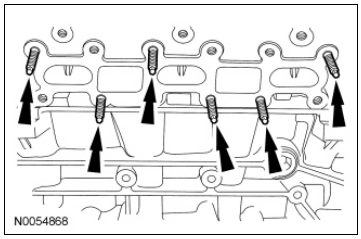
1. Remove the RH catalytic converter. For additional information, refer to Section 309-00 .

2. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.

3. Remove the 6 nuts and the RH exhaust manifold.
   - Discard the nuts and gasket.

4. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .

5. Remove and discard the 6 RH exhaust manifold studs.



6. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

   Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

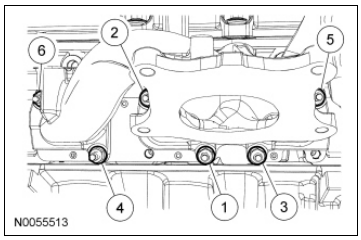
Installation

1. Install 6 new RH exhaust manifold studs.
   - Tighten to 12 Nm (106 lb-in).

2. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

   Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:

   - Stage 1: Tighten to 20 Nm (177 lb-in).
   - Stage 2: Tighten to 25 Nm (18 lb-ft).

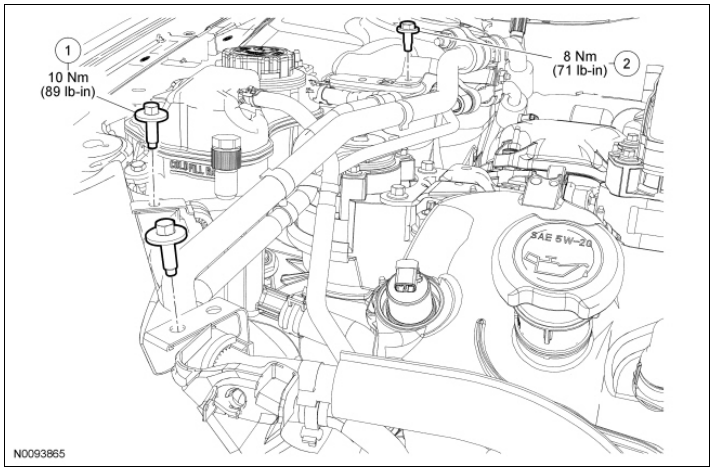


3. Connect the RH HO2S electrical connector.

4. Install the RH catalytic converter. For additional information, refer to Section 309-00 .

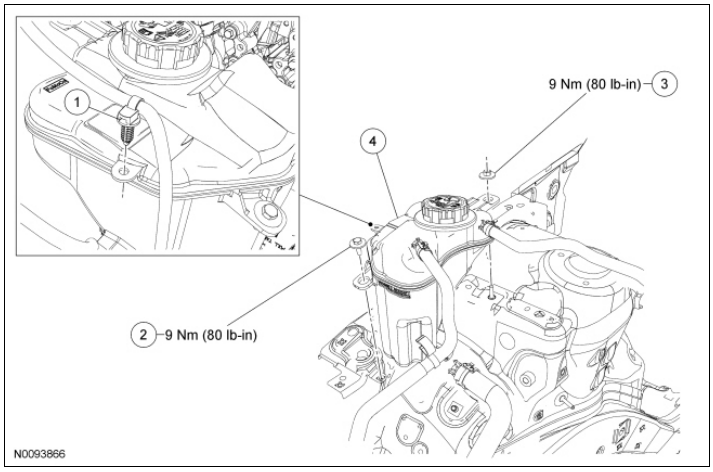
Engine Mount

Engine Mount (View 1 of 3)



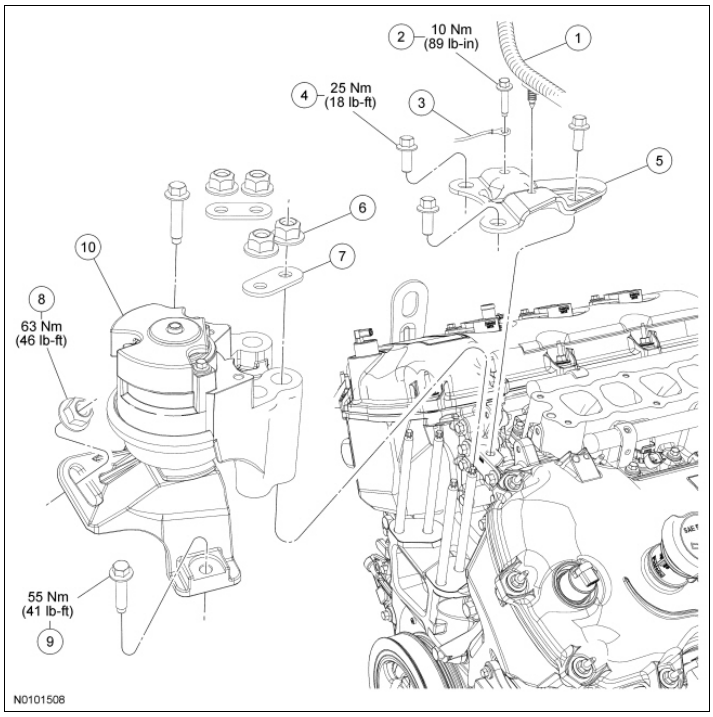
Item	Part Number	Description
1	W503924	A/C tube retaining clamp bolt (2 required)
2	W505422	A/C tube retaining clamp bolt

Engine Mount (View 2 of 3)



Item	Part Number	Description
1	14197	Wiring harness retainer
2	W707398	Engine coolant degas bottle-to-fender bolt
3	W709603	Engine coolant degas bottle-to-fender nut
4	8A080	Engine coolant degas bottle

Engine Mount (View 3 of 3)

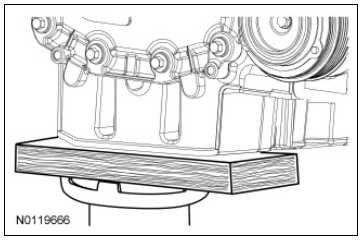


Item	Part Number	Description
1	3493	Power steering hose retainer
2	W705936	Ground wire bolt
3	19A905	Ground wire
4	W708764	Engine mount brace bolt (3 required)
5	6K075	Engine mount brace
6	W705891	Engine mount-to-engine nut (4 required)
7	6B095	Engine mount spacer (2 required)
8	W705891	Engine mount-to-frame nut
9	W500720	Engine mount-to-frame bolt (2 required)
10	6038	Engine mount

Removal and Installation

1. ***NOTICE:*** **Failure to position the wood block and floor jack as illustrated can result in damage to the oil pan.**

   Position a floor jack with a block of wood under the front of the oil pan.



2. Remove the A/C tube retaining clamp bolt.
   - To install, tighten to 8 Nm (71 lb-in).

3. Remove the 2 A/C tube retaining clamp bolts.
    - To install, tighten to 10 Nm (89 lb-in).

4. Detach the wiring harness retainer from the degas bottle.

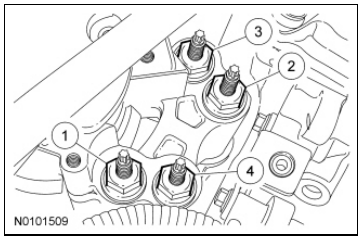
5. Remove the nut, bolt and position the engine coolant degas bottle aside.
    - To install, tighten to 9 Nm (80 lb-in).

6. Detach the power steering hose retainer from the engine mount brace.

7. Remove the bolt and the ground wire from the engine mount brace.
    - To install, tighten to 10 Nm (89 lb-in).

8. Remove the 3 bolts and the engine mount brace.
    - To install, tighten to 25 Nm (18 lb-ft).

9. Remove the 4 engine mount-to-engine nuts.
    - To install, tighten in the sequence shown to 70 Nm (52 lb-ft).



10. Remove the 2 engine mount spacers.

11. Using the floor jack, lower the engine 25 mm (1 in).

12. **NOTE:** It is necessary to reposition the A/C tubes to remove the engine mount.

    Remove the nut, the 2 bolts and the engine mount.

    - To install, tighten the bolts to 55 Nm (41 lb-ft) and the nut to 63 Nm (46 lb-ft).

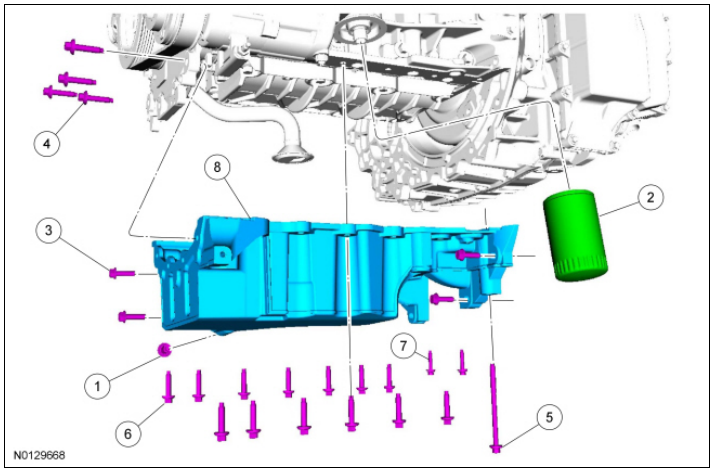
13. To install, reverse the removal procedure.

Oil Pan

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	-

Removal



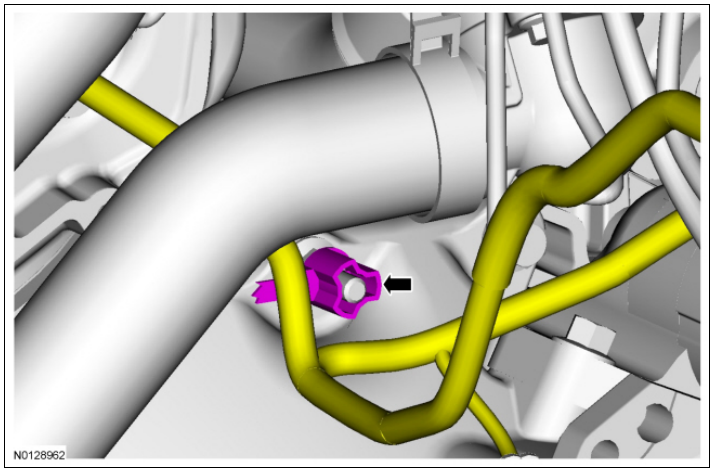
Item	Part Number	Description
1	6730ain plug - 27 Nm (20 lb-ft)	
2	6714	Engine oil filter
3	W714288	Oil pan-to-bellhousing bolt (4 required)
4	W503297	Engine front cover bolt (4 required)
5	W708221	Oil pan bolt
6	W712943	Oil pan bolt (13 required)
7	W503297	Oil pan bolt (2 required)

8	6675	Oil pan

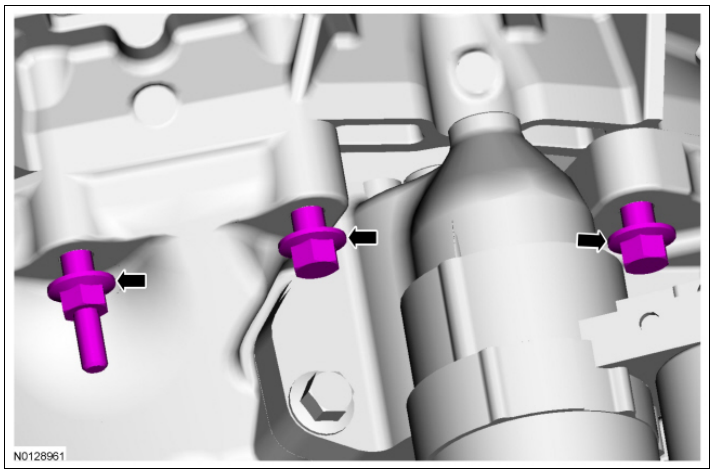
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

All Vehicles

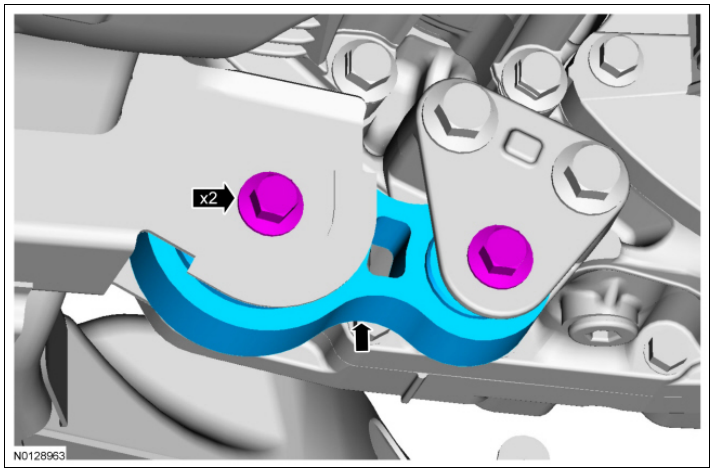
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the Air Cleaner (ACL) and outlet pipe assembly. For additional information, refer to Section 303-12C .
3. Remove the battery tray. For additional information, refer to Section 414-01 .
4. Remove the oil level indicator.
5. Detach the wiring harness retainer from the upper bell housing-to-engine stud bolt.



6. Loosen the 2 upper bellhousing-to-engine bolts and stud bolt 5 mm (0.19 in).



7. Remove the exhaust Y-pipe. For additional information, refer to Section 309-00 .
8. Remove the 2 bolts and the engine roll restrictor.



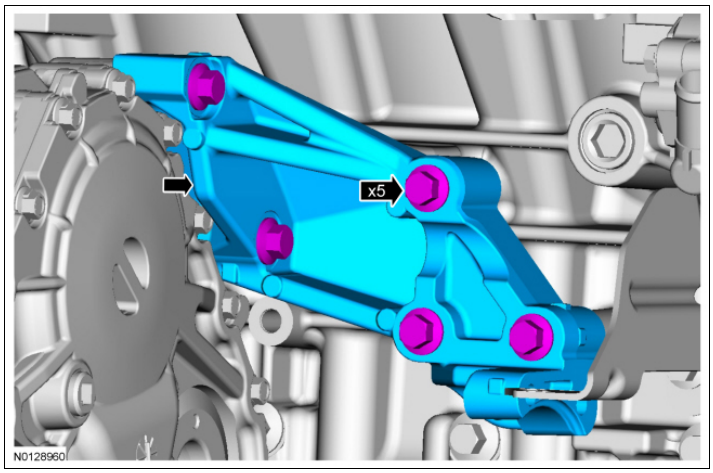
9. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).

10. Remove and discard the engine oil filter.

All-Wheel Drive (AWD) vehicles

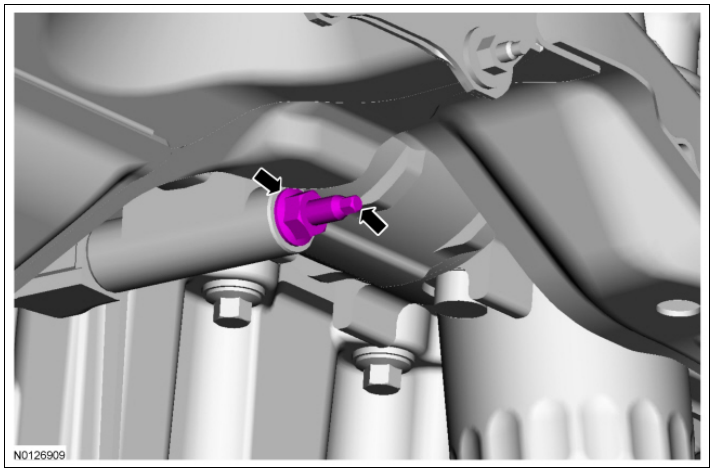
11. Remove the RH catalytic converter. For additional information, refer to Section 309-00 .

12. Remove the 5 bolts and the Power Transfer Unit (PTU) support bracket.

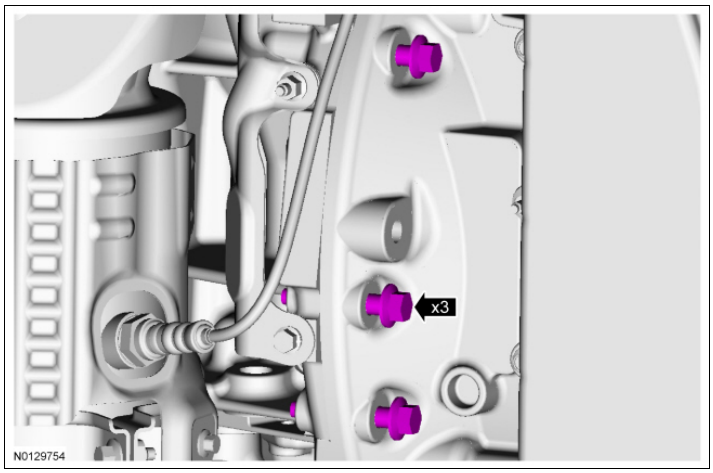


All vehicles

13. Remove the A/C compressor nut.
    - Remove the stud from the oil pan boss (stud will remain in compressor housing).

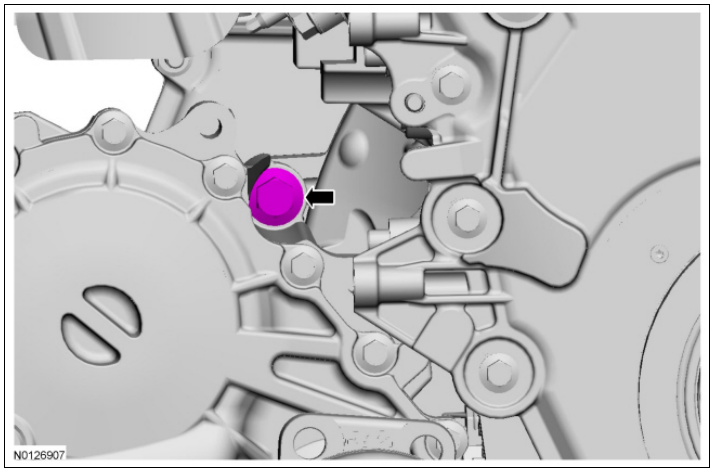


14. Loosen the 3 LH bellhousing-to-engine bolts 5 mm (0.19 in).

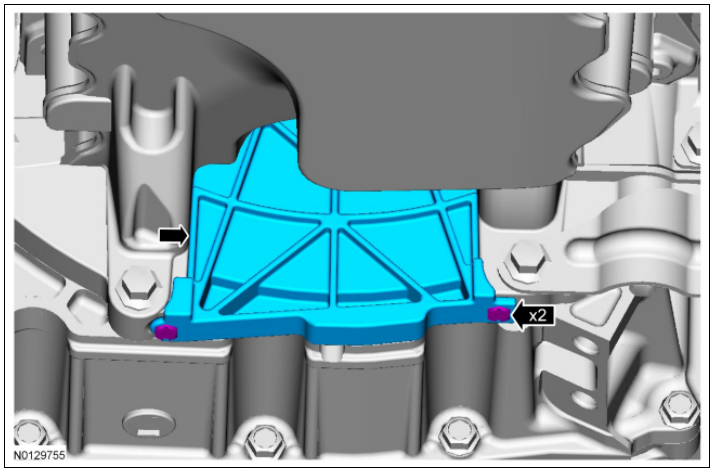


15. **NOTE:** All-Wheel Drive (AWD) vehicle shown, Front Wheel Drive (FWD) similar. Parts removed from graphic for clarity.

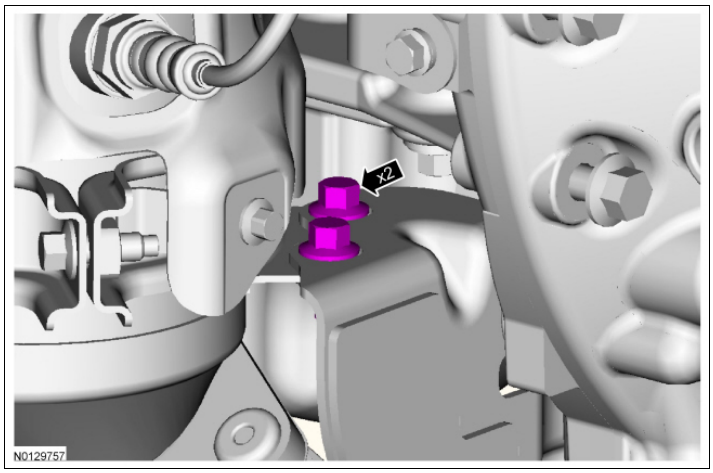
    Loosen the RH engine-to-bellhousing bolt 5 mm (0.19 in).



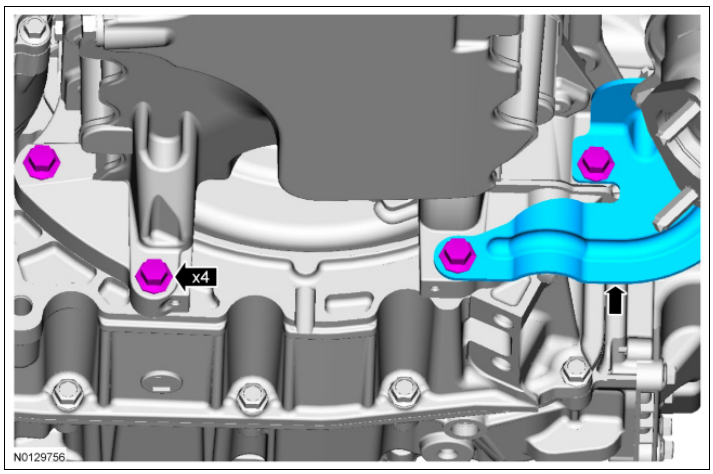
16. Remove the 2 fasteners and the inspection cover.



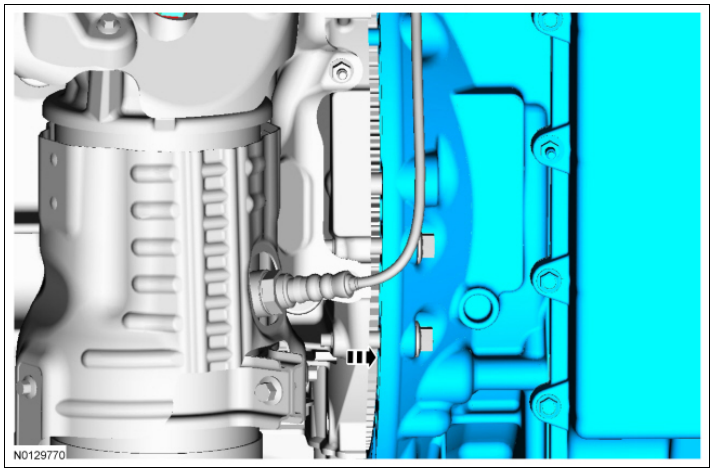
17. Remove the 2 LH catalytic converter bracket bolts.



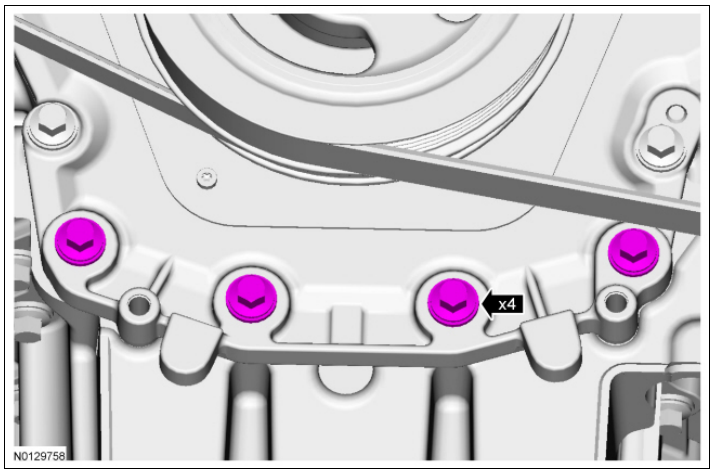
18. Remove the 4 oil pan-to-bellhousing bolts and the LH catalytic converter bracket.



19. Separate the engine and transaxle 5 mm (0.19 in).

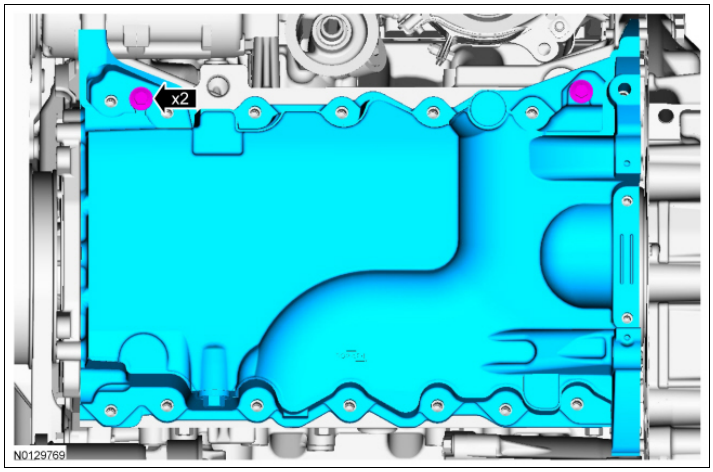


20. Remove the 4 lower engine front cover bolts.



21. Remove the 16 oil pan bolts.

22. Install 2 of the oil pan bolts (finger-tight) into the 2 threaded holes in the oil pan.
    - Alternately tighten the 2 bolts one turn at a time until the oil pan-to-cylinder block seal is released.
        - ♦ Remove the oil pan.



23. ***NOTICE:*** **Only use a 3MTM Roloc® Bristle Disk (2-in white, part number 07528) to clean the oil pan. Do not use metal scrapers, wire brushes or any other powerbrasive disk to clean. These tools cause scratches and gouges that make leak paths.**

Clean the engine oil pan using a 3MTM Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.

- Thoroughly wash the oil pan to remove any foreign material, including any abrasive particles created during the cleaning process.

24. ***NOTICE:*** **Do not use wire brushes, power abrasive discs or 3MTM Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that causes premature engine failure. Remove all traces of the gasket.**

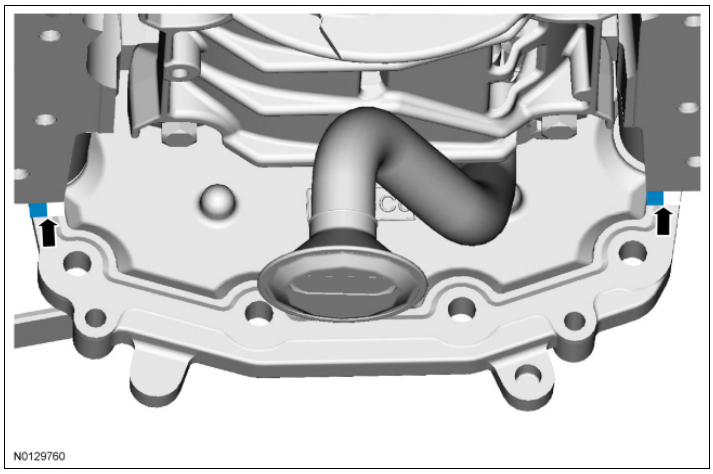
    Clean the sealing surfaces of the cylinder block and engine front cover in the following sequence.

    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

Installation

All vehicles

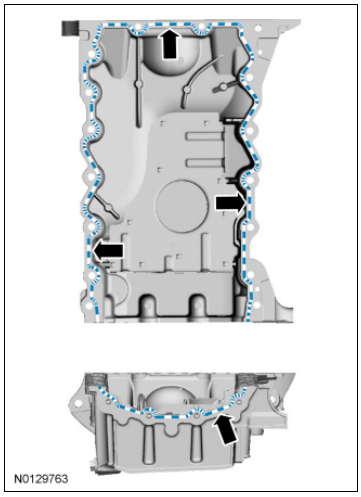
1. Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 engine front cover-to-cylinder block joint areas on the sealing surface of the oil pan.



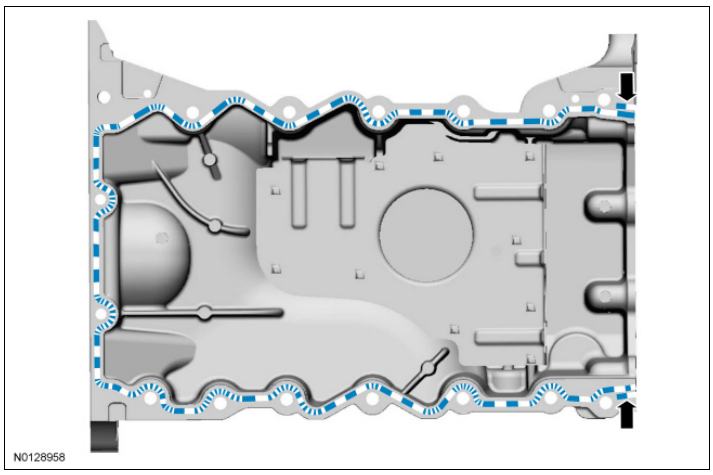
2. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: The oil pan and the 4 specified bolts must be installed and the oil pan aligned to the cylinder block within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.

    Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the oil pan-to-engine block and to the oil pan-to-engine front cover mating surface.



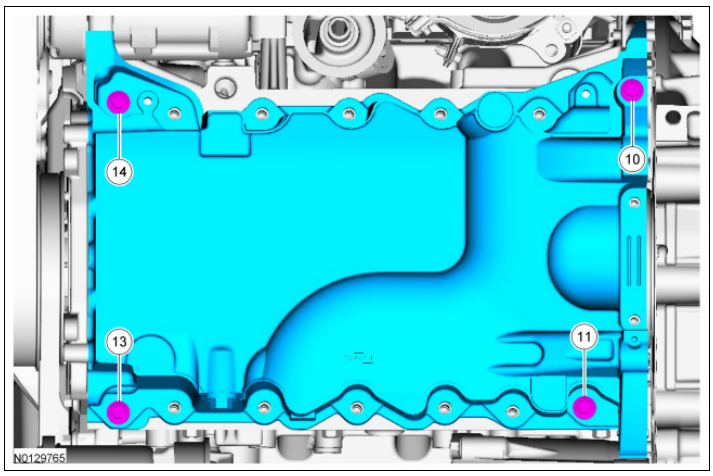
3. Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the 2 crankshaft seal retainer plate-to-cylinder block joint areas on the sealing surface of the oil pan.



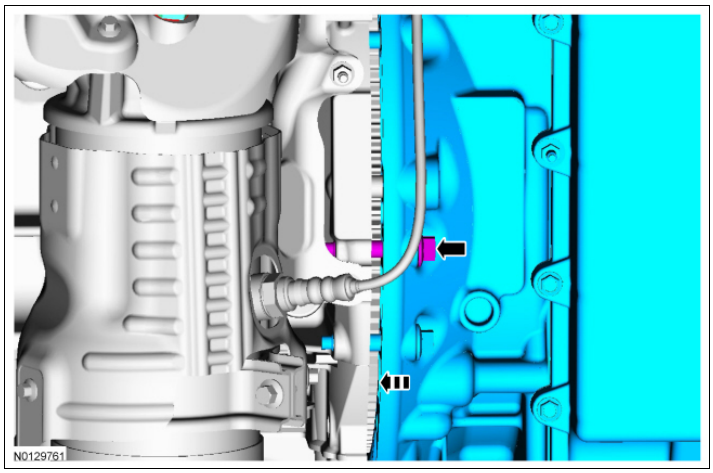
4. **NOTE:** The oil pan and the 4 specified bolts must be installed within 4 minutes of the start of sealant application.

   NOTE: Keep the oil pan as close as possible to the transmission while installing, then slide forward towards the engine front cover to prevent wiping off of the sealant.

   Install the oil pan and bolts 10, 11, 13 and 1inger tight.



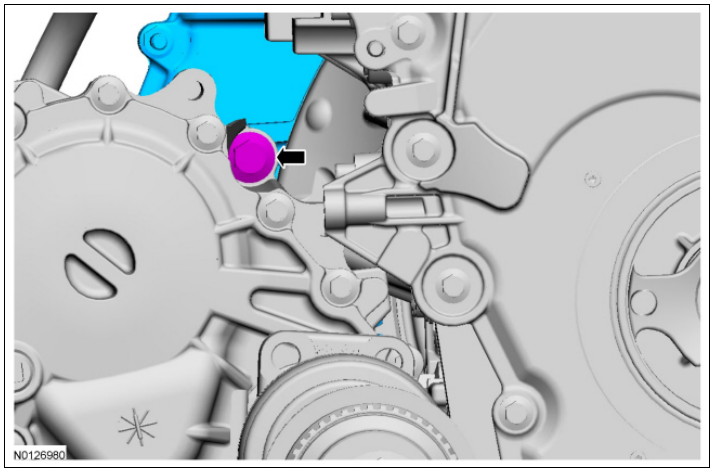
5. Draw the bellhousing up to the engine by tightening the LH bellhousing-to-engine bolt.
   - Do not torque at this time.



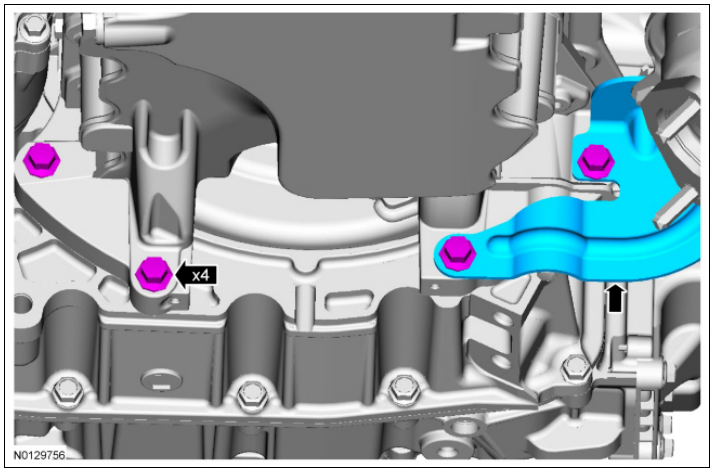
6. **NOTE:** All-Wheel Drive (AWD) vehicle shown, Front Wheel Drive (FWD) similar. Parts removed from graphic for clarity.

   Draw the bellhousing up to the engine by tightening the RH engine-to-bellhousing bolt.

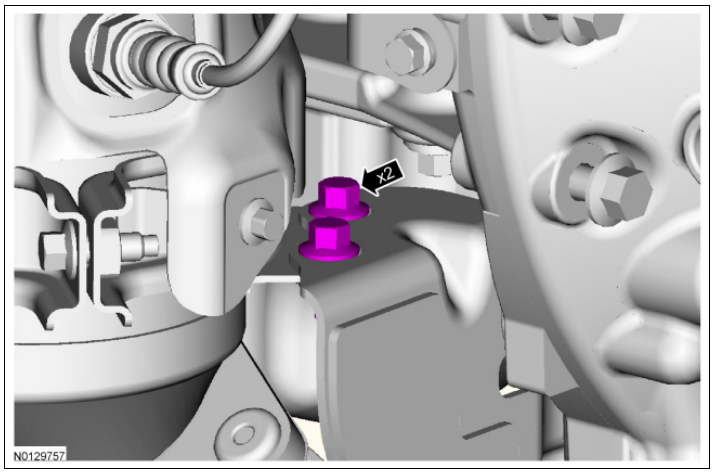
   - Do not torque at this time.



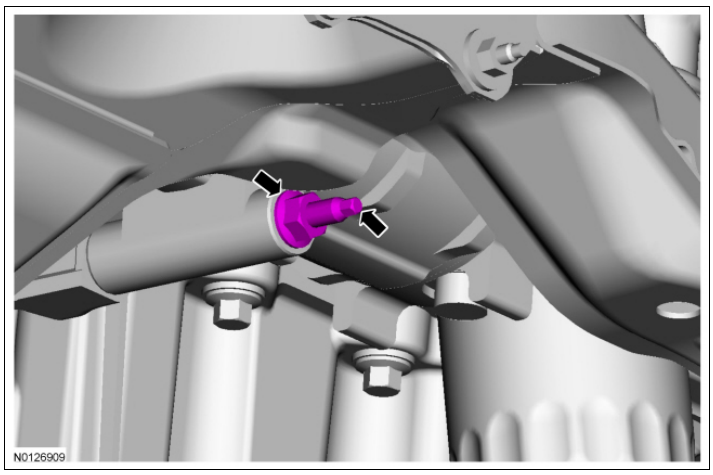
7. Install the LH catalytic converter bracket and the 4 oil pan-to-bellhousing bolts.
   - Do not torque at this time.



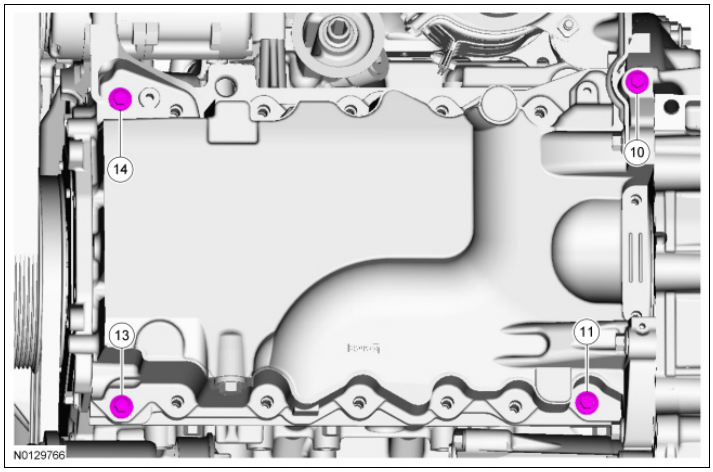
8. Install the 2 LH catalytic converter bracket bolts.
    - Tighten to 20 Nm (177 lb-in).



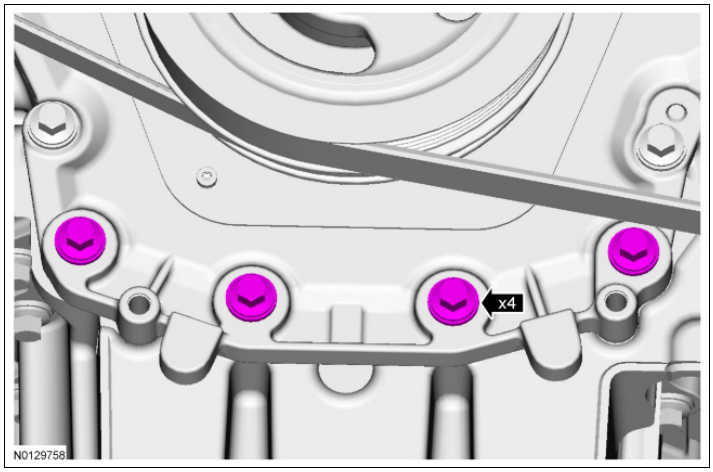
9. Install the A/C compressor stud and nut.
    - Tighten the stud to 9 Nm (80 lb-in).
    - Hand tighten the nut.



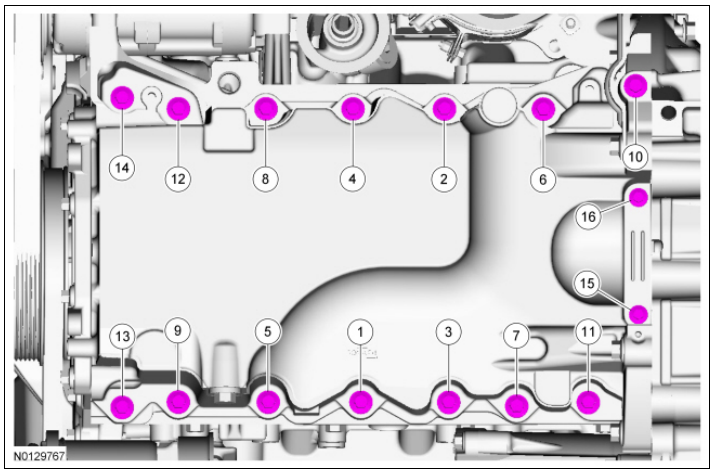
10. Tighten bolts 10, 11, 13 and 14 in the sequence shown to 3 Nm (27 lb-in).



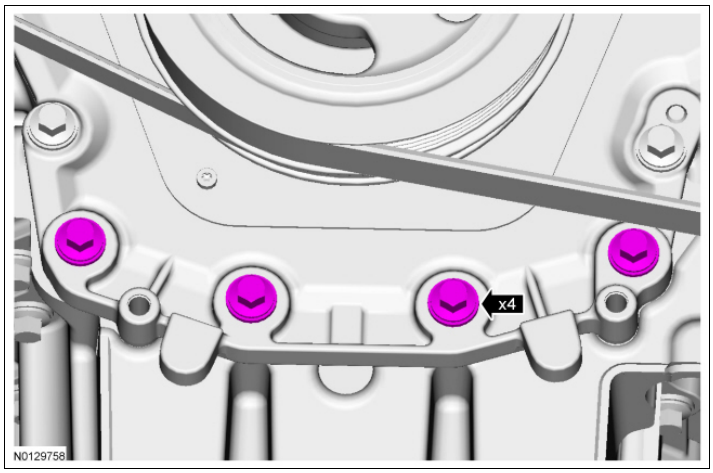
11. Install the 4 lower engine front cover bolts.
    - Do not torque at this time.



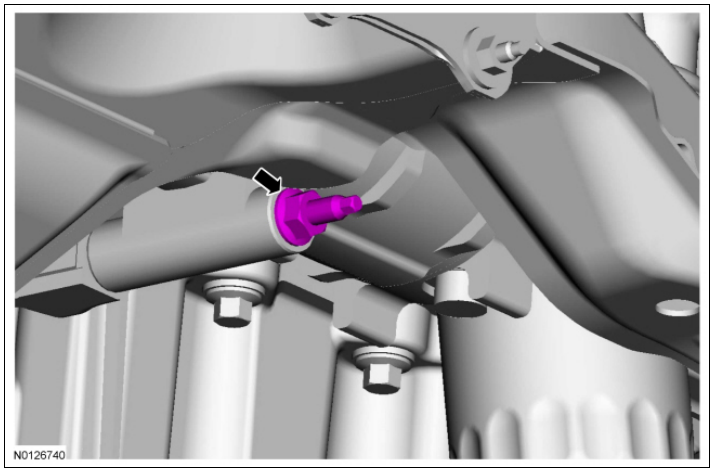
12. Install the remaining oil pan bolts and tighten in the sequence shown.
    - Tighten bolts 1 through 9 and 11 through 14 to 20 Nm (177 lb-in), then rotate an additional 45 degrees.
    - Tighten bolts 15 and 16 to 10 Nm (89 lb-in), then rotate an additional 45 degrees.
    - Tighten bolt 10 to 20 Nm (177 lb-in), then rotate an additional 90 degrees.



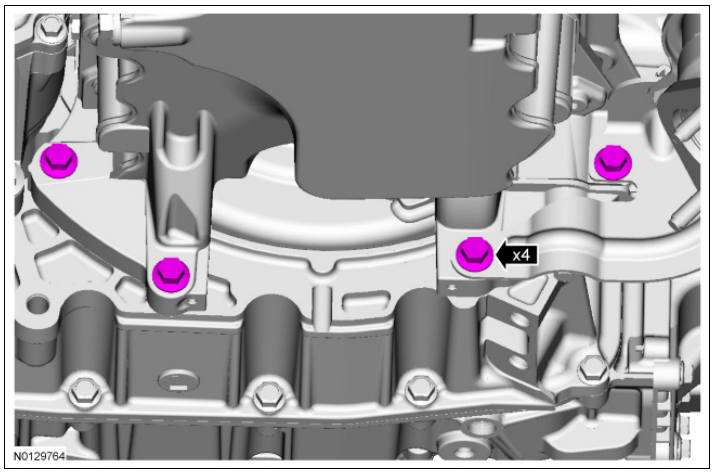
13. Tighten the 4 lower engine front cover bolts to 24 Nm (18 lb-ft).



14. Tighten the A/C compressor nut to 25 Nm (18 lb-ft).

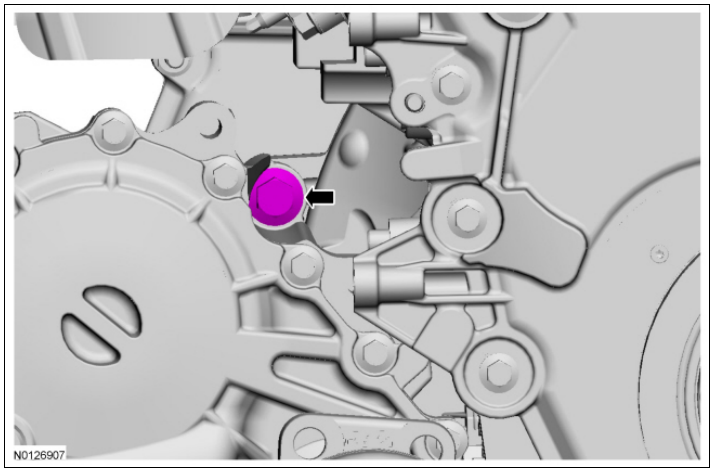


15. Tighten the 4 oil pan-to-bellhousing bolts to 48 Nm (35 lb-ft).

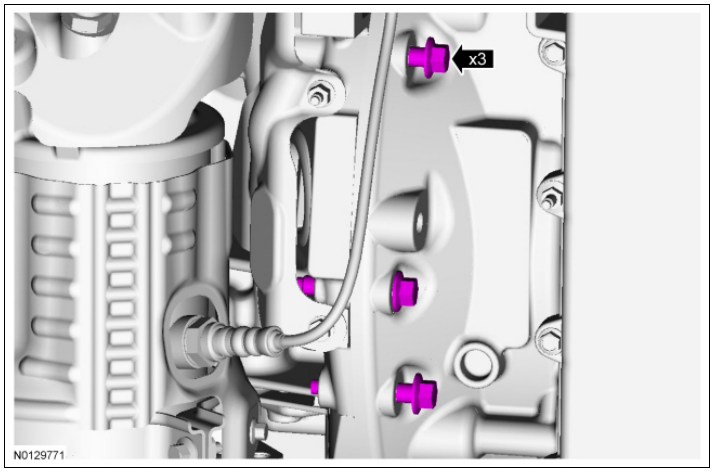


16. **NOTE:** All-Wheel Drive (AWD) vehicle shown, Front Wheel Drive (FWD) similar. Parts removed from graphic for clarity.

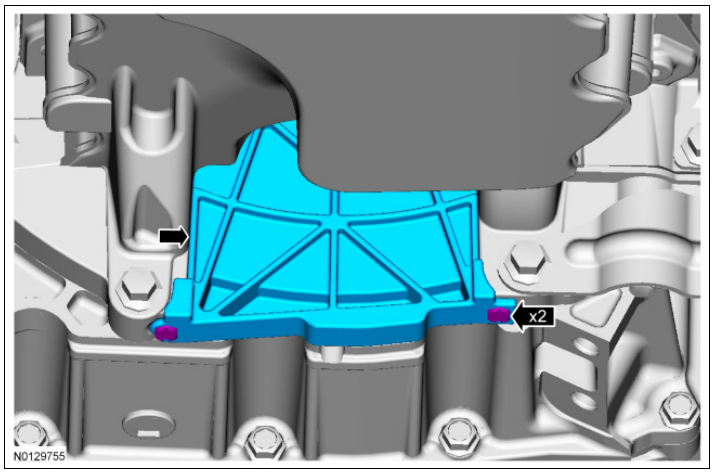
    Tighten the RH engine-to-bellhousing bolt to 48 Nm (35 lb-ft).



17. Tighten the 3 LH bellhousing-to-engine bolts to 48 Nm (35 lb-ft).

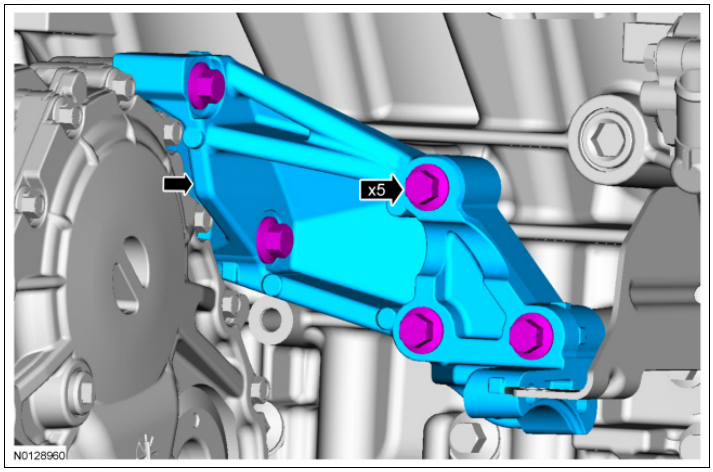


18. Install the inspection cover and the 2 fasteners.



All-Wheel Drive (AWD) vehicles

19. Install the Power Transfer Unit (PTU) support bracket and the 5 bolts.
    - Tighten to 48 Nm (35 lb-ft).



20. Install the RH catalytic converter. For additional information, refer to Section 309-00 .

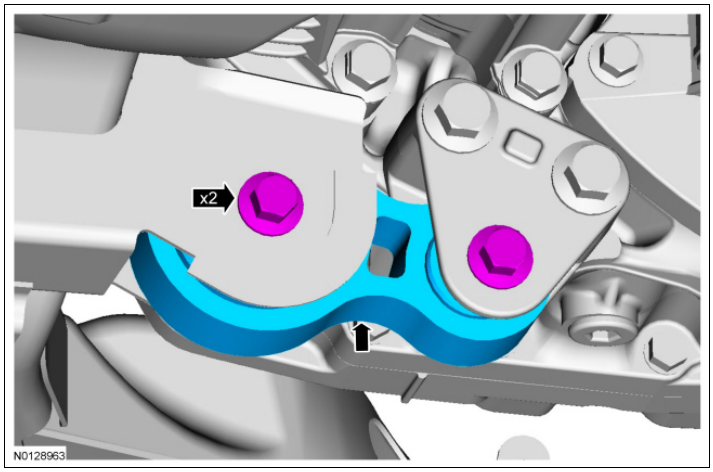
All vehicles

21. **NOTE:** Do not lubricate the engine oil filter gasket.

Install a new engine oil filter.

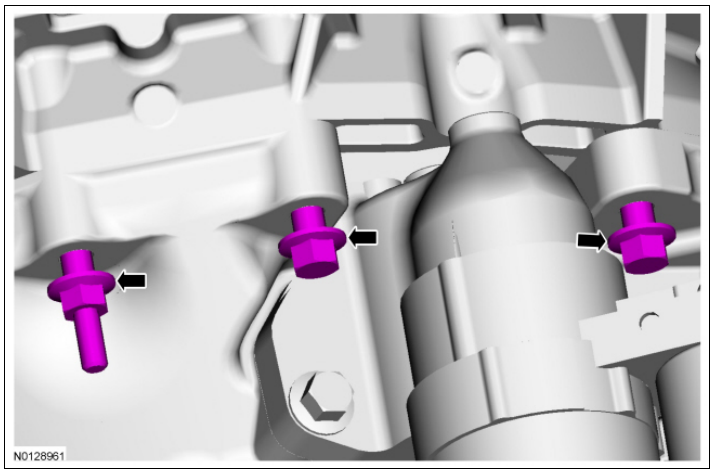
- Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

22. Install the engine roll restrictor and the 2 bolts.
    - Tighten to 90 Nm (66 lb-ft).

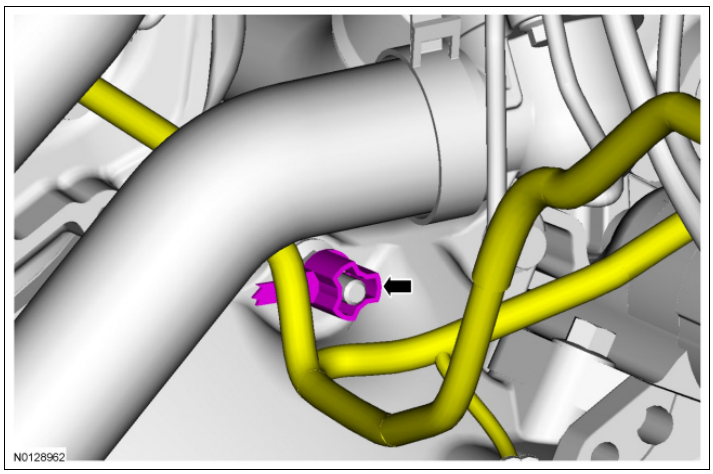


23. Install the exhaust Y-pipe. For additional information, refer to Section 309-00 .

24. Tighten the 3 upper bellhousing-to-engine bolts to 48 Nm (35 lb-ft).



25. Attach the wiring harness retainer to the upper bell housing-to-engine stud bolt.



26. Install the oil level indicator.

27. Install the battery tray. For additional information, refer to Section 414-01 .

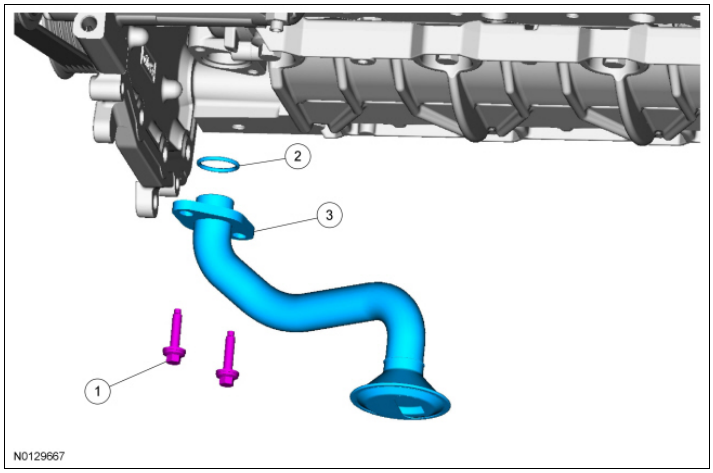
28. Install the Air Cleaner (ACL) and outlet pipe assembly. For additional information, refer to Section 303-12C .

29. ***NOTICE:*** **Do not expose the Motorcraft® High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the oil pan. Failure to follow these nstructions may cause engine oil leakage.**

    Fill the engine with clean engine oil.

Oil Pump Screen and Pickup Tube

Removal



Item	Part Number	Description
1	W503278	Oil pump screen and pickup tube bolt (2 required) - 10 Nm (89 lb-in)
2	6625	O-ring seal
3	6622	Oil pump screen and pickup tube

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.**

1. Remove the oil pan. For additional information, refer to Oil Pan in this section.

2. Remove the 2 bolts and the oil pump screen and pickup tube.
   - Discard the O-ring seal.

Installation

1. Using a new O-ring seal, install the oil pump screen and pickup tube and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).

2. Install the oil pan. For additional information, refer to Oil Pan in this section.

Crankshaft Rear Seal with Retainer Plate

Special Tool(s)

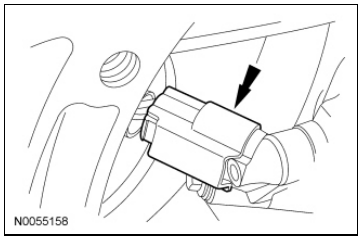
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2980-A	Installer, Rear Main Seal 303-1250
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)

Material

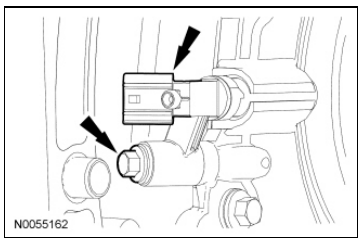
Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	-

Removal

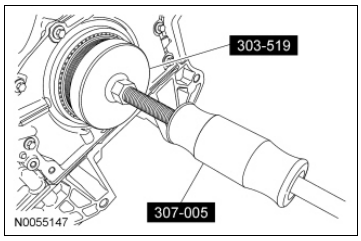
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the flexplate. For additional information, refer to Flexplate in this section.
3. Remove the crankshaft sensor ring.
4. Disconnect the Crankshaft Position (CKP) sensor electrical connector.



5. Remove the bolt and the CKP sensor.

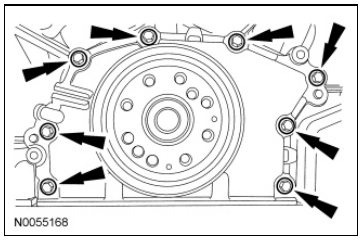


6. Using the Crankshaft Rear Oil Seal Remover and Slide Hammer, remove and discard the rear crankshaft seal.

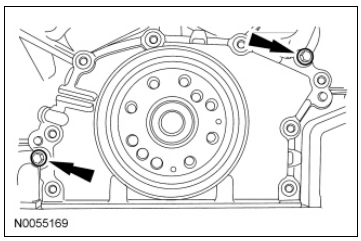


7. Remove the 2 oil pan to crankshaft rear seal retainer bolts.

8. Remove the 8 crankshaft rear seal retainer bolts.



9. Install the 2 M6 oil pan bolts (finger-tight) into the 2 threaded holes in the crankshaft rear seal retainer.
    - Alternately tighten the 2 bolts one turn at a time until the crankshaft rear seal retainer-to-cylinder block seal is released.
        - ♦ Remove the crankshaft rear seal retainer.



10. ***NOTICE:*** **Only use a 3MTM Roloc® Bristle Disk (2-in white, part number 07528) to clean the crankshaft rear seal retainer plate. Do not use metal scrapers, wire brushes or any other power**

abrasive disk to clean the crankshaft rear seal retainer plate. These tools cause scratches and gouges that make leak paths.

Clean the crankshaft rear seal retainer plate using a 3MTM Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.

- Thoroughly wash the crankshaft rear seal retainer plate to remove any foreign material, including any abrasive particles created during the cleaning process.

11. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.**

    NOTICE: **Do not use wireshes, power abrasive discs or 3MTM Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that will cause premature engine failure. Remove all traces of the gasket.**

    Clean the sealing surfaces of the cylinder block and oil pan flange in the following sequence.

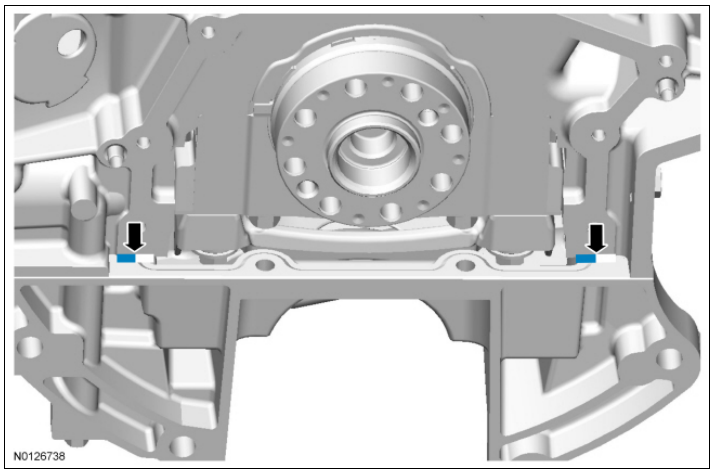
    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil or coolant and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

Installation

1. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 10 minutes of sealant application.

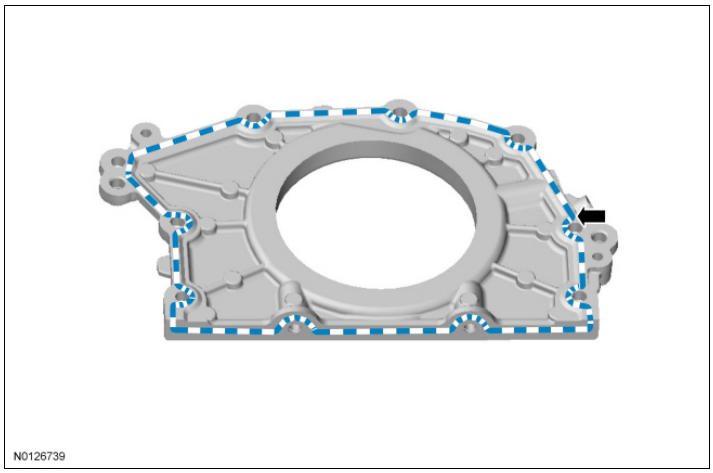
   Apply 5 mm (0.196 in) beads of Motorcraft® High Performance Engine RTV Silicone to the 2 cylinder block/oil pan joints.



2. ***NOTICE:*** **Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious e damage.**

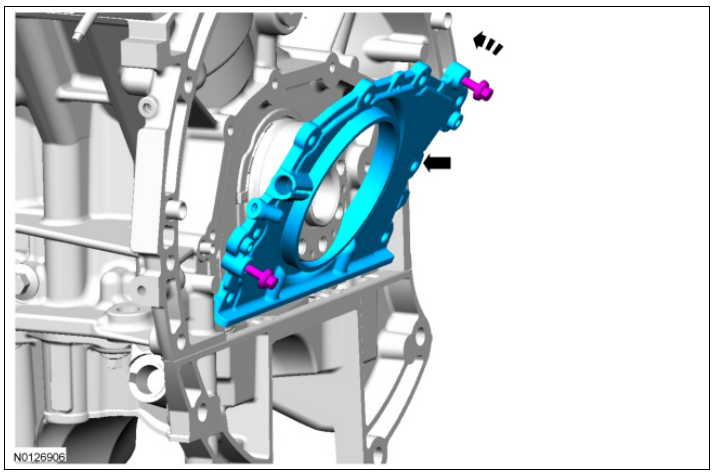
   NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 10 minutes of sealant application.

   Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the crankshaft rear seal retainer.

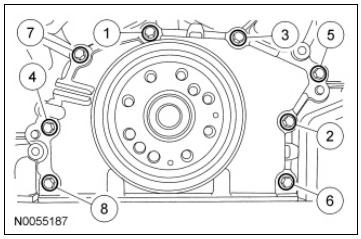


3. **NOTE:** Use the 2 oil pan bolts as handles during installation to avoid touching the sealant.

   Install the crankshaft rear seal retainer at an angle above the oil pan flange to avoid scraping off the sealer. Tilt the seal retainer up and onto the rear of the cylinder block.



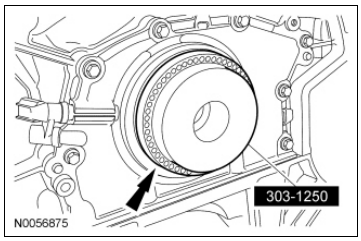
4. Install the 8 bolts and tighten in the sequence shown to 10 Nm (89 lb-in).



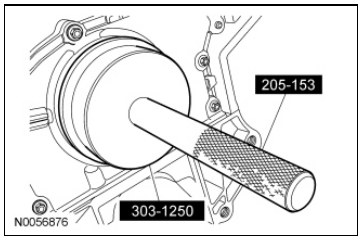
5. Install the 2 oil pan to crankshaft rear seal retainer bolts.
   - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.

6. **NOTE:** Lubricate the seal lips and bore ith clean engine oil prior to installation.

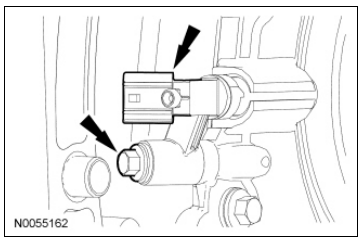
   Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.



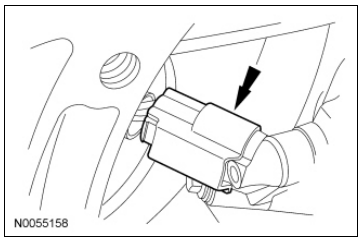
7. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.



8. Install the Crankshaft Position (CKP) sensor and install the bolt.
   - Tighten to 10 Nm (89 lb-in).



9. Connect the CKP sensor electrical connector.

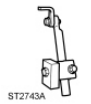


10. Install the crankshaft sensor ring.

11. Install the flexplate. For additional information, refer to Flexplate in this section.

Engine

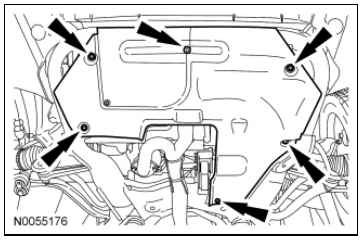
Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST2743A	Adjustable Grip Arm, 1735A 014-00001 or equivalent
 ST2976A	Engine Lift Eye 303-1245
 ST1293-A	Powertrain Lift 300-OTC1585AE
 ST1408-A	Remover, Tie-Rod End 211-105
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

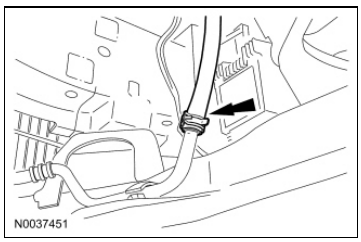
⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

All vehicles

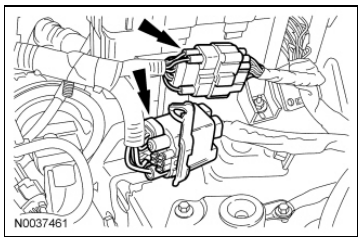
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Release the fuel system pressure. For additional information, refer to Section 310-00 .
3. Recover the A/C system. For additional information, refer to Section 412-00A .
4. Remove the accessory drive belt and the power steering belt. For additional information, refer to Section 303-05C .
5. Remove the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .
6. If equipped, remove the 6 screws and the underbody shield.



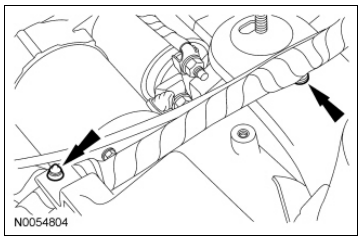
7. Disconnect the power steering cooler tube and drain the power steering fluid into a suitable drain pan.



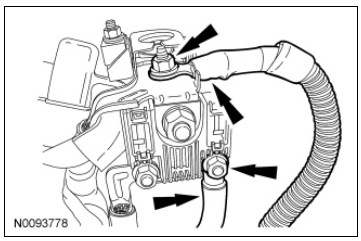
8. Drain the cooling system. For additional information, refer to Section 303-03A .
9. Remove the degas bottle. For additional information, refer to Section 303-03A .
10. Remove the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to Section 303-12C .
11. Remove the battery tray. For additional information, refer to Section 414-01 .
12. Disconnect the 2 engine wiring harness electrical connectors.



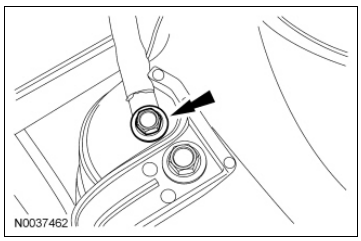
13. Detach the 2 wiring harness retainers from the transmission mount and the battery tray bracket.



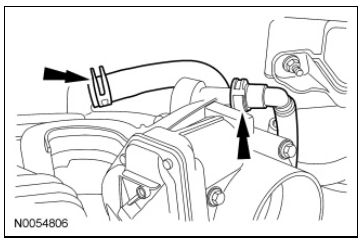
14. Remove the 2 nuts and the battery cables from the positive battery cable.



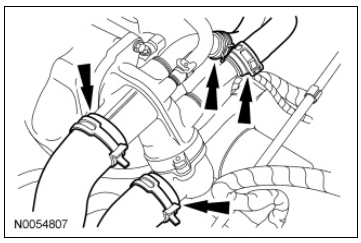
15. Remove the bolt and position aside the ground wire.



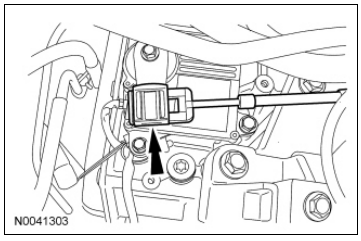
16. Disconnect the vacuum hose and the Evaporative Emission (EVAP) tube from the upper intake manifold.



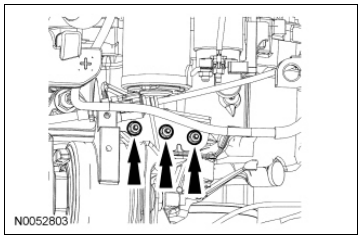
17. Disconnect the upper radiator hose, lower radiator hose and 2 heater hoses from the thermostat housing.



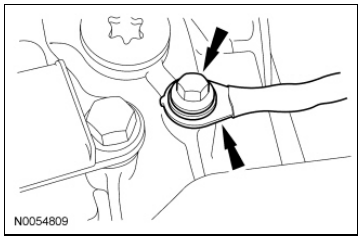
18. Disconnect the transaxle control cable from the control lever.



19. Remove the 3 nuts and position the transaxle control cable bracket aside.

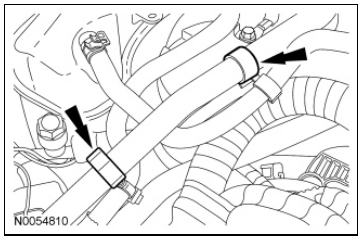


20. Remove the bolt and position the ground wire aside.

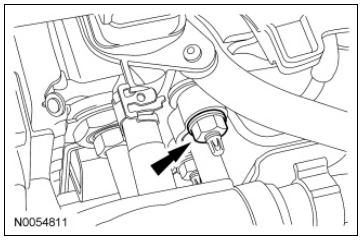


21. If equipped, detach the engine block heater harness from the radiator support, power steering hose, A/C tube and the engine wiring harness.

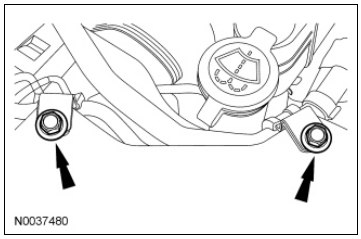
22. Detach the coolant tube retainer clips from the A/C tube.



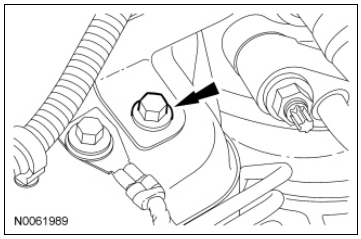
23. Remove the nut and disconnect the A/C tube from the condenser.
    - Discard the O-ring seal.



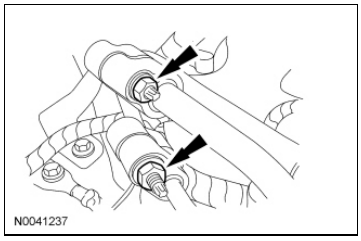
24. Remove the 2 A/C tube bracket bolts.



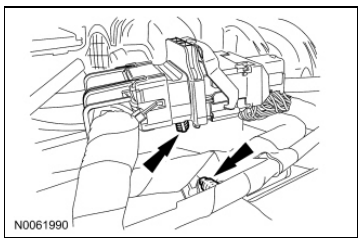
25. Remove the A/C tube bracket bolt.



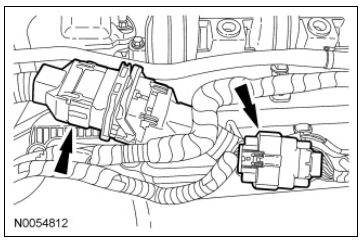
26. Remove the 2 nuts and disconnect the A/C tubes.
    - Discard the O-ring seal.



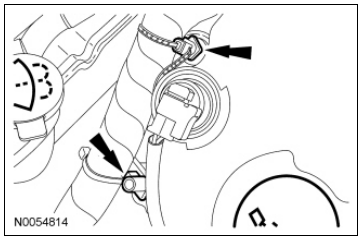
27. Detach the 2 wiring harness retainers.



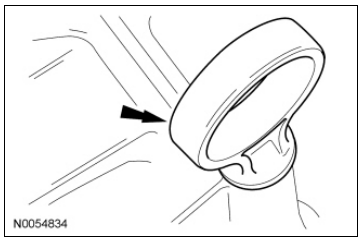
28. Disconnect the 2 engine wiring harness electrical connectors.



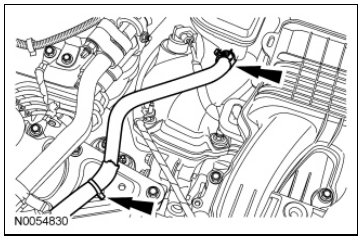
29. Remove the 2 wiring harness retainers from the LH valve cover stud bolts and position the wiring harness aside.



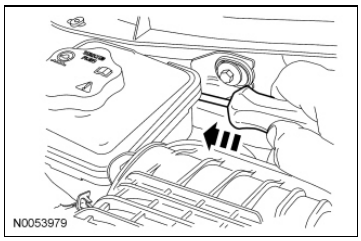
30. Remove the oil level indicator.



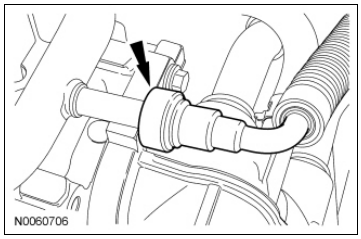
31. Disconnect the hose from the power steering reservoir.
    - Detach the pin-type retainer from the engine mount brace.



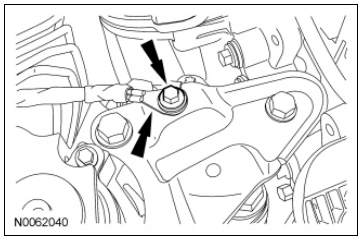
32. Using a small screwdriver, release the retaining clip and detach the power steering reservoir from the cowl.



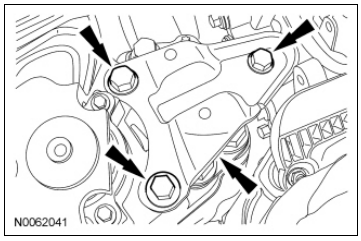
33. Disconnect the fuel supply tube from the fuel rail. For additional information, refer to Section 310-00 .



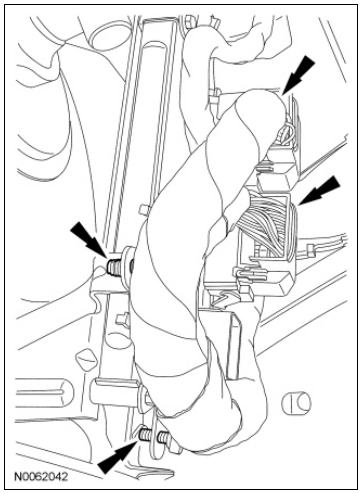
34. Remove the bolt and the ground wire from the engine mount brace.



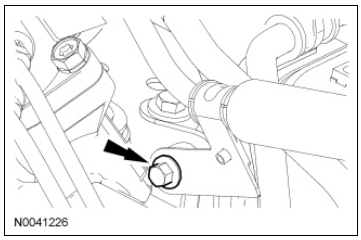
35. Remove the 3 bolts and the engine mount brace.



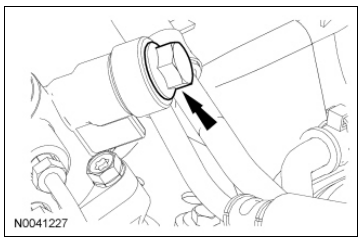
36. Disconnect the PCM electrical connectors and pin-type retainers.



37. Remove the Power Steering Pressure (PSP) hose bracket bolt.

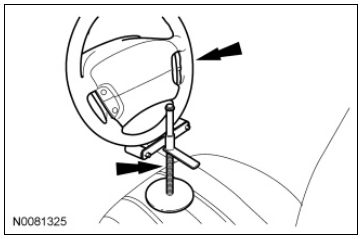


38. Remove and discard the PSP hose banjo bolt and the 2 seals from the steering gear.

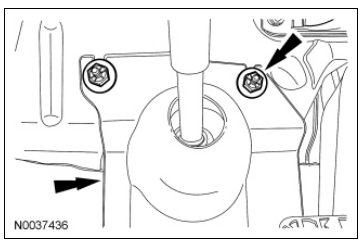


39. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

Using a suitable holding device, hold the steering wheel in the straight-ahead position.



40. Remove the 2 nuts and the steering joint cover.

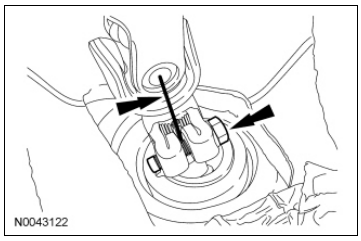


41. ***NOTICE:*** **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

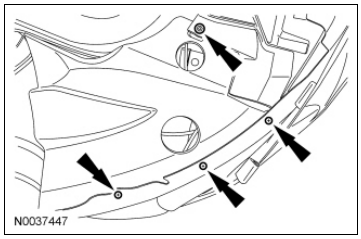
    NOTE: Index-mark the steering column shaft position to the steering gear for reference during installation.

    Remove the bolt and disconnect the steering column shaft from the steering gear.

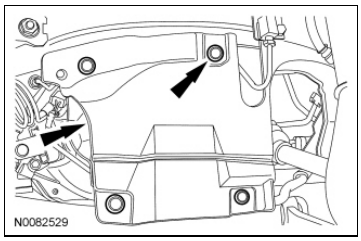
    - Discard the bolt.



42. Remove the 4 screws and position the LH fender splash shield aside.

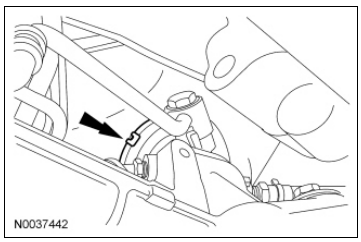


43. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.

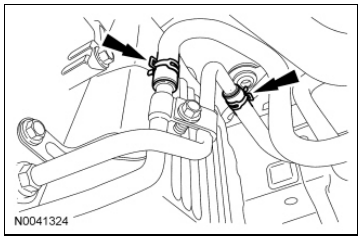


44. ***NOTICE:*** **The steering gear-to-dash seal must be removed or it will be damaged when lowering the subframe.**

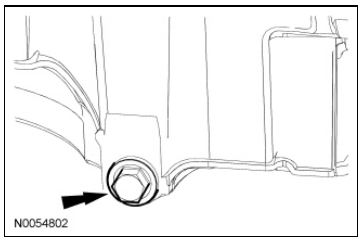
    Release the 4 clips and slide the steering gear-to-dash seal off of the steering gear and into the passenger compartment.



45. Disconnect the transaxle cooler hoses.

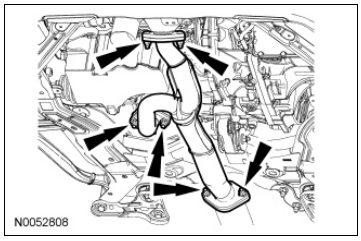


46. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).

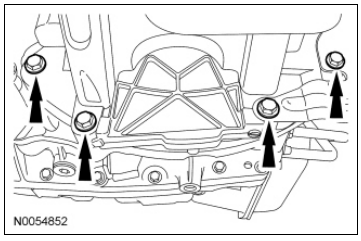


47. Remove and discard the engine oil filter.

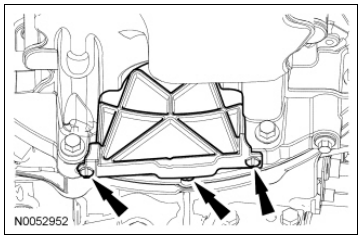
48. Remove the 6 nuts and the Y-pipe assembly.
    - Discard the gaskets and nuts.



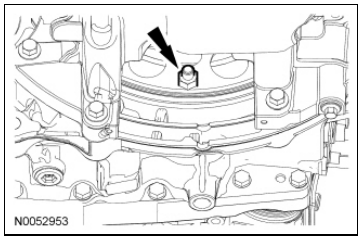
49. Remove the 4 oil pan-to-transaxle bolts.



50. Remove the 2 fasteners and the inspection cover.



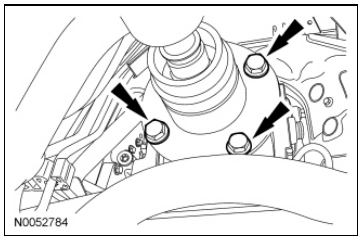
51. Remove and discard the 4 torque converter nuts.



All-Wheel Drive (AWD) vehicles

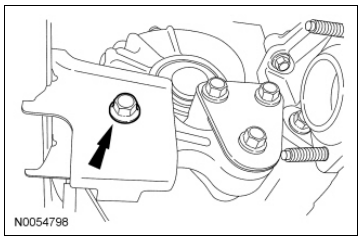
52. **NOTE:** Index-mark the driveshaft for installation.

    Remove and discard the 4 bolts (3 shown) and support the driveshaft with a length of mechanic's wire.



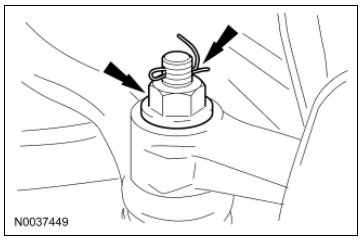
All vehicles

53. Remove the engine roll restrictor-to-subframe through bolt.



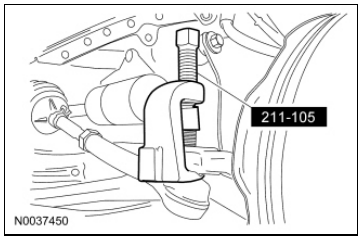
54. **NOTE:** LH shown, RH similar.

    Remove the cotter pins and nuts from the tie-rod ends.



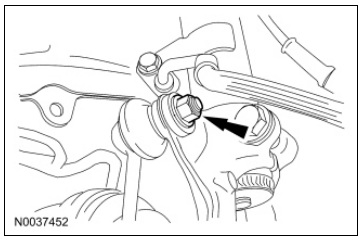
55. **NOTE:** LH shown, RH similar.

    Using the Tie-Rod End Remover, separate the tie-rod ends from the steering knuckles.



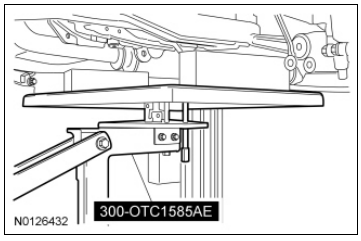
56. **NOTE:** LH shown, RH similar.

    Remove the nuts and separate the stabilizer bar links from the struts.



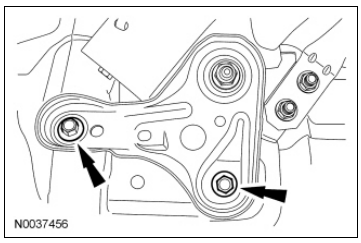
57. Using a wax pencil, mark the relationship of the front subframe to the underbody at the mounting locations.

58. Position the Powertrain Lift under the subframe assembly.



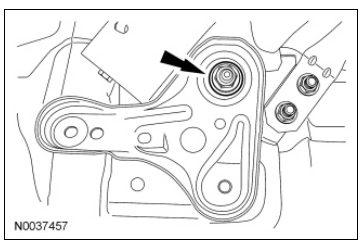
59. **NOTE:** LH shown, RH similar.

    Remove the 4 subframe bracket-to-body bolts.



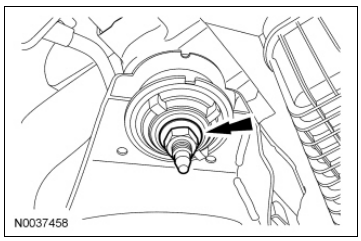
60. **NOTE:** LH shown, RH similar.

    Remove the 2 rear subframe nuts and the 2 subframe brackets.



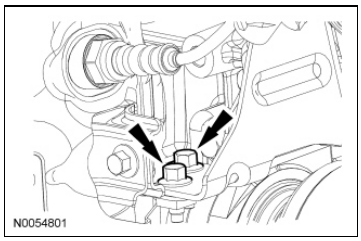
61. **NOTE:** LH shown, RH similar.

    Remove the 2 front subframe nuts.



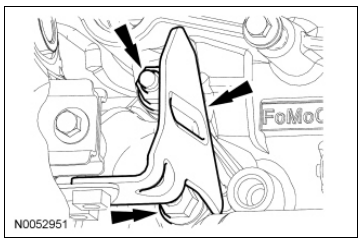
62. Lower the subframe assembly from the vehicle.

63. Remove the 2 RH catalytic converter bracket bolts.



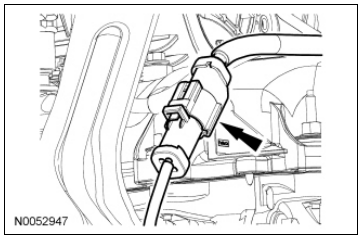
Front Wheel Drive (FWD) vehicles

64. Remove the 2 nuts and remove the RH catalytic converter bracket.

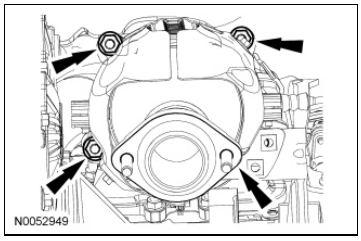


All-Wheel Drive (AWD) vehicles

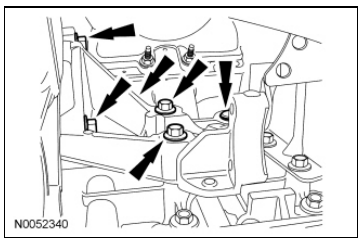
65. Disconnect the RH Catalyst Monitor Sensor (CMS) electrical connector.



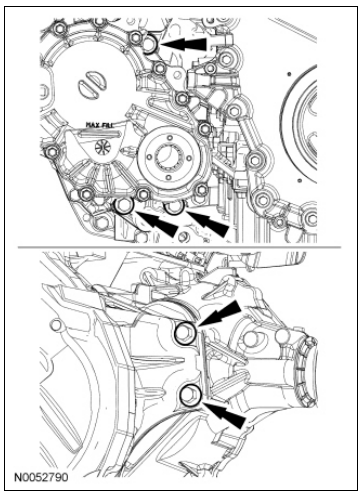
66. Remove the 4 nuts and the RH catalytic converter.
    - Discard the gasket.



67. Remove the 5 bolts and the Power Transfer Unit (PTU) support bracket.



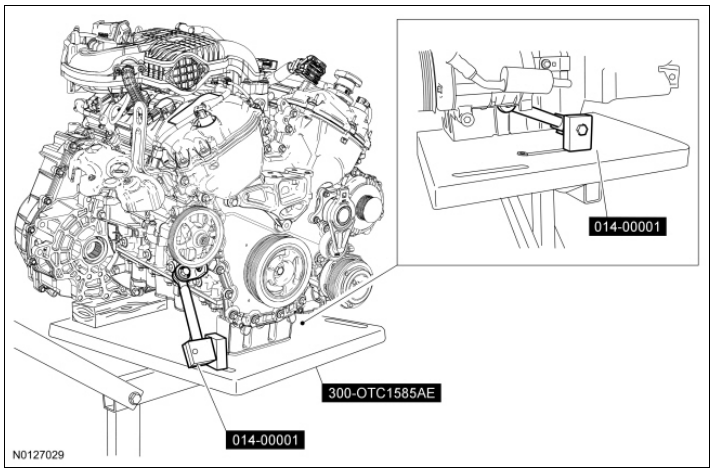
68. Remove the 5 bolts and the PTU .



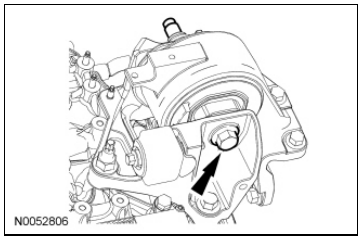
All vehicles

69. **NOTE:** Position a block of wood under the transaxle.

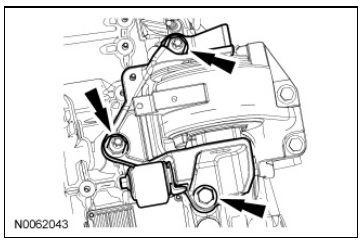
    Install the Powertrain Lift and Adjustable Grip Arms.



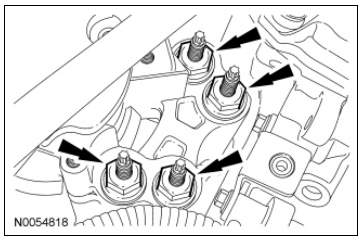
70. Remove the transaxle support insulator through bolt and nut.



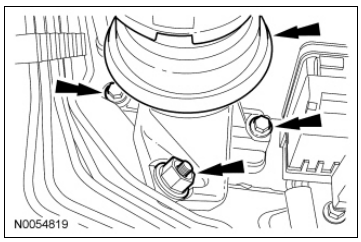
71. Remove the transaxle support insulator bracket bolt and the 2 nuts.



72. Remove the 4 engine mount nuts.
    - Remove the 2 engine mount spacers.

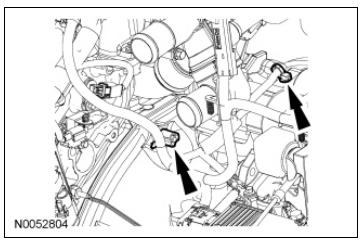


73. Remove the nut, 2 bolts and the engine mount.

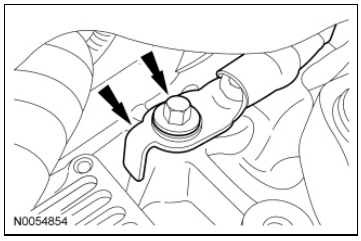


74. Lower the engine and transaxle assembly from the vehicle.

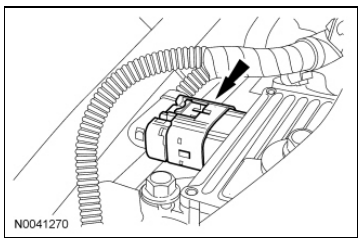
75. Disconnect the wiring harness fasteners from the transaxle-to-engine stud bolt and the starter.



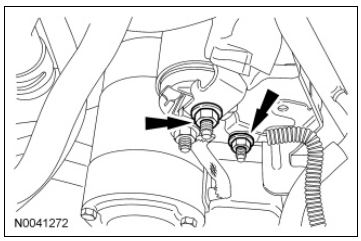
76. Remove the bolt and ground wire.



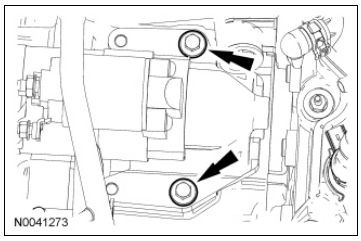
77. Disconnect the Transmission Control Module (TCM) electrical connector.



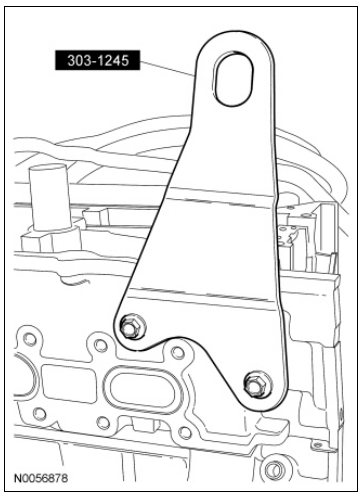
78. Remove the 2 nuts and the starter motor wiring.



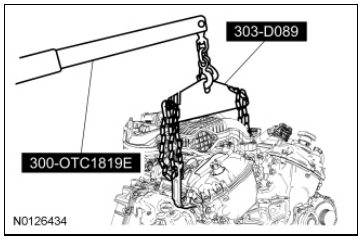
79. Remove the 2 bolts and the starter.



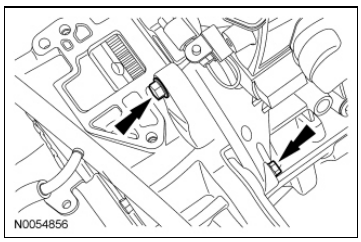
80. Install the Engine Lift Eye on the LH cylinder head.



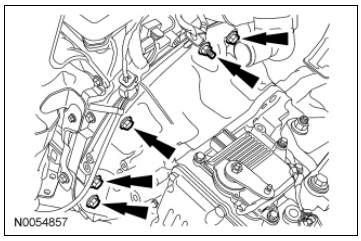
81. Using the Floor Crane and Spreader Bar, remove the engine and transaxle from the lift table.



82. Remove the 2 engine-to-transaxle bolts.

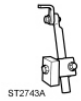


83. Remove the transaxle-to-engine stud bolt and the 4 transaxle-to-engine bolts.
    - Separate the transaxle from the engine.



Engine Front Cover

Special Tool(s)

 ST2743A	Adjustable Grip Arm, 1735A 014-00001 or equivalent
 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1326-A	Handle
 ST1293-A	Powertrain Lift 300-OTC1585AE
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)
 ST1408-A	Remover, Tie-Rod End 211-105
 ST2982-A	Remover, VCT Spark Plug Tube Seal 303-1247/1
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent

Material

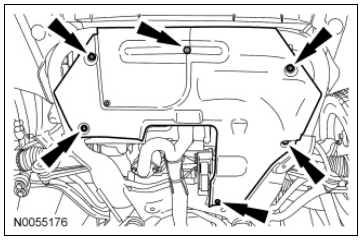
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

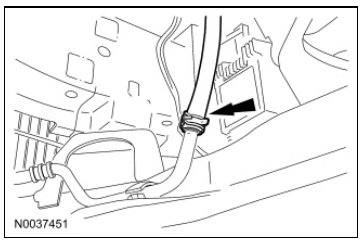
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

All vehicles

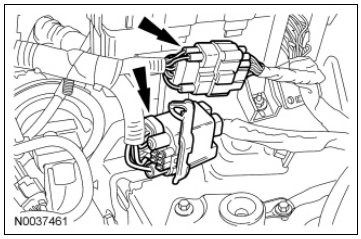
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Release the fuel system pressure. For additional information, refer to Section 310-00 .
3. Recover the A/C system. For additional information, refer to Section 412-00A .
4. Remove the accessory drive belt and the power steering belt. For additional information, refer to Section 303-05C .
5. Remove the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .
6. If equipped, remove the 6 screws and the underbody shield.



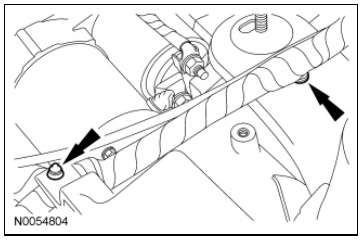
7. Disconnect the power steering cooler tube and drain the power steering fluid into a suitable drain pan.



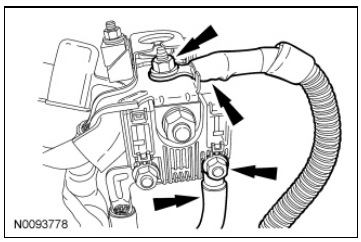
8. Drain the cooling system. For additional information, refer to Section 303-03A .
9. Remove the degas bottle. For additional information, refer to Section 303-03A .
10. Remove the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to Section 303-12C .
11. Remove the battery tray. For additional information, refer to Section 414-01 .
12. Disconnect the 2 engine wiring harness electrical connectors.



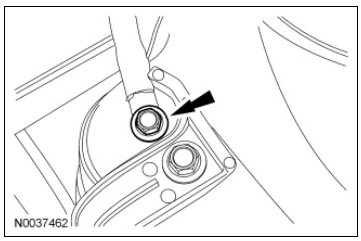
13. Detach the 2 wiring harness retainers from transmission mount and the battery tray bracket.



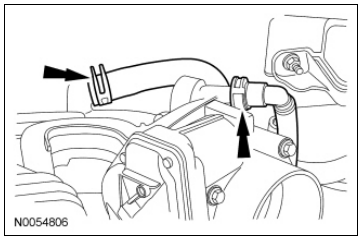
14. Remove the 2 nuts and the battery cables from the positive battery cable.



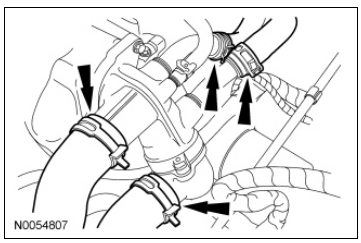
15. Remove the bolt and position aside the ground wire.



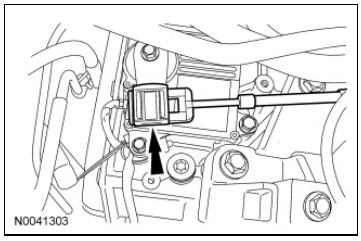
16. Disconnect the vacuum hose and the Evaporative Emission (EVAP) tube from the upper intake manifold.



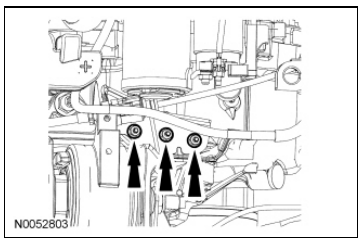
17. Disconnect the upper radiator hose, lower radiator hose and 2 heater hoses from the thermostat housing.



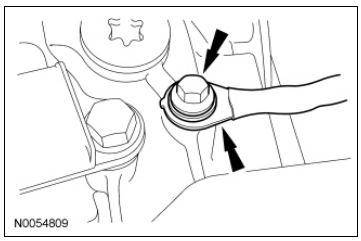
18. Disconnect the transaxle control cable from the control lever.



19. Remove the 3 nuts and position the transaxle control cable bracket aside.

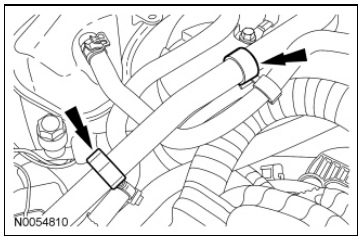


20. Remove the bolt and position the ground wire aside.

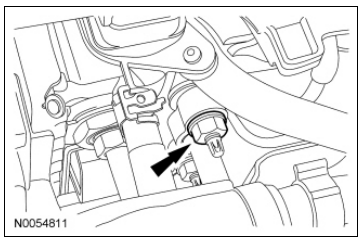


21. If equipped, detach the engine block heater harness from the radiator support, power steering hose, A/C tube and the engine wiring harness.

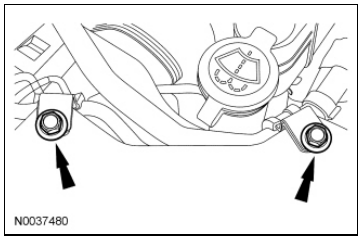
22. Detach the coolant tube retainer clips from the A/C tube.



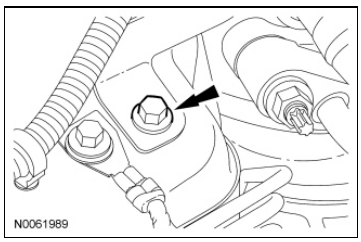
23. Remove the nut and disconnect the A/C tube from the condenser.
    - Discard the O-ring seals.



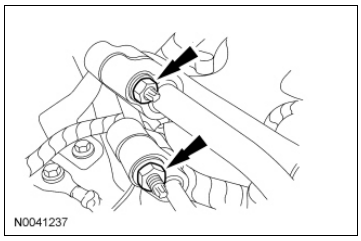
24. Remove the 2 A/C tube retaining clamp bolts.



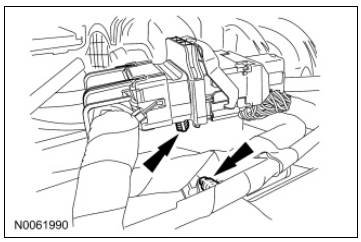
25. Remove the A/C tube bracket bolt.



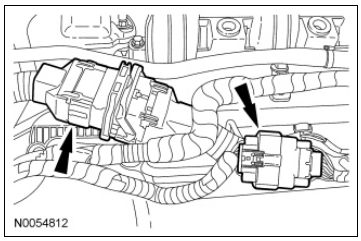
26. Remove the 2 nuts and disconnect the A/C tubes.
    - Discard the O-ring seals.



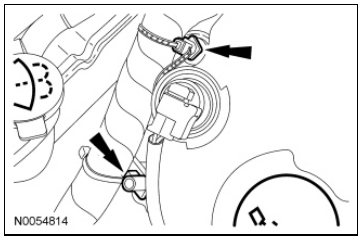
27. Detach the 2 wiring harness retainers.



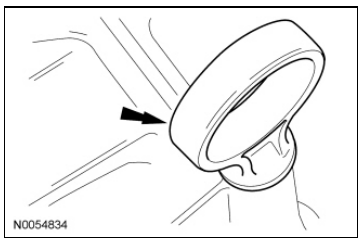
28. Disconnect the 2 engine wiring harness electrical connectors.



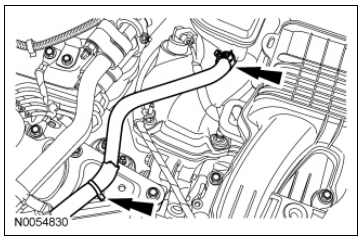
29. Remove the 2 wiring harness retainers from the LH valve cover stud bolts and position the wiring harness aside.



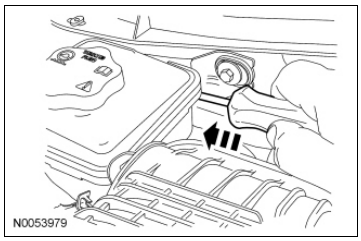
30. Remove the oil level indicator.



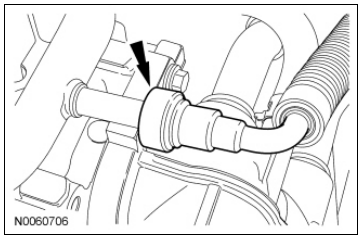
31. Disconnect the hose from the power steering reservoir.
    - Detach the pin-type retainer from the engine mount brace.



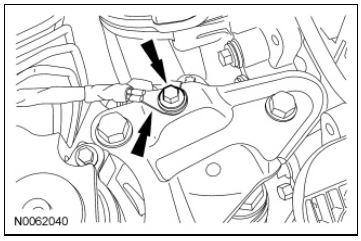
32. Using a small screwdriver, release the retaining clip and detach the power steering reservoir from the cowl.



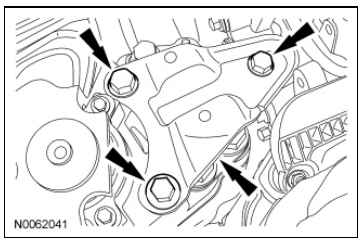
33. Disconnect the fuel supply tube from the fuel rail. For additional information, refer to Section 310-00 .



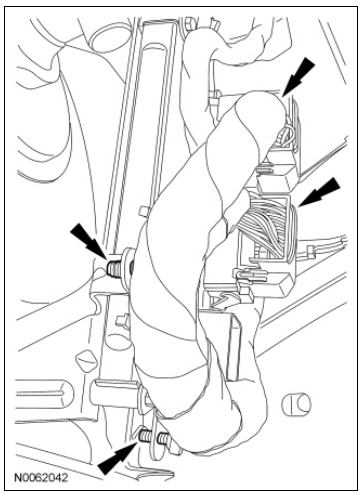
34. Remove the bolt and the ground wire from the engine mount brace.



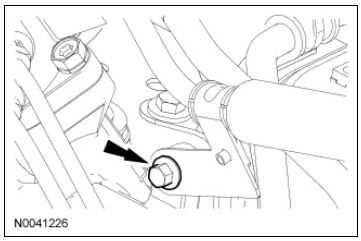
35. Remove the 3 bolts and the engine mount brace.



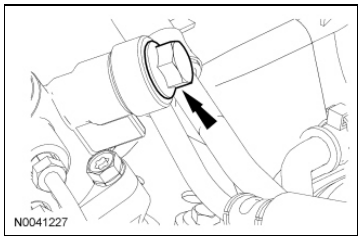
36. Disconnect the PCM electrical connectors and pin-type retainers.



37. Remove the Power Steering Pressure (PSP) hose bracket bolt.

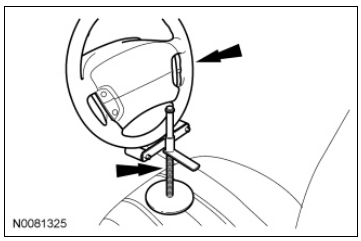


38. Remove and discard the PSP banjo bolt and the 2 seals from the steering gear.

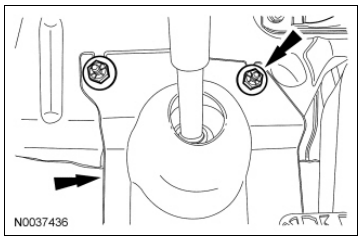


39. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

Using a suitable holding device, hold the steering wheel in the straight-ahead position.



40. Remove the 2 nuts and the steering joint cover.

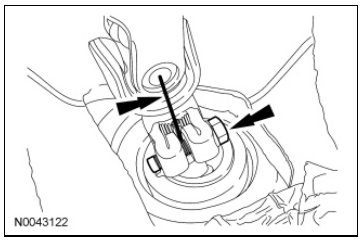


41. ***NOTICE:*** **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring may occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

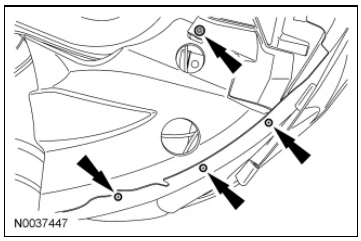
    NOTE: Index-mark the steering column shaft position to the steering gear for reference during installation.

    Remove the bolt and disconnect the steering column shaft from the steering gear.

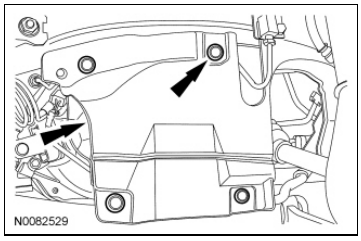
    - Discard the bolt.



42. Remove the 4 screws and position the LH fender splash shield aside.

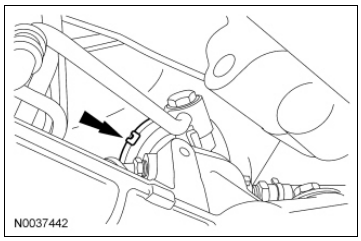


43. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.

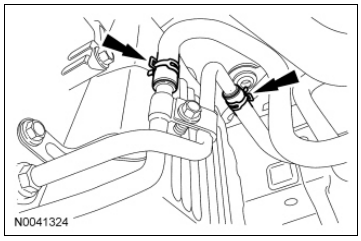


44. ***NOTICE:*** **The steering gear-to-dash seal must be removed or it will be damaged when lowering the subframe.**

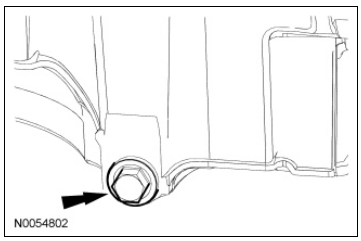
    Release the 4 clips and slide the steering gear-to-dash seal off of the steering gear and into the passenger compartment.



45. Disconnect the transaxle cooler hoses.

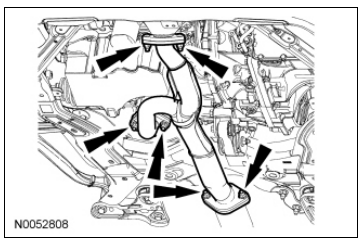


46. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 27 Nm (20 lb-ft).



47. Remove and discard the engine oil filter.

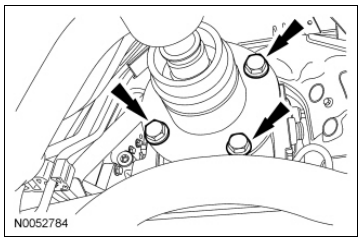
48. Remove the 6 nuts and the Y-pipe assembly.
    - Discard the gaskets and nuts.



All-Wheel Drive (AWD) vehicles

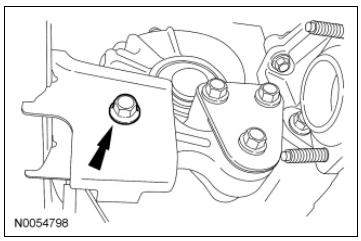
49. **NOTE:** Index-mark the driveshaft for installation.

    Remove and discard the 4 bolts (3 shown) and support the driveshaft with a length of mechanic's wire.



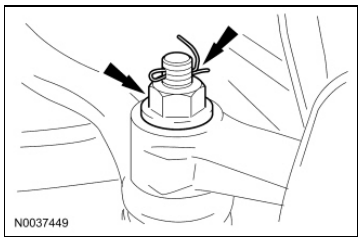
All vehicles

50. Remove the engine roll restrictor-to-subframe through bolt.



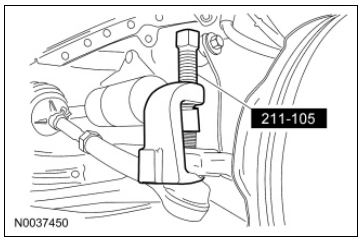
51. **NOTE:** LH shown, RH similar.

    Remove the cotter pins and nuts from the tie-rod ends.



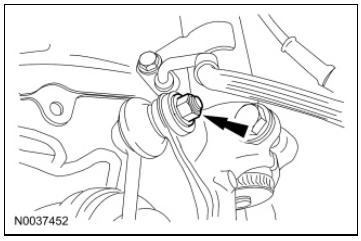
52. **NOTE:** LH shown, RH similar.

    Using the Tie-Rod End Remover, separate the tie-rod ends from the steering knuckles.



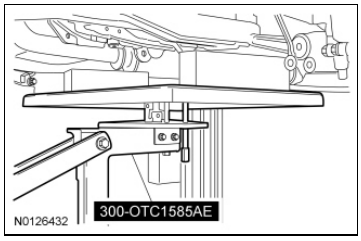
53. **NOTE:** LH shown, RH similar.

    Remove the nuts and separate the stabilizer bar links from the struts.



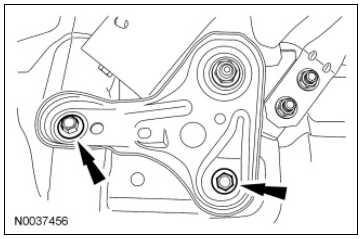
54. Using a wax pencil, mark the relationship of the front subframe to the underbody at the mounting locations.

55. Position the Powertrain Lift under the subframe assembly.



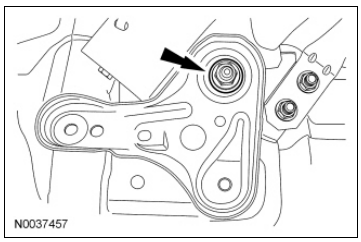
56. **NOTE:** LH shown, RH similar.

    Remove the 4 subframe bracket-to-body bolts.



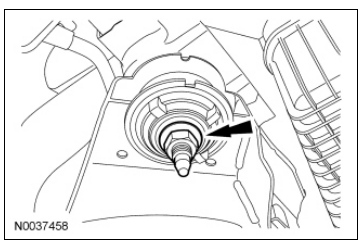
57. **NOTE:** LH shown, RH similar.

    Remove the 2 subframe nuts and the 2 subframe brackets.

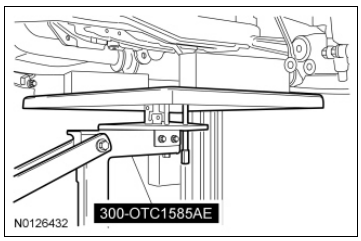


58. **NOTE:** LH shown, RH similar.

    Remove the 2 front subframe nuts.

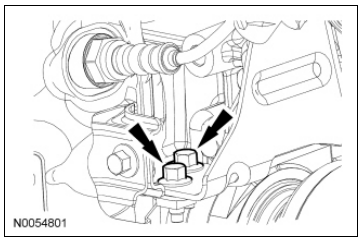


59. Using the Powertrain Lift, lower the subframe assembly from the vehicle.

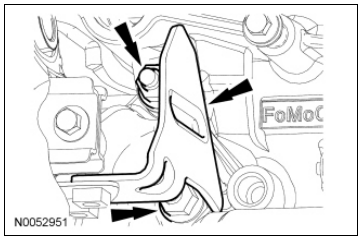


Front Wheel Drive (FWD) vehicles

60. Remove the 2 RH catalytic converter bracket bolts.



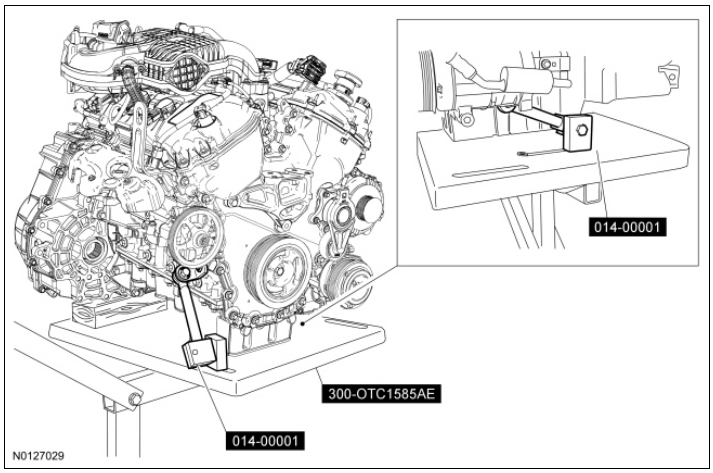
61. Remove the 2 nuts and remove the RH catalytic converter bracket.



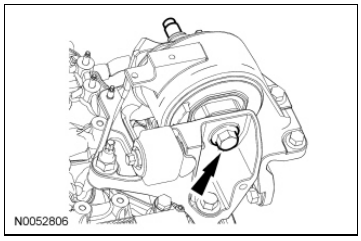
All vehicles

62. **NOTE:** Position a block of wood under the transaxle.

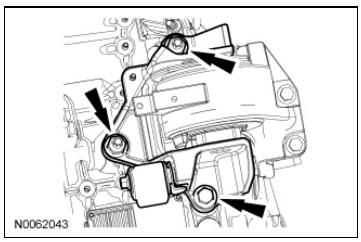
    Install the Powertrain Lift and Adjustable Grip Arms.



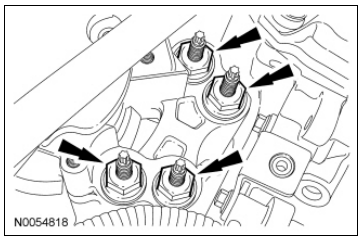
63. Remove the transaxle support insulator through bolt.



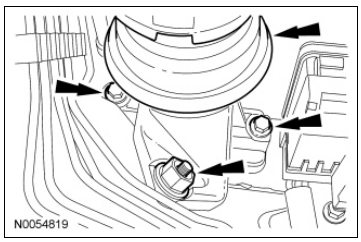
64. Remove the transaxle support insulator bracket bolt and the 2 nuts.



65. Remove the 4 engine mount nuts.
    - Remove the 2 engine mount spacers.

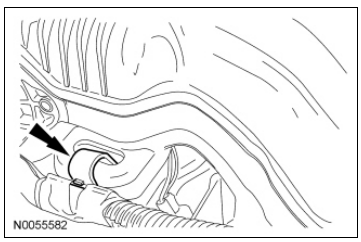


66. Remove the nut, 2 bolts and the engine mount.

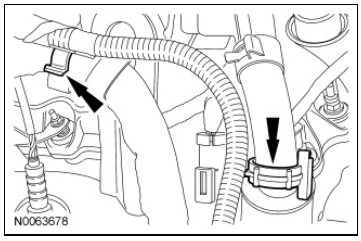


67. Lower the engine and transaxle assembly from the vehicle.

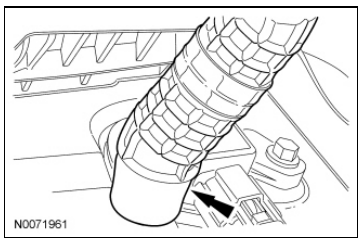
68. If equipped, detach the block heater wiring harness retainer from the upper intake manifold.



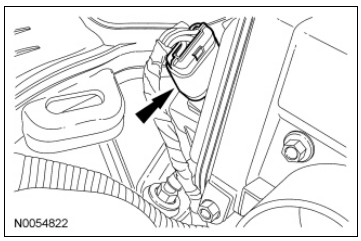
69. If equipped, detach the block heater wiring harness retainers from the PSP hose and the power steering reservoir hose.



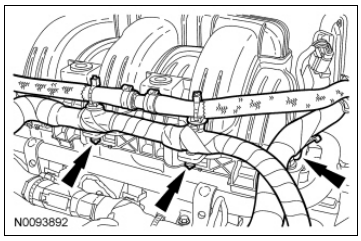
70. Disconnect the PCV hose from the PCV valve.



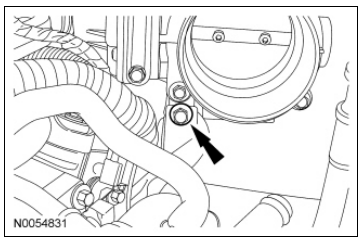
71. Disconnect the Throttle Body (TB) electrical connector.



72. Detach the wiring harness retainers from the upper intake manifold.



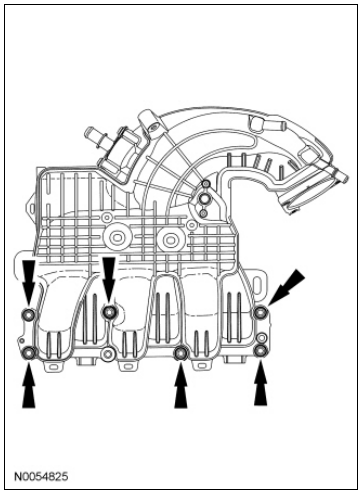
73. Remove the upper intake manifold support bracket bolt.



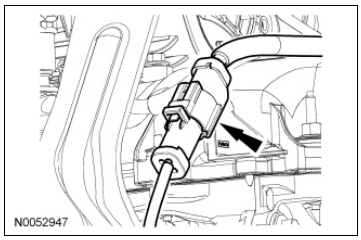
74. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    Remove the 6 bolts and the upper intake manifold.

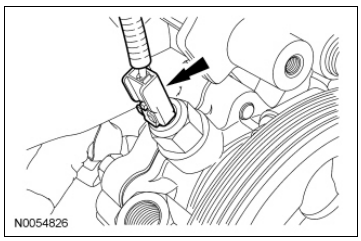
    - Discard the gaskets.



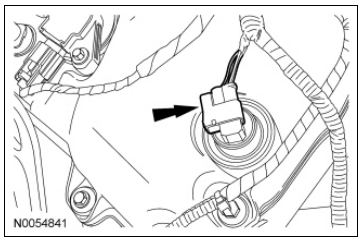
75. Disconnect the RH Catalyst Monitor Sensor (CMS) electrical connector.



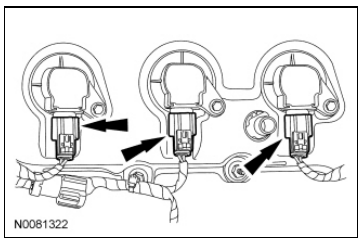
76. Disconnect the PSP switch electrical connector.



77. Disconnect the RH VCT solenoid electrical connector.

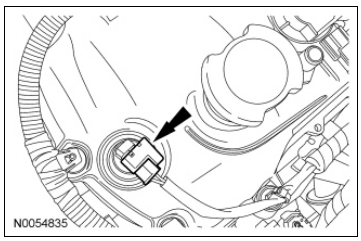


78. Disconnect the 3 RH coil-on-plug electrical connectors.

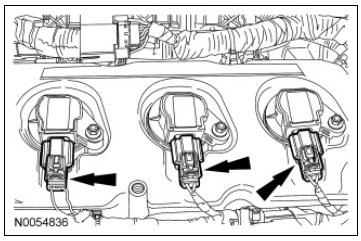


79. Detach all of the wiring harness retainers from the RH valve cover and stud bolts.

80. Disconnect the LH VCT solenoid electrical connector.



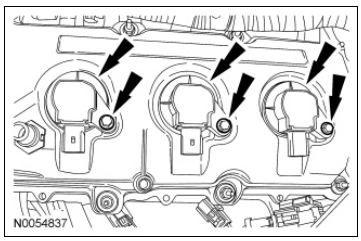
81. Disconnect the 3 LH coil-on-plug electrical connectors.



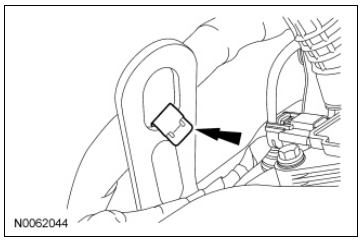
82. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.

83. **NOTE:** LH shown, RH similar.

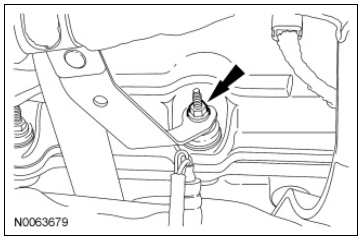
Remove the 6 bolts and the 6 coil-on-plugs.



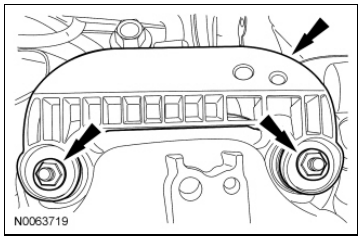
84. Detach the PSP hose retainer from the engine lifting eye.



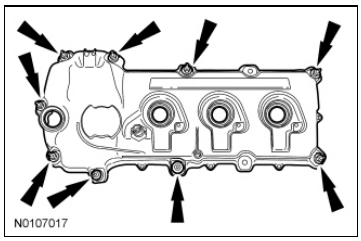
85. Remove the PSP hose bracket nut and position the PSP hose aside.



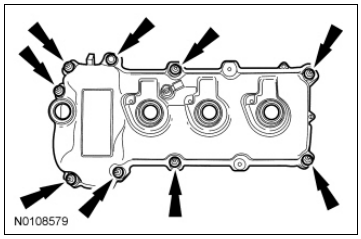
86. Remove the 2 nuts and the wiring harness retaining bracket.



87. Loosen the 9 stud bolts and remove the LH valve cover.
    - Discard the gasket.



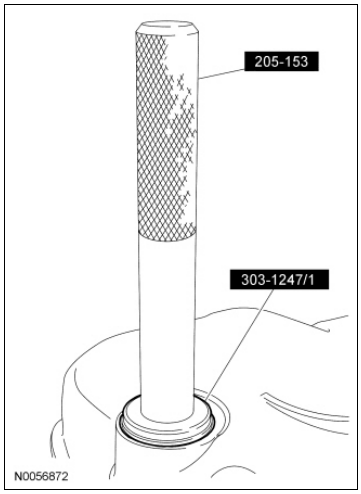
88. Loosen the bolt, the 8 stud bolts and remove the RH valve cover.
    - Discard the gasket.



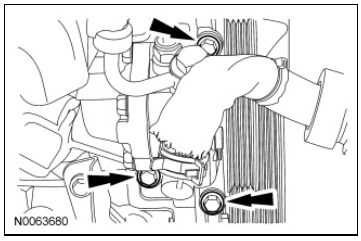
89. **NOTE:** VCT solenoid seal removal shown, spark plug tube seal removal similar.

    Inspect the VCT solenoid seals and the spark plug tube seals. Install new seals if damaged.

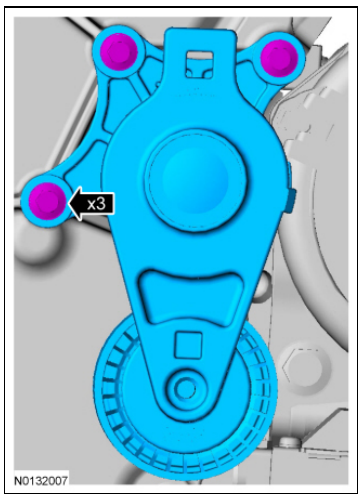
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



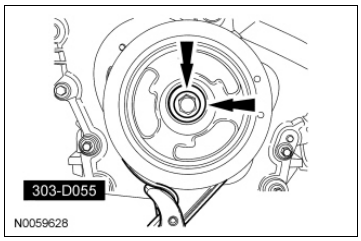
90. Remove the 3 bolts and position the power steering pump aside.



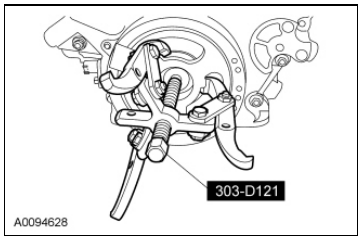
91. Remove the 3 bolts and the accessory drive belt tensioner.



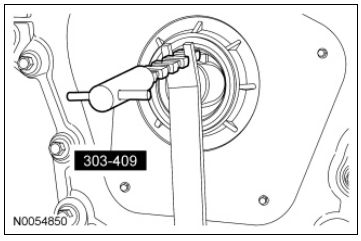
92. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
    - Discard the bolt.



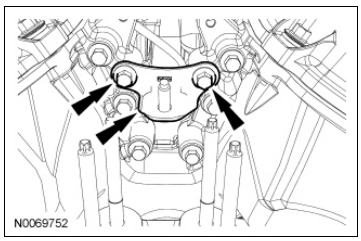
93. Using the 3 Jaw Puller, remove the crankshaft pulley.



94. Using the Oil Seal Remover, remove and discard the crankshaft front seal.

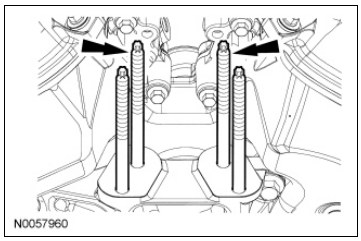


95. Remove the 2 bolts and the engine mount bracket.

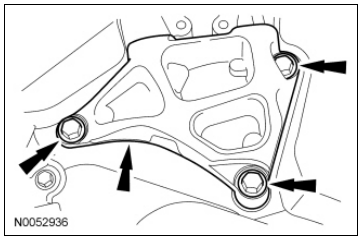


96. **NOTE:** Only use hand tools to remove the studs.

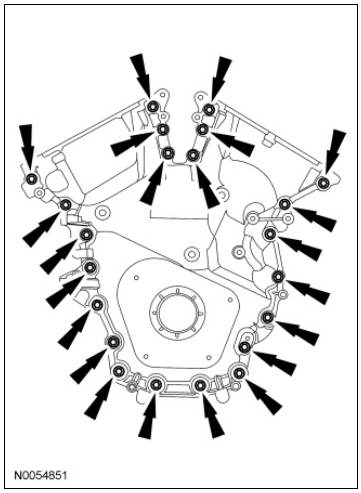
    Remove the 2 engine mount studs.



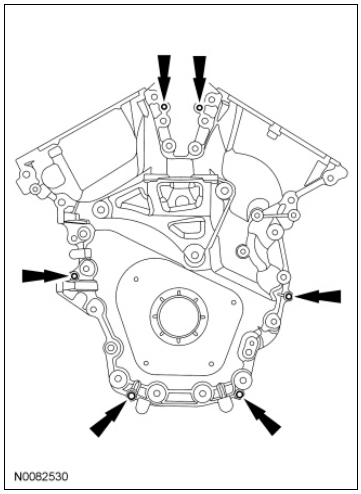
97. Remove the 3 bolts and the engine mount bracket.



98. Remove the 22 engine front cover bolts.



99. Install 6 of the engine front cover bolts (finger-tight) into the 6 threaded holes in the engine front cover in the following sequence.
    1. Tighten the bolts one turn at a time in a crisscross pattern until the engine front cover-to-cylinder block seal is released.
    2. Remove the engine front cover.



100. ***NOTICE:*** **Only use a 3M Roloc® Bristle Disk (2-in white, part number 07528) to clean the engine front cover. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean the engine front cover.**

     Clean the engine front cver using a 3M Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.

     - Thoroughly wash the engine front cover to remove any foreign material, including any abrasive particles created during the cleaning process.

101. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.**

     NOTICE: **Do not use wire brushes, power abrasive discs or 3MTM Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces of the engine block, cylinder heads, and oil pan. These tools cause contamination that can cause premature engine failure. Remove all traces of sealant, including any sealant from the inner surface of the cylinder block and cylinder head.**

     Clean all engine sealing surfaces, including the cylinder heads, the oil pan and cylinder block in the following sequence.

     1. Remove any large deposits of silicone or gasket material.
     2. Apply silicone gasket remover and allow to set for several minutes.
     3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
     4. Apply metal surface prep to remove any remaining traces of oil or coolant and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
     5. Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

sp;

Timing Drive Components

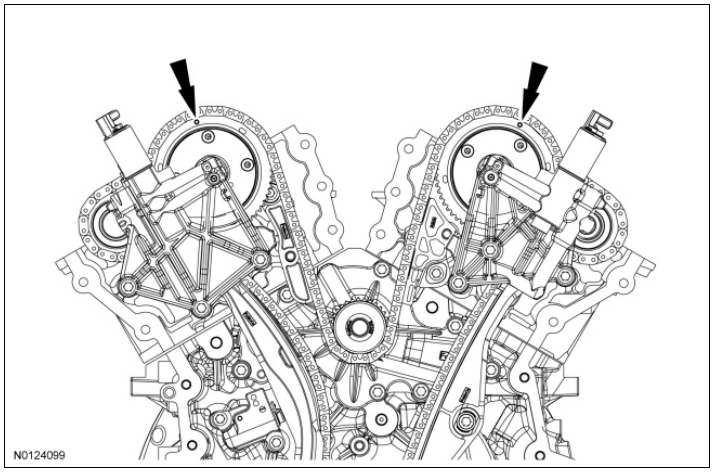
Special Tool(s)

 ST2979-A	Tool, Camshaft Holding 303-1248

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

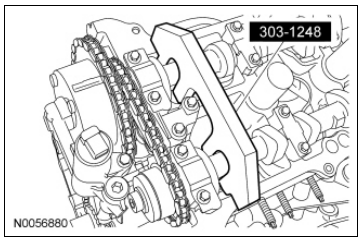
1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

2. Rotate the crankshaft clockwise and align timing marks on the Variable Camshaft Timing (VCT) assemblies as shown.



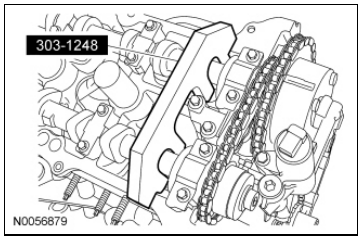
3. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.

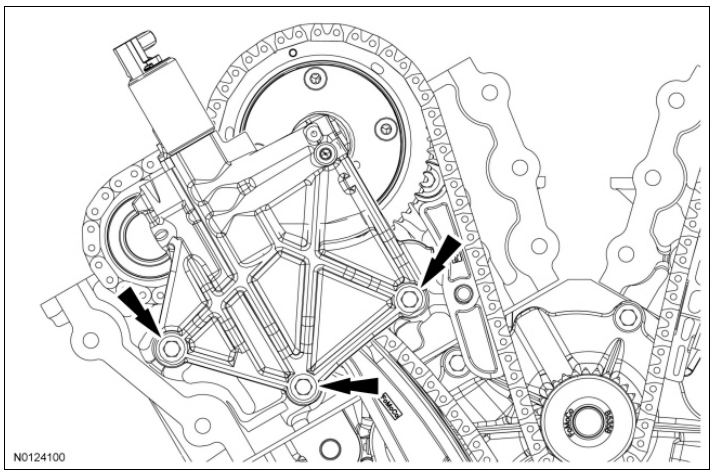


4. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

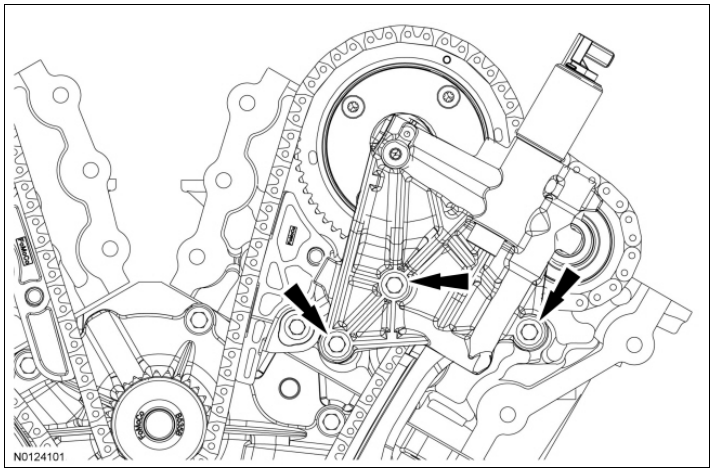
   Install the Camshaft Holding Tool onto the flats of the RH camshafts.



5. Remove the 3 bolts and the RH VCT housing.

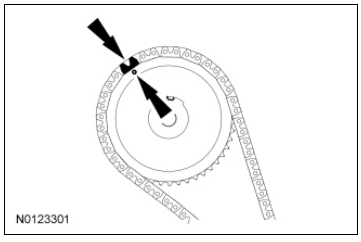


6. Remove the 3 bolts and the LH VCT housing.

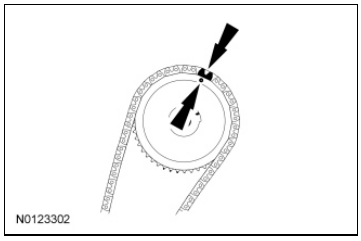


NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

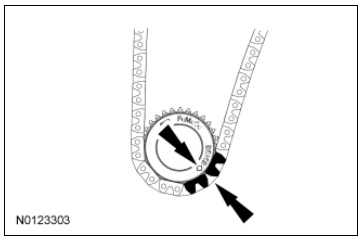


8. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

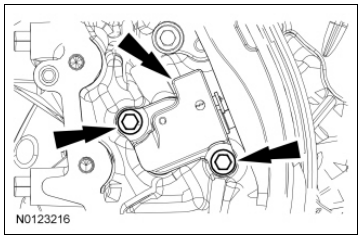


9. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

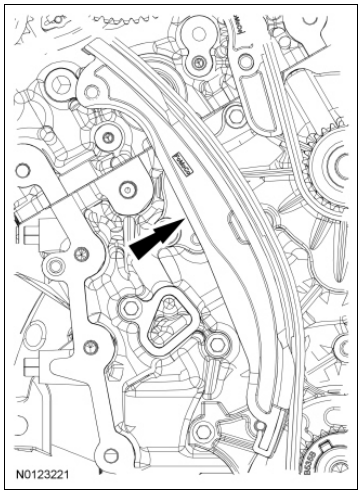
   Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



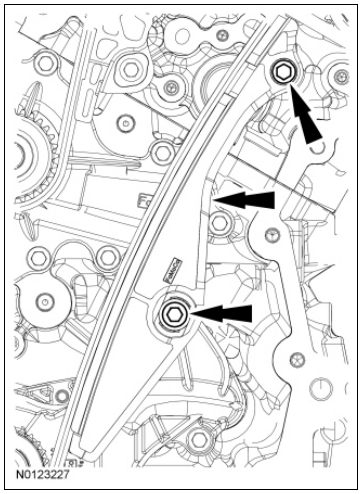
10. Remove the 2 bolts and the primary timing chain tensioner.



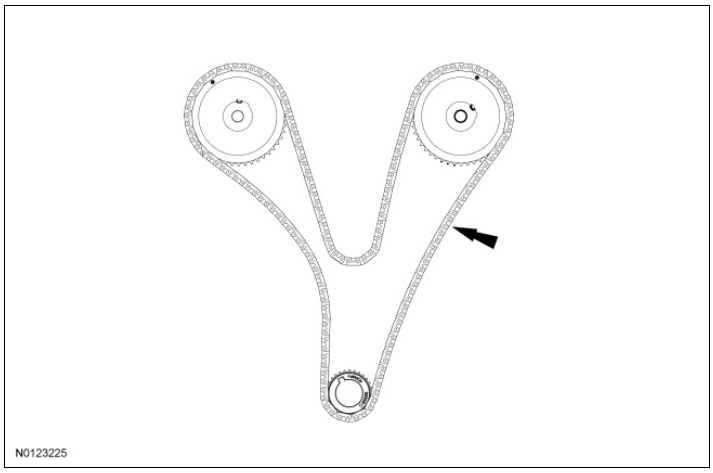
11. Remove the primary timing chain tensioner arm.



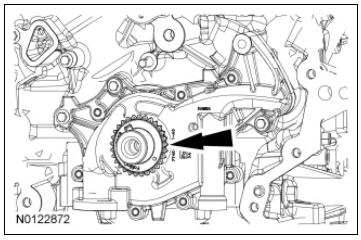
12. Remove the 2 bolts and the lower LH primary timing chain guide.



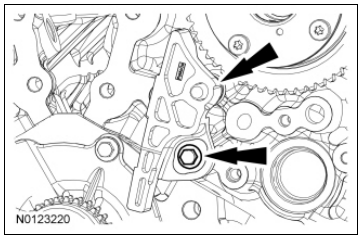
13. Remove the primary timing chain.



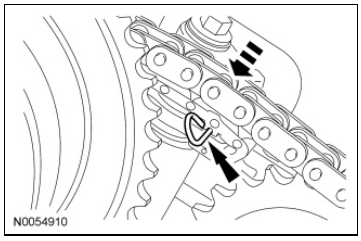
14. Remove the crankshaft timing chain sprocket.



15. Remove the bolt and the upper LH primary timing chain guide.



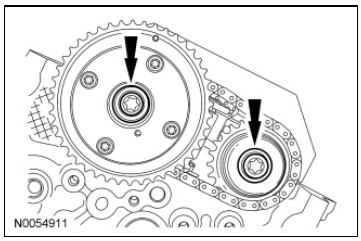
16. Compress the LH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



17. **NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

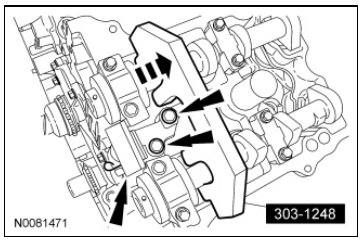
    Remove and discard the LH VCT assembly bolt and the LH exhaust camshaft sprocket bolt.

    - Remove the LH VCT assembly, secondary timing chain and the LH exhaust camshaft sprocket as an assembly.

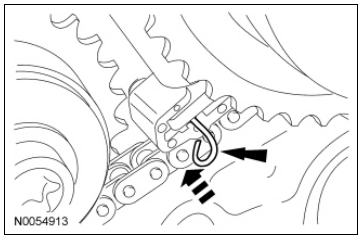


18. **NOTE:** It is necessary to tilt the Camshaft Holding Tool toward the rear of the engine to access the rearmost secondary timing chain tensioner bolt.

    Remove the 2 bolts and the LH secondary timing chain tensioner.



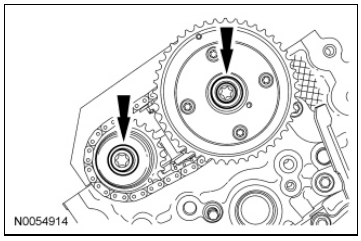
19. Compress the RH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



20. **NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

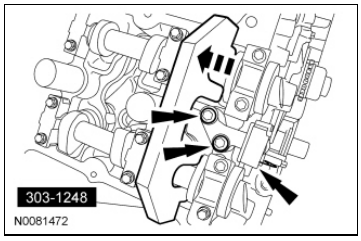
    Remove and discard the RH VCT assembly bolt and the RH exhaust camshaft sprocket bolt.

    - Remove the RH VCT assembly, secondary timing chain and the RH exhaust camshaft sprocket as an assembly.

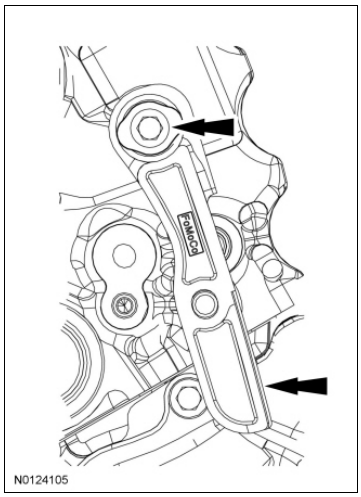


21. **NOTE:** It is necessary to tilt the Camshaft Holding Tool toward the rear of the engine to access the rearmost secondary timing chain tensioner bolt.

    Remove the 2 bolts and the RH secondary timing chain tensioner.



22. Remove the bolt and the RH timing chain guide.



Camshaft

Special Tool(s)

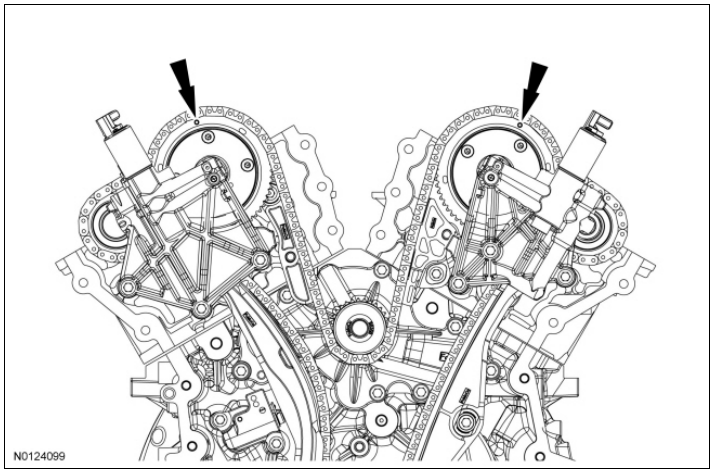
 ST2979-A	Tool, Camshaft Holding 303-1248

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

All camshafts

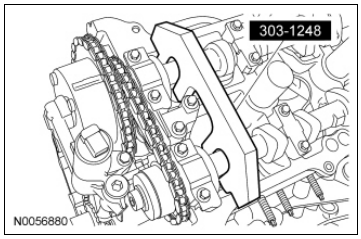
1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

2. Rotate the crankshaft clockwise and align thming marks on the Variable Camshaft Timing (VCT) assemblies as shown.



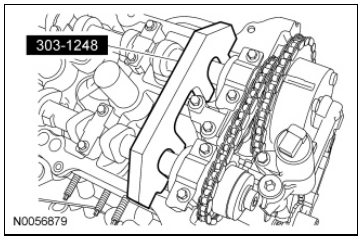
3. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.

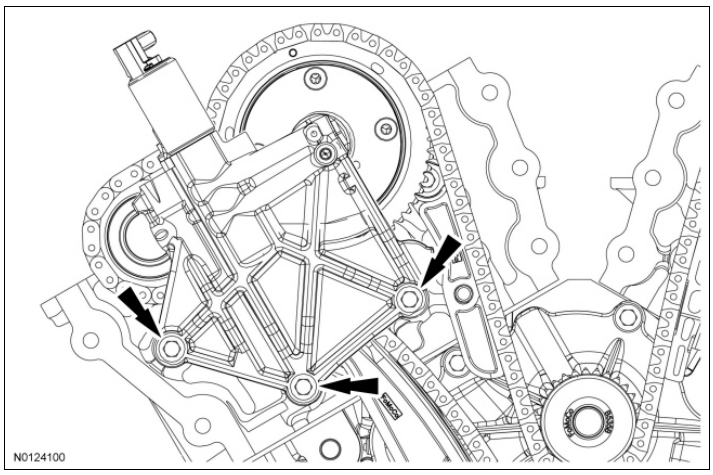


4. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

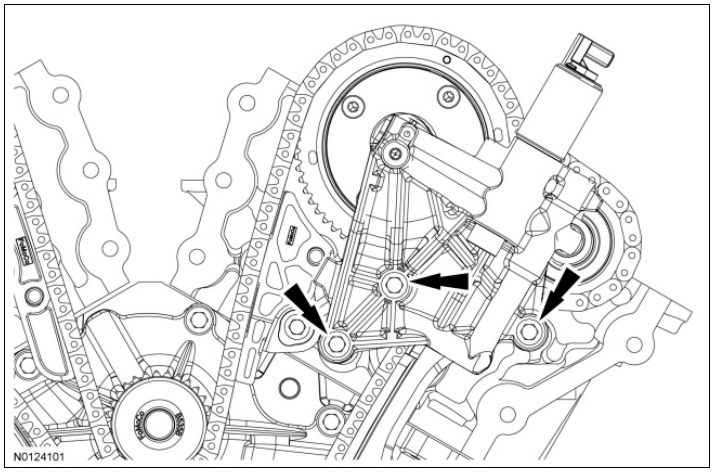
   Install the Camshaft Holding Tool onto the flats of the RH camshafts.



5. Remove the 3 bolts and the RH VCT housing.

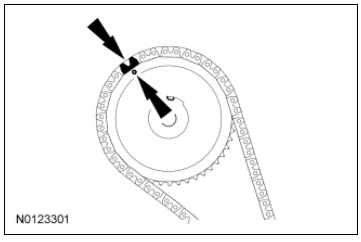


6. Remove the 3 bolts and the LH VCT housing.

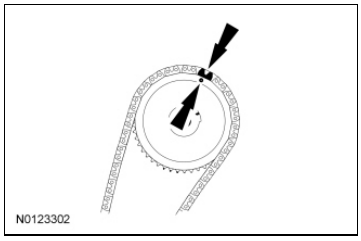


NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

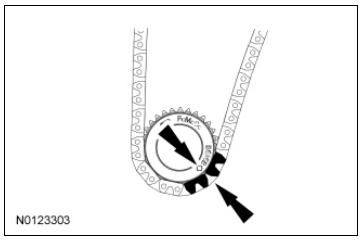


8. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

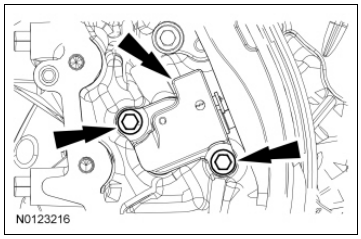


9. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

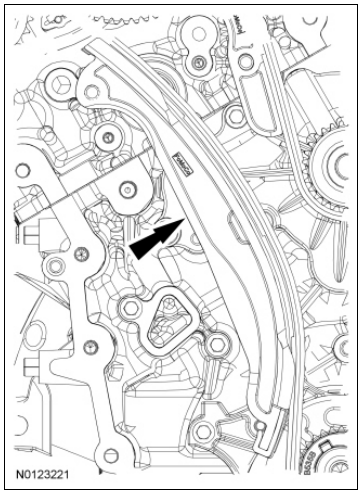
   Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



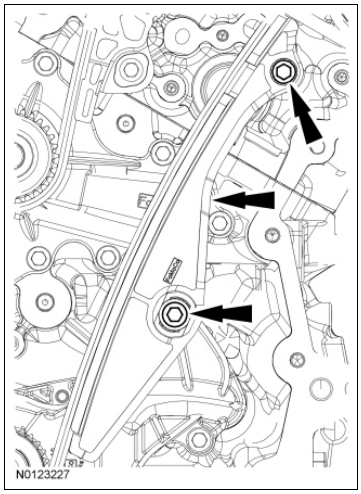
10. Remove the 2 bolts and the primary timing chain tensioner.



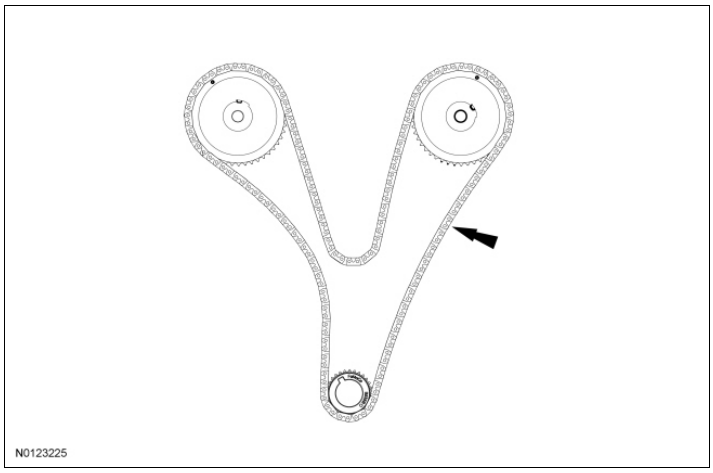
11. Remove the primary timing chain tensioner arm.



12. Remove the 2 bolts and the lower LH primary timing chain guide.

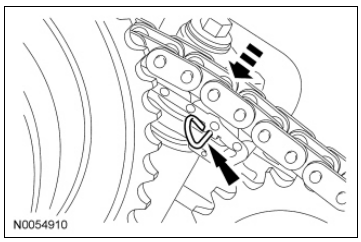


13. Remove the primary timing chain.



LH camshafts

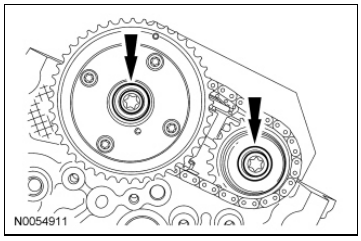
14. Compress the LH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



15. **NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

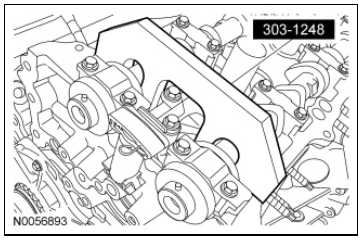
    Remove and discard the LH VCT assembly bolt and the LH exhaust camshaft sprocket bolt.

    - Remove the LH VCT assembly, secondary timing chain and the LH exhaust camshaft sprocket as an assembly.



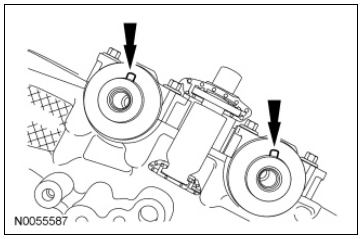
16. **NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure will rotate the LH camshafts approximately 3 degrees to a neutral position.

    Remove the Camshaft Holding Tool from the LH camshafts.



17. ***NOTICE:*** **The camshafts must remain in the neutral position during removal or engine damage may occur.**

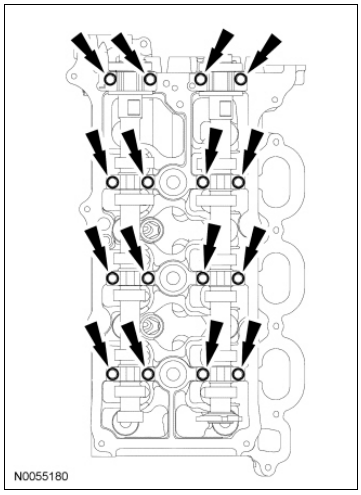
    Verify the LH camshafts are in the neutral position.



18. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

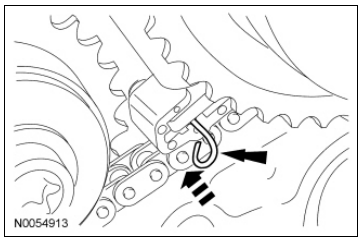
    Remove the bolts and the LH camshaft bearing caps.

    - Remove the LH camshafts.



RH camshafts

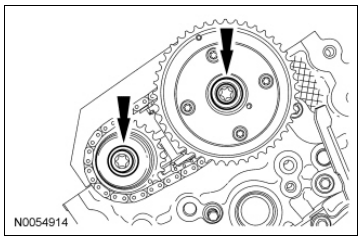
19. Compress the RH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



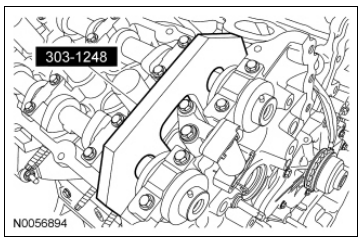
20. **NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

    Remove and discard the RH VCT assembly bolt and the RH exhaust camshaft sprocket bolt.

    - Remove the RH VCT assembly, secondary timing chain and the RH exhaust camshaft sprocket as an assembly.

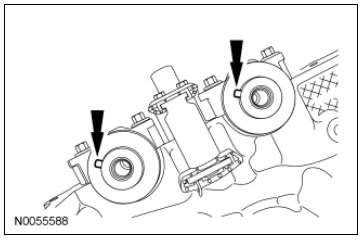


21. Remove the Camshaft Holding Tool from the RH camshafts.



22. ***NOTICE:*** **The camshafts must remain in the neutral position during removal or engine damage may occur.**

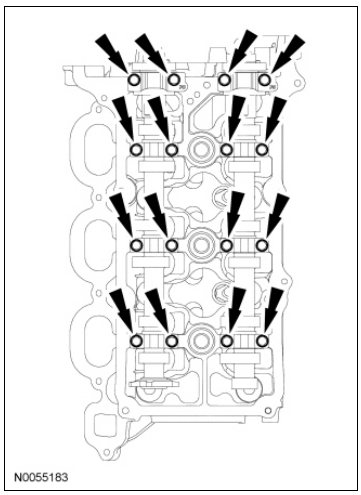
    Rotate the RH camshafts counterclockwise to the neutral position.



23. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

    Remove the bolts and the RH camshaft bearing caps.

- Remove the RH camshafts.



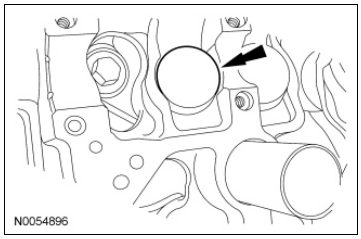
Valve Tappets

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Depending on the valve tappets being serviced, remove the LH and/or the RH camshafts. For additional information, refer to Camshaft in this section.

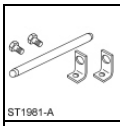
2. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

   Remove the valve tappets from the cylinder head.



Valve Spring, Retainer and Seal

Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. Remove the valve tappets from the cylinder being serviced. For additional information, refer to Valve Tappets in this section.

2. Rotate the crankshaft until the piston for the valve being serviced is at the top of its stroke.

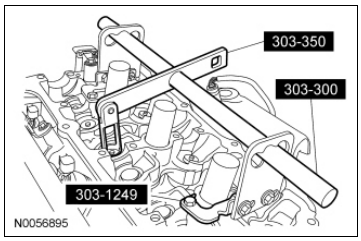
3. ***NOTICE:*** **If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal or engine damage may occur.**

   NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

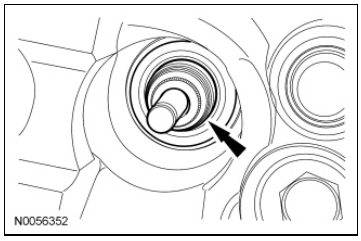
   NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to Cylinder Head - RH or Cylinder Head - LH in this section.

   Pressurize the cylinder using compressed air.

4. Using the Valve Spring Compressors, remove the keys, retainer and spring.



5. Remove and discard the valve stem seal.


N0056352

Cylinder Head - RH

Material

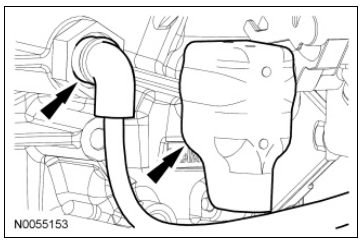
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

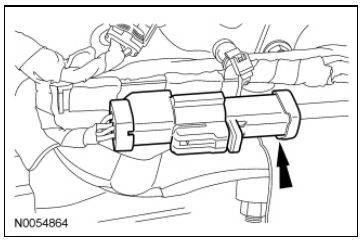
All vehicles

1. Remove the RH camshafts. For additional information, refer to Camshaft in this section.

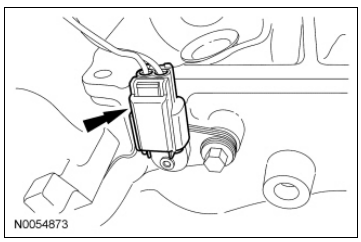
2. If equipped, remove the heat shield and disconnect the block heater electrical connector.
   - Remove the block heater wiring harness from the engine.li>



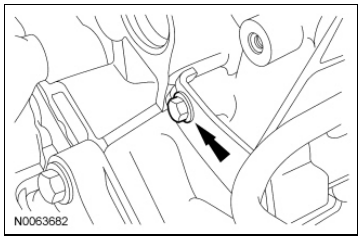
3. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.



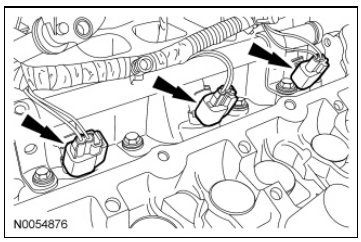
4. Disconnect the RH Camshaft Position (CMP) sensor electrical connector.



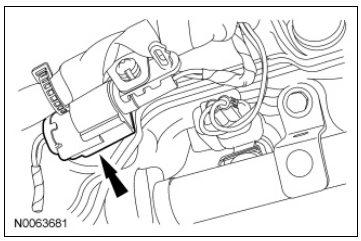
5. Remove the bolt and the Power Steering Pressure (PSP) tube and bracket assembly.



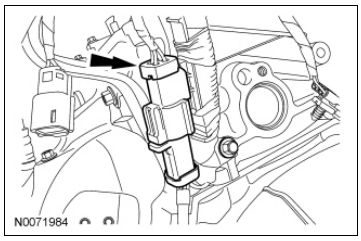
6. Disconnect the 6 fuel injector electrical connectors (3 shown).



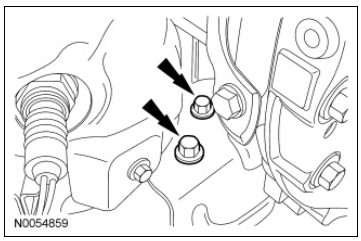
7. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.



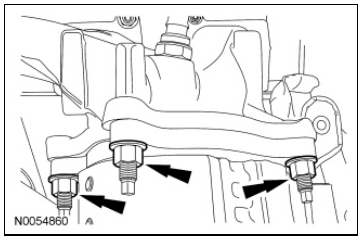
8. Disconnect the LH Catalyst Monitor Sensor (CMS) sensor electrical connector.



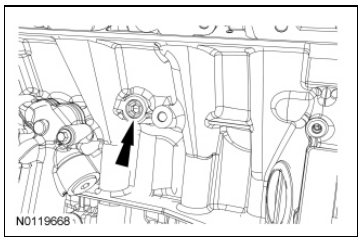
9. Remove the 2 LH catalytic converter bracket bolts.



10. Remove the 4 nuts (3 shown) and the LH catalytic converter.
    - Discard the nuts and the gasket.

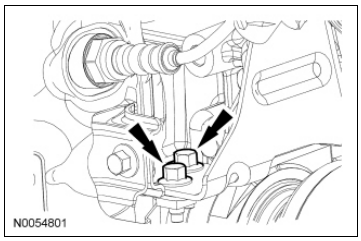


11. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.



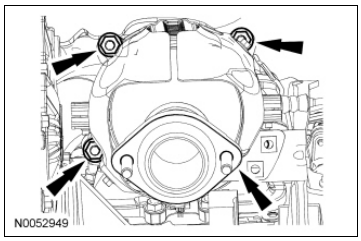
All-Wheel Drive (AWD) vehicles

12. Remove the 2 RH catalytic converter bracket bolts.

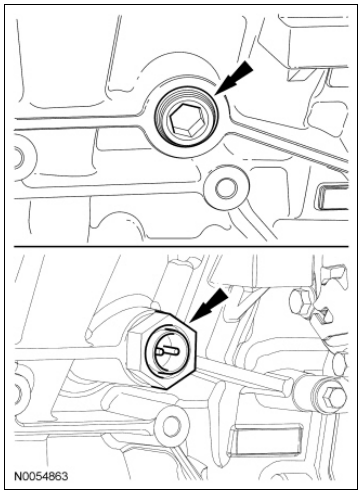


All vehicles

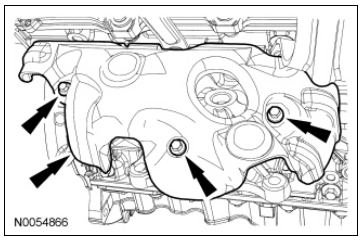
13. Remove the 4 nuts and the RH catalytic converter.
    - Discard the nuts and the gasket.



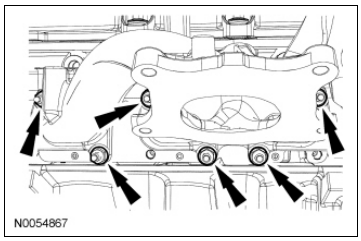
14. Remove the RH cylinder block drain plug or, if equipped, the block heater.
    - Allow coolant to drain from the cylinder block.



15. Remove the 3 bolts and the RH exhaust manifold heat shield.

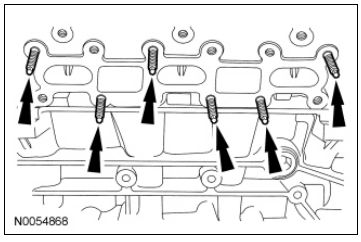


16. Remove the 6 nuts and the RH exhaust manifold.
    - Discard the nuts and exhaust manifold gaskets.

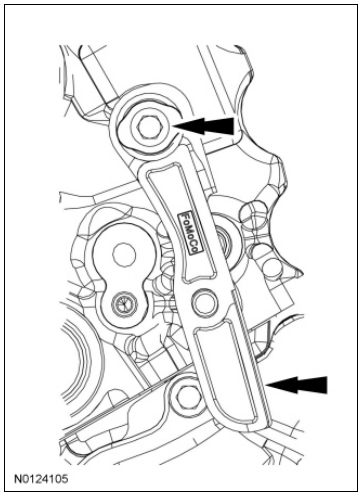


17. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .

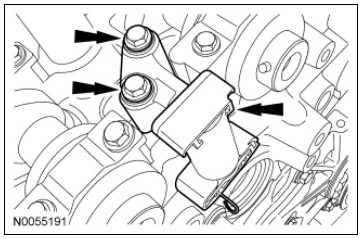
18. Remove and discard the 6 RH exhaust manifold studs.



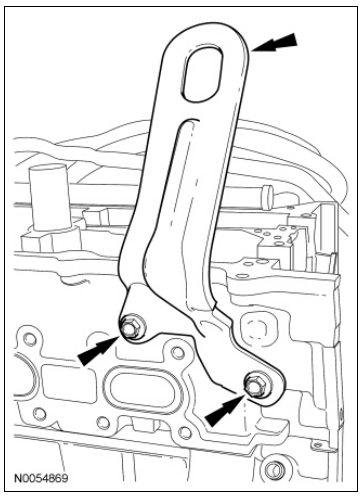
19. Remove the bolt and the RH timing chain guide.



20. Remove the 2 bolts and the RH secondary timing chain tensioner.

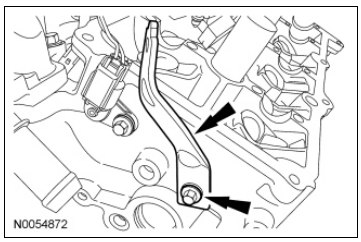


21. Remove the 2 bolts and the engine lifting eye.

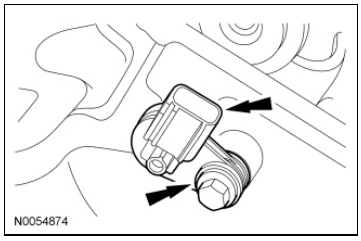


22. **NOTE:** Index-mark the location of the bracket on the cylinder head for installation.

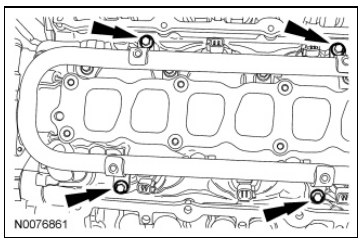
    Remove the bolt and the upper intake manifold support bracket.



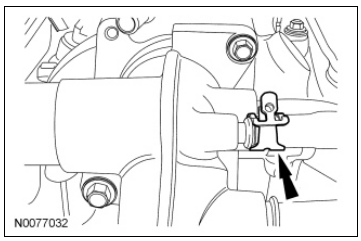
23. Remove the bolt and the RH CMP sensor.



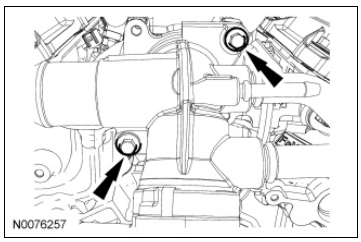
24. Remove the 4 bolts and the fuel rail and injectors as an assembly.



25. Disconnect the coolant bypass hose from the thermostat housing.



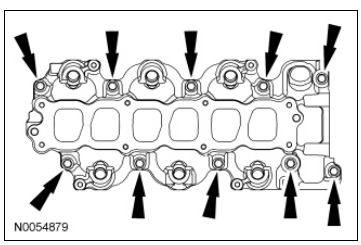
26. Remove the 2 thermostat housing-to-lower intake manifold bolts.
    - Remove the thermostat housing and discard the gasket and O-ring seal.



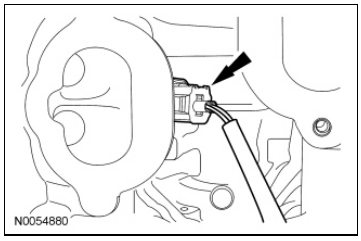
27. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    Remove the 10 bolts and the lower intake manifold.

    - Discard the gaskets.

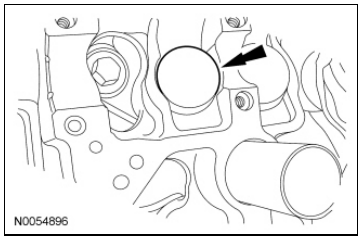


28. Disconnect and remove the CHT sensor jumper harness.

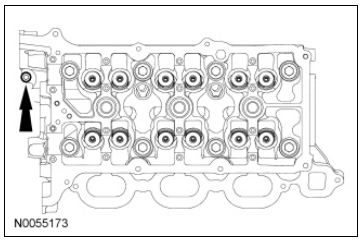


29. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

    Remove the valve tappets from the cylinder head.



30. Remove and discard the M6 bolt.



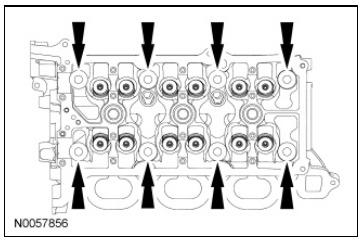
31. ***NOTICE:*** **Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.**

    NOTICE: **Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

    NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

    Remove and discard the 8 bolts from the cylinder head.

    - Remove the cylinder head.
    - Discard the cylinder head gasket.



32. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

    Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.

    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

33. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

Cylinder Head - LH

Material

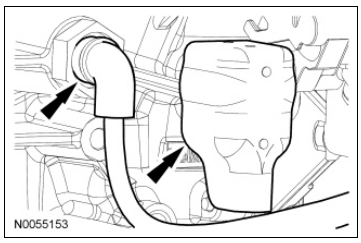
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

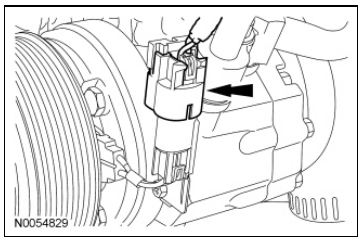
All vehicles

1. Remove the LH camshafts. For additional information, refer to Camshaft in this section.

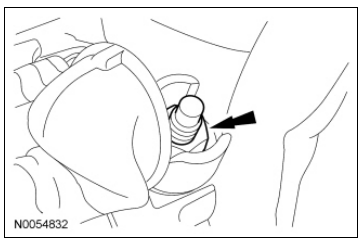
2. If equipped, remove the heat shield and disconnect the block heater electrical connector.
   - Remove the block heater wiring harness from the engine.li>



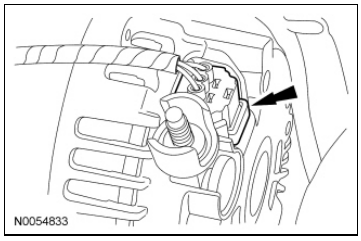
3. Disconnect the A/C compressor electrical connector.



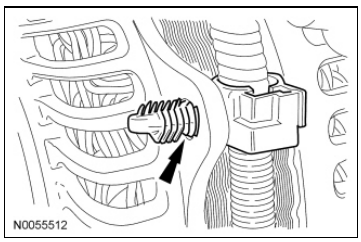
4. Remove the nut and disconnect the generator B+ cable.



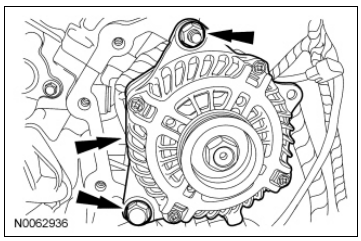
5. Disconnect the generator electrical connector.



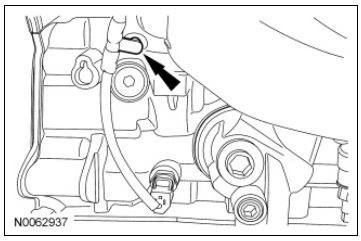
6. Detach the wiring harness retainer from the generator.



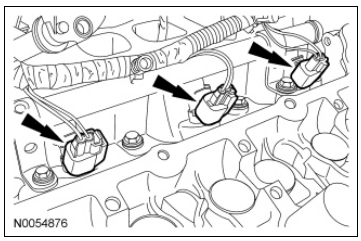
7. Remove the nut, bolt and the generator.



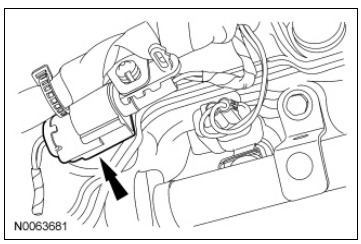
8. Detach the wiring harness pin-type retainer.



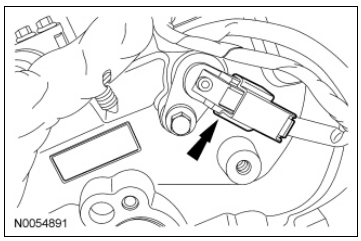
9. Disconnect the 6 fuel injector electrical connectors (3 shown).



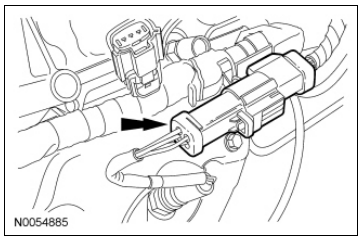
10. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.



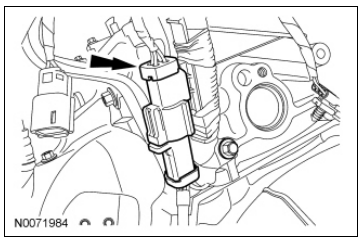
11. Disconnect the LH Camshaft Position (CMP) sensor electrical connector.



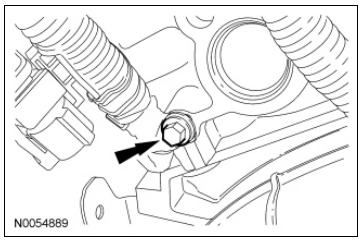
12. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector.



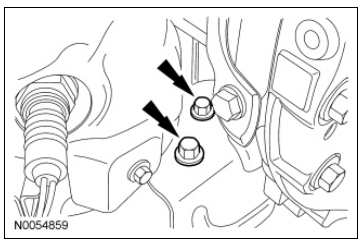
13. Disconnect the LH Catalyst Monitor Sensor (CMS) electrical connector.



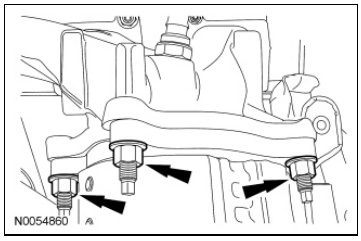
14. Remove the wiring harness retainer bolt from the rear of the LH cylinder head.



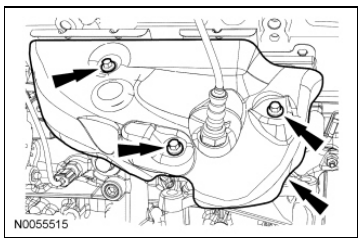
15. Remove the 2 LH catalytic converter bracket bolts.



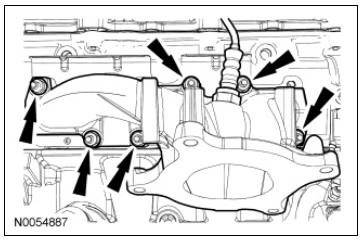
16. Remove the 4 nuts (3 shown) and the LH catalytic converter.
    - Discard the nuts and the gasket.



17. Remove the 3 bolts and the LH exhaust manifold heat shield.

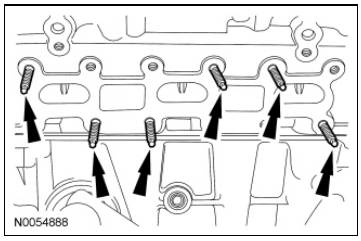


18. Remove the 6 nuts and the LH exhaust manifold.
    - Discard the nuts and the exhaust manifold gasket.

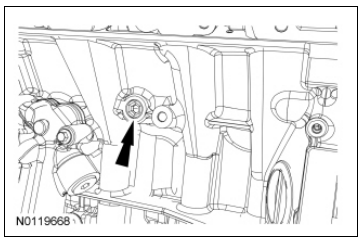


19. Clean and inspect the LH exhaust manifold. For additional information, refer to Section 303-00 .

20. Remove and discard the 6 LH exhaust manifold studs.

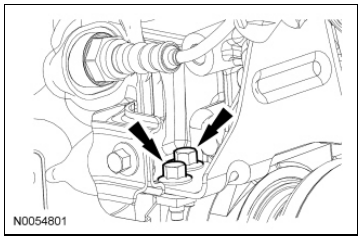


21. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.



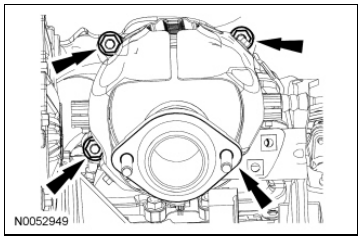
All-Wheel Drive (AWD) vehicles

22. Remove the 2 RH catalytic converter bracket bolts.

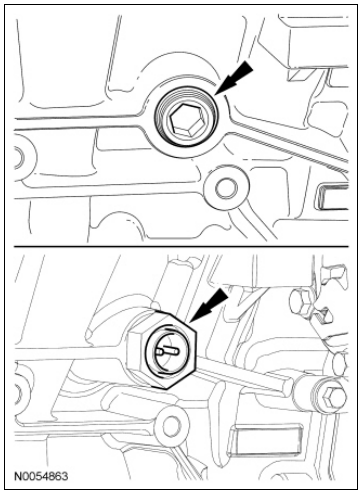


All vehicles

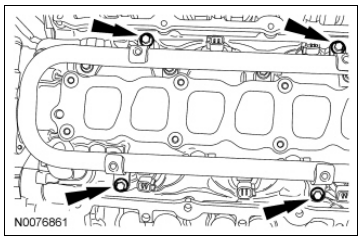
23. Remove the 4 nuts and the RH catalytic converter.
    - Discard the nuts and the gasket.



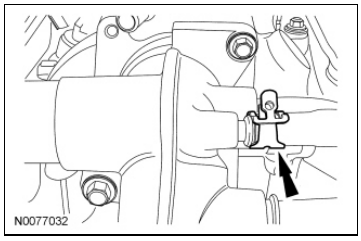
24. Remove the RH cylinder block drain plug or, if equipped, the block heater.
    - Allow coolant to drain from the cylinder block.



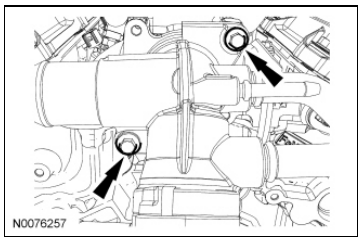
25. Remove the 4 bolts and the fuel rail and injectors as an assembly.



26. Disconnect the coolant bypass hose from the thermostat housing.



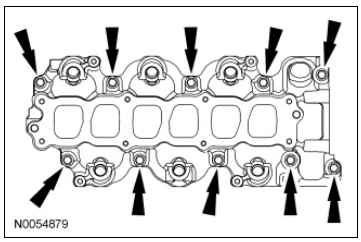
27. Remove the 2 thermostat housing-to-lower intake manifold bolts.
    - Remove the thermostat housing and discard the gasket and O-ring seal.



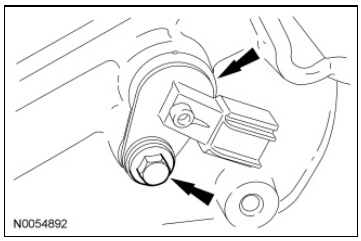
28. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    Remove the 10 bolts and the lower intake manifold.

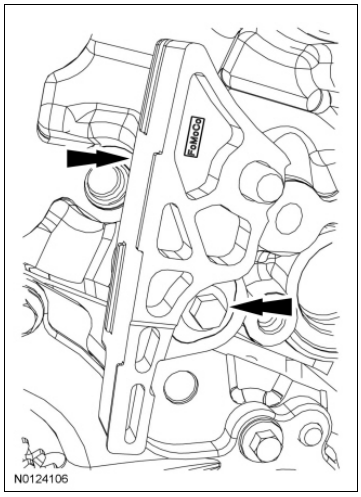
    - Discard the gaskets.



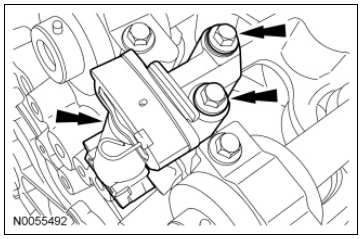
29. Remove the bolt and the LH CMP sensor.



30. Remove the bolt and the upper LH primary timing chain guide.

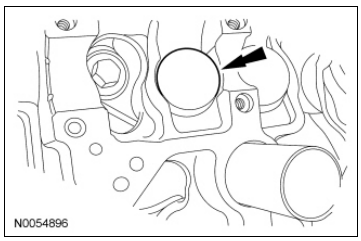


31. Remove the 2 bolts and the LH secondary timing chain tensioner.

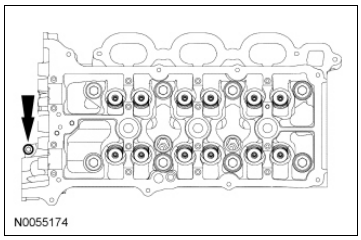


32. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

    Remove the valve tappets from the cylinder head.



33. Remove and discard the M6 bolt.



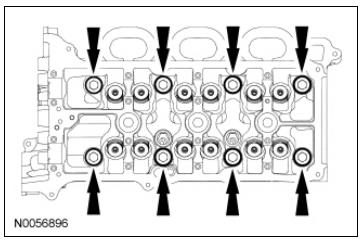
34. ***NOTICE:*** **Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.**

    NOTICE: **Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

Remove and discard the 8 bolts from the cylinder head.

- Remove the cylinder head.
- Discard the cylinder head gasket.



35. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

    Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.

    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

36. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

Oil Pump

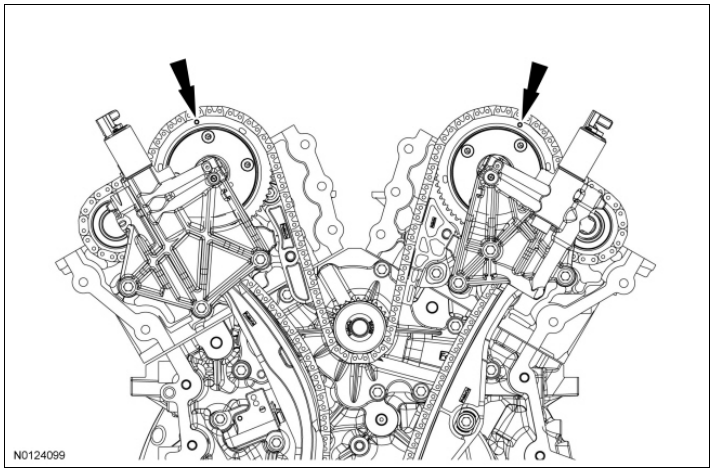
Special Tool(s)

 ST2979-A	Tool, Camshaft Holding 303-1248

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

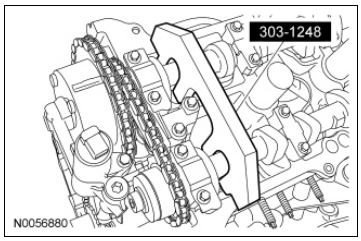
1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

2. Rotate the crankshaft clockwise and align the timing marks on the Variableshaft Timing (VCT) assemblies as shown.



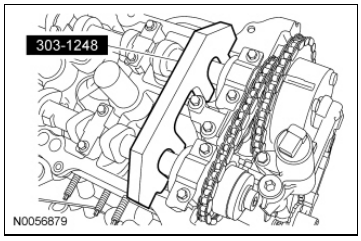
3. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.

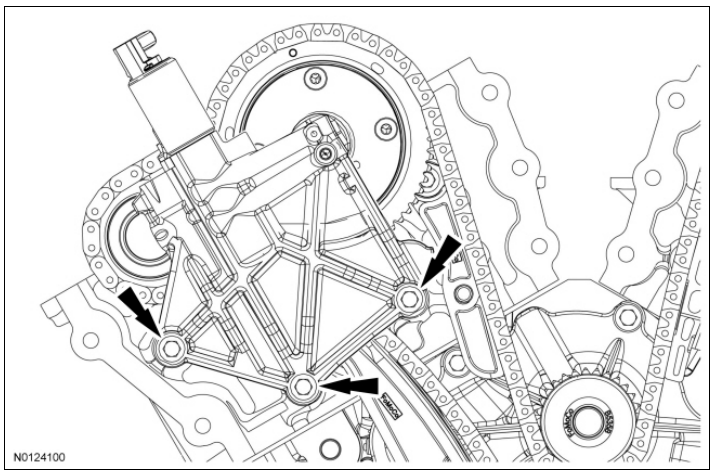


4. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

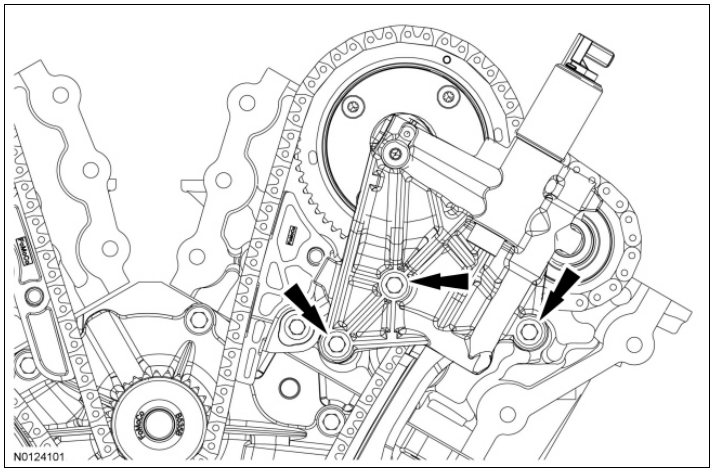
   Install the Camshaft Holding Tool onto the flats of the RH camshafts.



5. Remove the 3 bolts and the RH VCT housing.

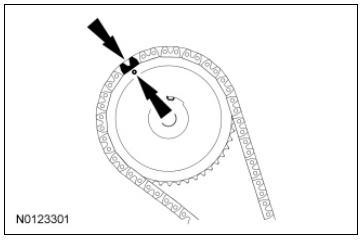


6. Remove the 3 bolts and the LH VCT housing.

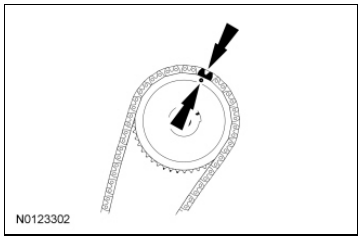


NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

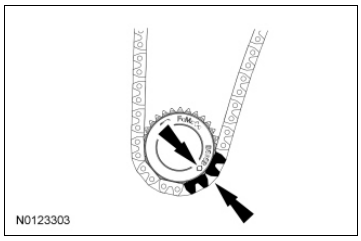


8. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

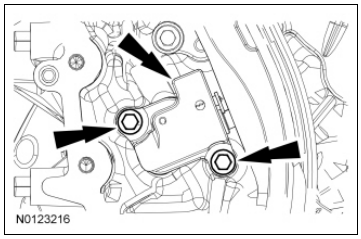


9. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

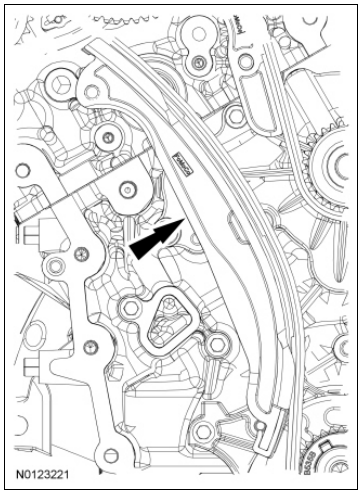
   Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



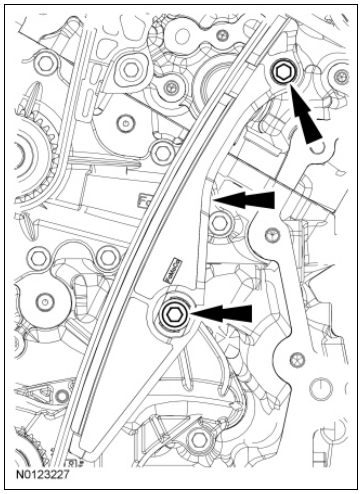
10. Remove the 2 bolts and the primary timing chain tensioner.



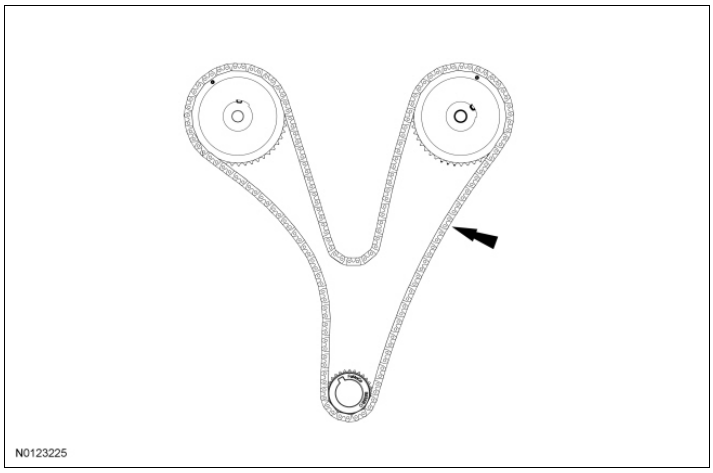
11. Remove the primary timing chain tensioner arm.



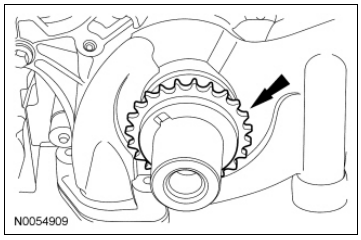
12. Remove the 2 bolts and the lower LH primary timing chain guide.



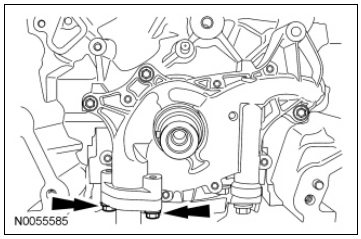
13. Remove the primary timing chain.



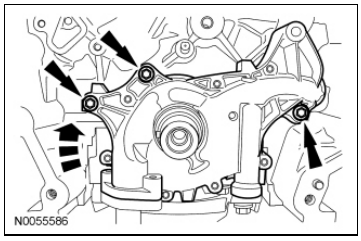
14. Remove the crankshaft timing chain sprocket.



15. Remove the 2 oil pump screen and pickup tube bolts.



16. Remove the 3 oil pump bolts.
    - Rotate the oil pump clockwise and separate the oil pump from the oil pump screen and pickup tube.
    - Remove the oil pump.
    - Discard the oil pump screen and pickup tube O-ring seal.


N0055586

Engine

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (-6701-EH)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700CH)
 ST2982-A	Remover, VCT Spark Plug Tube Seal 303-1247/1
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2979-A	Tool, Camshaft Holding 303-1248

Material

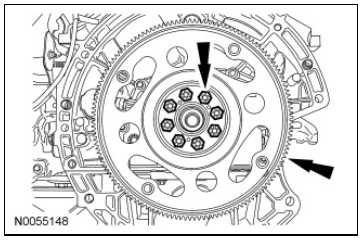
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Silicone Gasket Remover ZC-30	-

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

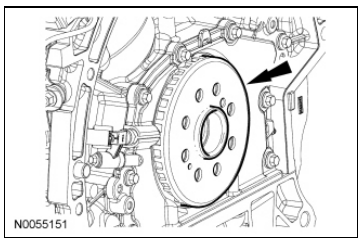
NOTE: For additional information, refer to the exploded view under the Assembly procedure in this section.

All engines

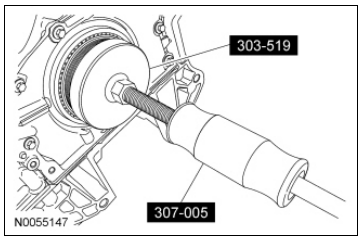
1. Remove the 8 bolts and the flexplate.



2. Remove the crankshaft sensor ring.



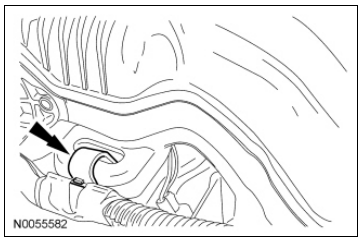
3. Using the Crankshaft Rear Oil Seal Remover and Slide Hammer, remove and discard the rear crankshaft seal.



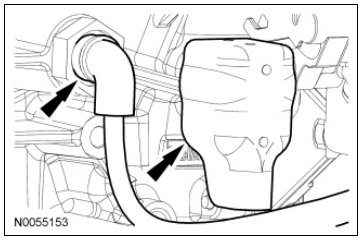
4. **NOTE:** Install the engine stand bolts into the cylinder block only. Do not install the bolts into the oil pan.

   Mount the engine on a suitable engine stand.

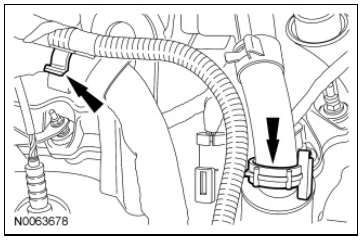
5. If equipped, detach the block heater wiring harness retainer from the upper intake manifold.



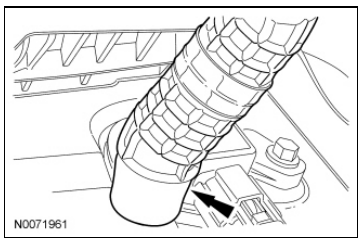
6. If equipped, remove the heat shield and disconnect the block heater electrical connector.



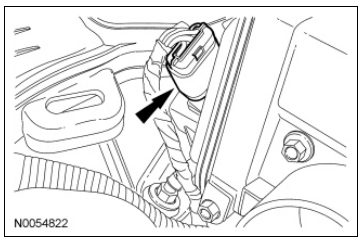
7. If equipped, detach the block heater wiring harness retainer from the power steering reservoir hose and the Power Steering Pressure (PSP) hose.
   - Remove the block heater wiring harness from the engine.



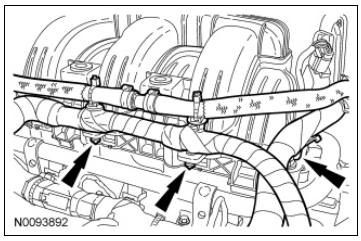
8. Disconnect the PCV hose from the PCV valve.



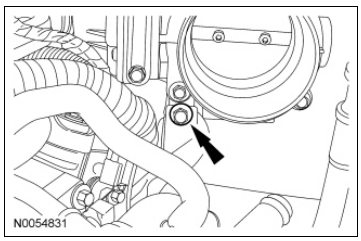
9. Disconnect the Throttle Body (TB) electrical connector.



10. Detach the wiring harness retainers from the upper intake manifold.



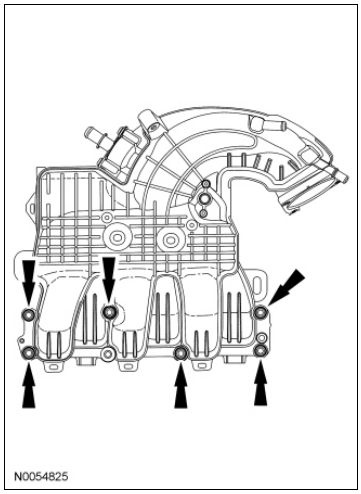
11. Remove the upper intake manifold support bracket bolt.



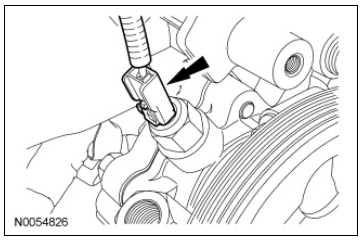
12. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    Remove the 6 bolts and the upper intake manifold.

    - Discard the gaskets.

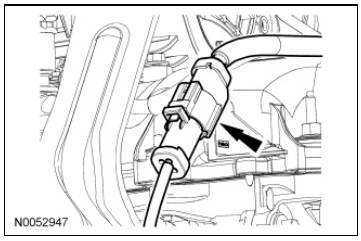


13. Disconnect the PSP switch electrical connector.



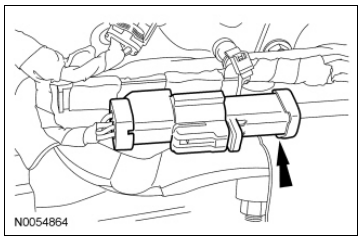
Front Wheel Drive (FWD) vehicles

14. Disconnect the RH Catalyst Monitor Sensor (CMS) sensor electrical connector.

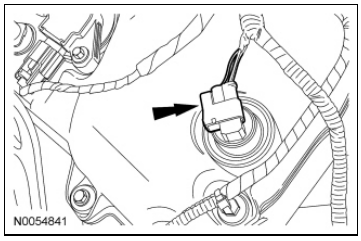


All engines

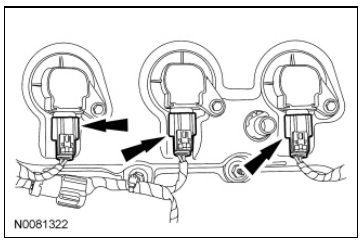
15. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.



16. Disconnect the RH Variable Camshaft Timing (VCT) solenoid electrical connector.

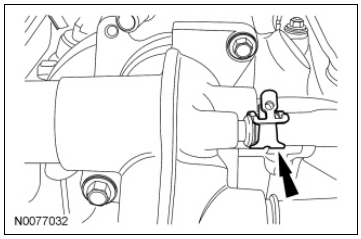


17. Disconnect the 3 RH coil-on-plug electrical connectors.

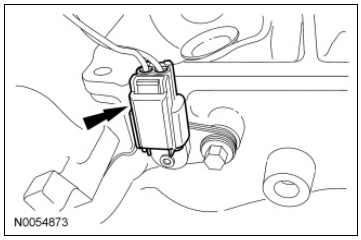


18. Detach all of the wiring harness retainers from the RH valve cover and stud bolts.

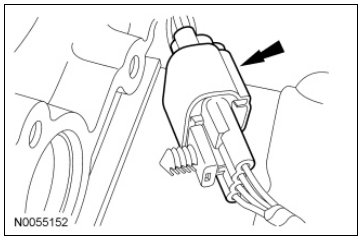
19. Disconnect the coolant bypass hose from the thermostat housing.



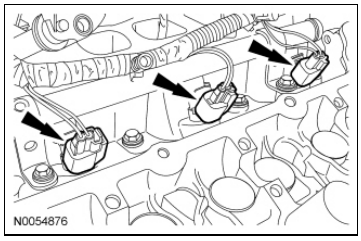
20. Disconnect the RH Camshaft Position (CMP) sensor electrical connector.



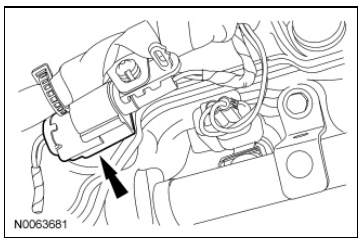
21. Disconnect the Knock Sensor (KS) electrical connector.



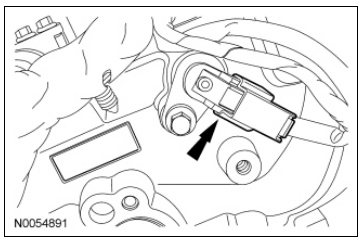
22. Disconnect the 6 fuel injector electrical connectors (3 shown).



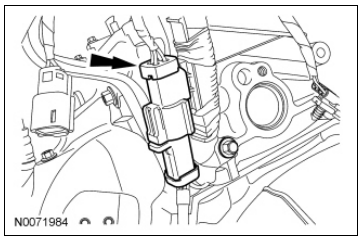
23. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.



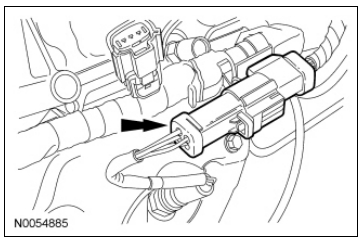
24. Disconnect the LH CMP sensor electrical connector.



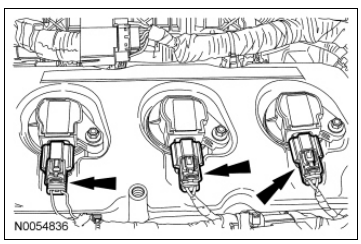
25. Disconnect the LH CMS sensor electrical connector.



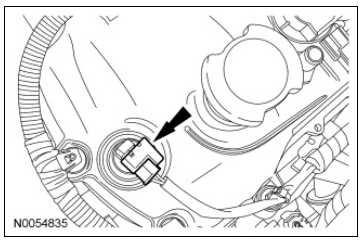
26. Disconnect the LH HO2S electrical connector.



27. Disconnect the 3 LH coil-on-plug electrical connectors.

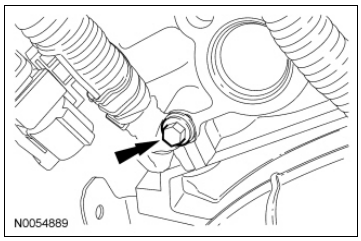


28. Disconnect the LH VCT solenoid electrical connector.

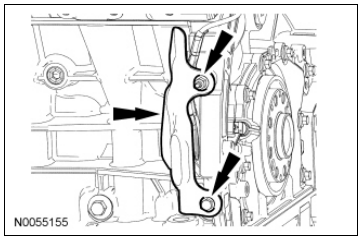


29. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.

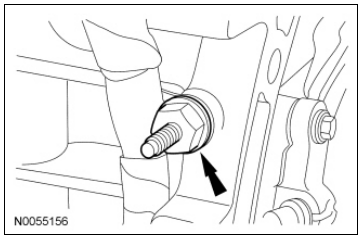
30. Remove the wiring harness retainer bolt from the rear of the LH cylinder head.



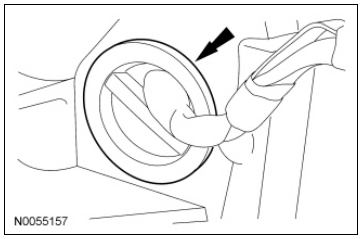
31. Remove the nut, the bolt and the heat shield.



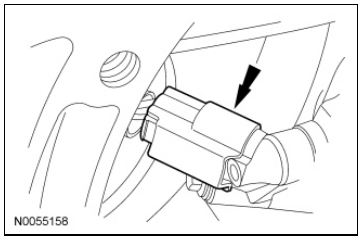
32. Remove the wiring harness retainer stud bolt.



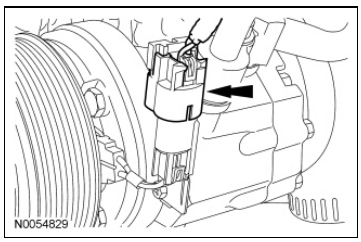
33. Remove the wiring harness grommet.



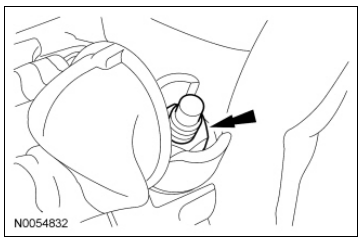
34. Disconnect the Crankshaft Position (CKP) sensor electrical connector.



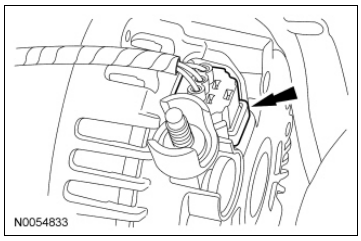
35. Disconnect the A/C compressor electrical connector.



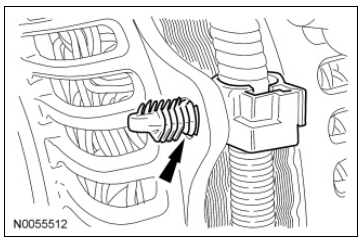
36. Remove the nut and disconnect the generator B+ cable.



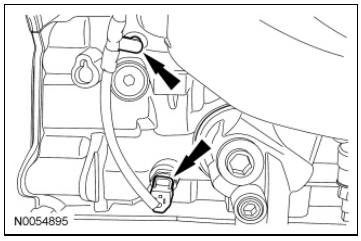
37. Disconnect the generator electrical connector.



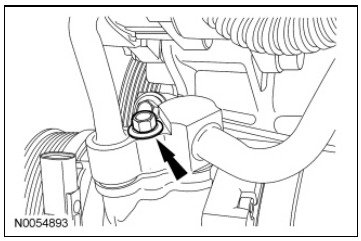
38. Detach the wiring harness retainer from the generator.



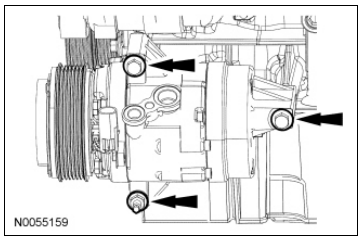
39. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and the wiring harness pin-type retainer.
    - Remove the wiring harness from the engine.



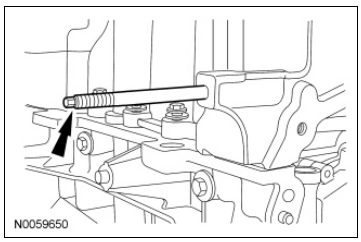
40. Remove the bolt and the A/C manifold.
    - Discard the O-ring seals.



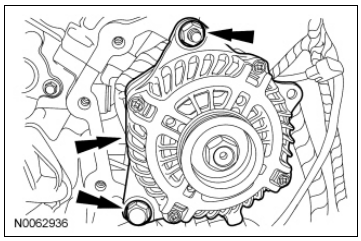
41. Remove the nut, 2 bolts and the A/C compressor.



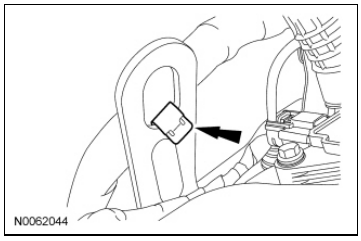
42. Remove the A/C compressor mounting stud from the oil pan.



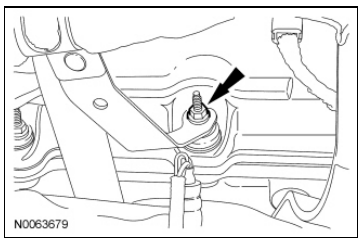
43. Remove the bolt, nut and the generator.



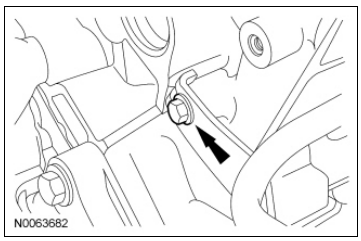
44. Detach the PSP hose retainer from the engine lifting eye.



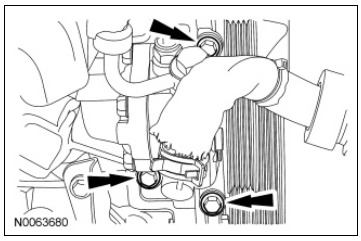
45. Remove the PSP hose bracket nut.



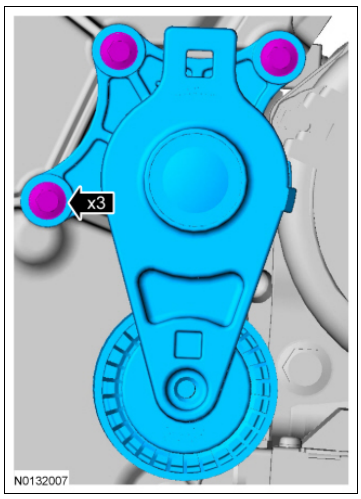
46. Remove the PSP tube bracket bolt from the RH cylinder head.



47. Remove the 3 bolts and the power steering pump.

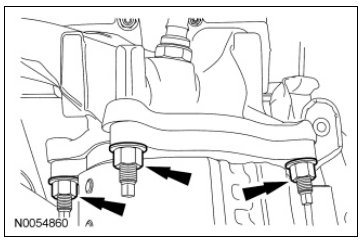


48. Remove the 3 bolts and the accessory drive belt tensioner.

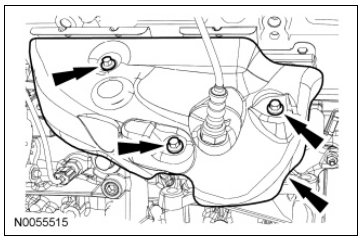


49. Remove the 4 nuts (3 shown) and the LH catalytic converter.

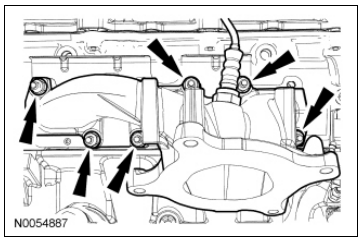
- Discard the nuts and the gasket.



50. Remove the 3 bolts and the LH exhaust manifold heat shield.

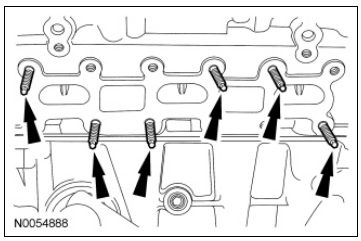


51. Remove the 6 nuts and the LH exhaust manifold.
    - Discard the nuts and the exhaust manifold gasket.



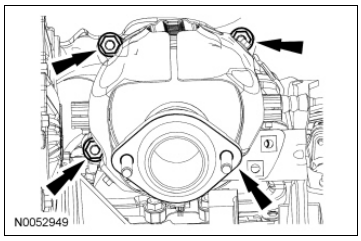
52. Clean and inspect the LH exhaust manifold. For additional information, refer to Section 303-00 .

53. Remove and discard the 6 LH exhaust manifold studs.



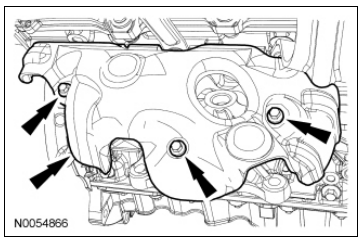
FWD vehicles

54. Remove the 4 nuts and the RH catalytic converter.
    - Discard the nuts and the gasket.

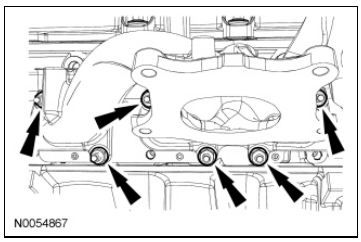


All engines

55. Remove the 3 bolts and the RH exhaust manifold heat shield.

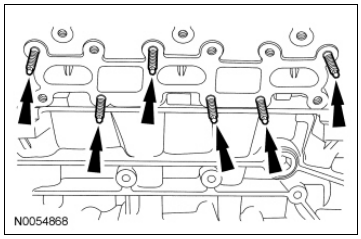


56. Remove the 6 nuts and the RH exhaust manifold.
    - Discard the nuts and the exhaust manifold gasket.

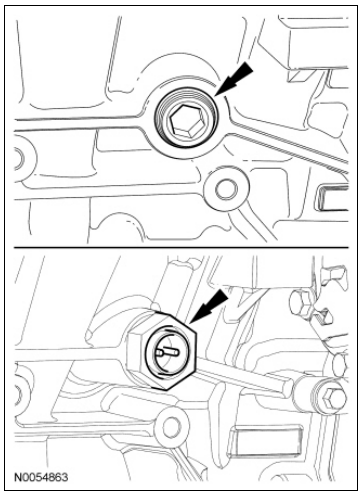


57. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .

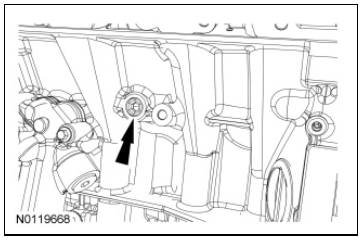
58. Remove and discard the 6 RH exhaust manifold studs.



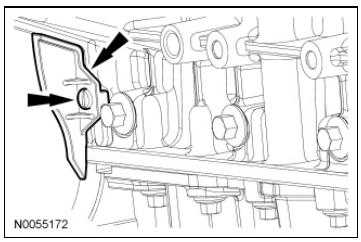
59. Remove the RH cylinder block drain plug or, if equipped, the block heater.
    - Allow coolant to drain from the cylinder block.



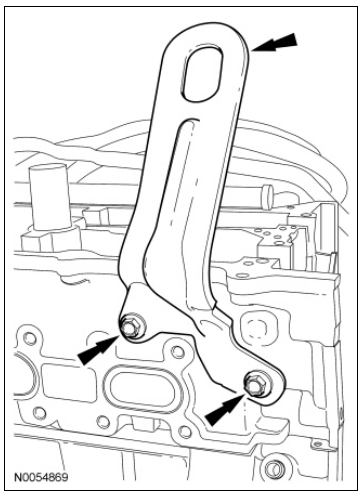
60. Remove the LH cylinder block drain plug.
    - Allow coolant to drain from the cylinder block.



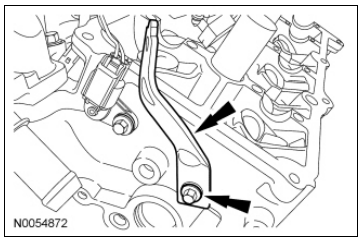
61. Remove the pin-type retainer and the cover.



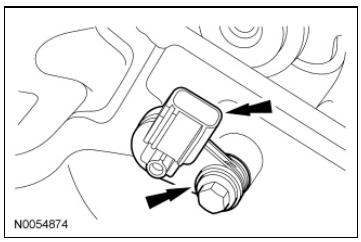
62. Remove the 2 bolts and the engine lifting eye.



63. Remove the bolt and the upper intake manifold support bracket.

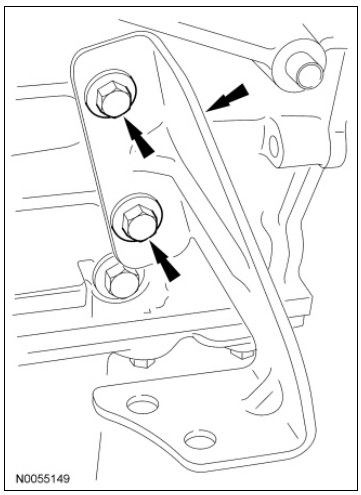


64. Remove the bolt and the RH CMP sensor.



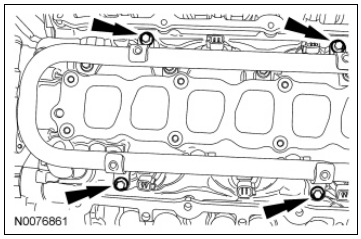
All-Wheel Drive (AWD) vehicles

65. Remove the 2 bolts and the catalytic converter bracket.

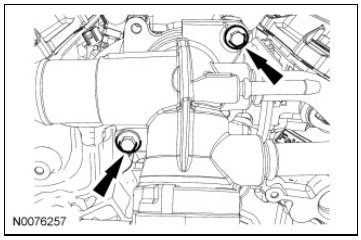


All engines

66. Remove the 4 bolts and the fuel rail and injectors as an assembly.



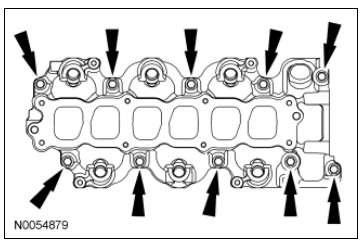
67. Remove the 2 thermostat housing-to-lower intake manifold bolts.
    - Remove the thermostat housing and discard the gasket.



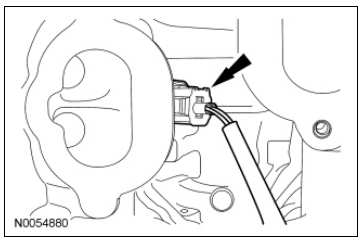
68. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    Remove the 10 bolts and the lower intake manifold.

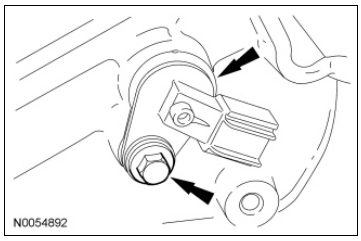
    - Discard the gaskets.



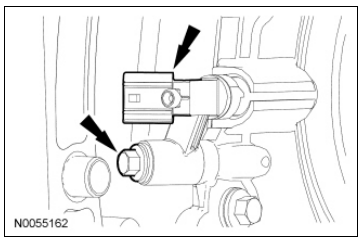
69. Disconnect and remove the CHT sensor jumper harness.



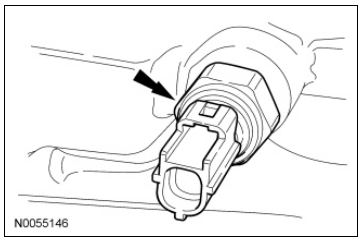
70. Remove the bolt and the LH CMP sensor.



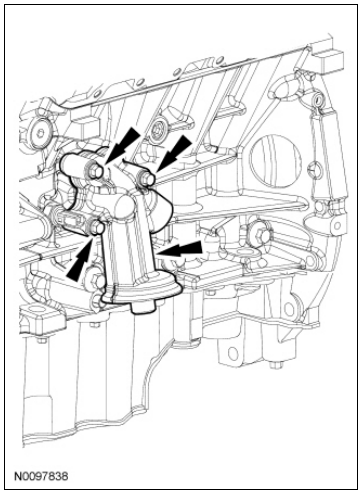
71. Remove the bolt and the CKP sensor.



72. Remove the EOP switch.

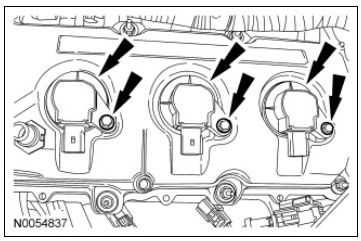


73. Remove the 3 bolts and the oil filter adapter.
    - Discard the gasket.

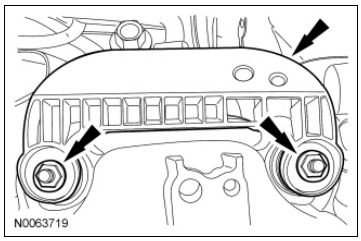


74. **NOTE:** LH shown, RH similar.

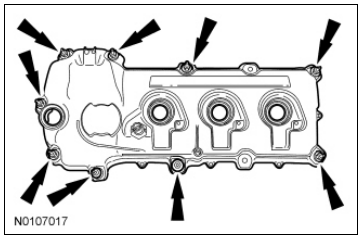
    Remove the 6 bolts and the 6 coil-on-plugs.



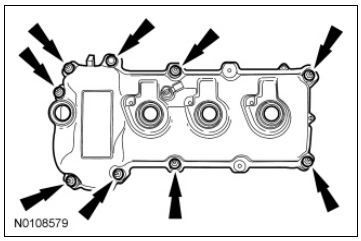
75. Remove the 2 nuts and the wiring harness retaining bracket.



76. Loosen the 9 stud bolts and remove the LH valve cover.
    - Discard the gasket.



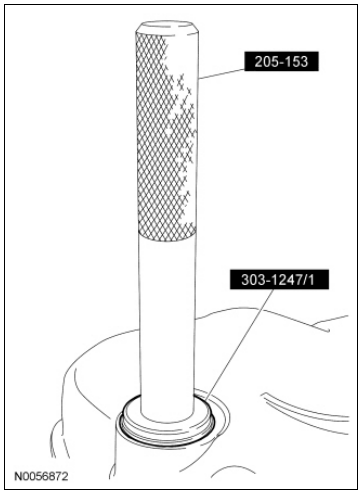
77. Loosen the bolt, 8 stud bolts and remove the RH valve cover.
    - Discard the gasket.



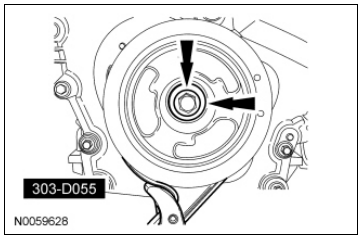
78. **NOTE:** VCT solenoid seal removal shown, spark plug tube seal removal similar.

    Inspect the VCT solenoid seals and the spark plug tube seals. Remove any damaged seals.

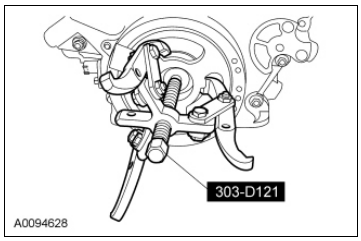
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



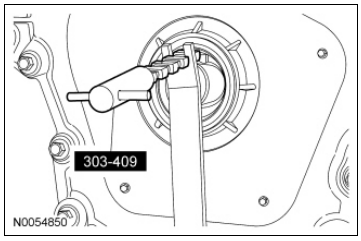
79. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
    - Discard the bolt.



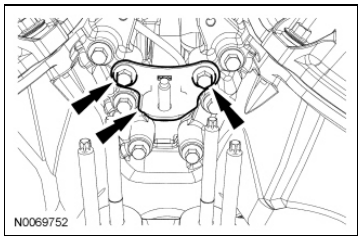
80. Using the 3 Jaw Puller, remove the crankshaft pulley.



81. Using the Oil Seal Remover, remove and discard the crankshaft front seal.

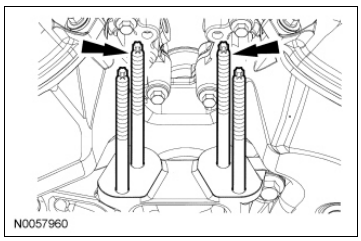


82. Remove the 2 bolts and the engine mount bracket.

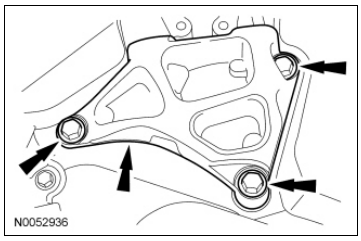


83. **NOTE:** Only use hand tools to remove the studs.

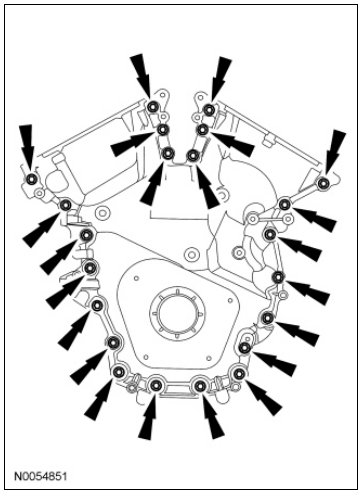
Remove the 2 engine mount studs.



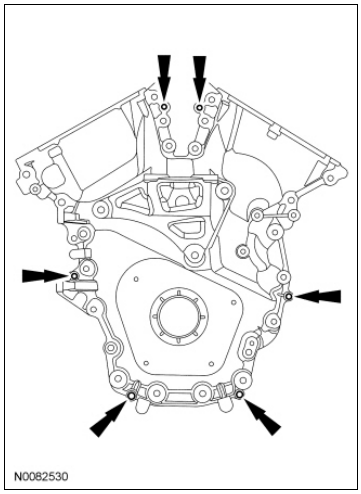
84. Remove the 3 bolts and the engine mount bracket.



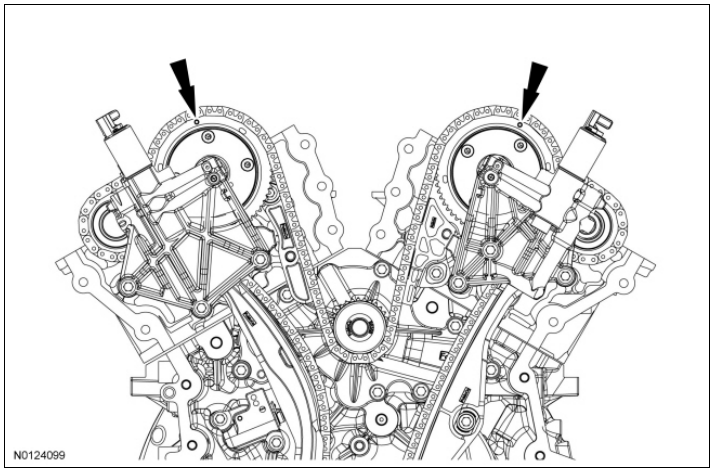
85. Remove the 22 engine front cover bolts.



86. Install 6 of the engine front cover bolts (finger-tight) into the 6 threaded holes in the engine front cover in the following sequence.
    1. Tighten the bolts one turn at a time in a crisscross pattern until the engine front cover-to-cylinder block seal is released.
    2. Remove the engine front cover.

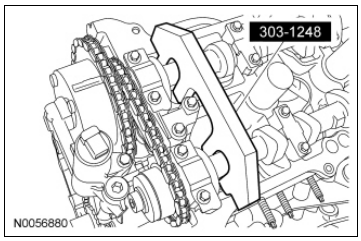


87. Rotate the crankshaft clockwise and align the timing marks on the Variable Camshaft Timing (VCT) assemblies as shown.



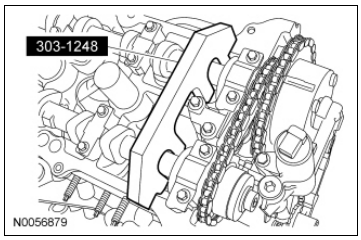
88. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

    Install the Camshaft Holding Tool onto the flats of the LH camshafts.

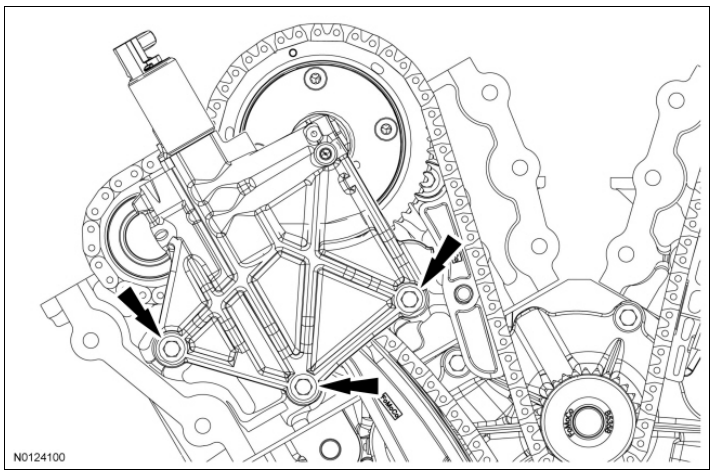


89. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

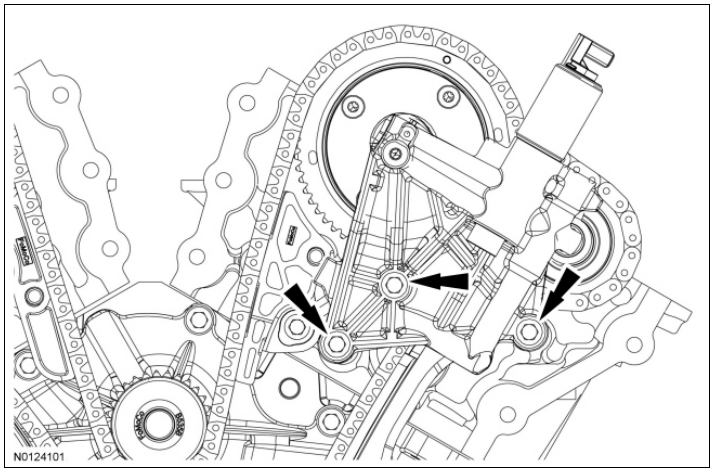
    Install the Camshaft Holding Tool onto the flats of the RH camshafts.



90. Remove the 3 bolts and the RH VCT housing.

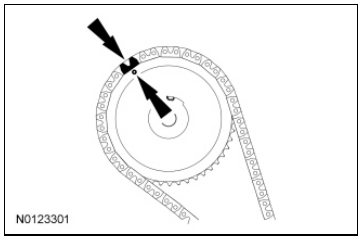


91. Remove the 3 bolts and the LH VCT housing.

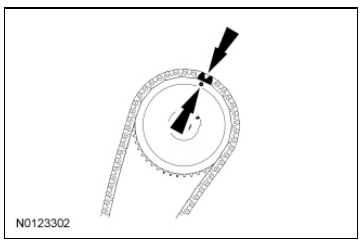


NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

92. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

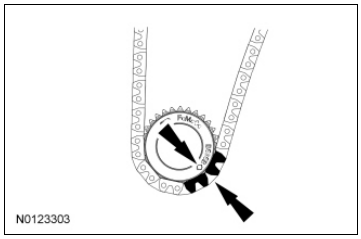


93. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

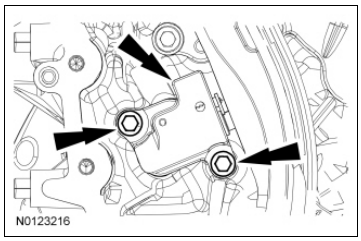


94. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

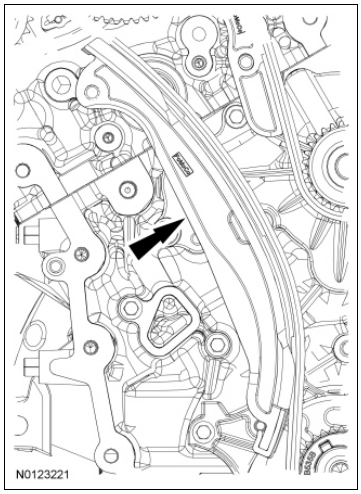
    Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



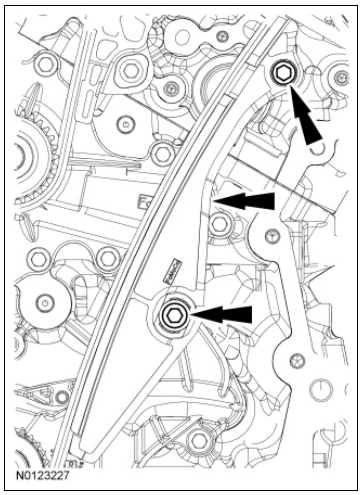
95. Remove the 2 bolts and the primary timing chain tensioner.



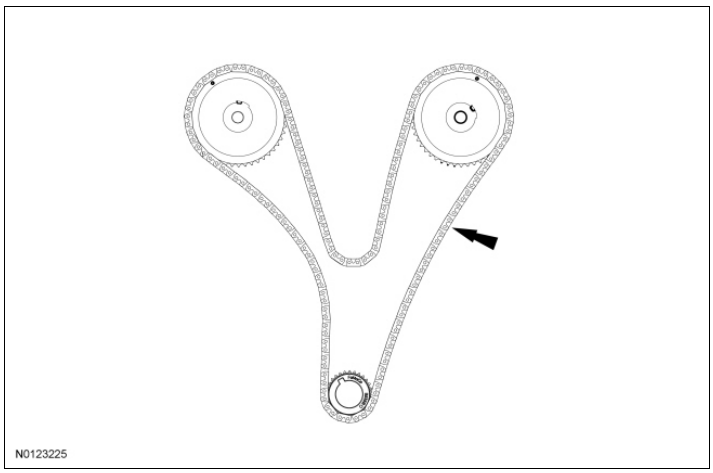
96. Remove the primary timing chain tensioner arm.



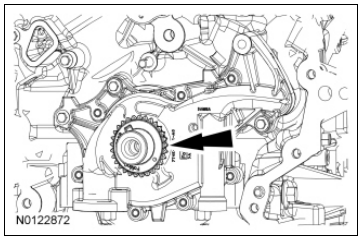
97. Remove the 2 bolts and the lower LH primary timing chain guide.



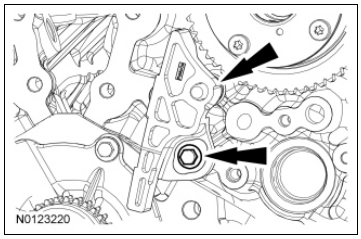
98. Remove the primary timing chain.



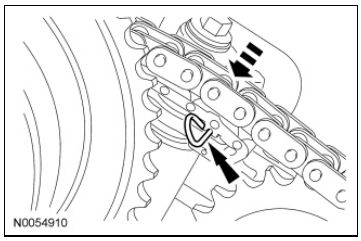
99. Remove the crankshaft timing chain sprocket.



100. Remove the bolt and the upper LH primary timing chain guide.



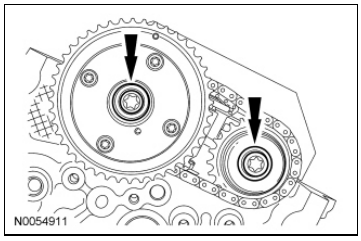
101. Compress the LH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



102. **NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

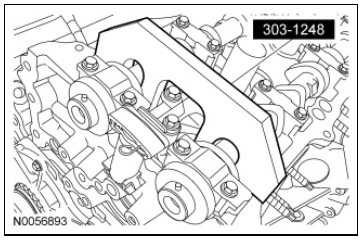
Remove and discard the LH VCT assembly bolt and the LH exhaust camshaft sprocket bolt.

- Remove the LH VCT assembly, secondary timing chain and the LH exhaust camshaft sprocket as an assembly.



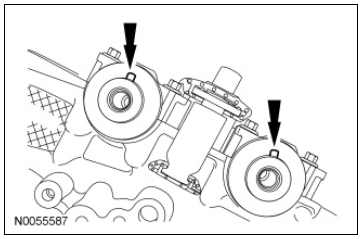
103. **NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure will rotate the LH camshafts approximately 3 degrees to a neutral position.

    Remove the Camshaft Holding Tool from the LH camshafts.

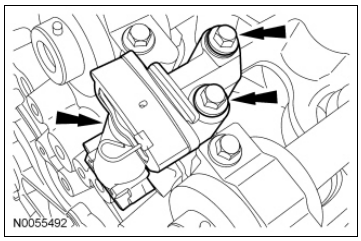


104. ***NOTICE:*** **The camshafts must remain in the neutral position during removal or engine damage may occur.**

    Verify the LH camshafts are in the neutral position.



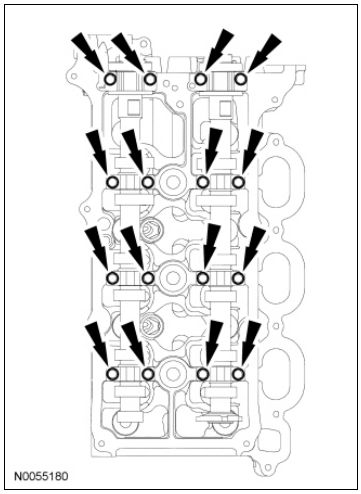
105. Remove the 2 bolts and the LH secondary timing chain tensioner.



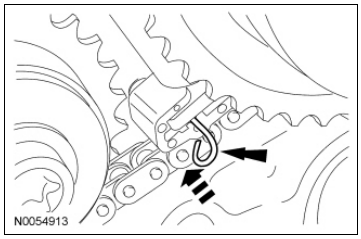
106. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

    Remove the bolts and the LH camshaft bearing caps.

    - Remove the LH camshafts.



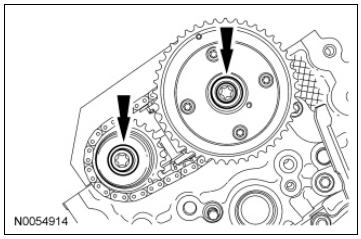
107. Compress the RH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



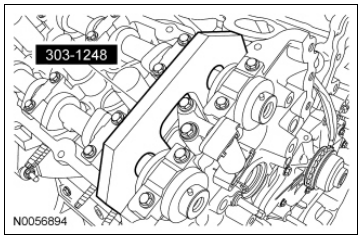
108. **NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

    Remove and discard the RH VCT assembly bolt and the RH exhaust camshaft sprocket bolt.

    - Remove the RH VCT assembly, secondary timing chain and the RH exhaust camshaft sprocket as an assembly.

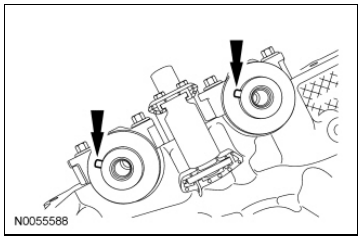


109. Remove the Camshaft Holding Tool from the RH camshafts.

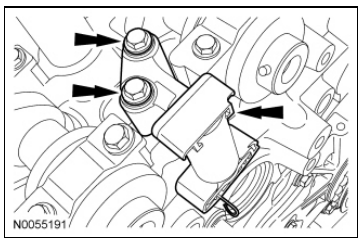


110. ***NOTICE:*** **The camshafts must remain in the neutral position during removal or engine damage may occur.**

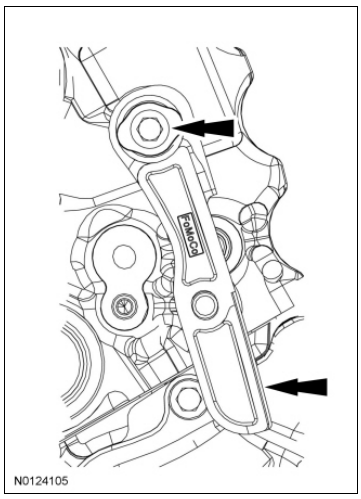
    Rotate the RH camshafts counterclockwise to the neutral position.



111. Remove the 2 bolts and the RH secondary timing chain tensioner.



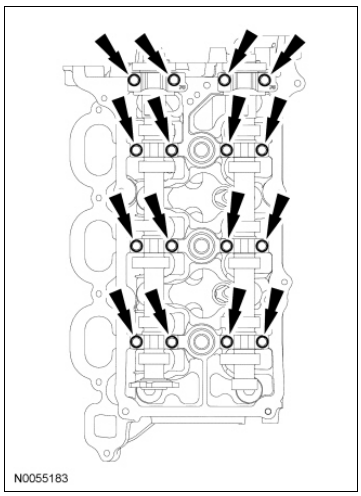
112. Remove the bolt and the RH timing chain guide.



113. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

    Remove the bolts and the RH camshaft bearing caps.

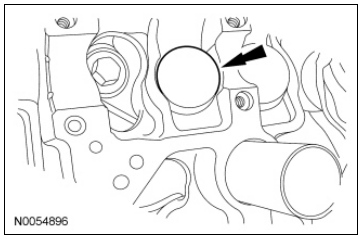
    - Remove the RH camshafts.



114. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

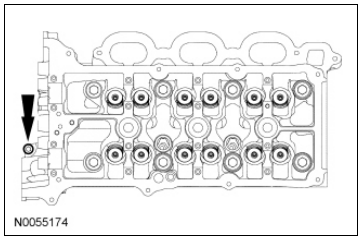
    NOTE: LH shown, RH similar.

    Remove the valve tappets from the cylinder heads.



115. **NOTE:** LH shown, RH similar.

    Remove and discard the M6 bolt from each cylinder head.



116. ***NOTICE:*** **Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.**

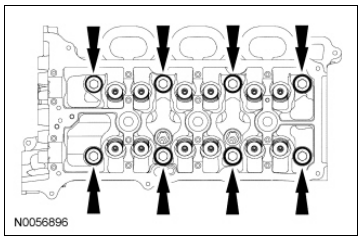
    NOTICE: **Aluminum surfaces are soft and may be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.**

    NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

    NOTE: LH shown, RH similar.

    Remove and discard the 8 bolts from each cylinder head.

    - Remove the cylinder heads.
    - Discard the cylinder head gaskets.



117. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the gasket.**

NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

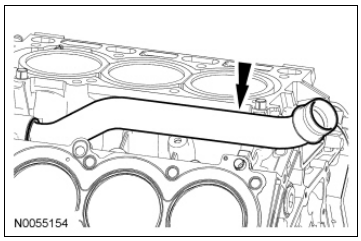
NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.

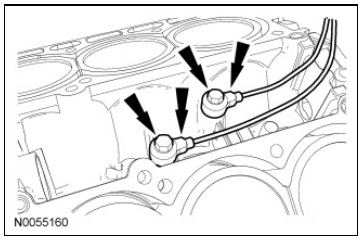
1. Remove any large deposits of silicone or gasket material with a plastic scraper.
2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

118. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

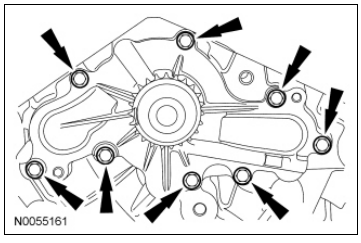
119. Remove the coolant inlet tube.
    - Remove and discard the O-ring seals.



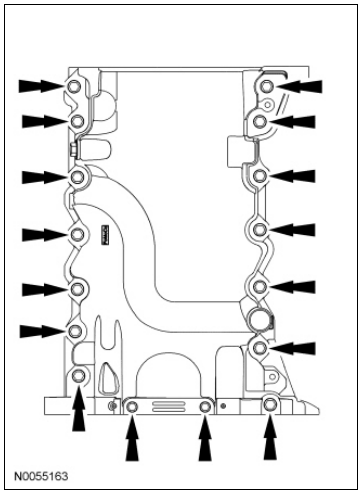
120. Remove the 2 bolts and the Knock Sensor (KS).



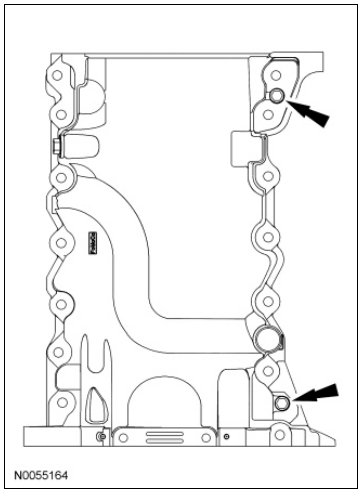
121. Remove the 8 bolts and the coolant pump.



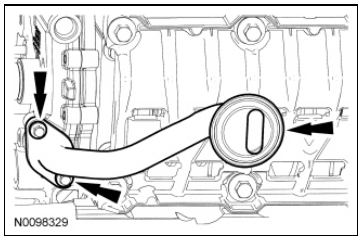
122. Remove the 16 oil pan bolts.



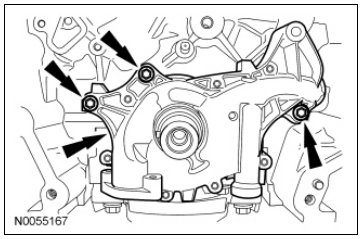
123. Install 2 of the oil pan bolts (finger-tight) into the 2 threaded holes in the oil pan in the following sequence.
    1. Alternately tighten the 2 bolts one turn at a time until the oil pan-to-cylinder block seal is released.
    2. Remove the oil pan.



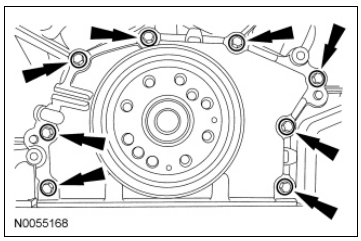
124. Remove the 2 bolts and the oil pump screen and pickup tube.
    - Discard the O-ring seal.



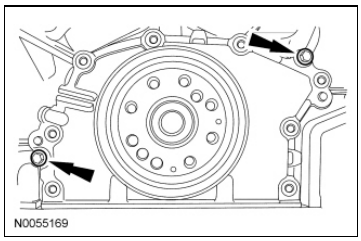
125. Remove the 3 bolts and the oil pump.



126. Remove the 8 crankshaft rear seal retainer bolts.



127. Install the 2 M6 oil pan bolts (finger-tight) into the 2 threaded holes in the crankshaft rear seal retainer in the following sequence.
    1. Alternately tighten the 2 bolts one turn at a time until the crankshaft rear seal retainer-to-cylinder block seal is released.
    2. Remove the crankshaft rear seal retainer.



128. ***NOTICE:*** **Only use a 3M Roloc® Bristle Disk (2-in white, part number 0752) to clean the engine front cover, oil pan and crankshaft rear seal retainer plate. Do not use metal scrapers, wire brushes or any other power abrasive disk to clean the engine front cover, oil pan and crankshaft rear seal retainer plate. These tools cause scratches and gouges that make leak paths.**

    Clean the engine front cover, oil pan and crankshaft rear seal retainer plate using a 3M Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.

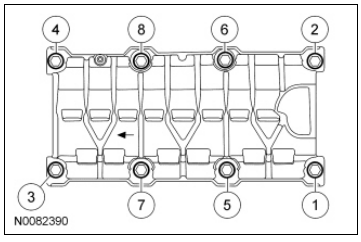
    - Thoroughly wash the engine front cover, oil pan and crankshaft rear seal retainer plate to remove any foreign material, including any abrasive particles created during the cleaning process.

129. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

130. **NOTE:** The main bearing cap support brace bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

    Remove the bolts in the sequence shown.

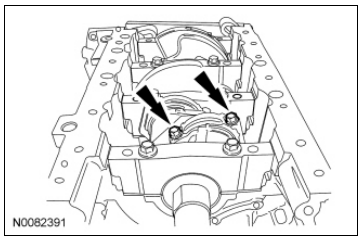
    - Remove the main bearing cap support brace.
    - Discard the bolts.



131. **NOTE:** The connecting rod cap bolts are torque to yield. The original connecting rod cap bolts will be used when measuring the connecting rod large end bore during assembly. The connecting rod cap bolts will be discarded after measurement.

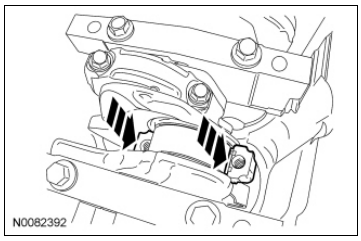
    NOTE: Clearly mark the positin and orientation of the connecting rods, connecting rod caps and connecting rod bearings for reassembly.

    Remove the connecting rod cap bolts and cap.



132. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

    Remove the piston/rod assembly from the engine block.



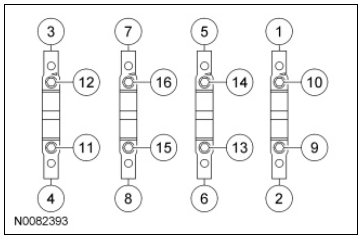
133. Repeat the previous 2 steps until all the piston/rod assemblies are removed from the engine block.

134. **NOTE:** The 8 main bearing cap side bolts and the 8 main bearing cap bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

    NOTE: Clearly mark the position and orientation of the main bearing caps for reassembly.

    Remove the 8 main bearing cap side bolts and the 8 main bearing cap bolts in the sequence shown.

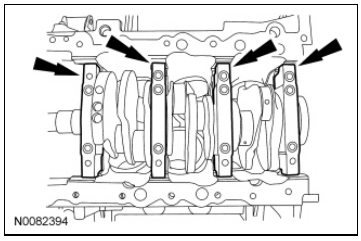
    - Discard the bolts.



135. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

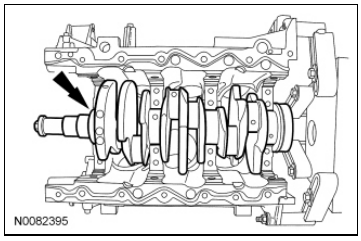
    NOTE: Note the position of the thrust washer on the outside of the No. 4 rear main bearing cap.

    Remove the 4 main bearing caps.



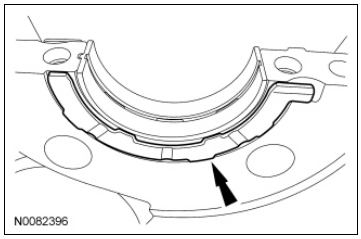
136. **NOTE:** Note the position of the 2 thrust washers on the inside and outside of the rear main bearing bulkhead.

    Remove the crankshaft.



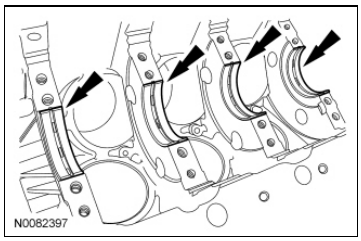
137. **NOTE:** Inside shown, outside similar.

    Remove the 2 crankshaft thrust bearings from the rear main bearing bulkhead.



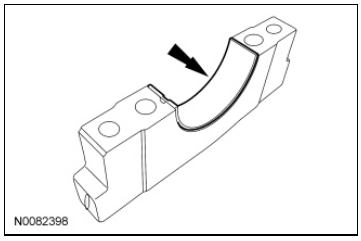
138. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

    Remove the 4 crankshaft main bearings from the cylinder block.



139. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

    Remove the 4 crankshaft main bearings from the main bearing caps.



140. Inspect the cylinder block, bearing cap support brace, pistons and connecting rods. For additional information, refer to Section 303-00 .

141. ***NOTICE:*** **Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.**

    NOTICE: **Do not use wire brushes, power abrasive discs or 3M Roloc® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that will cause premature engine failure. Remove all traces of the gasket.**

    Clean all engine sealing surfaces of the cylinder block in the folowing sequence.

    1. Remove any large deposits of silicone or gasket material.
    2. Apply silicone gasket remover and allow to set for several minutes.
    3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep to remove any remaining traces of oil or coolant and to prepare the surfaces to bond. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
    5. Make sure the 2 engine front cover locating dowel pins are seated correctly in the cylinder block.

Cylinder Head

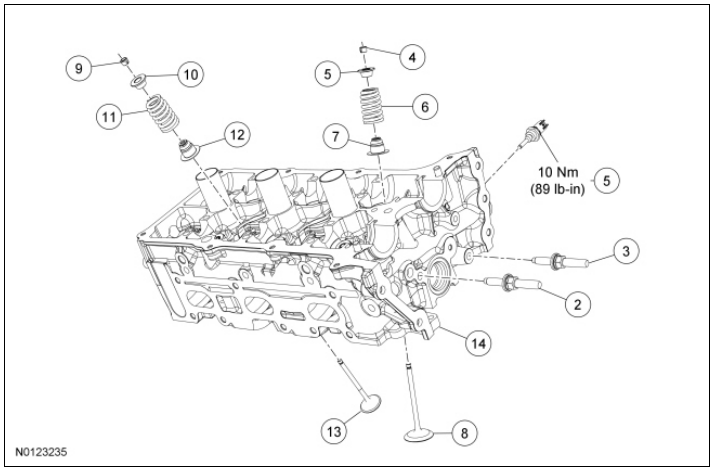
Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

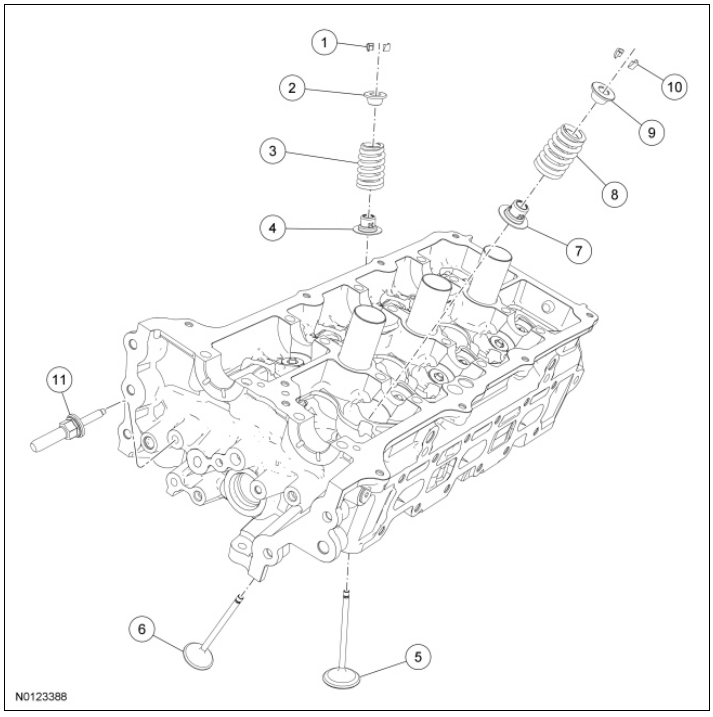
Cylinder Head - RH



Item	Part Number	Description

1	6G004	Cylinder Head Temperature (CHT) sensor
2	W714090	Timing chain tensioner arm pin
3	W714090	Timing chain guide pin
4	6518	Intake valve spring retainer key (12 required)
5	6514	Intake valve spring retainer (6 required)
6	6513	Intake valve spring (quired)
7	6A517	Intake valve stem seal (6 required)
8	6505	Intake valve (6 required)
9	6518	Exhaust valve spring retainer key (12 required)
10	6514	Exhaust valve spring retainer (6 required)
11	6513	Exhaust valve spring (6 required)
12	6A517	Exhaust valve stem seal (6 required)
13	6507	Exhaust valve (6 required)
14	6049	LH cylinder head

Cylinder Head - LH



Item	Part Number	Description
1	6518	Intake valve spring retainer key (12 required)
2	6514	Intake valve spring retainer (6 required)
3	6513	Intake valve spring (6 required)
4	6A517	Intake valve stem seal (6 required)
5	6505	Intake valve (6 required)
6	6507	Exhaust valve (6 required)
7	6A517	Exhaust valve stem seal (6 required)
8	13	Exhaust valve spring (6 required)

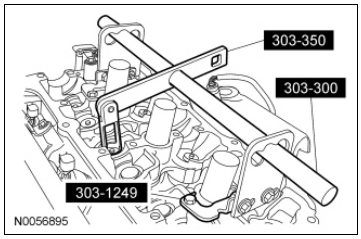
9	6514	Exhaust valve spring retainer (6 required)
10	6518	Exhaust valve spring retainer key (12 required)
11	W714090	Timing chain tensioner arm pin

Disassembly

All cylinder heads

NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

1. Using the Valve Spring Compressors, remove the keys, retainer and spring.



2. Remove the valve from the cylinder head.

3. Remove and discard the valve stem seal.

4. Repeat the above steps for each valve.

5. Remove the timing chain guide pin.

RH cylinder head

6. Remove the timing chain tensioner arm pin.

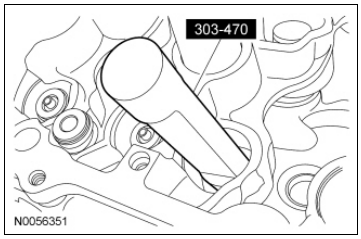
7. Remove and discard the Cylinder Head Temperature (CHT) sensor.

Assembly

All cylinder heads

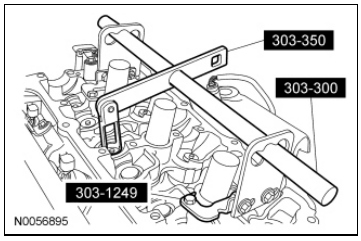
1. **NOTE:** Lubricate the valve stem seal with clean engine oil prior to installation.

   Using the Valve Stem Oil Seal Installer, install a new valve stem seal.



2. Install the valve.

3. Using the Valve Spring Compressors, install the valve spring, retainer and key.



4. Repeat the above steps for each valve.

5. Install the timing chain guide pin and tighten in 2 stages.
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten an additional 60 degrees.

RH cylinder head

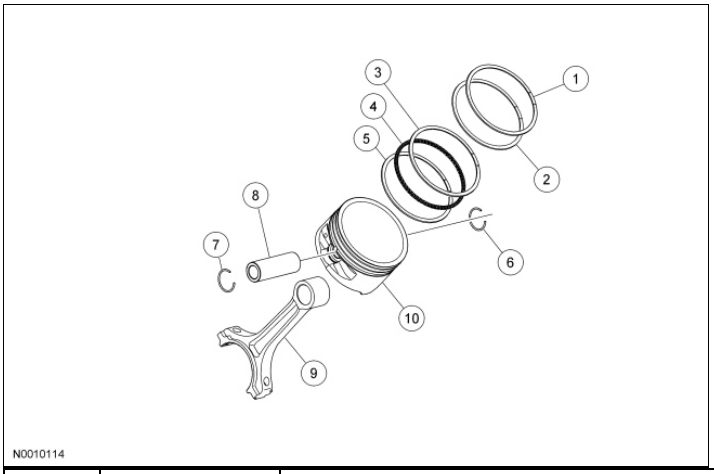
6. Install the timing chain tensioner arm pin and tighten in 2 stages.
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten an additional 60 degrees.

7. Install a new CHT sensor.
    - Tighten to 10 Nm (89 lb-in).

Piston

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item >	Part Number	Description
1	-	Piston compression upper ring (part of 6148)
2	-	Piston compression lower ring (part of 6148)
3	-	Piston oil control upper segment ring (part of 6148)
4	-	Piston oil control spacer (part of 6148)
5	-	Piston oil control lower segment ring (part of 6148)
6	6140	Piston pin retainer clip
7	6140	Piston pin retainer clip
8	6135	Piston pin
9	6200	Connecting rod
10	6110	Piston

Disassembly

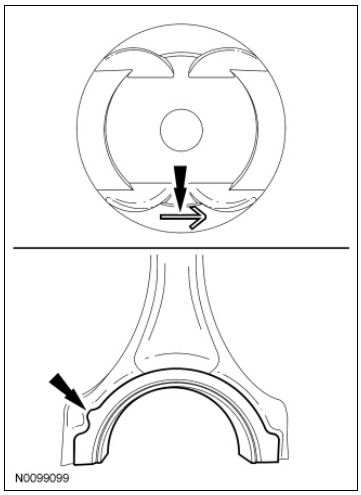
1. Remove the piston rings from the piston.
   - Discard the piston rings.

2. Remove the 2 piston pin retainers and the piston pin.
   - Discard the 2 piston pin retainer clips.

3. **NOTE:** If the piston and/or connecting rod are being installed new, the piston rod orientation marks and the arrow on the top of the dome of the piston should be facing toward the front of the engine block.

   NOTE: If the piston and connecting rod are to be reinstalled, they must be assembled in the same orientation. Mark the piston orientation to the connecting rod for reassembly.

   Separate the piston from the connecting rod.



4. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00 .

Assembly

1. Align the piston-to-connecting rod orientation marks and position the connecting rod in the piston.

2. Lubricate the piston pin and pin bore with clean engine oil.

3. Install the piston pin in the piston and connecting rod assembly.

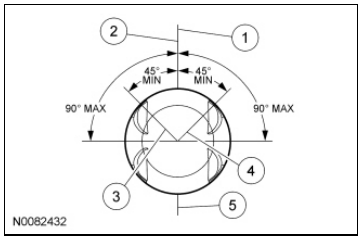
4. Install the new piston pin retaining clips in the piston.
   - The piston pin retaining clip gap orientation must be toward the top or dome of piston.

5. Lubricate the piston and the new piston rings with clean engine oil.

6. **NOTE:** The piston compression upper and lower ring should be installed with the "O" mark on the ring face pointing up toward the top of the piston.

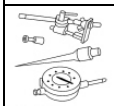
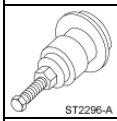
   Install the piston rings onto the piston as shown.

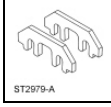
   1. Center line of the piston parallel to the wrist pin bore
   2. Upper compression ring gap location
   3. Upper oil control segment ring gap location
   4. Lower oil control segment ring gap location
   5. Expander ring and lower compression ring gap location


2
1
45° MIN
45° MIN
90° MAX
90° MAX
4
3
5
N0082432

Engine

Special Tool(s)

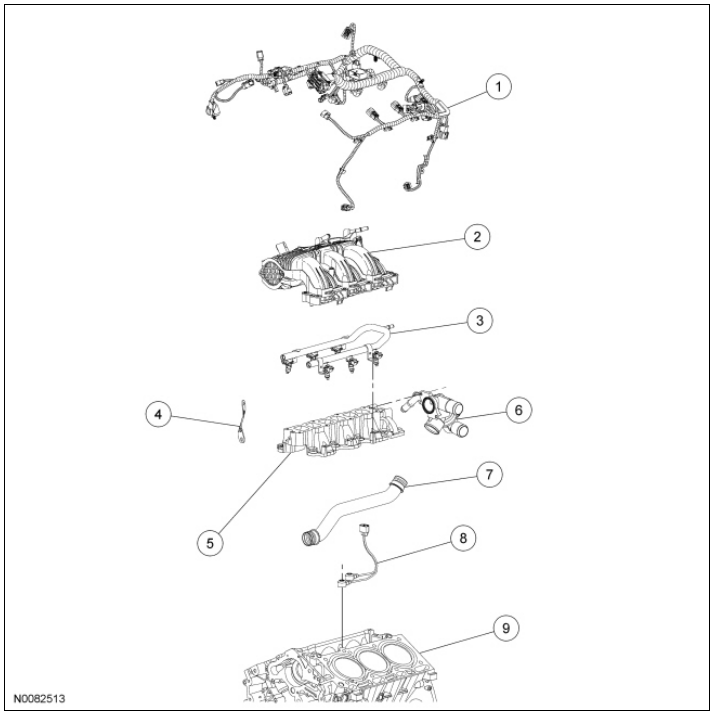
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST2433-A	Alignment Pins 307-399
 ST1376-A	Compressor, Piston Ring 303-D032 (D81L-6002-C) d>
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST2976A	Eye, Engine Lift 303-1245
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2296-A	Installer, Front Cover Oil Seal 303-335
 ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST2980-A	Installer, Rear Main Seal 303-1250
 ST2983-A	Installer, VCT Spark Plug Tube Seal 303-1247/2
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent

 ST2979-A	Tool, Camshaft Holding 303-1248

Material

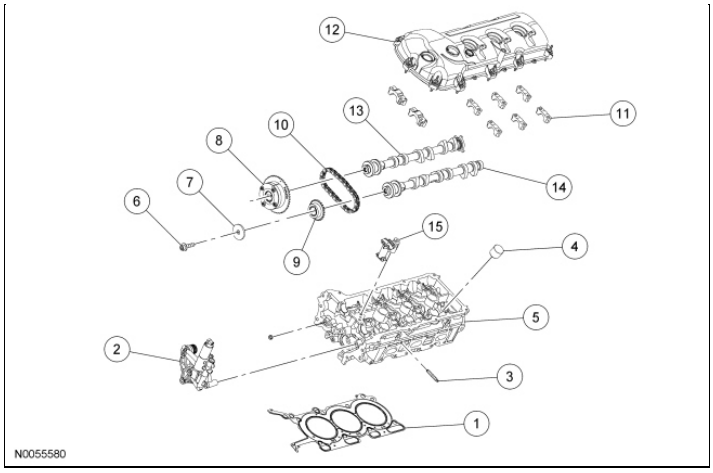
Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	-
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D
Thread Sealant with PTFE TA-24	WSK-M2G350-A2
Threadlock and Sealer TA-25	WSK-M2G351-A5

Engine Upper



Item	Part Number	Description
1	12A581	Engine control harness
2	9424	Upper intake manifold
3	9F792	Fuel rail
4	9J444	Upper intake manifold support bracket
5	9424	Lower intake manifold
6	8A586	Thermostat housing
7	9N271	Coolant tube
8	12A699	Knock Sensor (KS)
9	6010	Cylinder block

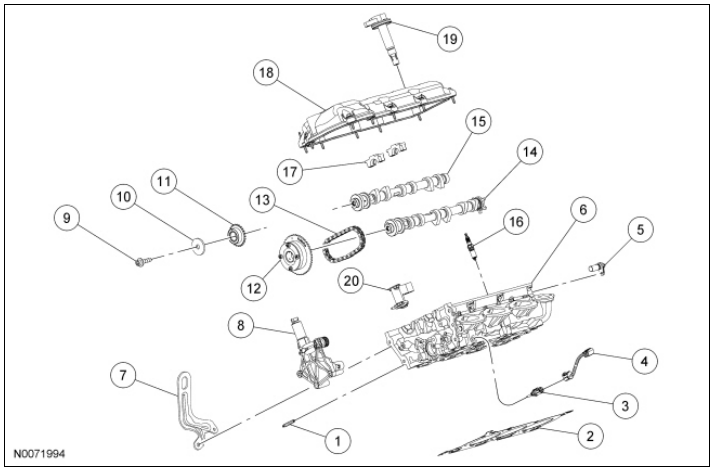
Engine Upper - LH Cylinder Head



Item	Part Number	Description
1	6051	LH cylinder head gasket

2	6C261	LH Variable Camshaft Timing (VCT) housing
3	W712244	LH exhaust manifold stud (6 required)
4	6500	Valve tappet (24 quired)
5	6049	LH cylinder head
6	6279	LH camshaft bolt (2 required)
7	W710738	LH exhaust camshaft sprocket washer
8	6A257	LH VCT assembly
9	6256	LH exhaust camshaft sprocket
10	6268	LH secondary timing chain
11	6A258	LH camshaft cap (8 required)
12	6582	LH valve cover
13	6250	LH intake camshaft
14	6250	LH exhaust camshaft
15	6K254	LH secondary timing chain tensioner

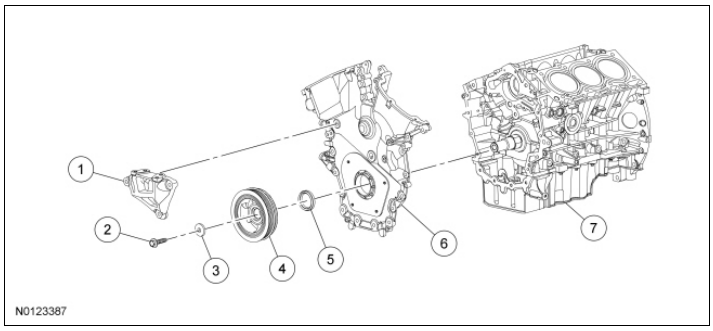
Engine Upper - RH Cylinder Head



Item	Part Number	Description
1	W712244	RH exhaust manifold stud (6 required)
2	6051	RH cylinder head gasket
3	6G004	Cylinder Head Temperature (CHT) sensor
14A411	CHT sensor jumper harness	
5	6B288	Camshaft Position (CMP) sensor (2 required)
6	6049	RH cylinder head
7	17A084	Engine lift eye
8	6C260	RH Variable Camshaft Timing (VCT) housing
9	6279	RH camshaft bolt (2 required)
10	W710738	RH exhaust camshaft sprocket washer

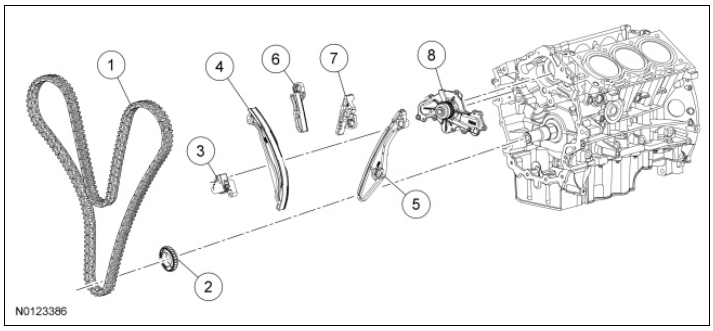
11	6256	RH exhaust camshaft sprocket
12	6A257	RH VCT assembly
13	6268	RH secondary timing chain
14	6250	RH intake camshaft
15	6250	RH exhaust camshaft
16	12405	Spark plug (6 required)
17	6A258	RH camshaft cap (8 required)
18	6582	RH valve cover
19	12A375	Coil-on-plug (6 required)
20	6C270	RH secondary timing chain tensioner

Engine Front



Item	Part Number	Description
1	6A0003	Engine mount bracket
2	W701512	Crankshaft pulley bolt
3	N806165	Crankshaft pulley washer
4	6316	Crankshaft pulley
5	6700	Crankshaft front seal
6	6C086	Engine front cover
7	6675	Oil pan

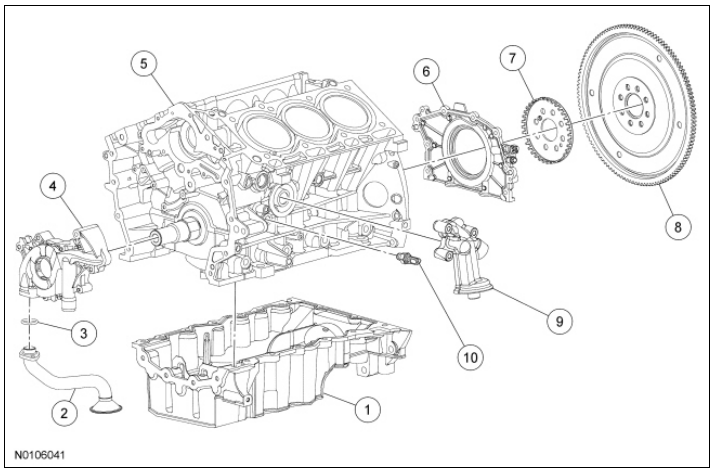
Timing Drive Components



Item	Part Number	Description
1	6268	Timing chain

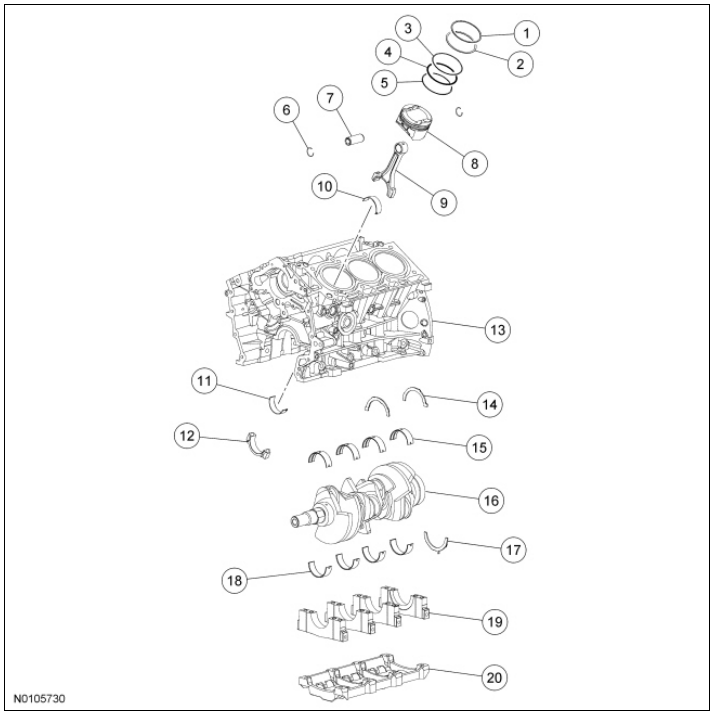
2	6306	Crankshaft timing sprocket
3	6K254	Primary timing chain tensioner
4	6K255	Primary timing chain tensioner arm
5	6B274	LH lower primary timing chain guide
6	6M256	RH primary timing chain guide
7	6K297	LH upper primary timing chain guide
8	8501	Coolant pump

Engine Lower (View 1)



Item	Part Number	Description
1	6675	Oil pan
2	6622	Oil pump screen and pickup tube
3	6625	Oil pump screen and pickup tube O-ring seal
4	6600	Oil pump
5	6010	Cylinder block
6	6K301	Crankshaft rear seal retainer
7	12A227	Crankshaft sensor ring
8	6375	Flexplate
9	6881	Oil filter adapter
10	9278	Engine Oil Pressure (EOP) switch

Lower Engine Block (View 2)



Item	Part Number	Description
1	-	Piston compression upper ring (6 required) (part of 6148)
2	-	Piston compression lower ring (6 required) (part of 6148)
3	-	Piston oil control upper segment ring (6 required) (part of 6148)
4	-	Piston oil control spacer (6 required) (part of 6148)
5	-	Piston oil control lower segment ring (6 required) (part of 6148)
6	6140	Piston pin retainer (12 required)
7	6135	Piston pin (6 required)
8	6110	Piston (6 required)
9	6200	Connecting rod (6 required)
10	6211	Connecting rod upper bearing (6 required)
11	6211	Connecting rod lower bearing (6 required)
12	-	Connecting rod cap (part of 6200) (6 required)
13	6010	Cylinder block
14	6D309	Crankshaft upper thrust washer (2 required)
15	6D309	Cylinder block crankshaft main bearing (4 required)
16	6303	Crankshaft
17	6K302	Crankshaft lower thrust washer
18	6D309	Lower crankshaft main bearings (4 required)
20	6C364	Main bearing cap support brace

NOTICE: **During engine repair procedures, cleanliness is extremely important. All parts must be thoroughly cleaned and any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

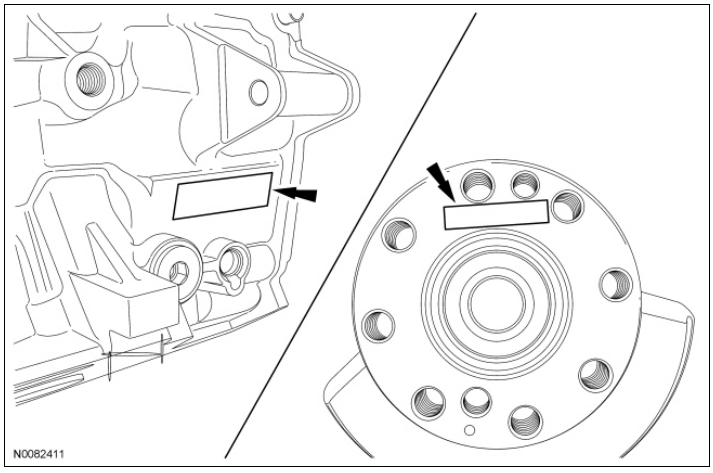
NOTE: Assembly of the engine requires various inspections/measurements of the engine components (engine block, crankshaft, connecting rods, pistons and piston rings). These inspections/measurements will aid in determining if the engine components will require replacement. For additional information, refer to Section 303-00 .

All engines

1. **NOTE:** This procedure is for selecting bearings using a new crankshaft.

   Select the crankshaft main bearings for each crankshaft journal.

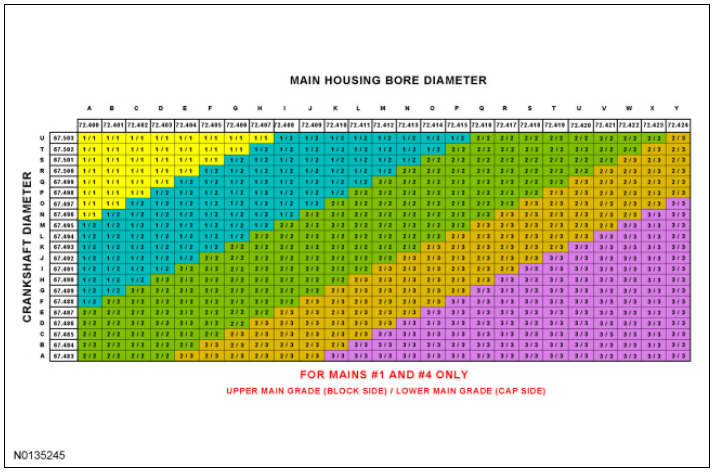
   - Read the code on the crankshaft flange.
   - Read the code on the cylinder block face.
     - The first letter after the first asterisk makes up the code for main No. 1 and the next letter for main No. 2. The first letter after the second asterisk makes up the code for main No. 3 and the last letter for main No. 4.



2. **NOTE:** This chart is for selecting main bearings 1 and 4 only, the remaining bearings will be selected using a different chart in the next step.

   Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings, determine the required bearing grade for main bearings 1 and 4.

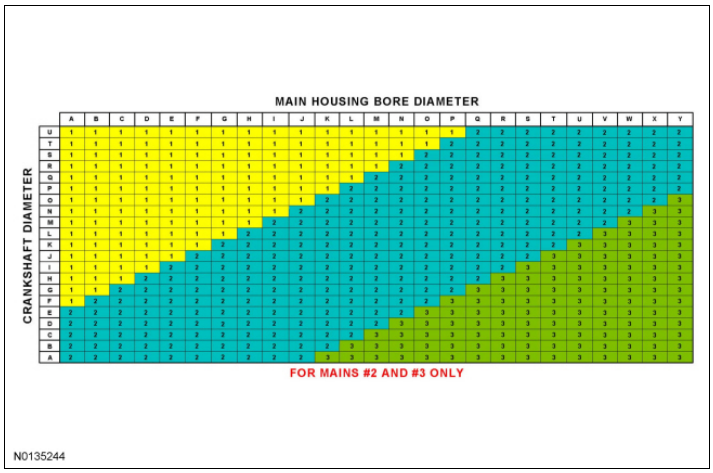
   - Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
   - Read down the column below the engine block main bearing code letter and across the row next to the crankshaft main bearing code letter, until the 2 intersect. This is the required bearing grade(s) for the No. 1 crankshaft main bearing.
   - As an example, if the engine block code letter is "F" and the crankshaft code letter is "P", the correct bearing grade for this main bearing is a "1" for the upper bearing and a "2" for the lower bearing.
   - Repeat the above steps using the fourth letter of the block and crankshaft codes to select the No. 4 bearing.



3. **NOTE:** This chart is for selecting main bearings 2 and 3 only.

   Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings, determine the required bearing grade for main bearings 2 and 3.

   - Read the second letter of the engine block main bearing code and the second letter of the crankshaft main bearing code.
   - Read down the column below the engine block main bearing code letter and across the row next to the crankshaft main bearing code letter, until the 2 intersect. This is the required bearing grade for the No. 2 crankshaft main bearing.
   - As an example, if the engine block code letter is "F" and the crankshaft code letter is "P", the correct bearing grade for this main bearing is "1".
   - Repeat the above steps using the third letter of the block and crankshaft codes to select the No. 3.



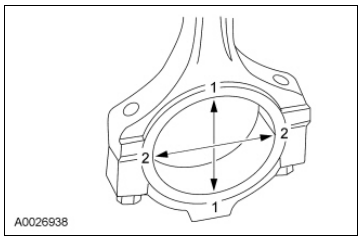
4. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

   Using the original connecting rod cap bolts, install the connecting rod caps and bolts.

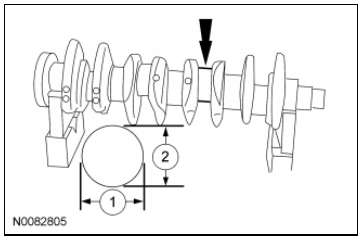
   - Tighten the bolts in 3 stages.
   - Stage 1: Tighten to 23 Nm (17 lb-ft).
   - Stage 2: Tighten to 43 Nm (32 lb-ft).
   - Stage 3: Tighten an additional 90 degrees.

5. Measure the connecting rod large end bore in 2 directions.

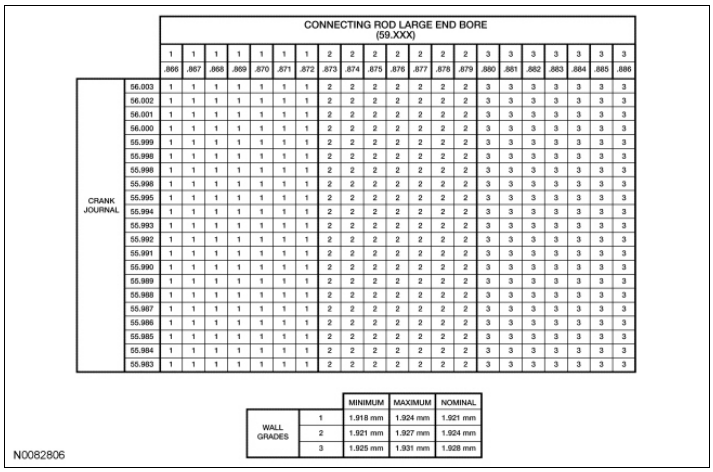
- Remove the bolts and the rod cap.
  - ♦ Discard the connecting rod cap bolts.



6. Measure each of the crankshaft connecting rod bearing journal diameters in at least 2 directions.



7. Using the chart, select the correct connecting rod bearings for each crankshaft connecting rod journal.

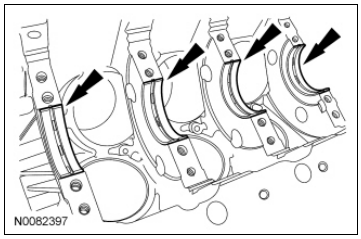


	CONNECTING ROD LARGE END BORE (59.XXX)																			
	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	.866	.867	.868	.869	.870	.871	.872	.873	.874	.875	.876	.877	.878	.879	.880	.881	.882	.883	.884	.885	.886
CRANK JOURNAL 56.003	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
56.002	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
56.001	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
56.000	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.999	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.998	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.995	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.994	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.993	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.992	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.991	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.990	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.989	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.988	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.987	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.986	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.985	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.984	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
55.983	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3

		MINIMUM	MAXIMUM	NOMINAL
WALL GRADES	1	1.918 mm	1.924 mm	1.921 mm
	2	1.921 mm	1.927 mm	1.924 mm
	3	1.925 mm	1.931 mm	1.928 mm

8. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

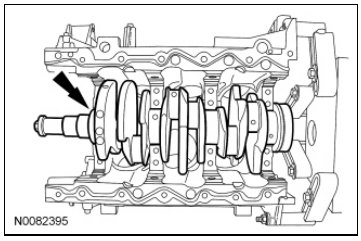
   Lubricate the upper crankshaft main bearings with clean engine oil and install the 4 crankshaft main bearings in the cylinder block.



9. **NOTE:** Do not install the upper thrust bearings until the crankshaft is installed.

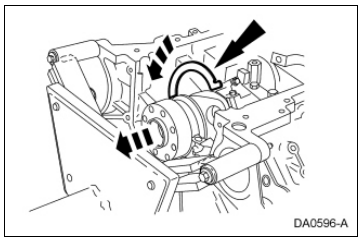
   NOTE: Lubricate the thrust surfaces of the crankshaft with clean engine oil.

   Install the crankshaft onto the upper main bearings.



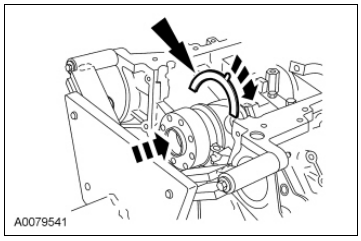
10. **NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

    Push the crankshaft rearward and install the rear crankshaft upper thrust washer at the back of the No. 4 rear bulkhead.

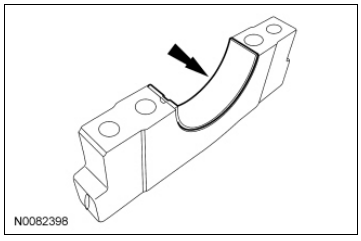


11. **NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

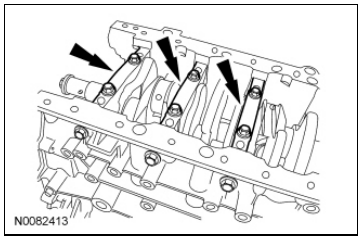
    Push the crankshaft forward and install the front crankshaft upper thrust washer at the front of the No. 4 rear bulkhead.



12. Lubricate the crankshaft lower main bearings with clean engine oil and install them into the main bearing caps. Visually check seating and squareness of the bearings to make sure of proper seating in caps.



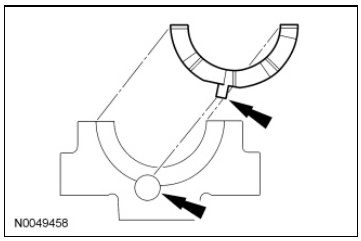
13. Position the No. 1, No. 2 and No. 3 main bearing caps on the cylinder block and, keeping the caps as square as possible, alternately draw the caps down evenly using the new bolts until the main bearing caps are seated.



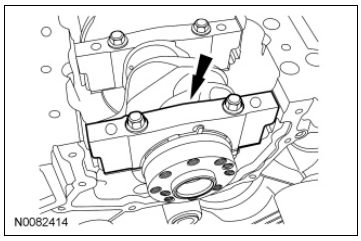
14. **NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

    NOTE: To aid in assembly, apply petroleum jelly to the back of the crankshaft thrust washer.

    Install the lower crankshaft thrust washer to the back side of the No. 4 rear main bearing cap, with the tab aligned with the cutout in the main bearing cap.



15. Position main bearing cap No. 4 on the cylinder block and keeping the cap as square as possible, alternately draw the cap down evenly using the new bolts until the main bearing cap is seated.

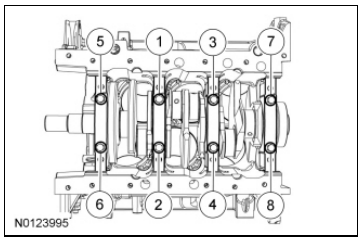


16. Loosen the No. 4 main bearing cap bolts.

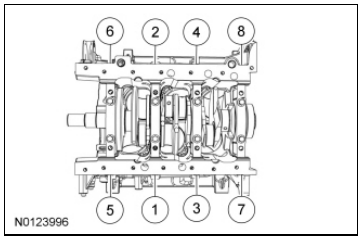
17. **NOTE:** While tightening the main bearing vertical bolts, push the crankshaft forward and the No. 4 main bearing cap rearward to seat the crankshaft thrust washers.

    Tighten the main bearing bolts in the sequence shown in 2 stages.

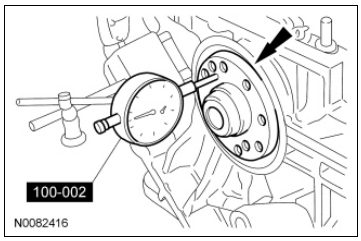
    - Stage 1: Tighten fasteners 1 through 8 to 33 Nm (24 lb-ft).
    - Stage 2: Tighten fasteners 1 through 8 an additional 135 degrees.



18. Install the new 8 main bearing cap side bolts. Tighten in the sequence shown in 2 stages.
    - Stage 1: Tighten fasteners 1 through 8 to 45 Nm (33 lb-ft).
    - Stage 2: Tighten fasteners 1 through 8 an additional 90 degrees.



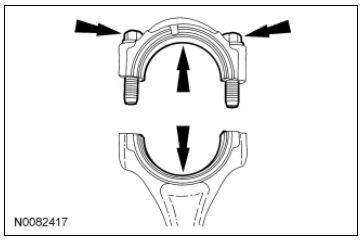
19. Using the Dial Indicator Gauge with Holding Fixture, measure crankshaft end play.
    - Position the crankshaft to the rear of the cylinder block.
    - Zero the Dial Indicator Gauge.
    - Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.



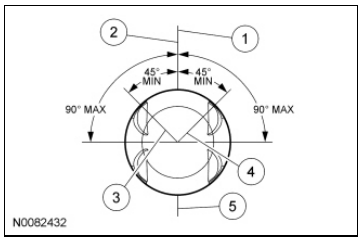
20. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

    Prepare the connecting rod and cap.

    - Insert the new bolts in the rod cap.
    - Insert the upper and lower rod bearings into the rod and cap.



21. Before installing the pistons into the cylinder block, verify proper ring gap location.
    1. Center line of the piston parallel to the wrist pin bore
    2. Upper compression ring gap location
    3. Upper oil control segment ring gap location
    4. Lower oil control segment ring gap location
    5. Expander ring and lower compression ring gap location



22. ***NOTICE:*** **Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.**

NOTE: The next 3 steps are for all 6 connecting rods, rod caps and pistons. Only 1 connecting rod, rod cap and piston is shown.

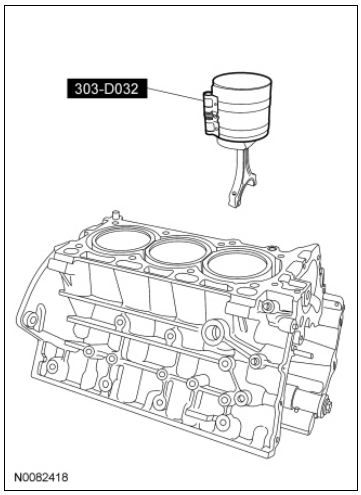
NOTE: Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with clean engine oil.

NOTE: Make sure the piston rings are positioned to specifications for installation. For additional information, refer to Disassembly and Assembly of Subassemblies - Piston in this section.

NOTE: If the piston and or connecting rod are being installed new, the piston rod orientation marks and the arrow on the top of the dome of the piston should be facing toward the front of the engine block.

NOTE: If the piston and connecting rod are to be reinstalled, they must be installed in the same orientation as disassembled.

Using the Piston Ring Compressor, install the piston and connecting rod assemblies.



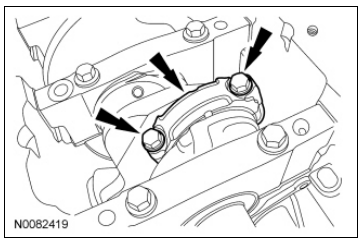
23. Seat the connecting rod on the crankshaft journal.

24. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

    NOTE: After installation of each piston, connecting rod, rod cap and bolts, rotate the crankshaft to verify smooth operation.

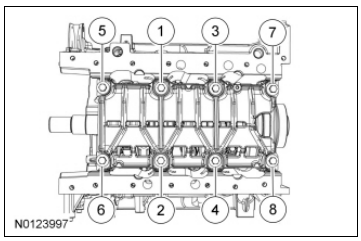
    Install the connecting rod cap and bolts.

    - Tighten the bolts in 3 stages.
    - Stage 1: Tighten to 23 Nm (17 lb-ft).
    - Stage 2: Tighten to 43 Nm (32 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.



25. Repeat the previous 3 steps until all 6 piston, connecting rod and connecting rod cap assemblies are installed.

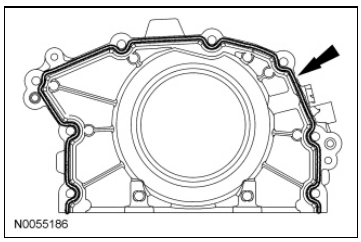
26. Install the main bearing cap support brace and the new bolts. Tighten in the sequence shown in 2 steps.
    - Stage 1: Tighten fasteners to 24 Nm (18 lb-ft).
    - Stage 2: Tighten fasteners an additional 180 degrees.



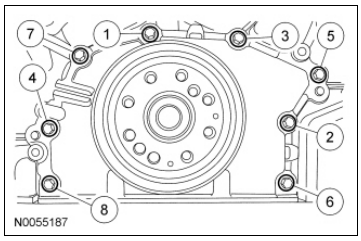
27. ***NOTICE:*** **Failure to use Motorcraft High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: The crankshaft rear seal retainer must be installed and the bolts tightened within 4 minutes of sealant application.

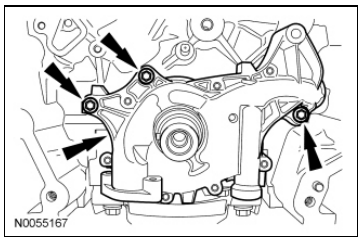
    Apply a 3 mm (0.11 in) bead of Motorcraft High Performance Engine RTV Silicone to the sealing surface of the crankshaft rear seal retainer.



28. Install the rear seal retainer and the 8 bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

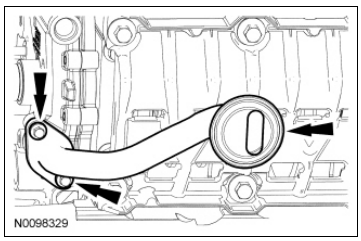


29. Install the oil pump and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



30. Using a new O-ring seal, install the oil pump screen and pickup tube and the 2 bolts.

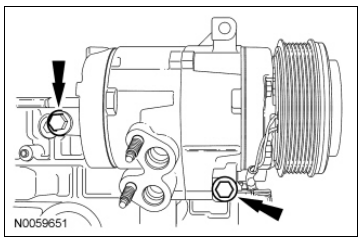
- Tighten to 10 Nm (89 lb-in).



31. **NOTE:** The A/C compressor must be installed on the cylinder block and the 2 bolts tightened prior to installing the oil pan.

    Install the A/C compressor and the 2 bolts.

    - Tighten to 25 Nm (18 lb-ft).

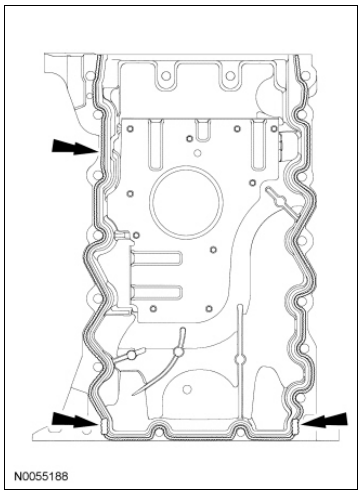


32. ***NOTICE:*** **Failure to use Motorcraft High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: The oil pan and the 4 specified bolts must be installed and the oil pan aligned to the cylinder block and A/C compressor within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.

    Apply a 3 mm (0.11 in) bead of Motorcraft High Performance Engine RTV Silicone to the sealing surface of the oil pan.

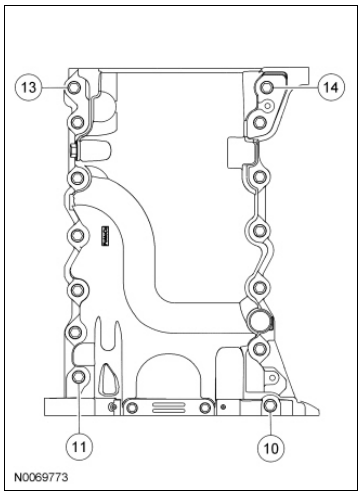
    - Apply a 5.5 mm (0.21 in) bead of Motorcraft High Performance Engine RTV Silicone to the 2 crankshaft seal retainer plate-to-cylinder block joint areas on the sealing surface of the oil pan.



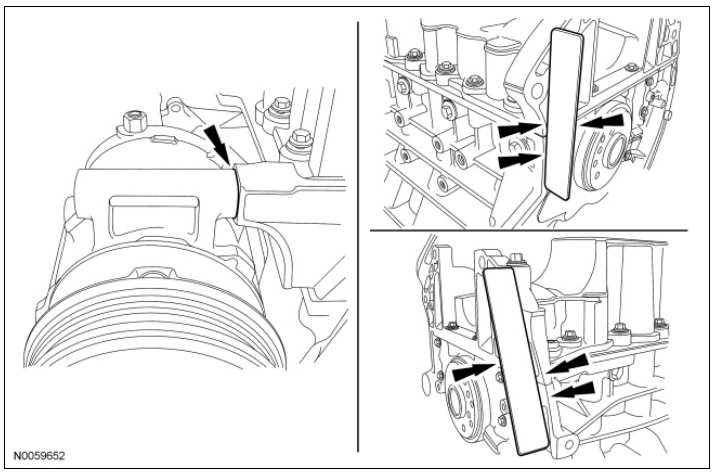
33. **NOTE:** The oil pan and the 4 specified bolts must be installed within 4 minutes of the start of sealant application.

Install the oil pan and bolts 10, 11, 13 and 14.

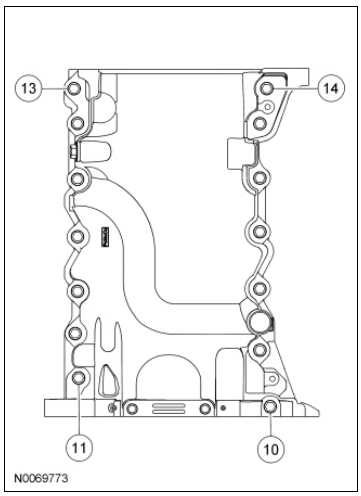
- Tighten the bolts in the sequence shown to 3 Nm (27 lb-in).
- Loosen the bolts 180 degrees.



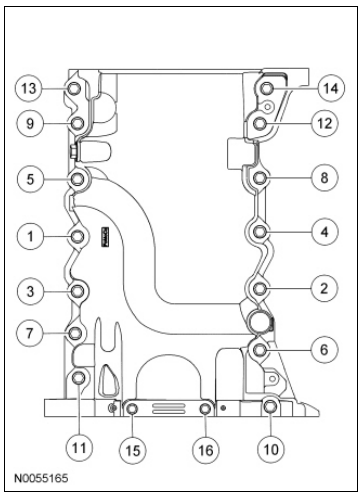
34. Align the oil pan to the cylinder block and A/C compressor.
    - Position the oil pan so the mounting boss is against the A/C compressor and using a straightedge, align the oil pan flush with the rear of the cylinder block at the 2 areas shown.



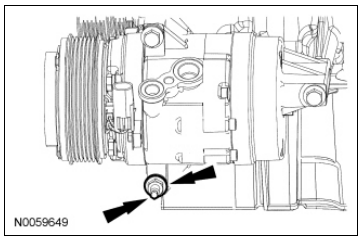
35. Tighten bolts 10, 11, 13 and 14 in the sequence shown, to 3 Nm (27 lb-in).



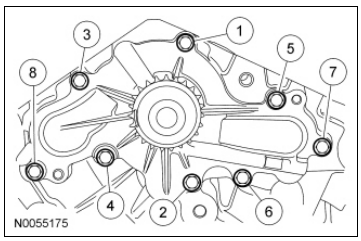
36. Install the remaining oil pan bolts. Tighten all the oil pan bolts in the sequence shown.
    - Tighten the large bolts (1-14) to 24 Nm (18 lb-ft).
    - Tighten the small bolts (15 and 16) to 10 Nm (89 lb-in).



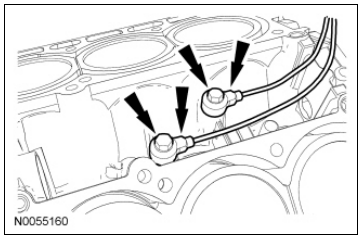
37. Install the A/C compressor mounting stud and nut.
    - Tighten the stud to 9 Nm (80 lb-in) and the nut to 25 Nm (18 lb-ft).



38. Install the coolant pump and the 8 bolts. Tighten in the sequence shown in 2 stages:
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.

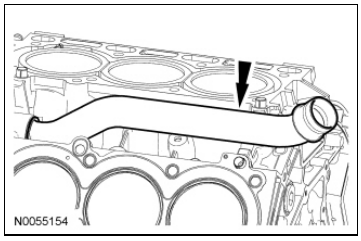


39. Install the Knock Sensor (KS) and the 2 bolts.
    - Tighten to 20 Nm (177 lb-in).

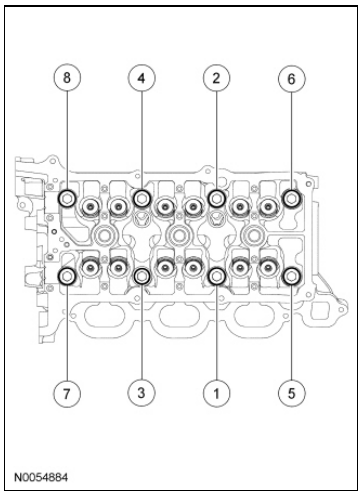


40. **NOTE:** Apply clean engine coolant to the O-ring seals prior to installation.

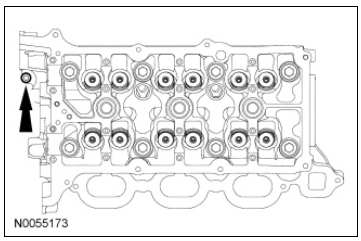
    Using new O-ring seals, install the coolant inlet tube.



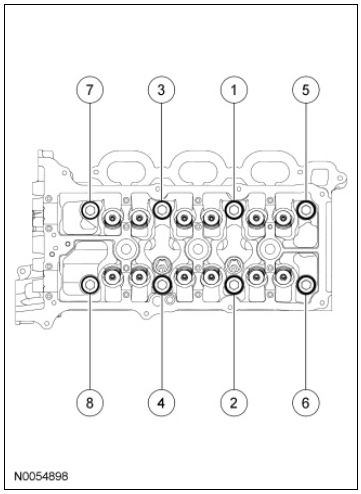
41. Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 35 Nm (26 lb-ft).
    - Stage 3: Tighten 90 degrees.
    - Stage 4: Tighten 90 degrees.
    - Stage 5: Tighten 45 degrees.



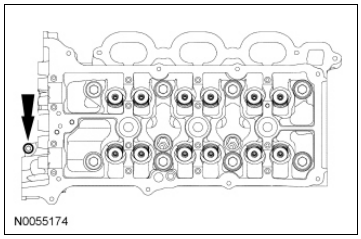
42. Install the new M6 bolt.
    - Tighten to 10 Nm (89 lb-in).



43. Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 35 Nm (26 lb-ft).
    - Stage 3: Tighten 90 degrees.
    - Stage 4: Tighten 90 degrees.
    - Stage 5: Tighten 45 degrees.

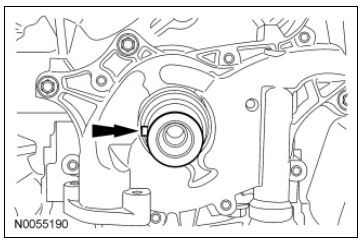


44. Install the new M6 bolt.
    - Tighten to 10 Nm (89 lb-in).



45. ***NOTICE:*** **The crankshaft must remain in the freewheeling position (crankshaft dowel pin at 9 o'clock) until after the camshafts are installed and the valve clearance is checked/adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.**

    Position the crankshaft dowel pin in the 9 o'clock position.

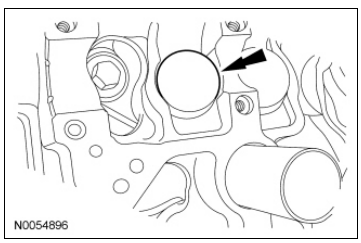


46. **NOTE:** The valve tappets must be installed in their original positions.

    NOTE: Coat the valve tappets with clean engine oil prior to installation.

    NOTE: LH shown, RH similar.

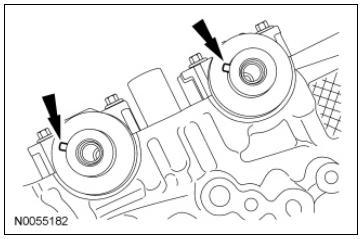
    Install the valve tappets.



47. ***NOTICE:*** **The camshafts must remain in the neutral position during installation or engine damage may occur.**

    NOTE: Coat the camshafts with clean engine oil prior to installation.

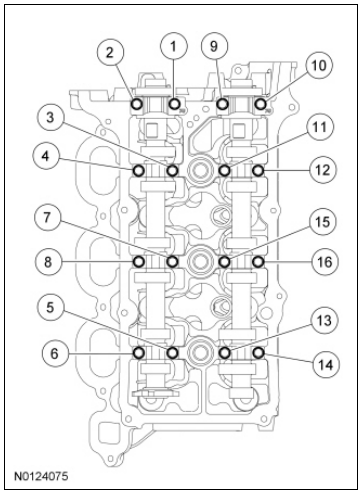
    Position the camshafts onto the RH cylinder head in the neutral position as shown.



48. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

    Install the 8 camshaft caps and the 16 bolts. Tighten the bolts in the sequence shown in the following stages:

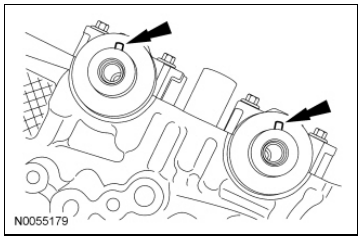
    - Stage 1: Tighten bolts 1, 2, 3 and 4 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 2: Tighten bolts 5 and 6 to 8 Nm (71 lb-in).
    - Stage 3: Tighten bolts 7 and 8 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 4: Loosen bolts 5 and 6.
        - ♦ Tighten bolts 5 and 6 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 5: Tighten bolts 9, 10, 11 and 12 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 6: Tighten bolts 13 and 14 to 8 Nm (71 lb-in).
    - Stage 7: Tighten bolts 15 and 16 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 8: Loosen bolts 13 and 14.
        - ♦ Tighten bolts 13 and 14 to 8 Nm (71 lb-in) then an additional 45 degrees.



49. ***NOTICE:*** **The camshafts must remain in the neutral position during installation or engine damage may occur.**

    NOTE: Coat the camshafts with clean engine oil prior to installation.

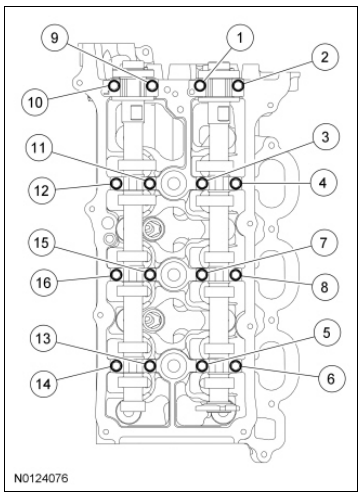
    Position the camshafts onto the LH cylinder head in the neutral position as shown.



50. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

    Install the 8 camshaft caps and the 16 bolts. Tighten the bolts in the sequence shown in the following stages:

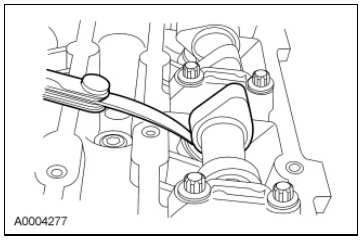
    - Stage 1: Tighten bolts 1, 2, 3 and 4 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 2: Tighten bolts 5 and 6 to 8 Nm (71 lb-in).
    - Stage 3: Tighten bolts 7 and 8 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 4: Loosen bolts 5 and 6.
        - ♦ Tighten bolts 5 and 6 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 5: Tighten bolts 9, 10, 11 and 12 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 6: Tighten bolts 13 and 14 to 8 Nm (71 lb-in).
    - Stage 7: Tighten bolts 15 and 16 to 8 Nm (71 lb-in) then an additional 45 degrees.
    - Stage 8: Loosen bolts 13 and 14.
        - ♦ Tighten bolts 13 and 14 to 8 Nm (71 lb-in) then an additional 45 degrees.



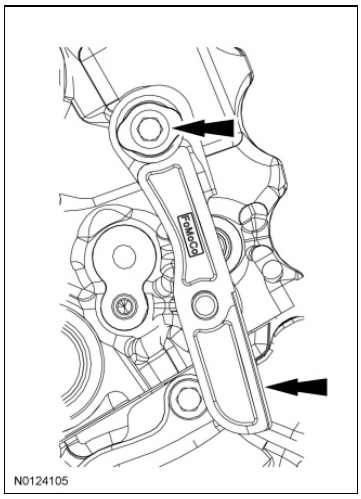
51. ***NOTICE:*** **If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.**

    NOTE: Use a camshaft sprocket bolt to turn the camshafts.

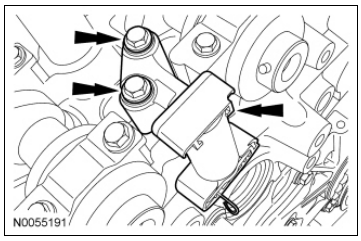
    Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet(s) of the correct size. For additional information, refer to Valve Clearance Check in this section.



52. Install the RH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).

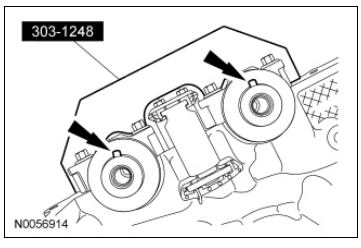


53. Install the RH secondary timing chain tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

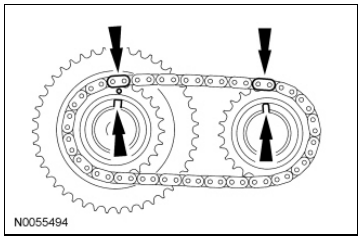


54. **NOTE:** Use a camshaft sprocket bolt to turn the camshafts.

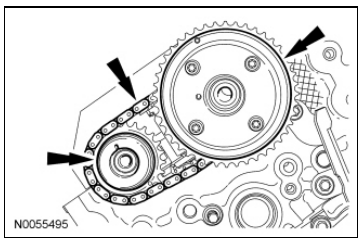
    Rotate the RH camshafts to the Top Dead Center (TDC) position and install the Camshaft Holding Tool on the flats of the camshafts.



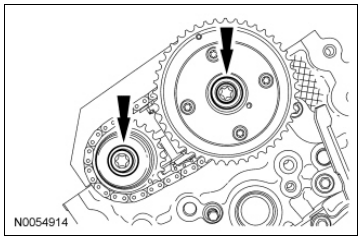
55. Assemble the RH Variable Camshaft Timing (VCT) assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.



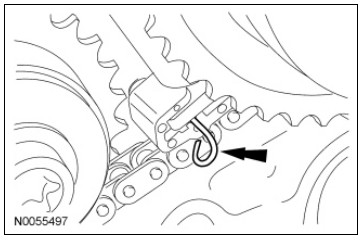
56. Position the RH secondary timing assembly onto the camshafts.



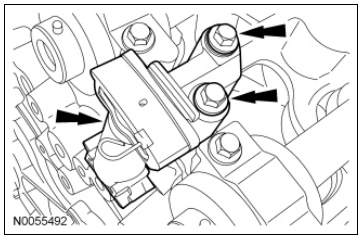
57. Install 2 new bolts and the original washer. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 10 Nm (89 lb-in).
    - Stage 4: Tighten 90 degrees.



58. Remove the lockpin from the RH secondary timing chain tensioner.

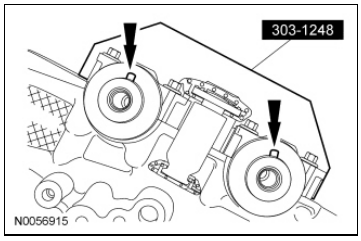


59. Install the LH secondary timing chain tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

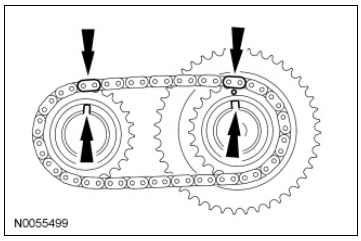


60. **NOTE:** Use a camshaft sprocket bolt to turn the camshafts.

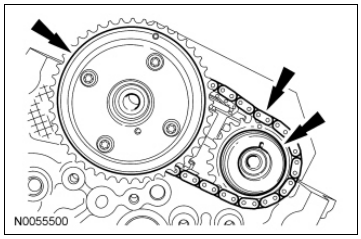
    Rotate the LH camshafts to the Top Dead Center (TDC) position and install the Camshaft Holding Tool on the flats of the camshafts.



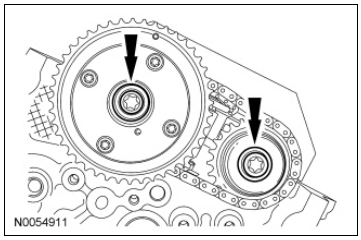
61. Assemble the LH VCT assembly, the LH exhaust camshaft sprocket and the LH secondary timing chain.
    - Align the colored links with the timing marks.



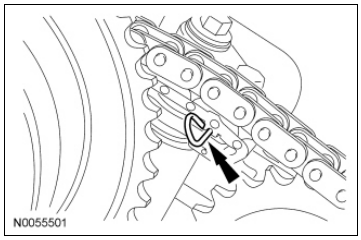
62. Position the LH secondary timing assembly onto the camshafts.



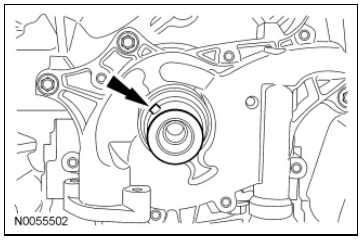
63. Install 2 new bolts and the original washer. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 10 Nm (89 lb-in).
    - Stage 4: Tighten 90 degrees.



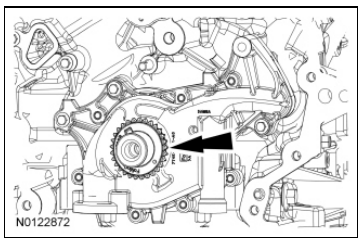
64. Remove the lockpin from the LH secondary timing chain tensioner.



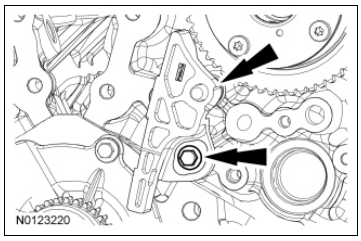
65. Rotate the crankshaft clockwise 60 degrees to the TDC position (crankshaft dowel pin at 11 o'clock).



66. Install the crankshaft timing chain sprocket.

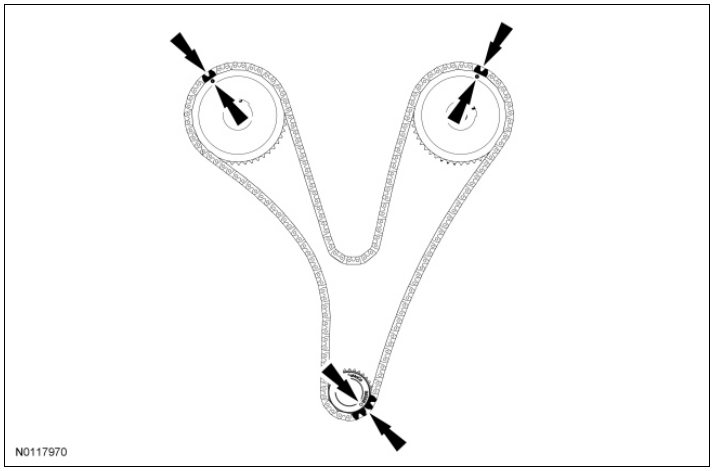


67. Install the upper LH primary timing chain guide and the bolt.
    - Tighten to 10 Nm (89 lb-in).

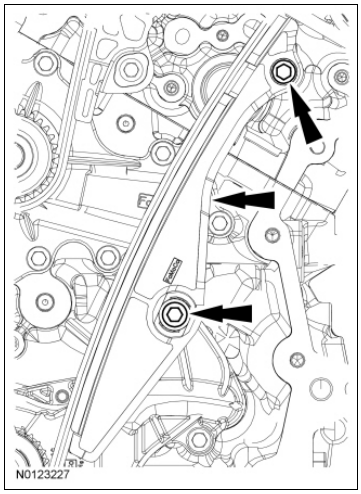


68. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

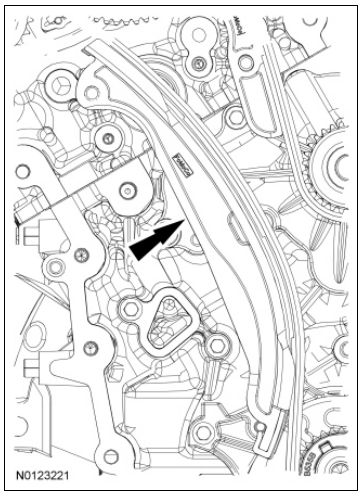
    Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.



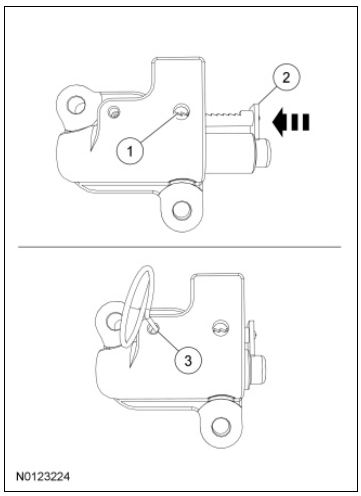
69. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



70. Install the primary timing chain tensioner arm.



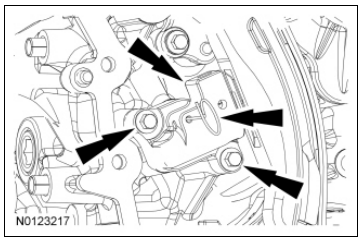
71. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.



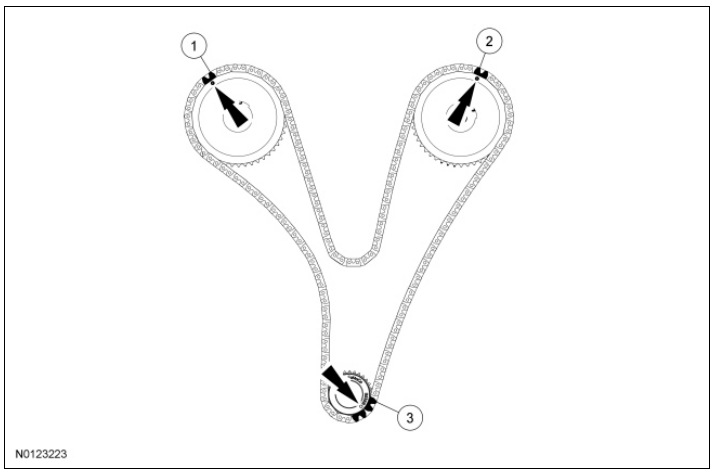
72. **NOTE:** It may be necessary to rotate the crankshaft slightly to remove slack from the timing chain and install the tensioner.

Install the primary tensioner and the 2 bolts.

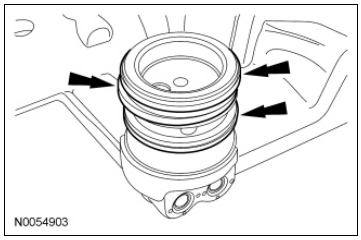
- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.



73. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links between the LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket colored links (3).



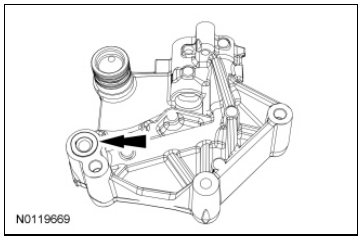
74. Inspect the VCT housing seals for damage and replace as necessary.



75. **NOTE:** RH shown, LH similar.

    NOTE: During removal, the O-ring seal may remain on the cylinder head. If so, remove the O-ring seal from the cylinder head, inspect the seal (replace as necessary) and install the O-ring seal on the VCT housing.

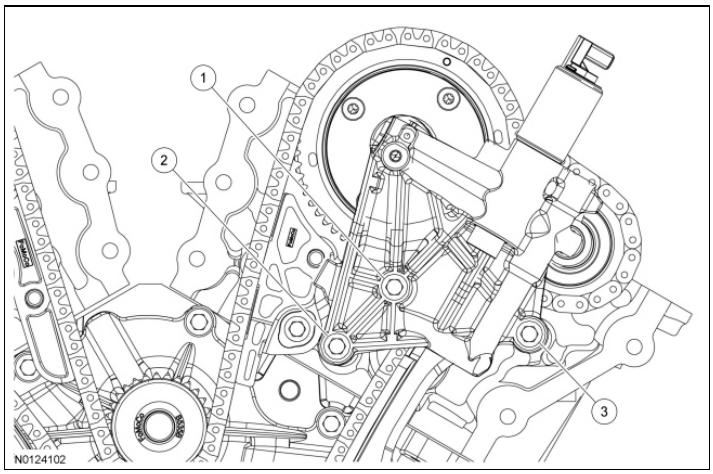
    Inspect the VCT housing-to-cylinder head O-ring seals for damage and replace as necessary.



76. ***NOTICE:*** **Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.**

    Install the LH VCT housing and the 3 bolts.

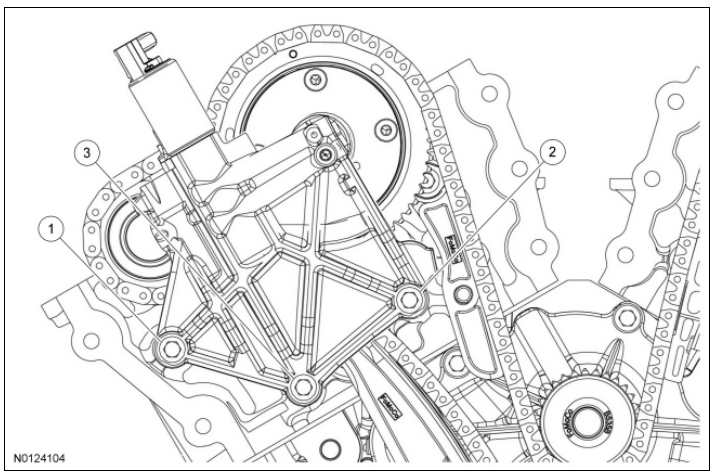
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



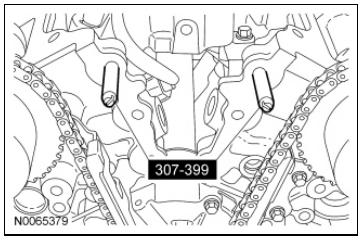
77. ***NOTICE:*** **Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.**

    Install the RH VCT housing and the 3 bolts.

    - Tighten in the sequence shown to 10 Nm (89 lb-in).



78. Install the Alignment Pins.

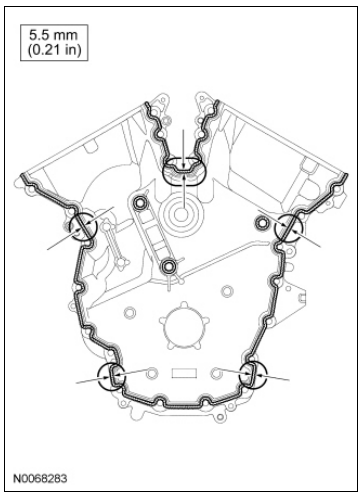


79. ***NOTICE:*** **Failure to use Motorcraft High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: The engine front cover and bolts 17, 18, 19 and 20 must be installed within 4 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

    Apply a 3.0 mm (0.11 in) bead of Motorcraft High Performance Engine RTV Silicone to the engine front cover sealing surfaces including the 3 engine mount bracket bosses.

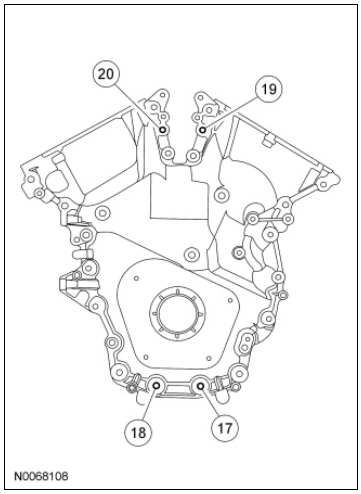
    - Apply a 5.5 mm (0.21 in) bead of Motorcraft High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.



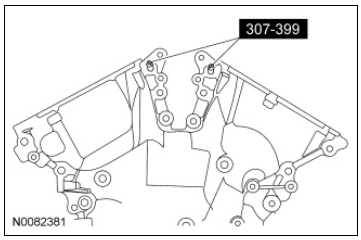
80. **NOTE:** Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

    Install the engine front cover and bolts 17, 18, 19 and 20.

    - Tighten in sequence to 3 Nm (27 lb-in).

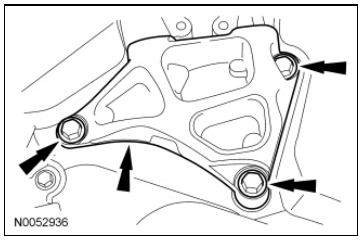


81. Remove the Alignment Pins.



82. **NOTE:** Do not tighten the bolts at this time.

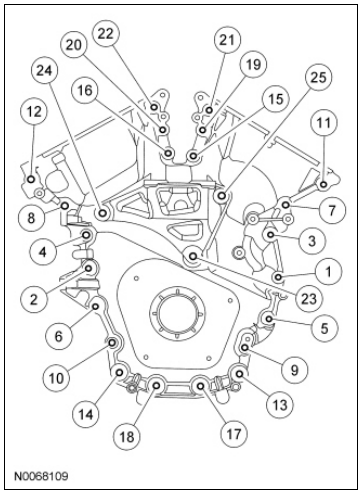
    Install the engine mount bracket and the 3 bolts.



83. ***NOTICE:*** **Do not expose the Motorcraft High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the engine front cover. Failure to follow this instruction may cause oil leakage.**

    Install the remaining engine front cover bolts. Tighten all of the engine front cover bolts and engine mount bracket bolts in the sequence shown in 2 stages:

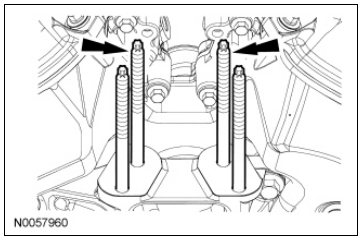
    - Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in) and bolts 23, 24 and 25 to 15 Nm (133 lb-in).
    - Stage 2: Tighten bolts 1 thru 22 to 24 Nm (18 lb-ft) and bolts 23, 24 and 25 to 75 Nm (55 lb-ft).



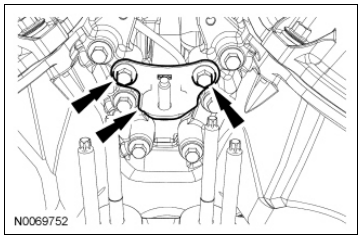
84. ***NOTICE:*** **The thread sealer on the engine mount studs (including new engine mount studs if applicable) must be cleaned off with a wire brush and new Threadlock and Sealer applied prior to installing the engine mount studs. Failure to follow this procedure may result in damage to the engine mount studs or engine.**

    Install the engine mount studs in the following sequence.

    1. Clean the front cover engine mount stud holes with pressurized air to remove any foreign material.
    2. Clean all the thread sealer from the engine mount studs (old and new studs).
    3. Apply new Threadlock and Sealer to the engine mount stud threads.
    4. Install the 2 engine mount studs.
        - Tighten to 20 Nm (177 lb-in).

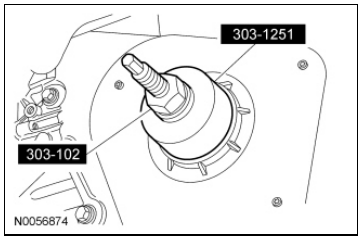


85. Install the engine mount bracket and the 2 bolts.
    - Tighten to 24 Nm (18 lb-ft).



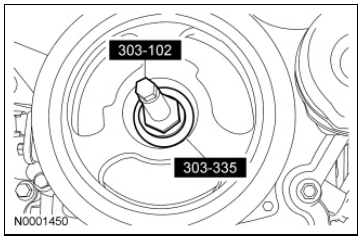
86. **NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

    Using the Front Crankshaft Seal Installer and Crankshaft Vibration Damper Installer, install a new crankshaft front seal.

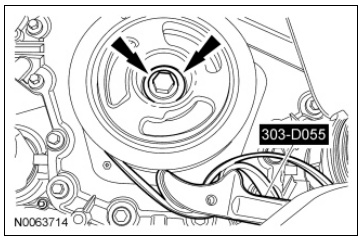


87. **NOTE:** Lubricate the outside diameter sealing surfaces with clean engine oil.

    Using the Front Cover Oil Seal Installer and Crankshaft Vibration Damper Installer, install the crankshaft pulley.



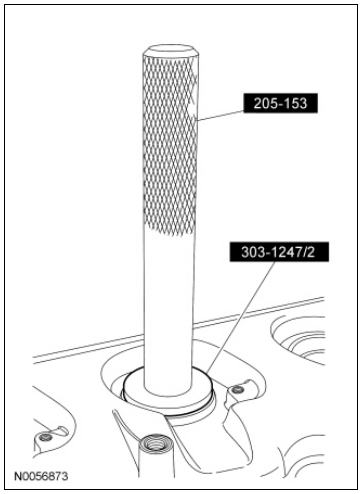
88. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
    - Stage 1: Tighten to 120 Nm (89 (lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.



89. **NOTE:** Installation of new seals is only required if damaged seals were removed during disassembly of the engine.

    NOTE: Spark plug tube seal installation shown, VCT solenoid seal installation similar.

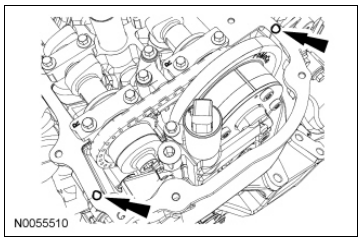
    Using the VCT Spark Plug Tube Seal Installer and Handle, install new VCT solenoid and/or spark plug tube seals.



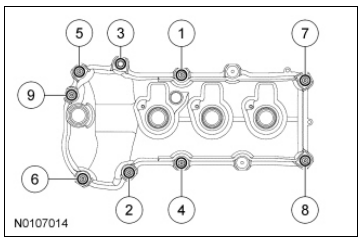
90. ***NOTICE:*** **Failure to use Motorcraft High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

    Apply an 8 mm (0.31 in) bead of Motorcraft High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.



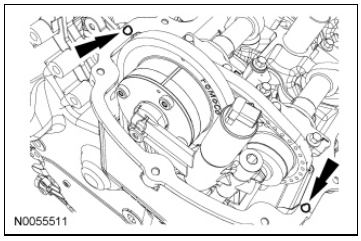
91. Using a new gasket, install the RH valve cover and tighten the bolt and 8 stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



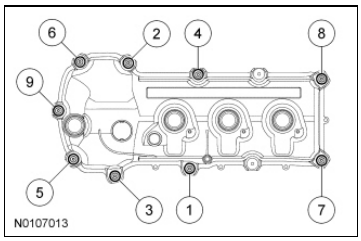
92. ***NOTICE:*** **Failure to use Motorcraft High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

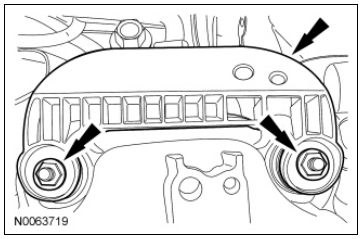
    Apply an 8 mm (0.31 in) bead of Motorcraft High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.



93. Using a new gasket, install the LH valve cover and tighten the 9 stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



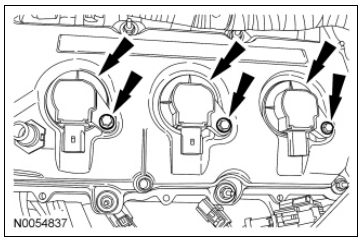
94. Install the wiring harness retaining bracket and the 2 nuts.
    - Tighten to 4 Nm (35 lb-in).



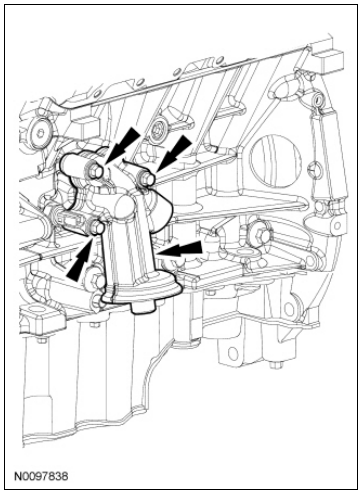
95. **NOTE:** LH shown, RH similar.

    Install the 6 coil-on-plug assemblies and the 6 bolts.

    - Tighten to 7 Nm (62 lb-in).



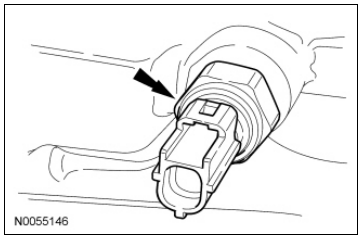
96. Using a new gasket, install the oil filter adapter and 3 bolts.
    - Tighten to 10 Nm (89 lb-in) plus an additional 45 degrees.



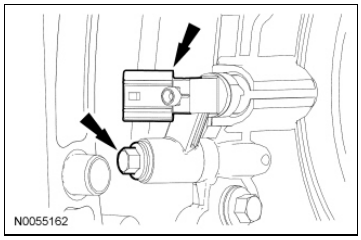
97. **NOTE:** Apply thread sealant with PTFE to the Engine Oil Pressure (EOP) switch threads.

    Install the EOP switch.

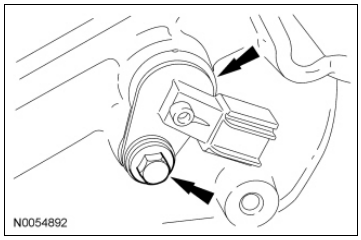
    - Tighten to 14 Nm (124 lb-in) plus an additional 180 degrees.



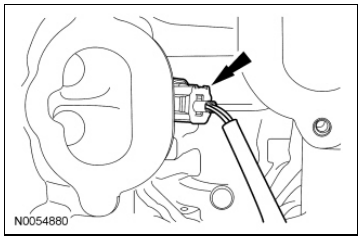
98. Install the Crankshaft Position (CKP) sensor and install the bolt.
    - Tighten to 10 Nm (89 lb-in).



99. Install LH Camshaft Position (CMP) sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).



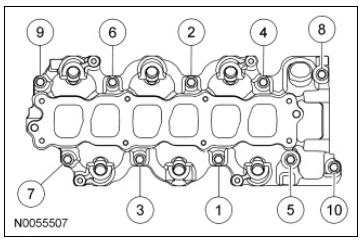
100. Install and connect the Cylinder Head Temperature (CHT) sensor jumper harness.



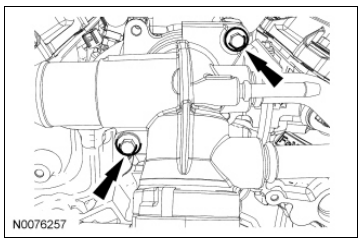
101. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    Using new gaskets, install the lower intake manifold and the 10 bolts.

    - Tighten in the sequence shown to 10 Nm (89 lb-in).



102. Using a new gasket, install the thermostat housing and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

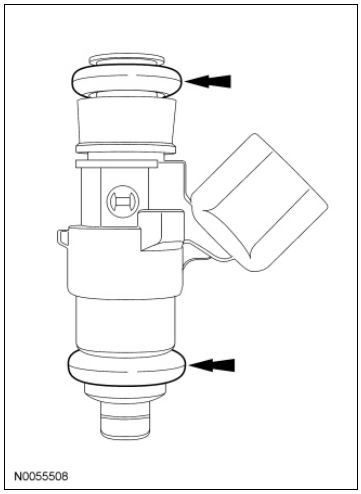


103. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-rings may cause the fuel system to leak. Do not reuse the O-ring seals.**

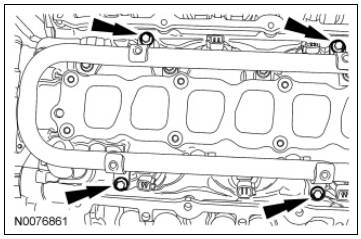
    NOTE: The upper and lower O-ring seals are not interchangeable.

    Install new fuel injector O-ring seals.

    - Remove the retaining clips and separate the fuel injectors from the fuel rail.
    - Remove and discard the O-ring seals.
    - Install new O-ring seals and lubricate with clean engine oil.
    - Install the fuel injectors and the retaining clips onto the fuel rail.

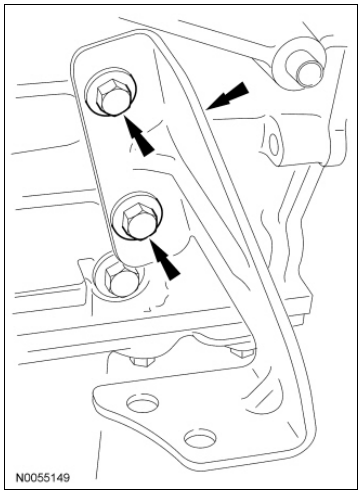


104. Install the fuel rail and injectors as an assembly and install the 4 bolts.
    - Tighten to 10 Nm (89 lb-in).



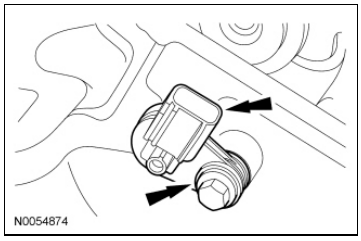
All-Wheel Drive (AWD) vehicles

105. Install the catalytic converter bracket and the 2 bolts.
    - Tighten to 40 Nm (30 lb-ft).

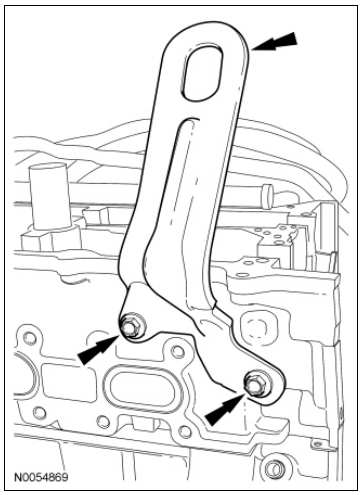


All engines

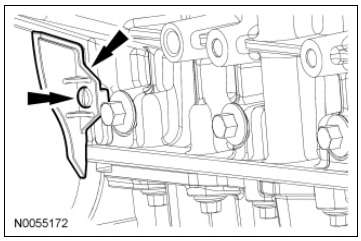
106. Install the RH CMP sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).



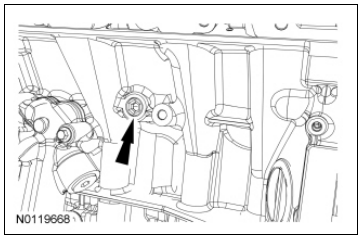
107. Install the engine lifting eye and the 2 bolts.
    - Tighten to 24 Nm (18 lb-ft).



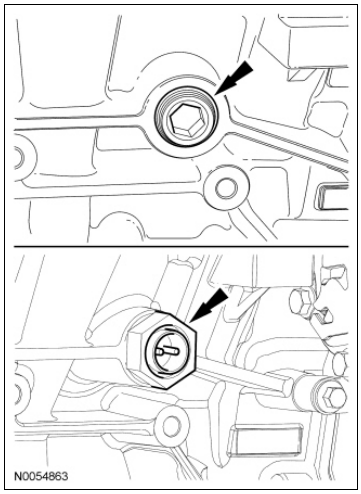
108. Install the cover and the pin-type retainer.



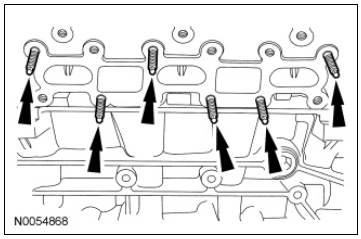
109. Install the LH cylinder block drain plug.
    - Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.



110. Install the RH cylinder block drain plug or, if equipped, the block heater.
    - Tighten the cylinder block drain plug to 10 Nm (89 lb-in) plus an additional 720 degrees.
    - Tighten the block heater to 40 Nm (30 lb-ft).



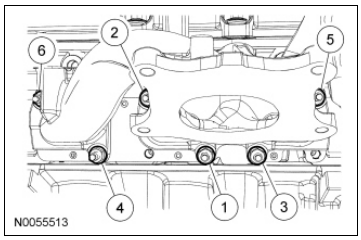
111. Install 6 new RH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).



112. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

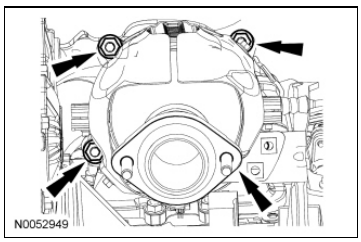
    Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:

    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).



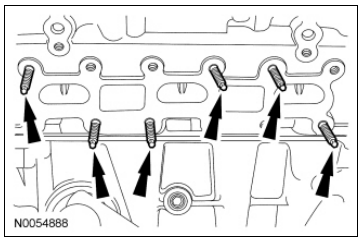
Front Wheel Drive (FWD) vehicles

113. Using a new gasket, install the RH catalytic converter and the 4 new nuts.
    - Tighten to 40 Nm (30 lb-ft).



All engines

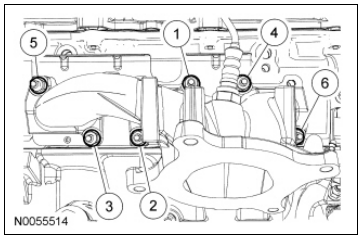
114. Install 6 new LH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).



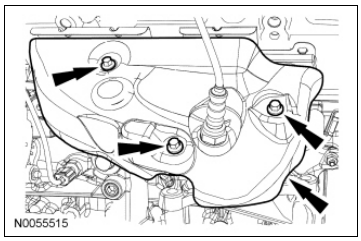
115. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

    Using a new gasket, install the LH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:

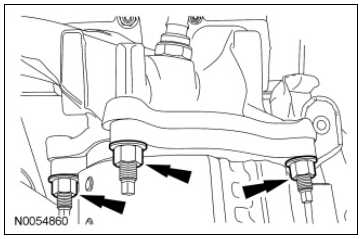
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).



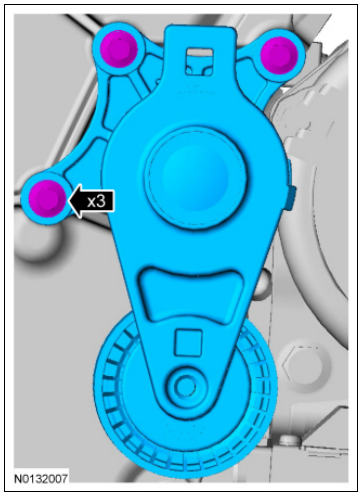
116. Install the LH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



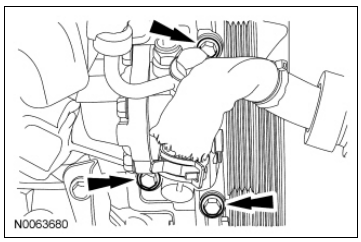
117. Using a new gasket, install the LH catalytic converter and the 4 new nuts (3 shown).
    - Tighten to 40 Nm (30 lb-ft).



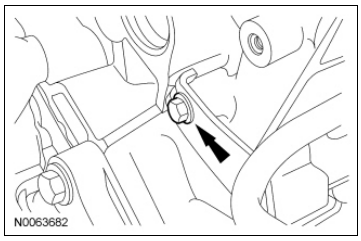
118. Install the accessory drive belt tensioner and the 3 bolts.
    - Tighten to 11 Nm (97 lb-in).



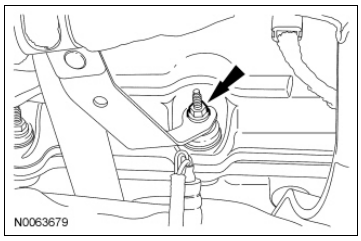
119. Install the power steering pump and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



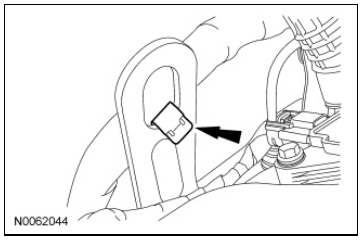
120. Install the Power Steering Pressure (PSP) tube bracket and bolt to the RH cylinder head.
    - Tighten to 10 Nm (89 lb-in).



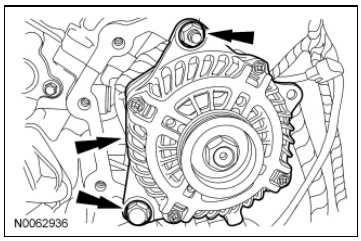
121. Install the PSP hose bracket nut.
    - Tighten to 9 Nm (80 lb-in).



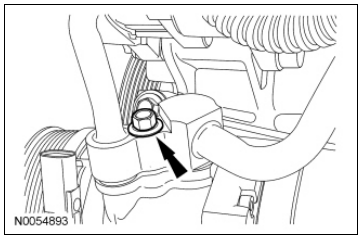
122. Attach the PSP hose retainer to the engine lifting eye.



123. Install the generator, the nut and the bolt.
    - Tighten to 48 Nm (35 lb-ft).

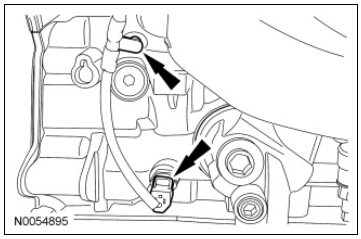


124. Using new O-ring seals, install the A/C manifold and the bolt.
    - Tighten to 25 Nm (18 lb-ft).

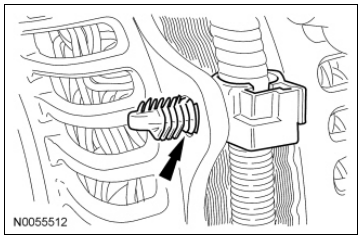


125. Position the wiring harness onto the engine.

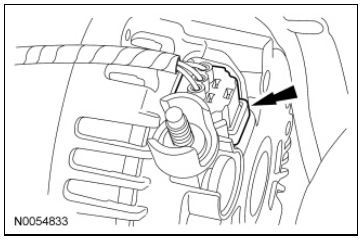
126. Connect the EOP switch electrical connector and the wiring harness pin-type retainer.



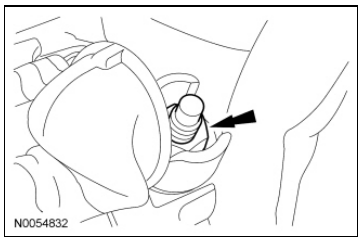
127. Attach the wiring harness retainer to the generator.



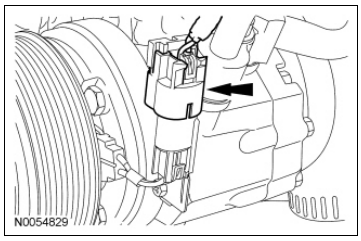
128. Connect the generator electrical connector.



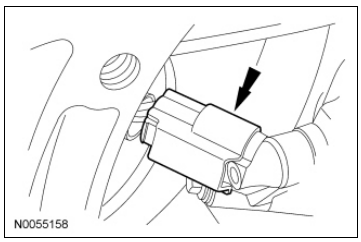
129. Connect the generator B+ cable and install the nut.
    - Tighten to 12 Nm (106 lb-in).



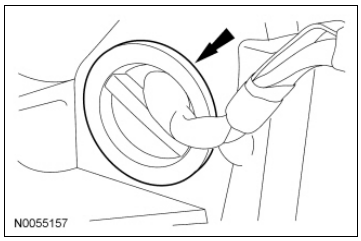
130. Connect the A/C compressor electrical connector.



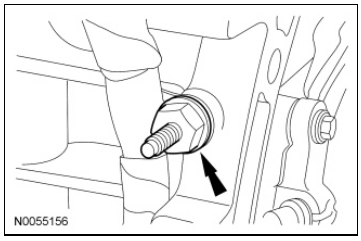
131. Connect the CKP sensor electrical connector.



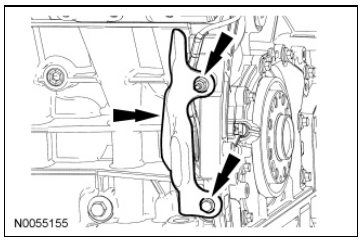
132. Install the wiring harness grommet.



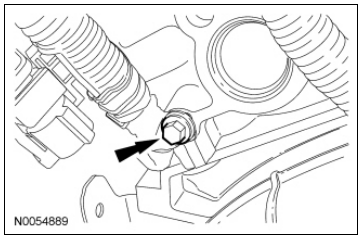
133. Install the wiring harness retainer stud bolt.
    - Tighten to 10 Nm (89 lb-in).



134. Install the heat shield, the nut and the bolt.
    - Tighten to 10 Nm (89 lb-in).

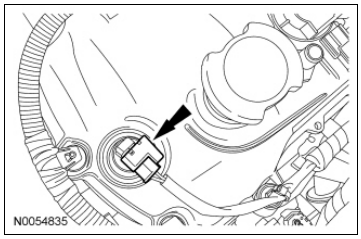


135. Install the wiring harness retainer bolt on the rear of the LH cylinder head.
    - Tighten to 10 Nm (89 lb-in).

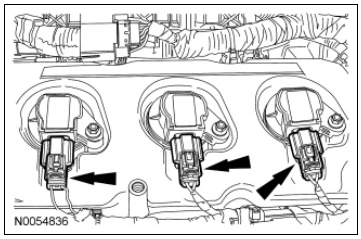


136. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.

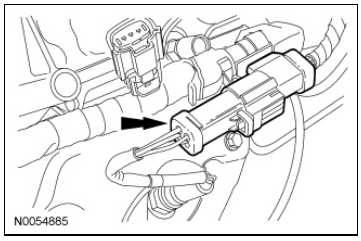
137. Connect the LH camshaft VCT solenoid electrical connector.



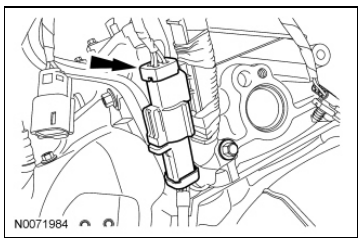
138. Connect the 3 LH coil-on-plug electrical connectors.



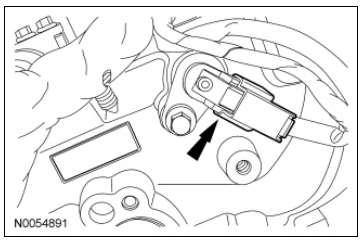
139. Connect the LH HO2S electrical connector.



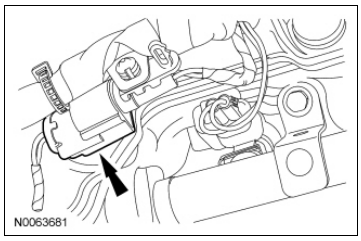
140. Connect the LH Catalyst Monitor Sensor (CMS) electrical connector.



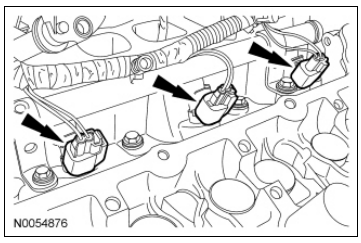
141. Connect the LH CMP sensor electrical connector.



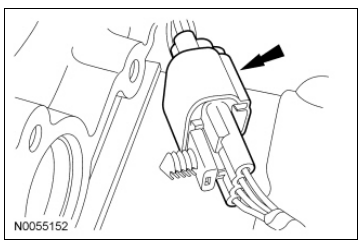
142. Connect the CHT sensor electrical connector.



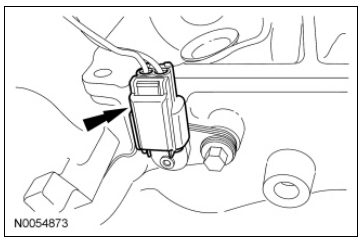
143. Connect the 6 fuel injector electrical connectors (3 shown).



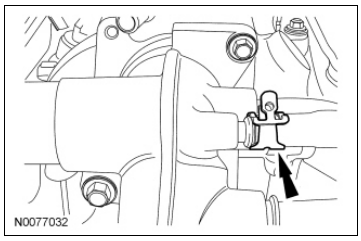
144. Connect the KS electrical connector.



145. Connect the RH CMP sensor electrical connector.

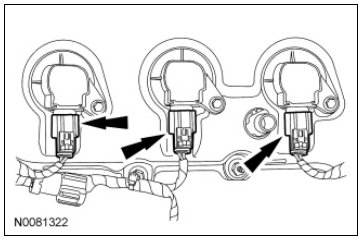


146. Connect the coolant bypass hose to the thermostat housing.

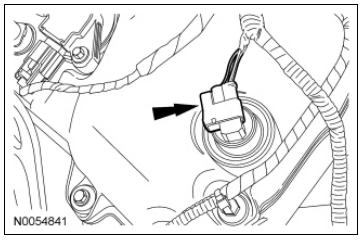


147. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.

148. Connect the 3 RH coil-on-plug electrical connectors.

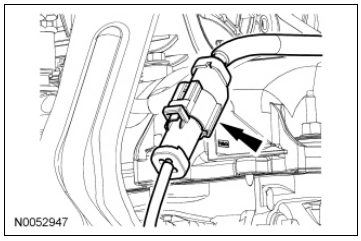


149. Connect the RH VCT solenoid electrical connector.



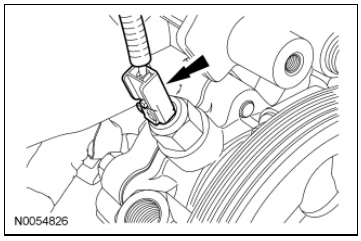
FWD vehicles

150. Connect the RH CMS electrical connector.



All engines

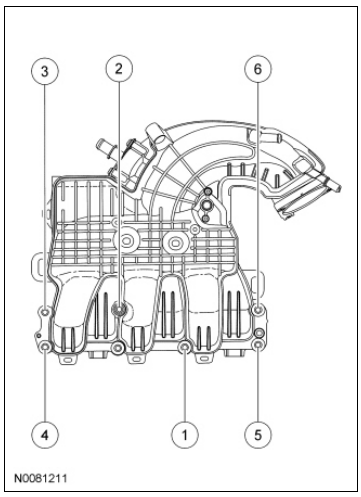
151. Connect the PSP switch electrical connector.



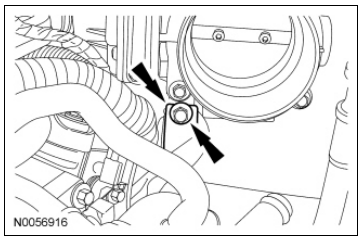
152. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    Using new gaskets, install the upper intake manifold and the 6 bolts.

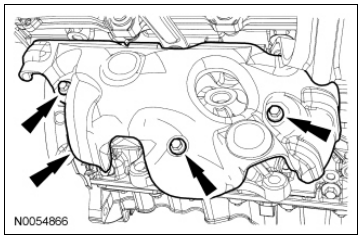
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



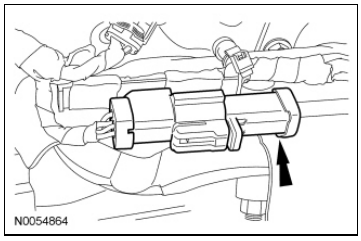
153. Install the upper intake manifold support bracket and the 2 bolts (one shown).
    - Tighten to 10 Nm (89 lb-in).



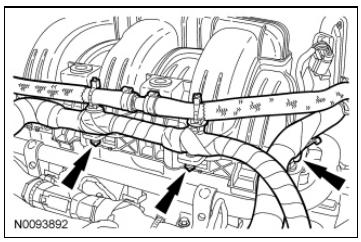
154. Install the RH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



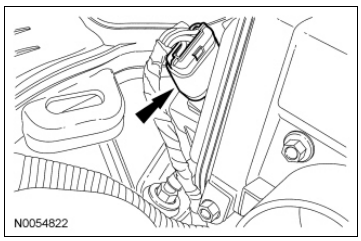
155. Connect the RH HO2S electrical connector.



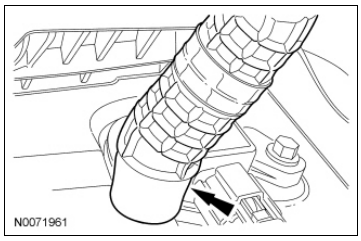
156. Attach the wiring harness retainers to the upper intake manifold.



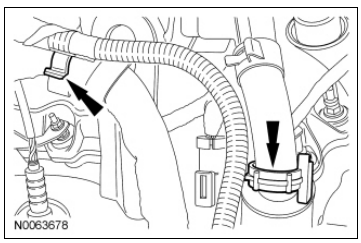
157. Connect the Throttle Body (TB) electrical connector.



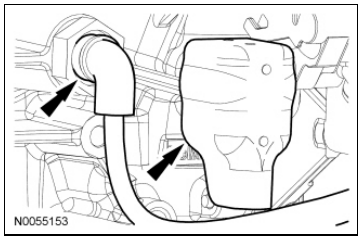
158. Connect the PCV hose to the PCV valve.



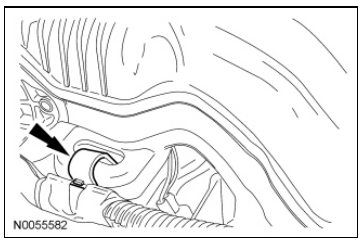
159. If equipped, position the block heater wiring harness onto the engine.
    - Attach the block heater wiring harness retainer to the power steering reservoir hose and the PSP hose.



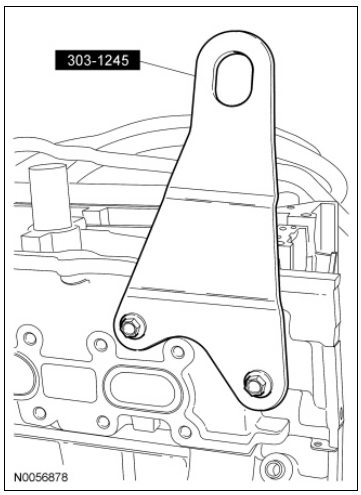
160. If equipped, connect the block heater electrical connector and install the heat shield.



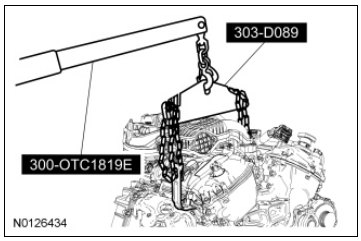
161. If equipped, attach the block heater wiring harness retainer to the upper intake manifold.



162. Install the Engine Lift Eye on the LH cylinder head.

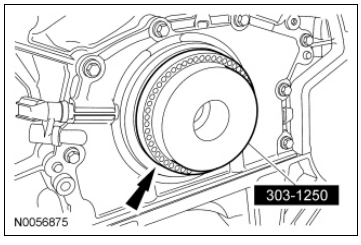


163. Using the Floor Crane and Spreader Bar, remove the engine from the stand.

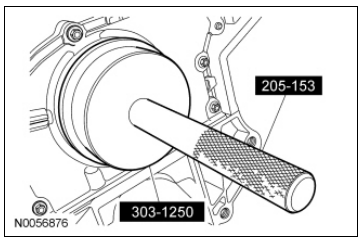


164. **NOTE:** Lubricate the seal lips and bore with clean engine oil prior to installation.

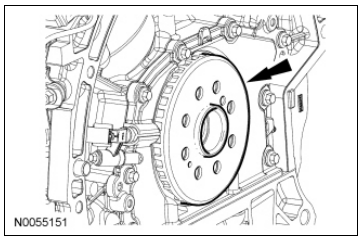
Position the Rear Main Seal Installer onto the end of the crankshaft and slide a new crankshaft rear seal onto the tool.



165. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.



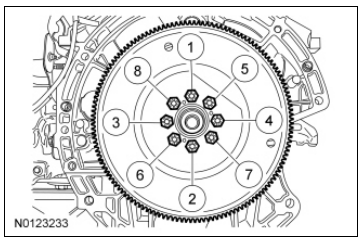
166. Install the crankshaft sensor ring.



167. **NOTE:** One of the 8 flexplate holes are offset so the flexplate can only be installed in one position.

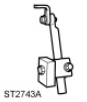
Install the flexplate and the 8 bolts.

- Tighten in the sequence shown to 80 Nm (59 lb-ft).



Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST2743A	Adjustable Grip Arm, 1735A 014-00001 or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

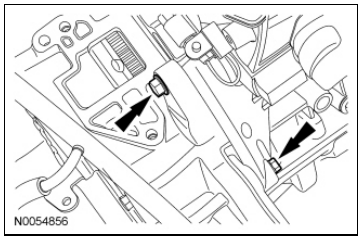
All vehicles

1. Align the transaxle to the engine.

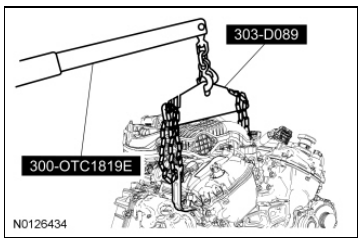
2. Install the 4 transaxle-to-engine bolts and the transaxle-to-engine stud bolt.
   - Tighten to 48 Nm (35 lb-ft).



3. Install the 2 engine-to-transaxle bolts.
   - Tighten to 48 Nm (35 lb-ft).

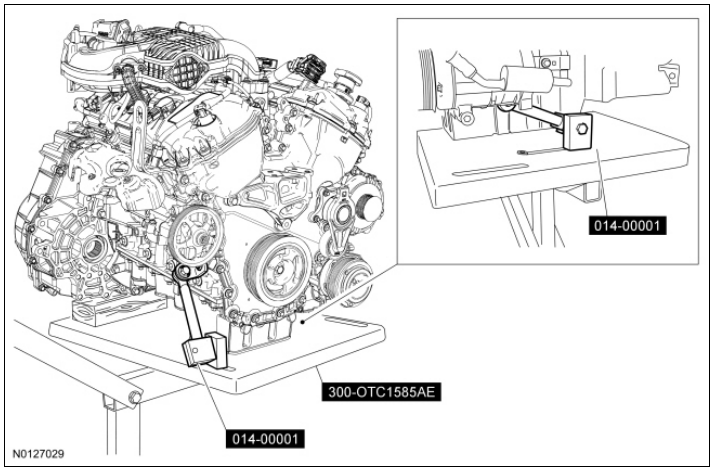


4. Using the Floor Crane and the Spreader Bar, position the engine and transaxle onto the lift table.

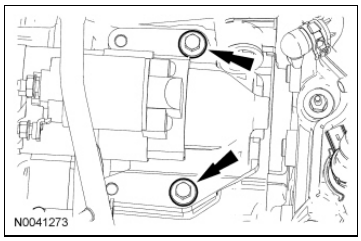


5. **NOTE:** Position a block of wood under the transaxle.

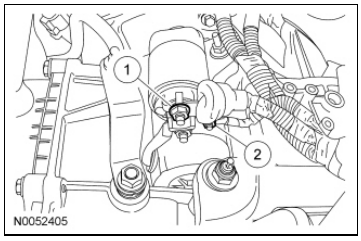
   Install the Powertrain Lift and Adjustable Grip Arms.



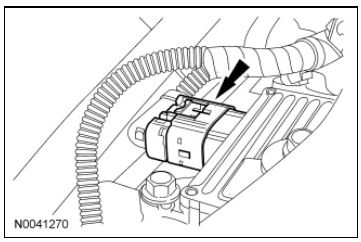
6. Install the starter and the 2 bolts.
   - Tighten to 26 Nm (19 lb-ft).



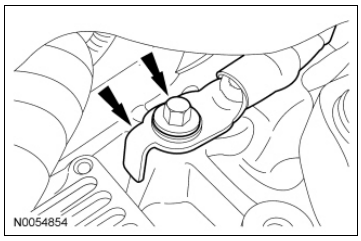
7. Attach the starter wire terminals and install the 2 nuts.
   1. Tighten to 12 Nm (106 lb-in).
   2. Tighten to 5 Nm (44 lb-in).
      - ♦ Position the starter terminal boot over the starter terminal.



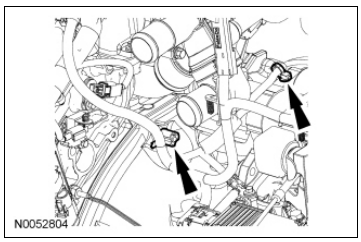
8. Connect the Transmission Control Module (TCM) electrical connector.



9. Install the ground wire and bolt.
   - Tighten to 12 Nm (106 lb-in).

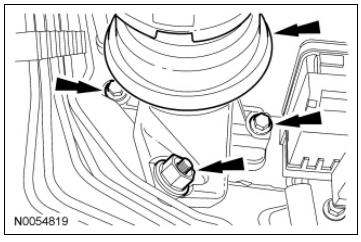


10. Connect the wiring harness fasteners to the transaxle-to-engine stud bolt and the starter.

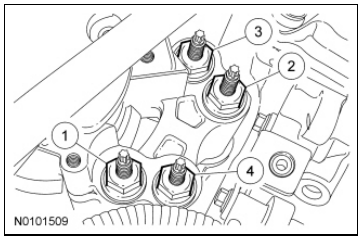


11. Raise the engine and transaxle assembly into the vehicle.

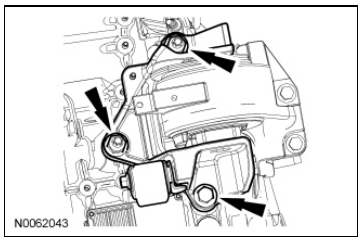
12. Install the engine mount, the nut and the 2 bolts.
    - Tighten the bolts to 55 Nm (41 lb-ft).
    - Tighten the nut to 63 Nm (46 lb-ft).



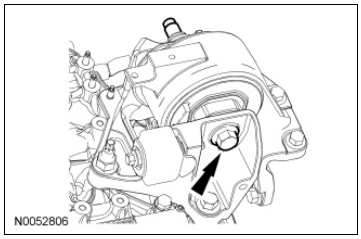
13. Install the 2 engine mount spacers and the 4 engine mount nuts.
    - Tighten in the sequence shown to 70 Nm (52 lb-ft).



14. Install the 2 transaxle support insulator bracket nuts and the bolt.
    - Tighten to 80 Nm (59 lb-ft).



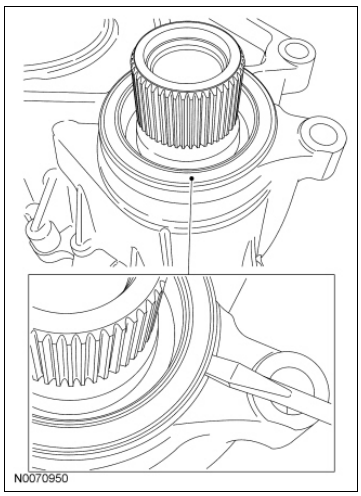
15. Install the transaxle support insulator through bolt and nut.
    - Tighten to 90 Nm (66 lb-ft).



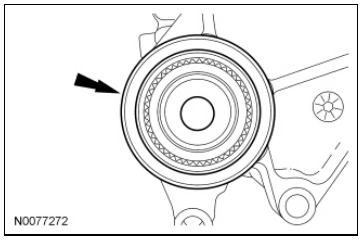
All-Wheel Drive (AWD) vehicles

16. **NOTE:** A new compression seal must be installed whenever the Power Transfer Unit (PTU) is moved from the vehicle.

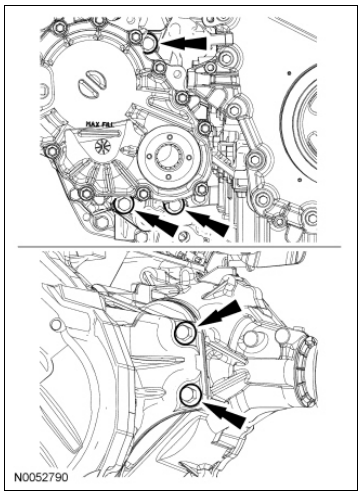
    Using a small screwdriver, remove the compression seal and discard.



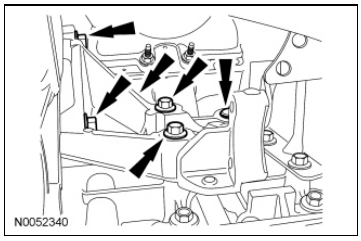
17. Using a soft face hammer, install the new compression seal.



18. Position the PTU in place and install the 5 bolts.
    - Tighten to 90 Nm (66 lb-ft).

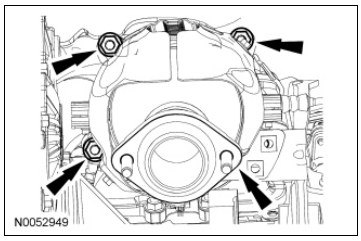


19. Position the PTU support bracket in place and install the 5 bolts.
    - Tighten to 70 Nm (52 lb-ft).

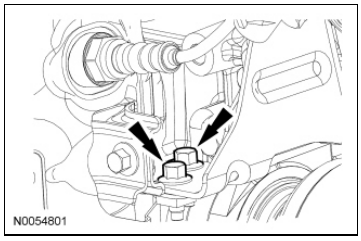


20. **NOTE:** Do not tighten the 4 catalytic converter nuts at this time.

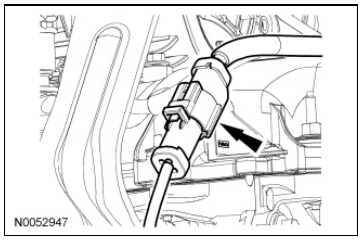
    Using a new gasket, install the RH catalytic converter and 4 new nuts.



21. Install the 2 catalytic converter-to-bracket bolts.
    - Tighten the 4 catalytic converter nuts to 40 Nm (30 lb-ft).
    - Tighten the 2 catalytic converter-to-bracket bolts to 20 Nm (177 lb-in).



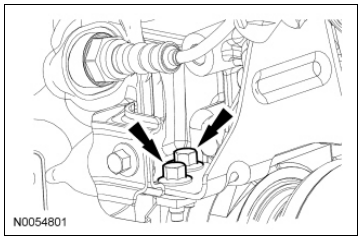
22. Connect the RH Catalyst Monitor Sensor (CMS) electrical connector.



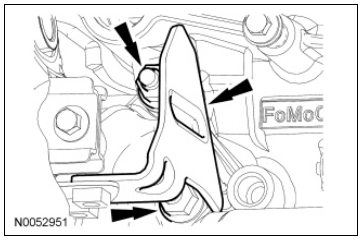
Front Wheel Drive (FWD) vehicles

23. **NOTE:** Do not tighten the 2 catalytic converter support bracket bolts at this time.

    Install the RH catalytic converter support bracket and the 2 bolts.



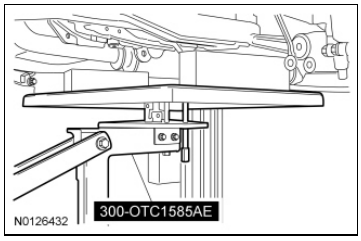
24. Install the 2 catalytic converter support bracket nuts.
    - Tighten to 40 Nm (30 lb-ft).
    - Tighten the 2 catalytic converter support bracket bolts to 20 Nm (177 lb-in).



All vehicles

25. **NOTE:** Align the index marks on the subframe to the index marks on the underbody that were made during removal.

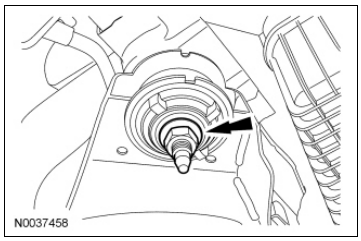
    Using the Powertrain Lift, raise the subframe into the installed position.



26. **NOTE:** LH shown, RH similar.

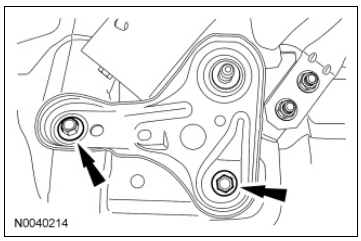
    Install the 2 front subframe nuts.

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



27. **NOTE:** LH shown, RH similar.

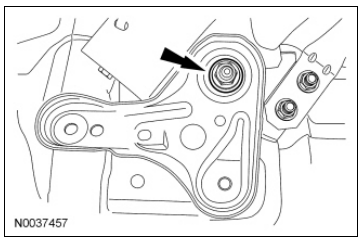
    Position the subframe brackets and install the 4 bolts finger-tight.



28. **NOTE:** LH shown, RH similar.

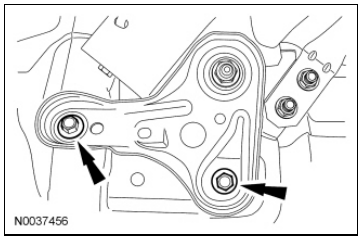
    Install the 2 rear subframe nuts.

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



29. **NOTE:** LH shown, RH similar.

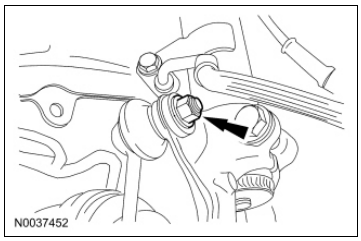
    Tighten the 4 subframe bracket-to-body bolts to 103 Nm (76 lb-ft).



30. **NOTE:** LH shown, RH similar.

    Install the stabilizer bar links and nuts to the struts.

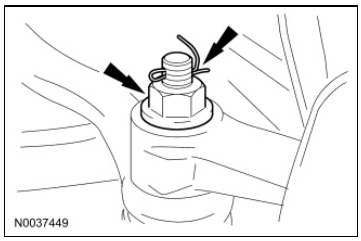
    - Tighten to 40 Nm (30 lb-ft).



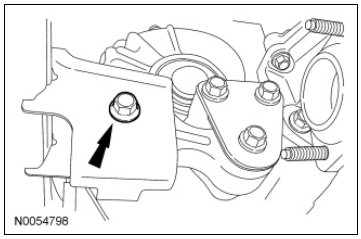
31. **NOTE:** LH shown, RH similar.

    Install the tie-rod ends and nuts.

    - Tighten to 48 Nm (35 lb-ft).
    - Install new cotter pins.

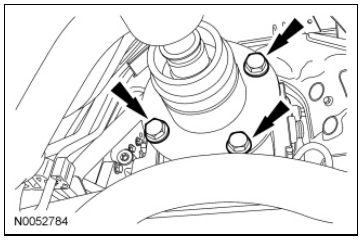


32. Install the engine roll restrictor-to-subframe through bolt.
    - Tighten to 90 Nm (66 lb-ft).



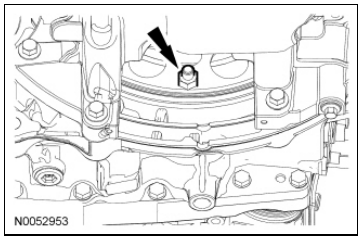
AWD vehicles

33. Line up the index marks on the rear driveshaft to the index marks on the PTU flange made during removal and install the 4 new bolts.
    - Tighten to 70 Nm (52 lb-ft).

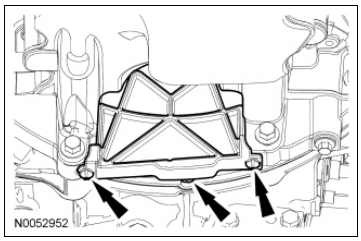


All vehicles

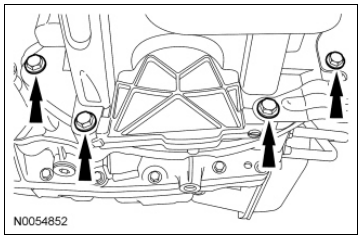
34. Install 4 new torque converter nuts.
    - Tighten to 36 Nm (27 lb-ft).



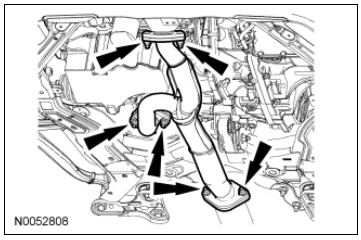
35. Install the inspection cover and the 2 fasteners.



36. Install the 4 oil pan-to-transaxle bolts.
    - Tighten to 48 Nm (35 lb-ft).

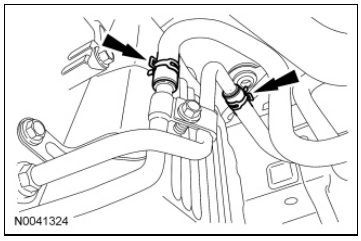


37. Using new gaskets, install the Y-pipe assembly and 6 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

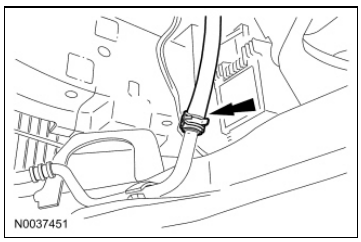


38. Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

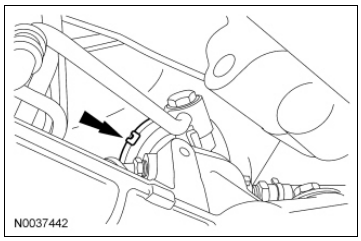
39. Connect the 2 transmission fluid cooler hoses.



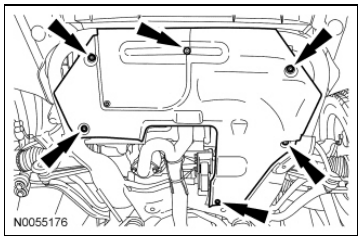
40. Connect the power steering cooler tube.



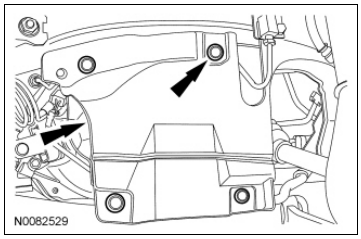
41. Slide the steering gear-to-dash seal onto the steering gear and engage the 4 retaining clips into the body.
    - From under the vehicle, verify that the seal is properly installed on the steering gear and the retaining clips are fully engaged into the body.



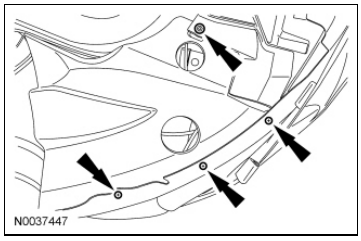
42. If equipped, install the underbody shield and the 6 screws.



43. Install the LH splash shield and the 6 pin-type retainers (4 shown).



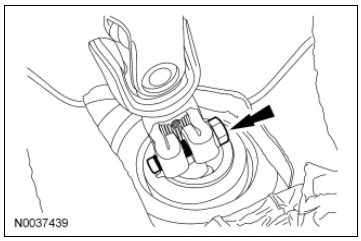
44. Position the LH fender splash shield and install the 4 screws.



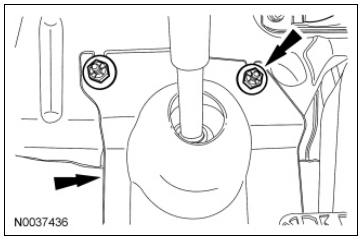
45. **NOTE:** Align the index marks made during removal.

    Install the steering intermediate shaft onto the steering gear and install a new bolt.

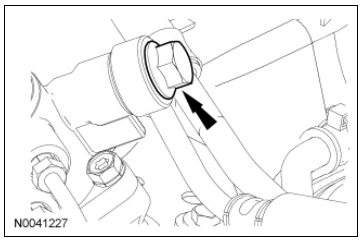
    - Tighten to 25 Nm (18 lb-ft).



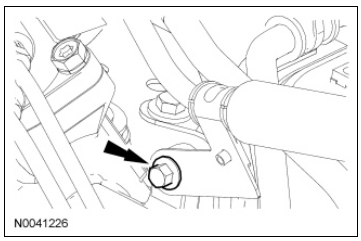
46. Install the steering joint cover and the 2 nuts.



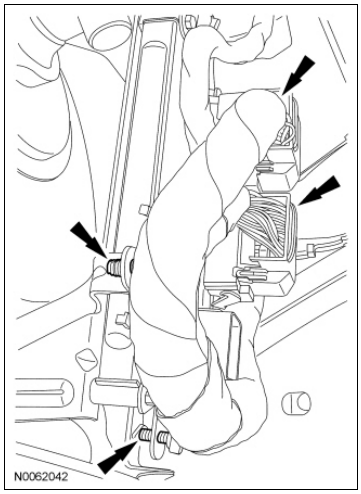
47. Using a new banjo bolt and 2 new seals, install the Power Steering Pressure (PSP) tube onto the steering gear.
    - Tighten to 37 Nm (27 lb-ft).



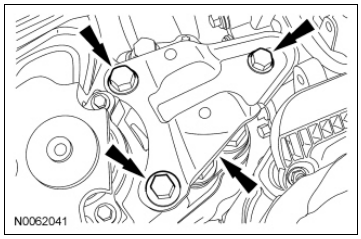
48. Install the PSP tube bracket and bolt.
    - Tighten to 10 Nm (89 lb-in).



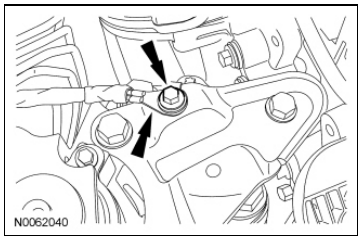
49. Connect the PCM electrical connectors and pin-type retainers.



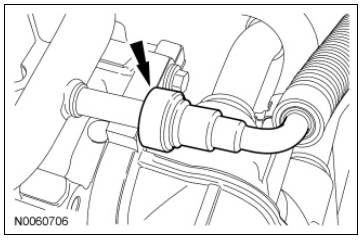
50. Install the engine mount brace and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



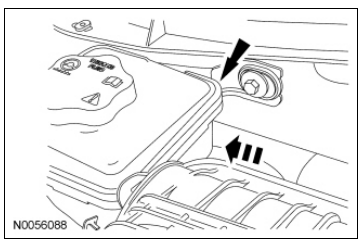
51. Install the ground wire and the bolt.
    - Tighten to 10 Nm (89 lb-in).



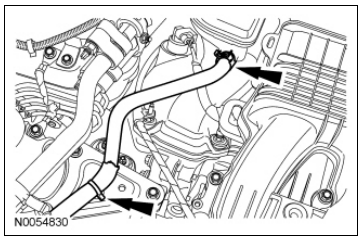
52. Connect the fuel supply tube from the fuel rail. For additional information, refer to Section 310-00 .



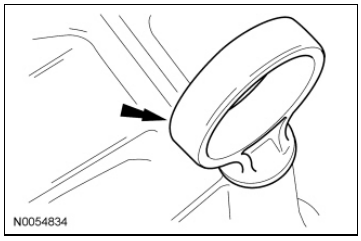
53. Attach the power steering reservoir onto the cowl.



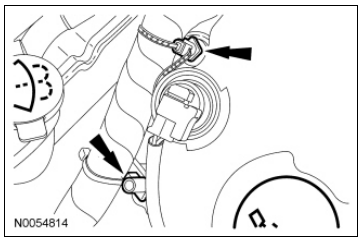
54. Connect the hose to the power steering reservoir.
    - Attach the pin-type retainer to the engine mount brace.



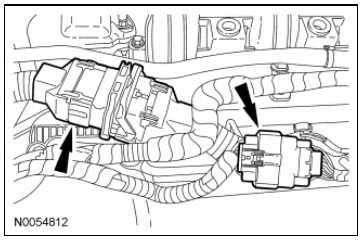
55. Install the oil level indicator.



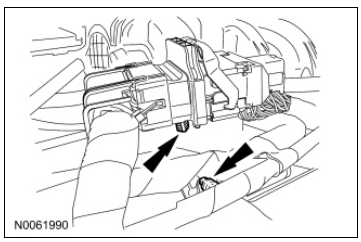
56. Attach the 2 wiring harness retainers to the LH valve cover stud bolts.



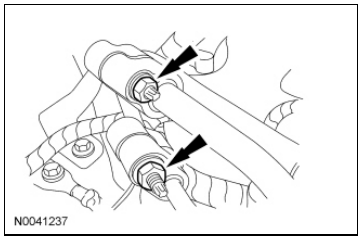
57. Connect the 2 engine wiring harness electrical connectors.



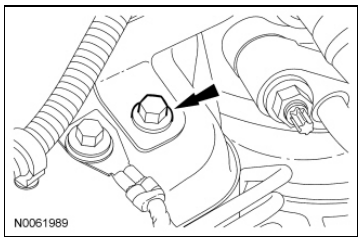
58. Attach the 2 wiring harness retainers.



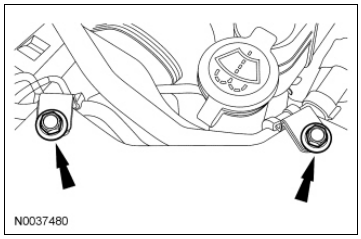
59. Using new O-ring seals, connect the A/C tubes and install the 2 nuts.
    - Tighten to 8 Nm (71 lb-in).



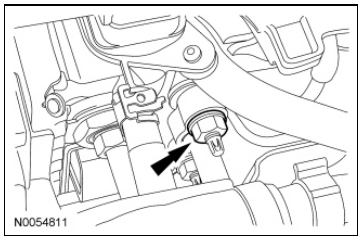
60. Install the A/C tube bracket bolt.
    - Tighten to 8 Nm (71 lb-in).



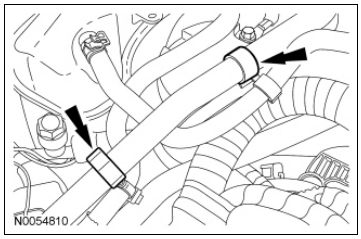
61. Install the 2 A/C tube bracket bolts.
    - Tighten to 10 Nm (89 lb-in).



62. Using a new O-ring seal, connect the A/C tube to the condenser and install the nut.
    - Tighten to 8 Nm (71 lb-in).

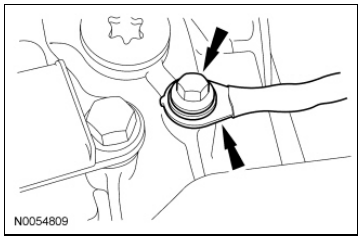


63. Attach the coolant tube retainer clips to the A/C tube.

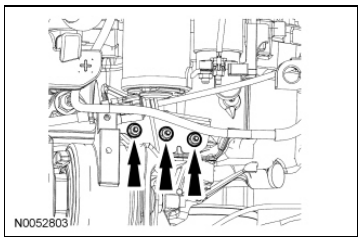


64. If equipped, attach the engine block heater harness to the radiator support, power steering hose, A/C tube and the engine wiring harness.

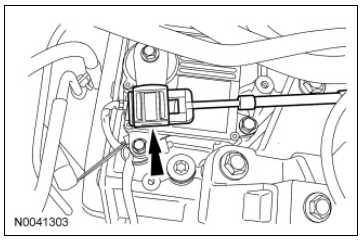
65. Install the ground wire and bolt.
    - Tighten to 12 Nm (106 lb-in).



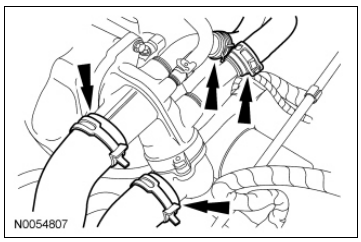
66. Position the transaxle control cable bracket in place and install the 3 nuts.
    - Tighten to 12 Nm (106 lb-in).



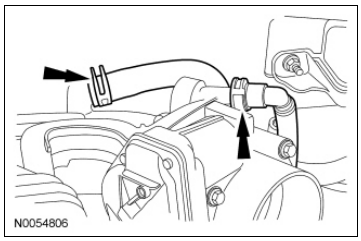
67. Connect the transaxle control cable to the control lever.



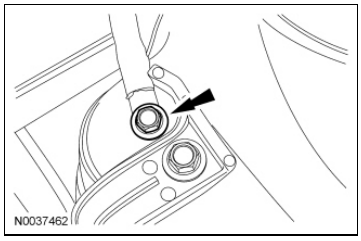
68. Connect the upper radiator hose, lower radiator hose and 2 heater hoses to the thermostat housing.



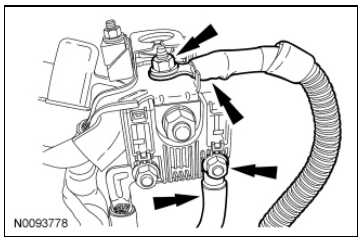
69. Connect the vacuum hose and the Evaporative Emission (EVAP) tube to the upper intake manifold.



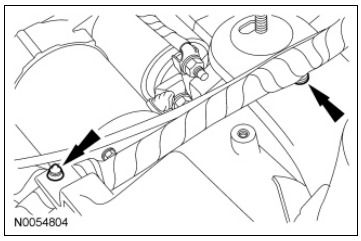
70. Install the ground wire and the bolt.
    - Tighten to 12 Nm (106 lb-in).



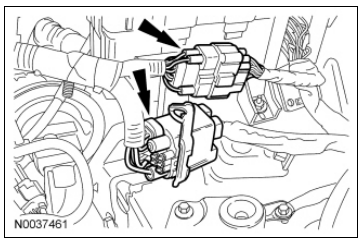
71. Install the 2 battery cables to the positive battery cable and the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



72. Attach the 2 wiring harness retainers to the transmission mount and the battery tray bracket.



73. Connect the 2 engine wiring harness electrical connectors.



74. Install the battery tray. For additional information, refer to Section 414-01 .

75. Install the engine Air Cleaner (ACL) and the ACL outlet pipe. For additional information, refer to Section 303-12C .

76. Install the degas bottle. For additional information, refer to Section 303-03A .

77. Install the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

78. Install the accessory drive belt and the power steering belt. For additional information, refer to Section 303-05C .

79. Fill the engine with clean engine oil.

80. Fill and bleed the cooling system. For additional information, refer to Section 303-03A .

81. Fill the power steering system. For additional information, refer to Section 211-00B .

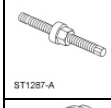
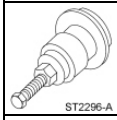
82. Check the transaxle fluid and add fluid if necessary. For additional information, refer to the Transmission Fluid Drain and Refill procedure in Section 307-01A .

83. Recharge the A/C system. For additional information, refer to Section 412-00A .

84. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Engine Front Cover

Special Tool(s)

 ST2433-A	Alignment Pins 307-399
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1287-A	Installer, Crankshaft Vibration Da 303-102 (T74P-6316-B)
 ST2296-A	Installer, Front Cover Oil Seal 303-335
 ST2981-A	Installer, Front Crankshaft Seal 303-1251
 ST2983-A	Installer, VCT Spark Plug Tube Seal 303-1247/2
 ST1293-A	Powertrain Lift 300-OTC1585AE
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada)	WSS-M2C945-A

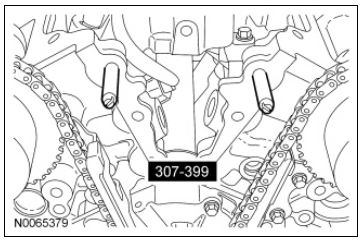
XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	
Motorcraft® Silicone Gasket Remover ZC-30	-
Threadlock and Sealer TA-25	WSK-M2G351-A5

⚠ **WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious persona**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

All vehicles

1. Install the Alignment Pins.

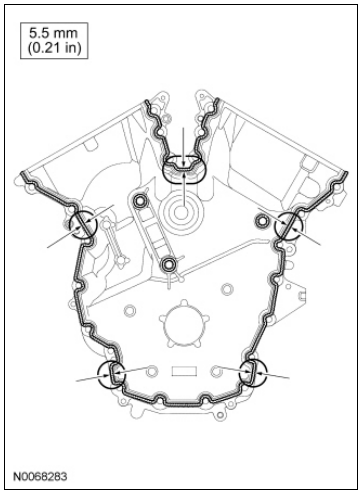


2. ***NOTICE:*** **Failure to use Motorcraft High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

   NOTE: The engine front cover and bolts 17, 18, 19 and 20 must be installed within 4 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

   Apply a 3.0 mm (0.11 in) bead of Motorcraft High Performance Engine RTV Silicone to the engine front cover sealing surfaces including the 3 engine mount bracket bosses.

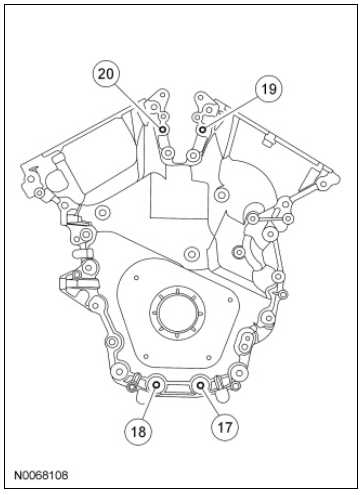
   - Apply a 5.5 mm (0.21 in) bead of Motorcraft High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.



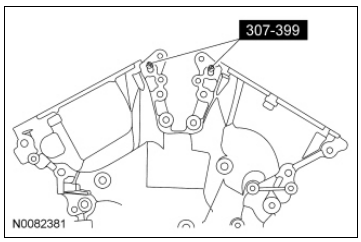
3. **NOTE:** Make sure the 2 locating dowel pins are seated correctly in the cylinder block.

   Install the engine front cover and bolts 17, 18, 19 and 20.

   - Tighten in sequence to 3 Nm (27 lb-in).

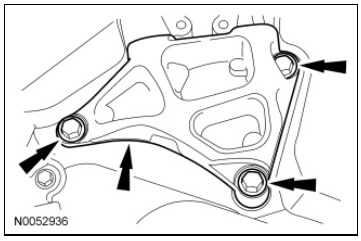


4. Remove the Alignment Pins.

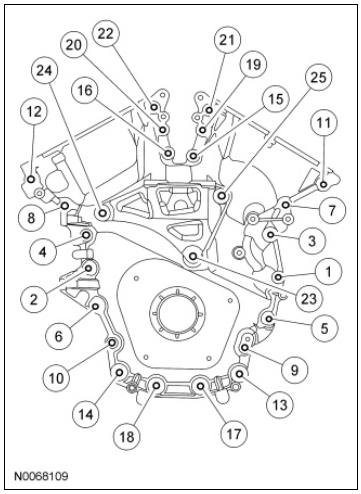


5. **NOTE:** Do not tighten the bolts at this time.

   Install the engine mount bracket and the 3 bolts.



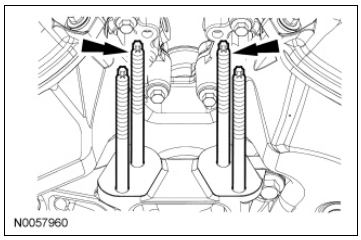
6. Install the remaining engine front cover bolts. Tighten all of the engine front cover bolts and engine mount bracket bolts in the sequence shown in 2 stages:
    - Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in) and bolts 23, 24 and 25 to 15 Nm (133 lb-in).
    - Stage 2: Tighten bolts 1 thru 22 to 24 Nm (18 lb-ft) and bolts 23, 24 and 25 to 75 Nm (55 lb-ft).



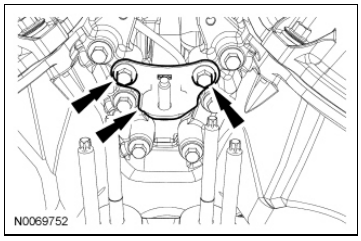
7. ***NOTICE:*** **The thread sealer on the engine mount studs (including new engine mount studs if applicable) must be cleaned off with a wire brush and new Threadlock and Sealer applied prior to installing the engine mount studs. Failure to follow this procedure may result in damage to the engine mount studs or engine.**

    Install the engine mount studs in the following sequence.

    1. Clean the front cover engine mount stud holes with pressurized air to remove any foreign material.
    2. Clean all the thread sealer from the engine mount studs (old and new studs).
    3. Apply new Threadlock and Sealer to the engine mount stud threads.
    4. Install the 2 engine mount studs.
        - ♦ Tighten to 20 Nm (177 lb-in).

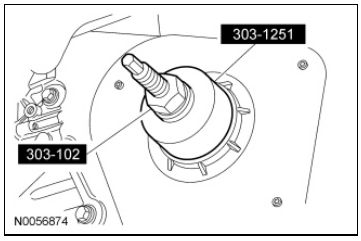


8. Install the engine mount bracket and the 2 bolts.
    - Tighten to 24 Nm (18 lb-ft).



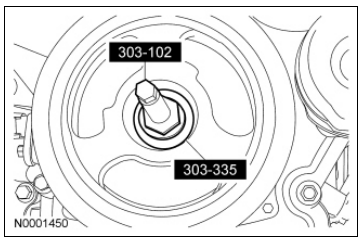
9. **NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.

   Using the Front Crankshaft Seal Installer and Crankshaft Vibration Damper Installer, install a new crankshaft front seal.

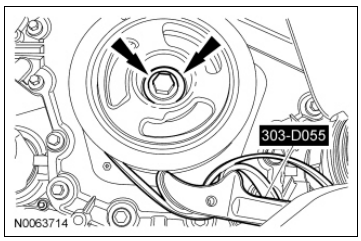


10. **NOTE:** Lubricate the outside diameter sealing surfaces with clean engine oil.

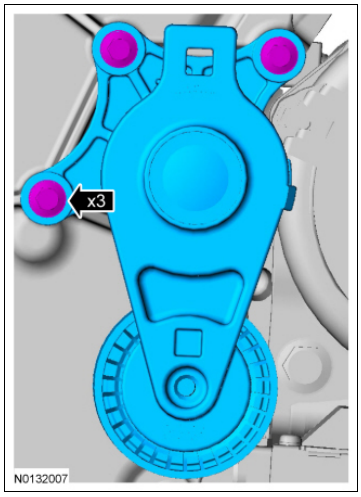
    Using the Front Cover Oil Seal Installer and Crankshaft Vibration Damper Installer, install the crankshaft pulley.



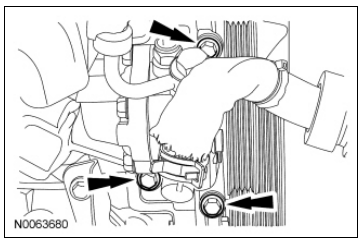
11. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
    - Stage 1: Tighten to 120 Nm (89 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.



12. Install the accessory drive belt tensioner and the 3 bolts.
    - Tighten to 11 Nm (97 lb-in).



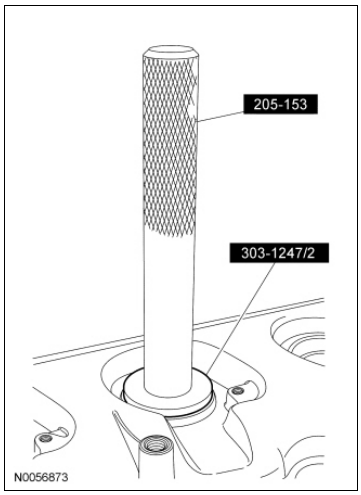
13. Install the power steering pump and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



14. **NOTE:** Installation of new seals is only required if damaged seals were removed during disassembly of the engine.

    NOTE: Spark plug tube seal installation shown, Variable Camshaft Timing (VCT) solenoid seal installation similar.

    Using the VCT Spark Plug Tube Seal Installer and Handle, install new VCT solenoid and/or spark plug tube seals.

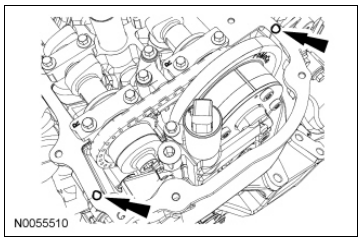


15. ***NOTICE:*** **Failure to use Motorcraft High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

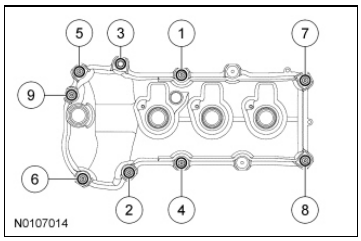
    NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover

and metal surface prep. Failure to follow this procedure can cause future oil leakage.

Apply an 8 mm (0.31 in) bead of Motorcraft High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.



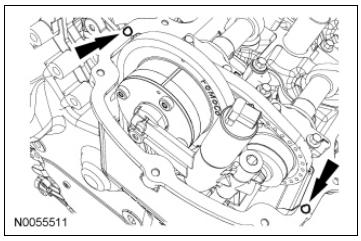
16. Using a new gasket, install the RH valve cover and tighten the bolt and 8 stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



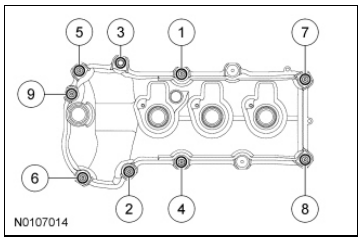
17. ***NOTICE:*** **Failure to use Motorcraft High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: If the valve cover is not installed and the fasteners tightened within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

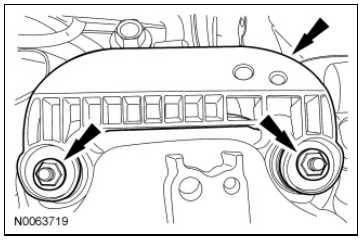
    Apply an 8 mm (0.31 in) bead of Motorcraft High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.



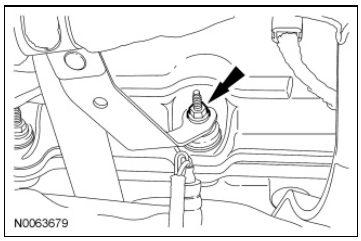
18. Using a new gasket, install the RH valve cover and tighten the 9 stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



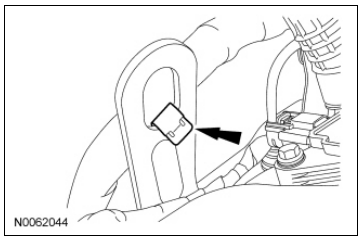
19. Install the wiring harness retaining bracket and the 2 nuts.
    - Tighten to 4 Nm (35 lb-in).



20. Install the Power Steering Pressure (PSP) hose bracket and nut.
    - Tighten to 9 Nm (80 lb-in).



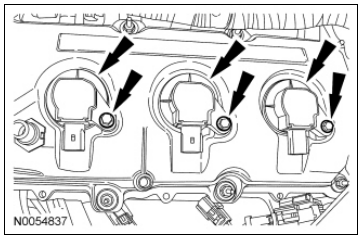
21. Attach the PSP hose retainer to the engine lifting eye.



22. **NOTE:** LH shown, RH similar.

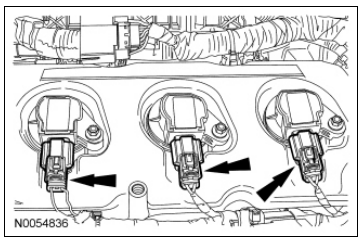
    Install the 6 coil-on-plug assemblies and the 6 bolts.

    - Tighten to 7 Nm (62 lb-in).

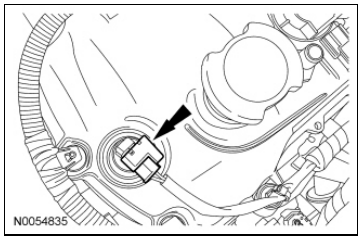


23. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.

24. Connect the 3 LH coil-on-plug electrical connectors.

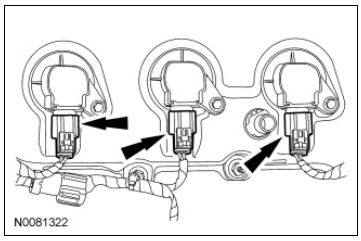


25. Connect the LH camshaft VCT solenoid electrical connector.

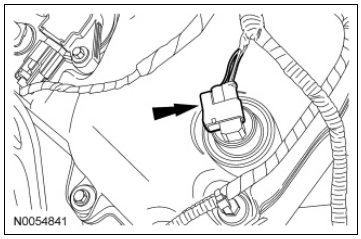


26. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.

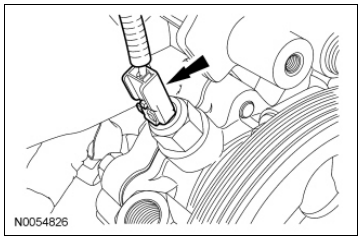
27. Connect the 3 RH coil-on-plug electrical connectors.



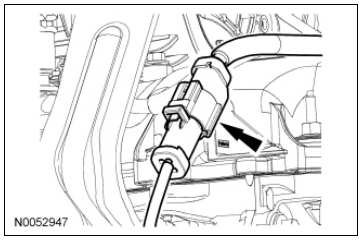
28. Connect the RH VCT solenoid electrical connector.



29. Connect the PSP switch electrical connector.



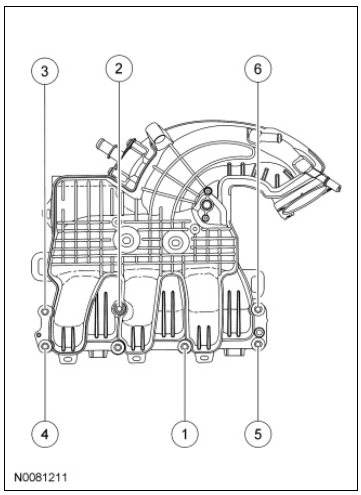
30. Connect the RH Catalyst Monitor Sensor (CMS) sensor electrical connector.



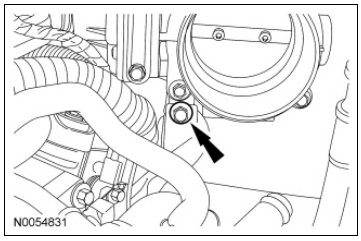
31. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    Using new gaskets, install the upper intake manifold and the 6 bolts.

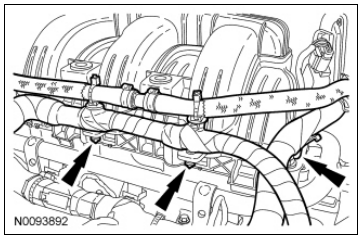
- Tighten in the sequence shown to 10 Nm (89 lb-in).



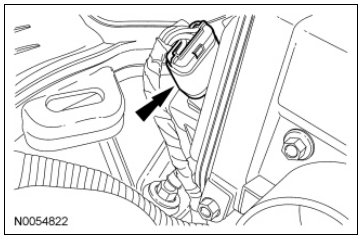
32. Install the upper intake manifold support bracket bolt.
    - Tighten to 10 Nm (89 lb-in).



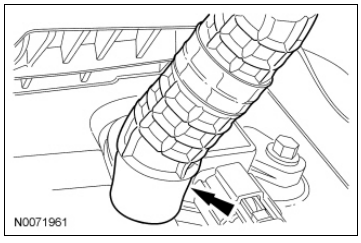
33. Attach the wiring harness retainers to the upper intake manifold.



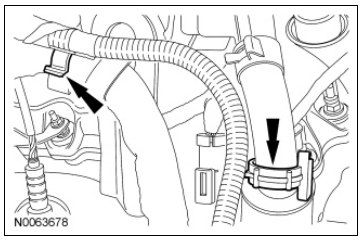
34. Connect the Throttle Body (TB) electrical connector.



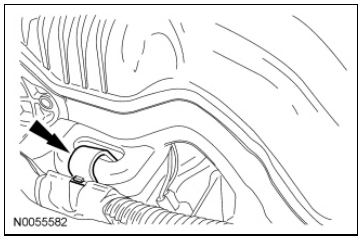
35. Connect the PCV hose to the PCV valve.



36. If equipped, attach the block heater wiring harness retainer to the PSP tube and the power steering reservoir hose.

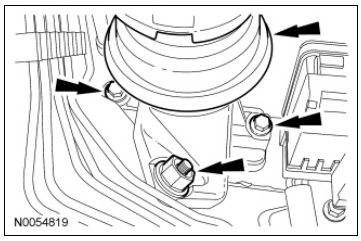


37. If equipped, attach the block heater wiring harness retainer to the upper intake manifold.

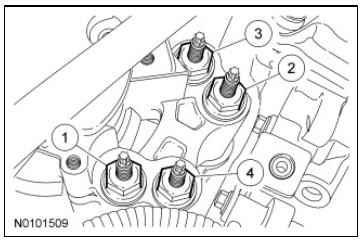


38. Raise the engine and transaxle assembly into the vehicle.

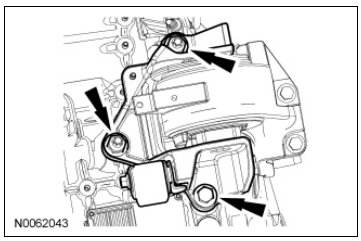
39. Install the engine mount, the nut and the 2 bolts.
    - Tighten the bolts to 55 Nm (41 lb-ft).
    - Tighten the nut to 63 Nm (46 lb-ft).



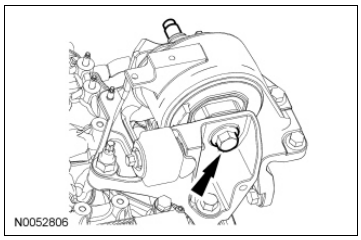
40. Install the 2 engine mount spacers and the 4 engine mount nuts.
    - Tighten in the sequence shown to 70 Nm (52 lb-ft).



41. Install the transaxle support insulator bracket, bolt and the 2 nuts.
    - Tighten to 80 Nm (59 lb-ft).



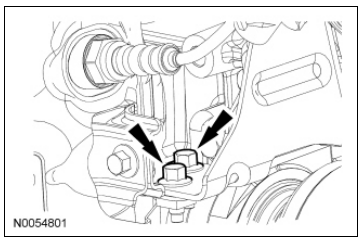
42. Install the transaxle support insulator through bolt and nut.
    - Tighten to 90 Nm (66 lb-ft).



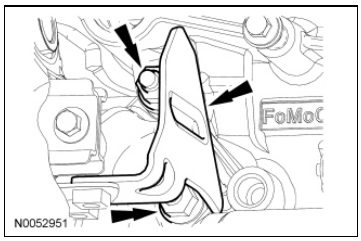
Front Wheel Drive (FWD) vehicles

43. **NOTE:** Do not tighten the 2 catalytic converter support bracket bolts at this time.

    Install the RH catalytic converter support bracket and the 2 bolts.



44. Install the 2 catalytic converter support bracket nuts.
    - Tighten to 40 Nm (30 lb-ft).
    - Tighten the 2 catalytic converter support bracket bolts to 20 Nm (177 lb-in).



All-Wheel Drive (AWD) vehicles

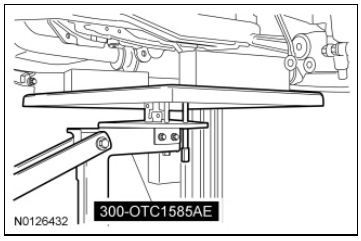
45. **NOTE:** A new Power Transfer Unit (PTU) seal must be installed whenever the intermediate shaft is removed.

    Install a new PTU seal. For additional information, refer to Section 303-07B .

All vehicles

46. **NOTE:** Align the index marks on the subframe to the index marks on the underbody that were made during removal.

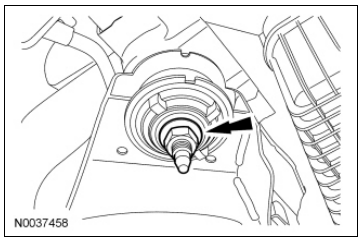
    Using the Powertrain Lift, raise the subframe into the installed position.



47. **NOTE:** LH shown, RH similar.

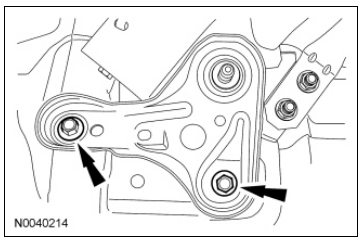
    Install the 2 front subframe nuts.

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



48. **NOTE:** LH shown, RH similar.

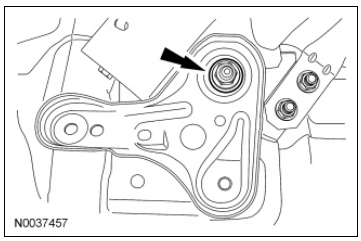
    Position the subframe brackets and install the 4 bolts finger-tight.



49. **NOTE:** LH shown, RH similar.

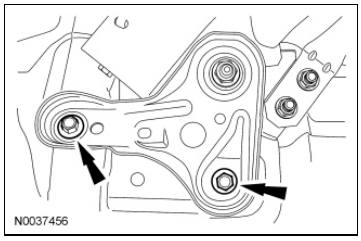
    Install the 2 rear subframe nuts.

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



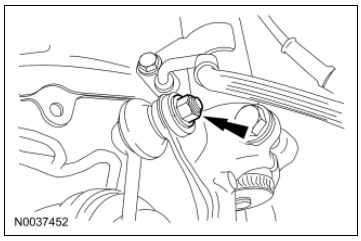
50. **NOTE:** LH shown, RH similar.

    Tighten the 2 subframe bracket-to-body bolts to 103 Nm (76 lb-ft).



51. **NOTE:** LH shown, RH similar.

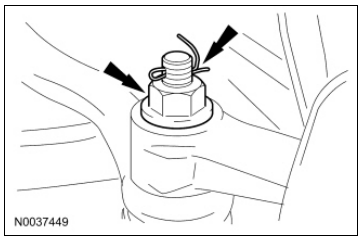
    Install the stabilizer bar links and nuts to the struts.



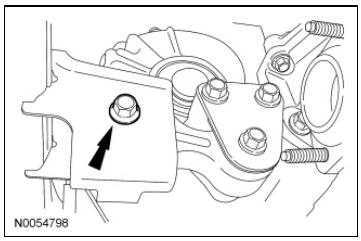
52. **NOTE:** LH shown, RH similar.

    Install the tie-rod ends and nuts.

    - Tighten to 48 Nm (35 lb-ft).
    - Install new cotter pins.

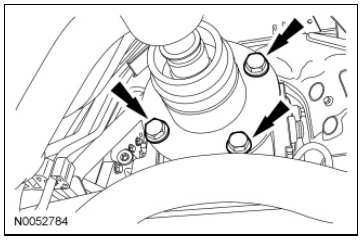


53. Install the engine roll restrictor-to-subframe through bolt.
    - Tighten to 90 Nm (66 lb-ft).



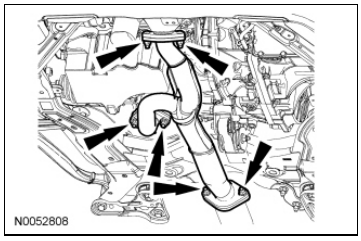
AWD vehicles

54. Line up the index marks on the rear driveshaft to the index marks on the PTU flange made during removal and install the 4 new bolts (3 shown).
    - Tighten to 70 Nm (52 lb-ft).



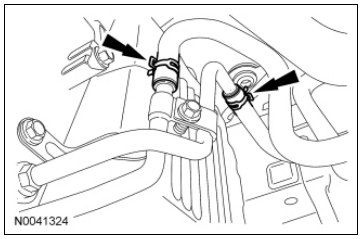
All vehicles

55. Using new gaskets, install the Y-pipe assembly and the 6 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

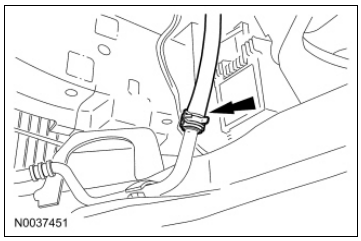


56. Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

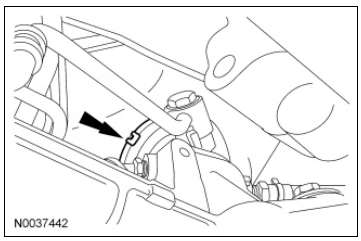
57. Connect the 2 transmission fluid cooler hoses.



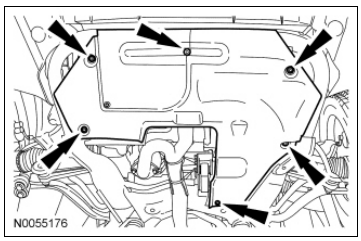
58. Connect the power steering cooler tube.



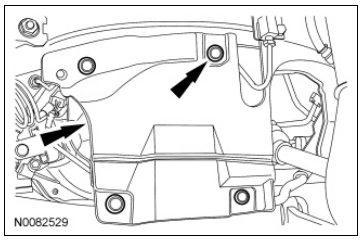
59. Slide the steering gear-to-dash seal onto the steering gear and engage the 4 retaining clips into the body.
    - From under the vehicle, verify that the seal is correctly installed on the steering gear and the retaining clips are fully engaged into the body.



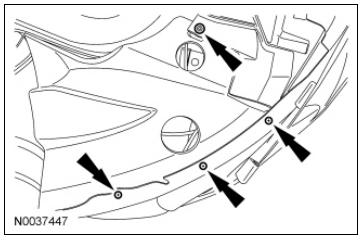
60. If equipped, install the underbody shield and the 6 screws.



61. Install the LH splash shield and the 6 pin-type retainers (4 shown).



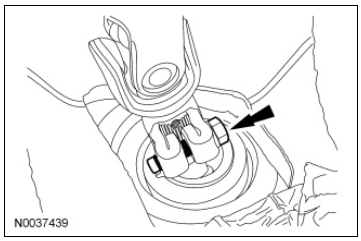
62. Position the LH fender splash shield and install the 4 screws.



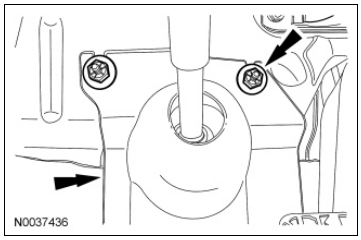
63. **NOTE:** Align the index marks made during removal.

    Install the steering intermediate shaft onto the steering gear and install a new bolt.

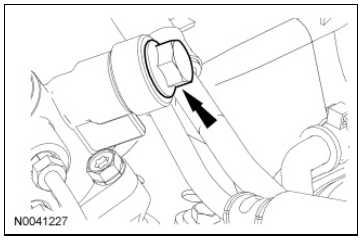
    - Tighten to 25 Nm (18 lb-ft).



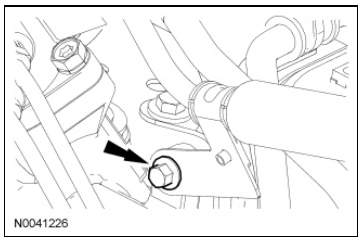
64. Install the steering joint cover and the 2 nuts.



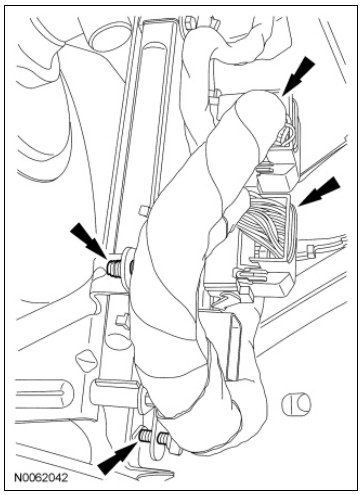
65. Using a new banjo bolt and 2 new seals, install the PSP tube onto the steering gear.
    - Tighten to 37 Nm (27 lb-ft).



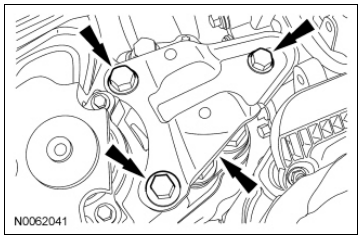
66. Install the PSP tube bracket and bolt.
    - Tighten to 10 Nm (89 lb-in).



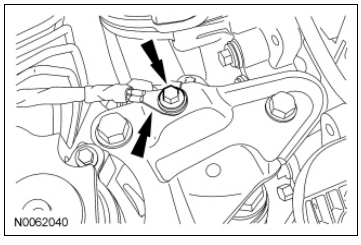
67. Connect the PCM connectors and pin-type retainers.



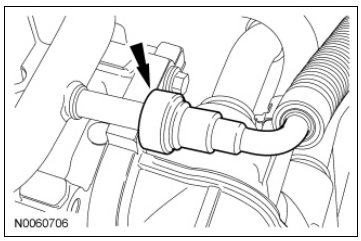
68. Install the engine mount brace and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



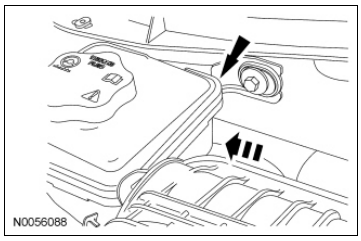
69. Install the ground wire and the bolt.
    - Tighten to 10 Nm (89 lb-in).



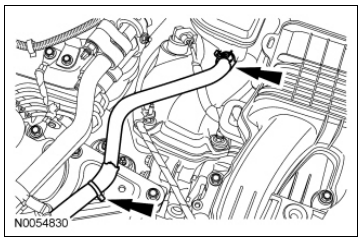
70. Connect the fuel supply tube to the fuel rail. For additional information, refer to Section 310-00 .



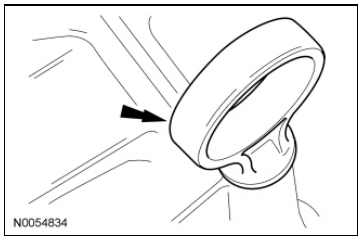
71. Attach the power steering reservoir onto the cowl.



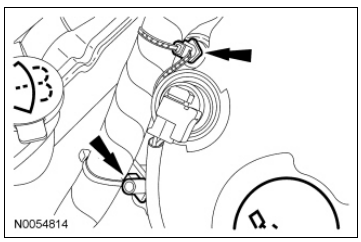
72. Connect the hose to the power steering reservoir.
    - Attach the pin-type retainer to the engine mount brace.



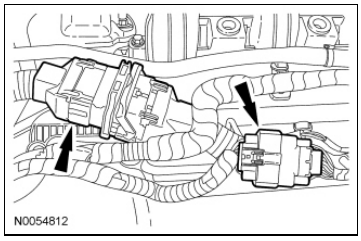
73. Install the oil level indicator.



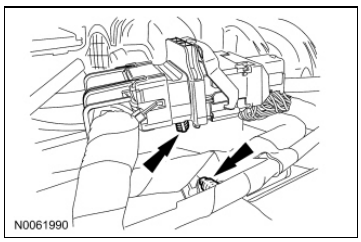
74. Attach the 2 wiring harness retainers to the LH valve cover stud bolts.



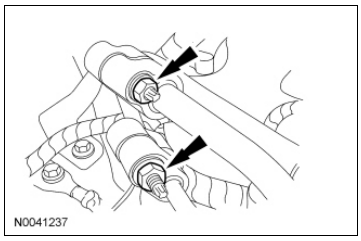
75. Connect the 2 engine wiring harness electrical connectors.



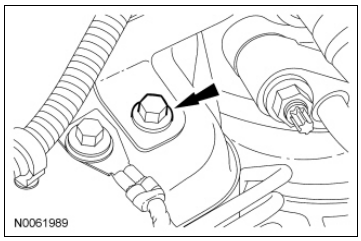
76. Attach the 2 wiring harness retainers.



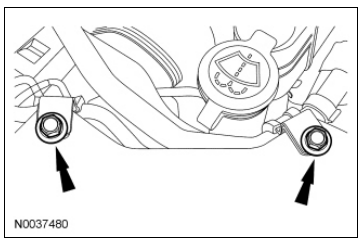
77. Using new O-ring seals, connect the A/C tubes and install the 2 nuts.
    - Tighten to 8 Nm (71 lb-in).



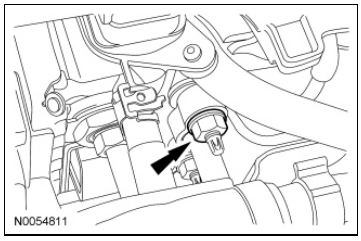
78. Install the A/C tube bracket bolt.
    - Tighten to 8 Nm (71 lb-in).



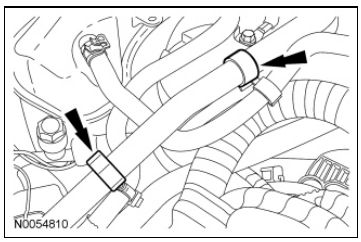
79. Install the 2 A/C tube retaining clamp bolts.
    - Tighten to 10 Nm (89 lb-in).



80. Using a new O-ring seal, connect the A/C tube to the condenser and install the nut.
    - Tighten to 8 Nm (71 lb-in).

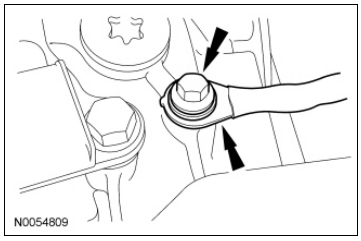


81. Attach the coolant tube retainer clips to the A/C tube.

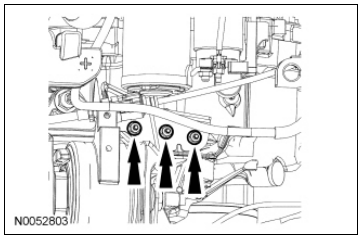


82. If equipped, attach the engine block heater harness to the radiator support, power steering hose, A/C tube and the engine wiring harness.

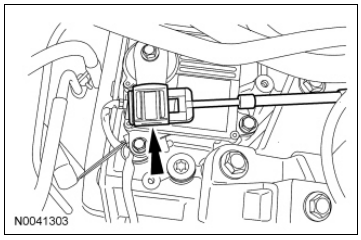
83. Install the ground wire and bolt.
    - Tighten to 12 Nm (106 lb-in).



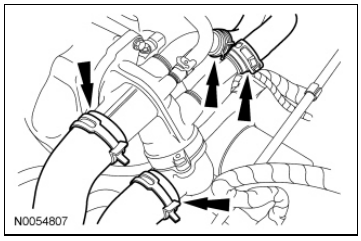
84. Position the transaxle control cable bracket in place and install the 3 nuts.
    - Tighten to 12 Nm (106 lb-in).



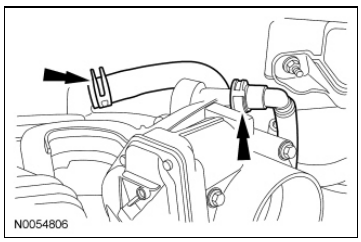
85. Connect the transaxle control cable to the control lever.



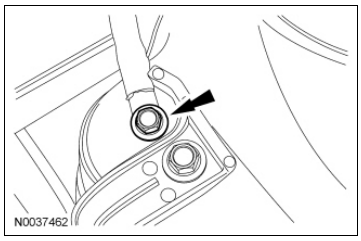
86. Connect the upper radiator hose, lower radiator hose and 2 heater hoses to the thermostat housing.



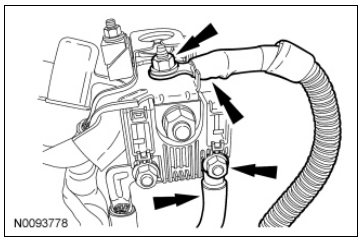
87. Connect the vacuum hose and the Evaporative Emission (EVAP) tube to the upper intake manifold.



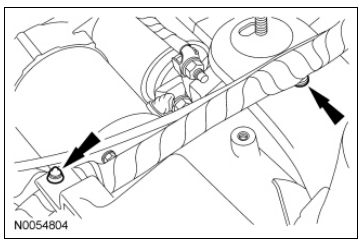
88. Install the ground wire and the bolt.
    - Tighten to 12 Nm (106 lb-in).



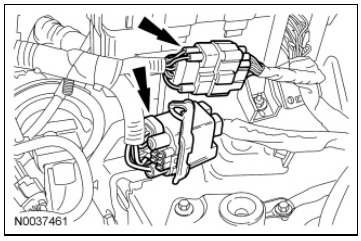
89. Install the 2 battery cables to the positive battery cable and the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



90. Attach the 2 wiring harness retainers to the transmission mount and the battery tray bracket.



91. Connect the 2 engine wiring harness electrical connectors.



92. Install the battery tray. For additional information, refer to Section 414-01 .

93. Install the engine Air Cleaner (ACL) and the ACL outlet pipe. For additional information, refer to Section 303-12C .

94. Install the degas bottle. For additional information, refer to Section 303-03A .

95. Install the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

96. Install the accessory drive belt and the power steering belt. For additional information, refer to Section 303-05C .

97. ***NOTICE:*** **Do not expose the Motorcraft High Performance Engine RTV Silicone to engine oil for at least 90 minutes after installing the engine front cover. Failure to follow this instruction may cause oil leakage.**

    Fill the engine with clean engine oil.

98. Fill and bleed the cooling system. For additional information, refer to Section 303-03A .

99. Fill the power steering system. For additional information, refer to Section 211-00B .

100. Check the transaxle fluid and add fluid if necessary. For additional information, refer to the Transmission Fluid Drain and Refill procedure in Section 307-01A .

101. Recharge the A/C system. For additional information, refer to Section 412-00A .

102. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

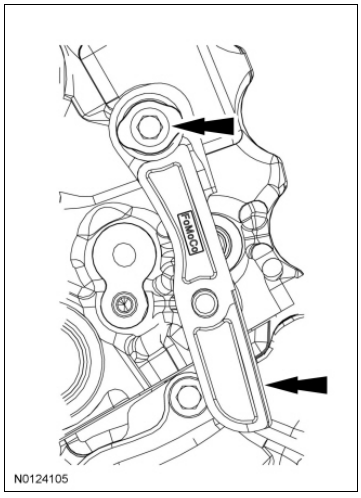
Timing Drive Components

Special Tool(s)

 ST2979-A	Tool, Camshaft Holding 303-1248

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

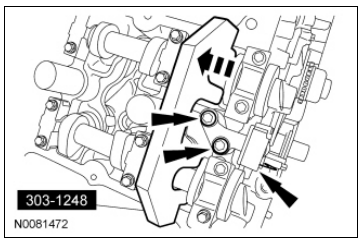
1. Install the RH timing chain guide and bolt.
   - Tighten to 10 Nm (89 lb-in).



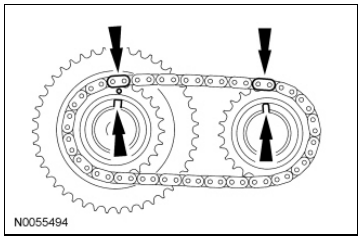
1. **NOTE:** It is necessary to tilt the Camshaft Holding Tool toward the rear of the engine to access the rearmost secondary timing chain tensioner bolt.

   Install the RH secondary timing chain tensioner and the 2 bolts.

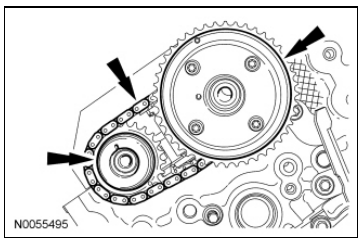
   - Tighten to 10 Nm (89 lb-in).



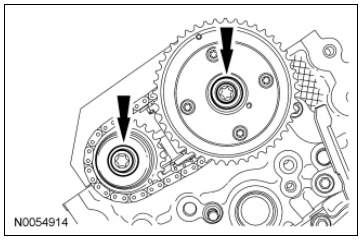
3. Assemble the RH Variable Camshaft Timing (VCT) assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
   - Align the colored links with the timing marks.



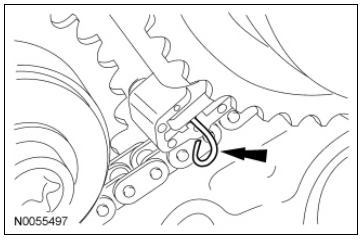
4. Position the RH secondary timing assembly onto the camshafts.



5. Install 2 new bolts and the original washer. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 10 Nm (89 lb-in).
    - Stage 4: Tighten 90 degrees.



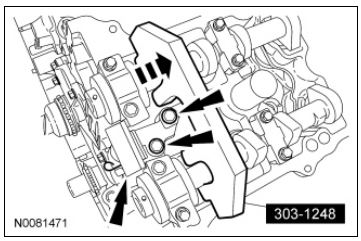
6. Remove the lockpin from the RH secondary timing chain tensioner.



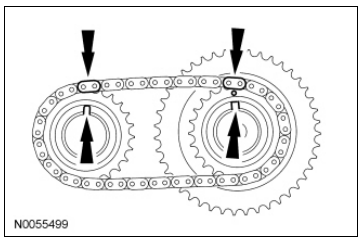
7. **NOTE:** It is necessary to tilt the Camshaft Holding Tool toward the rear of the engine to access the rearmost secondary timing chain tensioner bolt.

    Install the LH secondary timing chain tensioner and the 2 bolts.

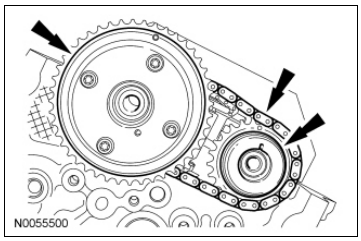
    - Tighten to 10 Nm (89 lb-in).



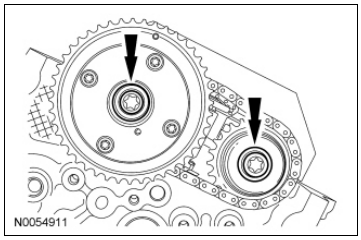
8. Assemble the LH VCT assembly, the LH exhaust camshaft sprocket and the LH secondary timing chain.
    - Align the colored links with the timing marks.



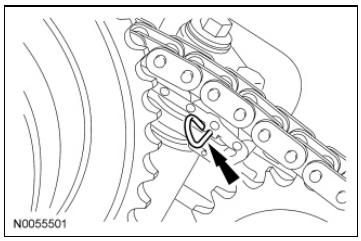
9. Position the LH secondary timing assembly onto the camshafts.



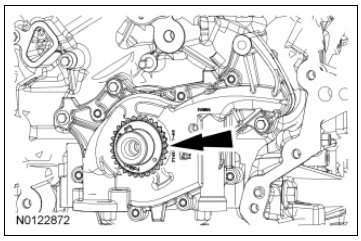
10. Install 2 new bolts and the original washer. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 10 Nm (89 lb-in).
    - Stage 4: Tighten 90 degrees.



11. Remove the lockpin from the LH secondary timing chain tensioner.

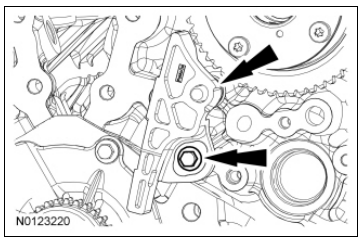


12. Install the crankshaft timing chain sprocket.



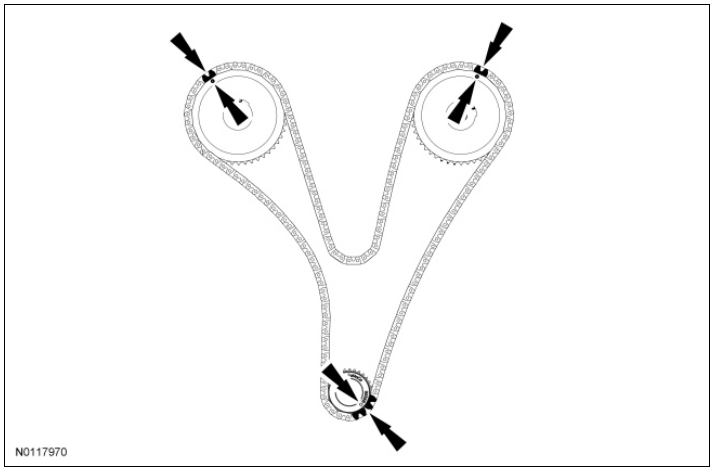
13. Install the upper LH primary timing chain guide and the bolt.

- Tighten to 10 Nm (89 lb-in).

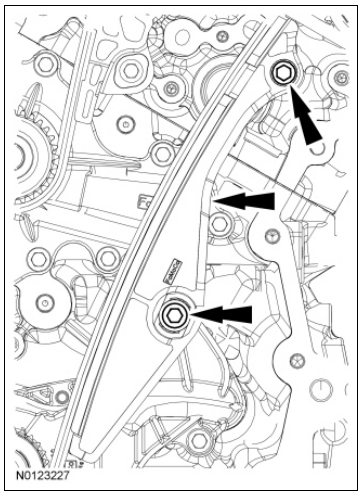


14. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

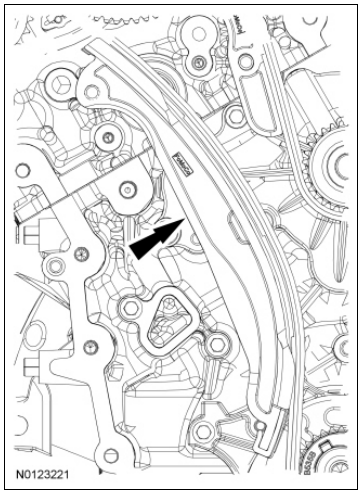
    Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.



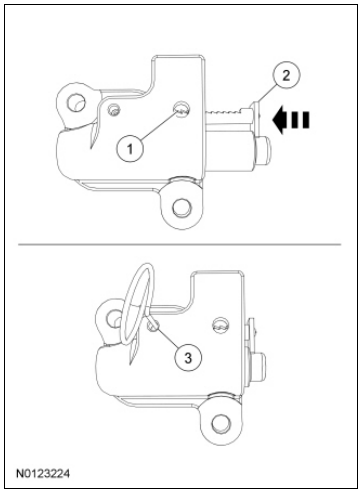
15. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



16. Install the primary timing chain tensioner arm.



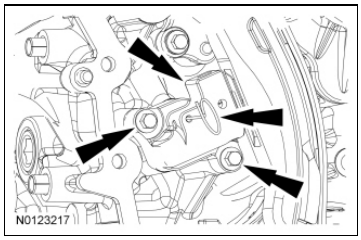
17. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.



18. **NOTE:** It may be necessary to rotate the crankshaft slightly to remove slack from the timing chain and install the tensioner.

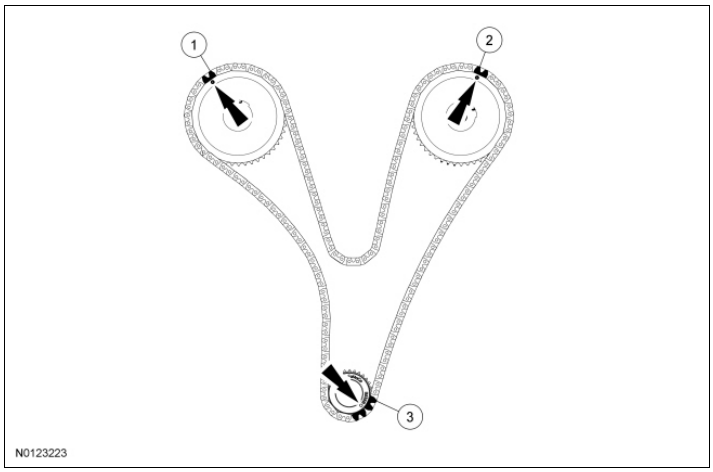
    Install the primary tensioner and the 2 bolts.

    - Tighten to 10 Nm (89 lb-in).
    - Remove the lockpin.

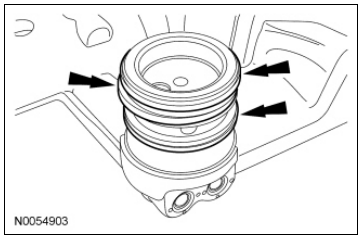


19. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).

- There are 35 links between the LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket colored links (3).



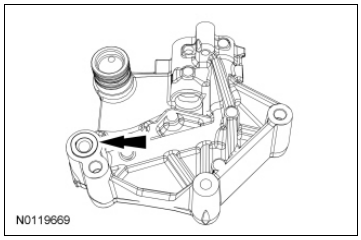
20. Inspect the VCT housing seals for damage and replace as necessary.



21. **NOTE:** RH shown, LH similar.

    NOTE: During removal, the O-ring seal may remain on the cylinder head. If so, remove the O-ring seal from the cylinder head, inspect the seal (replace as necessary) and install the O-ring seal on the VCT housing.

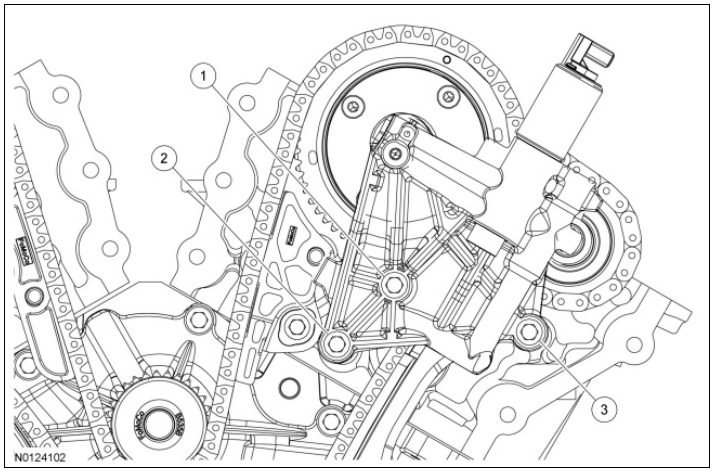
    Inspect the VCT housing-to-cylinder head O-ring seals for damage and replace as necessary.



22. ***NOTICE:*** **Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.**

    Install the LH VCT housing and the 3 bolts.

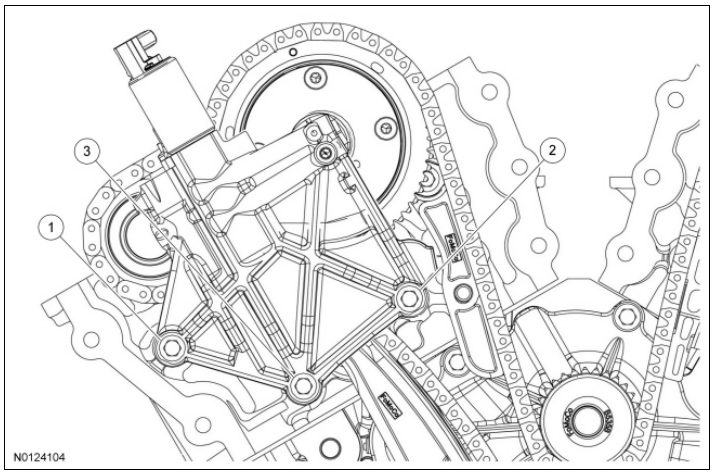
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



23. ***NOTICE:*** **Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.**

    Install the RH VCT housing and the 3 bolts.

    - Tighten in the sequence shown to 10 Nm (89 lb-in).



24. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Camshaft

Special Tool(s)

 ST2979-A	Tool, Camshaft Holding 303-1248

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

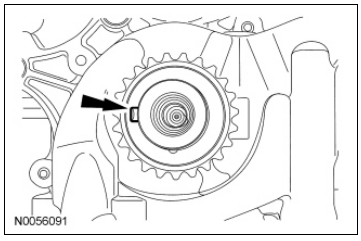
All camshafts

⚠ **WARNING: Do not smoke, carry lighted tobacco oran open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. ***NOTICE:*** **The crankshaft must remain in the freewheeling position (crankshaft dowel pin at 9 o'clock) until after the camshafts are installed and the valve clearance is checked/adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.**

   Rotate the crankshaft counterclockwise until the crankshaft dowel pin is in the 9 o'clock position.

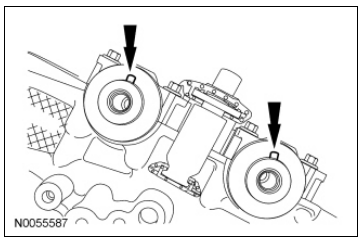

N0056091

LH camshafts

2. ***NOTICE:*** **The camshafts must remain in the neutral position during installation or engine damage may occur.**

   NOTE: Coat the camshafts with clean engine oil prior to installation.

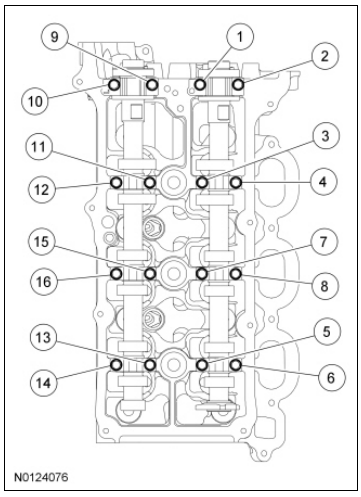
Position the camshafts onto the LH cylinder head in the neutral position as shown.



3. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

   Install the 8 camshaft caps and the 16 bolts. Tighten the bolts in the sequence shown in the following stages:

   - Stage 1: Tighten bolts 1, 2, 3 and 4 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 2: Tighten bolts 5 and 6 to 8 Nm (71 lb-in).
   - Stage 3: Tighten bolts 7 and 8 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 4: Loosen bolts 5 and 6.
     - ♦ Tighten bolts 5 and 6 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 5: Tighten bolts 9, 10, 11 and 12 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 6: Tighten bolts 13 and 14 to 8 Nm (71 lb-in).
   - Stage 7: Tighten bolts 15 and 16 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 8: Loosen bolts 13 and 14.
     - ♦ Tighten bolts 13 and 14 to 8 Nm (71 lb-in) then an additional 45 degrees.

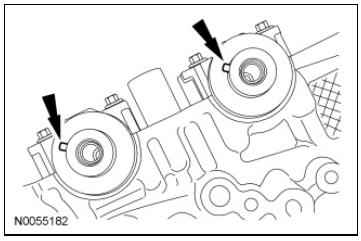


RH camshafts

4. ***NOTICE:*** **The camshafts must remain in the neutral position during installation or engine damage may occur.**

   NOTE: Coat the camshafts with clean engine oil prior to installation.

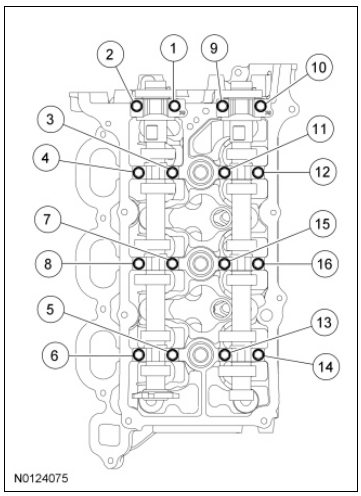
   Position the camshafts onto the RH cylinder head in the neutral position as shown.



5. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

   Install the 8 camshaft caps and the 16 bolts. Tighten the bolts in the sequence shown in the following stages:

   - Stage 1: Tighten bolts 1, 2, 3 and 4 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 2: Tighten bolts 5 and 6 to 8 Nm (71 lb-in).
   - Stage 3: Tighten bolts 7 and 8 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 4: Loosen bolts 5 and 6.
     - ♦ Tighten bolts 5 and 6 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 5: Tighten bolts 9, 10, 11 and 12 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 6: Tighten bolts 13 and 14 to 8 Nm (71 lb-in).
   - Stage 7: Tighten bolts 15 and 16 to 8 Nm (71 lb-in) then an additional 45 degrees.
   - Stage 8: Loosen bolts 13 and 14.
     - ♦ Tighten bolts 13 and 14 to 8 Nm (71 lb-in) then an additional 45 degrees.

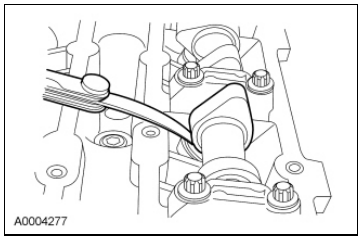


All camshafts

6. ***NOTICE:*** **If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage can occur.**

   NOTE: Use a camshaft sprocket bolt to turn the camshafts.

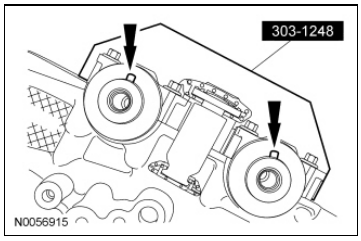
   Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet(s) of the correct size. For additional information, refer to Valve Clearance Check in this section.



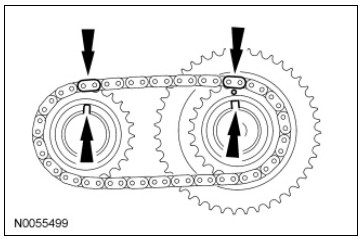
LH camshafts

7. **NOTE:** Use a camshaft sprocket bolt to turn the camshafts.

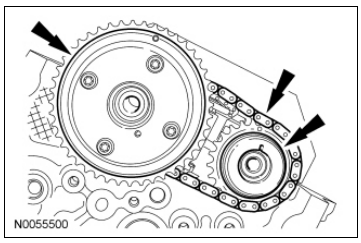
   Rotate the LH camshafts to the Top Dead Center (TDC) position and install the Camshaft Holding Tool on the flats of the camshafts.



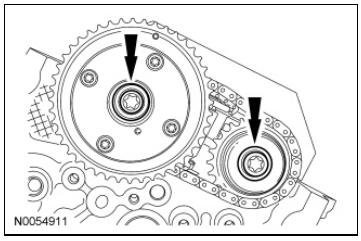
8. Assemble the LH Variable Camshaft Timing (VCT) assembly, the LH exhaust camshaft sprocket and the LH secondary timing chain.
   - Align the colored links with the timing marks.



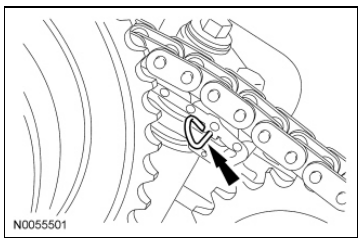
9. Position the LH secondary timing assembly onto the camshafts.



10. Install 2 new bolts and the original washer. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 10 Nm (89 lb-in).
    - Stage 4: Tighten 90 degrees.



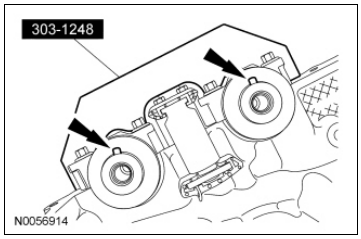
11. Remove the lockpin from the LH secondary timing chain tensioner.



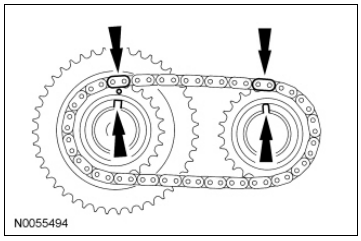
RH camshafts

12. **NOTE:** Use a camshaft sprocket bolt to turn the camshafts.

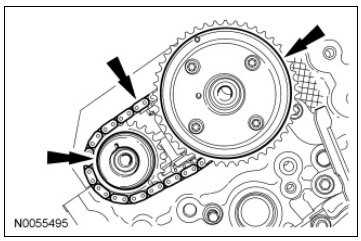
    Rotate the RH camshafts to the TDC position and install the Camshaft Holding Tool on the flats of the camshafts.



13. Assemble the RH VCT assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
    - Align the colored links with the timing marks.

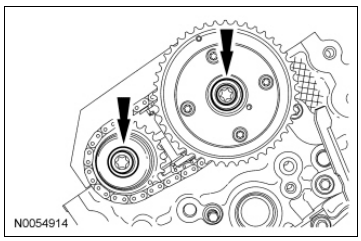


14. Position the RH secondary timing assembly onto the camshafts.

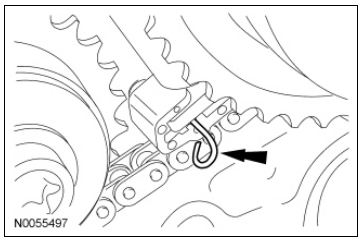


15. Install 2 new bolts and the original washer. Tighten in 4 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).

- Stage 2: Loosen one full turn.
- Stage 3: Tighten to 10 Nm (89 lb-in).
- Stage 4: Tighten 90 degrees.

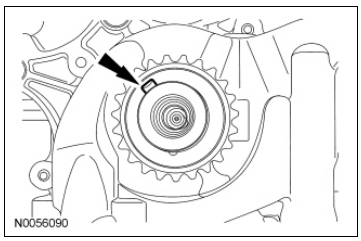


16. Remove the lockpin from the RH secondary timing chain tensioner.



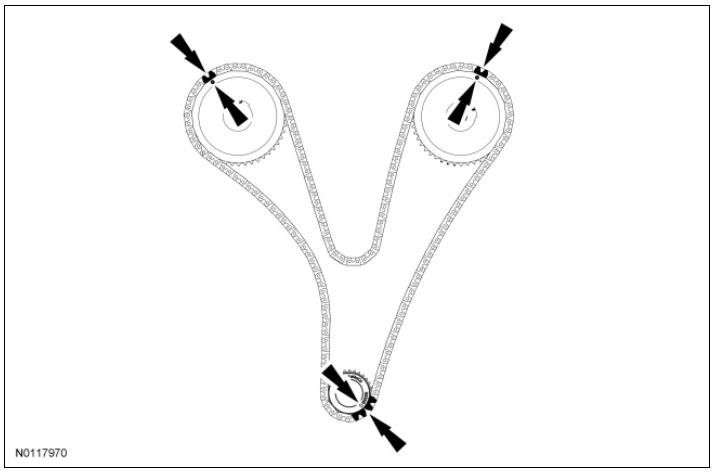
All camshafts

17. Rotate the crankshaft clockwise 60 degrees to the TDC position (crankshaft dowel pin at 11 o'clock).

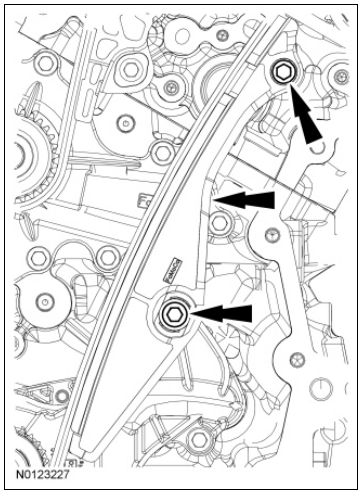


18. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

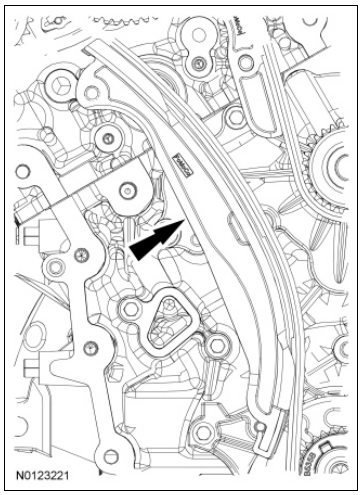
    Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.



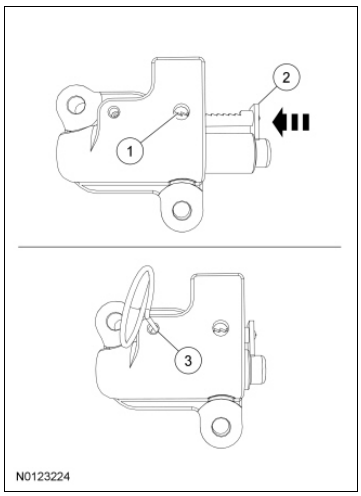
19. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



20. Install the primary timing chain tensioner arm.



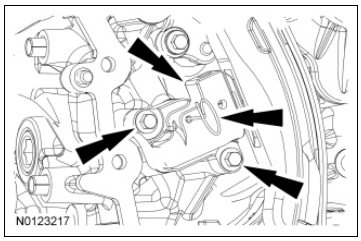
21. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.



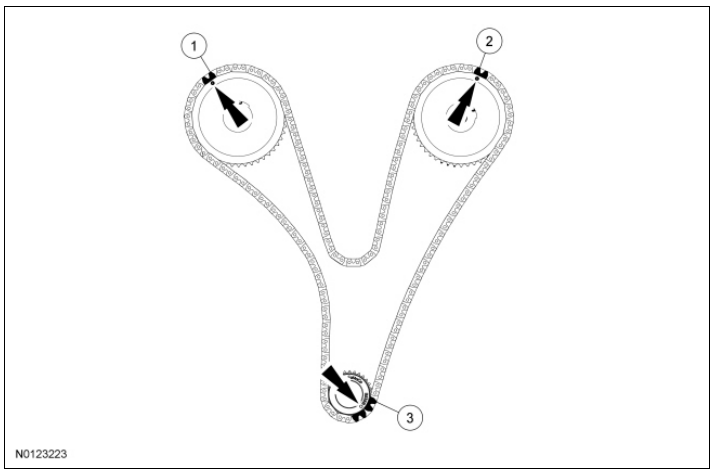
22. **NOTE:** It may be necessary to rotate the crankshaft slightly to remove slack from the timing chain and install the tensioner.

Install the primary tensioner and the 2 bolts.

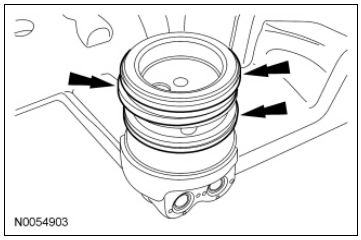
- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.



23. As a post-check, verify correct alignment of all timing marks.
    - There are 48 links between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 35 links between the LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket colored links (3).



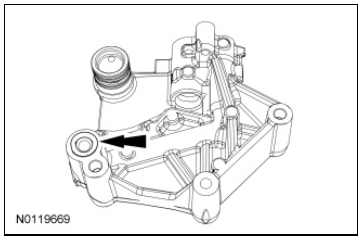
24. Inspect the VCT housing seals for damage and replace as necessary.



25. **NOTE:** RH shown, LH similar.

    NOTE: During removal, the O-ring seal may remain on the cylinder head. If so, remove the O-ring seal from the cylinder head, inspect the seal (replace as necessary) and install the O-ring seal on the VCT housing.

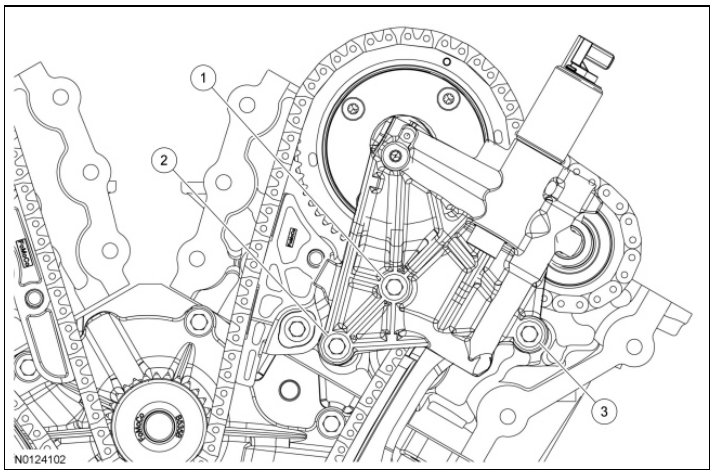
    Inspect the VCT housing-to-cylinder head O-ring seals for damage and replace as necessary.



26. ***NOTICE:*** **Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.**

    Install the LH VCT housing and the 3 bolts.

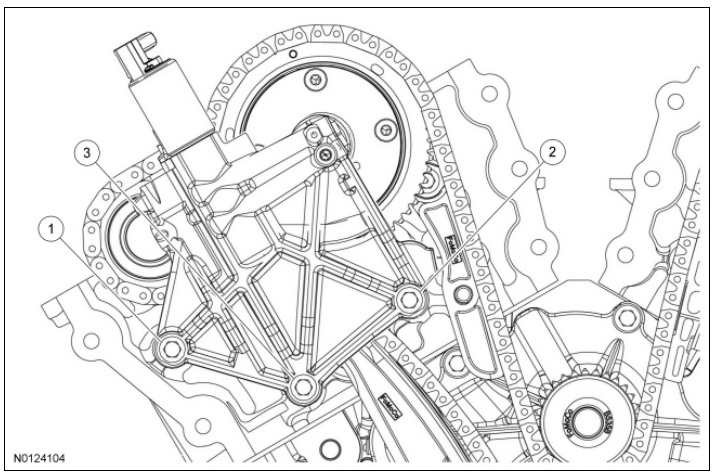
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



27. ***NOTICE:*** **Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.**

    Install the RH VCT housing and the 3 bolts.

    - Tighten in the sequence shown to 10 Nm (89 lb-in).



28. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Valve Tappets

Material

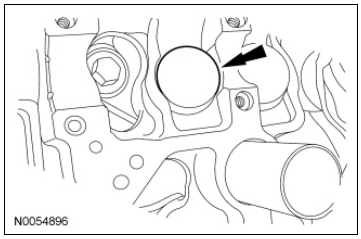
Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, may cause engine failure.**

1. **NOTE:** The valve tappets must be installed in their original positions.

   NOTE: Coat the valve tappets with clean engine oil prior to installation.

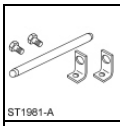
   Install the valve tappets.



2. Depending on the valve tappets being serviced, install the LH and/or the RH camshafts. For addial information, refer to Camshaft in this section.

Valve Spring, Retainer and Seal

Special Tool(s)

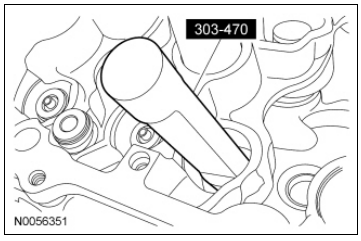
 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)

Material

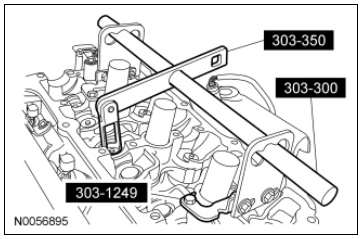
Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

1. **NOTE:** Lubricate the valve stem seal with clean engine oil prior to installation.

   Using the Valve Stem Oil Seal Installer, install a new valve stem seal.



2. Using the Valve Spring Compressors, install the valve spring, retainer and key.



3. Install the valve tappets. For additional information, refer to Valve Tappets in this section.

Cylinder Head - RH

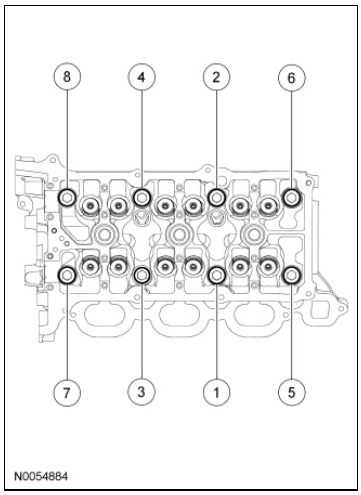
Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

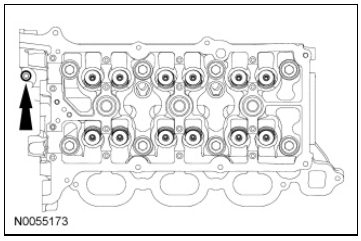
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

All engines

1. Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 35 Nm (26 lb-ft).
    - Stage 3: Tighten 90 degrees.
    - Stage 4: Tighten 90 degrees.
    - Stage 5: Tighten 45 degrees.



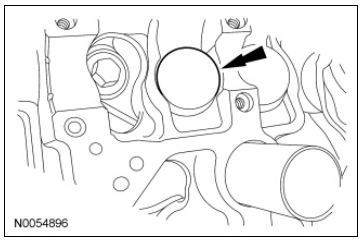
2. Install the new M6 bolt.
    - Tighten to 10 Nm (89 lb-in).



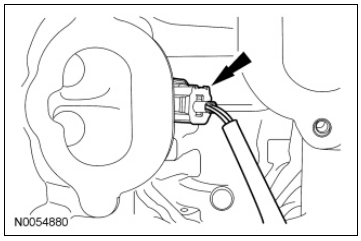
3. **NOTE:** The valve tappets must be installed in their original positions.

   NOTE: Coat the valve tappets with clean engine oil prior to installation.

   Install the valve tappets.



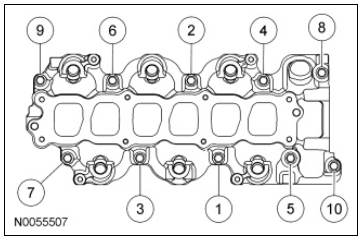
4. Install and connect the Cylinder Head Temperature (CHT) sensor jumper harness.



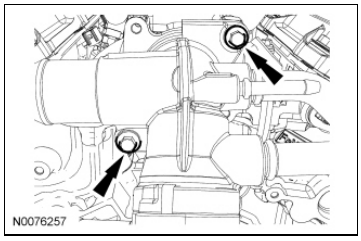
5. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

   Using new gaskets, install the lower intake manifold and the 10 bolts.

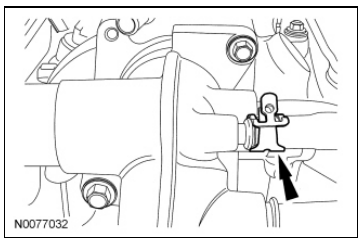
   - Tighten in the sequence shown to 10 Nm (89 lb-in).



6. Using a new gasket and O-ring seal, install the thermostat housing and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).



7. Connect the coolant bypass hose to the thermostat housing.

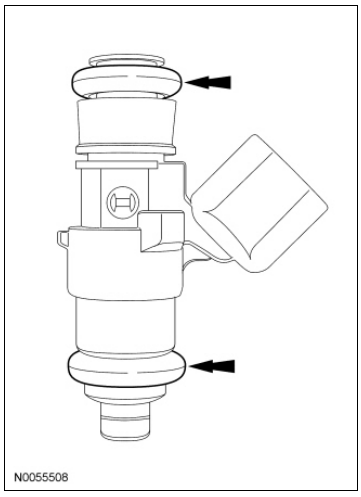


8. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-rings can cause the fuel system to leak. Do not reuse the O-ring seals.**

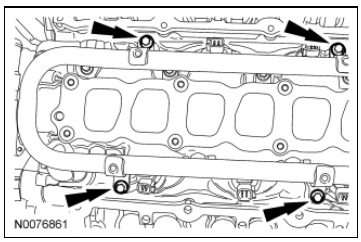
   NOTE: The upper and lower O-ring seals are not interchangeable.

   Install new fuel injector O-ring seals.

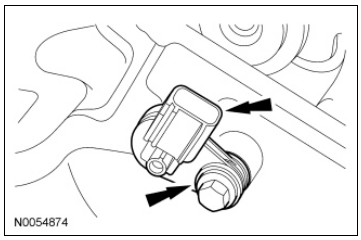
   - Remove the retaining clips and separate the fuel injectors from the fuel rail.
   - Remove and discard the O-ring seals.
   - Install new O-ring seals and lubricate with clean engine oil.
   - Install the fuel injectors and the retaining clips onto the fuel rail.



9. Install the fuel rail and injectors as an assembly and install the 4 bolts.
   - Tighten to 10 Nm (89 lb-in).



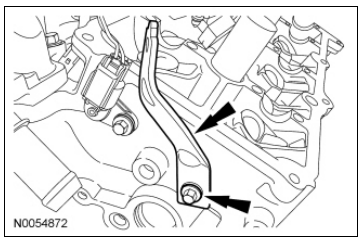
10. Install the RH Camshaft Position (CMP) sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).



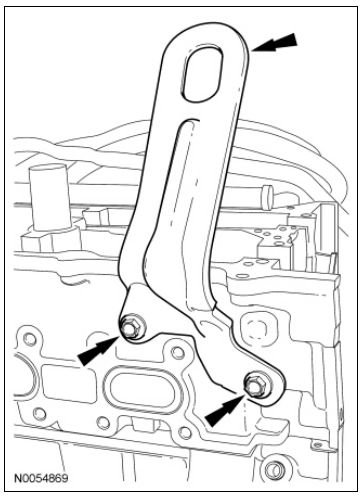
11. **NOTE:** Align the bracket with the index mark made during removal.

    Install the upper intake manifold support bracket and the bolt.

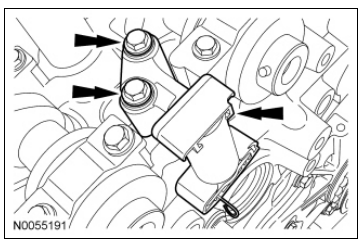
    - Tighten to 10 Nm (89 lb-in).



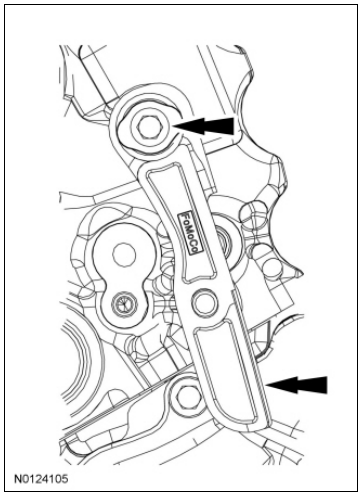
12. Install the engine lifting eye and the 2 bolts.
    - Tighten to 24 Nm (18 lb-ft).



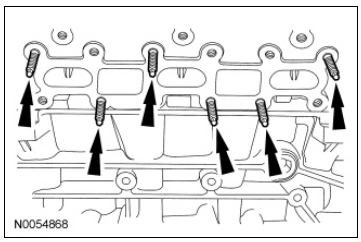
13. Install the RH secondary timing chain tensioner and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



14. Install the RH timing chain guide and bolt.
    - Tighten to 10 Nm (89 lb-in).



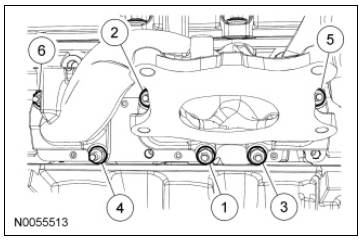
15. Install 6 new RH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).



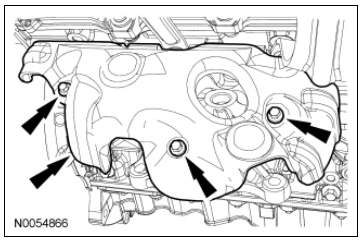
16. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

    Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:

    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).

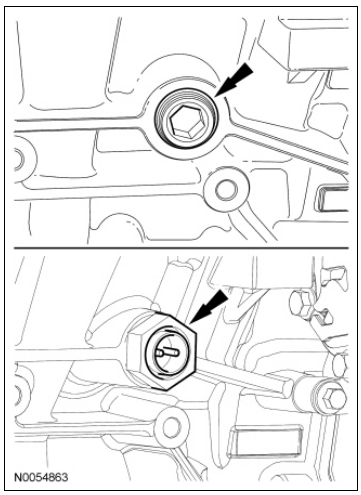


17. Install the RH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



18. Install the RH cylinder block drain plug or, if equipped, the block heater.
    - Tighten the cylinder block drain plug to 10 Nm (89 lb-in) plus an additional 720 degrees.

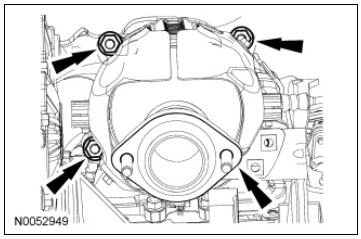
- Tighten the block heater to 40 Nm (30 lb-ft).



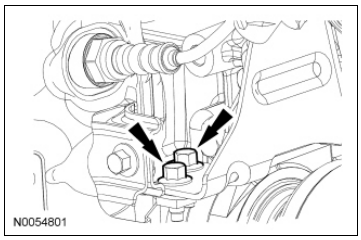
All-Wheel Drive (AWD) vehicles

19. **NOTE:** Do not tighten the 4 catalytic converter nuts at this time.

    Using a new gasket, install the RH catalytic converter and 4 new nuts.

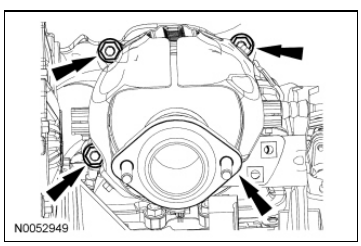


20. Install the 2 RH catalytic converter bracket bolts.
    - Tighten the 4 catalytic converter nuts to 40 Nm (30 lb-ft).
    - Tighten the 2 catalytic converter brackets to 20 Nm (177 lb-in).



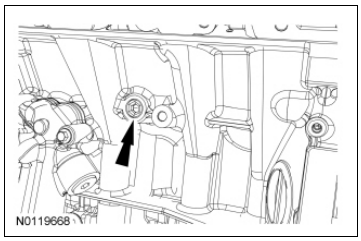
Front Wheel Drive (FWD) vehicles

21. Using a new gasket, install the RH catalytic converter and 4 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

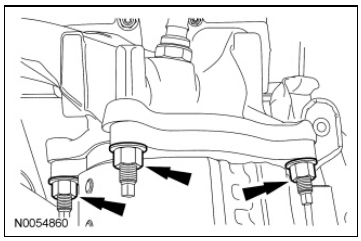


All engines

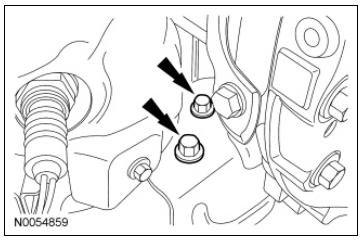
22. Install the LH cylinder block drain plug.
    - Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.



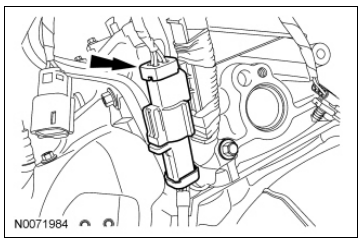
23. Using a new gasket, install the LH catalytic converter and 4 new nuts (3 shown).
    - Tighten to 40 Nm (30 lb-ft).



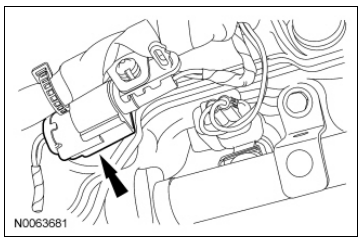
24. Install the 2 LH catalytic converter bracket bolts.
    - Tighten to 20 Nm (177 lb-in).



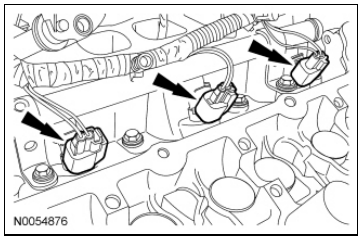
25. Connect the LH Catalyst Monitor Sensor (CMS) sensor electrical connector.



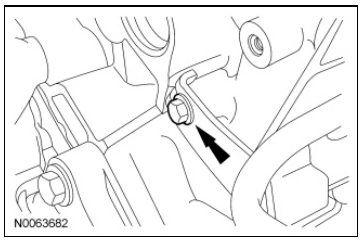
26. Connect the CHT sensor electrical connector.



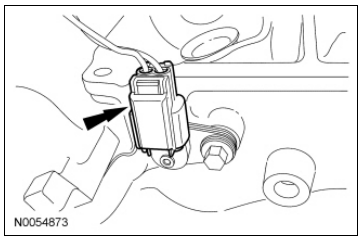
27. Connect the 6 fuel injector electrical connectors (3 shown).



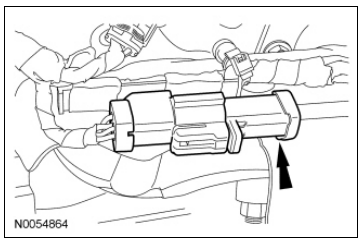
28. Install the Power Steering Pressure (PSP) tube bracket and bolt.
    - Tighten to 10 Nm (89 lb-in).



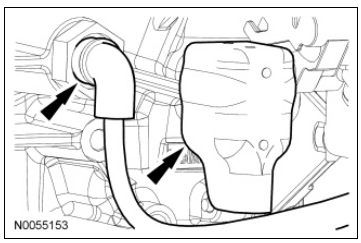
29. Connect the RH CMP sensor electrical connector.



30. Connect the RH HO2S electrical connector.



31. If equipped, install the block heater wiring harness onto the engine.
    - Connect the block heater electrical connector and install the heat shield.



32. Install the RH camshafts. For additional information, refer to Camshaft in this section.

Cylinder Head - LH

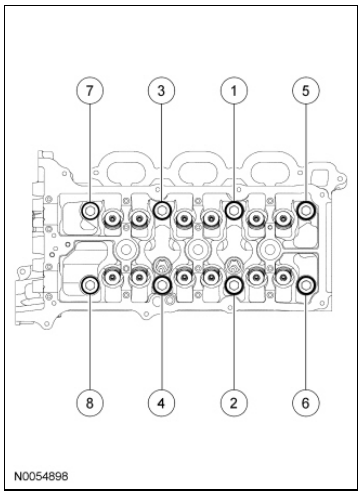
Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

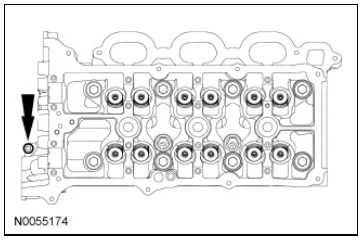
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

All vehicles

1. Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown in 5 stages:
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 35 Nm (26 lb-ft).
    - Stage 3: Tighten 90 degrees.
    - Stage 4: Tighten 90 degrees.
    - Stage 5: Tighten 45 degrees.



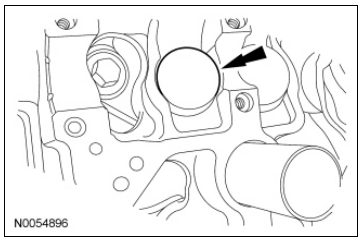
2. Install the new M6 bolt.
    - Tighten to 10 Nm (89 lb-in).



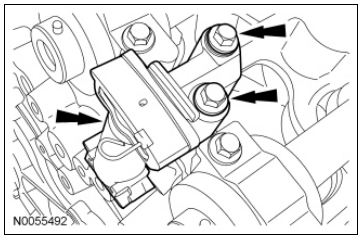
3. **NOTE:** The valve tappets must be installed in their original positions.

   NOTE: Coat the valve tappets with clean engine oil prior to installation.

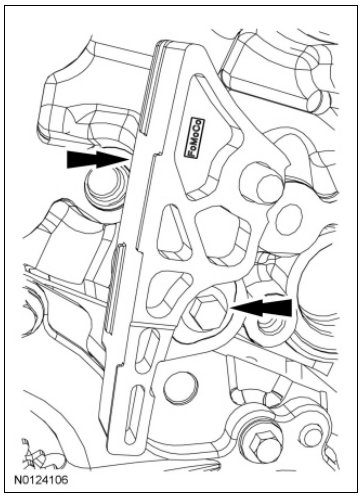
   Install the valve tappets.



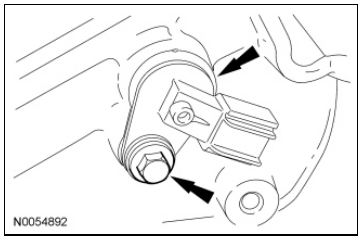
4. Install the LH secondary timing chain tensioner and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).



5. Install the upper LH primary timing chain guide and the bolt.
   - Tighten to 10 Nm (89 lb-in).



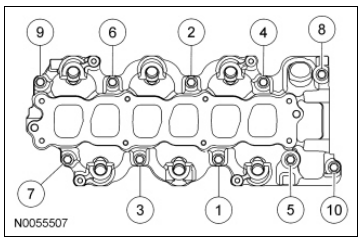
6. Install LH Camshaft Position (CMP) sensor and the bolt.
   - Tighten to 10 Nm (89 lb-in).



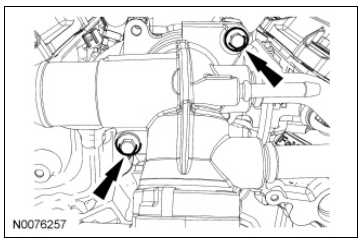
7. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

   Using new gaskets, install the lower intake manifold and the 10 bolts.

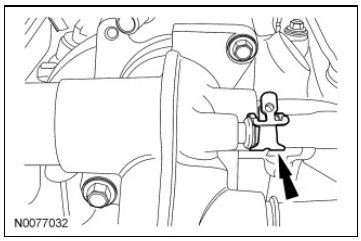
   - Tighten in the sequence shown to 10 Nm (89 lb-in).



8. Using a new gasket and O-ring seal, install the thermostat housing and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).



9. Connect the coolant bypass hose to the thermostat housing.



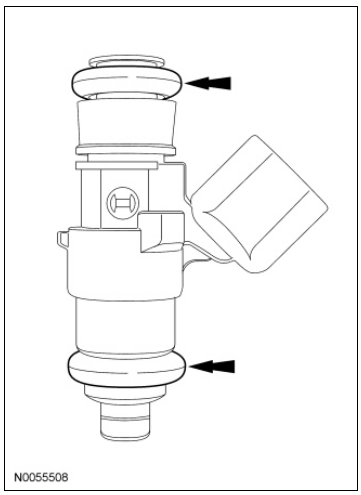
10. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-rings can cause the fuel system to leak. Do not reuse the O-ring seals.**

    NOTE: The upper and lower O-ring seals are not interchangeable.

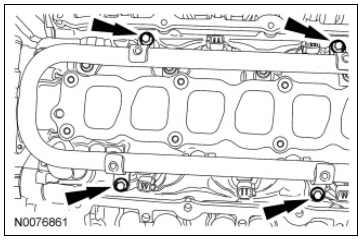
    Install new fuel injector O-ring seals.

    - Remove the retaining clips and separate the fuel injectors from the fuel rail.
    - Remove and discard the O-ring seals.
    - Install new O-ring seals and lubricate with clean engine oil.

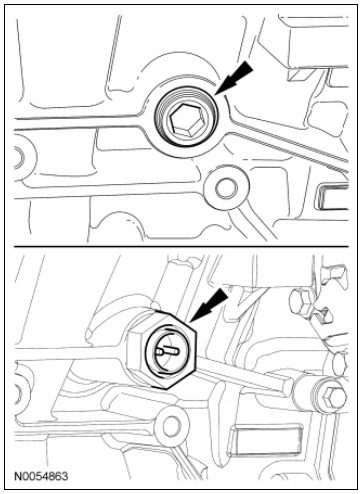
- Install the fuel injectors and the retaining clips onto the fuel rail.



11. Install the fuel rail and injectors as an assembly and install the 4 bolts.
    - Tighten to 10 Nm (89 lb-in).



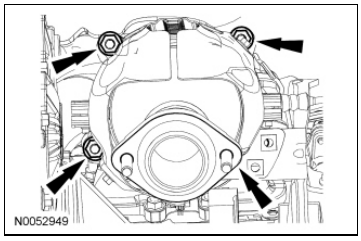
12. Install the RH cylinder block drain plug or, if equipped, the block heater.
    - Tighten the cylinder block drain plug to 10 Nm (89 lb-in) plus an additional 720 degrees.
    - Tighten the block heater to 40 Nm (30 lb-ft).



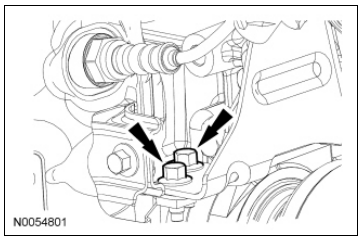
All-Wheel Drive (AWD) vehicles

13. **NOTE:** Do not tighten the 4 catalytic converter nuts at this time.

    Using a new gasket, install the RH catalytic converter and 4 new nuts.

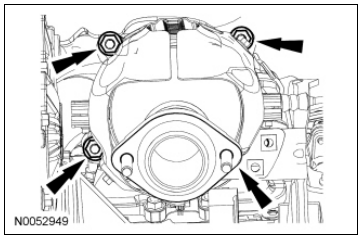


14. Install the 2 RH catalytic converter bracket bolts.
    - Tighten the 4 catalytic converter nuts to 40 Nm (30 lb-ft).
    - Tighten the 2 catalytic converter brackets to 20 Nm (177 lb-in).



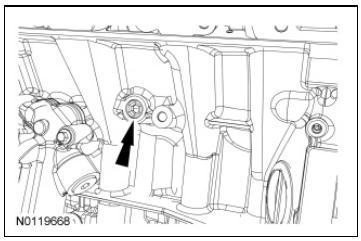
Front Wheel Drive (FWD) vehicles

15. Using a new gasket, install the RH catalytic converter and 4 new nuts.
    - Tighten to 40 Nm (30 lb-ft).

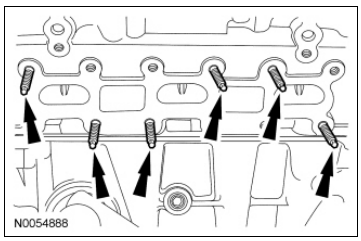


All vehicles

16. Install the LH cylinder block drain plug.
    - Tighten to 16 Nm (142 lb-in) plus an additional 180 degrees.



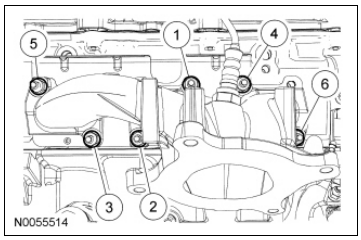
17. Install 6 new LH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).



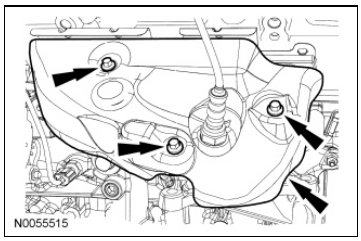
18. ***NOTICE:*** **Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.**

    Using a new gasket, install the LH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown:

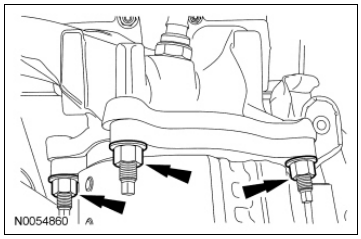
    - Stage 1: Tighten to 20 Nm (177 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).



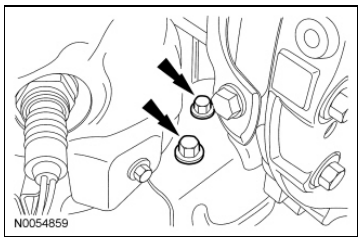
19. Install the LH exhaust manifold heat shield and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).



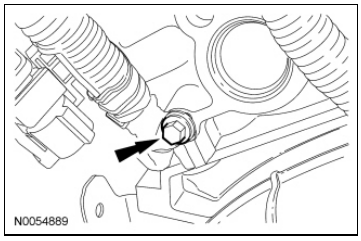
20. Using a new gasket, install the LH catalytic converter and 4 new nuts (3 shown).
    - Tighten to 40 Nm (30 lb-ft).



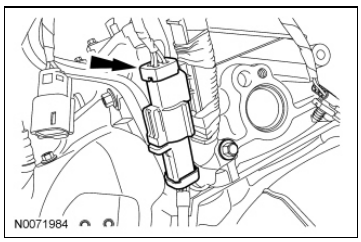
21. Install the 2 LH catalytic converter bracket bolts.
    - Tighten to 20 Nm (177 lb-in).



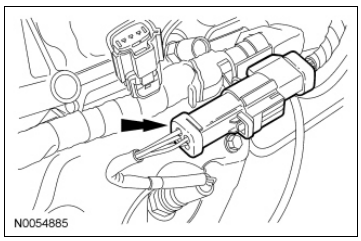
22. Install the wiring harness retainer bolt on the rear of the LH cylinder head.
    - Tighten to 10 Nm (89 lb-in).



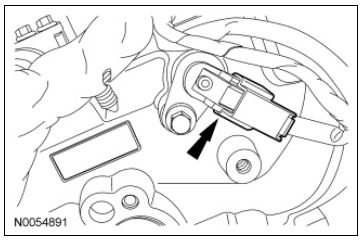
23. Connect the LH Catalyst Monitor Sensor (CMS) sensor electrical connector.



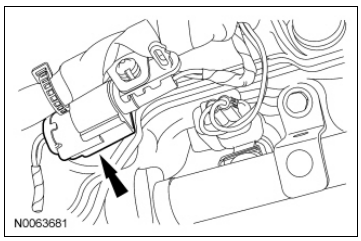
24. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector.



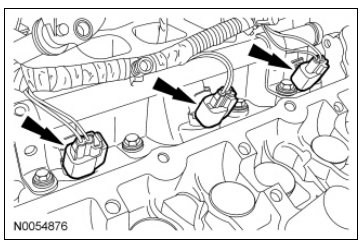
25. Connect the LH CMP sensor electrical connector.



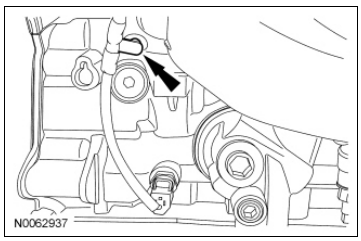
26. Connect the Cylinder Head Temperature (CHT) sensor electrical connector.



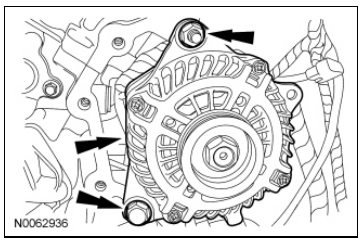
27. Connect the 6 fuel injector electrical connectors (3 shown).



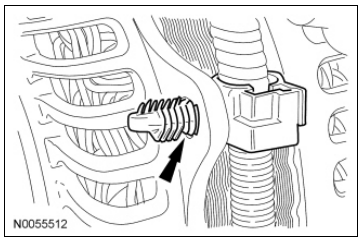
28. Attach the wiring harness pin-type retainer.



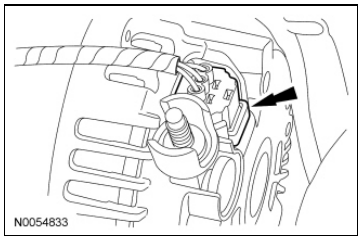
29. Install the generator, the bolt and the nut.
    - Tighten to 48 Nm (35 lb-ft).



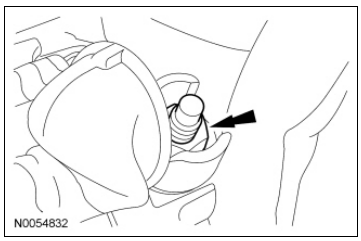
30. Attach the wiring harness retainer to the generator.



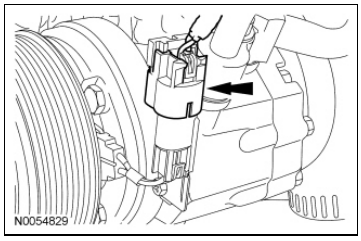
31. Connect the generator electrical connector.



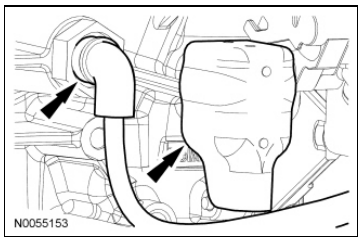
32. Connect the generator B+ cable and install the nut.
    - Tighten to 12 Nm (106 lb-in).



33. Connect the A/C compressor electrical connector.



34. If equipped, install the block heater wiring harness onto the engine.
    - Connect the block heater electrical connector and install the heat shield.



35. Install the LH camshafts. For additional information, refer to Camshaft in this section.

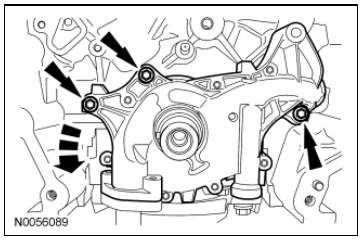
Oil Pump

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

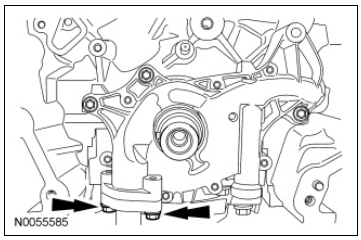
1. **NOTE:** Install a new oil pump screen and pickup tube O-ring seal prior to installing the oil pump.

   Position the oil pump onto the crankshaft and rotate counterclockwise to position the pump onto the oil pump screen and pickup tube.

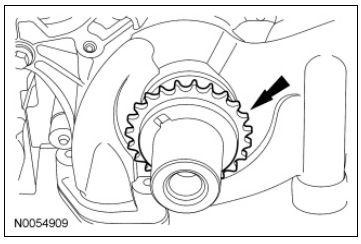
   - Install the 3 bolts and tighten to 10 Nm (89 lb-in).



2. Install the 2 oil pump screen and pickup tube bolts.
   - Tighten to 10 Nm (89 lb-in).

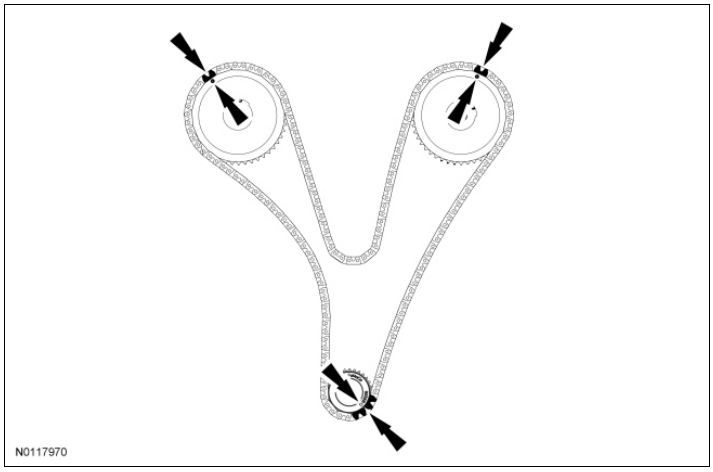


3. Install the crankshaft timing chain sprocket.

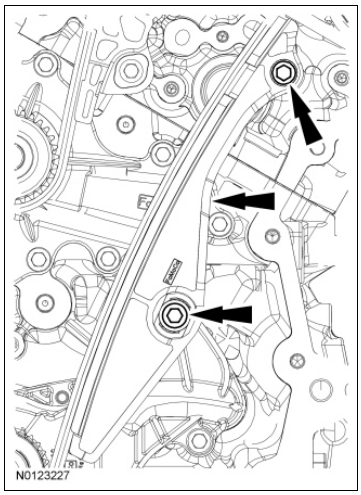


4. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

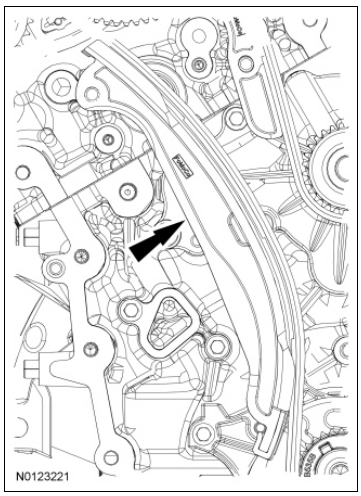
   Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.



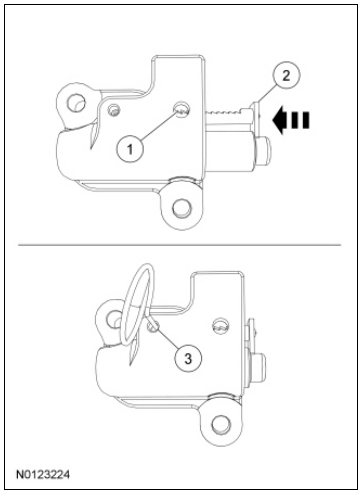
5. Install the lower LH primary timing chain guide and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



6. Install the primary timing chain tensioner arm.



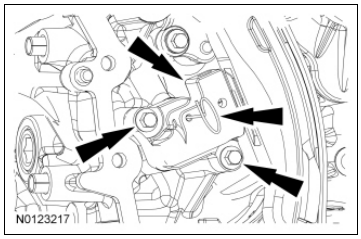
7. Reset the primary timing chain tensioner.
    1. Release the ratchet detent.
    2. Using a soft-jawed vise, compress the ratchet plunger.
    3. Align the hole in the ratchet plunger with the hole in the tensioner housing and install a suitable lockpin.



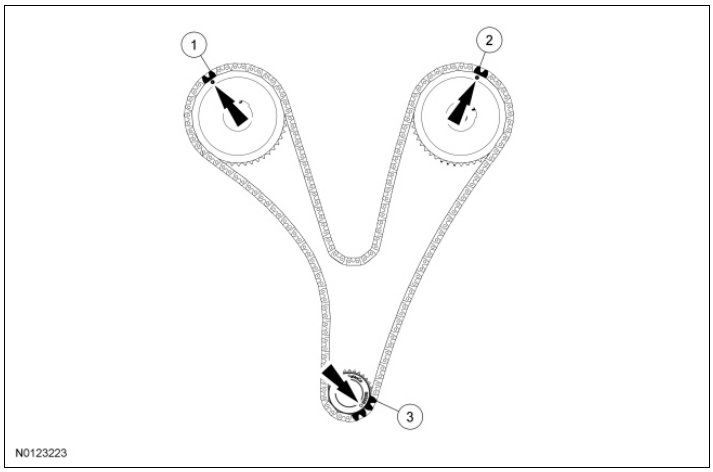
8. **NOTE:** It may be necessary to rotate the crankshaft slightly to remove slack from the timing chain and install the tensioner.

   Install the primary tensioner and the 2 bolts.

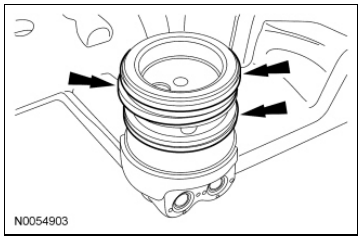
   - Tighten to 10 Nm (89 lb-in).
   - Remove the lockpin.



9. As a post-check, verify correct alignment of all timing marks.
   - There are 48 links between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
   - There are 35 links between the LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket colored links (3).



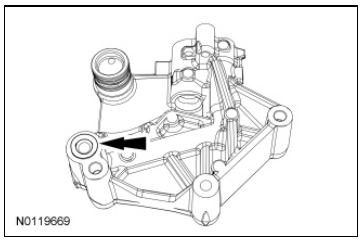
10. Install new VCT housing seals.



11. **NOTE:** RH shown, LH similar.

    NOTE: During removal, the O-ring seal may remain on the cylinder head. If so, remove the O-ring seal from the cylinder head, inspect the seal (replace as necessary) and install the O-ring seal on the VCT housing.

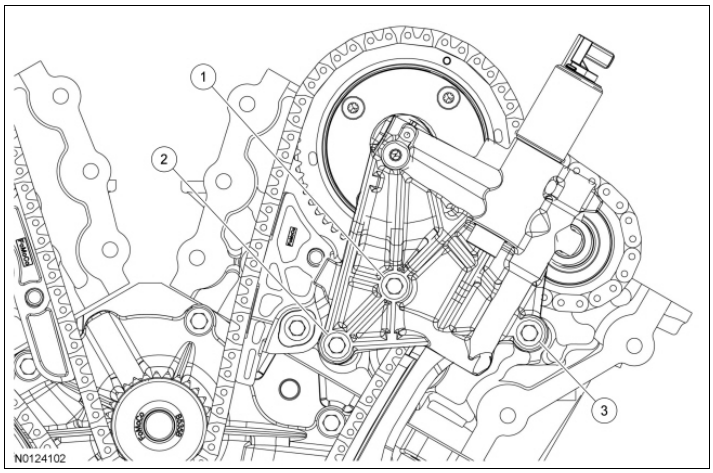
    Inspect the VCT housing-to-cylinder head O-ring seals for damage and replace as necessary.



12. ***NOTICE:*** **Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.**

    Install the LH VCT housing and the 3 bolts.

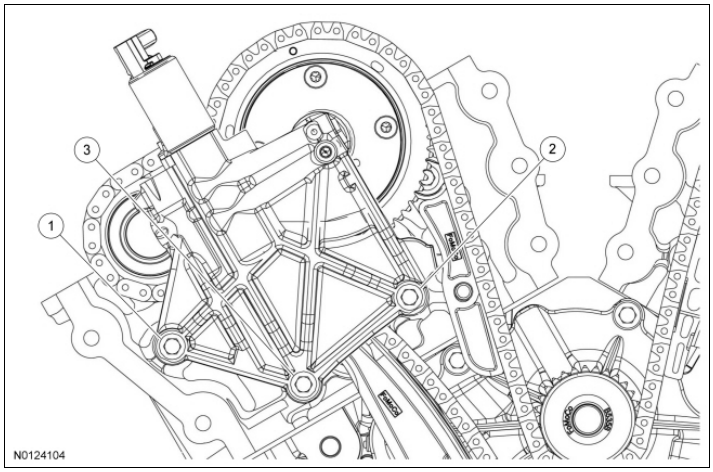
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



13. ***NOTICE:*** **Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.**

    Install the RH VCT housing and the 3 bolts.

    - Tighten in the sequence shown to 10 Nm (89 lb-in).



14. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Material

Item	Specification	Fill Capacity
Motorcraft® Metal Surface Prep ZC-31-A	-	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	5.0L (5.3 qt) includes filter change
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A	[a]
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D	[a]
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B	-
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	-
Silicone Gasket and Sealant TA-30	WSd>	-
Motorcraft® Silicone Gasket Remover ZC-30	-	-
Thread Sealant with PTFE TA-24	WSK-M2G350-A2	-

[a] Early build vehicle cooling systems are filled with Motorcraft® Specialty Green Engine Coolant and late build vehicle cooling systems are filled with Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.

General Specifications

Item	Specification
Displacement	2.5L
No. of cylinders	4

Bore/stroke	89/100
Firing order	1-3-4-2
Oil pressure (hot @ 2,000 rpm)	29-39 psi 200-268 kPa
Compression ratio	12.5:1
Engine weight (without accessory drive components)	121.3 kg (267.5 lb)
Engine and transaxle weight (without accessory drive components)	257.1 kg (567 lb)
Cylinder Block	
Cylinder bore diameter	89-89.3 mm (3.503-3.517 in)
Cylinder bore maximum out-of-round	0.008 mm (0.0003 in)
Main bearing bore diameter	57.018-57.040 mm (2.244-2.245 in)
Head gasket surface flatness	0.1 mm/general 0.05 mm/200 x 200 (0.003 in/general) (0.0019 in/7.87 x 7.87)
Piston	
Diameter (1)	88.965-88.975 mm (3.5025-3.5026 in)
Diameter (2)	88.975-88.985 mm (3.5026-3.5033 in)
Diameter (3)	88.985-88.995 mm (3.5033-3.5037 in)
Piston-to-bore clearance	0.025-0.045 mm (0.0009-0.0017 in)
Ring groove width - top	1.203-1.205 mm (0.0473-0.0474 in)
Ring groove width - 2nd	1.202-1.204 mm (0.0473-0.0474 in)
Ring groove width - oil	2.501-2.503 mm (0.0984-0.0985 in)
Piston skirt coating thickness	

	0.008-0.016 mm (0.0003-0.0006 in)
Piston Pin	
Diam	19.995-20 mm (0.7872-0.7874 in)
Length	54.7-55 mm (2.153-2.165 in)
Piston-to-pin clearance	Floating Pin
Pin-to-rod clearance	Clips
Cylinder Head	
Cylinder head flatness	0.08 mm (0.0031 in) maximum overall, a maximum of 0.05 mm (0.0019 in) within 150 mm (5.9 in)
Valve lift @ zero lash (exhaust)	7.7 mm (0.30 in)
Valve lift @ zero lash (intake)	8.8 mm (0.35 in)
Valve guide diameter	5.509-5.539 mm (0.216-0.218 in)
Valve seat width - intake/exhaust	0.99-1.84 mm (0.038-0.072 in)
Valve seat angle	45 degrees
Valve seat runout	0.075 mm (0.0029 in)
Valve lash adjuster bore diameter	31.00-31.03 mm (1.220-1.221 in)
Cam bore diameter	25.015-25.040 mm (0.984-0.985 in)
Valve	
Valve head diameter - intake	34.85-35.15 mm (1.3.383 in)
Valve head diameter - exhaust	29.85-30.15 mm (1.175-1.187 in)
Valve stem diameter - intake	5.470-5.485 mm (0.2153-0.2159 in)
Valve stem diameter - exhaust	5.465-5.480 mm (0.2151-0.2157 in)
Valve stem-to-guide clearance - intake	0.0027 mm (0.00010 in)
Valve stem-to-guide clearance - exhaust	0.0029 mm (0.00011 in)
Valve face runout (maximum)	0.075 mm (0.0029 in)
Valve face angle	45 degrees

Valve Spring - Compression Pressure	
Intake and exhaust (installed)	38.667 lb
Intake (valve open) 8.9 mm (0.35 in) of lift	97.032 lb
Exhaust (valve open) 7.4 mm of lift	93.338 lb
Free length	44.92 mm (1.768 in)
Assembled height	37.9 mm (1.492 in)
Crankshaft	
Main bearing journal diameter	51.978-52.002 mm (2.046-2.047 in)
Production repa valign="top" align="center">51.730-51.750 mm (2.036-2.037 in)	
Main bearing clearance	0.016-0.047 mm (0.0006-0.0015 in)
Connecting rod journal diameter	51.978-52.002 mm (2.0463-2.0473 in)
Production repair	51.730-51.750 mm (2.0366-2.0374 in)
End play	0.22-0.43 mm (0.008-0.016 in)
Rings	
Width - top	1.17-1.185 mm (0.0460-0.0466 in)
Width - 2nd	1.197-1.199 mm (0.0471-0.0472 in)
Width - oil	2.38-2.45 mm (0.093-0.096 in)
Ring gap (in bore) - top	0.16-0.26 mm (0.006-0.010 in)
Ring gap (in bore) - 2nd	0.31-0.46 mm (0.012-0.018 in)
Ring gap (in bore) - oil	0.2-0.7 mm (0.007-0.027 in)
Valve Tappet	
Diameter	30.97-30.98 mm (1.2192-1.2196 in)

Tappet-to-valve clearance - intake	0.22- 0.28 mm (0.008-0.011 in)
Tappet-to-valve exhaust	0.27-0.33 mm (0.010-0.013 in)
Tappet-to-bore clearance	0.02-0.06 mm (0.0007-0.0023 in)
Camshaft	
Lobe lift - intake	8.24999 mm (0.324 in)
Lobe lift - exhaust	7.80007 mm (0.307 in)
Runout (1) [a]	0.03 mm (0.001 in)
Thrust clearance	0.09-0.24 mm (0.003-0.009 in)
Journal diameter	24.96-24.98 mm (0.982-0.983 in)
Journal-to-bore clearance	0.035-0.080 mm (0.001-0.003 in)
Connecting Rod	
Bearing clearance	0.027-0.052 mm (0.001-0.002 in)
Bearing thickness	1.496-1.520 mm (0.058-0.059 in)
Crank bore diameter	55.023-55.047 mm (2.166-2.167 in)
Pin bore diameter	20.965-20.985 mm (0.825-0.826 in)
Length (center to center)	151.8 mm (5.976 in)
Side clearance	1.95-3.05 mm (0.076-0.12)
Axial clearance	0.14-0.36 mm (0.005-0.014 in)

[a] No. 3 Journal - Supported by No. 1 and No. 5 journals.

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bracket bolts	48	35	-
A/C compressor mounting bolts	25	18	-
A/C manifold tube-to-A/C compressor nut	15	-	133
A/C tube bracket bolt	6	-	53

A/C tube bracket-to-strut tower bolt	6	-	53
A/C tube-to-A/C compressor nut	15	-	133
A/C tube nut	15	-	133
Accessory drive belt tensioner	25	18	-
Air Cleaner (ACL) outlet tube clamps	3	-	27
Auxiliary coolant pump bolts	10	-	89
Balance shaft bolts [a]	-	-	-
Block heater (if equipped)	40	30	-
Block-off plate bolts	25	18	-
Camshaft bearing caps [a]	-	-	-
Camshaft sprocket bolt	72	53	-
Catalytic converter-to-cylinder head nuts [a]	-	-	-
Catalytic converter manifold bracket-to-engine block bolts	35	26	-
Catalytic converter manifold heat shield bolts	-	89	
Coil-on-plug retaining stud bolts	8	-	71
Connecting rod cap bolts [a]	-	-	-
Coolant outlet bolts	10	-	89
Coolant pump bolts	10	-	89
Coolant pump pulley bolts	20	-	177
Crankcase vent oil separator bolts	10	-	89
Crankshaft Position (CKP) sensor	7	-	62
Crankshaft pulley bolt [a]	-	-	-
Crankshaft rear oil seal with retainer bolts	10	-	89
Cylinder head bolts [a]	-	gn="center">-	
Cylinder Head Temperature (CHT) sensor	12	-	106
EGR tube	55	41	-
EGR valve assembly bolts	20	-	177
Engine front cover bolts [a]	-	-	-
Engine Oil Pressure (EOP) switch	15	-	133
Engine mount bolts and nut	55	41	-
Engine mount bracket ground strap bolt	10	-	89
Engine mount bracket-to-engine nuts	103	76	-
Engine mount bracket-to-mount bolt	115	85	-
Engine plug bolt	20	-	177
	90	66	-
Engine timing plug bolt	20	-	177
Engine-to-transaxle bolts	48	35	-
Engine wiring harness connector bracket	15	-	133
Electronic Power Assist Steering (EPAS) ground wire bolt	10	-	89
Exhaust manifold studs	17	-	150
Flywheel bolt [a]	-	-	-
Fuel rail bolts	23	17	-
Intake manifold bolts	18	-	159
Knock Sensor (KS)	20	-	177

Lower front cover timing hole plug	12		
Main bearing beam bolts [a]	-	-	-
Master cylinder reservoir bolts	10	-	89
Motor Electronics Cooling System (MECS) coolant expansion tank nut and bolt	10	-	89
Oil drain plug	28	21	-
Oil filter adapter bolts	25	18	-
Oil filter [b]	-	-	-
Oil pan bolts [a]	-	-	-
Oil pan-to-bellhousing bolts	48	35	-
Oil pump drive chain tensioner shoulder bolts	10	-	89
Oil pump screen and pickup tube bolts	10	89	
Oil pump sprocket bolt	25	18	-
Oil pump-to-engine block bolts [a]	-	-	-
Oil squirters	4	-	35
Radio capacitor nut	10	-	89
Spark plug	12	-	106
Stabilizer bar link nuts	40	30	-
Steering column shaft-to-steering gear bolt	23	17	-
Subframe bracket-to-body bolts	103	76	-
Subframe nuts	150	111	-
Thermostat housing bolts	10	-	89
Tie-rod end nuts	35	-	
Timing chain guide bolts	10	-	89
Timing chain tensioner bolts	10	-	89
Transaxle selector lever cable bracket nuts	12	-	106
Transaxle damper bolts	29	21	-
Transaxle ground wire nut	10	-	89
Transaxle harness wiring retainer bolt	10	-	89
Transaxle-to-engine bolts	48	35	-
Upper transaxle insulator nuts	90	66	-
Upper front cover timing hole plug	10	-	89
Vacuum pump assembly bolts	25	18	-
Vacuum pump assembly nut	25	18	-
Valve cover bolts [a]	-	-	-
Variable Camshaft Timing (VCT) plug	17	-	150
VCT solenoid bolt	10	-	89

[a] Refer to the procedure in this section.

[b] Tighten the pin-on oil filter three-fourths of a turn after the oil filter gasket makes contact with the oil filter adapter.

Engine

The 2.5L (153 CID) 4-cylinder engine has the following features:

- Dual overhead camshaft
- Four valves per cylinder
- Sequential Multi-Port Fuel Injection (SFI)
- Aluminum cylinder head
- Aluminum cylinder block
- Electronic ignition system with 4 coil-on-plug ignition coils

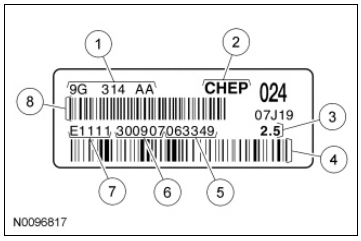
The 2.5L engine is a 4 valve-per-cylinder, dual overhead camshaft engine. The engine uses a coil-on-plug ignition system. The cylinder block is made of aluminum and the bearing caps are integrated into the ladder assembly. An aluminum oil pan bolts to the bottom of the lower cylinder block and to the transmission to provide greater strength. The camshafts are mounted in the cylinder heads and act against valve tappets to open and close the valves. The camshafts are driven off the front of the cylinder head by one timing chain. The chain isven by a sprocket that is located on the crankshaft. The piston assembly is an aluminum piston with a cast iron connecting rod. The oil pump is driven by the crankshaft via a dedicated chain that is driven by the same sprocket that drives the timing chain.

Engine Identification

Always refer to these labels when installation of new parts is necessary or when checking engine calibrations. The engine parts often differ within a CID family. Verification of the identification codes will make sure the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions. The Ford Catalog AdvantageTM or equivalent contains a complete listing of the codes and their applications.

Engine Code Information Label

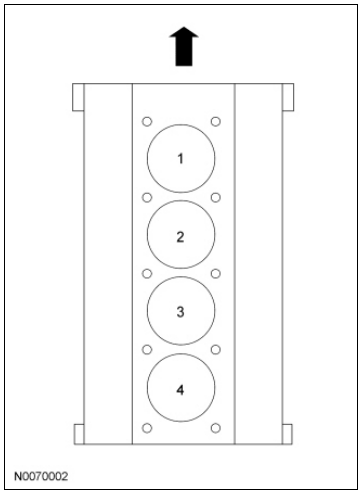
The engine code information label, located on the front side of the valve cover, contains the following:



Item	Description
1	Engine part number
2	Chihuahua engine plant
3	Engine displacement
4	Bar code
5	Running number

6	Engine build date (DDMMYY)
7	Plant shift line
8	Bar code

Engine Cylinder Identification



Exhaust Emission Control System

Operation and necessary maintenance of the exhaust emission control devices used on this engine are covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The SFI provides the fuel/air mixture needed for combustion in the cylinders. The 4 solenoid-operated fuel injectors:

- are mounted in the intake manifold.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.
- are connected in series with the fuel pressure sensor.
- supply fuel from the fuel tank with a fuel pump mounted in the fuel tank.

A constant fuel pressure is maintained across the fuel injectors by the fuel pressure sensor. The fuel pressure sensor:

- is positioned upstream from the fuel injectors on the fuel injection supply manifold.

Lubrication System

The engine lubrication system operates as follows:

- Oil is drawn into the oil pump through the oil pump screen cover and tube in the sump of the oil pan.
- Oil is pumped through the oil filter on the left front side of the cylinder block.
- Oil enters the main galley where it is distributed to the crankshaft main journals and to the cylinder head.

- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls, as well as the entire connecting rod, piston and piston ring assembly.

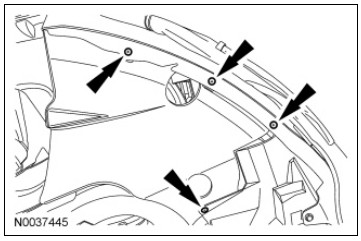
Engine

Refer to Section 303-00 for basic mechanical concerns or refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for driveability concerns.

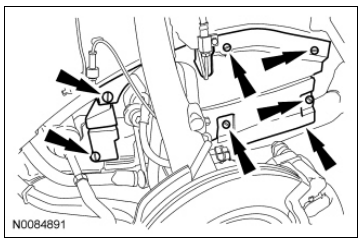
Valve Clearance Check

1. Remove the valve cover. For additional information, refer to Valve Cover in this section.

2. Remove the 4 screws and position the RH fender splash shield aside.



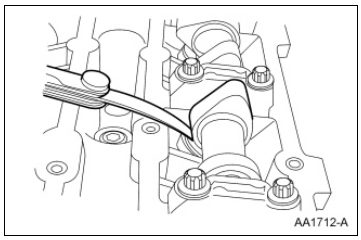
3. Remove the 6 pin-type retainers and the RH splash shield.



4. **NOTE:** Turn the engine clockwise only, and only use the crankshaft bolt.

   NOTE: Before removing the camshafts, measure the clearance of each valve at base circle, with the lobe pointed away from the tappet. Failure to measure all clearances prior to removing the camshafts will necessitate repeated removal and installation and wasted labor time.

   Use a feeler gauge to measure the clearance of each valve and record its location.



5. **NOTE:** The number on the valve tappet only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

   NOTE: The nominal clearance is:

   - intake: 0.25 mm (0.0095 in).
   - exhaust: 0.30 mm (0.0115 in).

   The acceptable clearances after being fully installed are:

   - intake: 0.22-0.28 mm (0.008-0.011 in).
   - exhaust: 0.27-0.33 mm (0.010-0.013 in).

Select tappets using this formula: tappet thickness = measured clearance + the existing tappet thickness - nominal clearance.

Select the closest tappet size to the ideal tappet thickness available and mark the installation location.

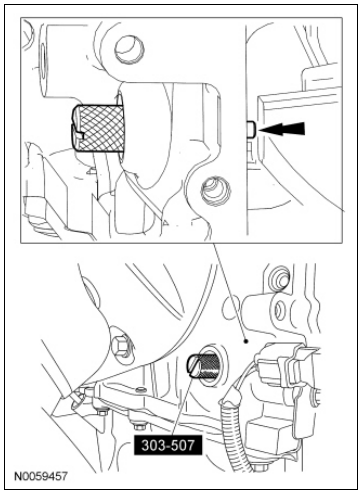
6. If any tappets do not measure within specifications, install new tappets in these locations. For additional information, refer to Valve Train Components - Exploded View and Valve Tappets in this section.

Balance Shaft Backlash

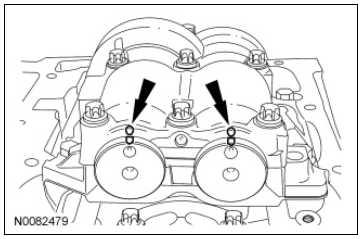
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

1. Install the Crankshaft TDC Timing Peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg. The engine is now at Top Dead Center (TDC).

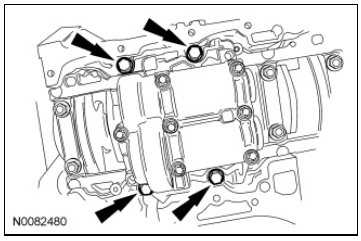


2. Mark the balancer unit and shafts on the top for reference that the balancer unit is at TDC .



3. **NOTE:** Due to the precision interior construction of the balancer unit, it should not be disassembled.

   Remove the 4 bolts and the balancer unit.

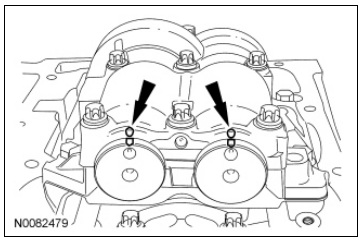


4. Remove the adjustment shims from the seat faces of the balancer unit.

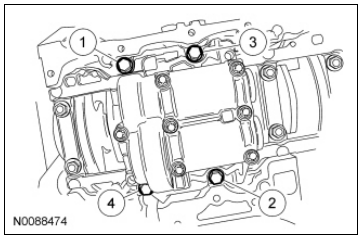
5. ***NOTICE:*** **Visually inspect the balancer unit gear for damage and verify that the shaft turns smoothly. If there is any damage or malfunction, replace the balancer unit.**

   Install the master adjustment shims (No. 50) on the seat faces of the balancer unit.

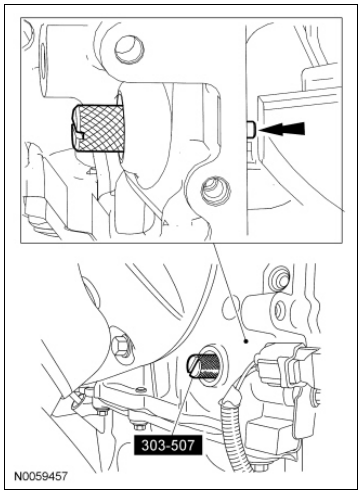
6. With the balancer unit shaft marks at the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.



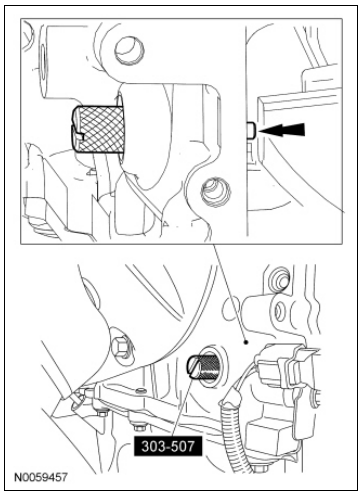
7. Install the balancer unit bolts.
   - Tighten in the sequence shown in 2 stages.
     - ♦ Stage 1: Tighten to 25 Nm (18 lb-ft).
     - ♦ Stage 2: Tighten to 50 Nm (37 lb-ft).



8. Remove the Crankshaft TDC Timing Peg.
   - Rotate the crankshaft to confirm that there are no meshing problems between the balancer unit gear and the crankshaft gear.



9. Install the Crankshaft TDC Timing Peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg.
    - Remove the Crankshaft TDC Timing Peg.



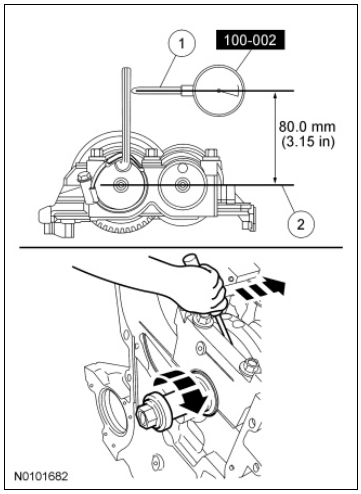
10. **NOTE:** Measure the backlash and verify that it is within specified range at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees. It will be necessary to reset the measuring equipment between measurements.

    NOTE: The measurement must be taken with the Dial Indicator Gauge with Holding Fixture, a 5-mm Allen wrench and worm clamp set up as shown. Mark the Allen wrench with a file 80 mm (3.149 in) above the driven gear shaft center. Make sure the worm clamp and Allen wrench are not touching the balance shaft housing.

    NOTE: For an accurate measurement while measuring the gear backlash, insert a screwdriver as shown into the crankshaft No. 1 crankweight area and set both the rotation and the thrust direction with the screwdriver, using a prying action as shown.

    Position the Dial Indicator Gauge with Holding Fixture as shown. Measure the gear backlash.

    - Position the Dial Indicator Gauge with Holding Fixture (1) on the Allen wrench 80 mm (3.149 in) above the driven gear shaft center (2) on the balancer unit.
    - Rotate the crankshaft clockwise and measure the backlash at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees.



11. **NOTE:** If maximum backlash exceeds 0.101 mm (0.003 in), install a new balancer unit.

    Using the backlash measurement, select the proper shims from the Adjustment Shim Selection Table.

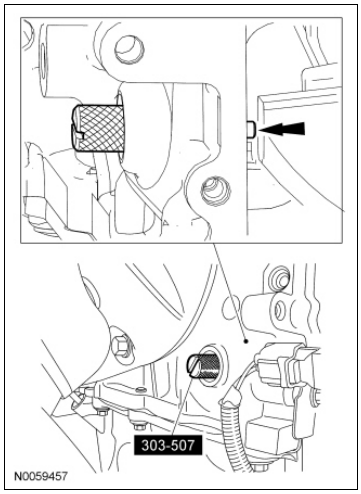
    - Remove the balancer unit from the cylinder block.
    - Install the selected adjustment shims on the seat faces of the balancer unit.

ADJUSTMENT SHIM SELECTION TABLE

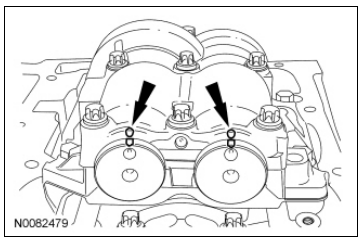
Backlash mm (in)	Selection shim (No.)	Shim thicness mm (in)	Backlash mm (in)	Selection shim (No.)	Shim thicness mm (in)
0.516-0.528 (0.0203-0.0207)	15	1.15 (0.0452)	0.245-0.257 (0.0096-0.0101)	35	1.35 (0.0531)
0.502-0.514 (0.0197-0.0202)	16	1.16 (0.0456)	0.232-.0243 (0.0091-0.0095)	36	1.36 (0.535)
0.489-0.500 (0.0192-0.0196)	17	1.17 (0.0460)	0.218-0.230 (0.0085-0.0090)	37	1.37 (0.539)
0.475-0.487 (0.0187-0.0191)	18	1.18 (0.0464)	0.205-.0216 (0.0080-0.0085)	38	1.38 (0.0543)
0.462-0.473 (0.0181-0.0186)	19	1.19 (0.0468)	0.191-0.203 (0.0075-0.0079)	39	1.39 (0.0547)
0.448-0.460 (0.0176-0.0181)	20	1.20 (0.0472)	0.178-0.189 (0.0070-0.0074)	40	1.40 (0.0551)
0.435-0.446 (0.0171-0.0175)	21	1.21 (0.0476)	0.164-0.176 (0.0064-0.0069)	41	1.41 (0.0555)
0.421-0.433 (0.0165-0.0170)	22	1.22 (0.0480)	0.151-0.162 (0.0059-0.0063)	42	1.42 (0.0559)
0.408-0.419 (0.0160-0.0164)	23	1.23 (0.0484)	0.137-0.149 (0.0053-0.0058)	43	1.43 (0.0562)
0.394-0.406 (0.0155-0.0159)	24	1.24 (0.0488)	0.124-0.135 (0.0048-0.0053)	44	1.44 (0.0566)
0.381-0.392 (0.0150-0.0154)	25	1.25 (0.492)	0.110-0.122 (0.0043-0.0048)	45	1.45 (0.0570)
0.367-0.379 (0.0144-0.0149)	26	1.26 (0.0496)	0.097-0.108 (0.0038-0.0042)	46	1.46 (0.0574)
0.354-0.365 (0.0139-0.0143)	27	1.27 (0.0499)	0.083-0.095 (0.0032-0.0037)	47	1.47 (0.0578)
0.340-0.352 (0.0133-0.0138)	28	1.28 (0.0503)	0.070-0.081 (0.0027-0.0031)	48	1.48 (0.0582)
0.327-0.338 (0.0128-0.0133)	29	1.29 (0.0507)	0.056-0.068 (0.0022-0.0026)	49	1.49 (0.0586)
0.313-0.325 (0.0123-0.0127)	30	1.30 (0.0511)	0.043-0.054 (0.0016-0.0021)	50 (master)	1.50 (0.0590)
0.300-0.311 (0.0118-0.0122)	31	1.31 (0.0515)	0.029-0.041 (0.0011-0.0016)	51	1.51 (0.0594)
0.286-0.298 (0.0112-0.0117)	32	1.32 (0.0519)	0.015-0.027 (0.0005-0.0010)	52	1.52 (0.0598)
0.272-0.284 (0.0107-0.0111)	33	1.33 (0.0523)	0.002-0.014 (0.00007-0.0005)	53	1.53 (0.0602)
0.259-0.271 (0.0101-0.0106)	34	1.34 (0.0527)	0.000-0.000 (0.0000-0.0000)	54	1.54 (0.0606)

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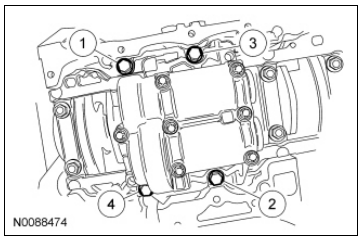
12. Install the Crankshaft TDC Timing Peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg. The engine is now at TDC .



13. With the balancer unit shaft marks in the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.



14. Install the balancer unit bolts.
    - Tighten in the sequence shown in 2 stages.
        - ♦ Stage 1: Tighten to 25 Nm (18 lb-ft).
        - ♦ Stage 2: Tighten to 50 Nm (37 lb-ft).



15. **NOTE:** Remeasure the backlash and verify that it is within specified range at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees. It will be necessary to reset the measuring equipment between measurements.

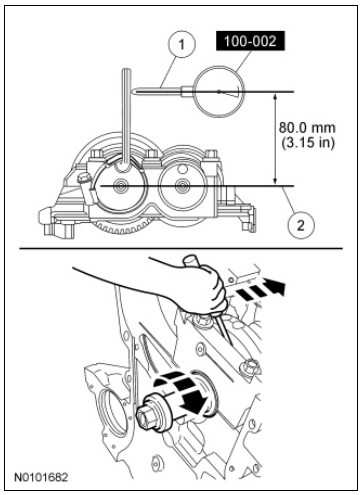
    NOTE: The measurement must be taken with the Dial Indicator Gauge with Holding Fixture, a 5-mm Allen wrench and worm clamp set up as shown. Mark the Allen wrench with a file 80 mm (3.149 in) above the driven gear shaft center. Make sure the worm clamp and Allen wrench are not touching the balance shaft housing.

    NOTE: For an accurate measurement while measuring the gear backlash, insert a screwdriver as shown into the crankshaft No. 1 crankweight area and set both the rotation and the thrust direction with the screwdriver, using a prying action as shown.

    Position the Dial Indicator Gauge with Holding Fixture as shown. Measure the gear backlash.

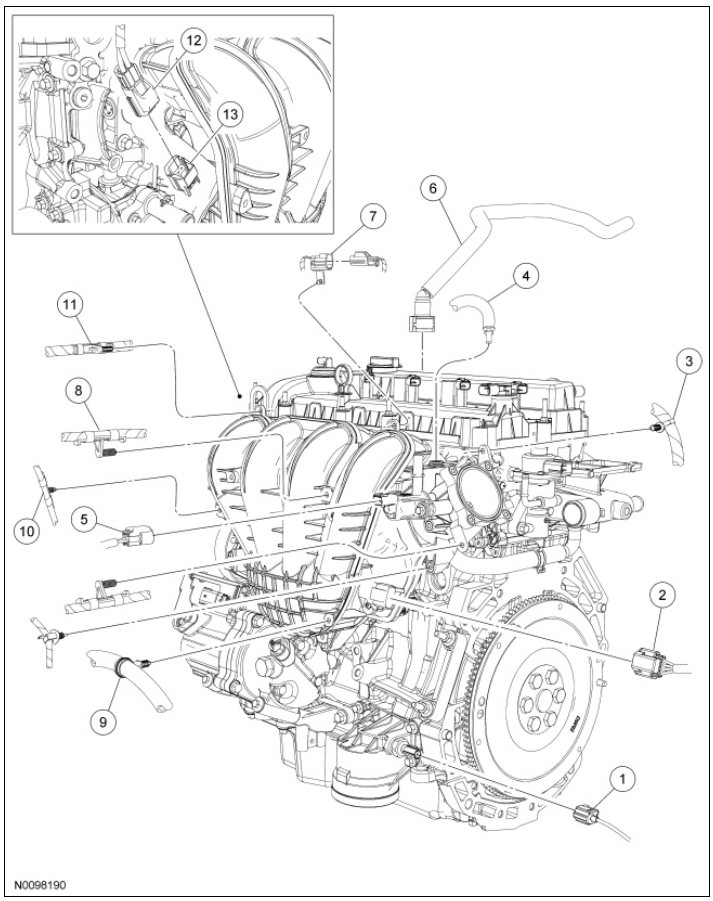
    - Position the Dial Indicator Gauge with Holding Fixture (1) on the Allen wrench 80 mm (3.149 in) above the driven gear shaft center (2) on the balancer unit.

- Rotate the crankshaft clockwise and measure the backlash at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees.
- If the backlash exceeds the specified range of 0.005 to 0.101 mm (0.00019 to 0.0039 in), install a new balancer unit and repeat the procedure.



Intake Manifold

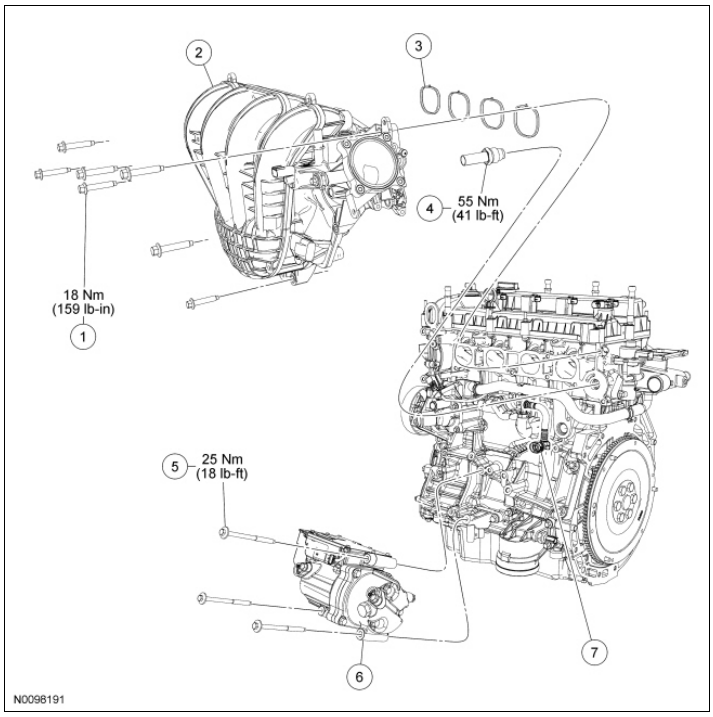
Intake Manifold (View 1 of 2)



Item	Part Number	Description
1	14A464	Engine Oil Pressure (EOP) switch electrical connector (part of 12A581)
2	14A464	Manifold Absolute Pressure (MAP) sensor electrical connector (part of 12A581)
3	-	Wiring harness retainer (3 required) (part of 12A581)
4	-	Vacuum tube
5	-	Evaporative Emission (EVAP) canister purge valve electrical connector (part of 12A581)
6	6C324	EVAP tube-to-EVAP canister purge valve quick connect coupling
7	-	Auxiliary coolant pump electrical connector

8	-	Auxiliary coolant pump wiring retainers (2 required)
9	-	Lower radiator hose retainer
10	-	Engine wiring harness retainer (part of 12A581)
11	-	Vehicle high voltage electrical system wire retainer
12	14A464	Knock Sensor (KS) electrical connector (male side, part of 12A581)
13	14A464	KS electrical connector (female side, part of 12A581)

Intake Manifold (View 2 of 2)



Item	Part Number	Description
1	W500311	Intake manifold bolt (7 required)
2	9424	Intake manifol/tr>
3	9441	Intake manifold gasket (4 required)
4	9E470	EGR tube
5	W500326	A/C compressor bolt (3 required)
6	19703	A/C compressor
7	6758	PCV hose connector

Removal and Installation

1. With vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. *NOTICE:* **Before removing the high voltage cables, the vehicle electrical system must be completely shut down for at least 5 minutes to allow for the high voltage capacitors to discharge.**

   Depower the vehicle high voltage electrical system. For additional information, refer to Section 414-03 .

3. Remove the fuel rail. For additional information, refer to Section 303-04D .

4. Remove the Throttle Body (TB). For additional information, refer to Section 303-04D .

5. Remove the accessory drive belt tensioner. For additional information, refer to Section 303-05D .

6. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

7. Disconnect the Manifold Absolute Pressure (MAP) sensor electrical connector.

8. Disconnect the Evaporative Emission (EVAP) canister purge valve electrical connector.

9. Disconnect the EVAP tube-to- EVAP canister purge valve quick connect coupling and the vacuum tube from the intake manifold.

10. Detach the 3 wiring retainers from the intake manifold near the throttle body mounting area.

11. Disconnect the auxiliary coolant pump electrical connector and detach the 2 wiring retainers.

12. Detach the lower radiator hose retainer from the intake manifold.

13. Detach the engine wiring harness retainer and the vehicle high voltage electrical system wire retainer from the intake manifold.

14. Disconnect the Knock Sensor (KS) electrical connector and detach the retainer from the intake manifold.

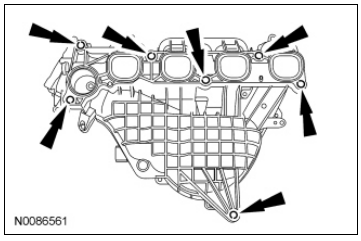
15. Remove the cooling fan motor and shroud. For additional information, refer to Section 303-03B .

16. Remove the 3 A/C compressor bolts and position the compressor aside.
    - To install, tighten to 25 Nm (18 lb-ft).

17. **NOTE:** The cylinder head side of the intake manifold is showing the location of the 7 bolts.

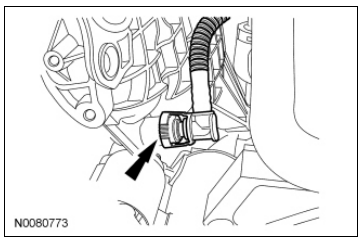
    Remove the 7 bolts and position the intake manifold aside to access the PCV hose connector.

    - To install, tighten to 18 Nm (159 lb-in).



Intake Manifold (View 2 of 2)

18. Squeeze the 2 PCV hose connector tabs and disconnect the PCV hose from the intake manifold.



19. Remove the intake manifold and gaskets.

20. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

    To install, reverse the removal procedure.

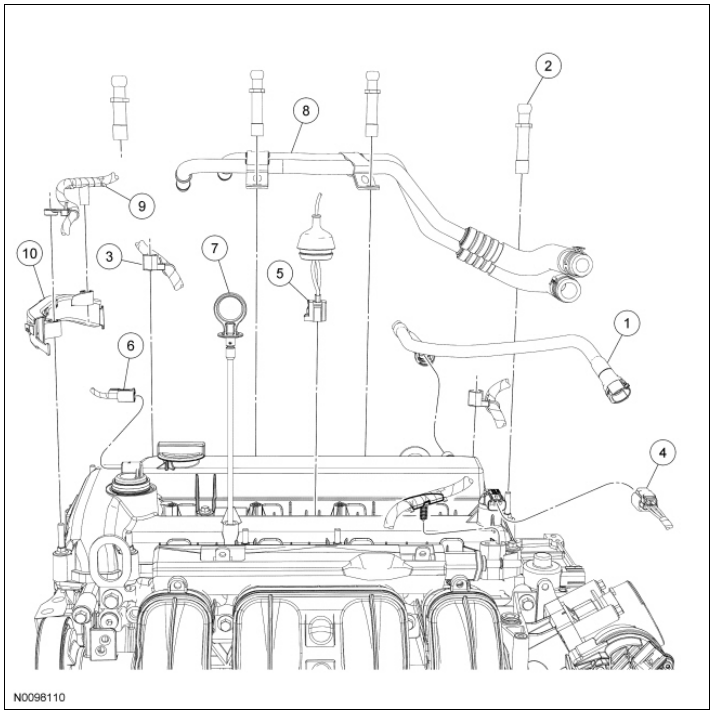
    - Inspect and install new intake manifold gaskets if necessary.

Valve Cover

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

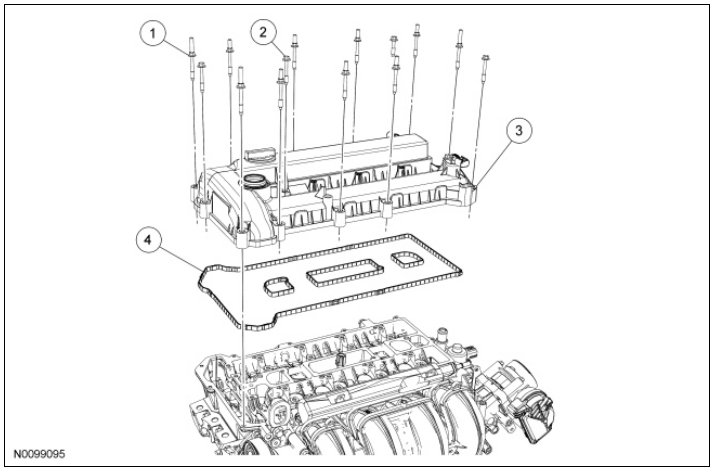
Valve Cover (View 1 of 2)



Item	Part Number	Description
1	6853	Crankcase vent hose
2	6A957	Engine cover stud (4 required)
3	14A163	
4	14A464	Camshaft Position (CMP) sensor electrical connector (part of 12A581)
5	14A464	Cylinder Head Temperature (CHT) sensor electrical connector (part of 12A581)
6	14A464	Variable Camshaft Timing (VCT) solenoid electrical connector (part of 12A581)
7	6750	Oil level indicator

8	18472	Heater hose tube assembly
9	-	Block heater wiring retainers (if equipped) (2 required)
10	-	High voltage wiring harness retainer (part of 14300)

Valve Cover (View 2 of 2)



Item	Part Number	Description
1	6C293	Valve cover retainer (10 required)
2	6C295	Valve cover retainer (4 required)
3	6582	Valve cover
4	6584	Valve cover gasket

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the ignition coil-on-plugs. For additional information, refer to Section 303-07A .
3. Disconnect the crankcase vent hose from the valve cover.
4. Detach the 2 block heater wiring harness retainers (if equipped) and the 2 high voltage wiring harness retainers from the valve cover studs.
5. Remove the 4 engine cover studs.
6. Position the heater tube assembly off the valve cover stud bolts.
7. Detach the 3 wire harness retainers from the valve cover and stud bolts.
8. Disconnect the Camshaft Position (CMP) sensor electrical connector.
9. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.

10. Disconnect the Variable Camshaft Timing (VCT) solenoid electrical connector.
11. Remove the oil level indicator.
12. Remove the 14 valve cover retainers, the valve cover and gasket.

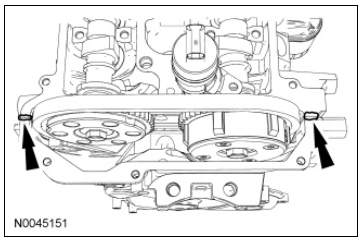
Installation

1. *NOTICE:* **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.**

   Clean and inspect the sealing surfaces.

2. **NOTE:** The valve cover must be secured within 4 minutes of silicone gasket application. If the valve cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep.

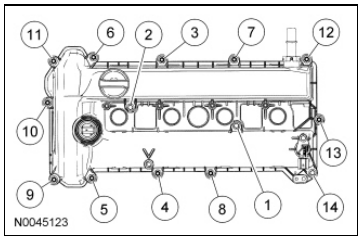
   Apply silicone gasket and sealant to the locations shown.



3. **NOTE:** Clean and inspect the gasket. Install a new gasket, if necessary.

   Install the valve cover, gasket and retainers.

   - Tighten in the sequence shown to 10 Nm (89 lb-in).



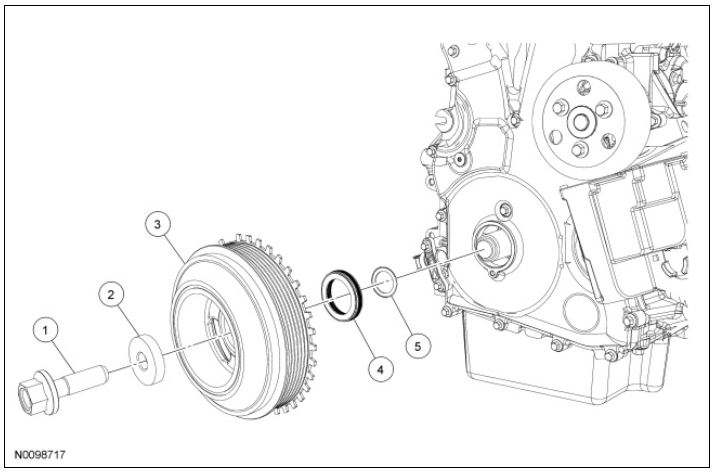
4. Install the oil level indicator.
5. Connect the VCT solenoid electrical connector.
6. Connect the CHT sensor electrical connector.
7. Connect the CMP sensor electrical connector.
8. Attach the 3 wire harness retainers to the valve cover stud bolts.
9. Position the heater tube assembly on the valve cover stud bolts.
10. Install the 4 engine cover studs.

11. Attach the 2 block heater wiring harness retainers (if equipped) and the 2 high voltage wiring harness retainers to the valve cover studs.

12. Connect the crankcase vent hose to the valve cover.

13. Install the ignition coil-on-plugs. For additional information, refer to Section 303-07A .

Crankshaft Pulley and Crankshaft Front Seal - Exploded View



Item	Part Number	Description
1	6K340	Crankshaft pulley bolt
2	-	Crankshaft pulley washer (part of 6K340)
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal
5	6378	Diamond washer

1. For additional information, refer to the procedures in this section.

>

Crankshaft Pulley

Special Tool(s)

 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST3054-A	Holding Tool, Crankshaft Damper 303-1416
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

General Equipment

6 mm x 18 mm bolt

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools or severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the RF wheel and tire. For additional information, refer to Section 204-04 .

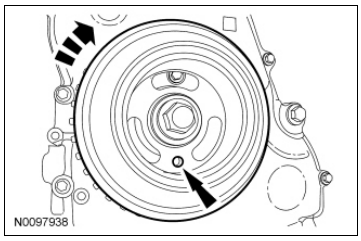
3. Remove the accessory drive belt. For additional information, refer to Section 303-05D .

4. Remove the valve cover. For additional information, refer to Valve Cover in this section.

5. ***NOTICE:*** **Failure to position the No. 1 piston at Top Dead Center (TDC) can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

   Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at Top Dead Center (TDC).

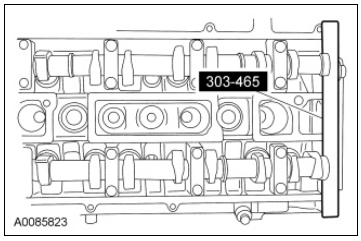
   - The hole in the crankshaft pulley should be in the 6 o'clock position.



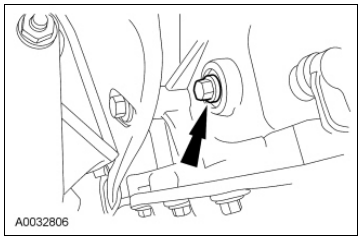
6. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   NOTE: The camshaft timing slots are offset. If the Camshaft Alignment Plate cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

   Install the Camshaft Alignment Plate in the slots on the rear of both camshafts.

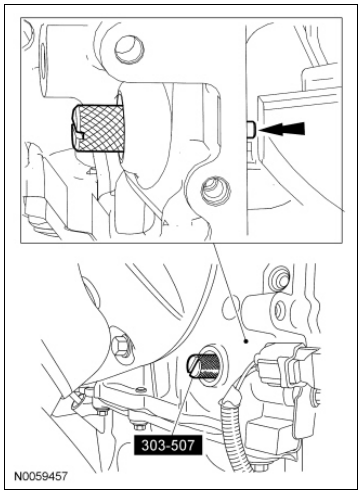


7. Remove the engine plug bolt.



8. **NOTE:** The Crankshaft TDC Timing Peg will contact the crankshaft and prevent it from turning past TDC . However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position during the crankshaft pulley removal and installation.

   Install the Crankshaft TDC Timing Peg.

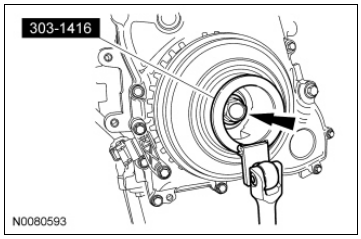


9. ***NOTICE:*** **The crankshaft must remain in the Top Dead Center (TDC) position during removal of the pulley bolt or damage to the engine can occur. Therefore, the crankshaft pulley must be held in place with the Crankshaft Damper Holding Tool, and the bolt should be removed using an air impact wrench (1/2-in drive minimum).**

   NOTICE: **The crankshaft sprocket diamond washer may come off with the crankshaft pulley. The diamond washer must be replaced. Remove and discard the diamond washer. If the diamond washer is not installed, engine damage may occur.**

   Use the Crankshaft Damper Holding Tool and a suitable 1/2-in drive hand tool to hold the crankshaft pulley. Use an air impact wrench to remove the crankshaft pulley bolt.

   - Remove and discard the crankshaft pulley bolt and washer.
   - Remove the crankshaft pulley.
   - Remove the diamond washer and discard.



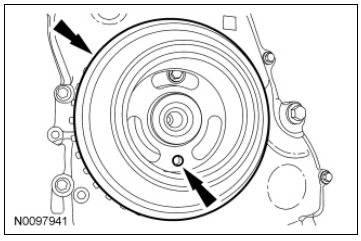
Installation

1. Install a new diamond washer.

2. **NOTE:** Do not install the crankshaft pulley bolt at this time.

   NOTE: Apply clean engine oil on the seal area before installing.

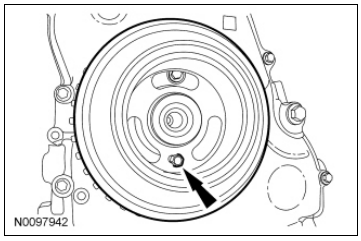
   Position the crankshaft pulley onto the crankshaft with the hole in the pulley at the 6 o'clock position.



3. *NOTICE:* **Only hand-tighten the 6 mm x 18 mm bolt or damage to the front cover can occur.**

   NOTE: This step will correctly align the crankshaft pulley to the crankshaft.

   Install a 6 mm x 18 mm bolt through the crankshaft pulley and thread it into the front cover.

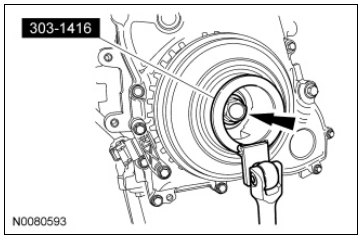


4. **NOTE:** The crankshaft must remain in the TDC position during installation of the pulley bolt or damage to the engine can occur. Therefore, the crankshaft pulley must be held in place with the Crankshaft Damper Holding Tool and the bolt should be installed using hand tools only.

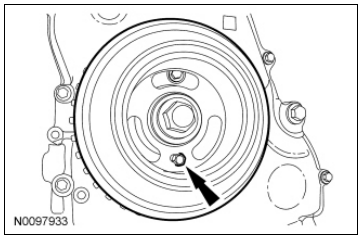
   NOTE: Do not reuse the crankshaft pulley bolt.

   Install a new crankshaft pulley bolt. Use the Crankshaft Damper Holding Tool and a suitable 1/2-in drive hand tool to hold the crankshaft pulley, tighten the crankshaft pulley bolt in 2 stages:

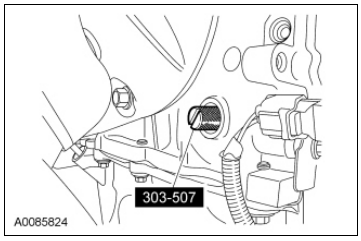
   - Stage 1: Tighten to 100 Nm (74 lb-ft).
   - Stage 2: Tighten an additional 90 degrees.



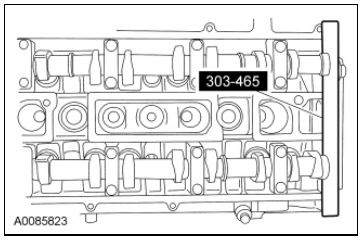
5. Remove the 6 mm x 18 mm bolt.



6. Remove the Crankshaft TDC Timing Peg.



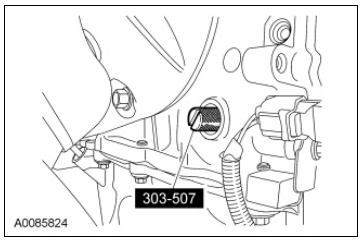
7. Remove the Camshaft Alignment Plate.



8. **NOTE:** Only turn the engine in the normal direction of rotation.

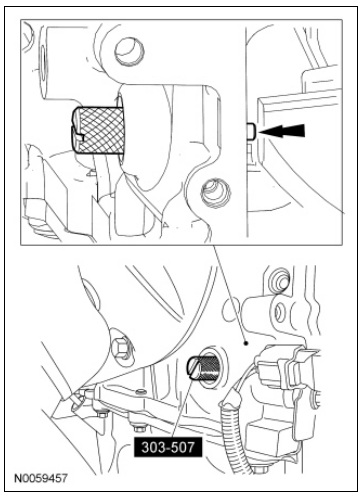
   Turn the crankshaft clockwise one and three-fourths turns.

9. Install the Crankshaft TDC Timing Peg.



10. **NOTE:** Only turn the engine in the normal direction of rotation.

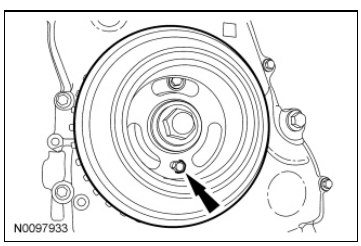
    Turn the crankshaft clockwise until the crankshaft contacts the Crankshaft TDC Timing Peg.



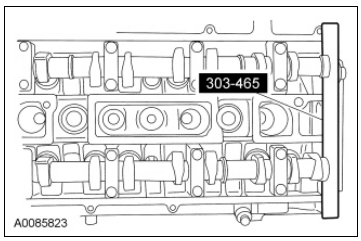
11. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

    Using the 6 mm x 18 mm bolt, check the position of the crankshaft pulley.

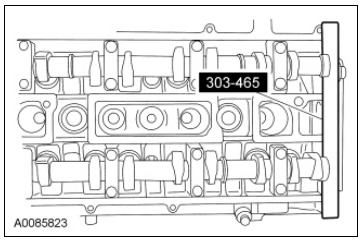
    - If it is not possible to install the bolt, the engine valve timing must be corrected by repeating this procedure.



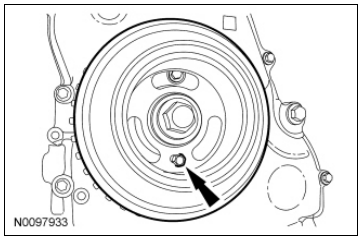
12. Install the Camshaft Alignment Plate to check the position of the camshafts.
    - If it is not possible to install the Camshaft Alignment Plate, the engine valve timing must be corrected by repeating this procedure.



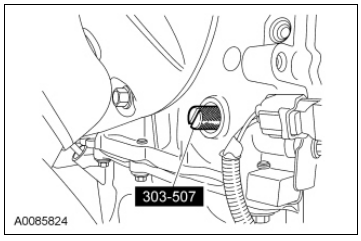
13. Remove the Camshaft Alignment Plate.



14. Remove the 6 mm x 18 mm bolt.



15. Remove the Crankshaft TDC Timing Peg.



16. Install the engine plug bolt.
    - Tighten to 20 Nm (177 lb-in).

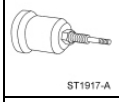
17. Install the accessory drive belt. For additional information, refer to Section 303-05D .

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

19. Install the valve cover. For additional information, refer to Valve Cover in this section.

Crankshaft Front Seal

Special Tool(s)

 ST1917-A	Installer, Camshaft Front Oil Seal 303-096 (T74P-6150-A)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); craft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

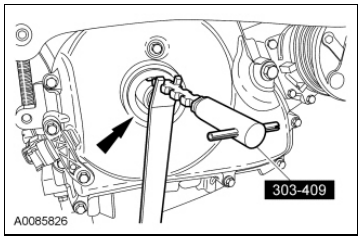
NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools or severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley and Crankshaft Front Seal - Exploded View and Crankshaft Pulley in this section.

2. ***NOTICE:*** **Use care not to damage the engine nt cover or the crankshaft when removing the seal.**

   Using the Oil Seal Remover, remove the crankshaft front seal.

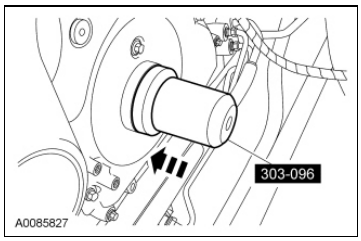


Installation

1. **NOTE:** Remove the through bolt from the Camshaft Front Oil Seal Installer.

   NOTE: Lubricate the oil seal with clean engine oil.

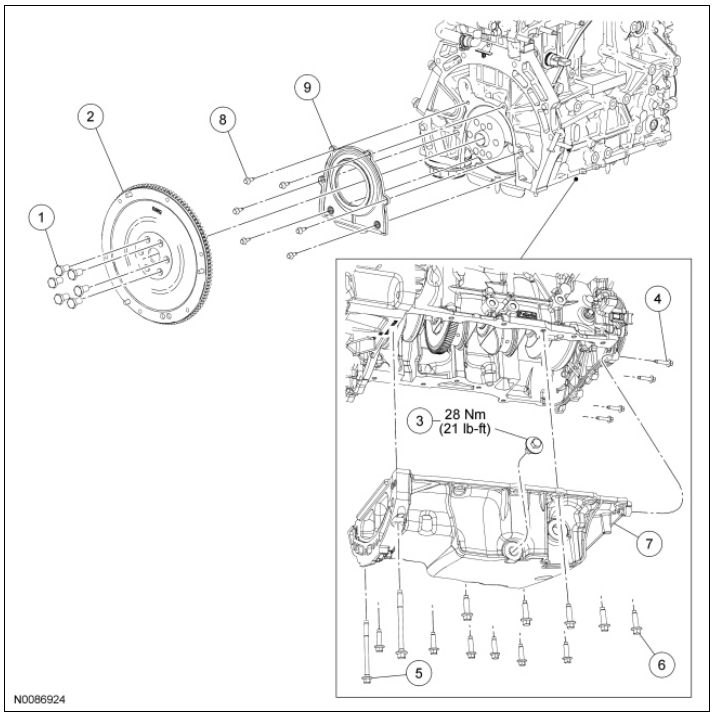
   Using the Camshaft Front Oil Seal Installer, install the crankshaft front oil seal.



2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley and Crankshaft Front Seal - Exploded View and Crankshaft Pulley in this section.

&nbs

Flexplate or Flywheel and Crankshaft Rear Seal - Exploded View



Item	Part Number	Description
1	6379	Flywheel bolt (6 required)
2	6477	Flywheel
3	6730	Oil pan drain plug
4	W500215	Engine front cover bolt (4 required)
5	W706284	Oil pan bolt (2 required)
6	W500224	Oil pan bolt (11 required)
7	6675	Oil pan
>	W500212	Crankshaft rear oil seal with retainer plate bolt (6 required)
9	6K318	Crankshaft rear oil seal with retainer plate

1. For additional information, refer to the procedures in this section.

Flywheel

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the engine. For additional information, refer to Engine in this section.

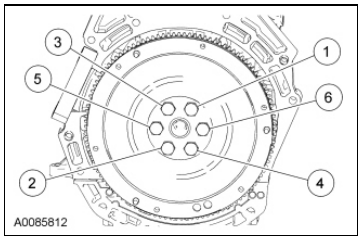
3. Remove the 6 bolts and the flywheel.

Installation

1. **NOTE:** Special bolts are used for installation. Do not use standard bolts.

   Install the flywheel and tighten the bolts in the sequence shown in the following 3 stages:

   - Stage 1: Tighten to 50 Nm (37 lb-ft).
   - Stage 2: Tighten to 80 Nm (59 lb-ft).
   - Stage 3: Tighten to 112 Nm (83 lb-ft).



2. Install the engine. For additional information, refer to Engine in this section.

Crankshaft Rear Seal

Special Tool(s)

 ST1506-A	Installer, Crankshaft Rear Main Oil Seal 303-328 (T88P-6701-B1)

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the flywheel. For additional information, refer to Flywheel in this section.

3. Drain the engine oil.
   - Install the drain plug.
   - Tighten to 28 Nm (21 lb-ft).

4. ***NOTICE:*** **If the oil pan is not removed, damage to the rear oil seal retainer joint can occur.**

   Remove the 17 bolts and the oil pan.

5. Remove the 6 bolts and the crankshaft rear oil seal with retainer plate.

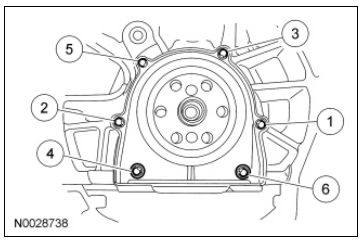
Installation

1. Using the Crankshaft Rear Main Oil Seal Installer, position the crankshaft rear oil seal with retainer plate onto the crankshaft.

src="SCS~us~en~file=A0087575.jpg~gen~ref.jpg" height="211" width="325" border="1">

2. Install the crankshaft rear oil seal with retainer plate and bolts.

- Tighten in the sequence shown to 10 Nm (89 lb-in).



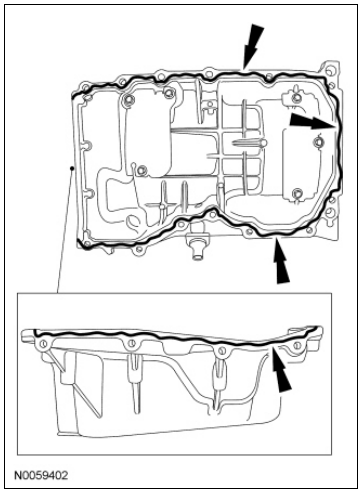
3. *NOTICE:* **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool and metal surface cleaner to remove traces of sealant.**

   Clean and inspect all the oil pan and cylinder block mating surfaces.

4. **NOTE:** If the oil pan is not secured within 4 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

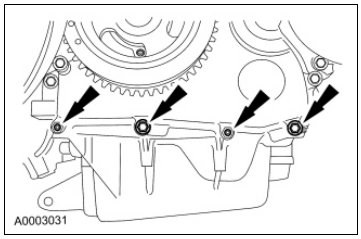
   NOTE: The oil pan must be installed and the bolts tightened within 4 minutes of applying the silicone gasket and sealant.

   Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the oil pan.

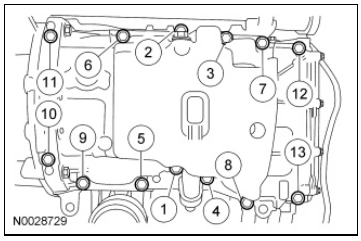


5. Install the oil pan. Install the 2 oil pan bolts finger-tight.

6. Install the 4 bolts.
   - Tighten to 10 Nm (89 lb-in).



7. Install the remaining oil pan bolts and tighten the oil pan bolts in the sequence shown to 25 Nm (18 lb-ft).



8. Install the flywheel. For additional information, refer to Flywheel in this section.

9. Fill the engine with clean engine oil.

Engine Front Cover

Special Tool(s)

 ST3055A	Aligner, Crankshaft Sensor 303-1417
 ST1917-A	Installer, Camshaft Front Oil Seal 303-096 (T74P-6150-A)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)

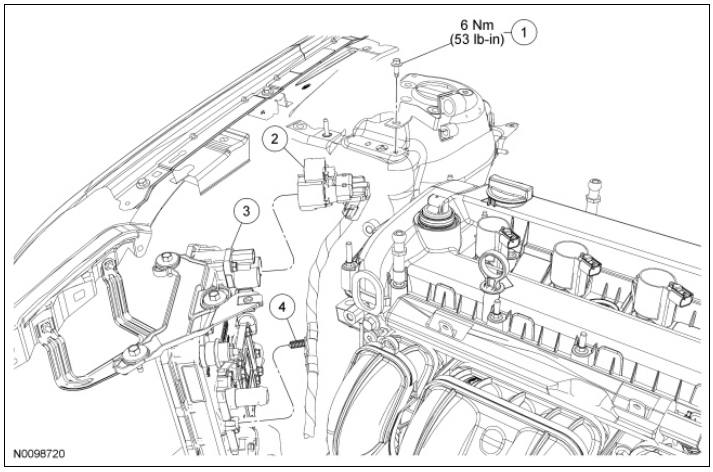
General Equipment

6 mm x 18 mm bolt

Material

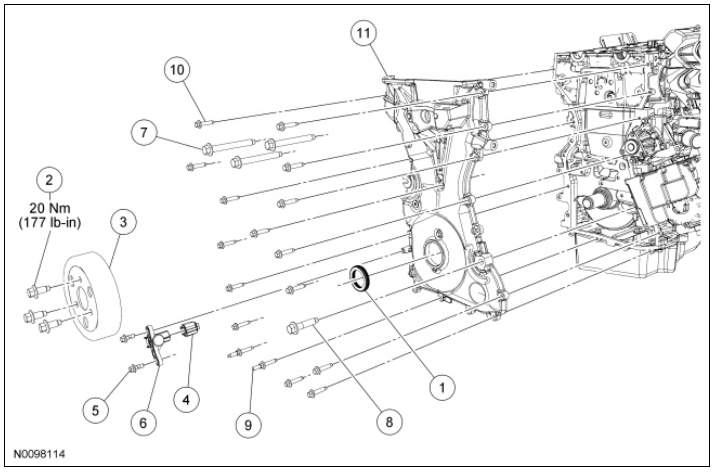
Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Engine Front Cover (View 1 of 2)



Item	Part Number	Description
1	W707399	A/C tube bracket bolt
2	-	Vehicle high voltage electrical connector (part of 14300)
3	14B227	DC/DC converter
4	-	Vehicle high voltage electrical wiring retainer (part of 14300)

Engine Front Cover (View 2 of 2)



Item	Part Number	Description
1	6700	Crankshaft front seal
2	W500221	Coolant pump pulley bolt (3 required)
3	8509	Coolant pump pulley
4	14A464	Crankshaft Position (CKP) sensor electrical connector (part of 12B637)
5	W701219	CKP sensor bolt (2 required)
6	6C315	CKP sensor
7	W500328	Engine front cover bolt (3 required)
8	W705310	Engine front cover stud bolt (2 required)

9	W500300	Engine from cover bolt
10	W500215	Engine front cover bolt (15 required)
11	6019	Engine front cover

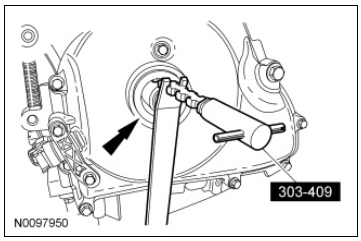
Removal

NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools or severe engine damage can occur.**

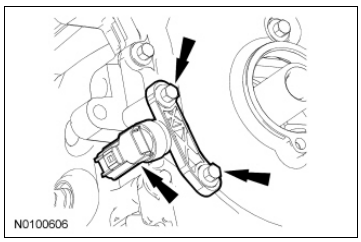
NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Depower the vehicle high voltage electrical system. For additional information, refer to Section 414-03 .
3. Remove the accessory drive belt and tensioner. For additional information, refer to Section 303-05D .
4. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
5. Remove the engine mount. For additional information, refer to Engine Mount in this section.
6. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

   Using the Oil Seal Remover, remove the crankshaft front seal.



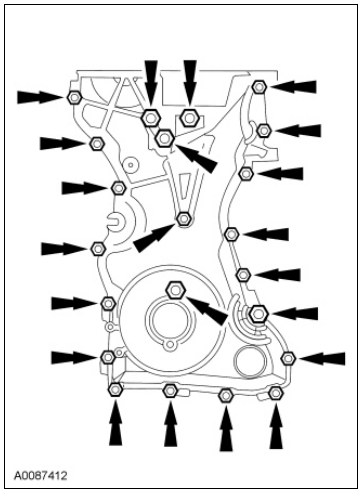
7. Remove the 3 bolts and the coolant pump pulley.
8. Disconnect the Crankshaft Position (CKP) sensor electrical connector.
9. Remove the 2 bolts and the CKP sensor.



10. Remove the A/C tube bracket bolt from the strut tower.

11. Disconnect the vehicle high voltage electrical connector from the DC/DC converter and detach the wiring retainer.

12. Remove the bolts and the engine front cover.



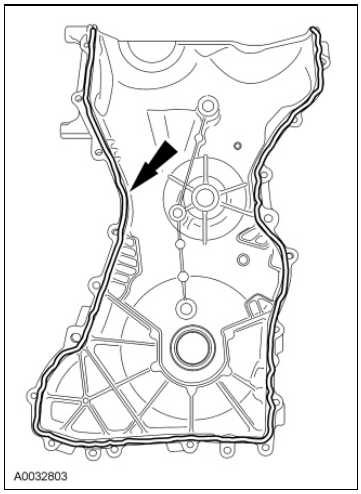
Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive disks or other abrasive means to clean sealing surfaces. These tools cause scratches and gouges which make leak paths.**

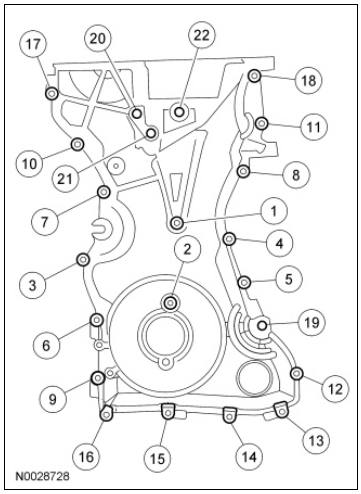
   Clean and inspect the mounting surfaces of the engine and the front cover.

2. **NOTE:** The engine front cover must be installed and the bolts tightened within 4 minutes of applying the silicone gasket and sealant.

   Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the cylinder head and oil pan joint areas. Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the front cover.



3. Install the engine front cover. Tighten the bolts in the sequence shown, to the following specifications:
   - Tighten the 8-mm bolts to 10 Nm (89 lb-in).
   - Tighten the 13-mm bolts to 48 Nm (35 lb-ft).



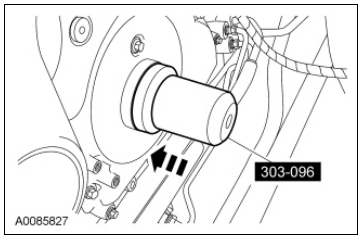
4. Connect the vehicle high voltage electrical connector to the DC/DC converter and attach the wiring retainer.

5. Install the A/C tube bracket bolt to the strut tower.
   - Tighten to 6 Nm (53 lb-in).

6. **NOTE:** Remove the through bolt from the Camshaft Front Oil Seal Installer.

   NOTE: Lubricate the oil seal with clean engine oil.

   Using the Camshaft Front Oil Seal Installer, install the crankshaft front seal.



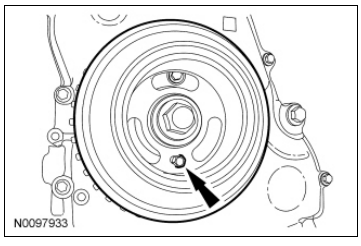
7. Install the coolant pump pulley and the 3 bolts.
   - Tighten to 20 Nm (177 lb-in).

8. Install the engine mount. For additional information, refer to Engine Mount in this section.

9. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

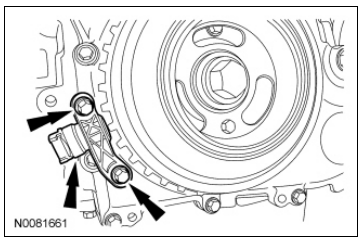
10. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

    Install a standard 6 mm (0.23 in) x 18 mm (0.7 in) bolt through the crankshaft pulley and thread it into the front cover.

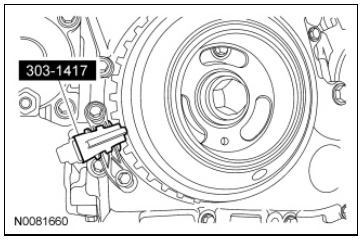


11. Install the CKP sensor and the 2 bolts.

- Do not tighten the bolts at this time.

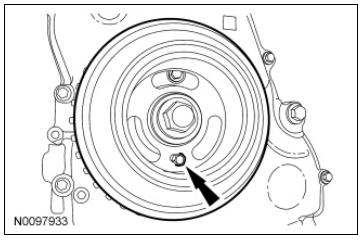


12. Using the Crankshaft Sensor Aligner, adjust the CKP sensor.
    - Tighten the 2 CKP bolts to 7 Nm (62 lb-in).



13. Connect the CKP sensor electrical connector.

14. Remove the 6 mm x 18 mm bolt.



15. Install the accessory drive belt and tensioner. For additional information, refer to Section 303-05D .

16. Repower the vehicle high voltage electrical system. For additional information, refer to Section 414-03 .

Timing Drive Components

Removal

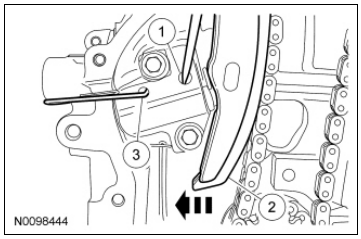
NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools or severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surf, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

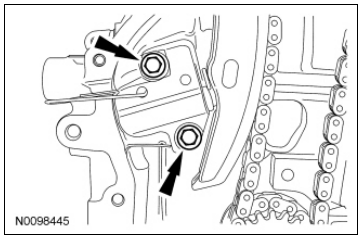
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

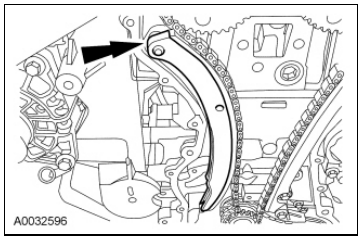
3. Compress the timing chain tensioner in the following sequence.
    1. Using a small pick, release and hold the ratchet mechanism.
    2. While holding the ratchet mechanism in the released position, compress the tensioner by pushing the timing chain arm toward the tensioner.
    3. Insert a paper clip into the hole to retain the tensioner.



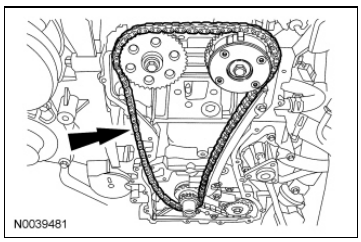
4. Remove the 2 bolts and timing chain tensioner.



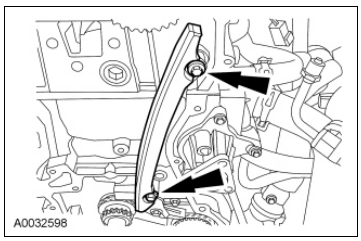
5. Remove the timing chain tensioner arm.



6. Remove the timing chain.

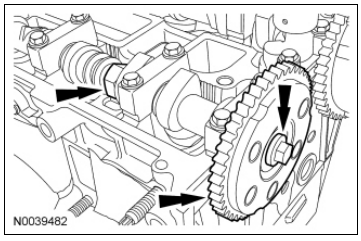


7. Remove the 2 bolts and the timing chain guide.



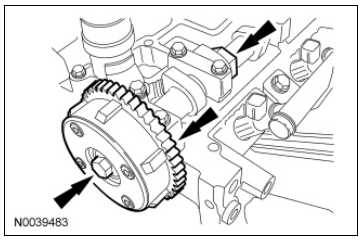
8. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the exhaust camshaft sprocket.



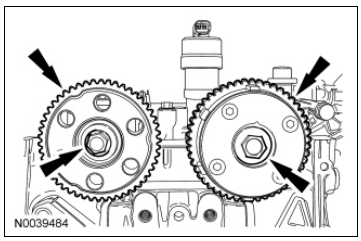
9. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the camshaft phaser and sprocket.

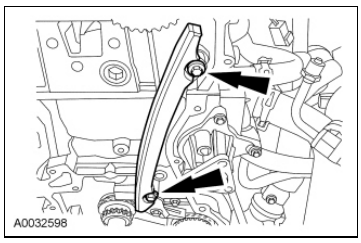


Installation

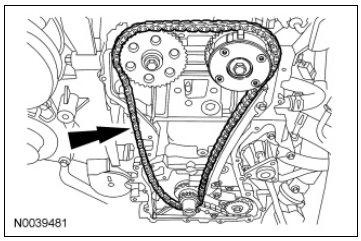
1. Install the camshaft sprockets and the bolts. Do not tighten the bolts at this time.



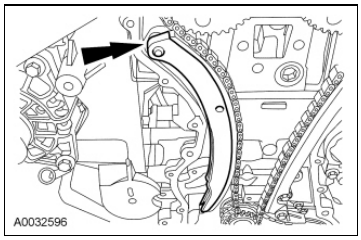
2. Install the timing chain guide and the 2 bolts.
   - To install, tighten to 10 Nm (89 lb-in).



3. Install the timing chain.



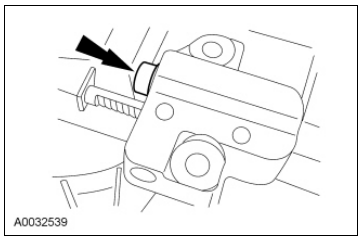
4. Install the timing chain tensioner arm.



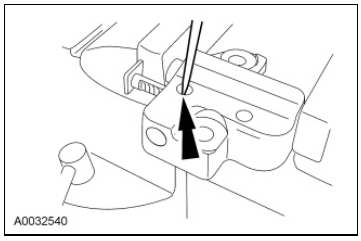
NOTE: If the timing chain tensioner plunger and ratchet assembly are not pinned in the compressed position, follow the next 4 steps.

5. ***NOTICE:*** **Do not compress the ratchet assembly. This will damage the ratchet assembly.**

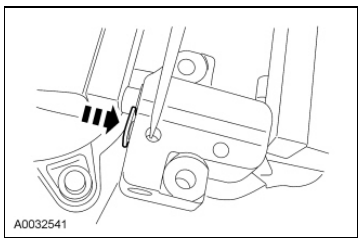
   Using the edge of a vise, compress the timing chain tensioner plunger.



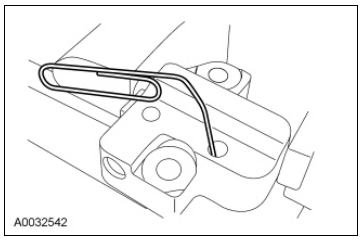
6. Using a small pick, push back and hold the ratchet mechanism.



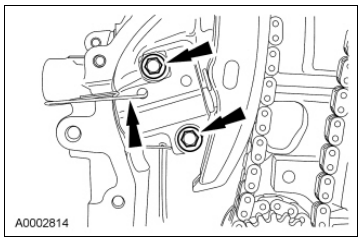
7. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.



8. Install a paper clip into the hole in the tensioner housing to hold the ratchet assembly and the plunger in during installation.



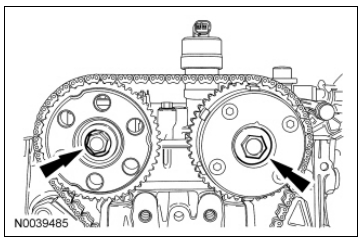
9. Install the timing chain tensioner and the 2 bolts. Remove the paper clip to release the piston.
   - Tighten to 10 Nm (89 lb-in).



10. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

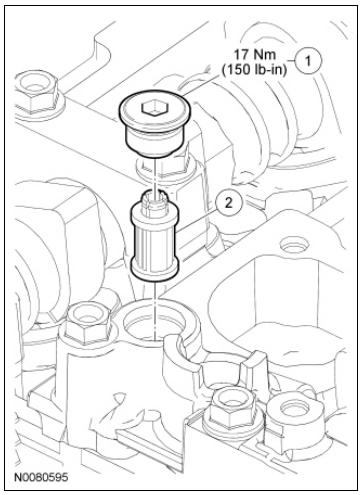
    Using the flats on the camshafts to prevent camshaft rotation, tighten the bolts.

    - Tighten to 72 Nm (53 lb-ft).



11. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Variable Camshaft Timing (VCT) System Oil Filter



Item	Part Number	Description
1	W710451	Plug
2	6731	Variable Camshaft Timing (VCT) system oil filter

Removal and Installation

1. Remove the Variable Camshaft Timing (VCT) solenoid. For additional information, refer to Section 303-14D .

2. Remove the plug and the VCT system oil filter from the intake camshaft thrust cap.
   - To install, tighten to 17 Nm (150 lb-in).

3. To install, reverse the removal procedure.

Camshafts

Special Tool(s)

 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

General Equipment

6 mm x 18 mm bolt
M6 x 30 mm bolt

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

NOTICE: **Do not rotate the camshafts unless instructed to in this procedure. Rotating the camshafts or crankshaft with timing components loosened or removed can cause serious damage to the valves and pistons.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the degas bottle. For additional information, refer to Section 303-03B .

3. Remove the Variable Camshaft Timing (VCT) oil control solenoid. For additional informationrefer to Section 303-14D .

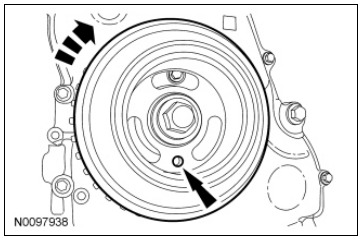
4. Check the valve clearance. For additional information, refer to Valve Clearance Check in this section.

5. Remove the accessory drive belt. For additional information, refer to Section 303-05D .

6. ***NOTICE:*** **Failure to position the No. 1 piston at Top Dead Center (TDC) can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

   Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at Top Dead Center (TDC).

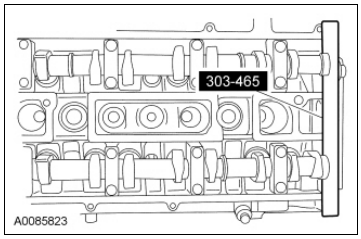
   - The hole in the crankshaft pulley should be in the 6 o'clock position.



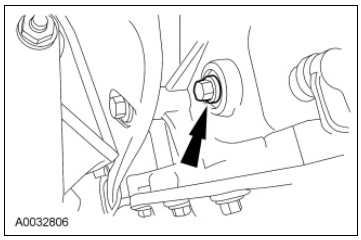
7. ***NOTICE:*** **The Camshaft Alignment Plate 303-465 is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   NOTE: The camshaft timing slots are offset. If the Camshaft Alignment Plate cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

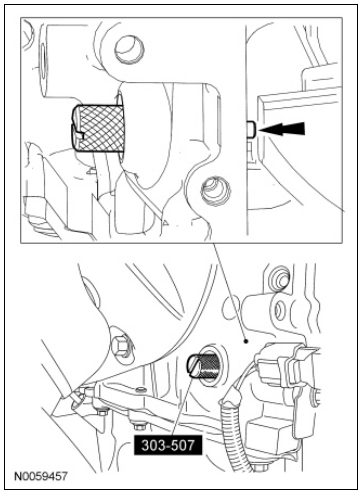
   Install the Camshaft Alignment Plate in the slots on the rear of both camshafts.



8. Remove the engine plug bolt.

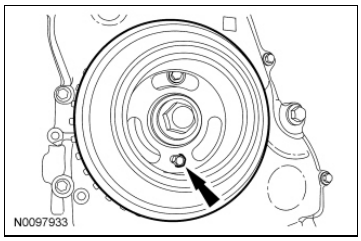


9. Install the Crankshaft TDC Timing Peg.

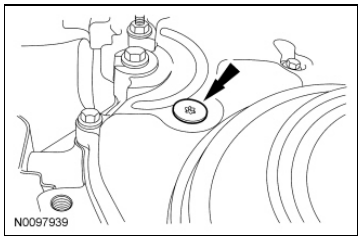


10. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

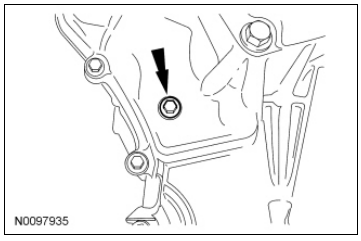
    Install a standard 6 mm x 18 mm bolt through the crankshaft pulley and thread it into the front cover.



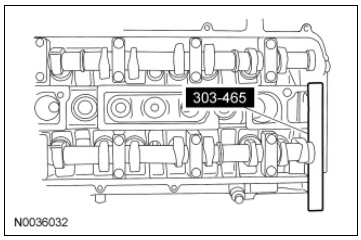
11. Remove the lower front cover timing hole plug from the engine front cover.



12. Remove the upper front cover timing hole plug from the engine front cover.



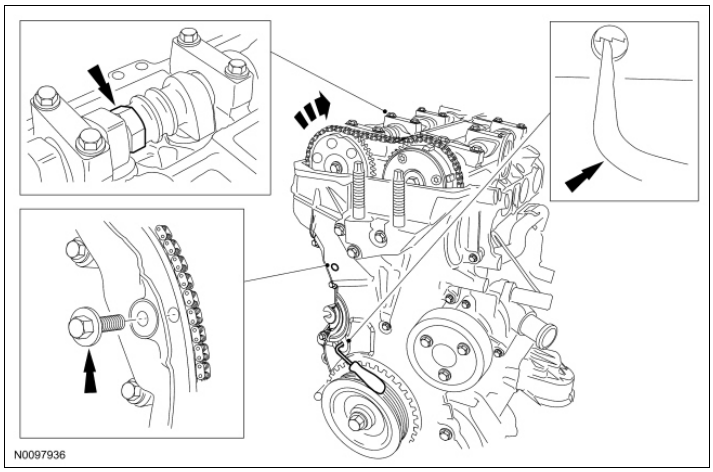
13. Reposition the Camshaft Alignment Plate to the slot on the rear of the intake camshaft only.



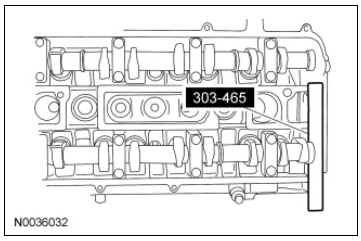
14. **NOTE:** Releasing the ratcheting mechanism in the timing chain tensioner allows the plunger to collapse and create slack in the timing chain. Installing an M6 x 30 mm (1.18 in) bolt into the upper front cover timing hole will hold the tensioner arm in a retracted position and allow enough slack in the timing chain for removal of the exhaust camshaft gear.

    Using a small pick tool, unlock the chain tensioner ratchet through the lower front cover timing hole.

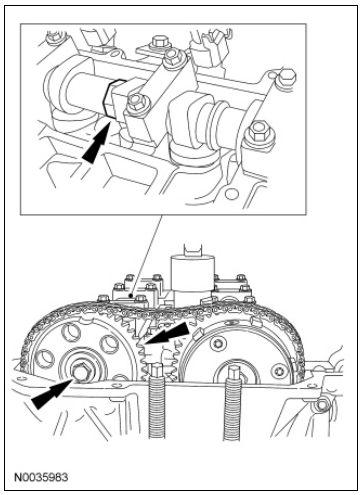
    - Using the flats of the camshaft, have an assistant rotate the exhaust camshaft clockwise to collapse the timing chain tensioner plunger.
    - Insert an M6 x 30 mm (1.18 in) bolt into the upper front cover timing hole to hold the tensioner arm in the retracted position.



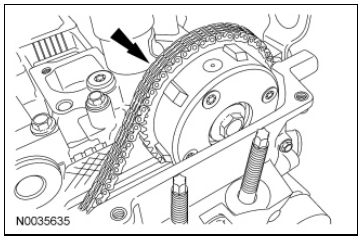
15. Remove the Camshaft Alignment Plate.



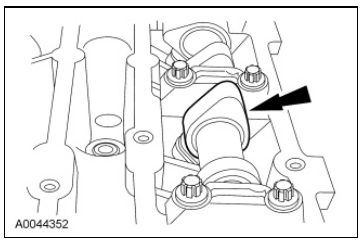
16. Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and exhaust camshaft drive gear.



17. Remove the timing chain from the camshaft phaser and sprocket.



18. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.

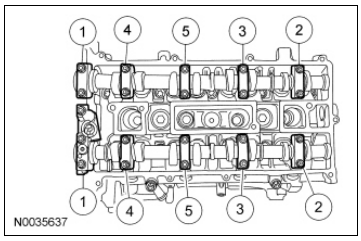


19. ***NOTICE:*** **Failure to follow the camshaft loosening procedure can result in damage to the camshafts.**

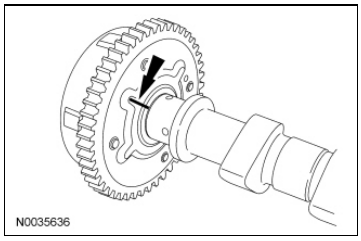
    NOTE: Mark the location and orientation of each camshaft bearing cap.

    Remove the camshafts from the engine.

    - Loosen the camshaft bearing cap bolts, in sequence, one turn at a time until all tension is released from the camshaft bearing caps.
    - Remove the bolts and the camshaft bearing caps.
    - Remove the camshafts.



20. If removal of the camshaft phaser and sprocket is necessary, mark the sprocket and camshaft for reference during installation.
    - If necessary, place the camshaft in a soft-jawed vise. Remove the bolt and the camshaft phaser and sprocket.

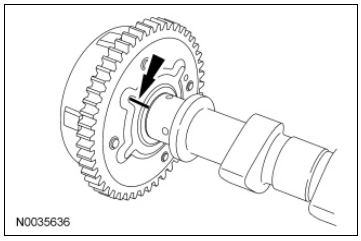


Installation

1. **NOTE:** If new parts are installed, transfer the reference marks made during disassembly to the new parts.

If necessary, position the camshaft in a soft-jawed vise and install the camshaft phaser and sprocket and the bolt.

- Align the reference marks on the camshaft phaser and sprocket and the camshaft. Tighten the bolt to 72 Nm (53 lb-ft).

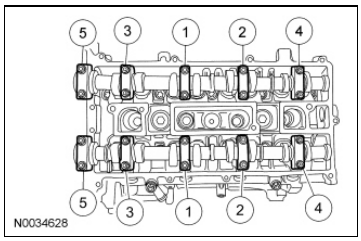


2. ***NOTICE:*** **Install the camshafts with the alignment slots in the camshafts lined up so the Camshaft Alignment Plate can be installed without rotating the camshafts. Make sure the lobes on the No. 1 cylinder are in the same position as noted in the removal procedure. Rotating the camshafts when the timing chain is removed, or installing the camshafts 180 degrees out of position can cause severe damage to the valves and pistons.**

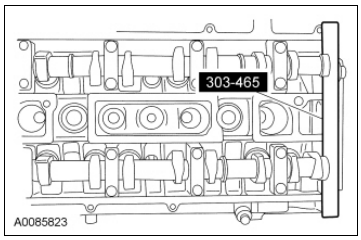
   NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

   Install the camshafts and bearing caps in their original location and orientation. Tighten the bearing caps in the sequence shown in 3 stages:

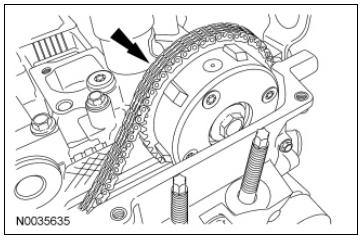
   - Stage 1: Tighten the camshaft bearing cap bolts one turn at a time, until finger-tight.
   - Stage 2: Tighten to 7 Nm (62 lb-in).
   - Stage 3: Tighten to 16 Nm (142 lb-in).



3. Install the Camshaft Alignment Plate.



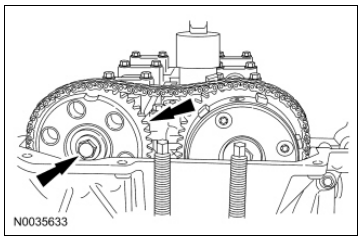
4. Install the timing chain on the camshaft phaser and sprocket.



5. **NOTE:** The timing chain must be correctly engaged on the teeth of the crankshaft timing sprocket and the intake camshaft drive gear in order to install the exhaust camshaft drive gear onto the exhaust camshaft.

   Position the exhaust camshaft drive gear in the timing chain and install the gear and bolt on the exhaust camshaft.

   - Hand-tighten the bolt.



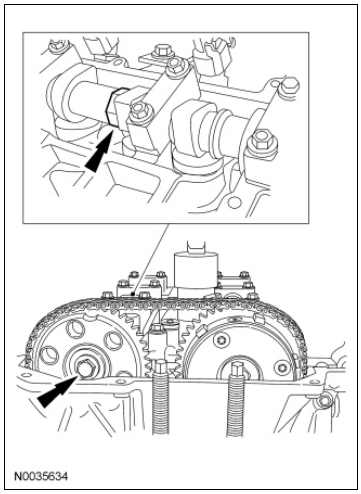
6. **NOTE:** Releasing the tensioner arm will remove the slack from the timing chain.

   Remove the M6 x 30 mm bolt from the upper front cover timing hole to release the tensioner arm.

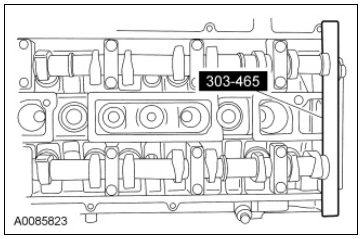
7. *NOTICE:* **The Camshaft Alignment Plate 303-465 is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   Using the flats on the camshaft to prevent camshaft rotation, tighten the bolt.

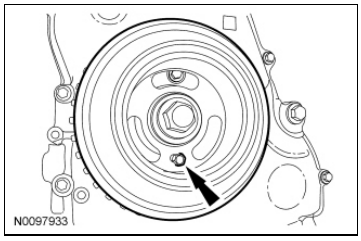
   - Tighten to 72 Nm (53 lb-ft).



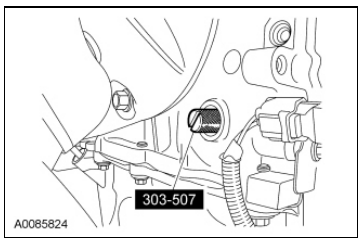
8. Remove the Camshaft Alignment Plate.



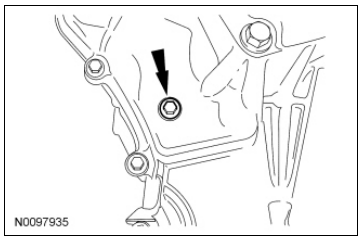
9. Remove the 6 mm x 18 mm bolt.



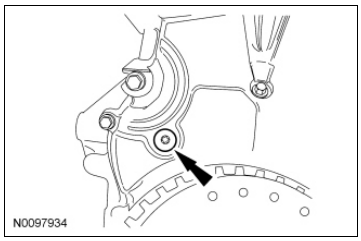
10. Remove the Crankshaft TDC Timing Peg.



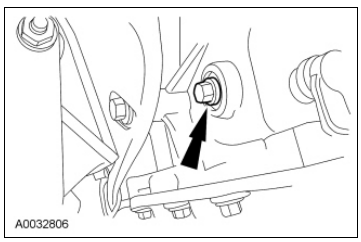
11. Install the upper front cover timing hole plug.
    - Tighten to 10 Nm (89 lb-in).



12. Apply silicone gasket and sealant to the threads of the lower front cover timing hole plug.
    - Install the plug and tighten to 12 Nm (106 lb-in).



13. Install the engine plug bolt.
    - Tighten to 20 Nm (177 lb-in).



14. Install the accessory drive belt. For additional information, refer to Section 303-05D .

15. Install the VCT oil control solenoid. For additional information, refer to Section 303-14D .

16. Install the valve cover. For additional information, refer to Valve Cover in this section.

17. Install the degas bottle. For additional information, refer to Section 303-03B .

Camshaft Phaser and Sprocket

Special Tool(s)

 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

General Equipment

6 mm (0.23 in) x 18 mm (0.7 in)
M6 x 30(1.18 in)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

NOTICE: **Do not rotate the camshafts or crankshaft unless instructed to do so in this procedure. Rotating the camshafts or crankshaft with timing components loosened or removed can cause serious damage to the valves or pistons.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the accessory drive belt. For additional information, refer to Section 303-05D .

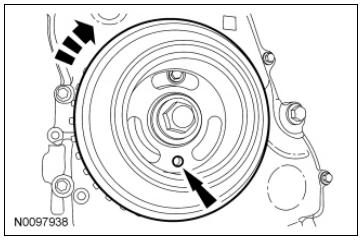
3. Reme the Variable Camshaft Timing (VCT) solenoid. For additional information, refer to Section 303-14D .

4. Check the valve clearance. For additional information, refer to Valve Clearance Check in this section.

5. ***NOTICE:*** **Failure to position the No. 1 piston at Top Dead Center (TDC) can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

   Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at Top Dead Center (TDC).

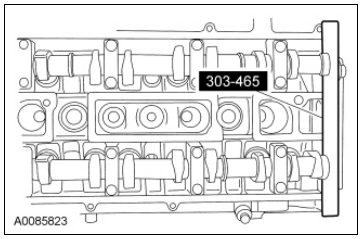
   - The hole in the crankshaft pulley should be in the 6 o'clock position.



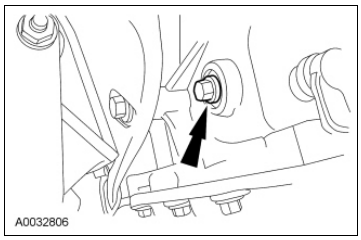
6. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

   NOTE: The camshaft timing slots are offset. If the Camshaft Alignment Plate cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

   Install the Camshaft Alignment Plate in the slots on the rear of both camshafts.

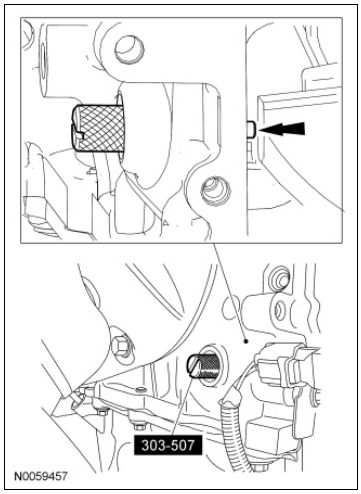


7. Remove the engine plug bolt.



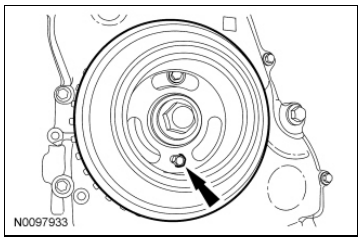
8. **NOTE:** The Crankshaft TDC Timing Peg will contact the crankshaft and prevent it from turning past TDC . However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position during the camshaft removal and installation.

   Install the Crankshaft TDC Timing Peg.

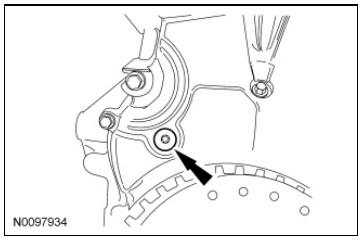


9. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

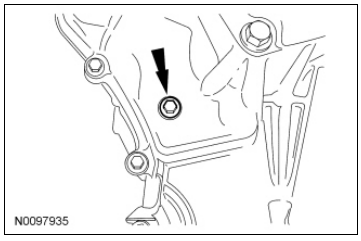
   Install a standard 6 mm x 18 mm bolt through the crankshaft pulley and thread it into the front cover.



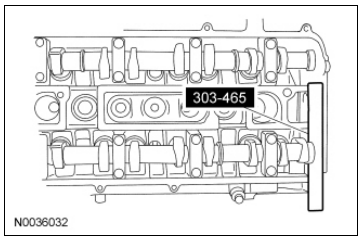
10. Remove the lower timing hole plug from the engine front cover.



11. Remove the upper timing hole plug from the engine front cover.



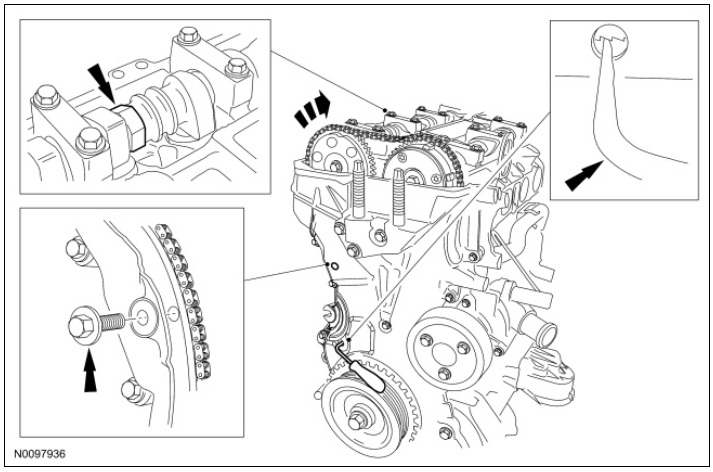
12. Reposition the Camshaft Alignment Plate to the slot on the rear of the intake camshaft only.



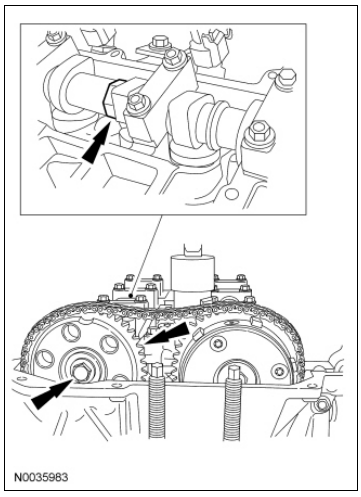
13. **NOTE:** Releasing the ratcheting mechanism in the timing chain tensioner allows the plunger to collapse and create slack in the timing chain. Installing the M6 x 30 mm (1.18 in) bolt into the upper front cover timing hole will lock the tensioner arm in a retracted position and allow enough slack in the timing chain for removal of the exhaust camshaft gear.

    Using a small pick tool, release the timing chain tensioner ratchet through the lower front cover timing hole.

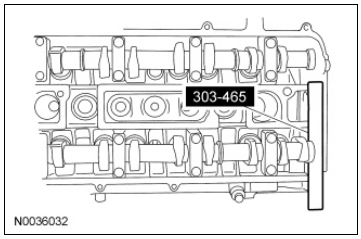
    - Have an assistant rotate (using the flats of the camshaft) the exhaust camshaft clockwise to collapse the timing chain tensioner plunger.
    - Insert the M6 x 30 mm (1.18 in) bolt into the upper front cover timing hole to hold the tensioner arm in the retracted position.



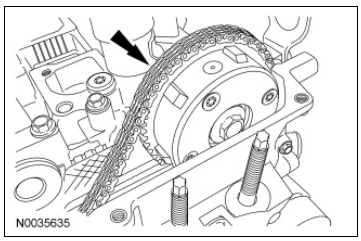
14. Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the exhaust camshaft drive gear.



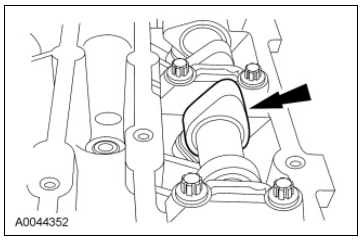
15. Remove the Camshaft Alignment Plate.



16. Remove the timing chain from the camshaft phaser and sprocket.



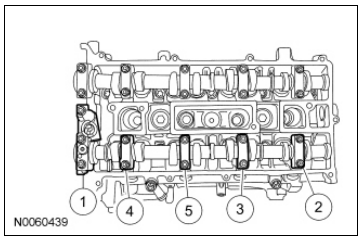
17. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.



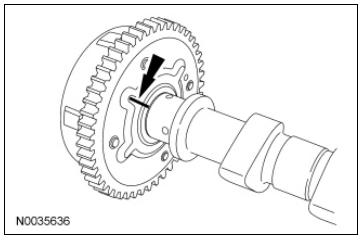
18. ***NOTICE:*** **Failure to follow the camshaft loosening procedure can result in damage to the intake camshaft.**

    Remove the intake camshaft from the engine.

    - Loosen the intake camshaft bearing cap bolts, in the sequence shown, one turn at a time until all tension is released from the camshaft bearing caps.
    - Remove the bolts and the camshaft bearing caps.
    - Remove the intake camshaft.



19. Mark the camshaft phaser and sprocket and the camshaft for reference during installation.



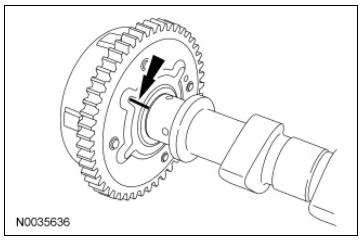
20. Place the camshaft in a soft-jawed vise. Remove the bolt and the camshaft phaser and sprocket.

Installation

1. **NOTE:** If new parts are installed, transfer the reference marks made during disassembly to the new parts.

   Position the camshaft in a soft-jawed vise. Install the camshaft phaser and sprocket and the bolt.

- Align the reference marks on the camshaft phaser and sprocket and the camshaft. Tighten the bolt to 72 Nm (53 lb-ft).

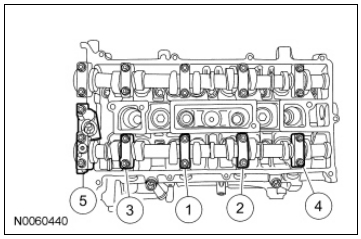


2. *NOTICE:* **Install the intake camshaft with the alignment slots in the camshafts lined up so the Camshaft Alignment Plate can be installed without rotating the camshafts. Make sure the lobes on the No. 1 cylinder are in the same position as noted in the removal procedure. Rotating the camshafts when the timing chain is removed, or installing the camshafts 180 degrees out of position can cause severe damage to the valves and pistons.**

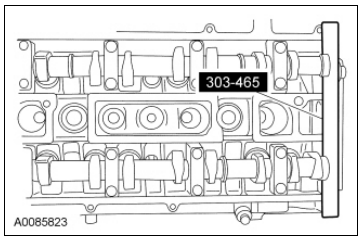
   NOTE: Lubricate the intake camshaft journals and bearing caps with clean engine oil.

   Install the intake camshafts and bearing caps. Tighten the intake camshaft bearing caps in the sequence shown in 3 stages:

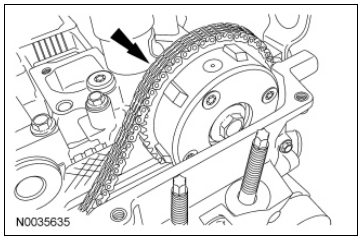
   - Stage 1: Tighten the intake camshaft bearing cap bolts until finger-tight.
   - Stage 2: Tighten to 7 Nm (62 lb-in).
   - Stage 3: Tighten to 16 Nm (142 lb-in).



3. Install the Camshaft Alignment Plate.



4. Install the timing chain on the camshaft phaser and sprocket.

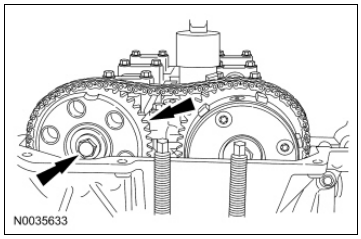


5. **NOTE:** The timing chain must be correctly engaged on the teeth of the crankshaft timing sprocket and the intake camshaft drive gear in order to install the exhaust camshaft drive gear onto the exhaust

camshaft.

Position the exhaust camshaft drive gear in the timing chain and install the gear and bolt on the exhaust camshaft.

- Hand-tighten the bolt.

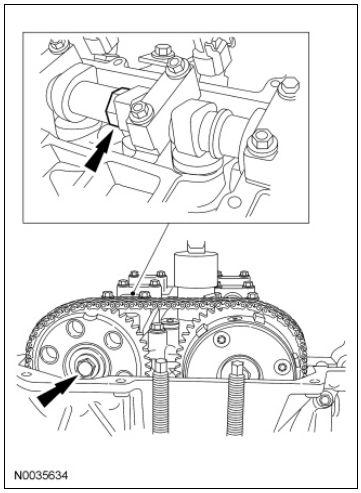


6. **NOTE:** Releasing the tensioner arm will remove the slack from the timing chain.

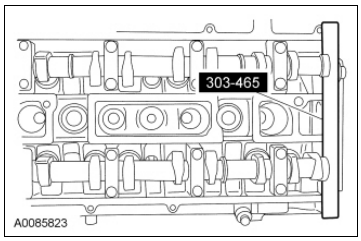
   Remove the M6 x 30 mm (1.18 in) bolt from the upper front cover timing hole to release the tensioner arm.

7. ***NOTICE:*** **The Camshaft Alignment Plate is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

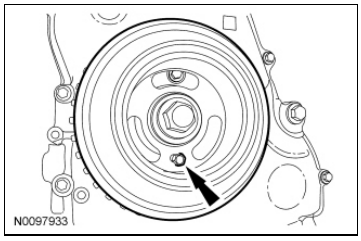
   Using the flats on the camshaft to prevent camshaft rotation, tighten the exhaust camshaft drive gear bolt to 72 Nm (53 lb-ft).



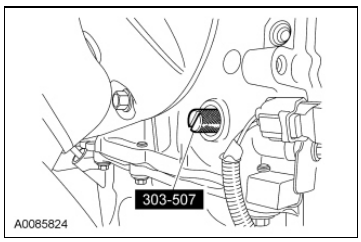
8. Remove the Camshaft Alignment Plate.



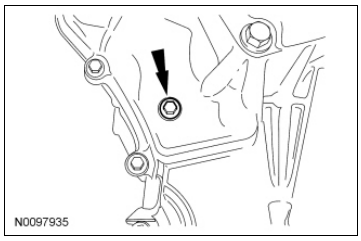
9. Remove the 6 mm x 18 mm bolt.



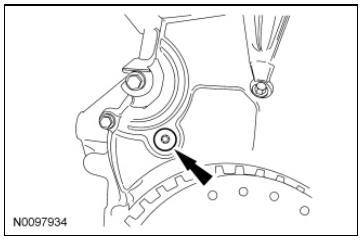
10. Remove the Crankshaft TDC Timing Peg.



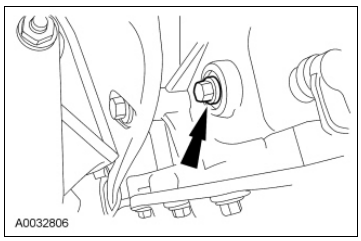
11. Install the upper timing hole plug in the engine front cover.
    - Tighten to 10 Nm (89 lb-in).



12. Apply silicone gasket and sealant to the threads of the lower timing hole plug.
    - Install the lower timing hole plug in the engine front cover.
        - ♦ Tighten to 12 Nm (106 lb-in).



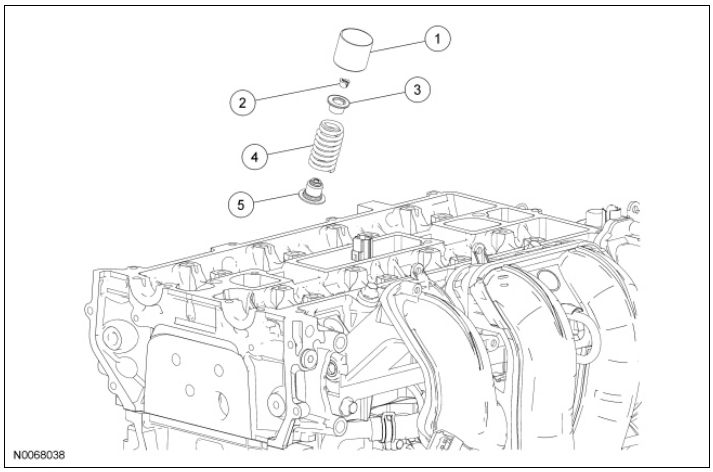
13. Install the engine plug bolt.
    - Tighten to 20 Nm (177 lb-in).



14. Install the accessory drive belt. For additional information, refer to Section 303-05D .

15. Install the VCT solenoid. For additional information, refer to Section 303-14D .

Valve Train Components - Exploded View

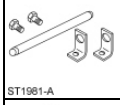


Item	Part Number	Description
1	6500	Valve tappet (16 required)
2	6518	Valve collet (16 required)
3	6514	Valve spring retainer (16 required)
6513	Valve spring (16 required)	
5	6517	Valve seal (16 required)

1. For additional information, refer to the procedures in this section.

Valve Springs

Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Sp 303-350 (T89P-6565-A)
 ST1902-A	Compressor, Valve Spring 303-472 (T94P-6565-AH)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the camshafts. For additional information, refer to Camshafts in this section.

3. **NOTE:** If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

   NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

   Remove and inspect the valve tappets. For additional information, refer to Section 303-00 .

4. Remove the spark plugs. For additional information, refer to Section 303-07A .

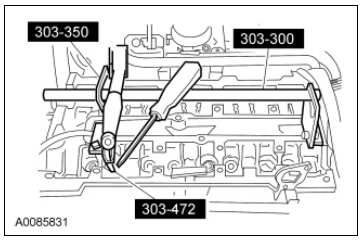
5. *NOTICE:* **Use compressed air at 7 to 10 bars (100-150 psi). Do not disconnect the compressed air from the cylinder until the valve spring, valve spring retainer and valve collet is installed. Any loss of air pressure will allow the valve to fall into the cylinder.**

   Connect the compressed air supply to the No. 1 cylinder.

6. **NOTE:** Place all parts in order to one side.

   Apply compressed air to the cylinder and remove the valve spring.

   - Using the Valve Spring Compressors, compress the valve spring and remove the valve collet, using some grease and a small screwdriver.
   - Remove the valve spring retainer and the valve spring.

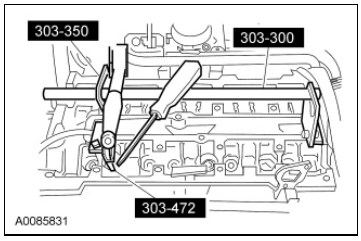


Installation

1. **NOTE:** Check the seating of the valve collet.

   Using the Valve Spring Compressors, install the valve spring.

   - Insert the valve spring and the valve spring retainer.
   - Compress the valve spring and install the valve collet using some grease and a small screwdriver.



2. Disconnect the compressed air supply.

3. Repeat the appropriate removal and installation steps for all of the other cylinders.

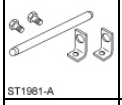
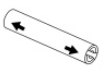
4. Install the spark plugs. For additional information, refer to Section 303-07A .

5. Coat the valve tappets with clean engine oil and insert them.

6. Install the camshafts. For additional information, refer to Camshafts in this section.

Valve Seals

Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Springbr>303-350 (T89P-6565-A)
 ST1902-A	Compressor, Valve Spring 303-472 (T94P-6565-AH)
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)
 ST1904-A	Remover, Valve Stem Oil Seal 303-468 (T94P-6510-AH)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XOW20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the camshafts. For additional information, refer to Camshafts in this section.

3. **NOTE:** If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

   NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

   Remove and inspect the valve tappets. For additional information, refer to Section 303-00 .

4. Remove the spark plugs. For additional information, refer to Section 303-07A .

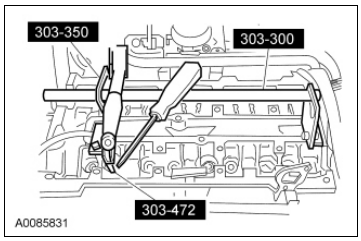
5. ***NOTICE:*** **Use compressed air at 7 to 10 bars (100-150 psi). Do not disconnect the compressed air from the cylinder until the valve spring, valve spring retainer and valve collet is installed. Any loss of air pressure will allow the valve to fall into the cylinder.**

   Connect the compressed air supply to the No. 1 cylinder.

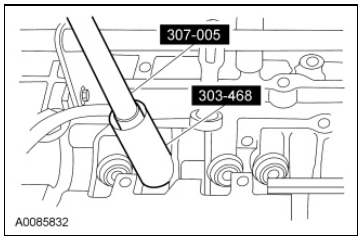
6. **NOTE:** Place all parts in order to one side.

   Apply compressed air to the cylinder and remove the valve spring.

   - Using the Valve Spring Compressors, compress the valve spring and remove the valve collet, using some grease and a small screwdriver.
   - Remove the valve spring retainer and the valve spring.

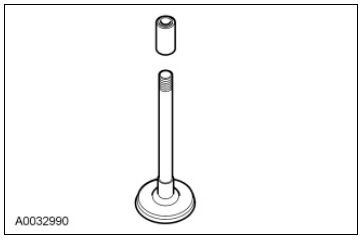


7. Using the Slide Hammer and the Valve Stem Oil Seal Remover, remove and discard the valve seal.

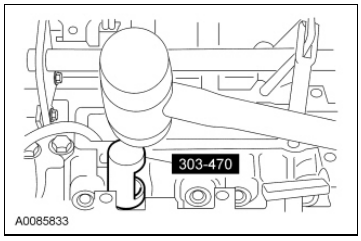


Installation

1. Install the valve stem seal installation sleeve.



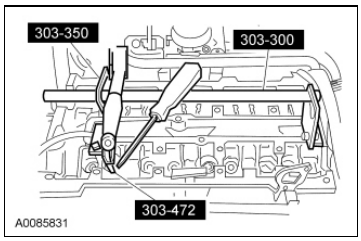
2. Using the Valve Stem Oil Seal Installer, install the valve seal.



3. **NOTE:** Check the seating of the valve collet.

   Using the Valve Spring Compressors, install the valve spring.

   - Insert the valve spring and the valve spring retainer.
   - Compress the valve spring and install the valve collet using some grease and a small screwdriver.



4. Disconnect the compressed air supply.

5. Install the spark plugs. For additional information, refer to Section 303-07A .

6. Repeat the appropriate removal and installation steps for all of the other cylinders.

7. Coat the valve tappets with clean engine oil and insert them.

8. Install the camshafts. For additional information, refer to Camshafts in this section.

Valve Tappets

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal and Installation

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant es or the oil pan can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the camshafts. For additional information, refer to Camshafts in this section.

3. **NOTE:** If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

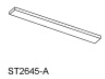
   NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

   Remove and inspect the valve tappets. For additional information, refer to Section 303-00 .

4. To install, reverse the removal procedure.
   - Coat the valve tappets with clean engine oil prior to installation.

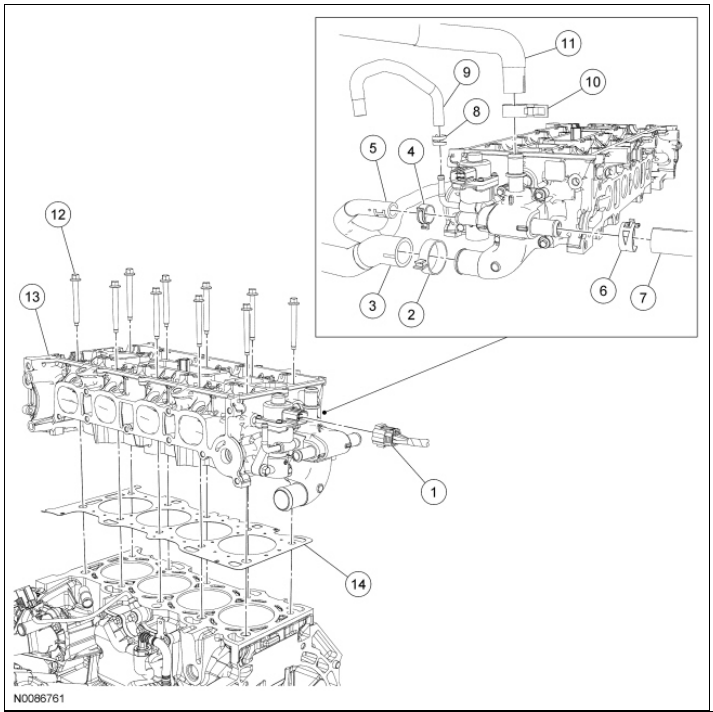
Cylinder Head

Special Tool(s)

 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant	WSE-M4G323-A4
Motorcraft® Silicone Gasket Remover ZC-30	-



Item	Part Number	Description

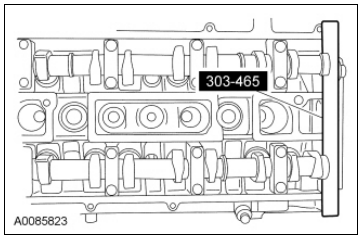
1	14A464	EGR valve electrical connector (part of 12A581)
2	W527372	Upper radiator hose clamp
3	8260	Upper radiator hose
4	W527212	Coolant bypass hose clamp
5	8075	Coolant bypass hose
6	W527362	Heater hose clamp
7	18472	Heater hose
8	W527302	EGR coolant hose clamp
9	18472	EGR coolant hose
10	W527362	Coolant vent hose clamp
11	18472	Coolant vent hose
12	6065	Cylinder head bolt (10 required)
13	6049	Cylinder head
14	6051	Cylinder head gasket

Removal

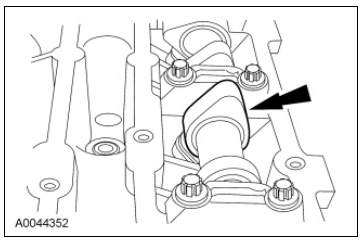
NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructin this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools or severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Release the fuel system pressure. For additional information, refer to Section 310-00 .
3. Drain the engine cooling system. For additional information, refer to Section 303-03B .
4. Remove the intake manifold. For additional information, refer to Intake Manifold in this section.
5. Remove the Variable Camshaft Timing (VCT) oil control solenoid. For additional information, refer to Section 303-14D .
6. Remove the timing drive components. For additional information, refer to Timing Drive Components in this section.
7. Remove the Camshaft Alignment Plate.



8. Mark the position of the camshaft lobes on the No. 1 cylinder for installation reference.

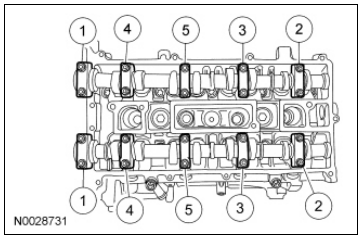


9. ***NOTICE:*** **Failure to follow the camshaft loosening procedure can result in damage to the camshafts.**

   NOTE: Mark the location and orientation of each camshaft bearing cap.

   Remove the camshafts from the engine.

   - Loosen the camshaft bearing cap bolts, in sequence, one turn at a time until all tension is released from the camshaft bearing caps.
   - Remove the bolts and the camshaft bearing caps.
   - Remove the camshafts.



10. **NOTE:** If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

    Remove the valve tappets.

11. Inspect the valve tappets. For additional information, refer to Section 303-00 .

12. Remove the catalytic converter. For additional information, refer to Section 309-00 .

13. Disconnect the EGR valve electrical connector.

14. Disconnect the upper radiator hose, coolant bypass hose, EGR coolant hose, heater hose and coolant vent hose from the engine coolant outlet and the EGR valve.

15. Remove the bolts and the cylinder head.
    - Discard the bolts and the cylinder head gasket.

Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

   NOTE: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

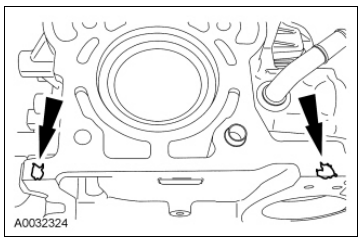
Clean the cylinder head-to-cylinder block mating surface of both the cylinder head and the cylinder block in the following sequence.

1. Remove any large deposits of silicone or gasket material with a plastic scraper.
2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply metal surface prep, following package directions, to remove any traces of oil or coolant, and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

2. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

3. Clean the cylinder head bolt holes in the cylinder block. Make sure all coolant, oil or other foreign material is removed.

4. Apply silicone gasket and sealant to the locations shown.

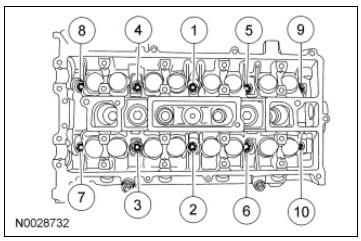


5. Install a new cylinder head gasket.

6. **NOTE:** The cylinder head bolts are torque-to-yield and must not be reused. New cylinder head bolts must be installed.

   Install the cylinder head and 10 new bolts. Tighten the bolts in the sequence shown in the following 5 stages:

   - Stage 1: Tighten to 5 Nm (44 lb-in).
   - Stage 2: Tighten to 15 Nm (133 lb-in).
   - Stage 3: Tighten to 45 Nm (33 lb-ft).
   - Stage 4: Turn 90 degrees.
   - Stage 5: Turn an additional 90 degrees.



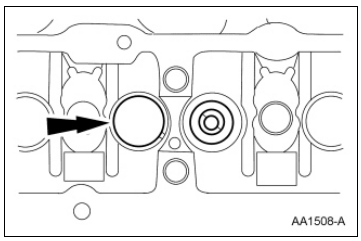
7. Connect the upper radiator hose, coolant bypass hose, EGR coolant hose, heater hose and coolant vent hose to the engine coolant outlet and the EGR valve.

8. Connect the EGR valve electrical connector.

9. Install the catalytic converter. For additional information, refer to Section 309-00 .

10. **NOTE:** Lubricate the valve tappets with clean engine oil.

    Install the valve tappets in their original positions.

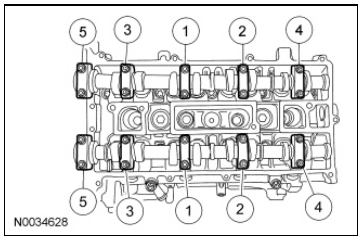


11. *NOTICE:* **Install the camshafts with the alignment notches in the camshafts lined up so the camshaft alignment plate can be installed. Make sure the lobes on the No. 1 cylinder are in the same position as noted in the removal procedure. Failure to follow this procedure can cause severe damage to the valves and pistons.**

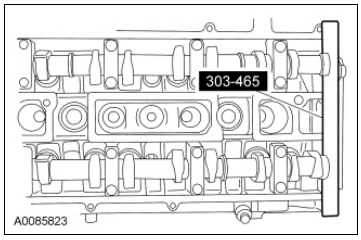
    NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

    Install the camshafts and bearing caps in their original location and orientation. Tighten the bearing caps in the sequence shown in 3 stages:

    - Stage 1: Tighten the camshaft bearing cap bolts, one turn at a time, until finger-tight.
    - Stage 2: Tighten the bolts to 7 Nm (62 lb-in).
    - Stage 3: Tighten the bolts to 16 Nm (142 lb-in).



12. Install the Camshaft Alignment Plate.



13. Install the timing drive components. For additional information, refer to Timing Drive Components in this section.

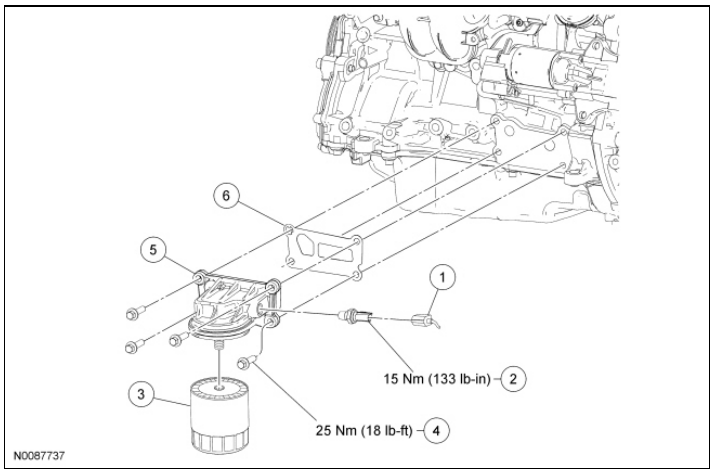
14. Install the VCT oil control solenoid. For additional information, refer to Section 303-14D .

15. Install the intake manifold. For additional information, refer to Intake Manifold in this section.

16. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03B .

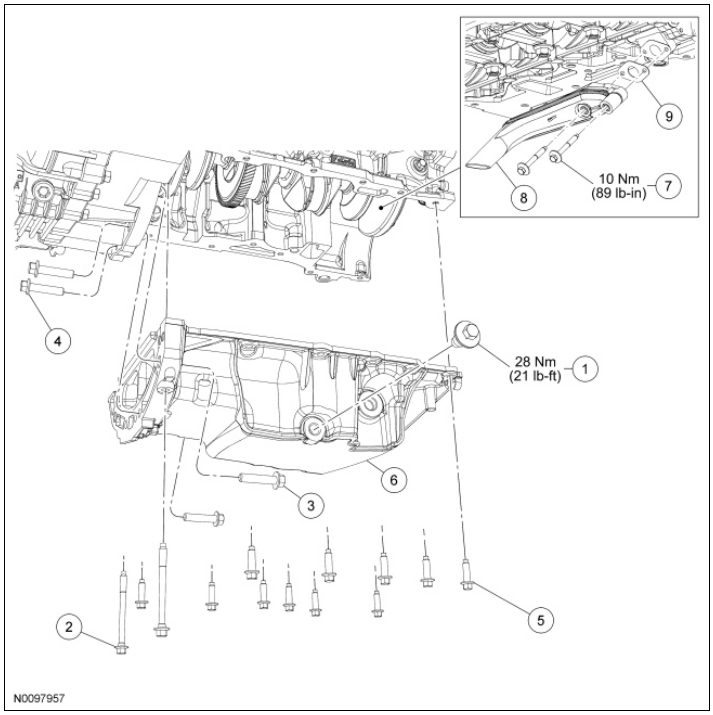
Engine Lubrication Components - Exploded View

Oil Filter Adapter, Oil Filter and Engine Oil Pressure (EOP) Switch



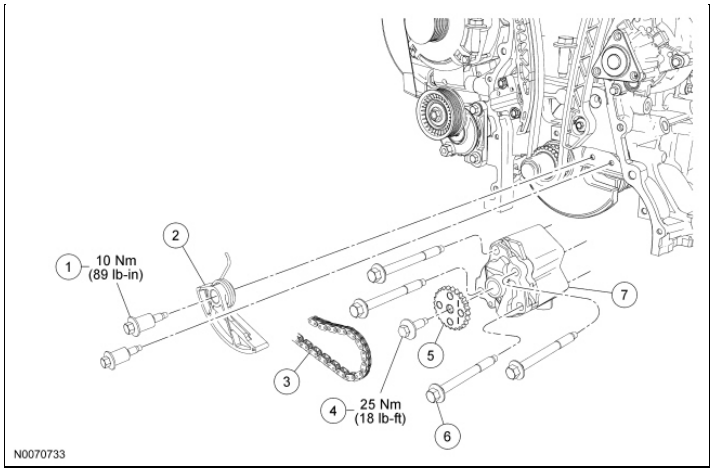
Item	Part Number	Description
1	14A464	Engine Oil Pressure (EOP) switch electrical connector (part of 12C508)
2	9278	EOP switch
3	6731	Oil filter
5	6884	Oil filter adapter
6	6A636	Oil filter adapter gasket

Oil Pan, Oil Pump Screen and Pickup Tube



Item	Part Number	Description
1	6730	Drain plug
2	W706284	Oil pan bolt (2 required)
3	W500122	Oil pan-to-bellhousing bolt (2 required)
4	W500122	Bellhousing-to-oil pan bolt (2 required)
5	W500224	Oil pan bolt (11 required)
6	6675	Oil pan
7	W706282	Oil pump screen and pickup tube bolt (2 required)
8	6622	Oil pump screen and pickup tube
9	6625	Oil pump screen and pickup tube gasket

Oil Pump



Item	Part Number	Description
1	W703651	

		Oil pump drive chain tensioner shoulder bolt (2 required)
2	6C271	Oil pump drive chain tensioner
3	6A895	Oil pump drive chain
4	W704397	Oil pump sprocket bolt
5	6652	Oil pump sprocket
6	W703647	Oil pump bolt (4 required)
7	6600	Oil pump

1. For additional information, refer to the procedures in this section.

Oil Filter Adapter

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

3. Remove oil filter.
   - To install, lubricate the oil filter O-ring with clean eoil and then tighten the oil filter three-fourths turn after the oil filter gasket makes contact with the oil filter adapter.

4. **NOTE:** Discard the gasket.

   Remove the 4 bolts and the oil filter adapter.

   - To install, tighten to 25 Nm (18 lb-ft).

5. To install, reverse the removal procedure.

Engine Oil Pressure (EOP) Switch

Material

Item	Specification
Thread Sealant with PTFE TA-24	WSK-M2G350-A2

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.

3. Remove the EOP switch.
   - To inl, tighten to 15 Nm (133 lb-in).

4. To install, reverse the removal procedure.
   - Apply thread sealant with PTFE to the EOP switch threads.

Oil Pan

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

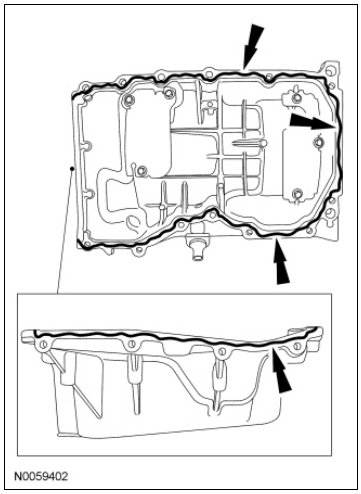
1. Witicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Drain the engine oil, then install the drain plug.
   - Tighten to 28 Nm (21 lb-ft).
3. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
4. Remove the 4 oil pan-to-bellhousing bolts.
5. Remove the 13 bolts and the oil pan.

Installation

1. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.**

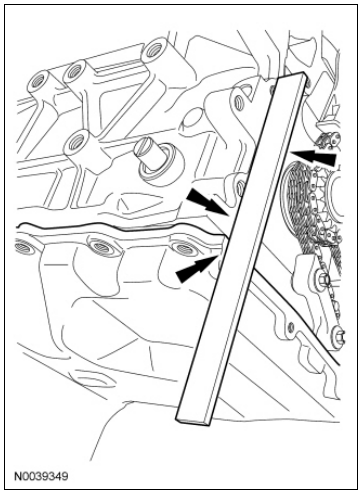
   Clean and inspect all mating surfaces.
2. **NOTE:** If the oil pan is not secured within 4 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

   Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the oil pan.

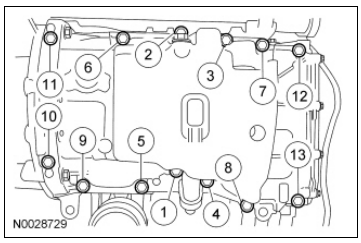


3. Position the oil pan and install the 2 rear oil pan bolts finger-tight.

4. Using a suitable straightedge, align the front surface of the oil pan flush with the front surface of the engine block.



5. Install the remaining oil pan bolts.
   - Tighten in the sequence shown to 25 Nm (18 lb-ft).



6. Install the 4 oil pan-to-bellhousing bolts.
   - Tighten to 48 Nm (35 lb-ft).

7. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

8. Fill the engine with clean engine oil.

Oil Pump Screen and Pickup Tube

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the oil pan. For additional information, refer to Engine Lubrication Components - Exploded View and Oil Pan in this section.

3. **NOTE:** Discard the gasket and clean and inspect the gasket mating surfaces.

   Remove the 2 bolts and the oil pump screen and pickup tube.

   - To install, tighten to 10 Nm (89 lb-in).

4. To install, reverse the removal procedure.

Oil Pump

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

1. With the engine in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

3. Drain the engine oil, then install the drain plug.
   - To install, tighten to 28 Nm (21 lb-ft).

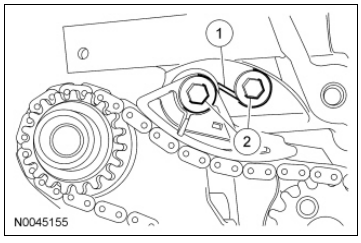
4. Remove the 4 oil pan-to-bellhousing bolts.

5. Remove the 13 bolts and the oil pan.

6. **NOTE:** Discard the gasket and clean and inspect the gasket mating surfaces.

   Remove the 2 bolts and the oil pump screen and pickup tube.

7. Remove the oil pump drive chain tensioner.
   1. Release the tension on the tensioner spring.
   2. Remove the 2 shoulder bolts and the tensioner.



8. Remove the chain from the oil pump sprocket.

9. Remove the bolt and oil pump sprocket.

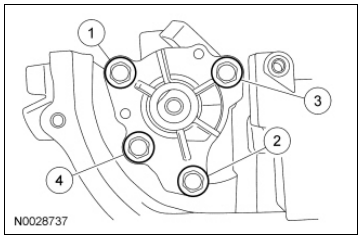
10. Remove the 4 bolts and the oil pump.

Installation

1. **NOTE:** Clean the oil pump and cylinder block mating surfaces with metal surface prep.

   Install the oil pump assembly. Tighten the 4 bolts in the sequence shown in 2 stages:

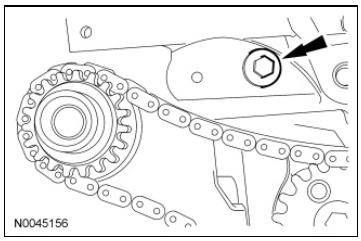
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten to 20 Nm (177 lb-in).



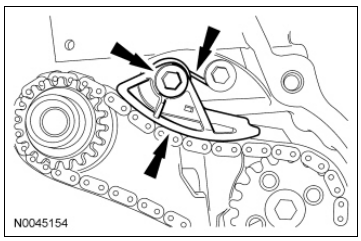
2. Install the oil pump sprocket and bolt.
   - Tighten to 25 Nm (18 lb-ft).

3. Install the chain onto the oil pump sprocket.

4. Install the oil pump drive chain tensioner shoulder bolt.
   - Tighten to 10 Nm (89 lb-in).



5. Install the oil pump drive chain tensioner and bolt. Hook the tensioner spring around the shoulder bolt.
   - Tighten to 10 Nm (89 lb-in).



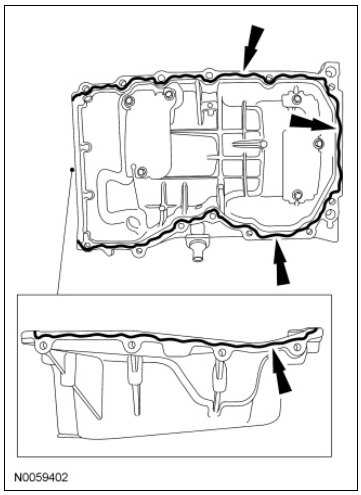
6. Install the oil pump screen and pickup tube and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).

7. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces to sealant.**

Clean all mating surfaces with metal surface prep.

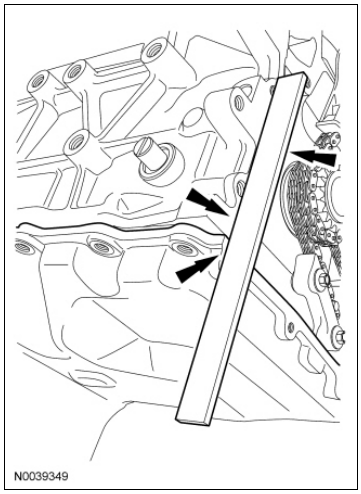
8. **NOTE:** If the oil pan is not secured within 4 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

   Apply a 2.5 mm (0.09 in) bead of sealant gasket and sealant to the oil pan.

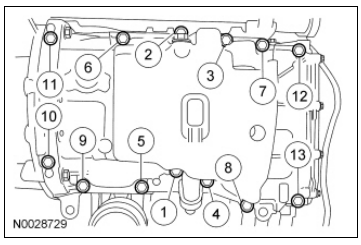


9. Position the oil pan onto the engine and install the 2 rear oil pan bolts finger-tight.

10. Using a suitable straight edge, align the front surface of the oil pan flush with the front surface of the engine block.



11. Install the remaining oil pan bolts.
    - Tighten in the sequence shown to 25 Nm (18 lb-ft).



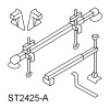
12. Install the 4 oil pan-to-bellhousing bolts.
    - Tighten to 48 Nm (35 lb-ft).

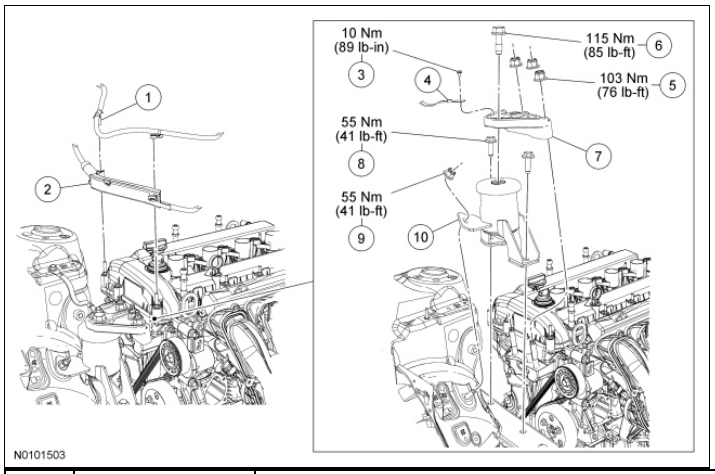
13. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

14. Fill the engine with clean engine oil.

Engine Mount

Special Tool(s)

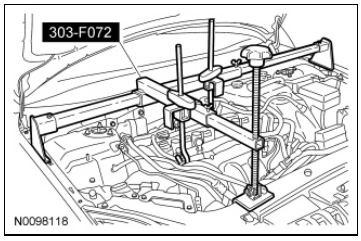
 ST2425-A	Support Bar, Engine 303-F072



Item	Part Number	Description
1	-	Block heater wiring retainer (if equipped) (2 required)
2	-	High voltage wiring harness retainer (part of 14300)
3	-	Ground strap bolt
4	-	Ground strap
5	N807144	Engine mount bracket nut (3 required)
6	W710824	Engine mount bracket bolt
7	6061	Engine mount bracket
8	W500233	Engine mount bolt (2 required)
9	-	Engine mount nut
10	6038	Engine mount

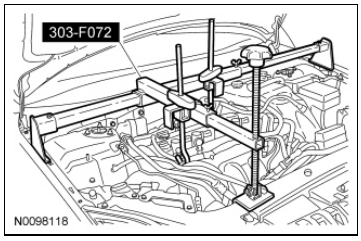
Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the engine coolant degas bottle. For additional information, refer to Section 303-03B .
3. Install the Engine Support Bar to the front and rear engine lifting eyes.



4. Remove the engine mount bracket bolt.
    - To install, tighten to 115 Nm (85 lb-ft).

5. Use the Engine Support Bar to raise the engine 25 mm (0.98 in).



6. Remove the bolt and the ground strap from the engine mount bracket.
    - Tighten to 10 Nm (89 lb-in).

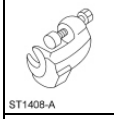
7. Remove the 3 nuts and the engine mount bracket.
    - To install, tighten to 103 Nm (76 lb-ft).

8. Remove the 2 bolts and nut and the engine mount.
    - To install, tighten to 55 Nm (41 lb-ft).

9. To install, reverse the removal procedure.

Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent
 ST1408-A	Remover, Tie-Rod End 211-105 (T85M-3395-A)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) (part of 303-DS086) or equivalent
 ST2743A	Adjustable Grip Arm, 1735A 014-00001 or equivalent

⚠ **WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Release the fuel system pressure. For additional information, refer to Section 310-00 .

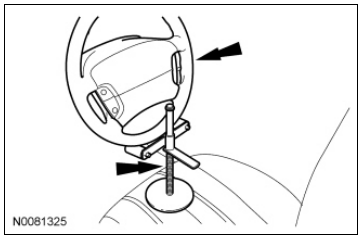
3. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

4. Depower the vehicle high voltage electrical system. For additional information, refer to Section 414-03 .

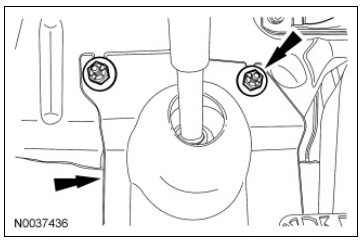
5. Recover the A/C system. For additional information, refer to Section 412-00B .

6. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

   Place the seering wheel in the straight-ahead position and the ignition key in the OFF position.

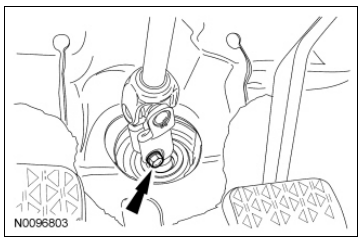

N0081325

7. Remove the 2 nuts and the steering joint cover.

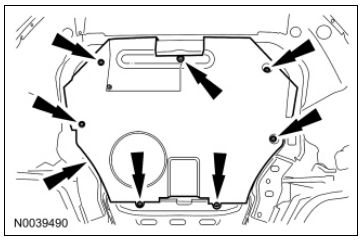


8. ***NOTICE:*** **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   Remove the bolt and disconnect the steering column shaft from the steering gear.



9. Remove the 7 screws and the underbody cover.



10. Drain the cooling system. For additional information, refer to Section 303-03B .

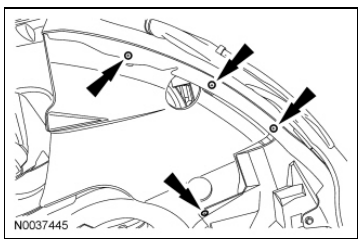
11. Drain the Motor Electronics Cooling System (MECS). For additional information, refer to Section 307-02B .

12. Remove the engine Air Cleaner (ACL) pipe. For additional information, refer to Section 303-12D .

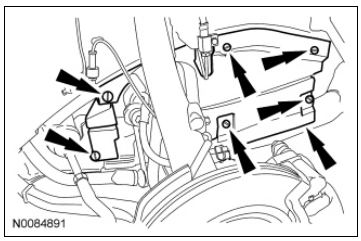
13. Remove the front wheels and tires. For additional information, refer to Section 204-04 .

14. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .

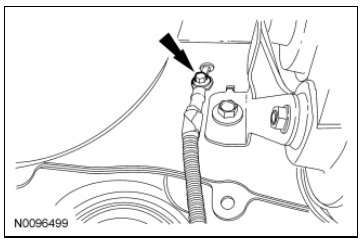
15. Remove the 4 screws and position the RH fender splash shield aside.



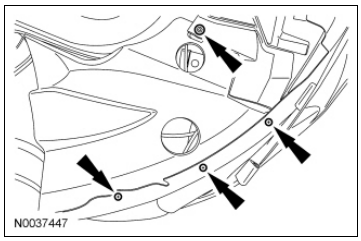
16. Remove the 6 pin-type retainers and the RH splash shield.



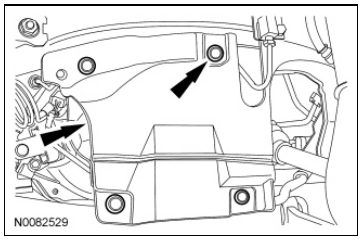
17. Remove the bolt and the Electronic Power Assist Steering (EPAS) wiring ground wire from in the RH front wheel well.



18. Remove the 4 screws and position the LH fender splash shield aside.



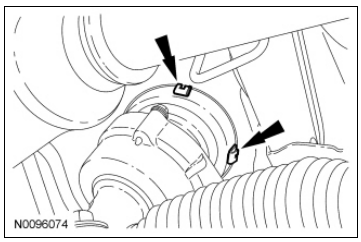
19. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.



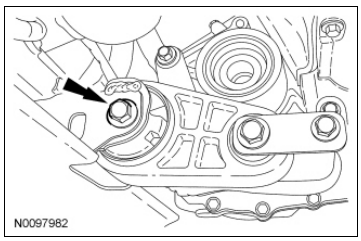
20. Remove the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

21. ***NOTICE:*** **The steering gear-to-dash seal must be removed or it will be damaged when lowering the subframe.**

    Release the 4 clips (2 shown) and slide the steering gear-to-dash seal off of the steering gear and into the passenger compartment.

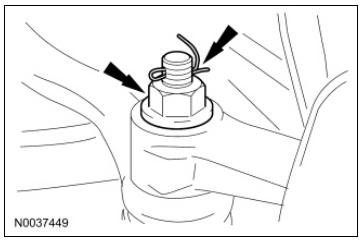


22. Remove the engine roll restrictor bolt.



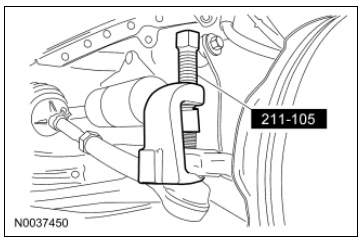
23. **NOTE:** RH shown, LH similar.

    Remove the cotter pins and nuts from the tie-rod ends.



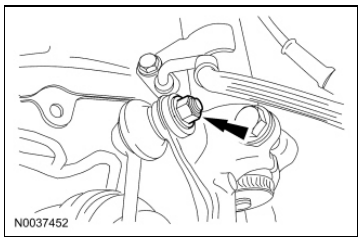
24. **NOTE:** RH shown, LH similar.

    Using the Tie-Rod End Remover, separate the tie-rod ends from the steering knuckles.

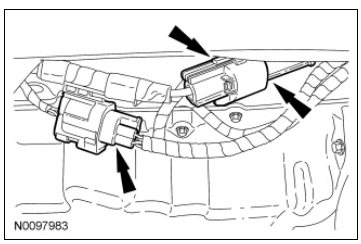


25. **NOTE:** RH shown, LH similar.

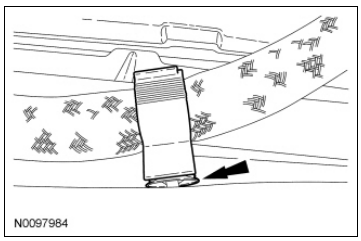
    Remove the nuts and separate the stabilizer bar links from the struts.



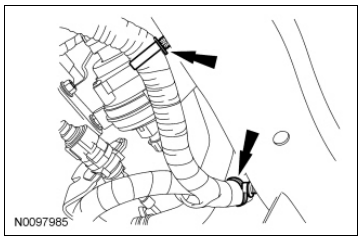
26. Disconnect the 2 EPAS electrical connectors near the front of the subframe.
    - Detach the connector retainer from the subframe.



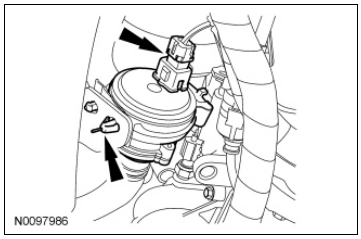
27. Detach the auxiliary coolant hose retainer from the subframe.



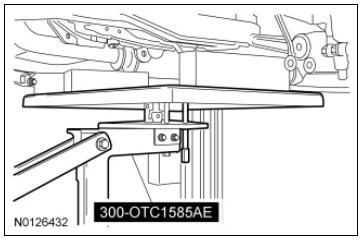
28. Detach the 3 wiring harness retainers (2 shown) from the LH front of the subframe.



29. Disconnect the MECS electrical connector and detach the pump from the bracket.

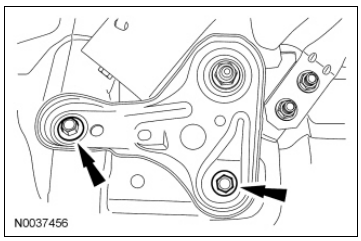


30. Position the Powertrain Lift under the subframe assembly.

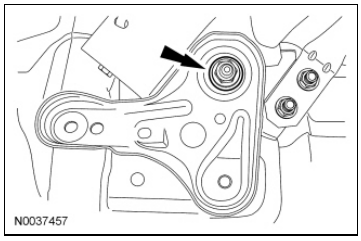


31. **NOTE:** LH shown, RH similar.

    Remove the subframe bracket-to-body bolts.

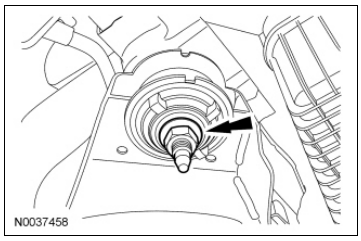


32. Remove the subframe nuts and the subframe brackets.



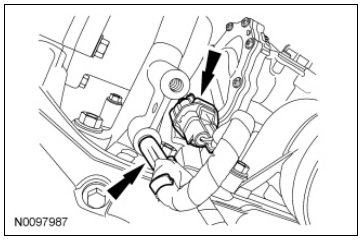
33. **NOTE:** LH shown, RH similar.

    Remove the front subframe nuts.

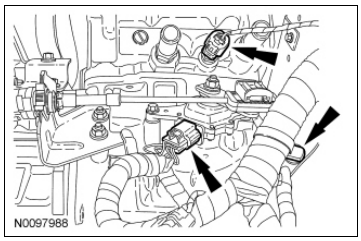


34. Lower the subframe assembly from the vehicle.

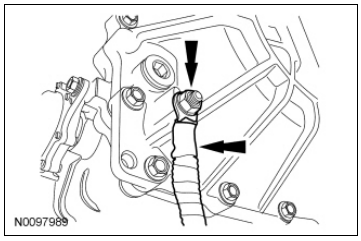
35. Disconnect the vacuum pump assembly electrical connector and detach the wiring retainer.



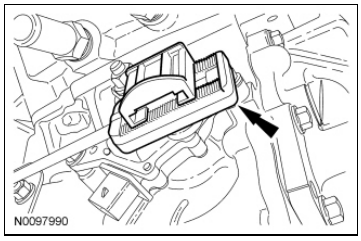
36. Disconnect the transaxle coolant temperature sensor and the Transmission Range (TR) sensor electrical connectors.
    - Detach the wiring harness retainer.



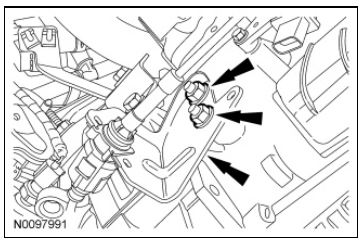
37. Remove the transaxle ground wire and nut.



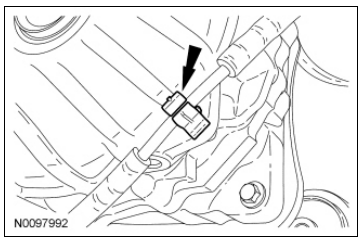
38. Disconnect the transaxle shift cable from the transaxle.



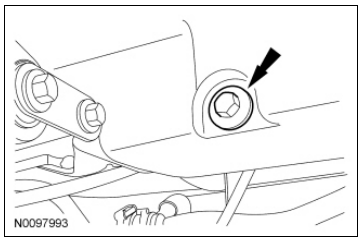
39. Remove the 2 nuts and the transaxle shift cable bracket.



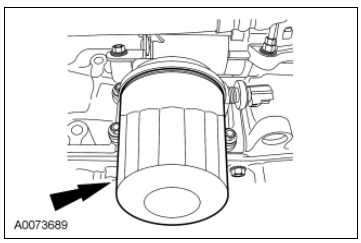
40. Detach the transaxle shift cable routing retainer from the transaxle.



41. Remove the drain plug and drain the engine oil.
    - Install the drain plug.
    - Tighten to 28 Nm (21 lb-ft).

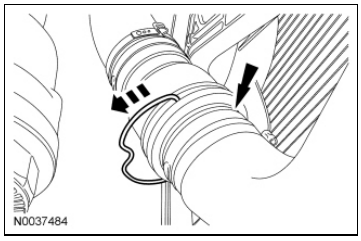


42. Remove the engine oil filter.

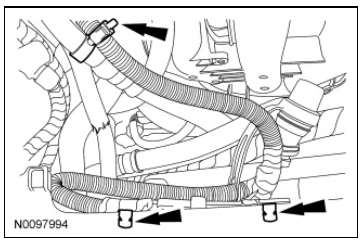


43. **NOTE:** Lower radiator hose shown, upper similar.

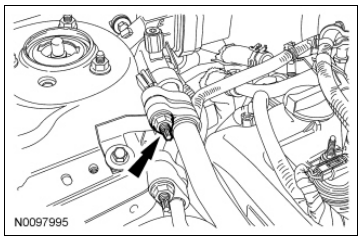
    Remove the retaining clips and disconnect the upper and the lower radiator hose.



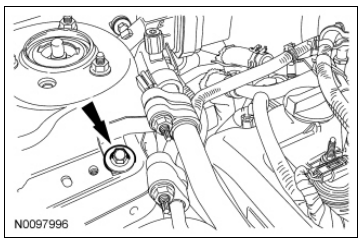
44. If equipped, detach the 3 block heater wiring retainers.



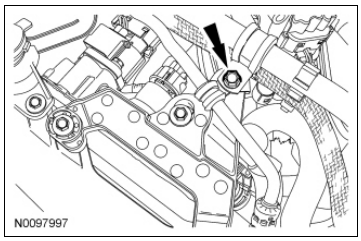
45. Remove the nut and disconnect the A/C tube.
    - Discard the gasket.



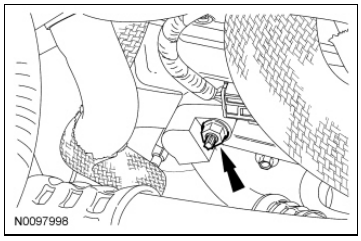
46. Remove the A/C tube bracket bolt from the strut tower.



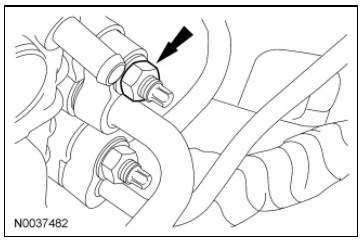
47. Remove the A/C tube bracket bolt.



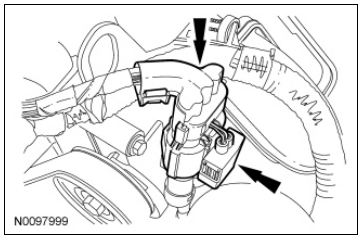
48. Remove the nut and disconnect the A/C tube from the A/C compressor.



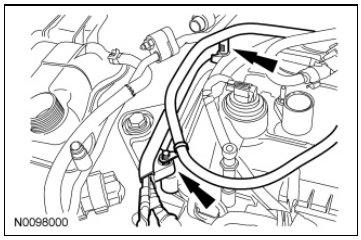
49. Remove the nut and disconnect the A/C tube from the A/C condenser.
    - Discard the gasket.



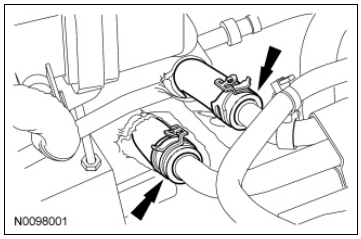
50. Disconnect the 2 vehicle high voltage electrical system electrical connectors.
    - Detach the wiring harness retainer.



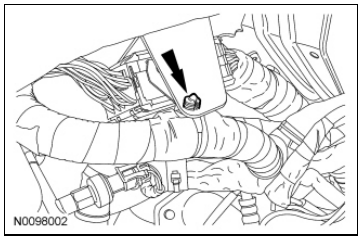
51. Detach the 2 block heaters (if equipped) and the high voltage electrical system wiring retainers from the valve cover stud bolts.



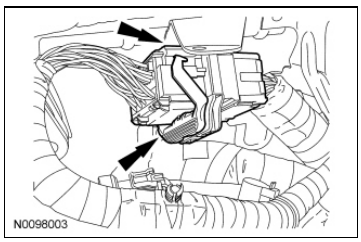
52. Disconnect the 2 heater hoses.



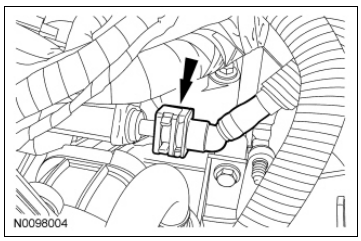
53. Detach the engine wiring harness retainer from the bracket.



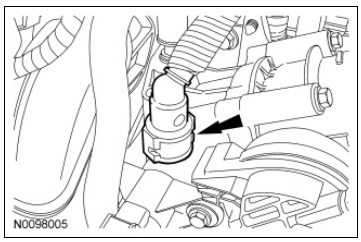
54. Disconnect the engine wiring harness connector and detach it from the bracket.



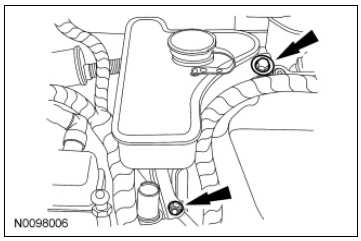
55. Disconnect the fuel supply tube. For additional information, refer to Section 310-00 .



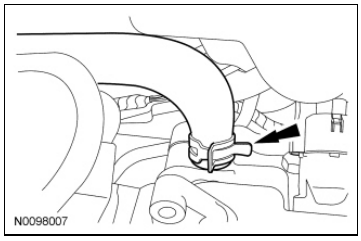
56. Disconnect the upper Evaporative Emission (EVAP) tube quick connect coupling from the purge valve. For additional information, refer to Section 310-00 .



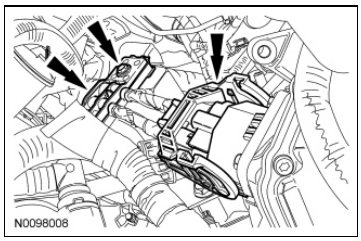
57. Remove the MECS coolant expansion tank nut and bolt.



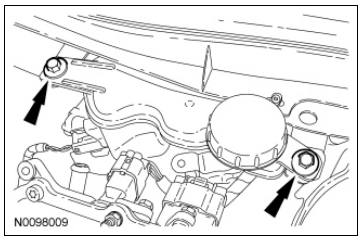
58. Disconnect the hose from the transaxle and remove the MECS coolant expansion tank.



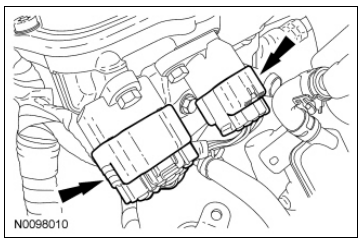
59. Remove the bolt and detach the wiring retainer.
    - Disconnect the transaxle harness electrical connector.



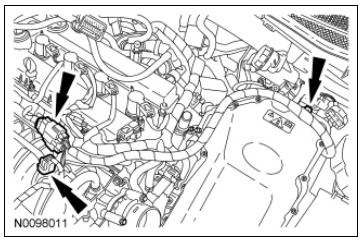
60. Remove the 2 bolts and position the master cylinder reservoir aside.



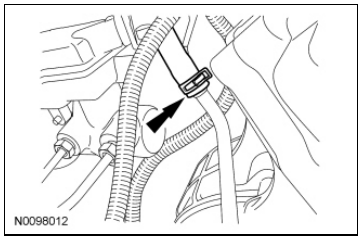
61. Disconnect the 2 transaxle electrical connectors.



62. Disconnect the 2 engine wiring harness connectors and detach the wiring retainer.

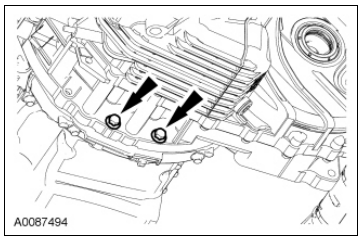


63. Disconnect the brake booster vacuum hose.



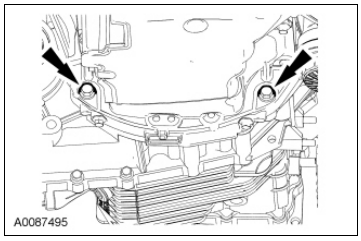
64. **NOTE:** The transaxle-to-engine bolts differ in length. Mark the bolts for correct installation.

    Remove the 2 transaxle-to-engine bolts.



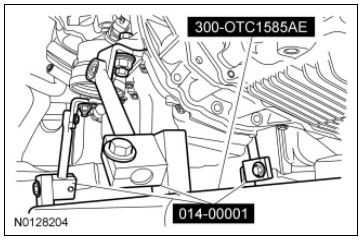
65. **NOTE:** The transaxle-to-engine bolts differ in length, mark the bolts for correct installation.

    Remove the 2 transaxle-to-engine bolts.

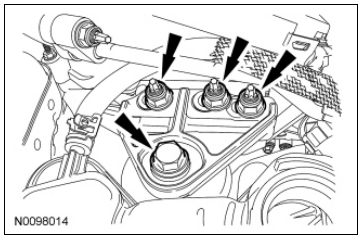


66. **NOTE:** Due to the weight of the transaxle, special care should be taken to mount the powertrain securely to the Powertrain Lift.

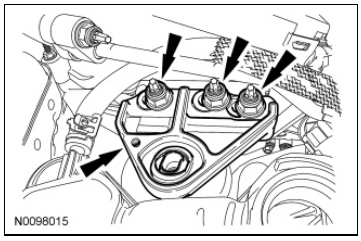
    Using the Powertrain Lift and Adjustable Grip Arm, secure the engine to the Powertrain Lift.



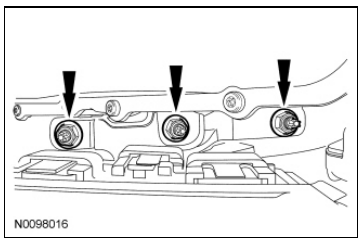
67. Remove the engine mount bracket bolt.



68. Remove the nuts and the engine mount bracket.

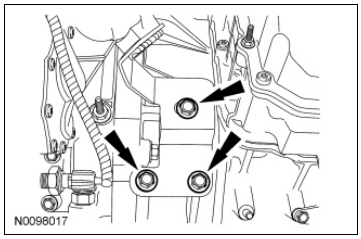


69. Remove the 3 nuts from the upper transaxle insulator.

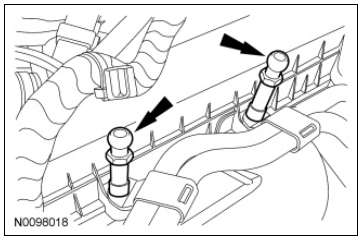


70. Lower the engine and transaxle from the vehicle.

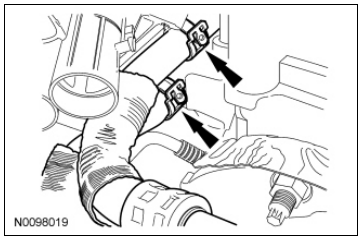
71. Remove the 3 bolts and position aside the auxiliary coolant pump and bracket.



72. Remove the 2 engine cover studs from the valve cover stud bolts..



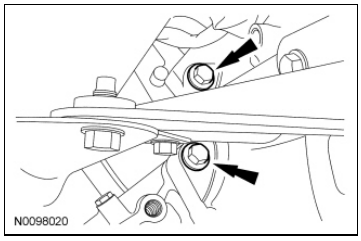
73. Disconnect the 2 heater hoses from the coolant outlet.



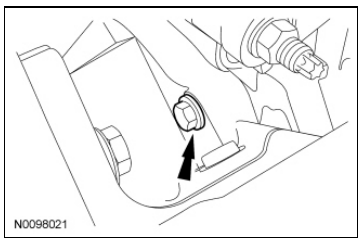
74. Using the Floor Crane and the Spreader Bar, remove the engine and transaxle from the Powertrain Lift.

75. **NOTE:** The transaxle-to-engine bolts differ in length, mark the bolts for correct installation.

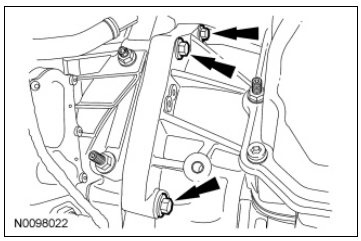
    Remove the 2 transaxle bolts.



76. Remove the transaxle bolt.



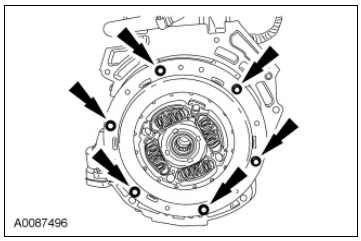
77. Remove the 3 transaxle bolts and separate the engine and transaxle.



78. **NOTE:** Due to packaging requirements the correct bolt must be used at the damper locations.

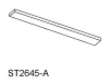
    NOTE: The damper contains a clutch which is designed to slip briefly during vehicle operation. It is essential that no grease, oil or cleaning solvents be allowed to contaminate the slip clutch. Do not use grease on transmission input shaft. Should the damper become contaminated, it must be replaced.

    Remove the bolts and the transaxle damper.



Engine

Special Tool(s)

 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST1910-A	Engine Stand 014-00232 or equivalent
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST3054-A	Holding Tool, Crankshaft Damper 303-1416
 ST1982-A	Installer, Connecting Rod 303-462 (T94P-6136-AH)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

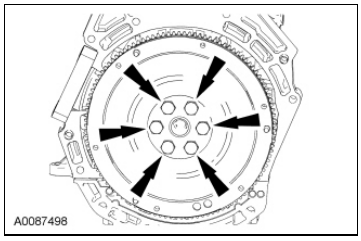
NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools or severe engine damage may occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

NOTE: Due to the precision fit and timing of the balancer shaft assembly, it cannot be removed from the engine block.

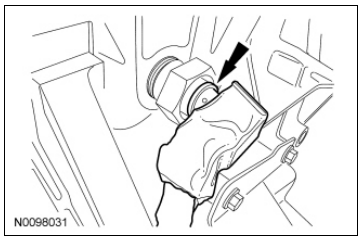
NOTE: For additional information, refer to the exploded views under engine Assembly in this section.

1. Remove the 6 bolts and the flywheel.

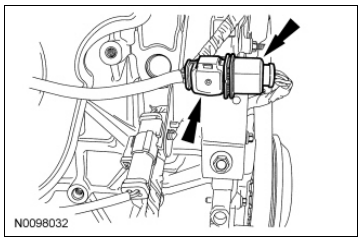


2. Mount the engine on a suitable engine stand.

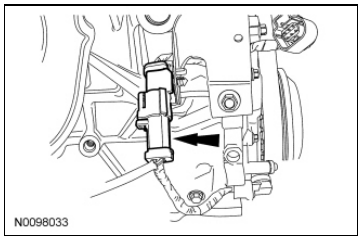
3. If equipped, disconnect the engine block heater.



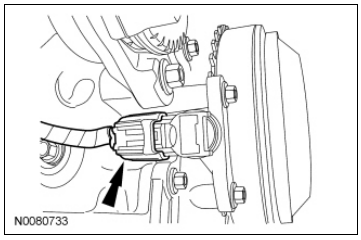
4. Disconnect the Heated Oxygen Sensor (HO2S) electrical connector.
    - Detach the connector from the engine wiring harness connector bracket.



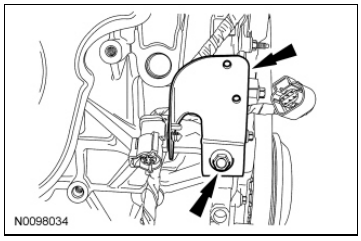
5. Disconnect the Catalyst Monitor Sensor (CMS) electrical connector.



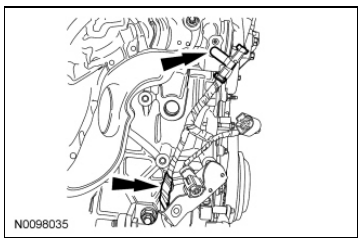
6. Disconnect the Crankshaft Position (CKP) sensor electrical connector.



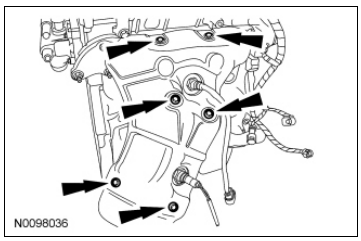
7. Remove the bolt and the engine wiring harness connector bracket.



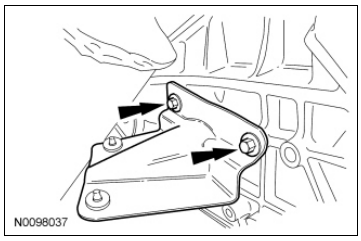
8. Detach the 2 engine wiring harness pin-type retainers.



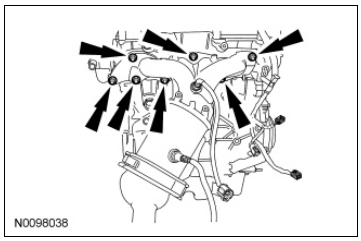
9. Remove the 6 bolts and the catalytic converter manifold heat shield.



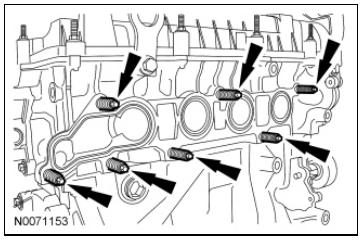
10. Remove the 2 catalytic converter manifold bracket-to-engine block bolts.



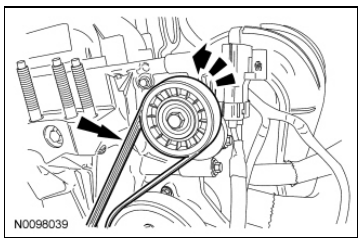
11. Remove the 7 nuts and the catalytic converter manifold.
    - Discard the nuts and the catalytic converter manifold gasket.



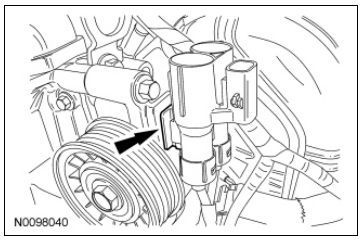
12. Remove and discard the 7 cylinder head studs.



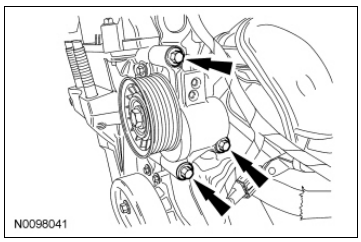
13. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.



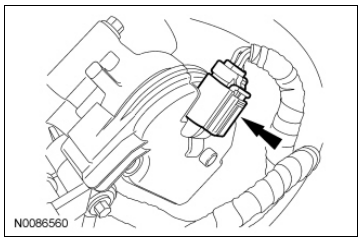
14. Detach the vehicle high voltage electrical system electrical connector retainer from the accessory drive belt tensioner.



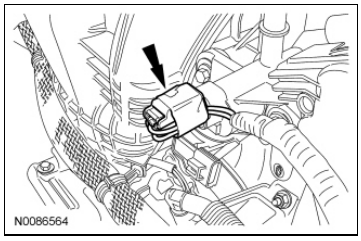
15. Remove the 3 bolts and the accessory drive belt tensioner.



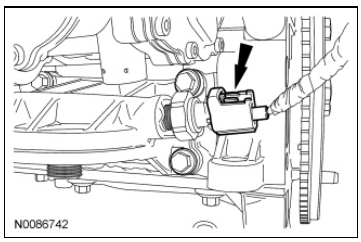
16. Disconnect the electronic throttle control electrical connector.



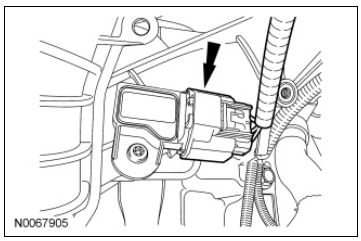
17. Disconnect the Evaporative Emission (EVAP) canister purge valve electrical connector.



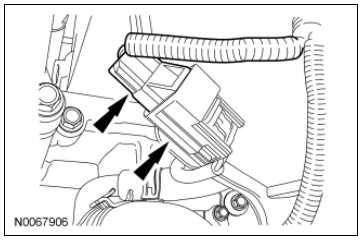
18. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.



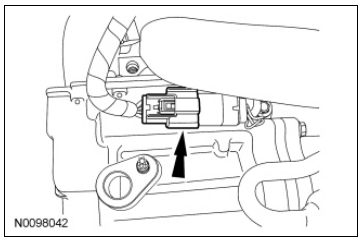
19. Disconnect the Manifold Absolute Pressure (MAP) sensor electrical connector.



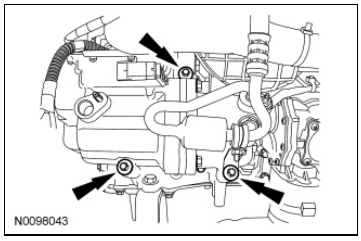
20. Disconnect the Knock Sensor (KS) electrical connector and detach the electrical connector pin-type retainer from the intake manifold.



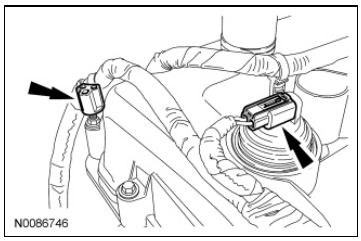
21. Disconnect the A/C compressor electrical connector.



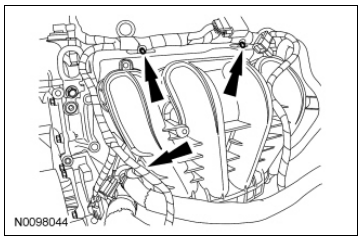
22. Remove the 3 bolts and the A/C compressor.



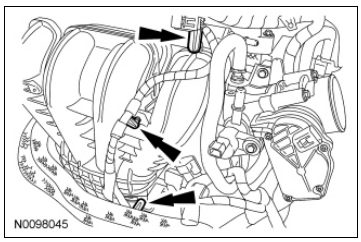
23. Disconnect the Variable Camshaft Timing (VCT) oil control solenoid electrical connector and detach the wiring harness retainer from the valve cover stud bolt.



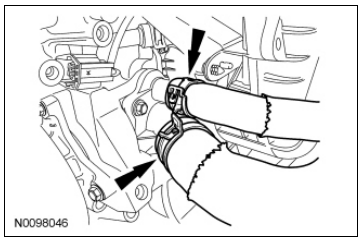
24. Detach the 3 wire harness pin-type retainers.



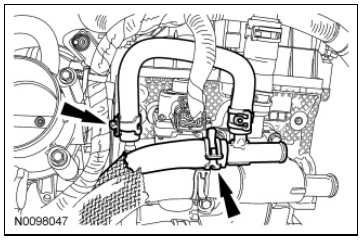
25. Detach the 2 auxiliary coolant pump wiring retainers and the lower radiator hose retainer.



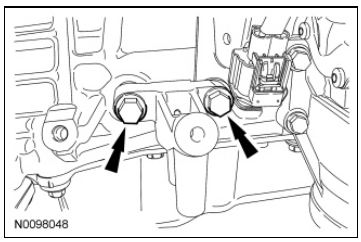
26. Disconnect the auxiliary coolant pump hose and the upper radiator hose.



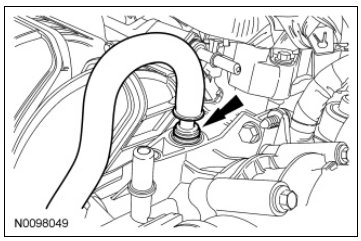
27. Disconnect the EGR coolant hose and the auxiliary coolant pump hose.
    - Remove the upper radiator hose and the auxiliary coolant pump as an assembly.



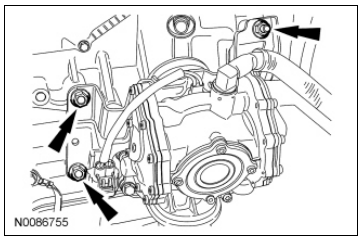
28. Remove the 2 bolts and the A/C compressor bracket.



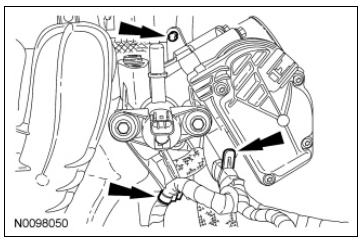
29. Disconnect the vacuum hose from the intake manifold.



30. Remove the 2 bolts, the nut and the vacuum pump assembly.

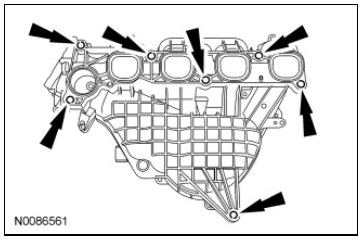


31. Detach the 3 wire harness pin-type retainers from the intake manifold.

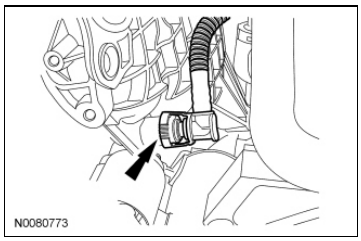


32. **NOTE:** The cylinder head side of the intake manifold is showing the location of the 7 bolts.

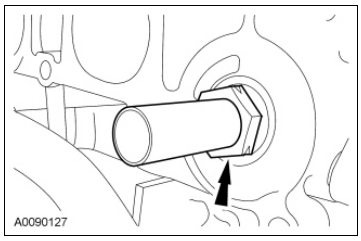
    Remove the 7 bolts and position the intake manifold aside to access the PCV hose connector.



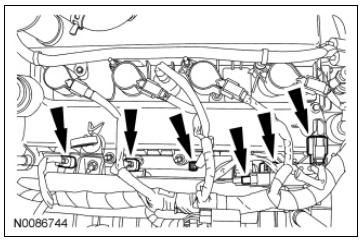
33. Squeeze the 2 PCV hose connector tabs and disconnect the PCV hose from the intake manifold.
    - Remove the intake manifold.



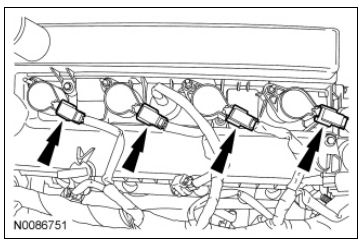
34. Remove the EGR tube.



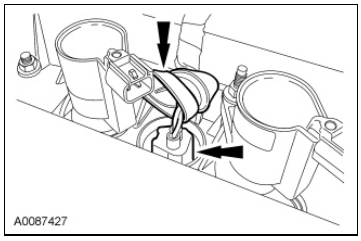
35. Disconnect the 4 fuel injector electrical connectors, radio capacitor electrical connector and the Camshaft Position (CMP) sensor electrical connector.



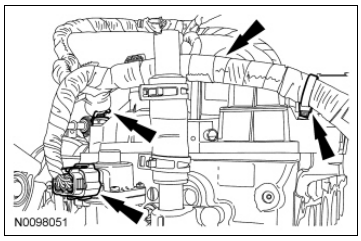
36. Disconnect the 4 coil-on-plug electrical connectors.



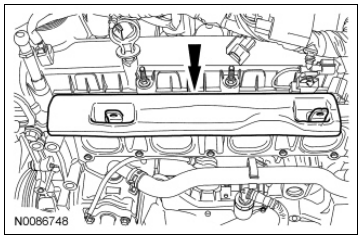
37. Position the rubber boot aside and disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.



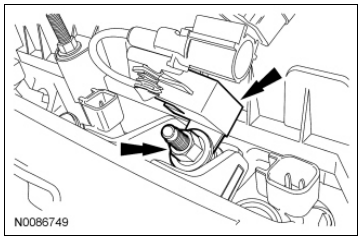
38. Disconnect the EGR valve electrical connector and detach the 2 wiring harness retainers from the valve cover and stud bolt.
    - Remove the engine control wiring harness from the engine.



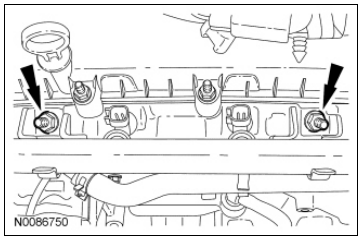
39. Remove the fuel rail insulator.



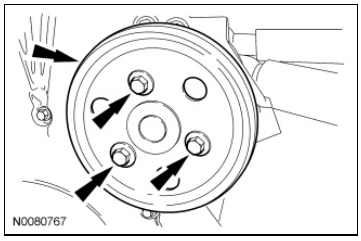
40. Remove the nut and the radio capacitor.



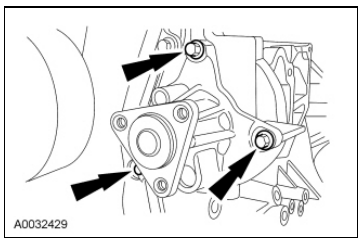
41. Remove the 2 stud bolts and the fuel rail with the fuel injectors.



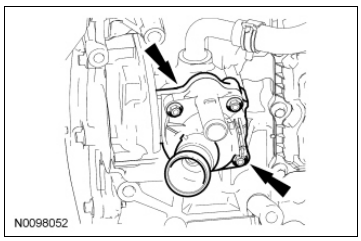
42. Remove the 3 bolts and the coolant pump pulley.



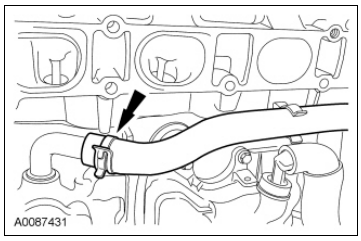
43. Remove the 3 bolts and the coolant pump.



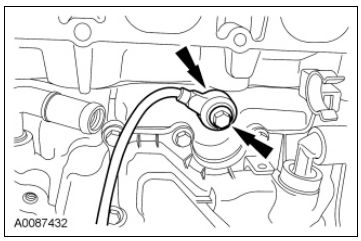
44. Remove the 3 bolts and the thermostat housing.



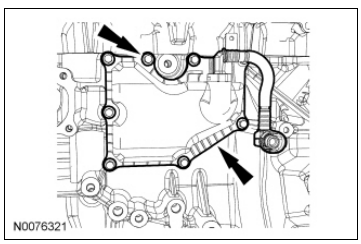
45. Disconnect the bypass hose.



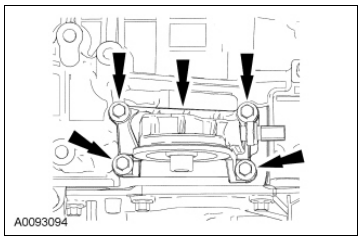
46. Remove the bolt and the KS .



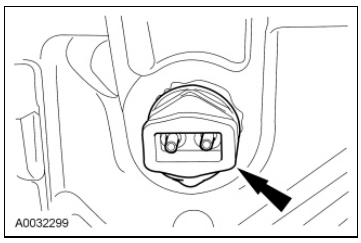
47. Remove the 8 bolts and the crankcase vent oil separator.



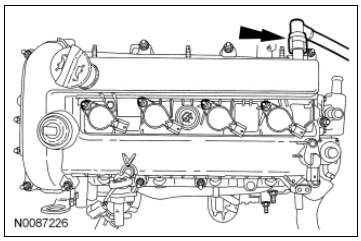
48. Remove the 4 bolts and the oil filter adapter.
    - Discard the gasket.



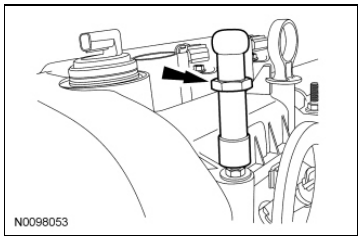
49. If equipped, remove the block heater.



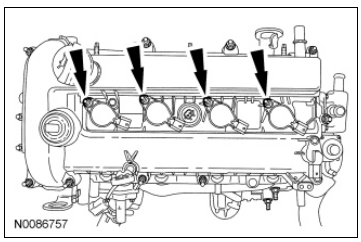
50. Remove the crankshaft vent tube.



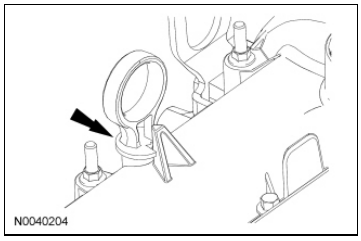
51. Remove the 2 engine cover studs (one shown).



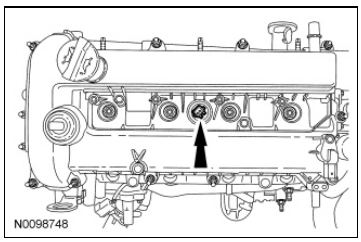
52. Remove the 4 stud bolts and the coil-on-plugs from the valve cover.



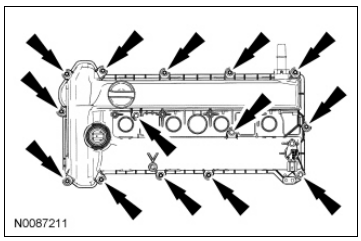
53. Remove the oil level indicator.



54. Remove the CHT sensor.



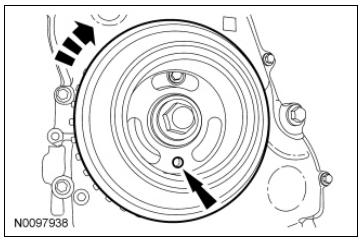
55. Remove the bolts and the valve cover.



56. ***NOTICE:*** **Failure to position the No. 1 piston at Top Dead Center (TDC) can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

    Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at Top Dead Center (TDC).

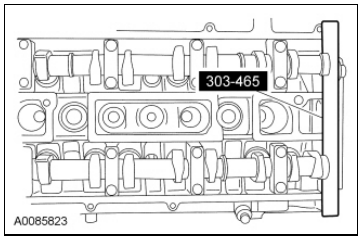
    - The hole in the crankshaft pulley should be in the 6 o'clock position.



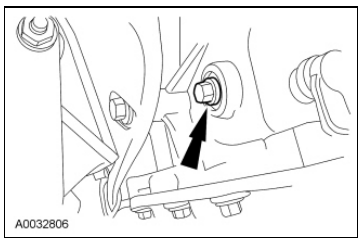
57. ***NOTICE:*** **The Camshaft Alignment Plate 303-465 is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

    NOTE: The camshaft timing slots are offset. If the Camshaft Alignment Plate 303-465 cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

    Install the Camshaft Alignment Plate in the slots on the rear of both camshafts.

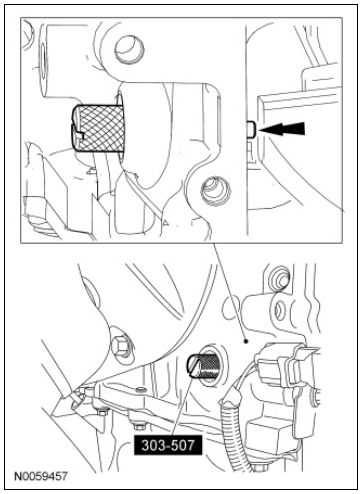


58. Remove the engine plug bolt.



59. **NOTE:** The Crankshaft TDC Timing Peg will contact the crankshaft and prevent it from turning past TDC . However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position during the crankshaft pulley removal and installation.

    Install the Crankshaft TDC Timing Peg.

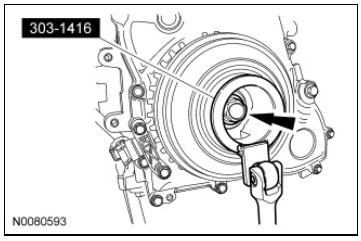


60. ***NOTICE:*** **The crankshaft must remain in the Top Dead Center (TDC) position during removal of the pulley bolt or damage to the engine can occur. Therefore, the crankshaft pulley must be held in place with the Crankshaft Damper Holding Tool and the bolt should be removed using an air impact wrench (1/2-in drive minimum).**

    NOTICE: **The crankshaft sprocket diamond washer may come off with the crankshaft pulley. The diamond washer must be replaced; remove and discard the diamond washer. If the diamond washer is not installed, engine damage may occur.**

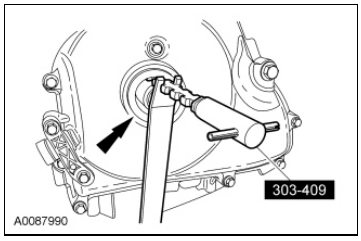
    Using the Crankshaft Damper Holding Tool and an air impact wrench, remove the crankshaft pulley.

    - Remove and discard the crankshaft pulley bolt and washer.
    - Remove the crankshaft pulley.
    - Remove the diamond washer and discard.

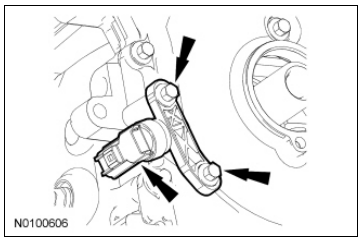


61. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

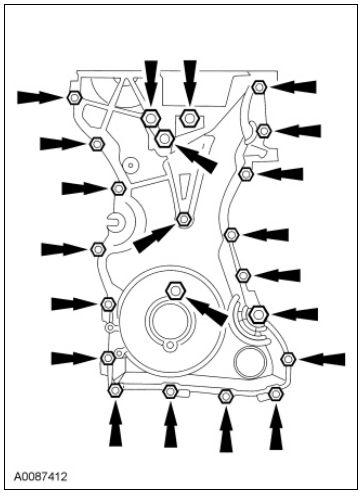
    Using the Oil Seal Remover, remove the crankshaft front oil seal.



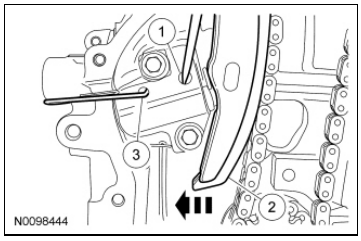
62. Remove the 2 bolts and the CKP sensor.



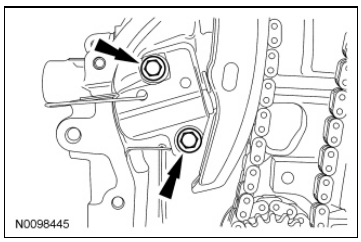
63. Remove the bolts and the engine front cover.



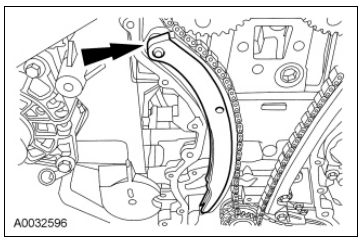
64. Compress the timing chain tensioner in the following sequence.
    1. Using a small pick, release and hold the ratchet mechanism.
    2. While holding the ratchet mechanism in the released position, compress the tensioner by pushing the timing chain arm toward the tensioner.
    3. Insert a paper clip into the hole to retain the tensioner.



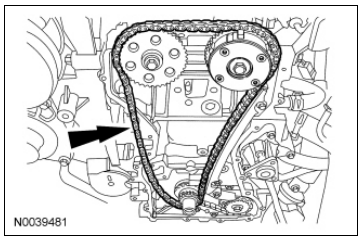
65. Remove the 2 bolts and timing chain tensioner.



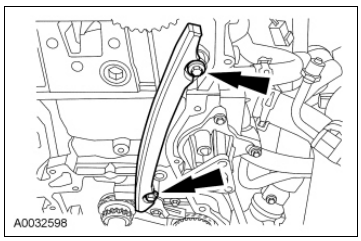
66. Remove the RH timing chain guide.



67. Remove the timing chain.

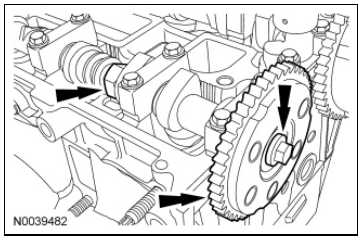


68. Remove the bolts and the LH timing chain guide.



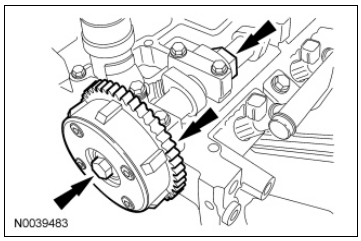
69. ***NOTICE:*** **Do not rely on the Camshaft Alignment Plate to prevent camshaft rotation. Damage to the tool or the camshaft can occur.**

    Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the exhaust camshaft sprocket.

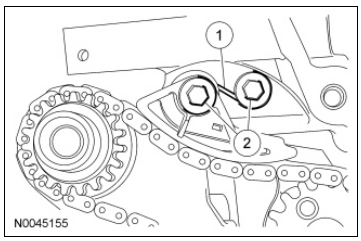


70. ***NOTICE:*** **The Camshaft Alignment Plate 303-465 is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

    Using the flats on the camshaft to prevent camshaft rotation, remove the bolt and the intake camshaft phaser and sprocket.



71. Remove the oil pump chain tensioner.
    1. Release the tension on the tensioner spring.
    2. Remove the tensioner and the shoulder bolts.

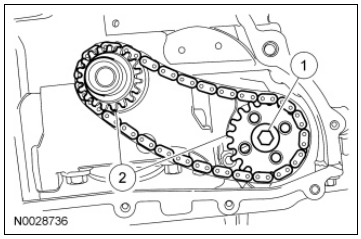


72. **NOTE:** Remove and discard the crankshaft sprocket diamond washer located behind the crankshaft sprocket.

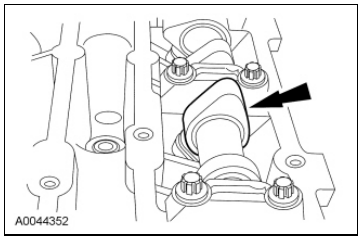
    NOTE: The oil pump chain sprocket must be held in place.

    Remove the oil pump chain and sprockets.

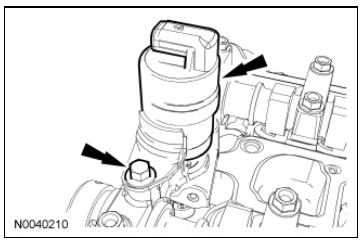
    1. Remove the bolt.
    2. Remove the chain and sprockets.



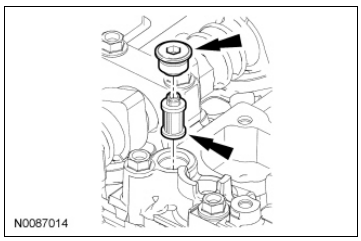
73. Mark the position of the camshaft lobes on the No. 1 cylinder for assembly reference.



74. Remove the bolt and the Variable Camshaft Timing (VCT) solenoid.



75. Remove the plug and the VCT system oil filter from the intake camshaft thrust cap.

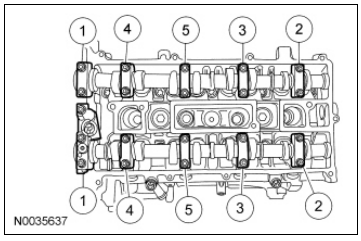


76. ***NOTICE:*** **Failure to follow the camshaft loosening procedure can result in damage to the camshafts.**

    NOTE: Mark the location and orientation of each camshaft bearing cap.

    Remove the camshafts from the engine.

    - Loosen the camshaft bearing bolts in the sequence shown, one turn at a time. Repeat until all the tension is released.
    - Remove the camshaft bearing caps.
    - Remove the camshafts.

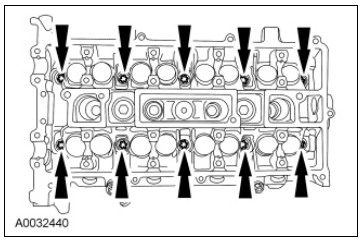


77. **NOTE:** If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions.

    NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

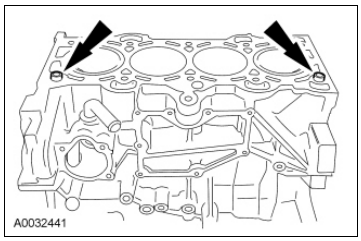
    Remove and inspect the valve tappets. For additional information, refer to Section 303-00 .

78. Remove the cylinder head.
    - Remove and discard the cylinder head bolts.
    - Remove the cylinder head.
    - Remove and discard the cylinder head gasket.

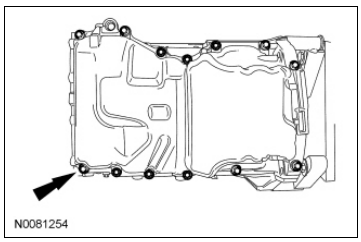


79. Support the cylinder heads on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to Section 303-00 .

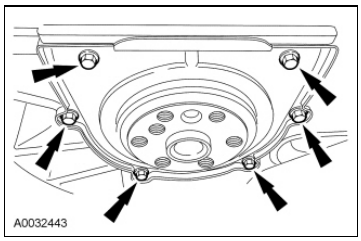
80. Remove the cylinder head alignment dowels.



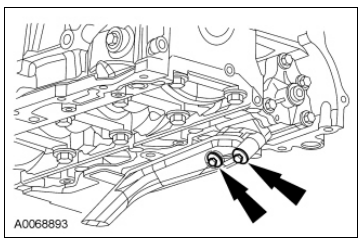
81. Remove the bolts and the oil pan.



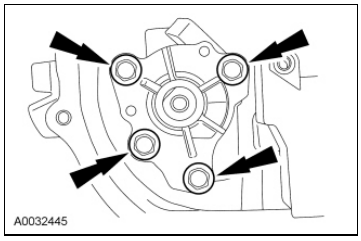
82. Remove the bolts and the crankshaft rear oil seal with retainer.



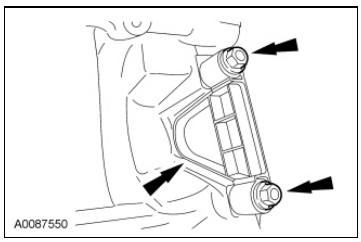
83. Remove the bolts, oil pump pickup tube and gasket.



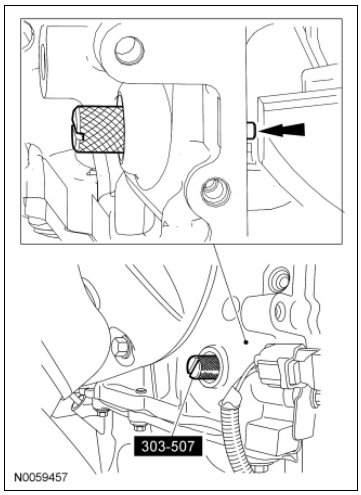
84. Remove the bolts and the oil pump.



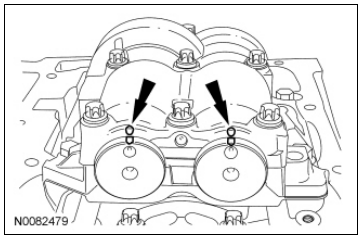
85. Remove the bolts and the block-off plate.



86. Make sure the Crankshaft TDC Timing Peg is still installed and the engine is still at Top Dead Center (TDC).
    - Rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg.

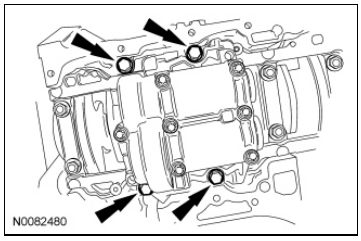


87. Mark the balancer unit front shafts on the top for reference that the balancer unit is at TDC .

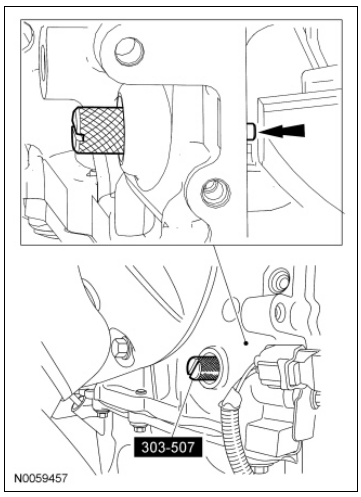


88. ***NOTICE:*** **Due to the precision interior construction of the balancer unit, it should not be disassembled.**

    Remove the 4 bolts and the balancer unit.



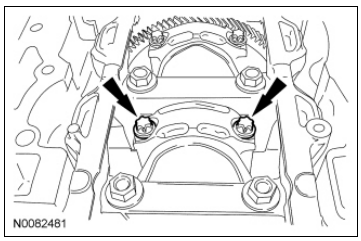
89. Remove the Crankshaft TDC Timing Peg.



90. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

91. **NOTE:** Clearly mark the connecting rods, connecting rod caps and connecting rod bearings in numerical order for correct orientation for reassembly.

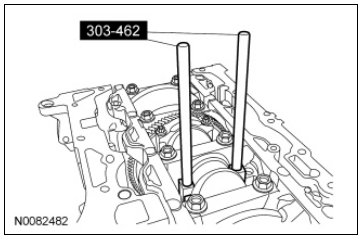
    Remove the connecting rod cap bolts and cap.



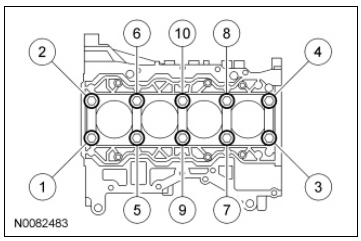
92. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

    Using the Connecting Rod Installer, remove the piston/rod assembly from the engine block.

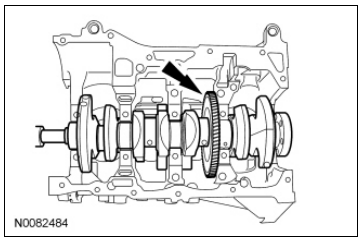
    - Repeat the previous 2 steps until all the piston/rod assemblies are removed from the engine block.



93. Remove the bolts in the sequence shown.
    - Remove the main bearing beam.
    - Discard the bolts.

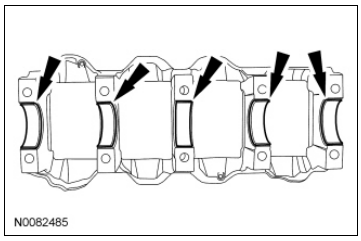


94. Remove the crankshaft from the engine block.



95. **NOTE:** If the main bearings are being reused, mark them in order for correct orientation and reassembly.

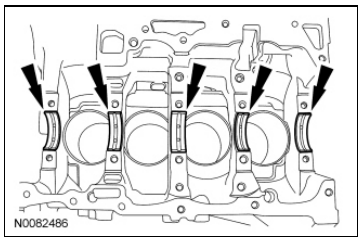
    Remove the main bearings from the main bearing beam.



96. **NOTE:** If the main bearings are being reused, mark them in order for correct orientation and reassembly.

    NOTE: The center bulkhead has the thrust bearing.

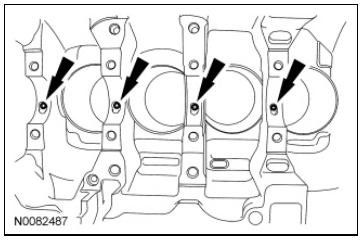
    Remove the main bearings from the cylinder block.



97. **NOTE:** If the oil squirters are being reused, mark them in order for correct location during reassembly.

    NOTE: The front bulkhead does not have an oil squirter.

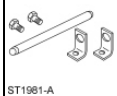
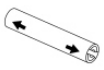
    Remove the 4 oil squirters.



98. Inspect the cylinder block, main bearing beam, pistons and connecting rods. For additional information, refer to Section 303-00 .

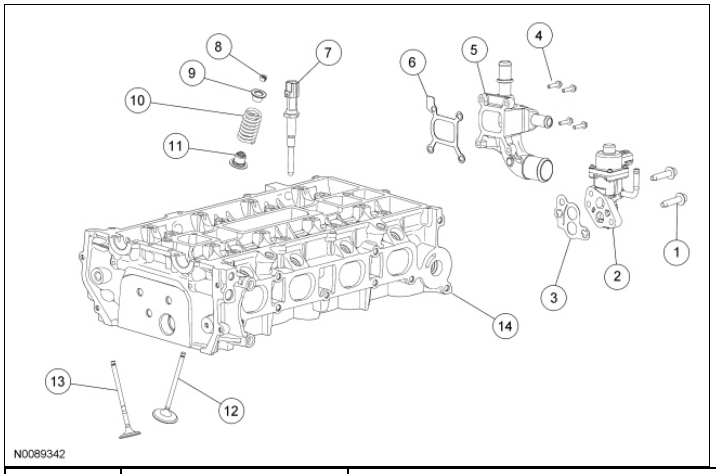
Cylinder Head

Special Tool(s)

 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST1902-A	Compressor, Valve Spring 303-472 (T94P-6565-AH)
 ST1906-A	Installer, Valve Stem Oil Seal 303-470 (T94P-6510-CH)
 ST1904-A	Remover, Valve Stem Oil Seal 303-468 (T94P-6510-AH)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)

Material

Item	Specification
Motorcraft® SE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B



Item	Part Number	Description
1	W500225	EGR valve bolt (2 required)
2	9D475	EGR valve
3	9D476	EGR valve gasket
4	W500015	Coolant outlet bolt (4 required)
5	8K556	Coolant outlet
6	8255	Coolant outlet gasket
7	6G004	Cylinder Head Temperature (CHT) sensor
8	6518	Valve collet (16 required)
9	6514	Valve spring retainer (16 required)
10	6513	Valve spring (16 required)
11	6A517	Valve seal (16 required)
12	6505	Intake valve (8 required)
13	6507	Exhaust valve (8 required)
14	6049	Cylinder head

Disassembly

NOTE: If the components are to be reinstalled, mark the location of the components removed, they must be installed in the same location.

1. Remove the 2 bolts and the EGR valve.
   - Discard the gasket.

2. Remove the 4 bolts and the coolant outlet.
   - Discard the gasket.

3. Remove the Cylinder Head Temperature (CHT) sensor.

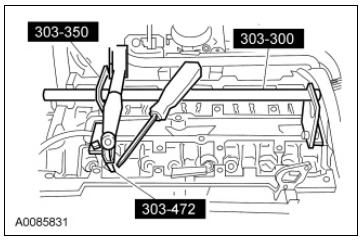
4. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plugs.**

   Remove the spark plugs.

5. Remove the valve tappets.

6. **NOTE:** Use a small screwdriver and grease to remove the valve collets.

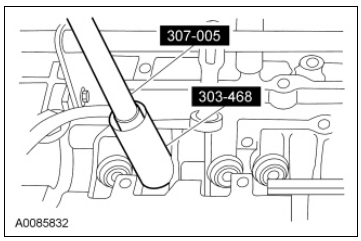
Using the Valve Spring Compressors, compress the valve springs and remove the valve collets, valve spring retainers and the valve springs.



7. Inspect the components, if necessary. For additional information, refer to Section 303-00 .

8. Remove the valves.

9. Using the Slide Hammer and the Valve Stem Oil Seal Remover, remove and discard the valve seals.



10. Inspect the valves. For additional information, refer to Section 303-00 . Install new parts, as necessary.

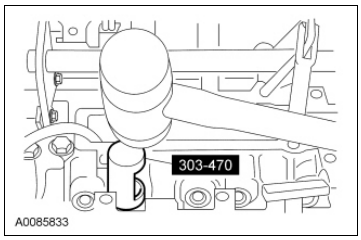
Assembly

1. **NOTE:** Coat the valve stems with clean engine oil.

   Install the valves.

2. **NOTE:** Use the protector provided with the replacement kit to prevent damage to the valve seals. Lubricate the valve stems and guides with clean engine oil.

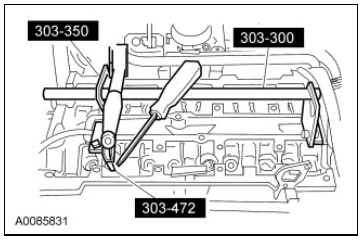
   Using the Valve Stem Oil Seal Installer, install the valve seals.



3. **NOTE:** Check the seating of the valve collets.

   Using the Valve Spring Compressors, install the valve springs.

   - Insert the valve springs and the valve spring retainers.
   - Compress the valve springs and install the valve collets, using grease and a small screwdriver.



4. **NOTE:** Coat the valve tappets with clean engine oil.

   Install the valve tappets.

5. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plugs.**

   Install the spark plugs.

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

6. Install the CHT sensor.
   - Tighten to 12 Nm (106 lb-in).

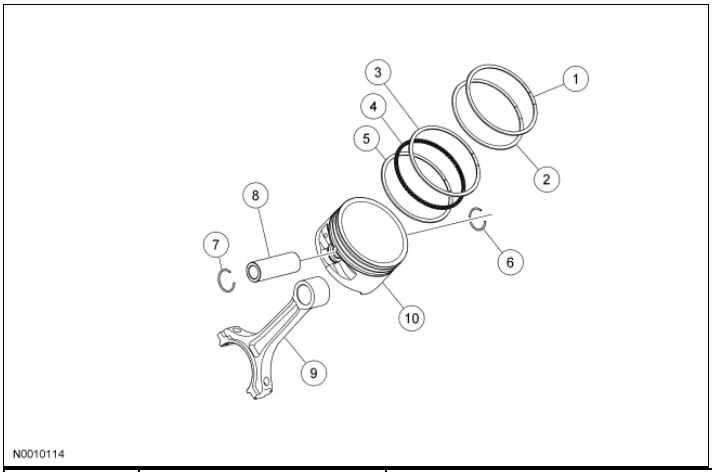
7. Using a new gasket, install the coolant outlet and bolts.
   - Tighten to 10 Nm (89 lb-in).

8. Install the EGR valve, using a new gasket.
   - Tighten to 20 Nm (177 lb-in).

Piston

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A



Item	Part Number	Description
1	6150	Piston compression upper ring
2	6152	Piston compression lower ring
3	6159	Piston oil control upper segment ring
4	6161	Piston oil control spacer
5	6159	Piston oil control lower segment ring
6	6140	Piston pin retainer
7	6140	Piston pin retainer
8	6135	Piston pin
9	6200	Connecting rod
10	6110	Piston

Disassembly

1. Remove the piston rings from the piston.
   - Discard the piston rings.

2. Remove the 2 piston pin retainers and the piston pin.

3. **NOTE:** If the piston and connecting rod are to be reinstalled, they must be assembled in the same orientation. Mark the piston orientation to the connecting rod for reassembly.

Separate the piston from the connecting rod.

4. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00 .

Assembly

1. **NOTE:** The arrow on the top of the piston points towards the front of the engine.

   Align the piston-to-connecting rod orientation marks, and position the connecting rod in the piston.

2. Lubricate the piston pin and pin bore with clean engine oil.

3. Install the piston pin in the piston and connecting rod assembly.

4. Install the piston pin retaining clips in the piston.

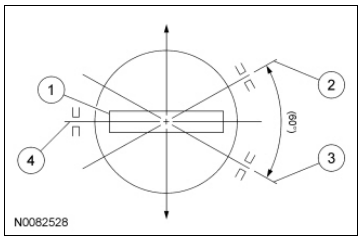
5. Lubricate the piston and the new piston rings with clean engine oil.

6. **NOTE:** The piston compression upper and lower ring should be installed with the paint mark on the outside diameter circumference of the ring to be positioned on the right side of the ring gap. The lower compression ring needs to be installed with the undercut side downward.

   NOTE: The upper and lower compression ring gaps are not controlled for installation.

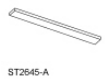
   Install the piston rings onto the piston as shown.

   1. Piston pin
   2. Upper oil control ring gap location
   3. Lower oil control ring gap location
   4. Center line of the piston pin bore and the expander gap



Engine

Special Tool(s)

 ST3055A	Aligner, Crankshaft Sensor 303-1417
 ST2645-A	Alignment Plate, Camshaft 303-465 (T94P-6256-CH)
 ST1376-A	Compressor, Pistong 303-D032 (D81L-6002-C)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST3054-A	Holding Tool, Crankshaft Damper 303-1416
 ST1917-A	Installer, Camshaft Front Oil Seal 303-096 (T74P-6150-A)
 ST1982-A	Installer, Connecting Rod 303-462 (T94P-6136-AH)
 ST1506-A	Installer, Crankshaft Rear Main Oil Seal 303-328 (T88P-6701-B1)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

General Equipment

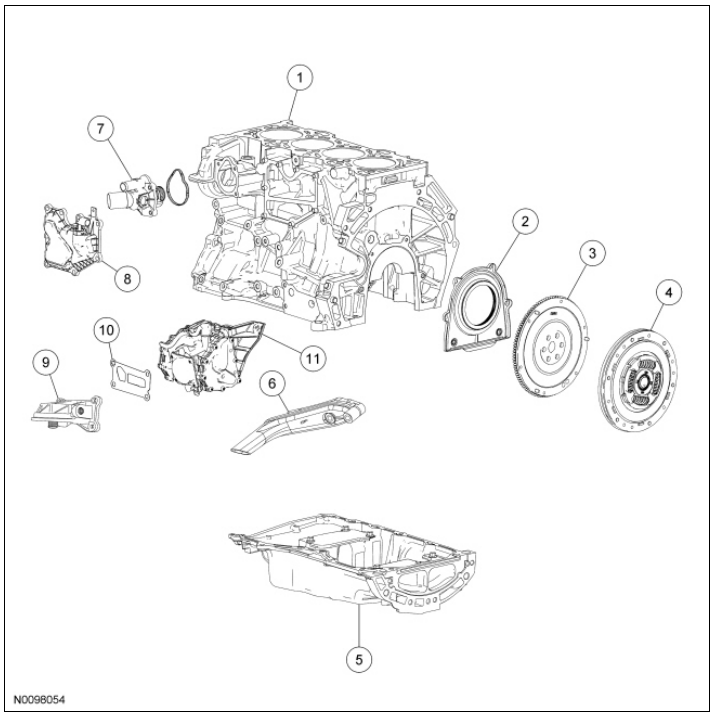
6 mm x 18 mm bolt

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	
Motorcraft® Specialty Green Engine Coolant [a] VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant [a] VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Motorcraft® Silicone Gasket Remover ZC-30	-

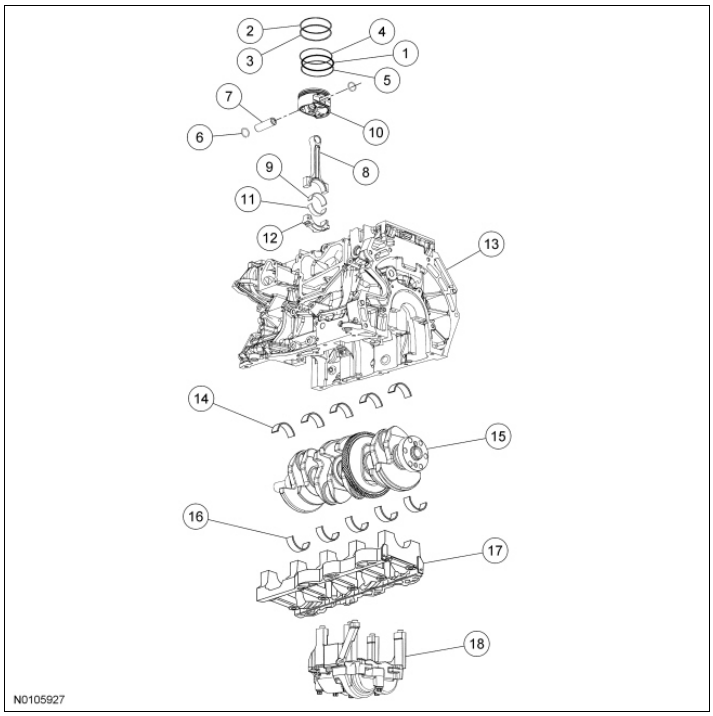
[a] Early build vehicle cooling systems are filled with Motorcraft® Specialty Green Engine Coolant and late build vehicle cooling systems are filled with Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.

Lower Engine Block (View 1)



Item	Part Number	Description
1	6010	Cylinder block
2	6K318	Crankshaft rear oil seal and retainer
3	6K390	Flywheel
5	6675	Oil pan
6	6622	Oil pump screen and pickup tube
7	8575	Thermostat assembly
8	6A785	Crankcase vent oil separator
9	6884	Oil filter adapter
10	6A636	Oil filter adapter gasket
11	2A451	Vacuum pump and bracket

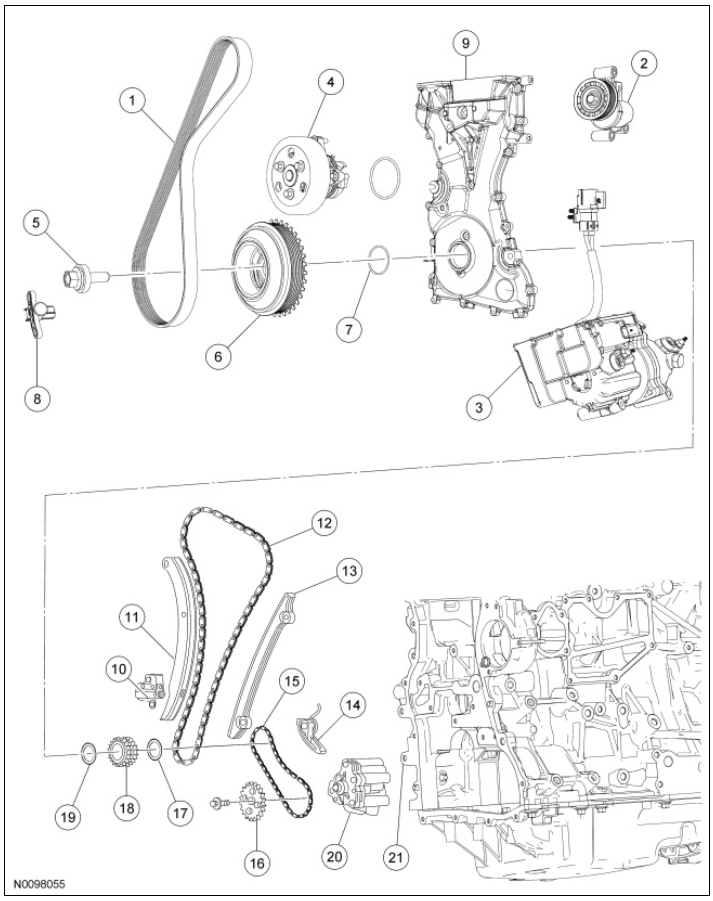
Lower Engine Block (View 2)



Item	Part Number	Description
1	6161	Piston oil control spacer (4 required)
2	6150	Piston compression upper ring (4 required)
3	6152	Piston compression lower ring (4 required)
4	6159	Piston oil control upper segment ring (4 required)
5	6159	Piston oil control lower segment ring (4 required)
6	6140	Piston pin retainer (8 required)
7	6135	Piston pin (4 required)
8	6200	Connecting rod (4 required)
9	6211	Connecting rod upper bearing (4 required)
10	6110	Piston (4 required)
11	6211	Connecting rod lower bearing (4 required)

12	6210	Connecting rod cap (4 required)
13	6010	Cylinder block
14	6333	Cylinder block crankshaft main bearing (5 required)
15	6303	Crankshaft
16	6333	Crankshaft main bearing beam bearing (5 required)
17	6F098	Main bearing beam
18	6K360	Balance shaft assembly

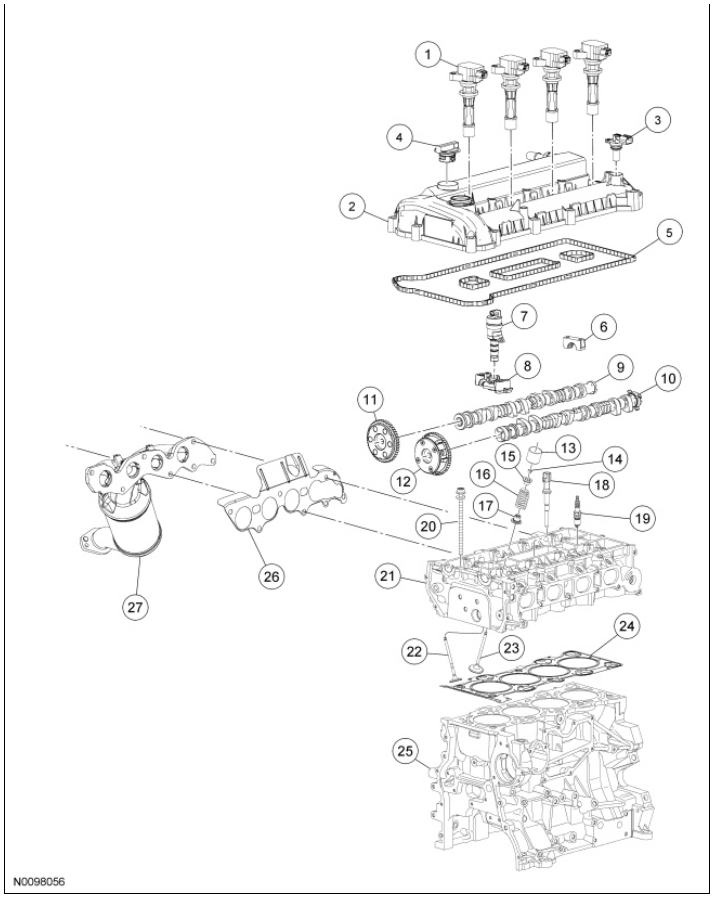
Front Engine Block



Item	Part Number	Description
1	6C301	Accessory drive belt
2	6A228	Accessory drive belt tensioner
3	19D629	Electric A/C compressor
4	8501	Coolant pump
5	6K340	Crankshaft pulley bolt
6	6316	Crankshaft pulley
7	6700	Crankshaft front seal
8	6C315	Crankshaft Position (CKP) sensor
9	6019	Engine front cover
10	6K254	Timing chain tensioner
11	6K255	Timing chain tensioner arm

12	6268	Timing chain
13	6K297	Timing chain guide
14	6C271	Oil pump chain tensioner
15	6A895	Oil pump chain
16	6652	Oil pump drive gear
17	6378	Diamond washer
18	6306	Crankshaft sprocket
19	6378	Diamond washer
20	6600	Oil pump
21	6010	Cylinder block

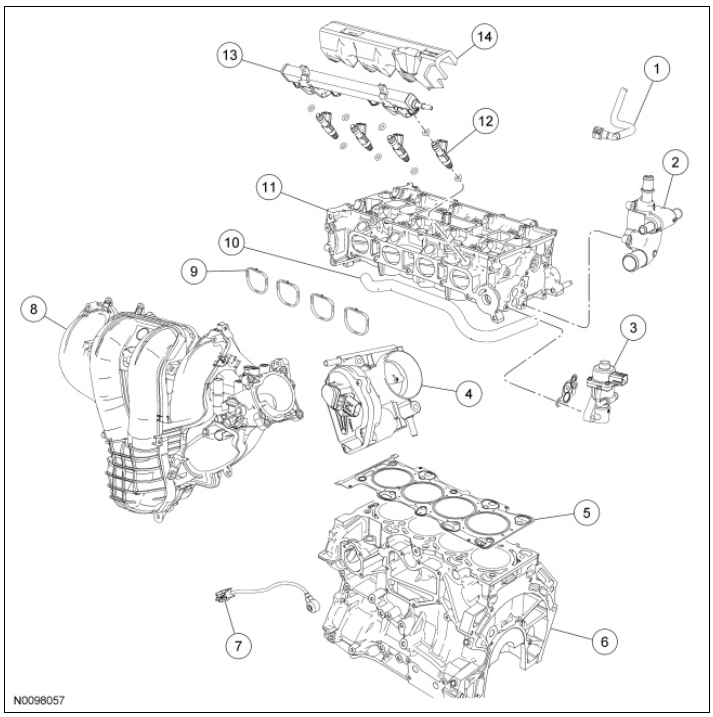
Cylinder Head



Item	Part Number	Description
1	12A366	Coil-on-plug assembly
2	6M293	Valve cover
3	12K073	Camshaft Position (CMP) sensor
4	6766	Oil filler cap
5	6M293	Valve cover gasket
6	6A284	Camshaft bearing cap
7	6M280	Variable Camshaft Timing (VCT) solenoid
8	6A258	Camshaft bearing cap

9	6A272	Camshaft (exhaust)
10	6A271	Camshaft (intake)
11	6C251	Camshaft sprocket
12	6C525	VCT actuator
13	6500	Valve tappet (16 required)
14	6518	Valve collet (16 required)
15	6514	Valve spring retainer (16 required)
16	6513	Valve spring (16 required)
17	6A517	Valve stem seal (16 required)
18	6G004	Cylinder Head Temperature (CHT) sensor
19	12405	Spark plug (4 required)
20	6065	Cylinder head bolt (10 required)
21	6049	Cylinder head
22	6505	Exhaust valve (8 required)
23	6507	Intake valve (8 required)
24	6051	Head gasket
25	6010	Cylinder block
26	9448	Catalytic converter gasket
27	5E211	Catalytic converter

Intake Manifold



Item	Part Number	Description
1	9288	Fuel supply tube
2	8K556	Coolant outlet
3	9D475	EGR valve

4	9F991	Electronic Throttle Body (TB)
5	6051	Cylinder head gasket
6	6010	Cylinder block
7	12A699	Knock Sensor (KS)
8	9424	Intake manifold
9	9439	Intake manifold gasket (4 required)
10	8A582	Coolant hose
11	6049	Cylinder head
12	9F593	Fuel injector (4 required)
13	9H487	Fuel rail
14	-	Fuel rail insulator

NOTICE: **Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instrucd in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if the pulley bolt is loosened. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special service tools or severe engine damage can occur.**

NOTICE: **During engine repair procedures, cleanliness is extremely important. All parts must be thoroughly cleaned and any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.**

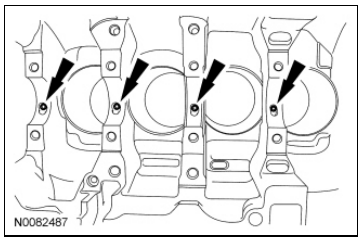
NOTE: Assembly of the engine requires various inspections/measurements of the engine components (engine block, crankshaft, connecting rods, pistons and piston rings). These inspections/measurements will aid in determining if the engine components will require replacement. For additional information, refer to Section 303-00 .

1. **NOTE:** If the oil squirters are being reused, they must be installed in the same location as marked during disassembly.

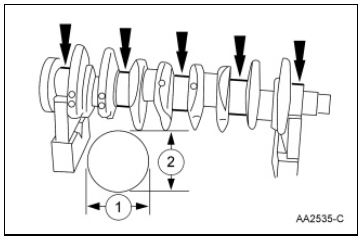
   NOTE: The front bulkhead does not have an oil squirter.

   Install the 4 oil squirters.

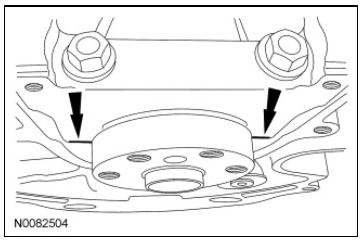
   - Tighten to 4 Nm (35 lb-in).



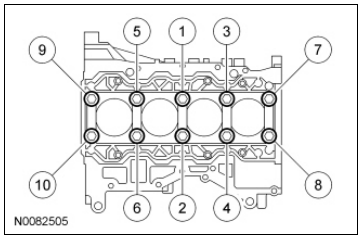
2. Measure each of the crankshaft main bearing journal diameters in at least 2 directions and record the smallest diameter for each journal.



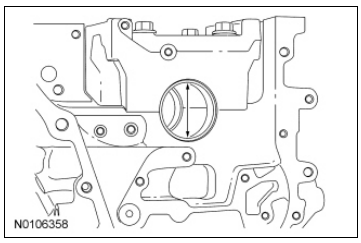
3. Position the main bearing beam in the engine block with the main bearing beam mounted flush with the rear face of the engine block.



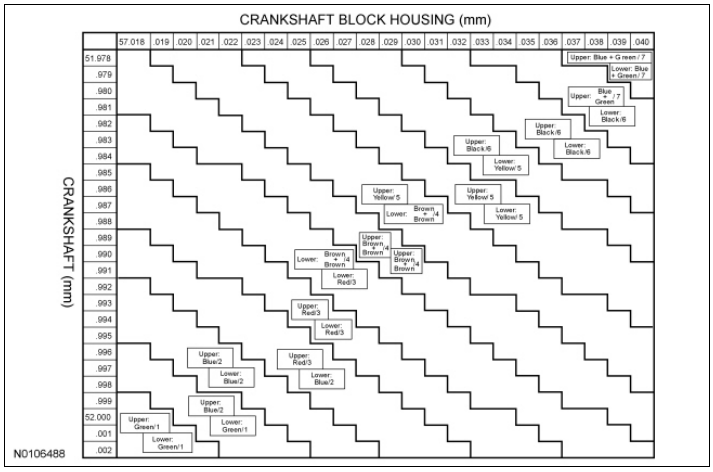
4. Using the original main bearing beam bolts, install and tighten the 10 main bearing beam bolts.
   - Tighten the bolts in the sequence shown in 3 stages.
   - Stage 1: Tighten to 5 Nm (44 lb-in).
   - Stage 2: Tighten to 25 Nm (18 lb-ft).
   - Stage 3: Tighten an additional 90 degrees.



5. Measure each crankshaft block main bearing bore diameter.
   - Remove the bolts and the main bearing beam.
   - Discard the main bearing beam bolts.



6. Using the chart, select the crankshaft main bearings.

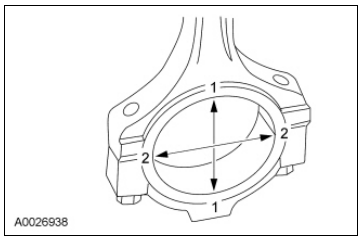


7. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

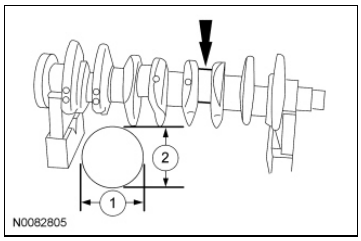
   Using the original connecting rod cap bolts, install the connecting caps and bolts.

   - Tighten the bolts in 2 stages.
   - Stage 1: Tighten to 29 Nm (21 lb-ft).
   - Stage 2: Tighten an additional 90 degrees.

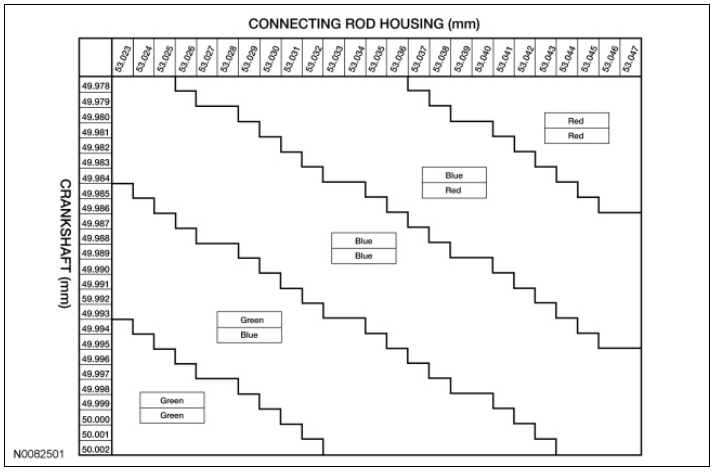
8. Measure the connecting rod large end bore in 2 directions. Record the smallest measurement for each connecting rod.
   - Remove the bolts and the connecting rod cap.
   - Discard the connecting rod cap bolts.



9. Measure each of the crankshaft connecting rod bearing journal diameters in at least 2 directions. Record the smallest measurement for each connecting rod journal.



10. Using the chart, select the correct connecting rod bearings for each crankshaft connecting rod journal.

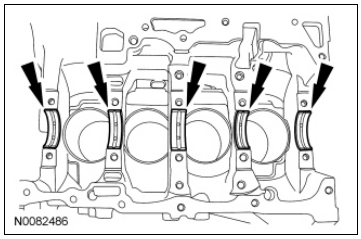


11. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

    NOTE: If reusing the crankshaft main bearings, install them in their original positions and orientation as noted during disassembly.

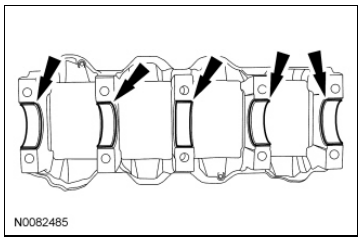
    NOTE: The center bulkhead is the thrust bearing.

    Lubricate the upper crankshaft main bearings with clean engine oil and install the 5 crankshaft main bearings in the cylinder block.



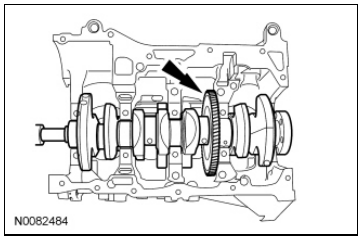
12. **NOTE:** If reusing the crankshaft main bearings, install them in their original positions and orientation as noted during disassembly.

    Lubricate the crankshaft main bearings with clean engine oil and install the 5 crankshaft main bearings in the main bearing beam.

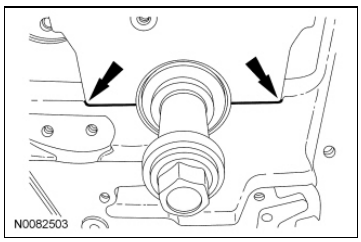


13. Lubricate journals on the crankshaft with clean engine oil.

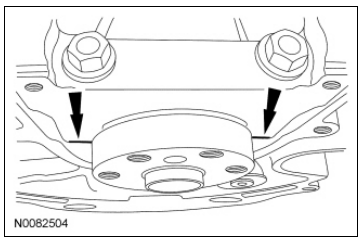
14. Position the crankshaft in the cylinder block.



15. Lubricate the 10 main bearing beam side fit surfaces (front 2 shown) with clean engine oil.



16. Lubricate the crankshaft bearing journals on the main bearing beam with clean engine oil. Then position the main bearing beam in the engine block with the main bearing beam mounted flush with the rear face of the engine block.

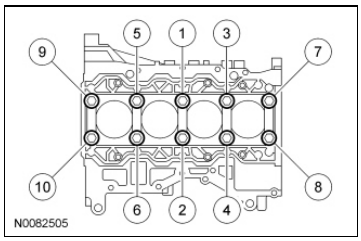


17. **NOTE:** Lubricate the main bearing beam bolts threads and under the bolt heads with clean engine oil.

    NOTE: Position the crankshaft to the rear of the cylinder block, then position the crankshaft to the front of the cylinder block before tightening the main bearing beam bolts.

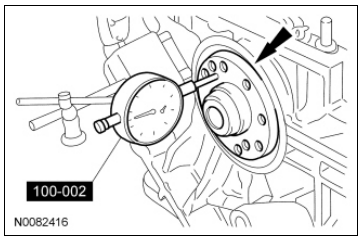
    Install and tighten the 10 new main bearing beam bolts.

    - Tighten the bolts in the sequence shown in 3 stages.
    - Stage 1: Tighten to 5 Nm (44 lb-in).
    - Stage 2: Tighten to 25 Nm (18 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.



18. Using the Dial Indicator Gauge with Holding Fixture, measure crankshaft end play.
    - Position the crankshaft to the rear of the cylinder block.
    - Zero the Dial Indicator Gauge with Holding Fixture.
    - Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.

- Acceptable crankshaft end play is 0.22-0.43 mm (0.008-0.016 in). If the crankshaft end play exceeds the specified range, install new parts as necessary.



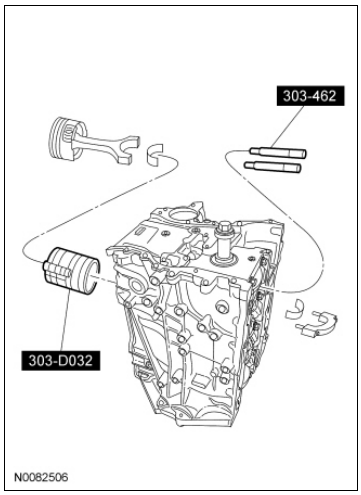
19. ***NOTICE:*** **Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.**

    NOTE: Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with clean engine oil.

    NOTE: Make sure the piston arrow on top is facing toward the front of the engine.

    Using the Piston Ring Compressor and the Connecting Rod Installer, install the piston and connecting rod assemblies.

    - When installing the pistons and connecting rod assemblies, the oil ring gaps must be positioned 60 degrees apart from each other and a minimum of 90 degrees from the expander gap.
    - The position of the upper and lower compression ring gaps are not controlled for installation.



20. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

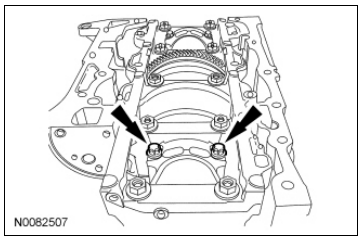
    NOTE: Install connecting rod caps and bolts on the connecting rods for cylinders 1 and 4 first and tighten. Then rotate crankshaft 180 degrees and install connecting rod caps and bolts on connecting rods for cylinders 2 and 3 and tighten.

    NOTE: After installation of each connecting rod cap, rotate the crankshaft to verify smooth operation.

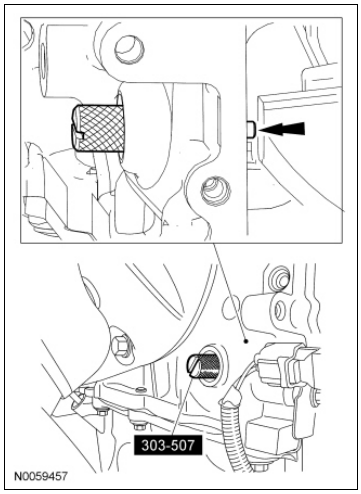
    Install the connecting rod caps and the new bolts.

    - Tighten the bolts in 2 stages.

- Stage 1: Tighten to 29 Nm (21 lb-ft).
- Stage 2: Tighten an additional 90 degrees.



21. Install the Crankshaft TDC Timing Peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg. The engine is now at Top Dead Center (TDC).



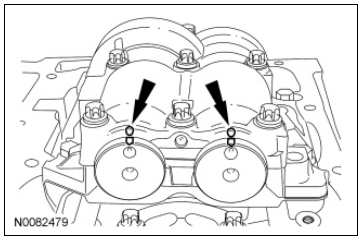
22. ***NOTICE:*** **Due to the precision interior construction of the balancer unit, it should not be disassembled.**

    NOTE: The original adjustment shims must be installed in their original position.

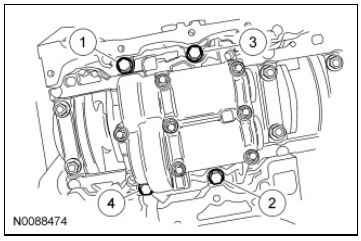
    NOTE: Confirm by visual inspection that there is no damage to the balancer unit gear and verify that the shaft turns smoothly. If there is any damage or malfunction, replace the balancer unit.

    Install the adjustment shims in their original position on the seat faces of the balancer unit.

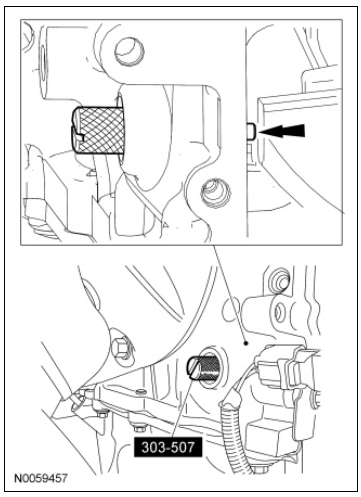
23. With the balancer unit shaft marks in the TDC position, slowly install the balancer unit to the cylinder block to avoid interference between the crankshaft drive gear and the balancer unit driven gear.



24. Install the balancer unit bolts.
    - Tighten in the sequence shown in 2 stages.
        - ♦ Stage 1: Tighten to 25 Nm (18 lb-ft).
        - ♦ Stage 2: Tighten to 50 Nm (37 lb-ft).

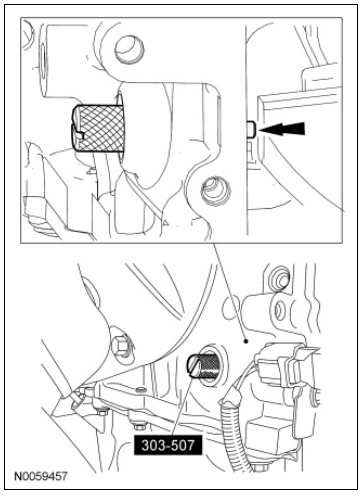


25. Remove the Crankshaft TDC Timing Peg.



26. Rotate the crankshaft to confirm that there are no meshing problems between the balancer unit gear and the crankshaft gear.

27. Install the Crankshaft TDC Timing Peg and rotate the crankshaft slowly clockwise until the crankshaft balance weight is up against the Crankshaft TDC Timing Peg.
    - Remove the Crankshaft TDC Timing Peg.



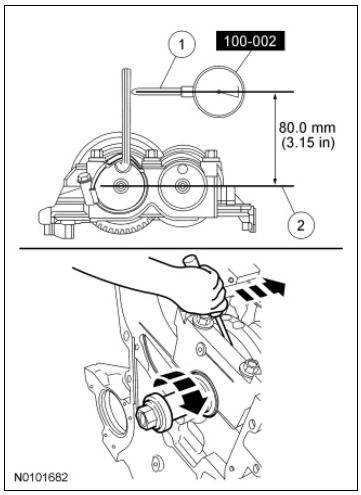
28. **NOTE:** Measure the backlash and verify that it is within specified range at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees. It will be necessary to reset the measuring equipment between measurements.

    NOTE: The measurement must be taken with the Dial Indicator Gauge with Holding Fixture, a 5-mm Allen wrench and worm clamp set up as shown. Mark the Allen wrench with a file 80 mm (3.149 in) above the driven gear shaft center. Make sure the worm clamp and Allen wrench are not touching the balance shaft housing.

NOTE: For an accurate measurement while measuring the gear backlash, insert a screwdriver as shown into the crankshaft No. 1 crankweight area and set both the rotation and the thrust direction with the screwdriver, using a prying action as shown.

Position the Dial Indicator Gauge with Holding Fixture as shown. Measure the gear backlash.

- Position the Dial Indicator Gauge with Holding Fixture (1) on the Allen wrench 80 mm (3.149 in) above the driven gear shaft center (2) on the balancer unit.
- Rotate the crankshaft clockwise and measure the backlash at all of the following 6 positions: 10 degrees, 30 degrees, 100 degrees, 190 degrees, 210 degrees and 280 degrees.
- Backlash specifications are 0.005 to 0.101 mm (0.00019 to 0.0039 in).
- If the backlash exceeds the specified range, carry out the balance shaft backlash procedure. For additional information, refer to the Balance Shaft Backlash procedure in this section.

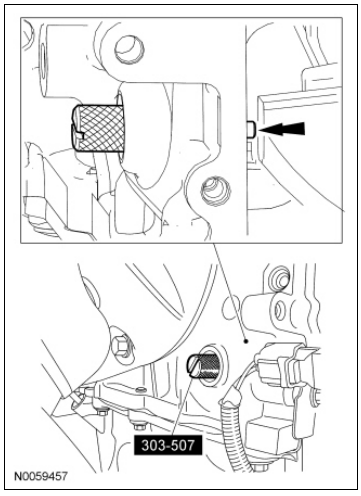


29. *NOTICE:* **Failure to position the No. 1 piston at Top Dead Center (TDC) can result in damage to the engine. Turn the engine in the normal direction of rotation only.**

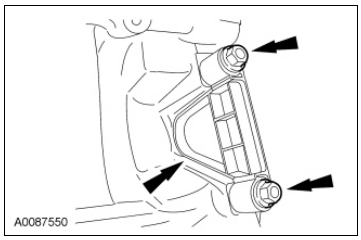
    Turn the crankshaft clockwise to position the No. 1 piston at Top Dead Center (TDC).

30. **NOTE:** The Crankshaft TDC Timing Peg will contact the crankshaft and prevent it from turning past TDC . However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position until the timing drive components and crankshaft pulley are installed.

    Install the Crankshaft TDC Timing Peg.



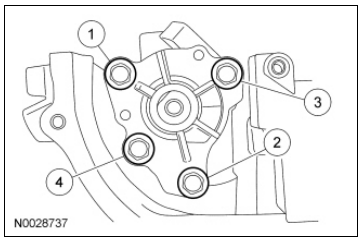
31. Install the block-off plate and bolts.
    - Tighten to 25 Nm (18 lb-ft).



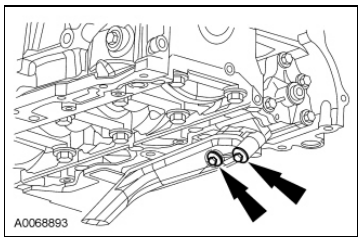
32. **NOTE:** Clean the oil pump and cylinder block mating surfaces with metal surface prep.

    Install the oil pump assembly. Tighten the bolts in the sequence shown in the following 2 stages:

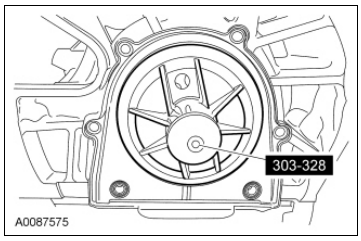
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten to 20 Nm (177 lb-in).



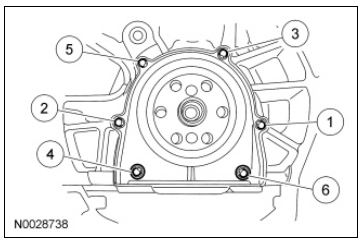
33. Install a new oil pump pickup tube gasket and the pickup tube.
    - Tighten to 10 Nm (89 lb-in).



34. Using the Crankshaft Rear Main Oil Seal Installer, install the crankshaft rear oil seal with retainer.



35. Tighten the crankshaft rear oil seal with retainer bolts in the sequence shown.
    - Tighten to 10 Nm (89 lb-in).



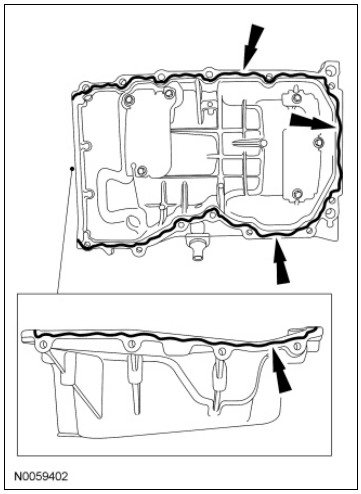
36. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool and metal surface cleaner to remove traces of sealant.**

    Clean and inspect all mating surfaces.

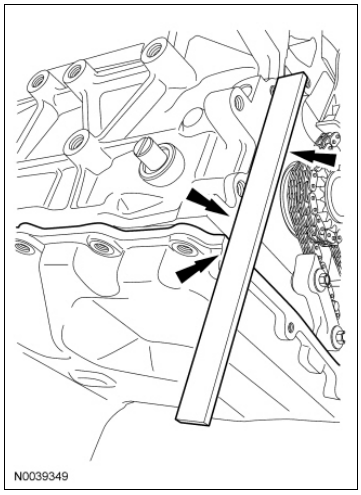
37. **NOTE:** If the oil pan is not secured within 4 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

    Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the oil pan.

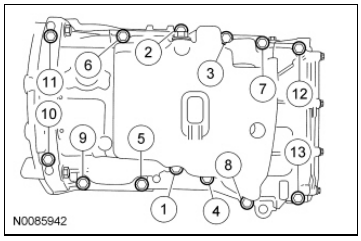
38. Install the oil pan and install the 2 oil pan bolts finger-tight.



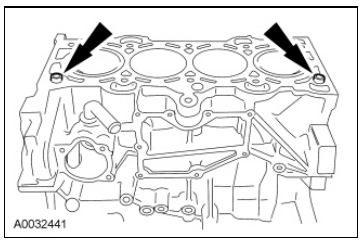
39. Using a suitable straightedge, align the front surface of the oil pan flush with the front surface of the engine block.



40. Install the remaining oil pan bolts and tighten the oil pan bolts in the sequence shown.
    - Tighten to 25 Nm (18 lb-ft).



41. Install the cylinder head alignment dowels. Dowels must be fully seated in the cylinder block.



42. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

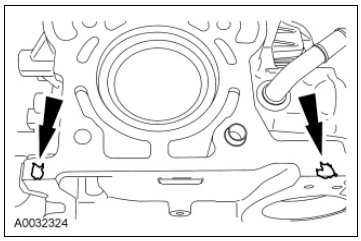
    NOTE: Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

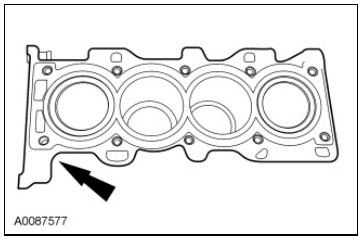
    Clean the cylinder head-to-cylinder block mating surface of both the cylinder head and the cylinder block in the following sequence.

    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any traces of oil or coolant, and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

43. Apply silicone gasket and sealant to the locations shown.



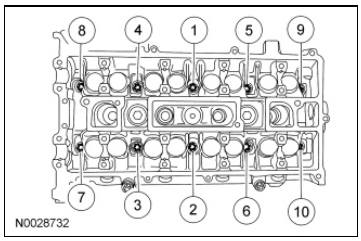
44. Install a new head gasket.



45. **NOTE:** The cylinder head bolts are torque-to-yield and must not be reused. New cylinder head bolts must be installed.

    Install the cylinder head and 10 new bolts. Tighten the bolts in the sequence shown in the following 5 stages:

    - Stage 1: Tighten to 5 Nm (44 lb-in).
    - Stage 2: Tighten to 15 Nm (133 lb-in).
    - Stage 3: Tighten to 45 Nm (33 lb-ft).
    - Stage 4: Turn 90 degrees.
    - Stage 5: Turn an additional 90 degrees.



46. **NOTE:** Coat the valve tappets with clean engine oil prior to installation.

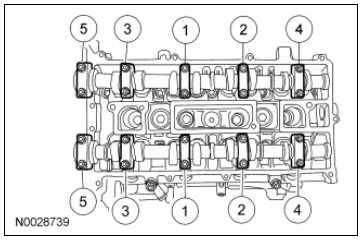
    Install the valve tappets.

47. ***NOTICE:*** **Install the camshafts with the alignment slots in the camshafts lined up so the Camshaft Alignment Plate can be installed without rotating the camshafts. Make sure the lobes on the No. 1 cylinder are in the same position as noted in the disassembly procedure. Rotating the camshafts when the timing chain is removed, or installing the camshafts 180 degrees out of position, can cause severe damage to the valves and pistons.**

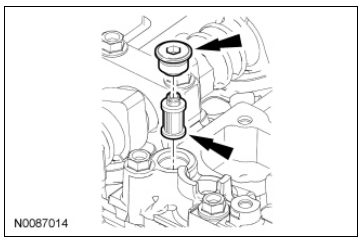
    NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

    Install the camshafts and bearing caps in their original location and orientation. Tighten the bearing caps in the sequence shown in 3 stages:

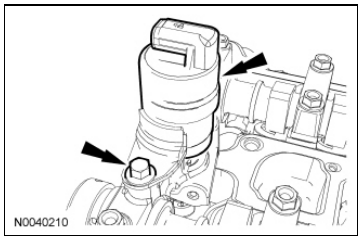
    - Stage 1: Tighten 1 turn at a time until tight.
    - Stage 2: Tighten to 7 Nm (62 lb-in).
    - Stage 3: Tighten to 16 Nm (142 lb-in).



48. Install the Variable Camshaft Timing (VCT) system oil filter and plug in the intake camshaft thrust cap.
    - Tighten to 17 Nm (150 lb-in).



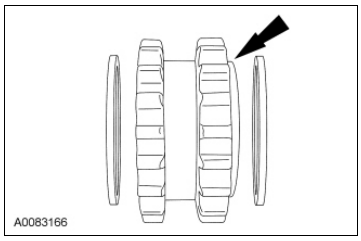
49. Install the VCT solenoid and the bolt.
    - Tighten to 10 Nm (89 lb-in).



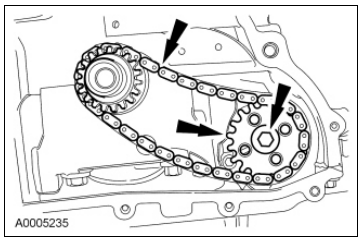
50. **NOTE:** Install a new crankshaft sprocket diamond washer on both sides of the crankshaft sprocket.

    Install the crankshaft sprocket, new crankshaft sprocket diamond washers, oil pump chain and oil pump sprocket.

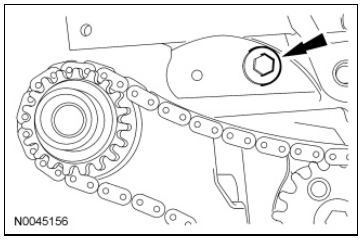
    - The crankshaft sprocket flange must be facing away from the engine block.



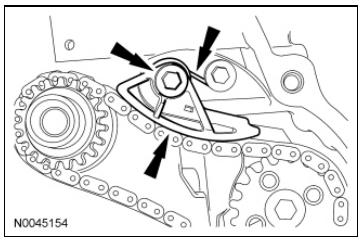
51. Install the oil pump chain, sprocket and bolt.
    - Tighten to 25 Nm (18 lb-ft).



52. Install the shoulder bolt.
    - Tighten to 10 Nm (89 lb-in).

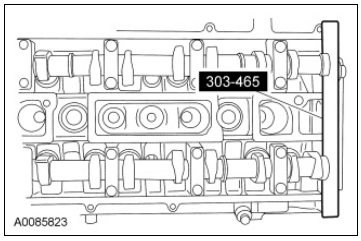


53. Install the oil pump chain tensioner and bolt. Hook the tensioner spring around the shoulder bolt.
    - Tighten to 10 Nm (89 lb-in).

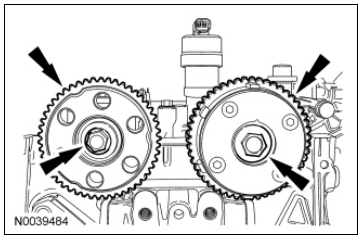


54. ***NOTICE:*** **The Camshaft Alignment Plate 303-465 is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

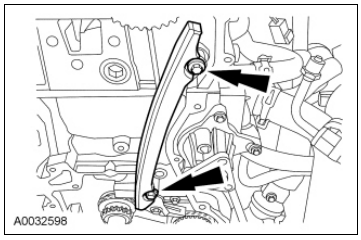
    Install the Camshaft Alignment Plate in the slots on the rear of both camshafts.



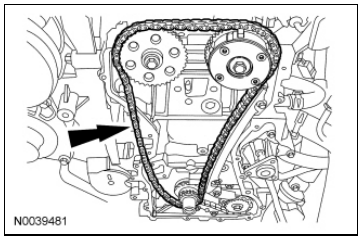
55. Install the camshaft sprockets and the bolts. Do not tighten the bolts at this time.



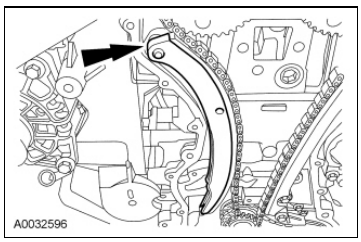
56. Install the LH timing chain guide and the bolts.
    - Tighten to 10 Nm (89 lb-in).



57. Install the timing chain.



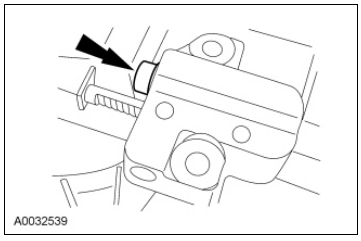
58. Install the RH timing chain guide.



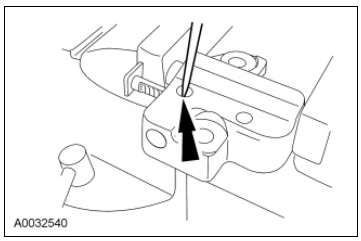
NOTE: If the timing chain tensioner plunger and ratchet assembly are not pinned in the compressed position, follow the next 4 steps.

59. ***NOTICE:*** **Do not compress the ratchet assembly. This will damage the ratchet assembly.**

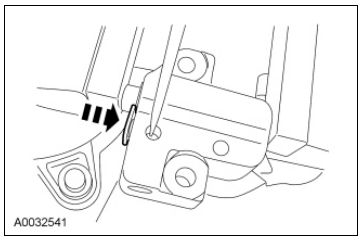
    Using the edge of a vise, compress the timing chain tensioner plunger.



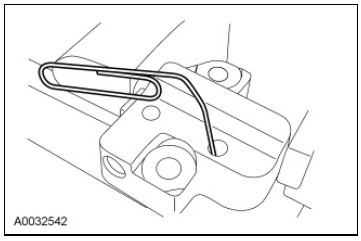
60. Using a small pick, push back and hold the ratchet mechanism.



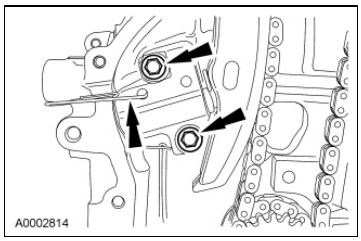
61. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.



62. Install a paper clip into the hole in the tensioner housing to hold the ratchet assembly and the plunger in during installation.



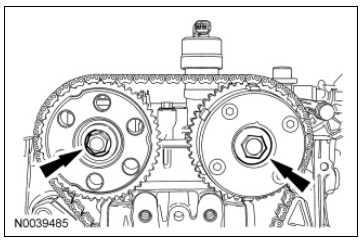
63. Install the timing chain tensioner and the 2 bolts. Remove the paper clip to release the piston.
    - Tighten to 10 Nm (89 lb-in).



64. ***NOTICE:*** **The Camshaft Alignment Plate 303-465 is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.**

    Using the flats on the camshafts to prevent camshaft rotation, tighten the bolts.

    - Tighten to 72 Nm (53 lb-ft).

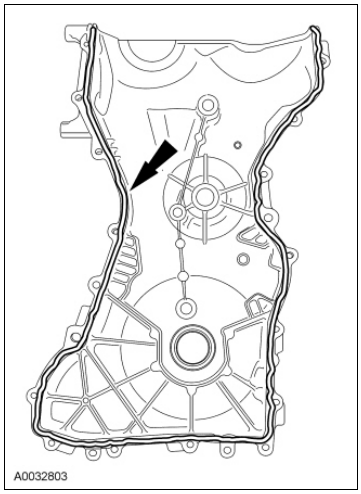


65. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive disks or other abrasive means to clean sealing surfaces. These tools cause scratches and gouges which make leak paths.**

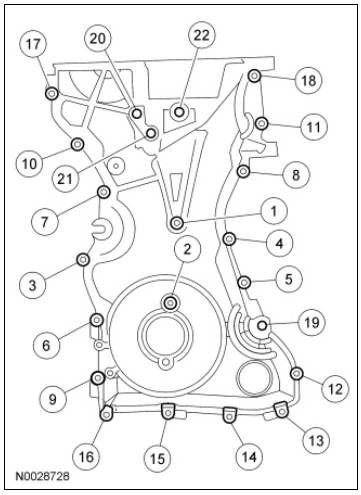
    Clean and inspect the mounting surfaces of the engine and the front cover.

66. **NOTE:** The engine front cover must be installed and the bolts tightened within 4 minutes of applying the silicone gasket and sealant.

    Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the cylinder head and oil pan joint areas. Apply a 2.5 mm (0.09 in) bead of silicone gasket and sealant to the front cover.



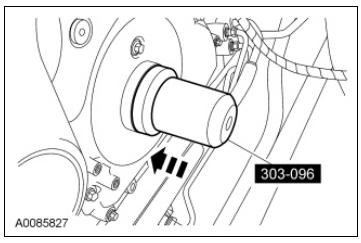
67. Install the engine front cover. Tighten the bolts in the sequence shown, to the following specifications:
    - Tighten the 8-mm bolts to 10 Nm (89 lb-in).
    - Tighten the 13-mm bolts to 48 Nm (35 lb-ft).



68. **NOTE:** Remove the through bolt from the Camshaft Front Oil Seal Installer.

    NOTE: Lubricate the oil seal with clean engine oil.

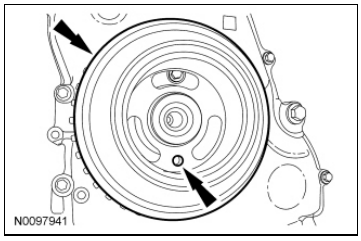
    Using the Camshaft Front Oil Seal Installer, install the crankshaft front seal.



69. **NOTE:** Do not install the crankshaft pulley bolt at this time.

    NOTE: Apply clean engine oil on the seal area before installing.

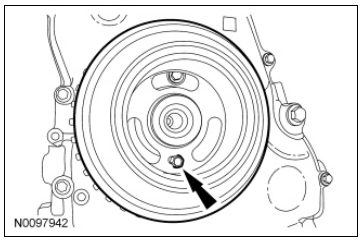
    Position the crankshaft pulley onto the crankshaft with the hole in the pulley at the 6 o'clock position.



70. ***NOTICE:*** **Only hand-tighten the 6-mm bolt or damage to the front cover can occur.**

    NOTE: This step will correctly align the crankshaft pulley to the crankshaft.

    Install a standard 6-mm x 18-mm bolt through the crankshaft pulley and thread it into the front cover.

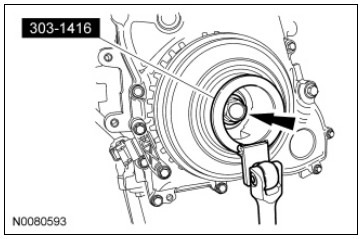


71. ***NOTICE:*** **The crankshaft must remain in the Top Dead Center (TDC) position during installation of the pulley bolt or damage to the engine can occur. Therefore, the crankshaft pulley must be held in place with the Crankshaft Damper Holding Tool and the bolt should be installed using hand tools only.**

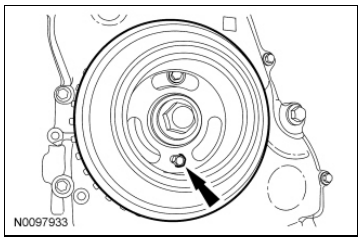
    NOTE: Do not reuse the crankshaft pulley bolt.

    Install a new crankshaft pulley bolt. Using the Crankshaft Damper Holding Tool to hold the crankshaft pulley in place, tighten the crankshaft pulley bolt in 2 stages:

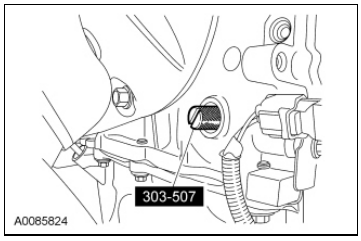
    - Stage 1: Tighten to 100 Nm (74 lb-ft).
    - Stage 2: Tighten an additional 90 degrees (one-fourth turn).



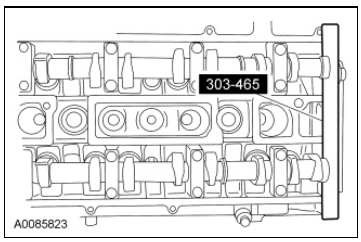
72. Remove the 6-mm x 18-mm bolt.



73. Remove the Crankshaft TDC Timing Peg.



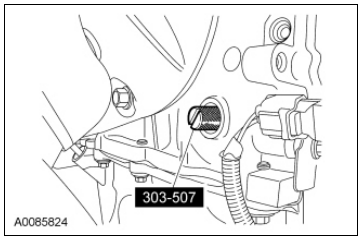
74. Remove the Camshaft Alignment Plate.



75. **NOTE:** Only turn the engine in the normal direction of rotation.

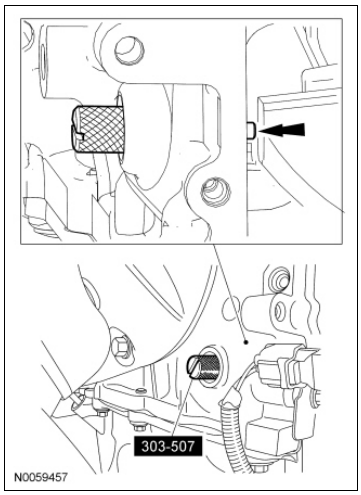
    Turn the crankshaft clockwise one and three-fourth turns.

76. Install the Crankshaft TDC Timing Peg.



77. **NOTE:** Only turn the engine in the normal direction of rotation.

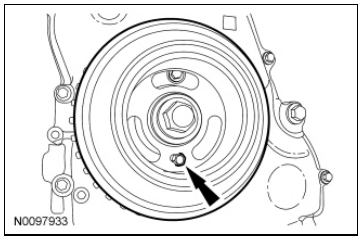
    Turn the crankshaft clockwise until the crankshaft contacts the Crankshaft TDC Timing Peg.



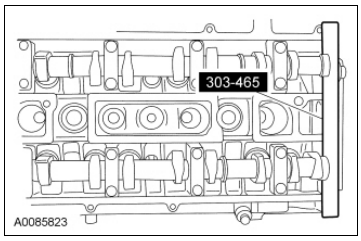
78. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

    Using the 6-mm x 18-mm bolt, check the position of the crankshaft pulley.

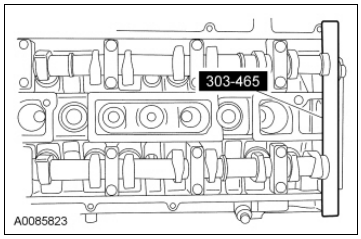
    - If it is not possible to install the bolt, the engine valve timing must be corrected.



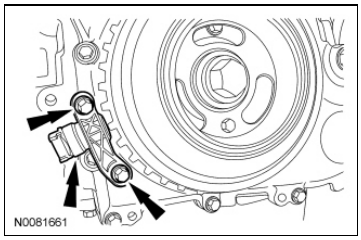
79. Install the Camshaft Alignment Plate to check the position of the camshafts.
    - If it is not possible to install the Camshaft Alignment Plate, the engine valve timing must be corrected.



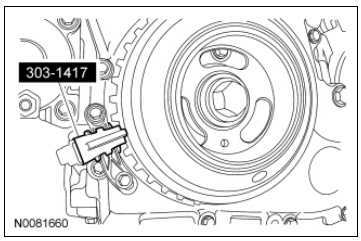
80. Remove the Camshaft Alignment Plate.



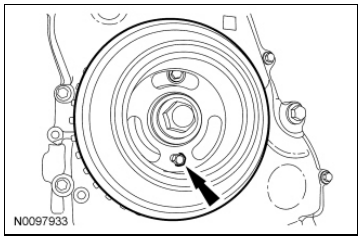
81. Install the Crankshaft Position (CKP) sensor and the 2 bolts.
    - Do not tighten the bolts at this time.



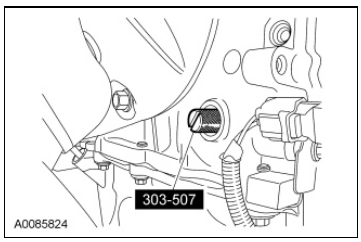
82. Using the Crankshaft Sensor Aligner, adjust the CKP sensor.
    - Tighten the 2 CKP bolts to 7 Nm (62 lb-in).



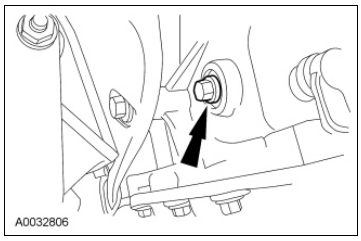
83. Remove the 6-mm x 18-mm bolt.



84. Remove the Crankshaft TDC Timing Peg.



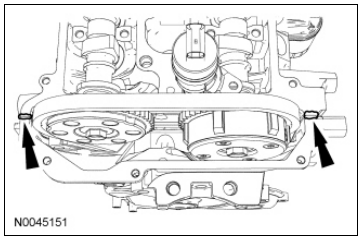
85. Install the engine plug bolt.
    - Tighten to 20 Nm (177 lb-in).



86. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.**

    Clean the valve cover gasket surface with metal surface prep.

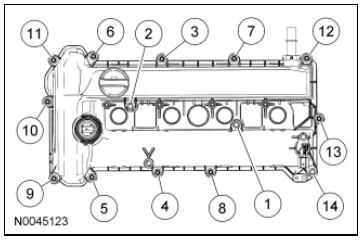
87. Apply silicone gasket and sealant to the locations shown.



88. **NOTE:** The valve cover must be secured within 4 minutes of silicone gasket application. If the valve cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner.

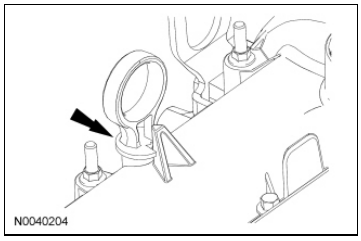
    Install the valve cover.

    - Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).

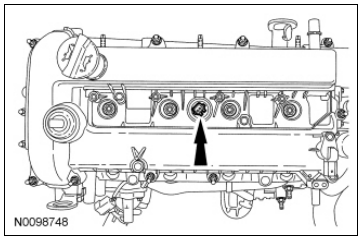


89. **NOTE:** Make sure the notch on the oil level indicator is aligned with the V-shaped boss on the valve cover and fully engaged into the valve cover.

    Install the oil level indicator.



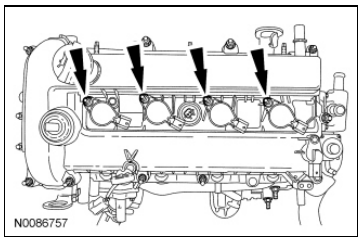
90. Install the Cylinder Head Temperature (CHT) sensor.
    - Tighten to 12 Nm (106 lb-in).



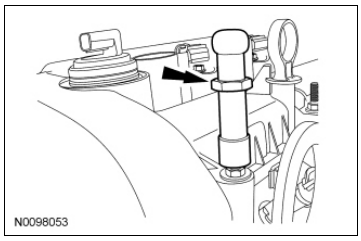
91. **NOTE:** Apply dielectric compound to the inside of the coil-on-plug boots.

    Install the 4 coil-on-plugs and the 4 bolts. Install the crankshaft vent tube.

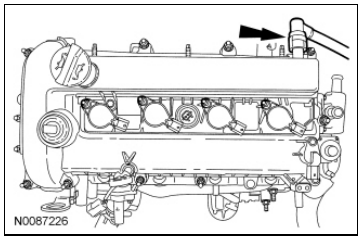
    - Tighten to 8 Nm (71 lb-in).



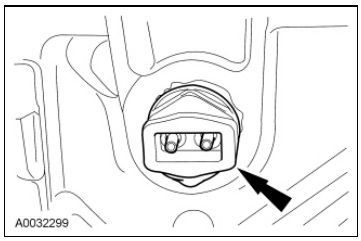
92. Install the engine cover studs (one shown).



93. Install the crankshaft vent tube.



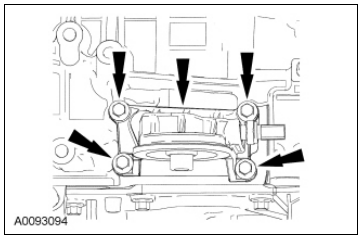
94. If equipped, install the block heater.
    - Tighten to 40 Nm (30 lb-ft).



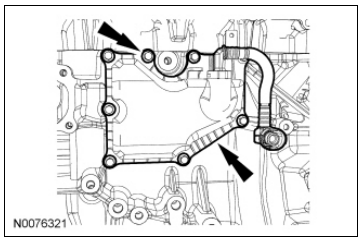
95. **NOTE:** Clean the gasket mating surfaces with metal surface prep.

    Install the oil filter adapter with a new gasket.

    - Tighten to 25 Nm (18 lb-ft).



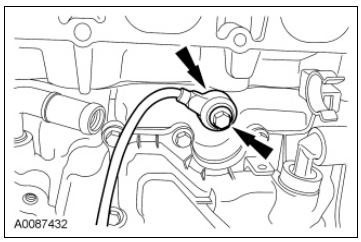
96. Install the crankcase vent oil separator and the 8 bolts.
    - Tighten to 10 Nm (89 lb-in).



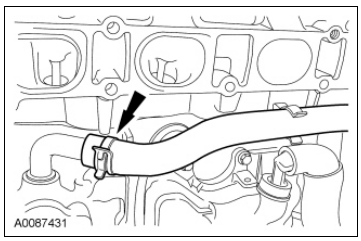
97. **NOTE:** The Knock Sensor (KS) must not touch the crankcase vent oil separator.

    Install the KS and the bolt.

    - Tighten to 20 Nm (177 lb-in).



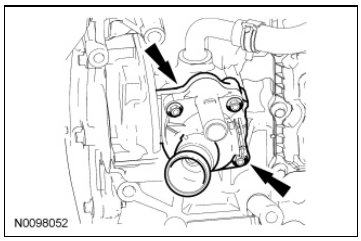
98. Install the coolant hose.



99. **NOTE:** Clean and inspect the thermostat housing gasket. Install a new gasket if necessary.

    Install the thermostat housing.

    - Tighten to 10 Nm (89 lb-in).



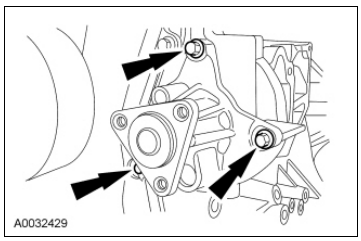
100. ***NOTICE:*** **Make sure the coolant pump is correctly seated to the engine block before installing and tightening the fasteners, or damage to the coolant pump may occur.**

     NOTE: Clean the coolant pump mating surface with metal surface cleaner.

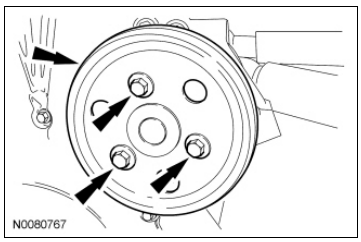
     NOTE: Lubricate the coolant pump O-ring with clean engine coolant.

     Install the new O-ring, coolant pump and the 3 bolts.

     - Tighten to 10 Nm (89 lb-in).



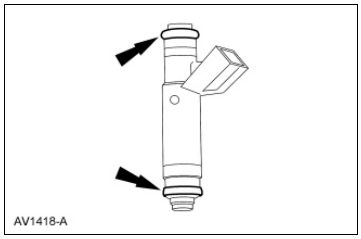
101. Install the coolant pump pulley and bolts.
     - Tighten to 20 Nm (177 lb-in).



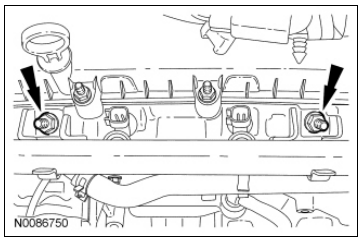
102. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. Use of ordinary O-rings can cause the fuel system to leak. Do not reuse the O-ring seals.**

Install new fuel injector O-rings.

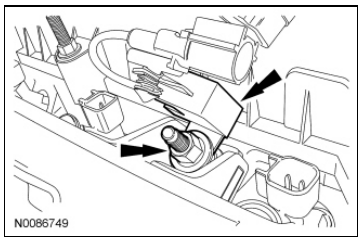
- Separate the fuel injectors from the fuel rail.
- Remove and discard the fuel injector O-rings.
- Install new O-rings and lubricate with clean engine oil.
- Install the fuel injectors onto the fuel rail.



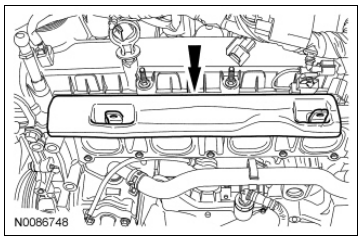
103. Install the fuel rail with the fuel injectors and stud bolts.
    - Tighten to 23 Nm (17 lb-ft).



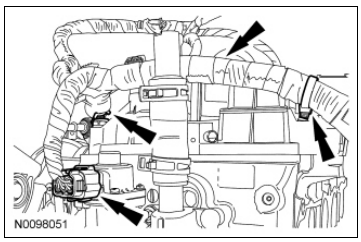
104. Install the radio capacitor and the nut.
    - Tighten to 10 Nm (89 lb-in).



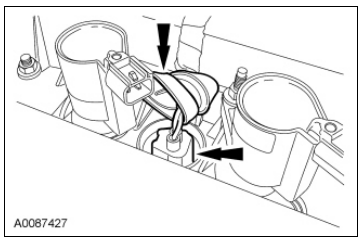
105. Install the fuel rail insulator.



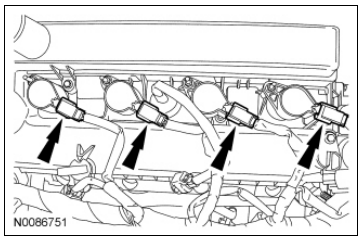
106. Attach the 2 wiring harness retainers to the valve cover and stud bolt.
    - Connect the EGR valve electrical connector.



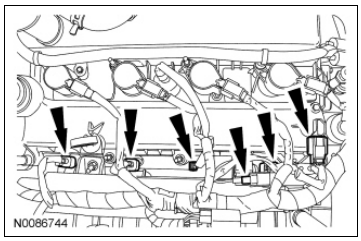
107. Connect the CHT sensor and install the rubber boot.



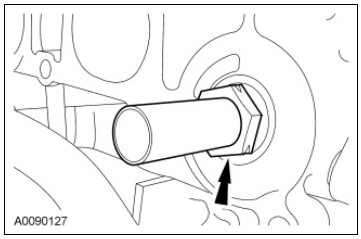
108. Connect the 4 coil-on-plug electrical connectors.



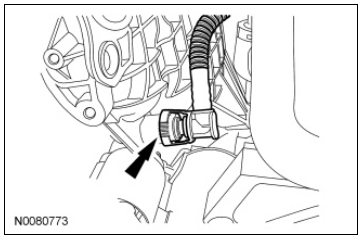
109. Connect the 4 fuel injector electrical connectors, radio capacitor electrical connector and the Camshaft Position (CMP) sensor electrical connector.



110. Install the EGR tube.
    - Tighten to 55 Nm (41 lb-ft).



111. Position the intake manifold and connect the PCV hose.



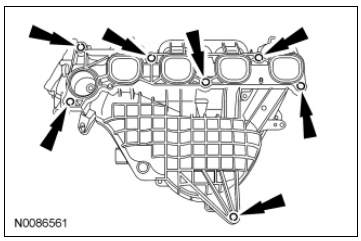
112. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

NOTE: Inspect and install new intake manifold gaskets, if necessary.

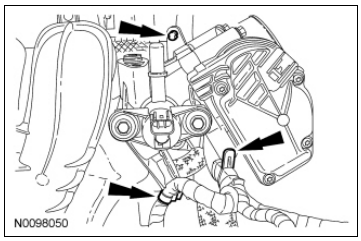
NOTE: The cylinder head side of the intake manifold is showing bolt location.

Install the intake manifold gasket, intake manifold and 7 bolts.

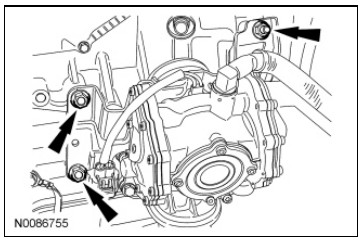
- Tighten to 18 Nm (159 lb-in).



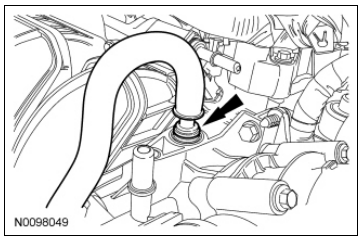
113. Attach the 3 wire harness pin-type retainers to the intake manifold.



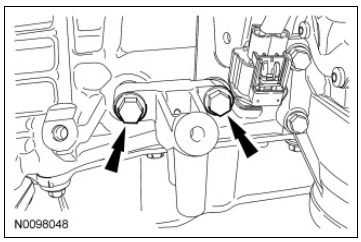
114. Install the vacuum pump assembly, the nut and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).



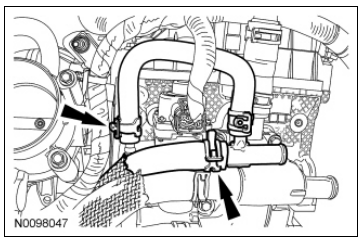
115. Connect the vacuum hose to the intake manifold.



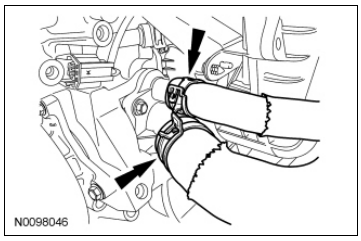
116. Install the A/C compressor bracket and 2 bolts.
    - Tighten to 48 Nm (35 lb-ft).



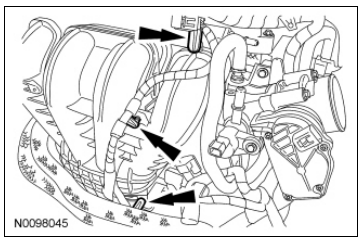
117. Connect the EGR coolant hose and the auxiliary coolant pump hose.



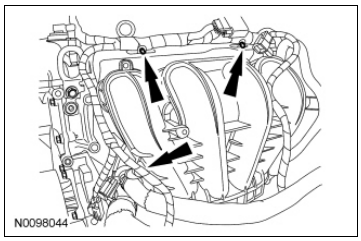
118. Connect the auxiliary coolant pump hose and the upper radiator hose.



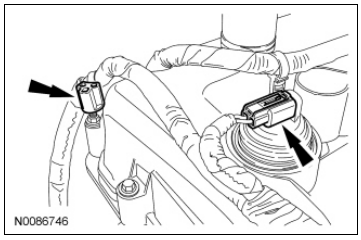
119. Attach the 2 auxiliary coolant pump wiring retainers and the lower radiator hose retainer.



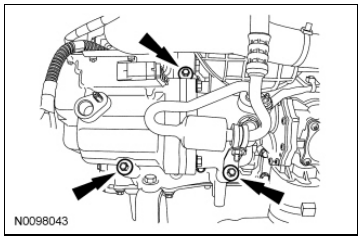
120. Attach the 3 wire harness pin-type retainers.



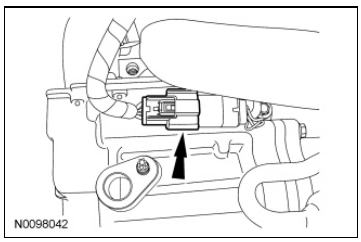
121. Connect the VCT electrical connector and attach the wiring harness retainer to the valve cover stud bolt.



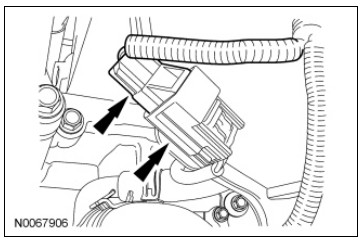
122. Install the A/C compressor and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



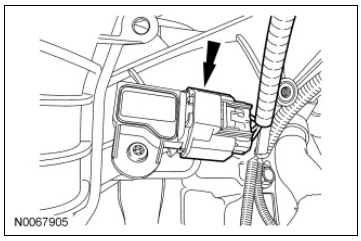
123. Connect the A/C compressor electrical connector.



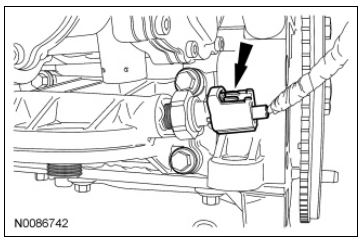
124. Attach the pin-type retainer to the intake manifold and connect the KS electrical connector.



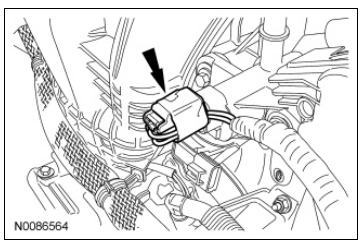
125. Connect the Manifold Absolute Pressure (MAP) sensor electrical connector.



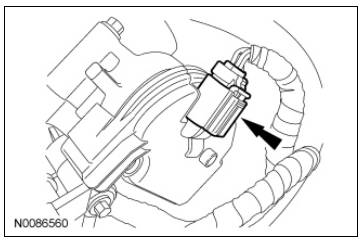
126. Connect the Engine Oil Pressure (EOP) switch electrical connector.



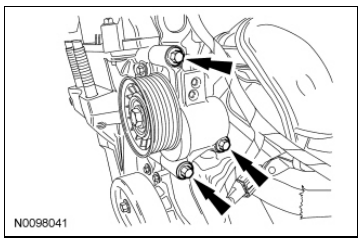
127. Connect the Evaporative Emission (EVAP) canister purge valve electrical connector.



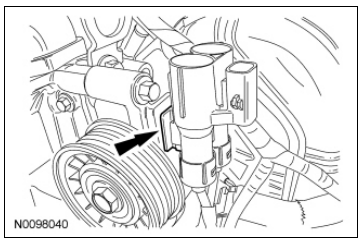
128. Connect the electronic throttle control electrical connector.



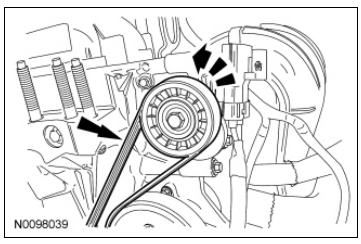
129. Install the accessory drive belt tensioner.
    - Tighten to 25 Nm (18 lb-ft).



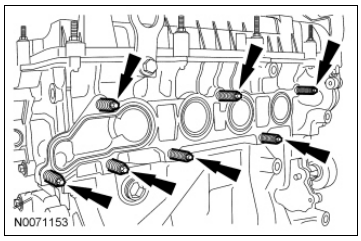
130. Attach the vehicle high voltage electrical system electrical connector retainer to the accessory drive belt tensioner.



131. Rotate the accessory drive belt tensioner counterclockwise and install the accessory drive belt.



132. Install 7 new cylinder head studs in the cylinder head.
    - Tighten to 17 Nm (150 lb-in).



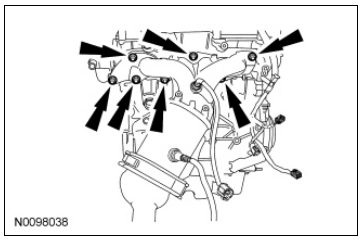
133. Install the new catalytic converter manifold gasket on the engine.

134. ***NOTICE:*** **Failure to tighten the catalytic converter nuts to specification before installing the converter bracket bolts will cause the converter to develop an exhaust leak.**

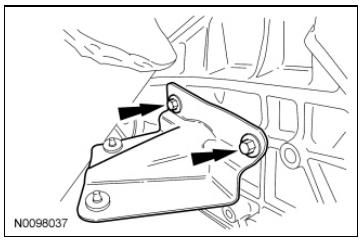
NOTICE: **Failure to tighten the catalytic converter nuts to specification a second time will cause the converter to develop an exhaust leak.**

Position the catalytic converter manifold and tighten the 7 new nuts in the sequence shown in 2 stages:

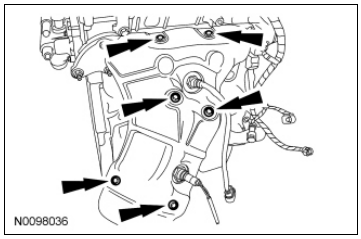
- Stage 1: Tighten to 48 Nm (35 lb-ft).
- Stage 2: Tighten to 48 Nm (35 lb-ft).



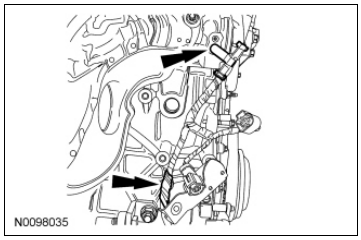
135. Install the 2 catalytic converter manifold bracket-to-engine block bolts.
    - Tighten to 35 Nm (26 lb-ft).



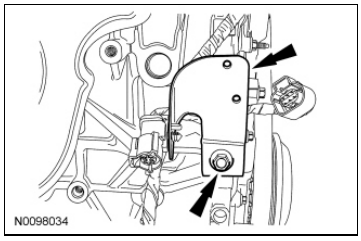
136. Install the catalytic converter manifold heat shield and the 6 bolts.
    - Tighten to 10 Nm (89 lb-in).



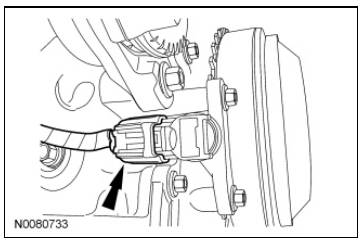
137. Attach the 2 engine wiring harness pin-type retainers.



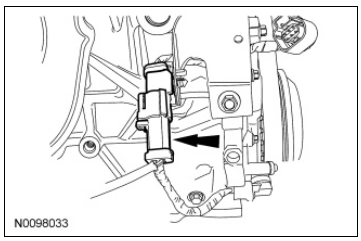
138. Install the engine wiring harness connector bracket.
    - Tighten to 15 Nm (133 lb-in).



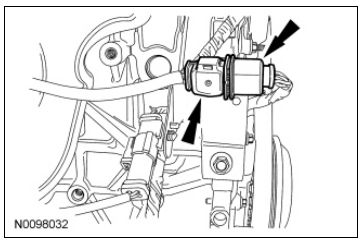
139. Connect the Crankshaft Position (CKP) sensor electrical connector.



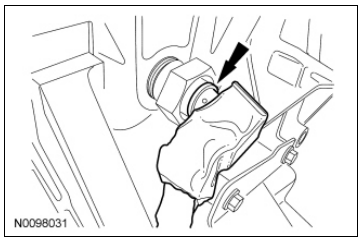
140. Connect the Catalyst Monitor Sensor (CMS) electrical connector.



141. Connect the Heated Oxygen Sensor (HO2S) connector. Attach the connector to the engine wiring harness connector bracket.



142. If equipped, connect the engine block heater.



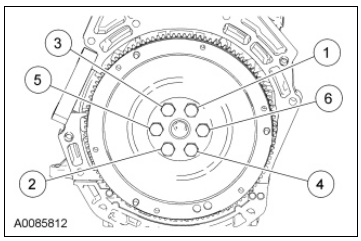
143. Using the Floor Crane and the Spreader Bar, remove the engine from the engine stand.

144. **NOTE:** Special bolts are used for installation. Do not use standard bolts.

Install the flywheel and the bolts. Tighten the bolts in the sequence shown in the following 3 stages:

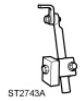
- Stage 1: Tighten to 50 Nm (37 lb-ft).
- Stage 2: Tighten to 80 Nm (59 lb-ft).

- Stage 3: Tighten to 112 Nm (83 lb-ft).



Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E or equivalent
 ST1602-A	Lifting Bracket, Engine 303-D089 (D93P-6001-A3) or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent
 ST2743A	Adjustable Grip Arm, 1735A 014-00001 or equivalent

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

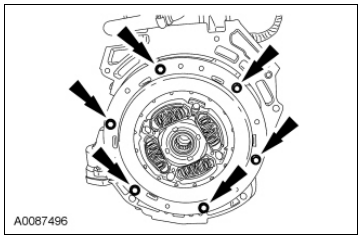
⚠ **WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.**

1. **NOTE:** Due to packaging requirements, the correct bolt must be used at the damper locations.

   NOTE: The damper contains a clutch which is designed to slip briefly during vehicle operation. It is essential that no grease, oil or cleaning solvents be allowed to contaminate the slip clutch. Do not use grease on transmission input sha. Should the damper become contaminated, it must be replaced.

   Install the transaxle damper.

   - Tighten to 29 Nm (21 lb-ft).

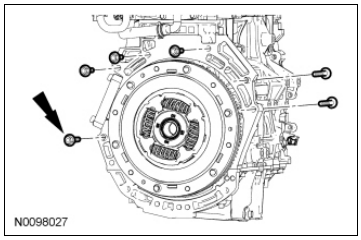

A0087496

2. **NOTE:** When positioning the engine to the transaxle, care must be taken to maintain alignment of the damper spline with the transaxle input shaft.

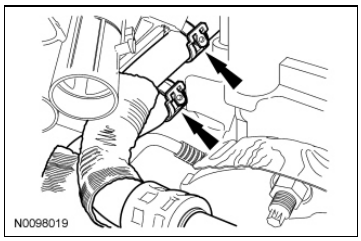
   NOTE: Transaxle removed from view for clarity.

   Using the Floor Crane and Spreader Bar, position the engine and transaxle together. Install the 6 transaxle-to-engine bolts.

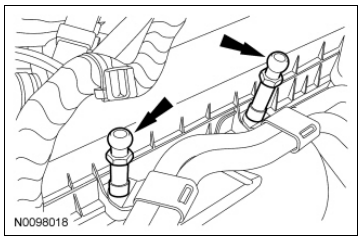
   - Tighten to 48 Nm (35 lb-ft).



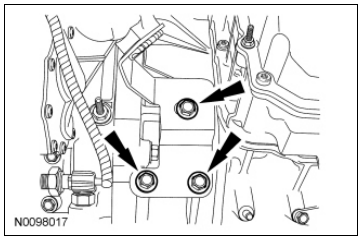
3. Connect the 2 heater hoses to the coolant outlet.



4. Install the 2 engine cover studs onto the valve cover studs.



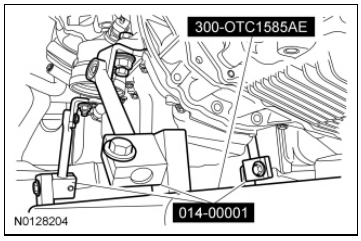
5. Position the auxiliary coolant pump and bracket and install the 3 bolts.
   - Tighten to 25 Nm (18 lb-ft).



6. Using the Floor Crane and Engine Lifting Bracket, position the engine and transaxle onto the Powertrain Lift.

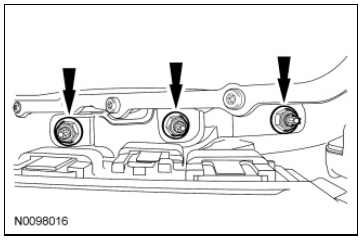
7. **NOTE:** Due to the weight of the transaxle, special care should be taken to mount the powertrain securely to the Powertrain Lift.

   Using the Adjustable Grip Arm, secure the engine to the Powertrain Lift.

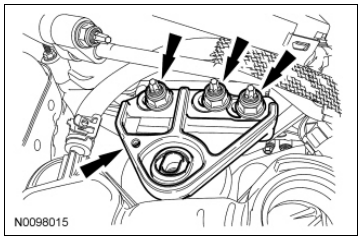


8. Raise the engine and transaxle into the vehicle.

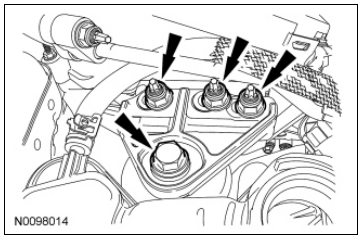
9. Install the 3 nuts on the upper transaxle insulator.
   - Tighten to 90 Nm (66 lb-ft).



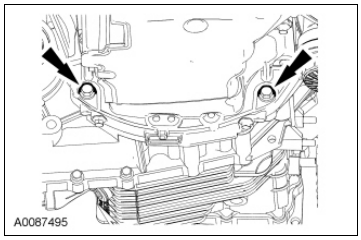
10. Install the engine mount bracket and 3 nuts.
    - Tighten to 103 Nm (76 lb-ft).



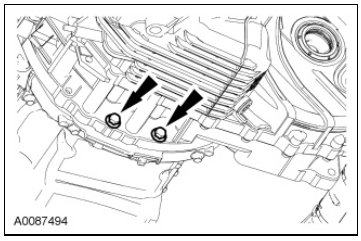
11. Install the engine mount bracket bolt.
    - Tighten to 115 Nm (85 lb-ft).



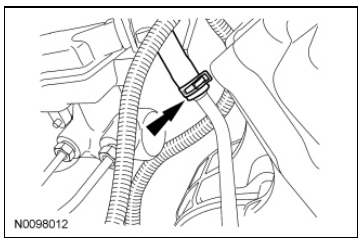
12. Install the 2 transaxle-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).



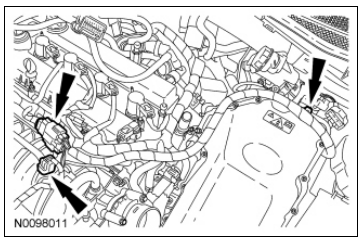
13. Install the 2 transaxle-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).



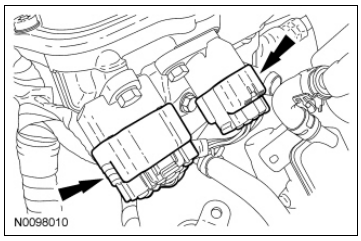
14. Connect the brake booster vacuum hose.



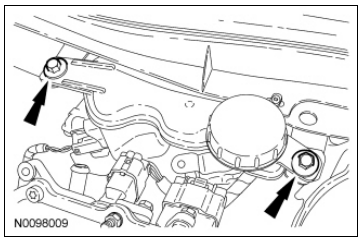
15. Connect the 2 engine wiring harness connectors and attach the wiring retainer.



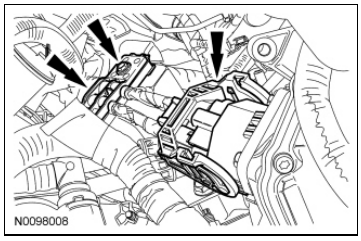
16. Connect the 2 transaxle electrical connectors.



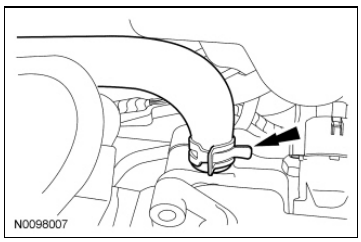
17. Position the master cylinder reservoir and install the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



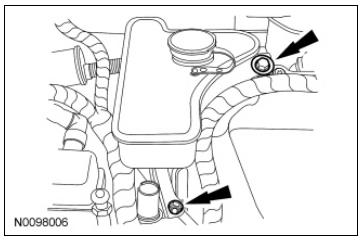
18. Connect the transaxle harness electrical connector, attach the wiring retainer and install the bolt.
    - Tighten to 10 Nm (89 lb-in).



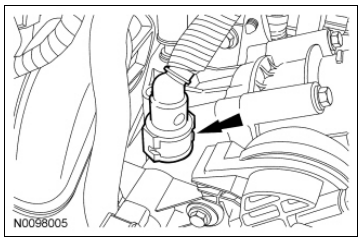
19. Connect the Motor Electronics Cooling System (MECS) coolant expansion tank hose.



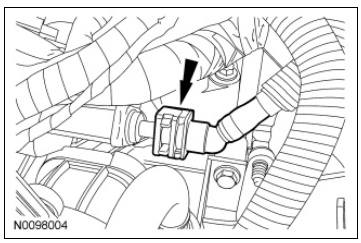
20. Install the MECS coolant expansion tank nut and bolt.
    - Tighten to 10 Nm (89 lb-in).



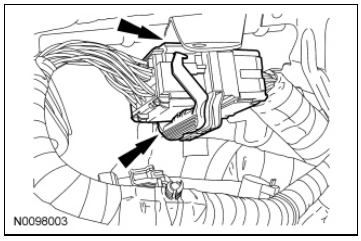
21. Connect the upper Evaporative Emission (EVAP) tube quick connect coupling to the purge valve. For additional information, refer to Section 310-00 .



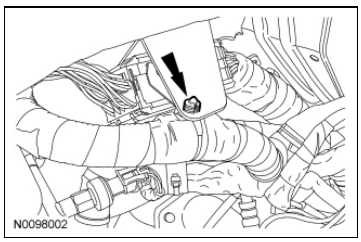
22. Connect the fuel supply tube. For additional information, refer to Section 310-00 .



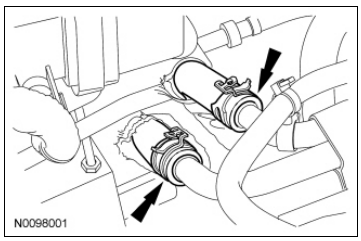
23. Connect the engine wiring harness connector and attach it to the bracket.



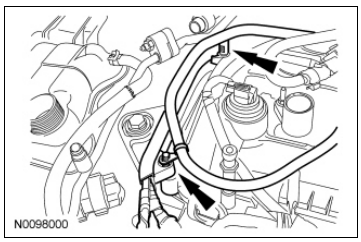
24. Attach the engine wiring harness retainer to the bracket.



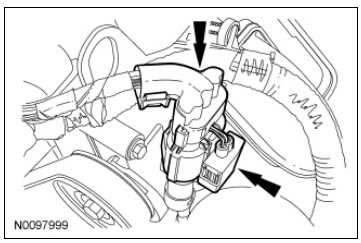
25. Connect the 2 heater hoses.



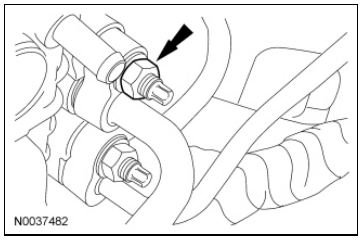
26. Attach the 2 block heater (if equipped) and the high voltage electrical system wiring retainers to the valve cover stud bolts.



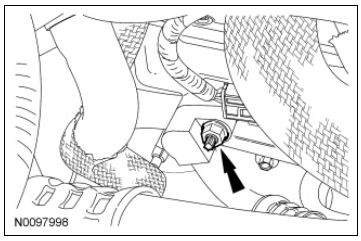
27. Connect the 2 vehicle high voltage electrical system electrical connectors.
    - Attach the wiring harness retainer.



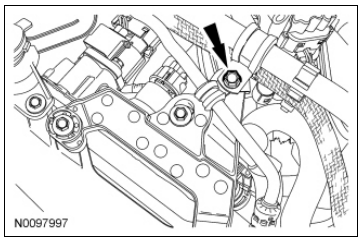
28. Install a new gasket and connect the A/C tube to the A/C condenser.
    - Install the nut.
    - Tighten to 15 Nm (133 lb-in).



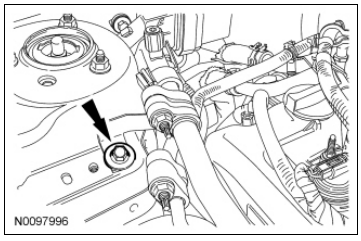
29. Install a new gasket and connect the A/C tube to the A/C compressor.
    - Install the nut.
    - Tighten to 15 Nm (133 lb-in).



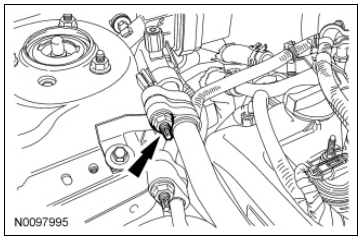
30. Install the A/C tube bracket bolt.
    - Tighten to 6 Nm (53 lb-in).



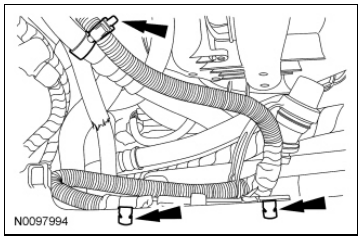
31. Install the A/C tube bracket bolt to the strut tower.
    - Tighten to 6 Nm (53 lb-in).



32. Install a new gasket and connect the A/C tube.
    - Install the nut.
    - Tighten to 15 Nm (133 lb-in).

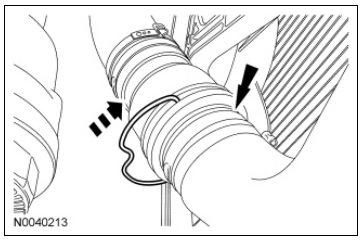


33. If equipped, attach the 3 block heater wiring retainers.



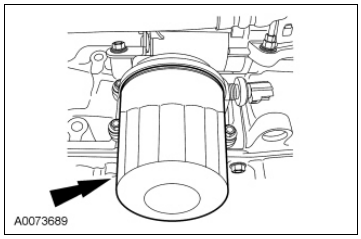
34. **NOTE:** Lower radiator hose shown, upper similar.

    Connect the upper and lower radiator hoses and install the retaining clips.

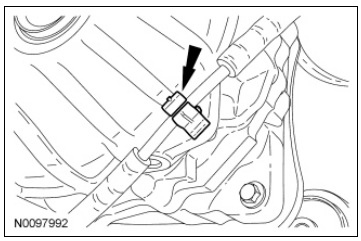


35. **NOTE:** Lubricate the oil filter O-ring with clean engine oil before installation.

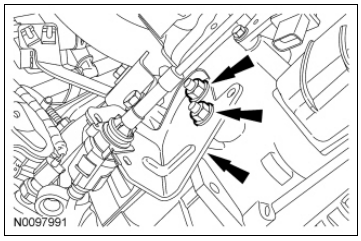
    Tighten the oil filter three-fourths of a turn after the oil filter gasket makes contact with the oil filter adapter.



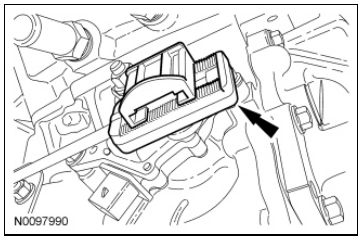
36. Attach the transaxle shift cable routing retainer to the transaxle.



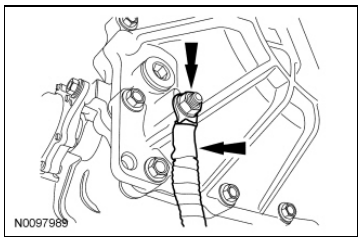
37. Position the selector lever cable bracket in place and install the 2 nuts.
    - Tighten to 12 Nm (106 lb-in).



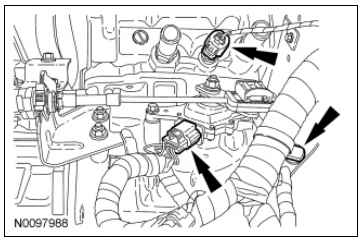
38. Connect the selector lever cable end to the manual control lever. Check selector lever cable adjustment. For additional information, refer to Section 307-05B .



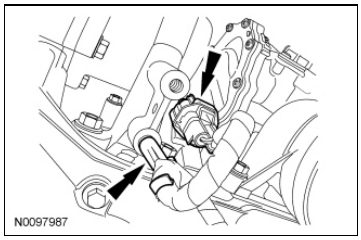
39. Install the transaxle ground wire and nut.
    - Tighten to 10 Nm (89 lb-in).



40. Connect the transaxle coolant temperature sensor and the Transmission Range (TR) sensor electrical connectors.
    - Attach the wiring harness retainer.



41. Connect the vacuum pump assembly electrical connector and attach the wiring retainer.

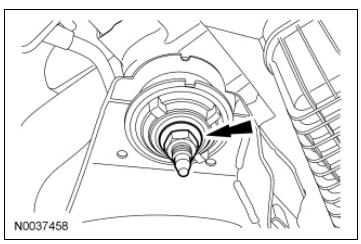


42. Place the subframe assembly on the Powertrain Lift and raise the subframe into the installed position.

43. **NOTE:** LH shown, RH similar.

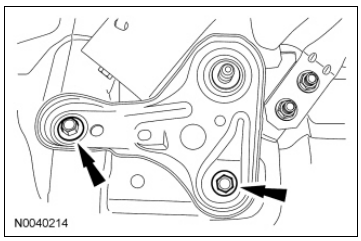
    Install the front subframe nuts.

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



44. **NOTE:** LH shown, RH similar.

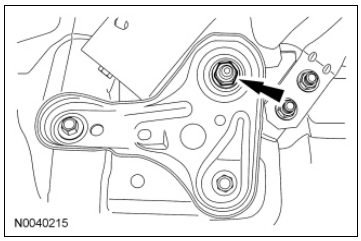
    Position the subframe brackets and install the bolts finger-tight.



45. **NOTE:** LH shown, RH similar.

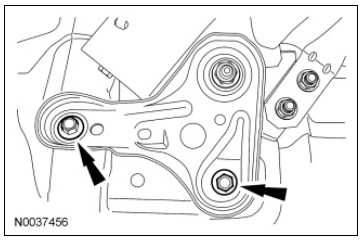
    Install the subframe nuts.

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

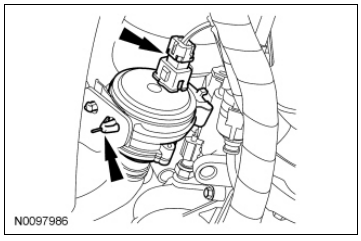


46. **NOTE:** LH shown, RH similar.

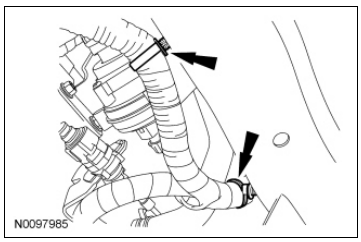
    Tighten the subframe bracket-to-body bolts to 103 Nm (76 lb-ft).



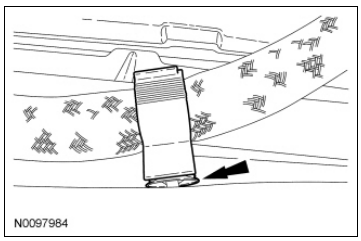
47. Connect the MECS electrical connector and attach the pump to the bracket.



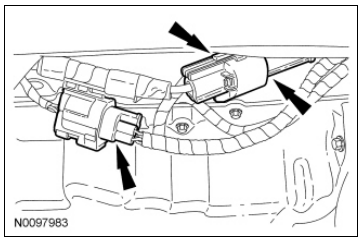
48. Attach the 3 wiring harness retainers (2 shown) to the LH front of the subframe.



49. Attach the auxiliary coolant hose retainer to the subframe.



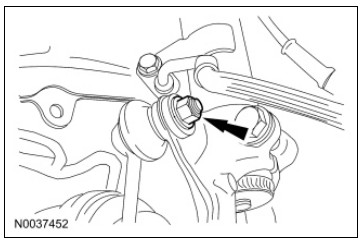
50. Connect the 2 Electronic Power Assist Steering (EPAS) electrical connectors near the front of the subframe.
    - Attach the connector retainer from the subframe.



51. **NOTE:** RH shown, LH similar.

    Install the stabilizer bar links and nuts to the struts.

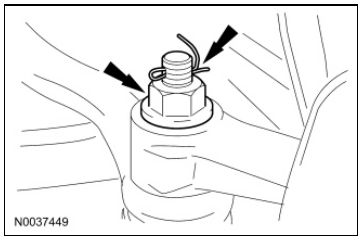
    - Tighten to 40 Nm (30 lb-ft).



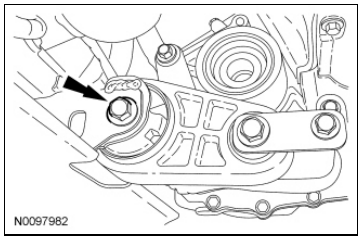
52. **NOTE:** RH shown, LH similar.

    Install tie-rod ends and nuts.

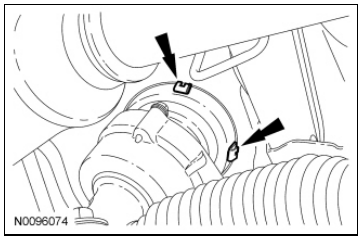
    - Tighten to 48 Nm (35 lb-ft).
    - Install the cotter pin.



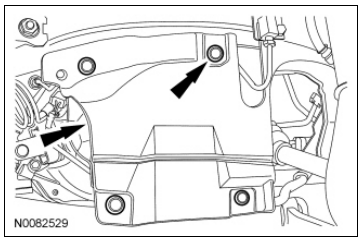
53. Install the engine roll restrictor bolt.
    - Tighten to 90 Nm (66 lb-ft).



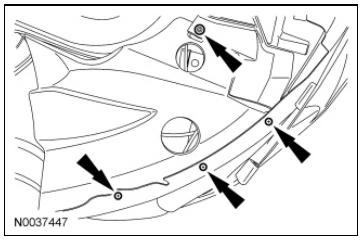
54. Slide the steering gear-to-dash seal onto the steering gear and engage the 4 retaining clips (2 shown) into the body.
    - From under the vehicle, verify that the seal is correctly installed on the steering gear and the 4 retaining clips are fully engaged into the dash.



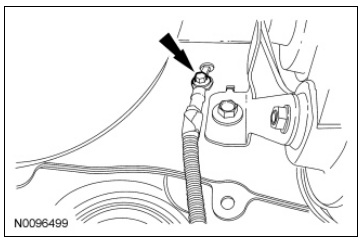
55. Install the LH splash shield and the 6 pin-type retainers (4 shown).



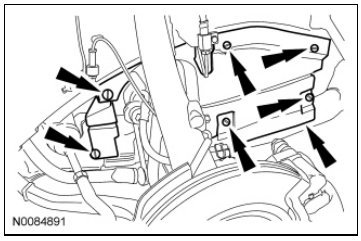
56. Position the LH fender splash shield and install the 4 screws.



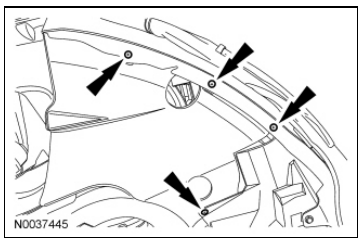
57. Install the EPAS wiring ground wire and bolt in the RH front wheel well.
    - Tighten to 10 Nm (89 lb-in).



58. Install the RH splash shield and the 6 pin-type retainers (4 shown).



59. Position the RH fender splash shield and install the 4 screws.

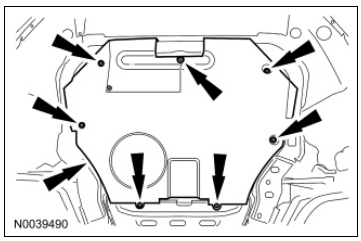


60. Install the exhaust flexible pipe. For additional information, refer to Section 309-00 .

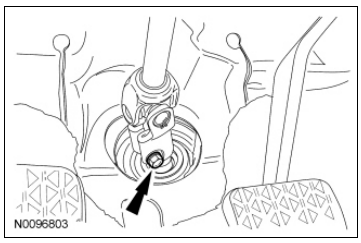
61. Install the front wheels and tires. For additional information, refer to Section 204-04 .

62. Fill the engine with clean engine oil.

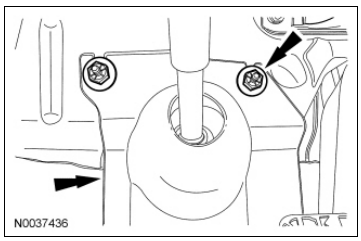
63. If equipped, install the underbody cover and 7 screws.



64. Connect the steering column shaft to the steering gear and install the bolt.
    - Tighten to 20 Nm (177 lb-in).



65. Install the steering joint cover and the 2 nuts.



66. Repower the vehicle high-voltage electrical system. For additional information, refer to Section 414-03 .

67. Connect the battery ground cable. For additional information, refer to Section 414-01 .
68. Install the engine Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12D .
69. Reset the Passive Anti-Theft System (PATS). For additional information, refer to Section 419-01B .
70. Fill and bleed the MECS . For additional information, refer to Section 307-02B .
71. Fill and bleed the cooling system. For additional information, refer to Section 303-03B .
72. Recharge the A/C system. For additional information, refer to Section 412-00B .

Material

Item	Specification	Fill Capacity
Motorcraft® Premium Cooling System Flush VC-1	ESR-M14P7-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	-
Motorcraft® Specialty Green Engine Coolant [a] [b] [c] VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A	2.5L engine 8.1L (8.6 qt); 3.0L engine 9.2L (9.7 qt); 3.5L engine 9.5L (10.0 qt)
Motorcraft® Specialty Orange Engine Coolant [a] [b] [d] VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D	2.5L engine 8.1L (8.6 qt); 3.0L engine 9.2L (9.7 qt); 3.5L engine 9.5L (10.0 qt)

[a] The cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used.
[b] Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.
[c] Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.
[d] During normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it requicoolant to be drained, the system to be flushed, or the engine coolant to be replaced.

General Specifications

Item	Specification
Pressure Tests	
Complete cooling system maximum pressure	124 kPa (18 psi)
Pressure relief cap	89-124 kPa (13-18 psi)
Radiator (out of vehicle)	138 kPa (20 psi)
Thermostat Opening Temperatures	
Thermostat starts to open (2.5L)	80-84°C (176-183°F)
Thermostat starts to open (3.0L)	84-88°C (183-190°F)
Thermostat starts to open (3.5L)	79.5-83.3°C (171.1-181.9°F)
Thermostat fully open (2.5L)	97°C (207°F)
Thermostat fully open (3.0L)	99°C (210°F)
Thermostat fully open (3.5L)	94.5°C (202.1°F)

Torque Specifications

Description	Nm	lb-ft	lb-in R>	Block heater	40	30	-
Cooling fan module bolt	7	-	62				
Coolant inlet pipe bolts	10	-	89				
Coolant inlet pipe hose clamp	5	-	44				
Coolant pump bolts (2.5L)	10	-	89				
Coolant pump bolts (3.0L)	10	-	89				
Coolant pump bolts (3.5L) [a]	-	-	-				
Coolant pump housing nuts and bolts (3.0L)	10	-	89				
Coolant pump housing studs (3.0L)	4	-	35				
Coolant pump pulley bolts (2.5L)	20	-	177				
Degas bottle-to-fender bolt and p" align="center">9	-	80					
Engine oil filter [a]	-	-	-				
Oil pan drain plug (3.5L)	27	20	-				
Primary timing chain guide bolts (3.5L)	10	-	89				
Primary timing chain tensioner bolts (3.5L)	10	-	89				
Thermostat housing bolts	10	-	89				
Transmission cooler tubes	30	22	-				
Upper radiator support bracket bolts	10	-	89				
Variable Camshaft Timing (VCT) oil control solenoid housing bolts (3.5L) [a]	-	-	-				

[a] Refer to the procedure in this section.

Engine Cooling

NOTICE: **The engine cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has be used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

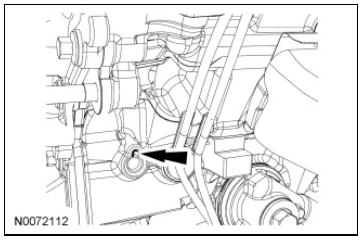
NOTICE: **Stop-leak style pellets/products must not be used as an additive in this engine cooling system. The addition of stop-leak style pellets/products can clog or damage the cooling system, resulting in degraded cooling system performance and/or failure.**

NOTE: During normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

The cooling system components are the:

- block heater (if equipped).
- radiator.
- bypass tube.
- pressure relief cap.
- degas bottle.
- radiator draincock.
- coolant pump.
- thermostat (cold side).
- Engine Coolant Temperature (ECT) sr.
- variable speed fan motor assembly.
- fan control module.
- engine block coolant weep hole (3.5L only).

On 3.5L engines the coolant pump is located under the engine front cover mounted to the block. A weep hole is provided on the front left side of the engine behind the generator. It is adjacent to a 13.5 mm (0.531 in) cup plug. The plug and the weep hole create a reservoir for normal coolant seepage and evaporation. Every coolant pump will have some leakage past the dynamic mechanical seal. Dampness and crusting around the weep hole is acceptable and an expected result of normal engine operation. Coolant spray or leakage amounts great enough to puddle should be addressed.



Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, maintain the engine coolant at the correct concentration and fluid level in the degas bottle.

When adding engine coolant, use a 50/50 mixture of engine coolant and distilled water. A coolant concentration of 50% provides freeze point protection down to -37°C (-34°F).

To maintain the integrity of the coolant and the cooling system:

- add Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Mixing different coolant types degrades the corrosion protection of the original coolant. Do not mix any type of coolants.
- do not add alcohol, methanol or brine, or any engine coolants mixed with alcohol or methanol antifreeze. T can cause engine damage from overheating or freezing.
- Ford Motor Company does NOT recommend the use of recycled engine coolant in vehicles.
- Used engine coolant should be disposed of in an appropriate manner. Follow the community's regulations and standards for recycling and disposing of automotive fluids.

Fail Safe Cooling

NOTE: If the driver is using a high percentage of throttle travel (for example, an overtaking maneuver) when the PCM starts, engine deactivation will be delayed for 10 seconds.

NOTE: After the cylinder deactivation operation has begun, the engine will not revert to operating on all cylinders, even if the temperature should fall, until the ignition is switched OFF and then ON again.

NOTE: The Malfunction Indicator Lamp (MIL) can only be extinguished by using a scan tool after the fault has been rectified and the DTC cleared.

The vehicle has a strategy built into the PCM that will control the engine if it starts to overheat.

Stage 1 of the strategy will commence if the engine starts to overheat. The Cylinder Head Temperature (CHT) sensor transmits a signal to the PCM, which then moves the temperature gauge pointer into the red zone.

If the engine is not switched OFF and the temperature continues to rise, the powertrain check lamp is illuminated. This indicates to the driver that the engine is approaching critical limits and should be stopped. At this point, DTC P1285 is set in the PCM and can be retrieved using a scan tool.

Stage 2 of the strategy will commence if the lamp and temperature gauge are ignored by the driver. The PCM will start to control the engine by cutting out cylinders and restricting the rpm to below 3,000 rpm. Simultaneously, the MIL will be illuminated. This indicates that long-term engine damage can occur and vehicle emissions will be affected. At this point, DTC 1299 is set in the PCM and can be retrieved using a scan tool.

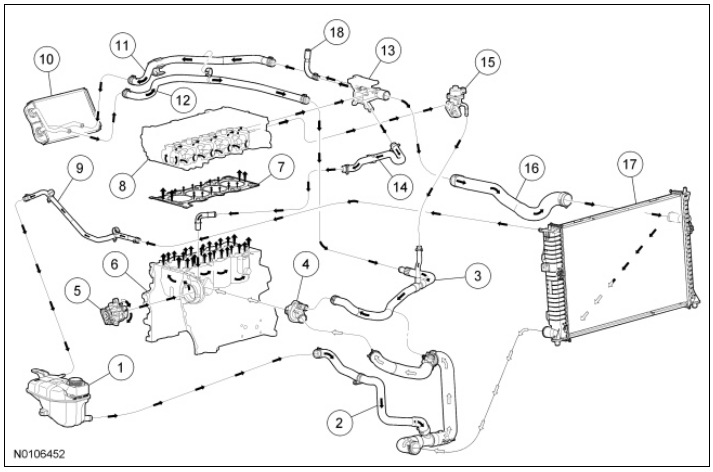
Air is then drawn into the deactivated cylinders. This helps to control the temperature of the engine internal components. The deactivated cylinders are alternated to allow even cooling of all the cylinders.

Stage 3 of the strategy will commence if the engine temperature still continues to rise. This will result in the engine being totally disabled before major engine damage or seizure occurs. The powertrain check lamp will begin to flash, indicating to the driver that the engine will be switched OFF after 30 seconds. This allows the driver time to choose a suitable parking place.

Coolant Flow Diagram

2.5L

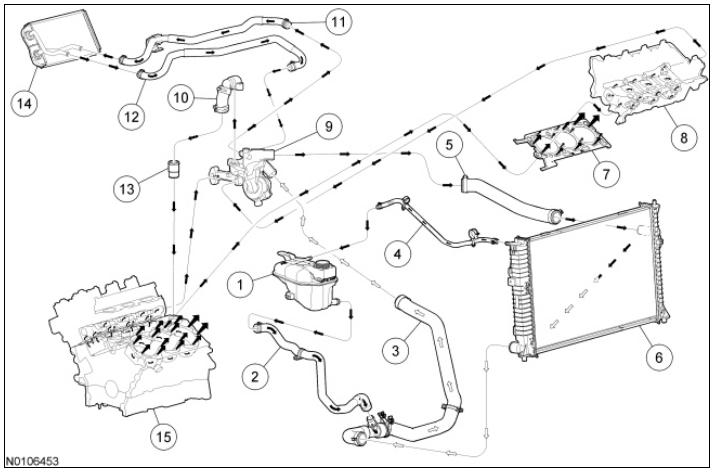
NOTE: Black arrows indicate hot, white arrows indicate cold.



Item	Part Number	Description
1	8A080	Degas bottle
2	8B273	Lower radiator hose
3	18C266	Heater core outlet-to-thermostat housing hose
4	8575	Thermostat housing
5	8501	Coolant pump
6	6010	Engine block
7	6051	Head gasket
8	6049	Cylinder head
9	8276	Degas bottle-to-radiator hose
10	19B555	Heater core
11	18C266	Heater core inlet hose
12	18C266	Heater core outlet hose
13	8K556	Coolant outlet adapter
14	8A582	Coolant outlet adapter-to-engine block hose
15	9D475	EGR valve assembly
16	8B274	Upper radiator hose
17	8005	Radiator
18	8C362	Bleed valve hose

3.0L

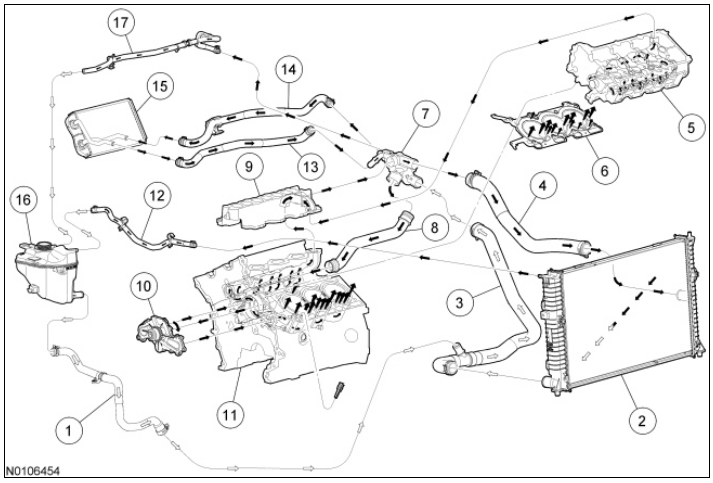
NOTE: Black arrows indicate hot, white arrows indicate cold.



Item	Part Number	Description
1	8A080	Degas bottle
2	8C351	Lower degas bottle hose
3	8B273	Lower radiator hose
4	8276	Degas bottle-to-radiator hose
5	8B274	Upper radiator hose
6	8005	Radiator
7	6083	Cylinder head gasket
8	6050	Cylinder head
9	8B585	Thermostat and coolant pump housing
10	9N271	Coolant inlet pipe
11	18C266	Heater core inlet hose
12	18C266	Heater core outlet hose
13	8A505	Coolant inlet tube
14	19B555	Heater core
15	6010	Engine block

3.5L

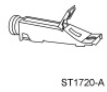
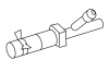
NOTE: Black arrows indicate hot, white arrows indicate cold.



Item	Part Number	Description
1	8C351	Lower degas bottle hose
2	8005	Radiator
3	8B273	Lower radiator hose
4	8B274	Upper radiator hose
5	6050	Cylinder head
6	6083	Cylinder head gasket
7	8A586	Thermostat housing
8	9N271	Water inlet tube
9	9K461	Lower intake manifold
10	8501	Coolant pump
11	6010	Engine block
12	8276	Degas bottle-to-radiator hose
13	18C266	Heater core outlet hose
14	18C266	Heater core inlet hose
15	19B555	Heater core
16	8A080	Degas bottle
17	8B541	Degas bottle-to-thermostat housing hose

Engine Cooling

Special Tool(s)

 ST3106-A	3-Way HD Antifreeze Coolant Test Kit 328-00001
 ST1720-A	Coolant/Battery Refractometer ROB75240 or equivalent
 ST3280-A	D-Gas Adapter 300-OTC014-R1068 or equivalent
 ST3281-A	Radiator Tester STN12270 or equivalent
 ST3254-A	UView® Combustion Leak Tester UVU560000-R
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware or equivalent scan tool

Material

Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D

Principles of Operation

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. Coolant is sent from the coolant pump through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The 2.5L engine coolant pump is operated by engine rotation through a pulley driven by the accessory drive belt. The 3.0L coolant pump is operated by a V-ribbed belt driven by a pulley attached to the camshaft. The 3.5L coolant pump is operated through a sprocket driven by the timing chain. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is opened, coolant flows through the radiator circuit to transfer engine-generated heat to the outside air.

The degas bottle holds surplus coolant and removes air from the cooling system, which reduces hot spots. It also allows for coolant expansion and system pressurization, replenishes coolant to the cooling system and serves as the locati for service fill.

The cooling fan draws air through the radiator to help cool the system coolant as it passes through the radiator.

The thermostat monitor is a function of the PCM and is designed to verify correct thermostat operation. The monitor executes once per drive cycle and has a monitor run duration of 300-800 seconds. If a malfunction occurs, DTC P0125 or P0128 is set, and the Malfunction Indicator Lamp (MIL) will be illuminated.

For engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

Inspection and Verification

⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

NOTICE: **The engine cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

NOTE: During normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

NOTE: Vehicles have the pressure relief cap on the degas bottle and no radiator cap.

1. Verify the customer concern.

2. Visually check the engine coolant level at the degas bottle when the system is cold.

3. Make sure the pressure relief cap is installed correctly.

4. Record any cooling system DTCs retrieved. Refer to the PCM DTC Chart in this section for DTC descriptions.

5. **NOTE:** Take note of any coolant odor or steam coming from cooling system components.

   If the system coolant is filled correctly and no DTCs associated with fail-safe cooling are retrieved, verify the customer's concern by operating the engine to duplicate the condition.

6. **NOTE:** For the coolant flow diagrams, refer to Engine Cooling in the Description and Operation portion of this section.

Visually inspect for obvious signs of any mechanical or electrical concerns damage.

Visual Inspection Chart

Mechanical	Electrical
• Leaks or weeps at: ♦ Hoses ♦ Tubes ♦ Clamp joints ♦ Gaskets ♦ O-rings ♦ Thermostat housing ♦ Radiator ♦ Pressure relief cap ♦ Coolant pump weep hole (LH side of block, 3.5L only) ♦ Heater core (wet floor or coolant odor in vehicle) ♦ Degas bottle ♦ Coolant pump housing ♦ Cylinder block core plugs ♦ Cylinder head core plugs ♦ Block heater (if equipped)	• Inoperative or damaged: ♦ Electric cooling fan ♦ Wiring, connectors, relays or modules ♦ Cylinder Head Temperature (CHT) sensor ♦ Vehicle Speed Sensor (VSS)
• Cracked or damaged: ♦ Hoses ♦ Tubes ♦ Hose clamps ♦ Thermostat housing ♦ Radiator ♦ Pressure relief cap ♦ Cooling fan ♦ Coolant pump ♦ Degas bottle ♦ Coolant pump housing ♦ Cylinder block core plugs ♦ Cylinder head core plugs ♦ Block heater (if equipped) • Restricted airflow through the A/C condenser/radiator • Excessive white or light gray exhaust smoke (may have burnt coolant odor) • Coolant in engine oil • Engine oil in coolant • Coolant in automatic transmission fluid (if equipped) • Automatic transmission fluid (if equipped) in coolant • Engine vent hose check valve installed correctly (3.5L only)	

7. If the inspection reveals an obvious concern that can be readily identified, repair it as necessary. Test the system for normal operation.

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NOTE: NOTE: During normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

Inspect the coolant condition in the following sequence:

1. Inspect the coolant color.
    - ♦ If the coolant has a clear or pale green color, this indicates higher water content than required. Test the engine coolant freezing point range with the Coolant/Battery Refractometer. The freezing point should be in the range -50°C to -26°C (-58°F to -15°F). If the vehicle is driven in cold climates less than -37°C (-34°F), it may be necessary to increase the coolant concentration to get adequate freeze protection. Recommended coolant concentration is 50/50 engine coolant to distilled water.
    - ♦ Discoloration of Motorcraft® Specialty Orange Engine Coolant may indicate that incorrect coolant may have been added to the system. Use of incorrect (green or yellow) coolant degrades the corrosion protection of Motorcraft® Specialty Orange Engine Coolant. Addition of Motorcraft® Specialty Green Engine Coolant may cause the color to appear to be a murky green-brown color. The addition of Motorcraft® Premium Gold Engine Coolant, however, may not change the color or appearance of the orange colored coolant. Detection of contamination with Motorcraft® Premium Gold Engine Coolant is determined by the presence of nitrite. If contamination with Motorcraft® Premium Gold Engine Coolant is suspected, test the coolant with the 3-Way HD Antifreeze Coolant Test Kit. Follow the directions in the kit with regard to nitrite testing. If nitrite is prese system and refill with the correct mixture of Motorcraft® Specialty Orange Engine Coolant and distilled water. Refer to Cooling System Flushing in this section.
    - ♦ A darker color with the presence of debris could indicate a commercially available stop-leak may have been used and could result in loss of coolant flow the critical parts of the engine. If sediment is present in the coolant sample, flush the system and refill with the correct mixture of distilled water and the correct engine coolant. Refer to Cooling System Flushing in this section.
    - ♦ A light or reddish brown color or reddish brown particles indicate that rust may be present in the cooling system. Flush the system and refill with the correct mixture of

8. distilled water and the correct engine coolant. Refer to Cooling System Flushing in this section.
   - An iridescent sheen on top of the coolant could indicate a trace of oil is entering the system. For information on engine diagnosis, refer to Section 303-00 .
   - A milky brown color may indicate that engine oil is entering the cooling system. Pressure test the cooling system. Refer to Component Tests in this section. If engine oil is suspected, the cause of the leak may be internal to the engine. Refer to Section 303-00 . Flush the cooling system. Refer to Cooling System Flushing in this section.
2. If the engine coolant appearance is acceptable, test the engine coolant freezing point range with the Coolant/Battery Refractometer. The freezing point should be in the range -50°C to -26°C (-50°F to -15°F). If the vehicle is driven in cold climates less than -37°C (-34°F), it may be necessary to increase the coolant concentration to get adequate freeze protection. Recommended coolant concentration is 50/50 engine coolant to distilled water.
   - Maximum coolant concentration is 60/40 for cold weather areas.
   - Minimum coolant concentration is 40/60 for warm weather areas.
3. Adjust coolant ranglevel if necessary:
   - If coolant is low, add specified coolant mixture only.
   - If the engine coolant tests too weak, remove some of the engine coolant and add undiluted engine coolant until the readings are within acceptable levels.
   - If the engine coolant tests strong, remove some of the engine coolant and add distilled water until the readings are within acceptable levels.

9. If an obvious cause for an observed or reported concern is found, correct the cause and test the system for normal operation before proceeding to the next step.

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

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

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

    If the scan tool does not communicate with the VCM :

    - check the VCM connection to the vehicle.
    - check the scan tool connection to the VCM .
    - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

12. If the scan tool does not communicate with the vehicle:
    - verify the ignition key is in the ON position.
    - verify the scan tool operation with a known good vehicle.
    - refer to Section 418-00 to diagnose no response from the PCM.

13. Carry out the network test.
    - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
    - If the network test passes, retrieve and record continuous memory DTCs.

14. Clear the continuous DTCs and carry out the self-test diagnostics PCM.

15. If the DTCs recovered are related to the concern, go to the PCM DTC Chart. For all other PCM DTCs, refer to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L (4V) engines, or Section 303-14C for 3.5L engines.

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

DTC Chart

PCM DTC Chart

DTC	Description	Action
P0125	Insufficient Coolant Temp For Closed Loop Fuel Control	GO to Pinpoint Test C .
P0128	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature)	GO to Pinpoint Test C .
P0217	Engine Coolant Overtemperature Condition	GO to Pinpoint Test B .
P0480 P0481 P0482	Fan 1, 2 or 3 Control Circuit, Respectively	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1285	Cylinder Head Overtemperature Condition	GO to Pinpoint Test B .
P1299	Cylinder Head Overtemperature Protection Active	GO to Pinpoint Test B .
All Other PCM DTCs	-	REFER to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L (4V) engines or Section 303-14C for 3.5L engines.

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: Loss of Coolant

Normal Operation

The engine cooling system is a closed system providing for coolant expansion and contraction and also changes in pressure as coolant warms and cools with engine operation. Various gaskets, seals, hoses and clamps contain coolant within the cooling system and keep other fluids and contaminants from entering the cooling system.

Coolant loss can be attributed to either external or internal leaks anywhere within the cooling system.

For engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

This pinpoint test is intended to diagnose the following:

- Coolant hoses or tubes
- Hose clamps
- Thermostat O-ring seal
- Thermostat housing O-ring seal
- Thermostat housing
- Coolant pump O-ring seal or gasket
- Coolant pump housing
- Coolant pump
- Radiator
- Transmission fluid cooler in radiator (if equipped)
- Pressure relief cap
- Coolant pump leaking from weep hole
- Heater core
- Engine gaskets
- Degas bottle
- Cylinder block core plugs
- Cylinder head core plugs
- Block heater (if equipped)

PINPOINT TEST A: LOSS OF COOLANT

⚠ WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

Test Step	Result / Action to Take
A1 CARRY OUT INSPECTION AND VERIFICATION	
• Carry out the Inspection and Verification procedure in this section. • **Were any concerns found?**	**Yes** REPAIR as needed. TEST the system for normal operation. **No** GO to A2 .
A2 CHECK THE ENGINE COOLANT LEVEL	
NOTE: Allow the engine to cool before checking the engine coolant level. • Ignition OFF. • Visually inspect the engine coolant level at the degas bottle. • **Is the engine coolant level within specifications?**	**Yes** GO to A3 . **No** ADJUST the engine coolant level as necessary. GO to A3 .
A3 PRESSURE TEST THE ENGINE COOLING SYSTEM	

• Pressure test the engine cooling system. Refer to Component Tests, Cooling System Pressure Test in this section. • **Does the engine cooling system leak externally?**	**Yes** REPAIR or INSTALL new components. TEST the system for normal operation. **No** GO to A4 .
A4 CHECK THE ENGINE COOLANT FOR AN INTERNAL LEAK	
• Inspect the engine coolant in the degas bottle for signs of engine oil. • **Is engine oil evident in the coolant?**	**Yes** If engine oil is evident, GO to Section 303-00 for engine diagnosis. **No** GO to A5 .
A5 CHECK THE ENGINE OIL AND TRANSMISSION FLUID FOR COOLANT	
• Remove the oil level indicators from the engine and the transmission. • **Is coolant evident in the oil or transmission fluid?**	**Yes** If coolant is in the engine oil, GO to Section 303-00 . If coolant is in the transmission fluid, INSTALL a new radiator. REPAIR the transmission as necessary. Refer to the appropriate section in Group 307 for the procedure. **No** GO to A6 .
A6 CHECK THE COOLING SYSTEM FOR COMBUSTION GASES	
• **NOTE:** Use UView® Combustion Leak Tester, part No. UVU560000-R or equivalent. • Using a cooling system combustion gas leak tester, following the instructions supplied with the tester, check the coolant for combustion gases. • **Are combustion gases present?**	**Yes** GO to Section 303-00 for engine diagnosis. **No** The cooling system is operational.

Pinpoint Test B: The Engine Overheats

Normal Operation

The engine cooling system maintains engine temperatures during operation. Correct coolant flow through the engine, radiator and remainder of cooling system passages and components is essential to maintaining a correct engine temperatue.

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. From the coolant pump, coolant is sent through the engine block and cylinder heads. Coolant is sent from the coolant pump through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The 2.5L engine coolant pump is operated by engine rotation through a pulley driven by the accessory drive belt. The 3.0L coolant pump is operated by a V-ribbed belt driven by a pulley attached to the camshaft. The 3.5L coolant pump is operated through a sprocket driven by the timing chain. The coolant

thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is opened, coolant flows through the radiator circuit in order to transfer engine-generated heat to the outside air.

Engine overheating generally occurs when there is a disruption in the ability to control either coolant flow at the correct rate, the inability to transfer heat from the engine through the coolant (including low coolant) or an inability to transfer engine-generated heat to the outside air through the radiator.

For engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

- DTC P0217 (Engine Coolant Overtemperature Condition) - Indicates an engine overheat condition was sensed by the Cylinder Head Temperature (CHT) sensor.
- DTC P1285 (Cylinder Head Overtemperature Condition) - Indicates an engine overheat condition was sensed by the CHT sensor.
- DTC P1299 (Cylinder Head Overtemperature Protection Active) - Indicates an engine overheat condition was detected by the CHT sensor. A failure mode effects management strategy called fail-safe cooling was activated to cool the engine.

This pinpoint test is intended to diagnose the following:

- Low coolant level
- External engine coolant leak
- Airlock in system
- Pressure relief cap installation
- Restricted airflow through the A/C condenser/radiator
- Internal engine coolant leak
- Coolant condition/concentration
- Accessory drive components
- Non-OEM engine enhancement components
- Electric cooling fan
- Engine Coolant Temperature (ECT) gauge
- Cylinder Head Temperature (CHT) sensor
- Heater core
- Coolant pump
- Coolant flow restriction
- Missing engine vent hose check valve or incorrect orientation of check valve (3.5L only)

PINPOINT TEST B: THE ENGINE OVERHEATS

⚠ WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructis may result in serious personal injury.

Test Step	Result / Action to Take
B1 CARRY OUT INSPECTION AND VERIFICATION	
• Carry out the Inspection and Verification procedure in this section. • **Were any concerns found?**	**Yes** REPAIR as needed. TEST the system for normal operation. **No** GO to B2 .

B2 CHECK FOR DTCs	
• Check for DTC P0217, P1285 or P1299. • **Is DTC P0217, P1285 or P1299 present?**	**Yes** GO to B3 . **No** Actual engine overheating has not been verified. CHECK the ECT gauge operation. REFER to Section 413-01 . If any other PCM DTCs are retrieved, REFER to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L (4V) engines or Section 303-14C for 3.5L engines.
B3 CHECK FOR AN AIRFLOW OBSTRUCTION	
• Check the radiator or A/C condenser for an external obstruction such as leaves or cardboard. • **Is an obstruction present?**	**Yes** REMOVE the obstruction. TEST the system for normal operation. **No** GO to B4 .
B4 CHECK THE ENGINE COOLANT LEVEL	
NOTE: Allow the engine to cool before checking the coolant level. • Ignition OFF. • Visually check the engine coolant level in the degas bottle. • **Is the engine coolant level within specification?**	**Yes** GO to B5 . **No** ADJUST the engine coolant level as necessary. GO to B5 .
B5 PRESSURE TEST THE ENGINE COOLING SYSTEM	
• Pressure test the engine cooling system. Refer to Component Tests, Cooling System Pressure Test in this section. • **Does the engine cooling system leak externally?**	**Yes** REPAIR or INSTALL new components. TEST the system for normal operation. **No** GO to B6 .
B6 CHECK THE ENGINE COOLANT FOR AN INTERNAL LEAK	
• Inspect the engine coolant in the degas bottle for signs of engine oil. • **Is engine oil evident in the coolant?**	**Yes** If engine oil is evident, GO to Section 303-00 for engine diagnosis. **No** GO to B7 .
B7 CHECK THE ENGINE OIL AND TRANSMISSION FLUID FOR COOLANT	
	Yes If coolant is in the engine oil, GO to Section 303-00 . If

• Remove the oil level indicators from the engine and the transmission. • **Is coolant evident in the oil or transmission fluid?**	coolant is in the transmission fluid, INSTALL a new radiator. REPAIR the transmission as necessary. Refer to the appropriate section in Group 307 for the procedure. **No** GO to B8 .
B8 CHECK THE COOLING SYSTEM FOR COMBUSTION GASES	
• **NOTE:** Use UView® Combustion Leak Tester, part No. UVU560000-R or equivalent. • Using a cooling system combustion gas leak tester, following the instructions supplied with the tester, check the coolant for combustion gases. • **Are combustion gases present?**	**Yes** GO to Section 303-00 for engine diagnosis. **No** GO to B9 .
B9 CHECK COOLANT CONDITION	
• Check the coolant for dirt, rust or contamination and check the coolant concentration. • **Is the coolant condition OK?**	**Yes** GO to B10 . **No** FLUSH the engine cooling system. REFER to Cooling System Flushing in this section. TEST the system for normal operation.
B10 CHECK THE ELECTRIC COOLING FAN OPERATION	
• Start the engine. • Place the climate control function selector in the MAX A/C position and the blower motor switch in the HI position. • **Did the electric cooling fan operate?**	**Yes** GO to B11 . **No** DIAGNOSE the electric cooling fan operation. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B11 CHECK THE COOLANT PUMP OPERATION	
• Start the engine. • Allow the engine to run for 30 minutes. Place the climate control function selector in the MAX HEAT position. Feel the heater outlet hose. • **Is the heater outlet hose hot?**	**Yes** GO to B12 . **No** INSTALL a new coolant pump. TEST the system for normal operation.
B12 CHECK THE THERMOSTAT OPERATION	
• Start the engine.	**Yes** CHECK the ECT gauge operation. REFER to Section 413-01 .

• Allow the engine to run for 30 minutes. Feel the lower radiator hose. • **Is the lower radiator hose hot?**	**No** For 3.5L engines, GO to B13 . For 2.5L and 3.0L engines, GO to B14 .
B13 CHECK THE ENGINE VENT HOSE CHECK VALVE	
• Disconnect the engine vent hose from the engine and degas bottle. • Using a light, look inside the end of the vent hose that connects to the engine. A check valve should be installed 50 mm (1.96 in) from the end of the hose. • Using regulated compressed air, confirm air flows freely from the engine end to the degas bottle end. • Using regulated compressed air, confirm air does not flow from the degas bottle end to the engine end. • **Is the check valve installed in the vent hose and does air flow through in one direction and not the other?**	**Yes** GO to B14 . **No** INSTALL a new engine vent hose. TEST the system for normal operation.
B14 VISUALLY INSPECT THE THERMOSTAT	
• Carry out the Thermostat Visual Inspection in the Component Tests portion of this section. • **Is the thermostat damaged?**	**Yes** INSTALL a new thermostat. TEST the system for normal operation. **No** INSTALL a new thermostat. TEST the system for normal operation. If the engine still overheats, INSTALL a new radiator. TEST the system for normal operation.

Pinpoint Test C: The Engine Does Not Reach Normal Operating Temperature

Normal Operation

The engine cooling system maintains engine temperatures during operation. Correct coolant flow through the engine, radiator and remainder of cooling system passages and components is essential to maintaining a correct engine temperature.

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. From the coolant pump, coolant is sent through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The 2.5L engine coolant pump is operated by engine rotation through a pulley driven by the accessory drive belt. The 3.0L coolant pump is operated by a V-ribbed belt driven by a pulley attached to the camshaft. The 3.5L coolant pump is operated through a sprocket driven by the timing chain. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is

opened, coolant flows through the radiator circuit in order to transfer engine generated heat to the outside air.

Concerns of engine inability to reach normal operating temperature typically occur when the rate of coolant flow through some coolant circuits (radiator, heater core) is more than expected given the conditions, or when the electric cooling fans operate all the time. Heat is not allowed to build in the engine because a heat exchanger is removing too much heat, including the radiator, heater core and oil cooler. In addition, perceived concerns that the engine does not reach normal operating temperature can be related to a low coolant level or trapped air which does not allow for hot coolant to be available at the heater core, an inoperative climate control system, or for concerns perceived or related to an incorrect engine temperature gauge indication.

For engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

- DTC P0125 (Insufficient Coolant Temp for Closed Loop Fuel Control) - Indicates the Cylinder Head Temperature (CHT) sensor has not achieved the required temperature level to enter closed loop operating conditions within a specified amount of time after starting the engine.
- DTC P0128 (Coolant Thermostat [Coolant Temp Below Thermostat Regulating Temperature]) - Indicates that the thermostat monitor has not achieved the required engine operating temperature within a specified amount of time after starting the engine.

This pinpoint test is intended to diagnose the following:

- Low coolant level
- Thermostat
- Engine Coolant Temperature (ECT) gauge
- Engine cooling fan

PINPOINT TEST C: THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE

⚠ WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcly when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

Test Step	Result / Action to Take
C1 CARRY OUT INSPECTION AND VERIFICATION	
• Carry out the Inspection and Verification procedure in this section. • **Were any concerns found?**	**Yes** REPAIR as needed. TEST the system for normal operation. **No** GO to C2 .
C2 CHECK FOR DTC P0125 or P0128	
• Check for DTC P0125 or P0128. • **Is DTC P0125**	**Yes** GO to C3 . **No**

or P0128 present?	The cooling system is operational. If an inoperative engine coolant temperature gauge is suspected, CHECK the engine coolant temperature gauge operation. REFER to Section 413-01 . If an inoperative climate control system is suspected, CHECK the climate control system operation. REFER to Section 412-00A . If any other PCM DTCs are retrieved, REFER to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L (4V) engines or Section 303-14C for 3.5L engines.
C3 CHECK THE ELECTRIC COOLING FAN OPERATION	
• Allow the engine to cool. • Make sure the A/C switch is OFF (if equipped). • Start the engine. • Check the electric cooling fan. • **Is the electric cooling fan on all the time?**	**Yes** DIAGNOSE the electric cooling fan operation. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to C4 .
C4 CHECK THE COOLANT LEVEL	
• **NOTE:** Allow the engine to cool before checking the coolant level. • Visually check the engine coolant level in the degas bottle. • **Is the engine coolant level within specification?**	**Yes** INSTALL a new thermostat. TEST the system for normal operation. **No** GO to Pinpoint Test A to diagnose a coolant leak.

Component Tests

Cooling System Pressure Test

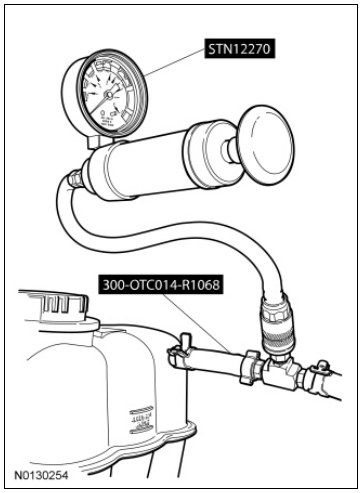
⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

NOTE: Vehicles have the pressure relief cap on the degas bottle and no radiator cap.

1. Turn the engine OFF.

2. Check the engine coolant level. Adjust the coolant level as necessary.

3. Attach the D-Gas Adapter to the degas bottle nipple and overflow hose. Install the Radiator Tester to the quick connect fitting of the D-Gas Adapter.



4. *NOTICE:* **Do not pressurize the cooling system beyond the maximum pressure listed in the specifications table in this section or cooling system components may be damaged.**

   NOTE: If the plunger of the pressure tester is pressed too fast, an erroneous pressure reading will result.

   Slowly press the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained. If the pressure reading exceeds the maximum cap pressure listed in the specifications table, install a new pressure relief cap.

5. If the system does not hold pressure, remove the pressure relief cap and wash in clean water to dislodge all the foreign material from the gasket. Check the sealing surface in the filler neck of the degas bottle for nicks or cuts. Install the pressure relief cap.

6. Pressurize the engine cooling system as described in Step 4. Observe the gauge reading for approximately 2 minutes. Pressure should not drop during this time. If the pressure drops within this time, inspect for leaks and repair as necessary.

7. If no leaks are found and the pressure drops. the pressure relief cap may be leaking. Install a new pressure relief cap and retest the system.

8. If no leaks are found after a new pressure relief cap is installed, and the pressure drops, the leak may be internal to the radiator transmission cooler (if equipped). Inspect the coolant for transmission fluid and the transmission fluid for coolant. Repair as necessary.

9. If there is no contamination of the coolant or transmission fluid, the leak may be internal to the engine. Inspect the coolant for engine oil and the engine oil for coolant. Refer to Section 303-00 to diagnose the engine.

10. Release the system pressure by loosening the pressure relief cap. Check the coolant level and adjust as necessary.

Thermostat

A new thermostat should be installed only after the following tests and checks have been carried out:

- Pinpoint Test A, B or C
- Thermostat Visual Inspection

Thermostat Visual Inspection

1. Remove the thermostat.

2. Examine the thermostat for signs of damage including:
   - Valve not fully seated (light visible through the valve)
   - Foreign material lodged in the main valve
   - Bent or broken frame or flange
   - Bent or broken spring
   - Bent or broken valve or valve stem
   - Wax leaking from wax reservoir or a bulge in the reservoir
   - Any other damage or distortion

3. **NOTE:** If no damage is found during the inspection, do not attempt to open the thermostat using hot water or other heat sources. This method is not an accurate means to test the function of the thermostat and may damage the thermostat.

   If damage is found during the inspection, remove any foreign material or broken pieces and install a new thermostat.

4. If no damage is found during the inspection, continue troubleshooting the system concern. Go to the Symptom Chart for further instructions.

Radiator Leak Test, Removed From Vehicle

NOTICE: **Never leak test an aluminum radiator in the same water that copper/brass radiators are tested in. Flux and caustic cleaners may be present in the cleaning tank and they will damage aluminum radiators.**

NOTE: Always install plugs in the oil cooler fittings before leak testing or cleaning any radiator.

NOTE: Clean the radiator before leak testing to avoid contamination of tank.

Leak test the radiator in clean water with air pressurized to the maximum pressure listed in the Specifications.

Cooling System Draining, Filling and Bleeding

Special Tool(s)

 ST2818-A	Airlift Cooling System Tester UVU550000 or equivalent

Material

Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D

Draining

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. ⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

   NOTE: **The coolant must be recovered in a suitable, clean container for reuse. If the coolant is contaminated it must be recycled or disposed of correctly. Using contaminated coolant may result in damage to the engine or cooling system components.**

   NOTICE: **The engine cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

   NOTICE: **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

   NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure**

causes this product to degrade.

NOTICE: **Stop-leak style pellets/products must not be used as an additive in this engine cooling system. The addition of stop-leak style pellets/products may clog or damage the cooling system, resulting in degraded cooling system performance and/or failure.**

NOTE: During normal vehicle operation, Motorcraft Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as thene coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

NOTE: Less than 80% of coolant capacity can be recovered with the engine in the vehicle. Dirty, rusty or contaminated coolant requires replacement.

Release the pressure in the cooling system by slowly turning the pressure relief cap one-half turn counterclockwise. When the pressure is released, remove the pressure relief cap.

3. Place a suitable container below the radiator draincock.
    - Open the draincock and allow to drain.
    - Close the draincock after draining.

Filling and Bleeding with a Vacuum Cooling System Filler - 2.5L and 3.0L Engines

1. *NOTICE:* **The cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

   NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

   NOTICE: **Engine coolant provides boil protection, corrosion protection, freeze protection, and cooling efficiency to the engine and cooling components. In order to obtain these protections, maintain the engine coolant at the correct concentration and fluid level in the degas bottle.**

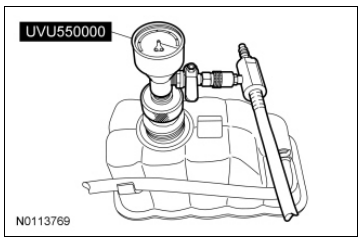
   To maintain the integrity of the coolant and the cooling system:

    - Add Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types.
    - Do not add or mix with any other type of engine coolant. Mixing coolants may degrade the coolant's corrosion protection.
    - Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
    - Ford Motor Company does NOT recommend the use of recycled engine coolant in v originally equipped with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant since a Ford-approved recycling process is not yet available.

   NOTICE: **Stop-leak style pellets/products must not be used as an additive in this engine cooling system. The addition of stop-leak style pellets/products can clog or damage the cooling system resulting in degraded cooling system performance and/or failure.**

Install the vacuum cooling system filler and follow the manufacturer's instructions to fill and bleed the cooling system.

- Recommended coolant concentration is 50/50 engine coolant to distilled water.
- For extremely cold climates (less than -37°C [-34°F]):
  - ♦ It may be necessary to increase the coolant concentration above 50%.
  - ♦ NEVER increase the coolant concentration above 60%.
  - ♦ Maximum coolant concentration is 60/40 for cold weather areas.
  - ♦ A coolant concentration of 60% provides freeze point protection down to -50°C (-58°F).
  - ♦ Engine coolant concentration above 60% decreases the overheat protection characteristics of the engine coolant and may damage the engine.
- For extremely hot climates:
  - ♦ It is still necessary to maintain the coolant concentration above 40%.
  - ♦ NEVER decrease the coolant concentration below 40%.
  - ♦ Minimum coolant concentration is 40/60 for warm weather areas.
  - ♦ A coolant concentration of 40% provides freeze point protection down to -26°C (-15°F).
  - ♦ Engine coolant concentration below 40% decreases the corrosion and freeze protection characteristics of the engine coolant and may damage the engine. l>
- Vehicles driven year-round in non-extreme climates should use a 50/50 mixture of engine coolant and distilled water for optimum cooling system and engine protection.



Filling and Bleeding without a Vacuum Cooling System Filler - 2.5L and 3.0L Engines

NOTICE: **The cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

NOTICE: **Engine coolant provides boil protection, corrosion protection, freeze protection, and cooling efficiency to the engine and cooling components. In order to obtain these protections, maintain the engine coolant at the correct concentration and fluid level in the degas bottle.**

To maintain the integrity ofcoolant and the cooling system:

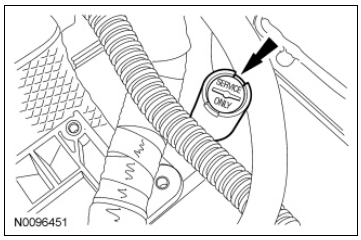
- Add Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types.
- Do not add or mix with any other type of engine coolant. Mixing coolants may degrade the coolant's corrosion protection.

- Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Ford Motor Company does NOT recommend the use of recycled engine coolant in vehicles originally equipped with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant since a Ford-approved recycling process is not yet available.

NOTICE: **Stop-leak style pellets/products must not be used as an additive in this engine cooling system. The addition of stop-leak style pellets/products can clog or damage the cooling system resulting in degraded cooling system performance and/or failure.**

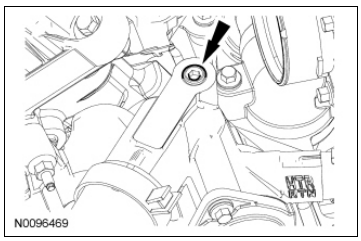
2.5L engine

1. Remove the degas bottle cap and the bleed valve on the back of the engine coolant outlet.



3.0L engine

2. Remove the degas bottle cap and the bleed valve on the top of the coolant pump housing.



2.5L and 3.0L engines

3. **NOTE:** Make sure the coolant flows from the radiator through the upper radiator hose and fills the engine. When full, coolant should flow from the bleed hole.

   Fill the degas bottle to the MAX fill line.

   - Recommended coolant concentration is 50/50 engine coolant to distilled water.
   - For extremely cold climates (less than -37°C [-34°F]):
     - ♦ It may be necessary to increase the coolant concentration above 50%.
     - ♦ NEVER increase the coolant concentration above 60%.
     - ♦ Maximum coolant concentration is 60/40 for cold weather areas.
     - ♦ A coolant concentration of 60% provides freeze point protection down to -50°C (-58°F).
     - ♦ Engine coolant concentration above 60% decreases the overheat protection characteristics of the engine coolant and may damage the engine.
   - For extremely hot climates:
     - ♦ It is still necessary to maintain the coolant concentration above 40%.
     - ♦ NEVER decrease the coolant concentration below 40%.
     - ♦ Minimum coolant concentration is 40/60 for warm weather areas.
     - ♦ A coolant concentration of 40% provides freeze point protection down to -26°C

(-15°F).
- ♦ Engine coolant concentration below 40% decreases the corrosion and freeze protection characteristics of the engine coolant and may damage the engine.

- Vehicles driven year-round in non-extreme climates should use a 50/50 mixture of engine coolant and distilled water for optimum cooling system and engine protection.

- Install the degas bottle cap and the bleed valve leaving both loose.

5. Start the engine and let it idle A mixture of air and coolant should escape from the open bleed valve.

6. After all of the air has escaped from the bleed valve turn off the engine and close the bleed valve and the degas bottle cap.

NOTICE: **If the engine overheats or the fluid level drops below the minimum fill line, shut off the engine and add fluid to the degas bottle maximum fill line once the engine cools. Failure to follow these instructions may result in damage to the engine.**

7. Start the engine and let it idle for 10 minutes (3.0L), 30 minutes (2.5L) or until the engine reaches normal operating temperature.

8. Carry out the following:
    1. Increase the engine speed to 3,000 rpm for 10 seconds.
    2. Idle engine for 50 seconds.
    3. Repeat Steps 1 and 2 a total of 15 times.

9. ⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

    Check the engine coolant level in degas bottle and fill as necessary.

Filling and Bleeding - 3.5L Engine

Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.

NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

NOTICE: **Engine coolant provides boil protection, corrosion protection, freeze protection, and cooling efficiency to the engine and cooling components. In order to obtain these protections, maintain the engine coolant at the correct concentration and fluid level in the degas bottle.**

To maintain the integrity of the coolant and the cooling system:

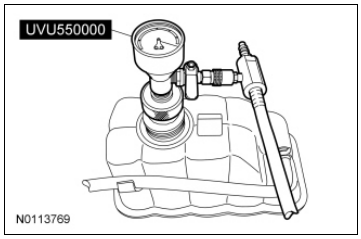
- Add Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types.
- Do not add or mix with any other type of engine coolant. Mixing coolants may degrade the coolant's corrosion protection.

- Do notalcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Ford Motor Company does NOT recommend the use of recycled engine coolant in vehicles originally equipped with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant since a Ford-approved recycling process is not yet available.

NOTICE: **Stop-leak style pellets/products must not be used as an additive in this engine cooling system. The addition of stop-leak style pellets/products can clog or damage the cooling system resulting in degraded cooling system performance and/or failure.**

Install the vacuum cooling system filler and follow the manufacturer's instructions to fill and bleed the cooling system.

- Recommended coolant concentration is 50/50 engine coolant to distilled water.
- For extremely cold climates (less than -37°C [-34°F]):
  - ♦ It may be necessary to increase the coolant concentration above 50%.
  - ♦ NEVER increase the coolant concentration above 60%.
  - ♦ Maximum coolant concentration is 60/40 for cold weather areas.
  - ♦ A coolant concentration of 60% provides freeze point protection down to -50°C (-58°F).
  - ♦ Engine coolant concentration above 60% decreases the overheat protection characteristics of the engine coolant and may damage the engine.
- For extremely hot climates:
  - ♦ It is still necessary to maintain the coolant concentration above 40%.
  - ♦ NEVER decrease the coolant concentration below 40%.
  - ♦ Minimum coolant concentration is 40/60 for warm weather areas.
  - ♦ A coolant concentration of ovides freeze point protection down to -26°C (-15°F).
  - ♦ Engine coolant concentration below 40% decreases the corrosion and freeze protection characteristics of the engine coolant and may damage the engine.
- Vehicles driven year-round in non-extreme climates should use a 50/50 mixture of engine coolant and distilled water for optimum cooling system and engine protection.



2. Fill the degas bottle to 25 mm (0.984 in) above the COLD FILL line.

3. Install the degas bottle cap until at least 1 audible click is heard.

4. Turn the climate control system off.

5. Start the engine and increase the engine speed to 3,500 rpm and hold for 30 seconds.

6. Turn the engine off for and wait for 1 minute to purge any large air pockets from the cooling system.

7. ⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in seris personal injury.**

Check the engine coolant level in degas bottle and if necessary fill to 25 mm (0.984 in) above the top of the COLD FILL LEVEL on the degas bottle if the engine is warm or to the top of the COLD FILL LEVEL if the engine is cold.

8. Start the engine and let it idle until the engine reaches normal operating temperature and the thermostat is fully open. A fully open thermostat is verified by the cooling fan cycling on at least once.

9. Increase the engine speed to 3,500 rpm and hold for 30 seconds.

10. Allow the engine to idle for 30 seconds.

11. Turn the engine off for 1 minute.

12. Repeat steps 9 through 11 a total of 5 times to remove any remaining air trapped in the system.

13. ⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

    Check the engine coolant level in degas bottle and if necessary fill to 25 mm (0.984 in) above the top of the COLD FILL LEVEL on the degas bottle if the engine is warm or to the top of the COLD FILL LEVEL if the engine is cold.

14. Install the degas bottle cap until at least 1 audible click is heard.

Cooling System Flushing

Material

Item	Specification
Motorcraft® Premium Cooling System Flush VC-1	ESR-M14P7-A

NOTE: To remove rust, sludge and other foreign material from the cooling system, use cooling system flush that is safe for use with aluminum radiators. For additional information, refer to Specifications in this section. This cleaning restores cooling system efficiency and helps prevent overheating. A pulsating or reversed direction of flushing water will loosen sediment more quickly than a steady flow in the normal coolant flow direction. In severe cases where cleaning solvents will not clean the cooling system efficiently, it will be necessary to use the pressure flushing method using cooling system flusher. Dispose of old coolant and flushing water contaminated with antifreeze and cleaning chemicals in accordance with local, state or federal laws.

1. Add Premium Cooling System Flush to the cooling system and follow the directions on the package.

2. Remove the radiator. For additional information, refer to Radiator - 2.5L, 3.0L (4V) or Radiator - 3.5L in this section.

3. ***NOTICE:*** **Radiator internal pressure must not exceed 138 kPa (20 psi). Damage to the radiator can result.**

   Backflush the radiator with the radiator in an upside-down position with a high-pressure hose in the lower hose location and backflush.

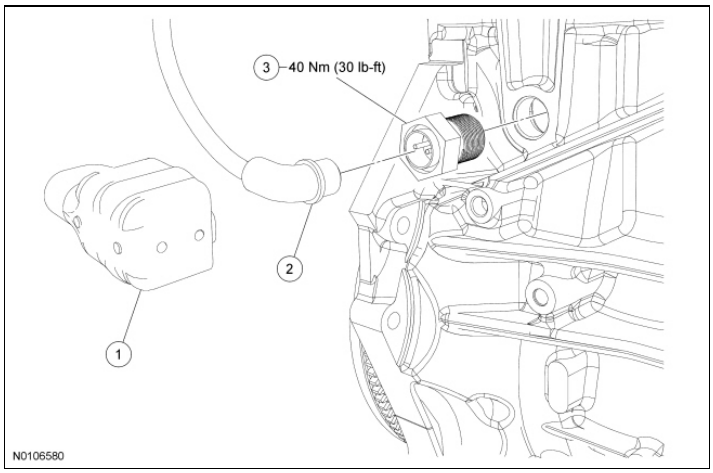
4. **NOTE:** On 2.5L engines, the thermostat and housing are serviced as an assembly.

   Remove the thermostat. For additional information, refer to Thermostat Housing - 2.5L , Thermostat - 3.0L (4V) or Thermostat - 3.5L in this section.

5. Backflush the engine. Position the high-pressure water hose into the engine through the upper radiator hose and backflush the engine.

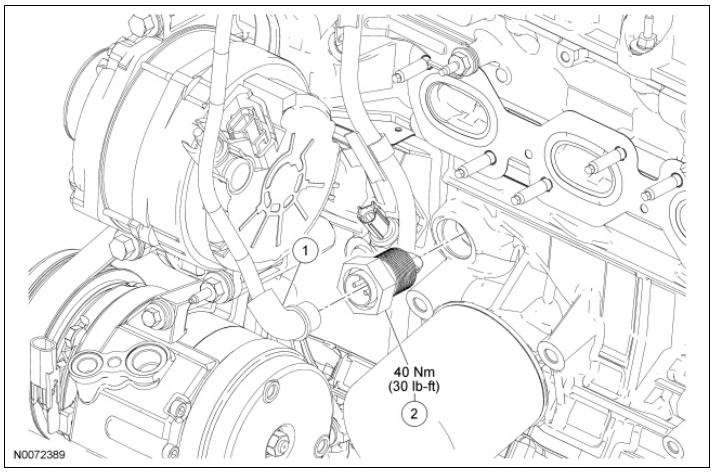
Block Heater

2.5L



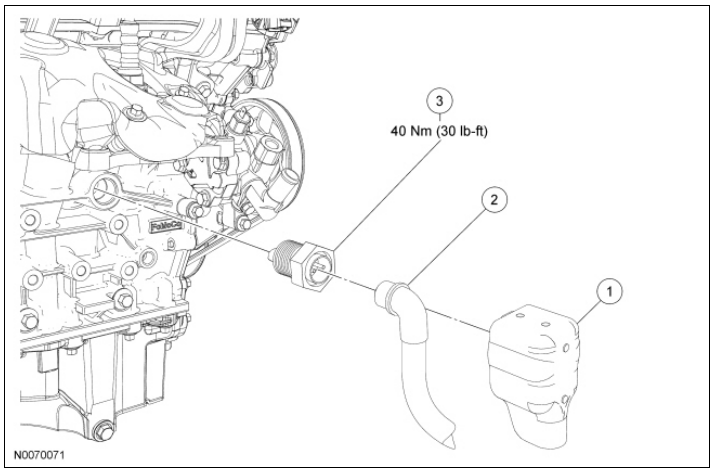
Item	Part Number	Description
1	-	Block heater electrical connector heat shield (part of 6B018)
2	6B018	Block heater electrical connector
3	6A051	Block heater

3.0L



Item	Part Number	Description
1	6B018	Block heater electrical connector
2	6A051	Block heater

3.5L



Item	Part Number	Description
1	030104	Block heater heat shield
2	6B018	Block heater electrical connector
3	6A051	Block heater

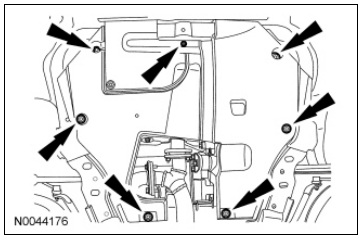
Removal and Installation

All engines

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

3. If equipped, remove the 7 screws and the underbody cover.



2.5L engine

4. Position the block heater heat shield aside.

3.5L engine

5. Remove the RH catalytic converter. For additional information, refer to Section 309-00 .

6. Remove the block heater heat shield.

All engines

7. ***NOTICE:*** **Make sure that the block heater wiring is routed and secured away from rotating or hot components, or damage to the wiring can occur.**

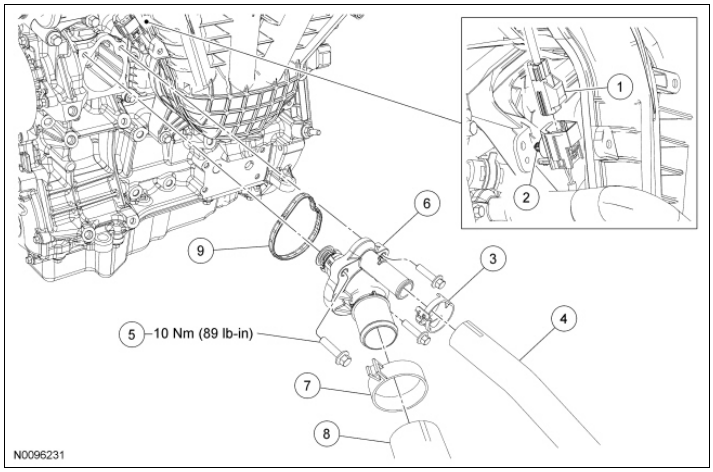
   Disconnect the block heater electrical connector.

8. Remove the block heater.
   - To install, tighten to 40 Nm (30 lb-ft).

9. To install, reverse the removal procedure.

10. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Thermostat Housing - 2.5L



Item	Part Number	Description
1	14A464	Knock Sensor (KS) electrical connector (part of 12C508)
2	14A624	KS electrical connector pin-type retainer (part of 12C508)
3	W527362	Heater hose clamp
4	18C266	Heater hose
5	W500015	Thermostat housing bolt (3 required)
6	8575	Thermostat housing
7	W527372	Lower radiator hose clamp
8	8B273	Lower radiator hose
9	8K530	Gasket

Removal and Installation

NOTE: The thermostat and thermostat housing are serviced as an assembly.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

3. Disconnect the Knock Sensor (KS) electrical connector and detach the wiring harness pin-type retainer.

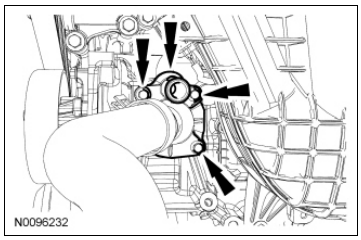
4. **NOTE:** Disconnecting the heater hose first will aid in the removal of the bottom thermostat housing bolt.

   Disconnect the heater hose at the thermostat housing.

5. **NOTE:** The view of the thermostat housing bolts is obstructed by A/C and engine components. However, the bolts can be removed using 1/4-in drive hand tools.

   Remove the 3 bolts and reposition the thermostat housing to gain access to the lower radiator hose clamp.

   - Remove and discard the gasket.
   - To install, tighten to 10 Nm (89 lb-in).



6. Disconnect the lower radiator hose at the thermostat housing.

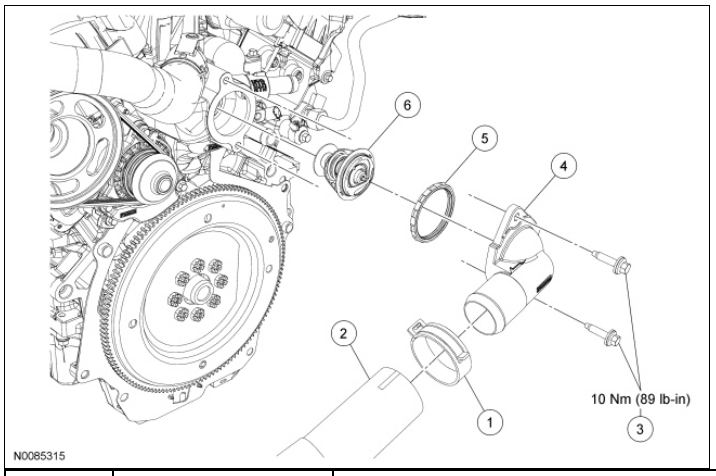
7. To install, reverse the removal procedure.
   - Install a new gasket.

8. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Thermostat - 3.0L (4V)

Material

Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	W527375	Radiator hose clamp
2	8B273	Lower radiator hose
3	W500015	Thermostat housing cover bolts (2 required)
4	8K528	Thermostat housing cover
5	N806807	O-ring seal
6	8575	Thermostat

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
3. Disconnect the positive battery cable. For additional information, refer to Section 414-01 .
4. Disconnect the lower radiator hose from the thermostat housing.

5. Remove the 2 bolts, thermostat housing cover, O-ring seal and thermostat.
    - To install, tighten to 10 Nm (89 lb-in).

6. ***NOTICE:*** **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

   NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

   To install, reverse the removal procedure.

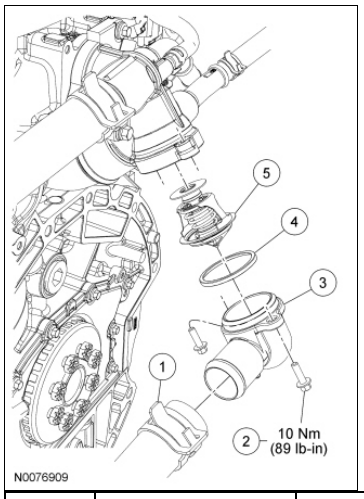
    - Clean and inspect the O-ring seal. Install a new seal if necessary.
    - Lubricate the thermostatring seal with clean engine coolant.

7. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Thermostat - 3.5L

Material

Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	8B273	Lower radiator-to-thermostat housing cover hose
2	W500014	Thermostat housing cover bolt (2 required)
3	8594	Thermostat housing cover
4	-	O-ring seal
5	8575	Thermostat

Removal and Installation

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Removr cleaner and outlet pipe. For additional information, refer to Section 303-12C .

3. Disconnect the lower radiator hose from the thermostat housing cover and position it aside.

4. Remove the 2 bolts, thermostat housing cover, O-ring seal and thermostat.
   - Clean and inspect the O-ring seal. Install a new seal if necessary.
   - To install, tighten to 10 Nm (89 lb-in).

5. ***NOTICE:*** **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

   NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

   To install, reverse the removal procedure.

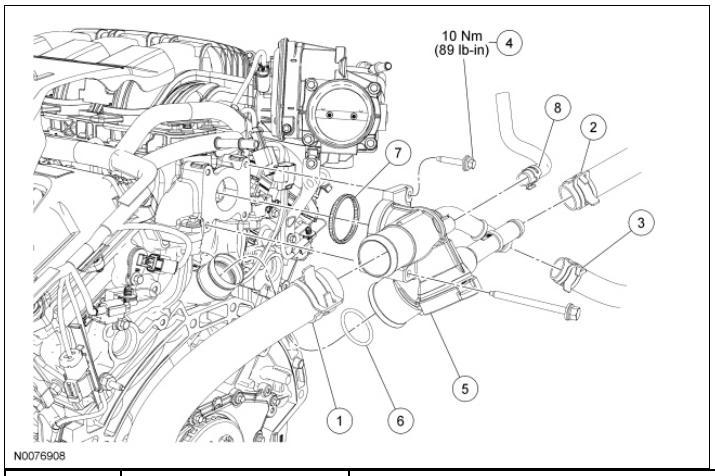
   - Lubricate the thermostat O-ring seal with clean engine coolant.

6. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in thisction.

Thermostat Housing - 3.5L

Material

Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	8B274	Upper radiator-to-thermostat housing hose
2	18C266	Heater outlet hose
3	18C266	Heater inlet hose
4	W503279	Thermostat housing bolt (2 required)
5	8A586	Thermostat housing
6	8565	O-ring seal
7	8A571	O-ring seal
8	8B541	Thermostat housing-to-degas bottle hose

Removal and Installation

1. Remove the thermostat. For additional information, refer to Thermostat - 3.5L in this section.

2. Disconnect the 4 coolant hoses from the thermostat housing and position them aside.

3. Remove the 2 thermostat housing bolts.
   - To install, tighten to 10 Nm (89 lb-in).

4. **NOTE:** Do not pull the other end of the coolant tube out of the engine block when separating the thermostat housing.

   Separate the thermostat housing from the coolant tube and remove the thermostat housing.

   - Remove and discard the O-ring seals.

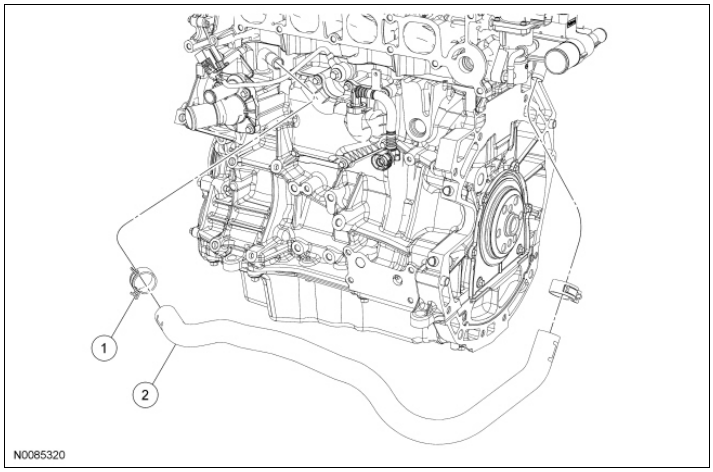
5. ***NOTICE:*** **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

   NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

   To install, reverse the removal procedure.

   - Lubricate the new O-ring seals with clean engine coolant.

Bypass Tube - 2.5L



Item	Part Number	Description
1	W525958	Hose clamp (2 required)
2	8548	Bypass tube

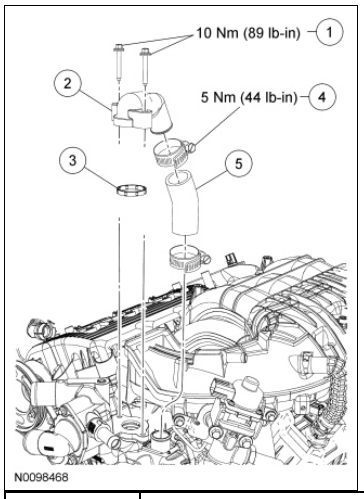
Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
3. Remove the intake manifold. For additional information, refer to Section 303-01A .
4. Disconnect and remove the coolant bypass tube from the engine.
5. To install, reverse the removal procedure.
6. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Coolant Inlet Pipe - 3.0L (4V)

Material

Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	W503281	Coolant inlet pipe bolts
2	8594	Coolant inlet pipe
3	8255	O-ring seal
4	W527485	Coolant inlet pipe clamp (2 required)
5	8B573	Coolant inlet pipe hose

Removal and Installation

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remo Throttle Body (TB). For additional information, refer to Section 303-04B .

3. Remove the 2 coolant inlet pipe housing bolts.
   - To install, tighten to 10 Nm (89 lb-in).

4. Loosen the clamp and disconnect the coolant inlet pipe from the coolant inlet pipe hose.
   - To install, tighten to 5 Nm (44 lb-in).

5. Remove and inspect the O-ring seal, install a new seal if necessary.

6. ***NOTICE:*** **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

   NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

   To install, reverse the removal procedure.

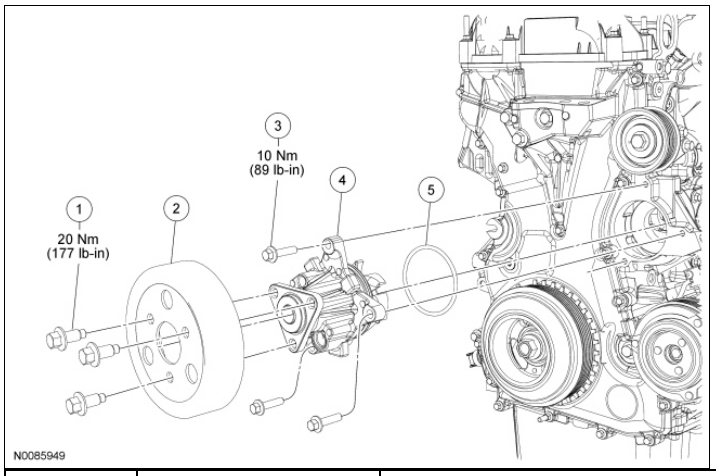
   - Lubricate the O-ring seal with clean engine coolant.

7. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filg and Bleeding in this section.

Coolant Pump - 2.5L

Material

Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D



Item	Part Number	Description
1	W500221	Coolant pump pulley bolt (3 required)
2	8509	Coolant pump pulley
3	W500015	Coolant pump bolt (3 required)
4	8501	Coolant pump
5	8507	Coolant pump O-ring seal

Removal and Installation

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Loosen the 3nt pump pulley bolts.
   - To install, tighten to 20 Nm (177 lb-in).

3. Remove the accessory drive belt. For additional information, refer to Section 303-05A .

4. Remove the 3 bolts and the coolant pump pulley.

5. ***NOTICE:*** **Make sure the coolant pump is correctly seated to the engine block before installing and tightening the fasteners, or damage to the coolant pump may occur.**

   Remove the 3 bolts and the coolant pump.

   - Remove and discard the O-ring seal.
   - To install, tighten to 10 Nm (89 lb-in).

6. ***NOTICE:*** **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

   NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

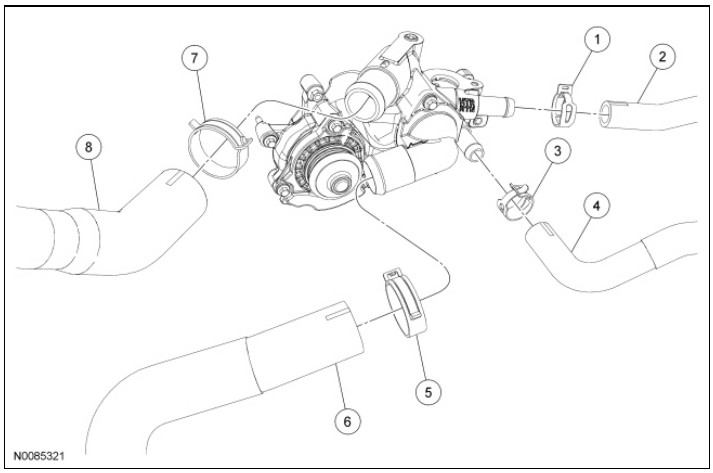
   To install, reverse the removal procedure.

   - Lubricate the new O-ring seal with clean engine coolant.

7. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

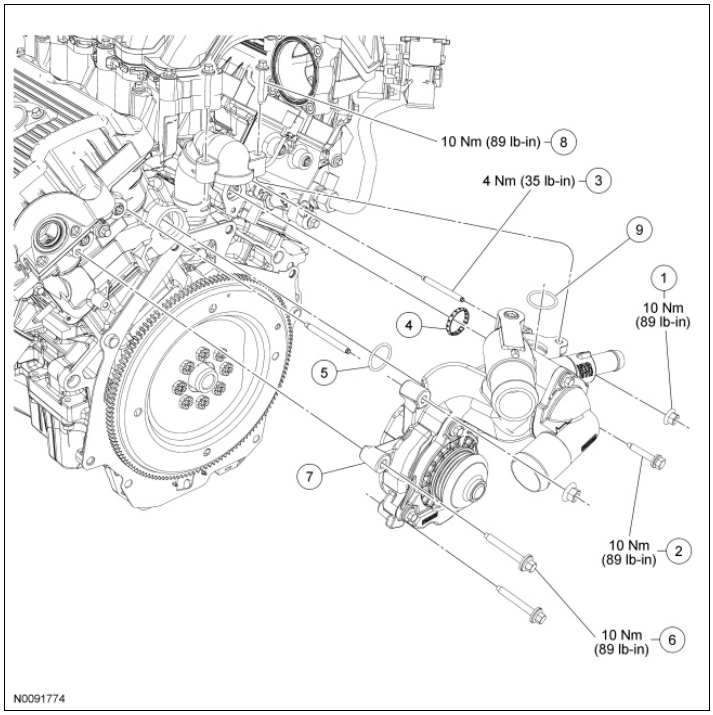
Coolant Pump Housing - 3.0L (4V)

Coolant Hoses



Item	Part Number	Description
1	W532958	Heater hose clamp
2	18K580	Heater outlet hose
3	W532958	Heater hose clamp
4	18K579	Heater inlet hose
5	W525871	Lower radiator hose clamp
6	8B273	Lower radiator hose
7	W525872	Upper radiator hose clamp
8	8B274	Upper radiator hose

Coolant Pump Housing



Item	Part Number	Description
1	W705764	Coolant pump housing nut (2 required)
2	W707643	Coolant pump housing bolt
3	W713511	Coolant pump housing stud (2 required)
4	8C387	Gasket
5	8565	O-ring seal
6	W503281	Coolant pump housing bolt (2 required)
7	8B858	Coolant pump housing
8	W503281	Coolant inlet pipe bolt (2 required)
9	8255	O-ring seal

Removal and Installation

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the Throttle Body (TB). For additional information, refer to Section 303-04B .

3. Remove the coolant pump belt. For additional information, refer to Section 303-05B .

4. Disconnect the upper radiator hose from the coolant pump housing.

5. Disconnect the lower radiator hose from the thermostat housing.

6. Disconnect both heater hoses from the coolant pump housing.

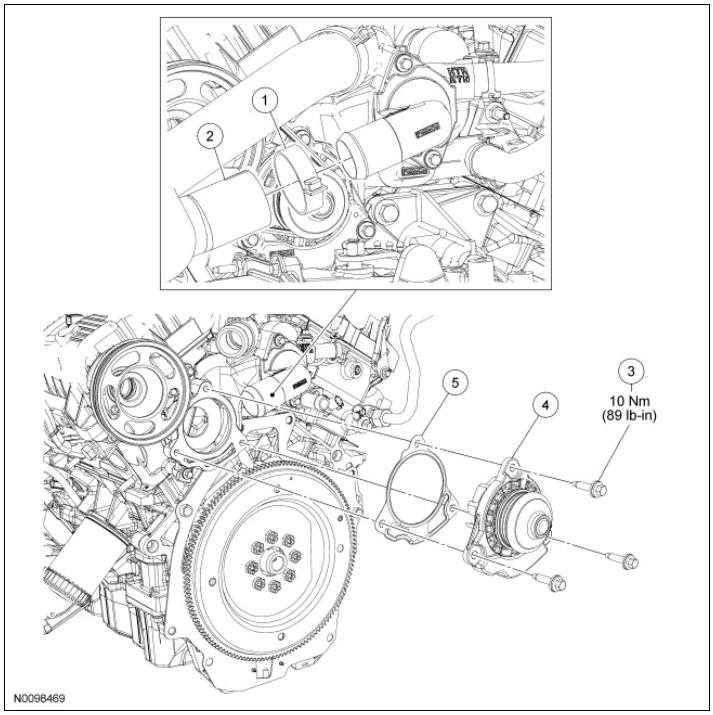
7. Remove the 2 coolant inlet pipe bolts.
   - To install, tighten to 10 Nm (89 lb-in).

8. Remove the 3 bolts, 2 nuts and the coolant pump housing.
   - Remove and discard the O-ring seals and gasket.
   - To install, tighten to 10 Nm (89 lb-in).

9. To install, reverse the removal procedure.
    - Install new O-ring seals and gasket.

10. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Coolant Pump - 3.0L (4V)



Item	Part Number	Description
1	W527376	Lower radiator hose clamp
2	8B273	Lower radiator hose
3	W503276	Coolant pump assembly bolt (3 required)
4	8501	Coolant pump assembly
5	8507	Gasket

Removal and Installation

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12B .

3. Disconnect the lower radiator hfrom the thermostat housing.

4. Remove the coolant pump belt. For additional information, refer to Section 303-05B .

5. Remove the 3 bolts and the coolant pump.
   - Remove and discard the gasket.
   - To install, tighten to 10 Nm (89 lb-in).

6. To install, reverse the removal procedure.
   - Install a new gasket.

7. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Coolant Pump - 3.5L

Special Tool(s)

 ST2979-A	Camshaft Holding Tool 303-1248

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

NOTICE: **During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.**

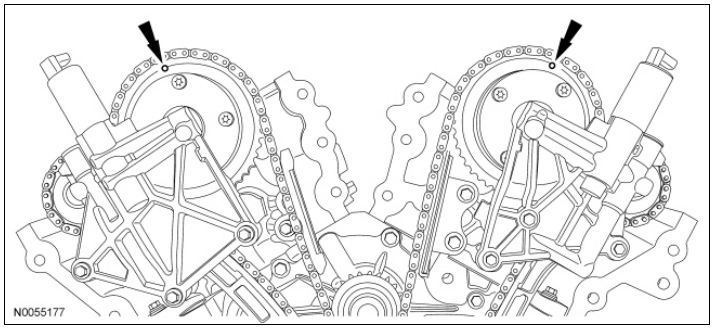
NOTE: On early build engines, the timing chain rides on the inner side of the RH timing chain guide. Late build engines are equipped with a different design RH timing chain guide that requires the timing chain to ride on the outer side of the RH timing chain guide. For service, all replacement RH timing chain guides will be the late build design.

All vehicles

1. Remove the engine front cover. For additional information, refer to Section 303-01C .
2. Remove and discard the engine oil filter.

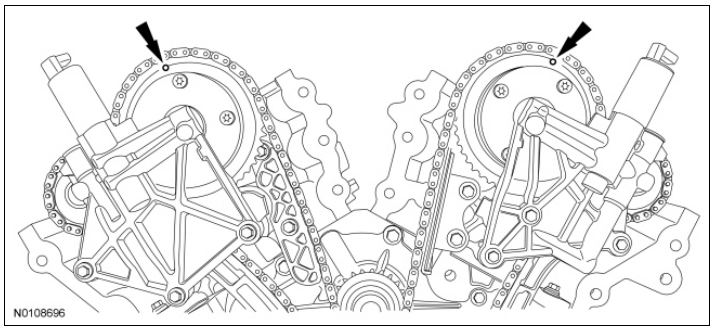
Engines equipped with early build RH timing chain guides

3. Rotate the crankshaft clockwise and align the timing marks on the Variable Camshaft Timing (VCT) assemblies as shown.



Engines equipped with late build/replacement RH timing chain guides

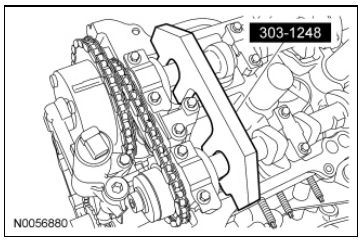
4. Rotate the crankshaft clockwise and align the timing marks on the VCT assemblies as shown.



All vehicles

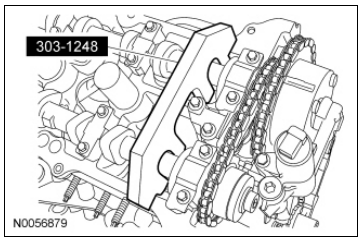
5. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

   Install the Camshaft Holding Tool onto the flats of the LH camshafts.

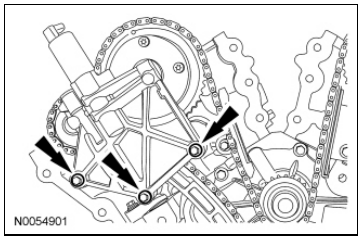


6. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC .

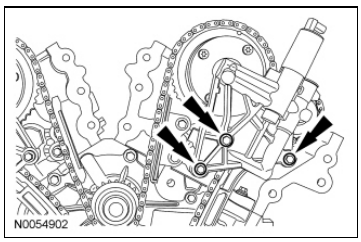
   Install the Camshaft Holding Tool onto the flats of the RH camshafts.



7. Remove the 3 bolts and the RH VCT housing.

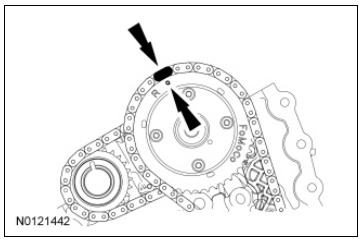


8. Remove the 3 bolts and the LH VCT housing.

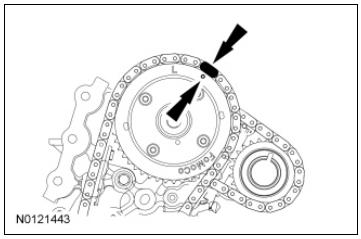


NOTE: The following 3 steps are for primary timing chains when the colored links are not visible.

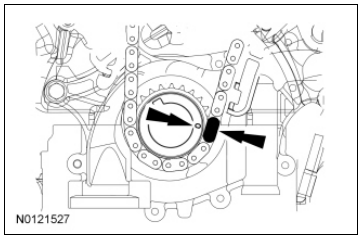
9. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.



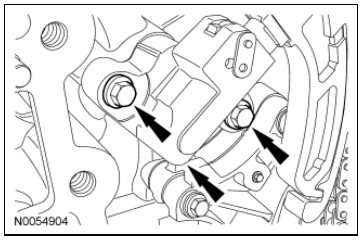
10. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.



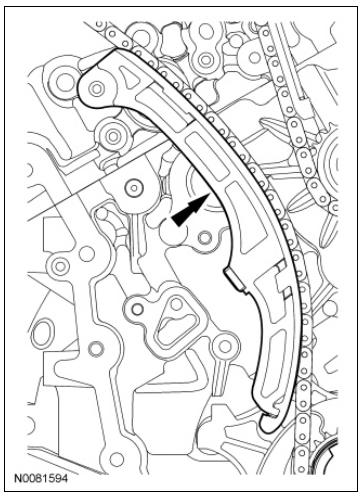
11. Mark the timing chain link that aligns with the timing mark on the crankshaft sprocket as shown.



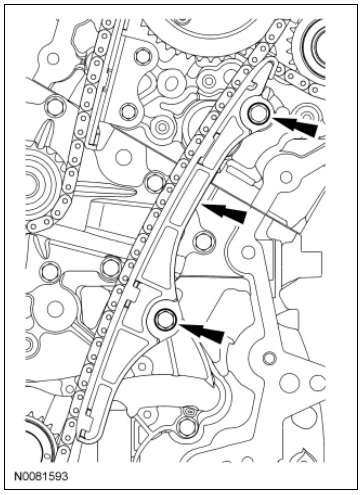
12. Remove the 2 bolts and the primary timing chain tensioner.



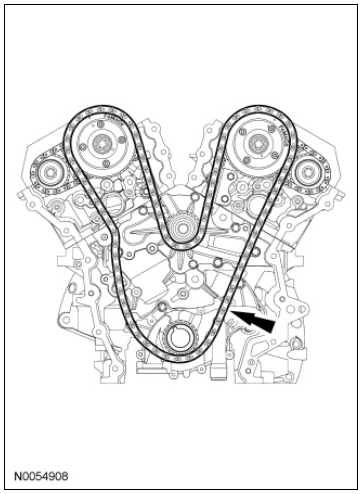
13. Remove the primary timing chain tensioner arm.



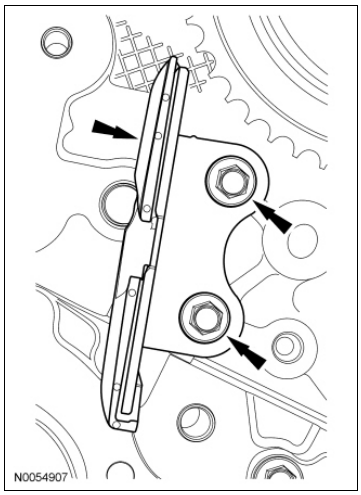
14. Remove the 2 bolts and the lower LH primary timing chain guide.



15. Remove the primary timing chain.

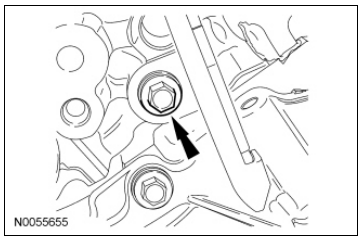


16. Remove the 2 bolts and the upper LH primary timing chain guide.



Engines equipped with early build RH timing chain guides

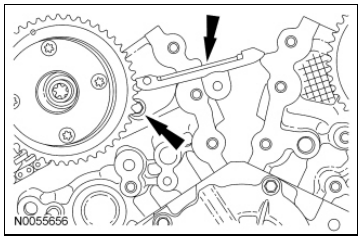
17. Remove the RH primary timing chain guide lower bolt.



18. **NOTE:** The RH primary timing chain guide must be repositioned to allow the coolant pump to be removed.

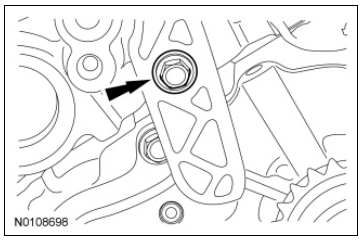
    Loosen the RH primary timing chain guide upper bolt.

    - Rotate the guide and tighten the bolt.



Engines equipped with late build/replacement RH timing chain guides

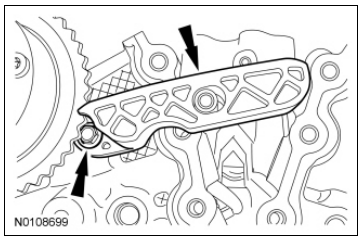
19. Remove the RH primary timing chain guide lower bolt.



20. **NOTE:** The RH primary timing chain guide must be repositioned to allow the coolant pump to be removed.

    Loosen the RH primary timing chain guide upper bolt.

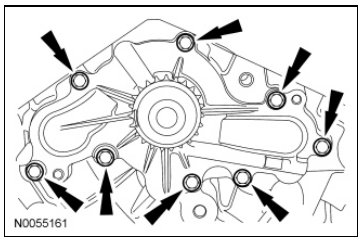
    - Rotate the guide and tighten the bolt.



All vehicles

21. Place clean, lint-free shop towels in the oil pan opening to prevent coolant from entering the oil pan during coolant pump removal.

22. Remove the 8 bolts and the coolant pump.



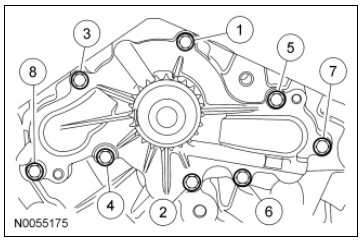
Installation

All vehicles

1. **NOTE:** Clean and inspect all sealing surfaces.

Install the coolant pump and the 8 bolts. Tighten in the sequence shown in 2 stages:

- Stage 1: Tighten to 10 Nm (89 lb-in).
- Stage 2: Tighten an additional 45 degrees.



2. Remove all of the shop towels from the oil pan opening.

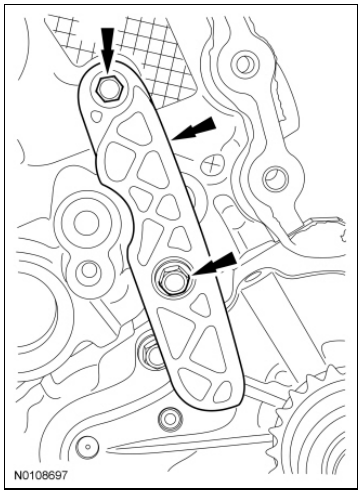
3. ***NOTICE:*** **Any coolant that has accumulated in the oil pan must be drained from the pan and any residual coolant cleaned from the front of the engine and oil pan. Failure to remove all traces of the coolant can result in oil contamination and severe engine damage.**

   Remove the oil pan drain plug and allow any accumulated coolant to drain.

   - Remove any residual coolant from the front of the engine and the oil pan using regulated, compressed air and clean, lint-free shop towels.
   - Install the oil pan drain plug and tighten to 27 Nm (20 lb-ft).

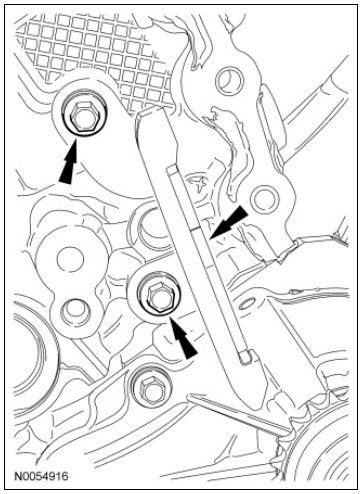
Engines equipped with late build/replacement RH timing chain guides

4. Loosen the RH primary timing chain guide upper bolt.
   - Position the RH primary timing chain guide and install the lower bolt.
   - Tighten the 2 bolts to 10 Nm (89 lb-in).



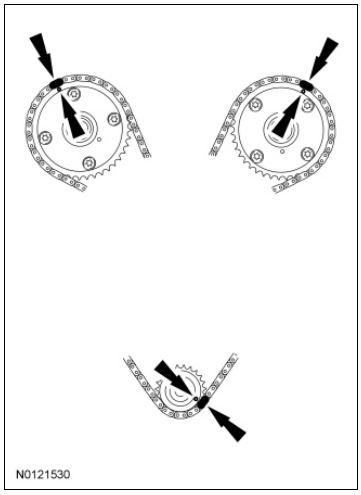
Engines equipped with early build RH timing chain guides

5. Loosen the RH primary timing chain guide upper bolt.
   - Position the RH primary timing chain guide and install the lower bolt.
   - Tighten the 2 bolts to 10 Nm (89 lb-in).

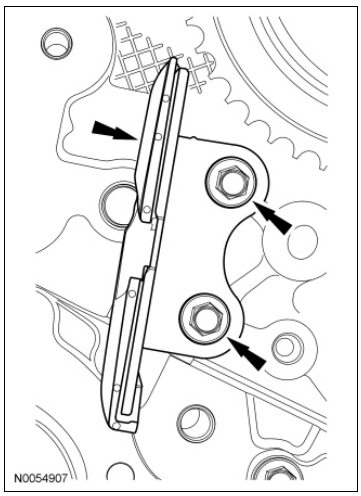


All vehicles

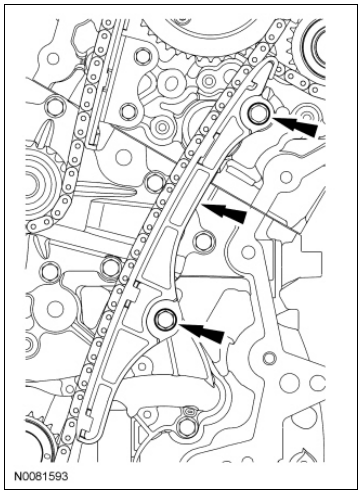
6. Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.



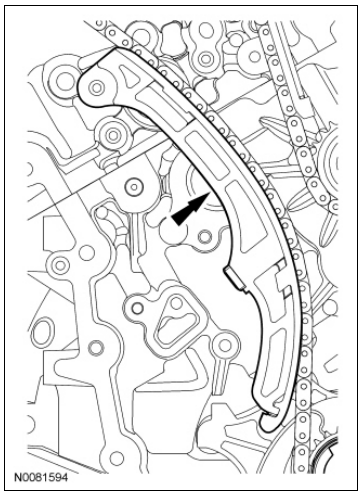
7. Install the upper LH primary timing chain guide and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).



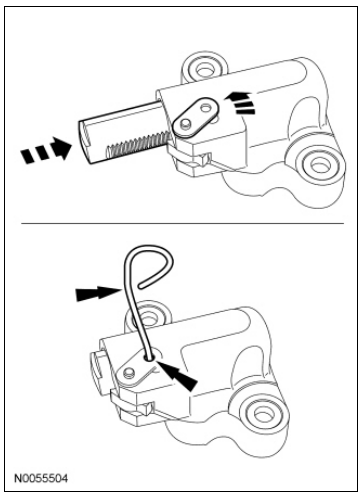
8. Install the lower LH primary timing chain guide and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).



9. Install the primary timing chain tensioner arm.



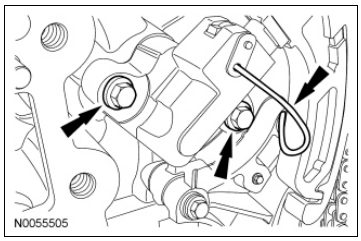
10. Reset the primary timing chain tensioner.
    - Rotate the lever counterclockwise.
    - Using a soft-jawed vise, compress the plunger.
    - Align the hole in the lever with the hole in the tensioner housing.
    - Install a suitable lock pin.



11. **NOTE:** It may be necessary to rotate the crankshaft slightly to remove slack from the timing chain and install the tensioner.

Install the primary tensioner and the 2 bolts.

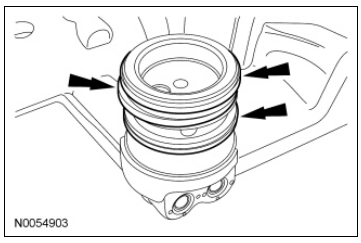
- Tighten to 10 Nm (89 lb-in).
- Remove the lock pin.



12. As a post-check, verify correct alignment of all timing marks.
    - There are 38 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
    - There are 27 links in between LH intake VCT assembly colored link (2) and the crankshaft sprocket link (3).



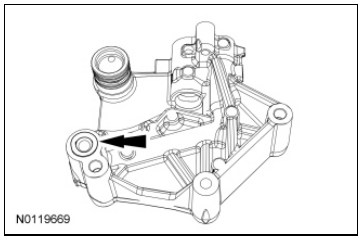
13. Inspect the VCT housing seals for damage and replace as necessary.



14. **NOTE:** RH shown, LH similar.

    NOTE: During removal, the O-ring seal may remain on the cylinder head. If so, remove the O-ring seal from the cylinder head, inspect the seal (replace as necessary) and install the O-ring seal on the VCT housing.

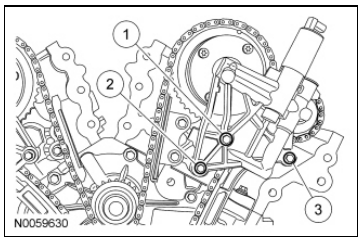
    Inspect the VCT housing-to-cylinder head O-ring seals for damage and replace as necessary.



15. ***NOTICE:*** **Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.**

    Install the LH VCT housing and the 3 bolts.

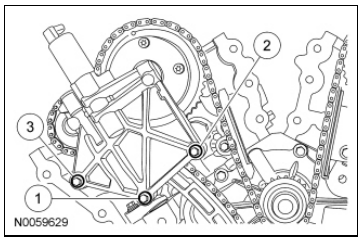
    - Tighten in the sequence shown to 10 Nm (89 lb-in).



16. ***NOTICE:*** **Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.**

    Install the RH VCT housing and the 3 bolts.

    - Tighten in the sequence shown to 10 Nm (89 lb-in).



17. **NOTE:** Lubricate the engine oil filter gasket with clean engine oil prior to installing the oil filter.

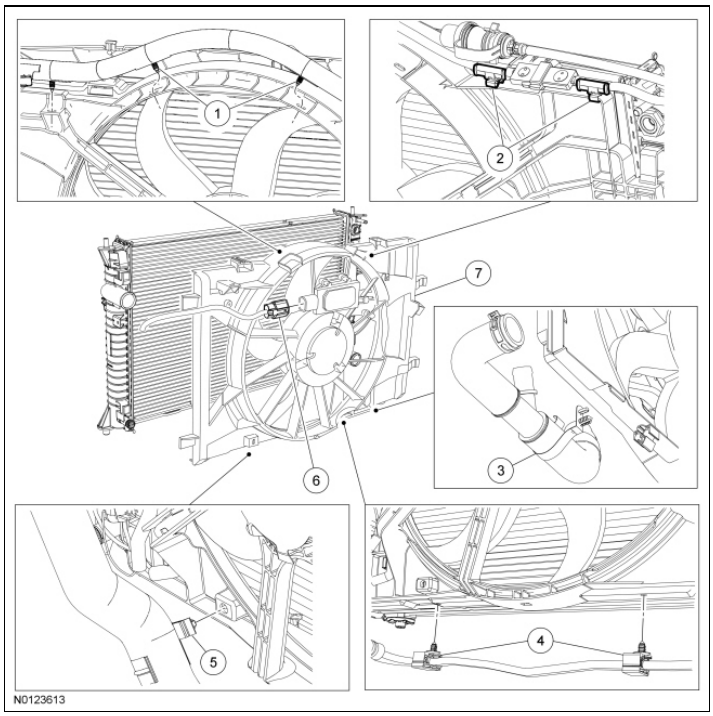
    Install a new engine oil filter.

    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

18. Install the engine front cover. For additional information, refer to Section 303-01C .

Cooling Fan Motor and Shroud - 2.5L, 3.0L (4V)

2.5L and 3.0L Engines

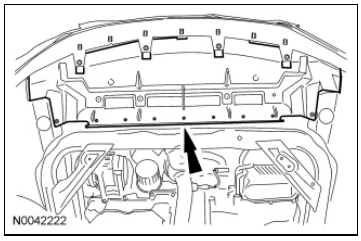


Item	Part Number	Description
1	13A506	Wiring harness retainers
2	14A163	Block heater retainers (part of 6B018)
3	-	RH lower radiator hose pin-type retainer (part of 8B273)
4	256844	Transmission fluid cooler tube retaining clips (automatic transmission only) (part of 7R081)
5	-	LH lower radiator hose pin-type retainer (3.0L only)
6	14A464	Cooling fan motor electrical connector
7	8C607	Cooling fan motor and shroud

1. Detach all the wiring harness retainers from the cooling fan and shroud.

2. If equipped, detach the 2 block heater wiring retainers from the cooling fan motor and shroud.

3. Remove the splash shield.



4. Detach the RH lower radiator hose pin-type retainer from the cooling fan motor and shroud.

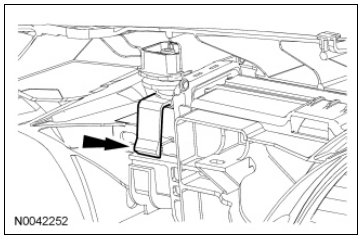
5. If equipped, detach the 2 transmission cooler tube retainers from the cooling fan motor and shroud.

6. If equipped, detach the LH lower radiator hose pin-type retainer from the cooling fan motor and shroud.

7. Disconnect the cooling fan electrical connector.
    - Detach the pin-type retainer.

8. **NOTE:** LH shown, RH similar.

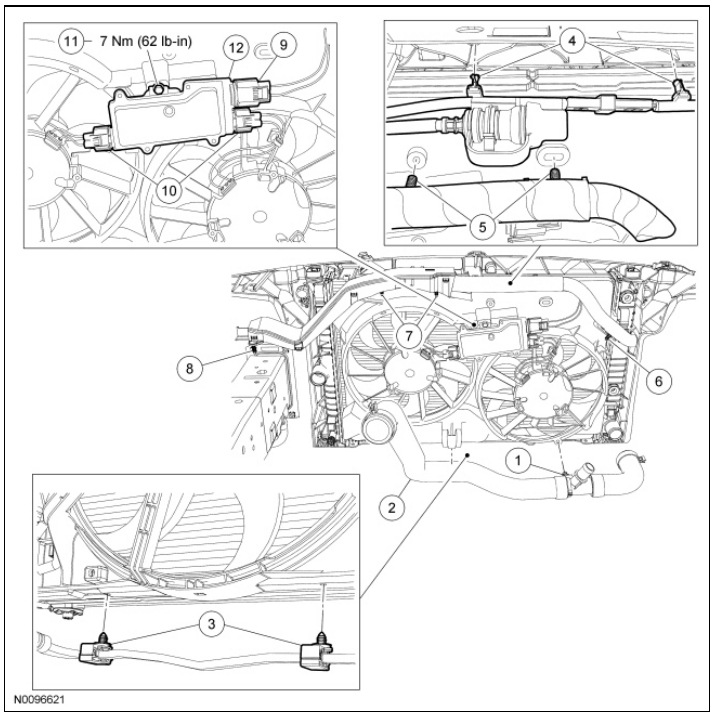
   Release the 2 tabs and remove the cooling fan motor and shroud.



9. To install, reverse the removal procedure.

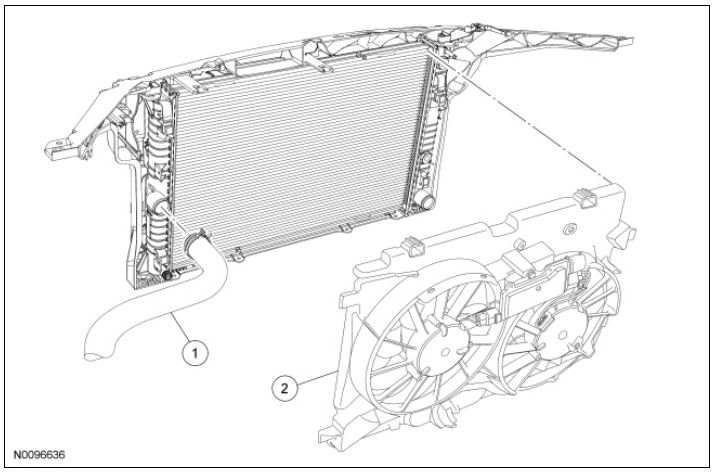
Cooling Fan Motor and Shroud - 3.5L

Cooling Fan Motor and Shroud (View 1 of 2)



Item	Part Number	Description
1	-	RH lower radiator hose pin-type retainer (part of 8B273)
2	8B273	Lower radiator hose
3	256844	Transmission fluid cooler tube retaining clips (part of 7R081)
4	13A506	Block heater retainers (part of 6B018)
5	14A099	Wire harness retainers (part of 14290)
6	14A099	Wire harness retainer (part of 14290)
7	14A099	Wire harness shield retainers (part of 14290)
8	14A099	Wire harness shield retainer (part of 14290)
9	14A464	Cooling fan module electrical connector (part of 14290)
10	-	Cooling fan module electrical connectors (part of 8C607)
11	-	Cooling fan module bolt
12	-	Cooling fan module

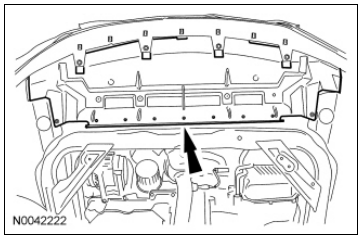
Cooling Fan Motor and Shroud (View 2 of 2)



Item	Part Number	Description
1	8B274	Upper radiator hose
2	8C607	Cooling fan motor and shroud

Removal and Installation

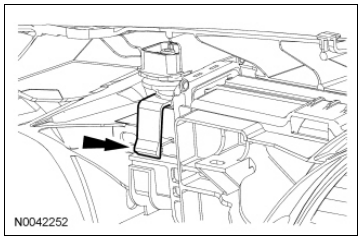
1. With vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the splash shield.



3. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
4. Detach the lower radiator hose pin-type retainer from the RH side of the cooling fan motor and shroud.
5. Detach the lower radiator hose from the LH side of the cooling fan motor and shroud.
6. Detach the transmission cooler tube retaining clips from the cooling fan motor and shroud.
7. Remove the Air Cleaner (ACL) and inlet air resonator. For additional information, refer to Section 303-12C .
8. If equipped, detach the 2 block heater wiring retainers from the cooling fan motor and shroud.
9. Disconnect the 3 cooling fan module electrical connectors.
10. Remove the bolt and the cooling fan module.
    - To install, tighten to 7 Nm (62 lb-in).

11. Detach the 5 pin-type retainers from the cooling fan and shroud.
12. Detach the wiring harness pin-type retainer from the frame rail.
13. Disconnect the upper radiator hose from the radiator.
14. **NOTE:** LH shown, RH similar.

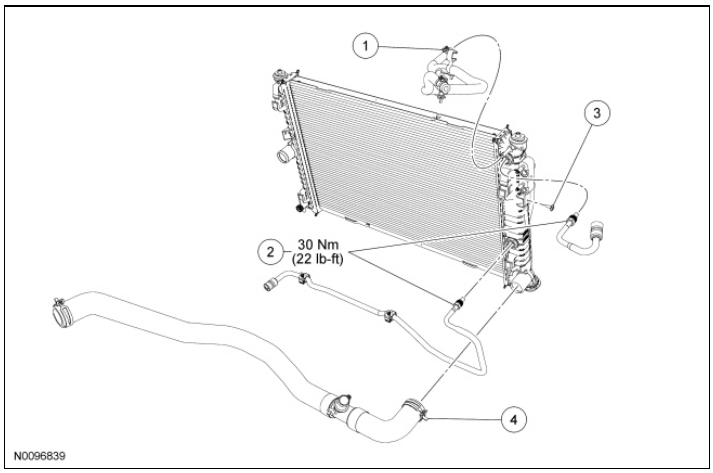
    Release the 2 tabs and remove the cooling fan motor and shroud.



15. To install, reverse the removal procedure.
16. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

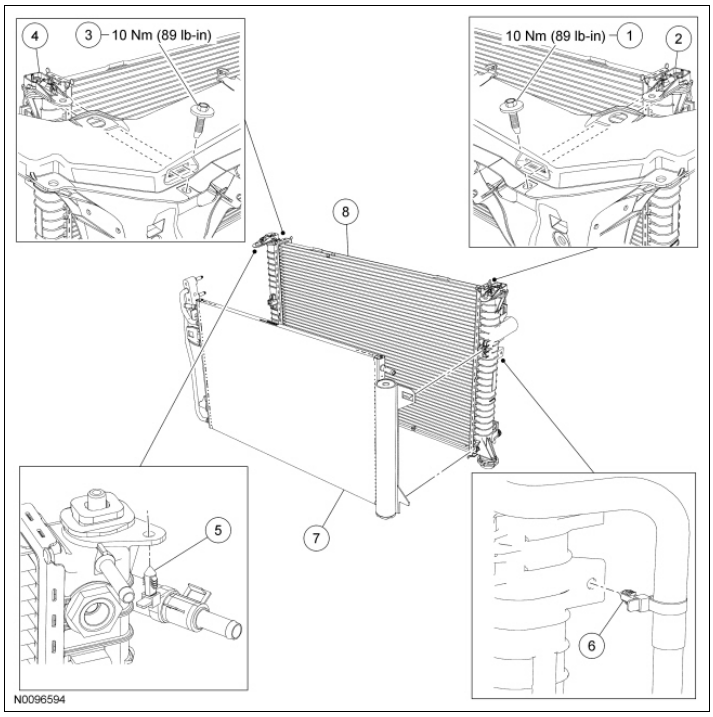
Radiator - 3.5L

Radiator (View 1 of 2)



Item	Part Number	Description
1	8276	Radiator-to-degas bottle hose
2	7H420	Transmission cooler tubes (2 required)
3	19710	A/C condenser-to-radiator pin-type retainer
4	8B273	Lower radiator hose

Radiator (View 2 of 2)

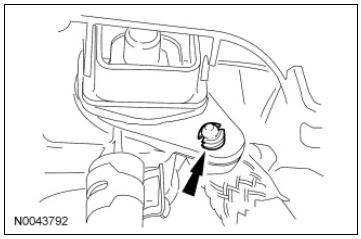


Item	Part Number	Description
1	W500214	LH upper radiator support bracket bolt
2	8A194	LH upper radiator support bracket
3	W500214	RH upper radiator support bracket bolt
4	8A194	RH upper radiator support bracket
5	-	Power steering hose retainer
6	3493	Coolant hose retainer
7	19710	A/C condenser
8	8005	Radiator

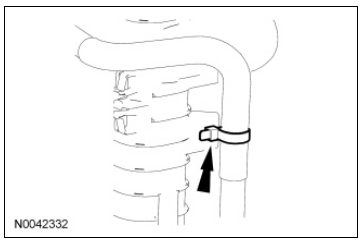
1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the cooling fan motor and shroud. For additional information, refer to Cooling Fan Motor and Shroud - 3.5L in this section.

3. Detach the power steering hose retainer from the radiator.



4. Detach the coolant hose retainer from the radiator.

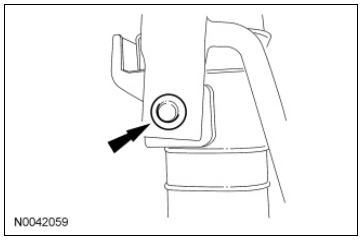


-34. Disconnect the 2 transmission cooling tubes from the radiator.
- To install, tighten to 30 Nm (22 lb-ft).

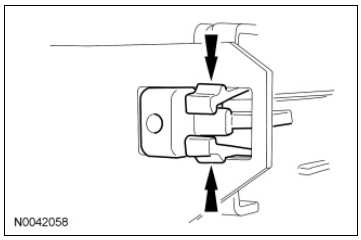
7. Disconnect the lower radiator hose from the radiator.

8. Remove the 2 bolts from the upper radiator support brackets and position the radiator towards the engine and remove the 2 upper radiator support brackets from the radiator.
- To install, tighten to 10 Nm (89 lb-in).

9. Remove the A/C condensor-to-radiator pin-type retainer.



10. Squeeze the tabs and separate the A/C condenser from the radiator.
    - Remove the radiator.

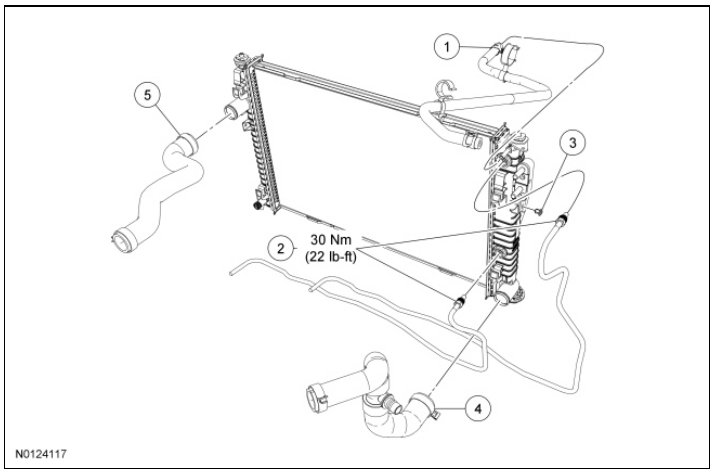


11. To install, reverse the removal procedure.

12. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

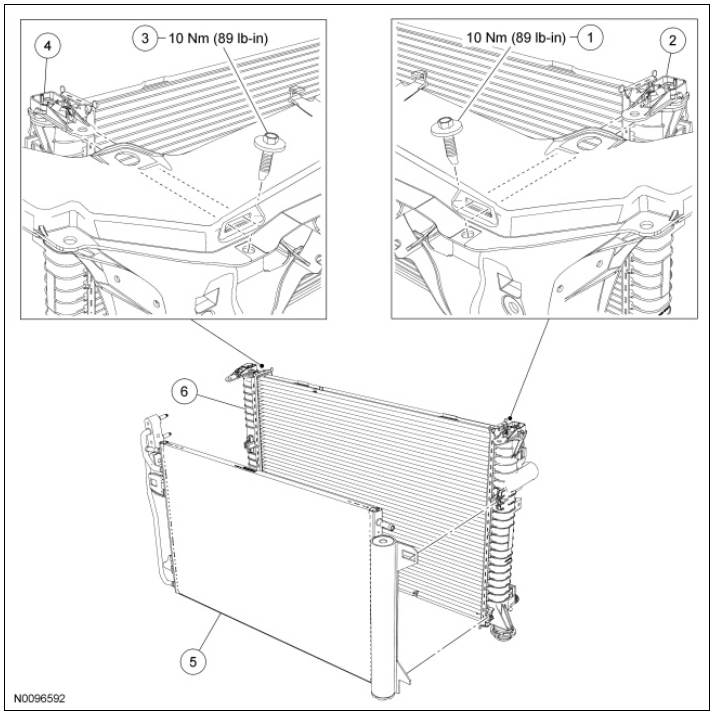
Radiator - 2.5L, 3.0L (4V)

Radiator (View 1 of 2)



Item	Part Number	Description
1	8276	Radiator-to-degas bottle hose
2	7H420	Transmission cooler tubes (automatic transmissions) (2 required)
3	19710	A/C condenser-to-radiator pin-type retainer
4	8286	Lower radiator hose
5	8260	Upper radiator hose

Radiator (View 2 of 2)



Item	Part Number	Description
1	W500214	LH upper radiator support bracket bolt
2	8A194	LH upper radiator support bracket
3	W500214	RH upper radiator support bracket bolt
4	8A194	RH upper radiatorport bracket
5	19710	A/C condenser
6	8005	Radiator

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the cooling fan motor and shroud. For additional information, refer to Cooling Fan Motor and Shroud - 2.5L, 3.0L (4V) in this section.

3. Disconnect the upper radiator hose from the radiator.

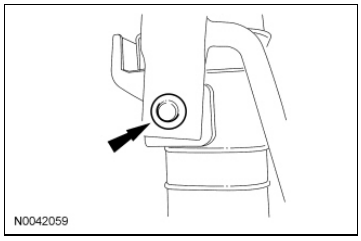
4. Disconnect the radiator-to-degas bottle hose from the radiator.

5. If equipped, disconnect the 2 transmission cooling tubes from the radiator.
   - To install, tighten to 30 Nm (22 lb-ft).

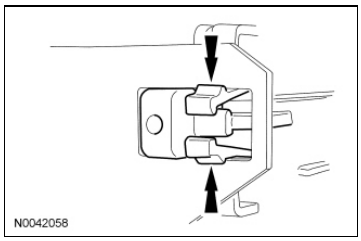
6. Disconnect the lower radiator hose from the radiator.

7. Remove the 2 bolts from the upper radiator support brackets, position the radiator towards the engine and remove the 2 upper radiator support brackets from the radiator.
   - To install, tighten to 10 Nm (89 lb-in).

8. Remove the A/C condensor-to-radiator pin-type retainer.



9. Squeeze the tabs and separate the A/C condenser from the radiator.
    - Remove the radiator.

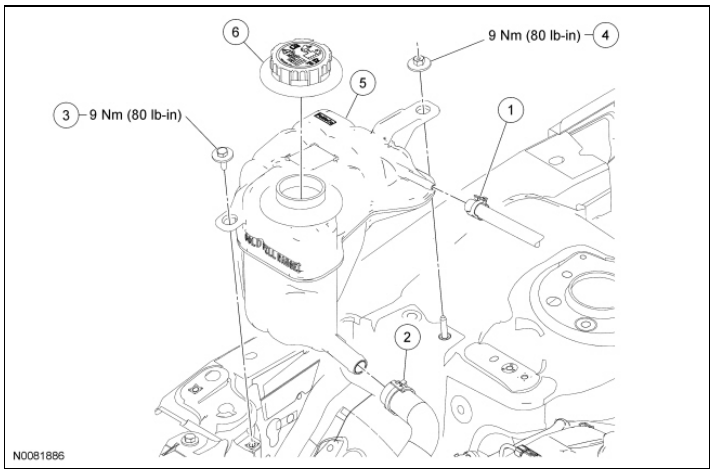


10. To install, reverse the removal procedure.

11. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

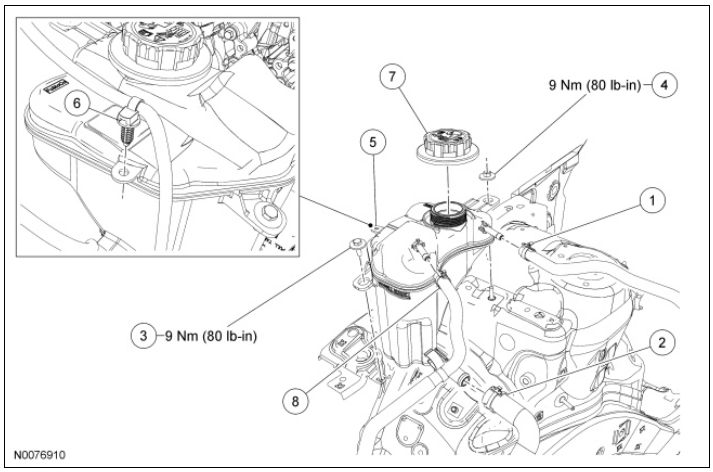
Degas Bottle

2.5L and 3.0L Engines



Item	Part Number	Description
1	8276	Degas bottle-to-radiator hose
2	8C351	Lower degas bottle hose
3	W707398	Degas bottle-to-fender bolt
4	W709603	Degas bottle-to-fender nut
5	8A080	Degas bottle
6	8100	Pressure relief cap

3.5L Engines



Item	Part Number	Description
1	8B541	Degas bottle-to-thermostat housing hose
2	8C351	Lower degas bottle hose

3	W707398	Degas bottle-to-fender bolt
4	W709603	Degas bottle-to-fender nut
5	8A080	Degas bottle
6	14197	Wiring harness retainer (if equipped)
7	8100	Pressure relief cap
8	8276	Degas bottle-to-radiator hose

Removal and Installation

All vehicles

1. ⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

   Release the pressure in the cooling system by slowly turning the pressure relief cap one-half turn counterclockwise. When the pressure is released, remove the pressure relief cap.

2. Using hose clamp pliers, clamp the lower degas bottle hose.

3. Using a suitable suction device, siphon the coolant from the degas bottle.

4. Disconnect the degas bottle-to-radiator hose.

3.5L engines

5. If equipped, detach the wiring harness retainer from the degas bottle.

6. Disconnect the degas bottle-to-thermostat housing hose.

All vehicles

7. Disconnect the lower degas bottle hose.

8. Remove the nut, bolt and the degas bottle.
   - To install, tighten to 9 Nm (80 lb-in).

9. To install, reverse the removal procedure.

10. Fill the degas bottle. Refer to Cooling System Draining, Filling and Bleeding in this section for the recommended coolant mixture and fill level.

Material

Item	Specification	Fill Capacity
Motorcraft® Premium Cooling System Flush VC-1	ESR-M14P7-A	-
Motorcraft® Specialty Green Engine Coolant [a] [b] [c] VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A	9.0L (9.5 qt)
Motorcraft® Specialty Orange Engine Coolant [a] [b] [d] VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D	9.0L (9.5 qt)

[a] The cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used.
[b] Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant typee coolant corrosion protection and may damage the engine or cooling system.
[c] Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.
[d] During normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

General Specifications

Item	Specification
Pressure Tests	
Complete cooling system maximum pressure	124 kPa (18 psi)
Pressure relief cap	89-124 kPa (13-18 psi)
Radiator (out of vehicle)	138 kPa (20 psi)
Thermostat Opening Temperatures	
Thermostat starts to open	80-84°C (176-183°F)
Thermostat fully open	97°C (207°F)

Torque Specifications

Description	Nm	lb-in
A/C tubes retainer bolt	7	62
Auxiliary relay box bolts	8	71
Block heater	20	177
Coolant pump bolts	10	89
Coolant pump pulley bolts	20	177
Degas bottle-to-fender bolt	9	80
Degas bottle-to-fender nut	9	80
Thermostat housing bolts	10	89
Upper radiator support bracket bolts	10	89

Engine Cooling

NOTICE: **The engine cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or tded light exposure causes this product to degrade.**

NOTICE: **Stop-leak style pellets/products must not be used as an additive in this engine cooling system. The addition of stop-leak style pellets/products can clog or damage the cooling system, resulting in degraded cooling system performance and/or failure.**

NOTE: During normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

The cooling system components are the:

- block heater (if equipped).
- radiator.
- bypass tube.
- pressure relief cap.
- degas bottle.
- radiator draincock.
- coolant pump.
- thermostat housing.
- auxiliary coolant flow pump, refer to Section 412-01 for removal and installation and Section 412-00B for diagnostics.

Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, maintain the engine coolant at the correctconcentration and fluid level in the degas bottle.

When adding engine coolant, use a 50/50 mixture of engine coolant and distilled water. A coolant concentration of 50% provides freeze point protection down to -37°C (-34°F).

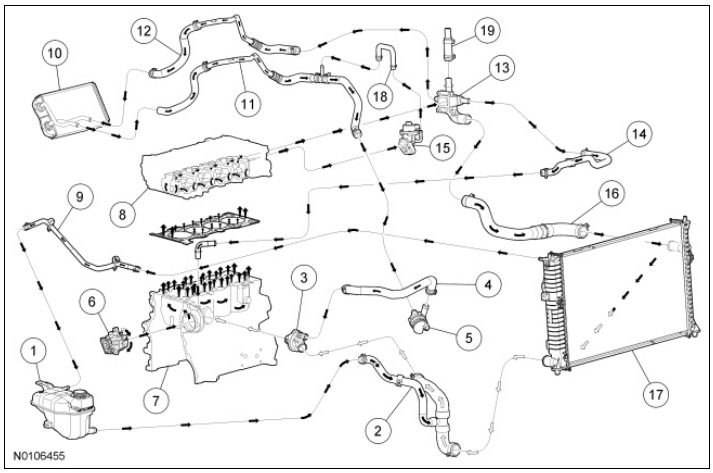
To maintain the integrity of the coolant and the cooling system:

- add the correct coolant type to the engine cooling system. The engine cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use

the same type of coolant that was originally used to fill the cooling system. Mixing different coolant types degrades the corrosion protection of the original coolant. Do not mix any type of coolants.
- do not add alcohol, methanol or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Ford Motor Company does NOT recommend the use of recycled engine coolant in vehicles.

Coolant Flow Diagram

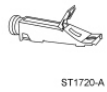
NOTE: Black arrows indicate hot, white arrows indicate cold.



Item	Part Number	Description
1	8A080	Degas bottle
2	8B273	Lower radiator hose
3	8575	Thermostat housing
4	18C266	Thermostat housing-to-auxiliary coolant pump hose
5	18D473	Auxiliary coolant flow pump
6	8501	Coolant pump
7	6010	Engine block
8	6049	Cylinder head
9	8276	Degas bottle-to-radiator hose
10	19B555	Heater core
11	18C266	Heater core outlet hose
12	18C266	Heater core inlet hose
13	8K556	Coolant outlet adapter
14	8A582	Coolant outlet adapter-to-engine bypass tube hose
15	9D475	EGR valve assembly
16	8B274	Upper radiator hose
17	8005	Radiator
18	18C266	EGR valve assembly-to-heater core outlet hose
19	8C362	Bleed valve hose

Engine Cooling

Special Tool(s)

 ST3106-A	3-Way HD Antifreeze Coolant Test Kit 328-00001
 ST1720-A	Coolant/Battery Refractometer ROB75240 or equivalent
	D-Gas Adapter 300-OTC014-R1068 or equivalent
 ST3281-A	Radiator Tester STN12270 or equivalent
 ST3254-A	UView® Combustion Leak Tester UVU560000-R
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware or equivalent scan tool

Material

Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D

Principles of Operation

Engine coolant flows primarily from thngine to the radiator circuit and back to the coolant pump. Coolant is sent from the coolant pump through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core and turbochargers with coolant. The coolant pump, operated by engine rotation through a sprocket which is driven by the timing chain, circulates the coolant. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is opened, coolant flows through the radiator circuit to transfer engine-generated heat to the outside air.

The degas bottle holds surplus coolant and removes air from the cooling system, which reduces hot spots. It also allows for coolant expansion and system pressurization, replenishes coolant to the cooling system and

serves as the location for service fill.

The cooling fan draws air through the radiator to help cool the system coolant as it passes through the radiator.

The thermostat monitor is a function of the PCM and is designed to verify correct thermostat operation. The monitor executes once per drive cycle and has a monitor run duration of 300-800 seconds. If a malfunction occurs, DTC P0125 or P0128 is set, and the Malfunction Indicator Lamp (MIL) is illuminated.

For engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

Inspection and Verification

⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

NOTICE: **The engine cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

NOTE: During normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

NOTE: Vehicles have the pressure relief cap on the degas bottle and no raor cap.

1. Verify the customer concern.

2. Visually check the engine coolant level at the degas bottle when the system is cold.

3. Make sure the pressure relief cap is installed correctly.

4. Record any cooling system DTCs retrieved. Refer to the PCM DTC Chart in this section for DTC descriptions.

5. **NOTE:** Take note of any coolant odor or steam coming from cooling system components.

   If the system coolant is filled correctly and no DTCs associated with fail-safe cooling are retrieved, verify the customer's concern by operating the engine to duplicate the condition.

6. **NOTE:** For the coolant flow diagram, refer to Engine Cooling in the Description and Operation portion of this section.

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

Visual Inspection Chart

Mechanical	Electrical
• Leaks or weeps at: ♦ Hoses ♦ Tubes ♦ Clamp joints ♦ Gaskets ♦ O-rings ♦ Thermostat housing ♦ Radiator ♦ Pressure relief cap ♦ Heater core (wet floor or coolant odor in vehicle) ♦ Degas bottle ♦ Coolant crossover ♦ Cylinder block core plugs ♦ Cylinder head core plugs ♦ Auxiliary coolant flow pump ♦ Block heater (if equipped)	• Inoperative or damaged: ♦ Electric cooling fan ♦ Wiring, connectors, relays or modules ♦ Cylinder Head Temperature (CHT) sensor
• Cracked or damaged: ♦ Hoses ♦ Tubes ♦ Hose clamps ♦ Thermostat housing ♦ Radiator ♦ Pressure relief cap ♦ Cooling fan ♦ Coolant pump ♦ Degas bottle ♦ Cylinder block core plugs ♦ Cylinder head core plugs ♦ Auxiliary coolant flow pump ♦ Block heater (if equipped) • Restricted airflow through the A/C condenser/radiator • Excessive white or light gray exhaust smoke (may have burnt coolant odor) • Coolant in engine oil • Engine oil in coolant	

7. If the inspection reveals an obvious concern that can be readily identified, repair it as necessary. Test the system for normal operation.

8. ***NOTICE:*** **The engine cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolanse the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

NOTICE: **Stop-leak style pellets/products must not be used as an additive in this engine cooling system. The addition of stop-leak style pellets/products can clog or damage the cooling system, resulting in degraded cooling system performance and/or failure.**

NOTE: NOTE: During normal vehicle operation, Motorcraft® Specialty Orange Engine Coolant may change color from orange to pink or light red. As long as the engine coolant is clear and uncontaminated, this color change does not indicate the engine coolant has degraded nor does it require the engine coolant to be drained, the system to be flushed, or the engine coolant to be replaced.

Inspect the coolant condition in the following sequence:

1. Inspect the coolant color.
    - ♦ If the coolant has a clear or pale green color, this indicates higher water content than required. Test the engine coolant freezing point range with the Coolant/Battery Refractometer. The freezing point should be in the range -50°C to -26°C (-58°F to -15°F). If the vehicle is driven in cold climates less than -37°C (-34°F), it may be necessary to increase the coolant concentration to get adequate freeze protection. Recommended coolant concentration is 50/50 engine coolant to distilled water.
    - ♦ Discoloration of Motorcraft® Specialty Orange Engine Coolant may indicate that incorrect coolant may have been added to the system. Use of incorrect (green or yellow) coolant degrades the corrosion protectioncraft® Specialty Orange Engine Coolant. Addition of Motorcraft® Specialty Green Engine Coolant may cause the color to appear to be a murky green-brown color. The addition of Motorcraft® Premium Gold Engine Coolant, however, may not change the color or appearance of the orange colored coolant. Detection of contamination with Motorcraft® Premium Gold Engine Coolant is determined by the presence of nitrite. If contamination with Motorcraft® Premium Gold Engine Coolant is suspected, test the coolant with the 3-Way HD Antifreeze Coolant Test Kit. Follow the directions in the kit with regard to nitrite testing. If nitrite is present, flush the system and refill with the correct mixture of Motorcraft® Specialty Orange Engine Coolant and distilled water. Refer to Cooling System Flushing in this section.
    - ♦ A darker color with the presence of debris could indicate a commercially available stop-leak may have been used and could result in loss of coolant flow the critical parts of the engine. If sediment is present in the coolant sample, flush the system and refill with the correct mixture of distilled water and the correct engine coolant. Refer to Cooling System Flushing in this section.
    - ♦ A light or reddish brown color or reddish brown particles indicate that rust may be present in the cooling system. Flush the system and refill with the corrxture of distilled water and the correct engine coolant. Refer to Cooling System Flushing in this section.
    - ♦ An iridescent sheen on top of the coolant could indicate a trace of oil is entering the system. For information on engine diagnosis, refer to Section 303-00 .
    - ♦ A milky brown color may indicate that engine oil is entering the cooling system. Pressure test the cooling system. Refer to Component Tests in this section. If engine

oil is suspected, the cause of the leak may be internal to the engine. Refer to Section 303-00 . Flush the cooling system. Refer to Cooling System Flushing in this section.

2. If the engine coolant appearance is acceptable, test the engine coolant freezing point range with the Coolant/Battery Refractometer. The freezing point should be in the range -50°C to -26°C (-58°F to -15°F). If the vehicle is driven in cold climates less than -37°C (-34°F), it may be necessary to increase the coolant concentration to get adequate freeze protection. Recommended coolant concentration is 50/50 engine coolant to distilled water.
    - ♦ Maximum coolant concentration is 60/40 for cold weather areas.
    - ♦ Minimum coolant concentration is 40/60 for warm weather areas.
3. Adjust coolant range and level if necessary:
    - ♦ If coolant is low, add specified coolant mixture only.
    - ♦ If the engine coolant tests too weak, remove some of the engine coolant and add undiluted engine coolant until the readings are within acceptable levels.
    - ♦ If the engine coolant tests strong, remove some of the engine coolant and add distilled water until the readings are within acceptable levels.

9. If an obvious cause for an observed or reported concern is found, correct the cause and test the system for normal operation before proceeding to the next step.

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

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

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

    If the scan tool does not communiith the VCM :

    - check the VCM connection to the vehicle.
    - check the scan tool connection to the VCM .
    - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

12. If the scan tool does not communicate with the vehicle:
    - verify the ignition key is in the ON position.
    - verify the scan tool operation with a known good vehicle.
    - refer to Section 418-00 to diagnose no response from the PCM.

13. Carry out the network test.
    - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
    - If the network test passes, retrieve and record continuous memory DTCs.

14. Clear the continuous DTCs and carry out the self-test diagnostics PCM.

15. If the DTCs recovered are related to the concern, go to the PCM DTC Chart. For all other PCM DTCs, refer to Section 303-14D .

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

DTC Chart

PCM DTC Chart

DTC	Description	Action
P0125	Insufficient Coolant Temp For Closed Loop Fuel Control	GO to Pinpoint Test C .
P0128	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature)	GO to Pinpoint Test C .
P0217	Engine Coolant Overtemperature Condition	GO to Pinpoint Test B .
P0480 P0481 P0482	Fan 1, 2 or 3 Control Circuit, Respectively	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1285	Cylinder Head Overtemperature Condition	GO to Pinpoint Test B .
P1299	Cylinder Head Overtemperature Protection Active	GO to Pinpoint Test B .
All Other PCM DTCs	-	REFER to Section 303-14D .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: Loss of Coolant

Normal Operation

The engine cooling system is a closed system providing for coolant expansion and contraction and also changes in pressure as coolant warms and cools with engine operation. Various gaskets, seals, hoses and clamps contain coolant within the cooling system and keep other fluids and contaminants from entering the cooling system.

Coolant loss can be attributed to either external or internal leaks anywhere within the cooling system.

For engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

This pinpoint test is intended to diagnose the following:

- Coolant hoses or tubes
- Hose clamps
- Thermostat housing gasket
- Coolant pump O-ring seal
- Thermostat housing
- Radiator
- Pressure relief cap
- Coolant pump leaking from weep hole
- Heater core
- Engine gaskets

- Degas bottle
- Cylinder block core plugs
- Cylinder head core plugs
- Block heater (if equipped)

PINPOINT TEST A: LOSS OF COOLANT

⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

Test Step	Result / Action to Take
A1 CARRY OUT INSPECTION AND VERIFICATION	
• Carry out the Inspection and Verification procedure in this section. • **Were any concerns found?**	**Yes** REPAIR as needed. TEST the system for normal operation. **No** GO to A2 .
A2 CHECK THE ENGINE COOLANT LEVEL	
NOTE: Allow the engine to cool before checking the engine coolant level. • Ignition OFF. • Visually inspect the engine coolant level at the degas bottle. • **Is the engine coolant level within specifications?**	**Yes** GO to A3 . **No** ADJUST the engine coolant level as necessary. GO to A3 .
A3 PRESSURE TEST THE ENGINE COOLING SYSTEM	
• Pressure test the engine cooling system. Refer to Component Tests, Cooling System Pressure Test in this section. • **Does the engine cooling system leak externally?**	**Yes** REPAIR or INSTALL new components. TEST the system for normal operation. **No** GO to A4 .
A4 CHECK THE ENGINE COOLANT FOR AN INTERNAL LEAK	
• Inspect the engine coolant in the degas bottle for signs of engine oil. • **Is engine oil evident in the coolant?**	**Yes** If engine oil is evident, GO to Section 303-00 for engine diagnosis. **No** GO to A5 .
A5 CHECK THE ENGINE OIL FOR COOLANT	
• Remove the oil level indicator from the engine. • **Is coolant evident in the oil?**	**Yes** If coolant is in the engine oil, GO to Section 303-00 .

	No GO to A6 .
A6 CHECK THE COOLING SYSTEM FOR COMBUSTION GASES	
• **NOTE:** Use UView® Combustion Leak Tester, part No. UVU560000-R or equivalent. • Using a cooling system combustion gas leak tester, following the instructions supplied with the tester, check the coolant for combustion gases. • **Are combustion gases present?**	**Yes** GO to Section 303-00 for engine diagnosis. **No** The cooling system is operational.

Pinpoint Test B: The Engine Overheats

Normal Operation

The engine cooling system maintains engine temperatures during operation. Correct coolant flow through the engine, radiator and remainder of cooling system passages and components is essential to maintaining a correct engine temperature.

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. Coolant is sent from the coolant pump through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The coolant pump, operated by engine rotation through a sprocket driven by the timing chain, circulates the coolant. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is opened, coolant is allowed to flow through the radiator circuit in order to transfer engine-generated heat to the outside air.

Engine overheating generally occurs when there is a disruption in the ability to control either coolant flow at the correct rate, the inability to transfer heat from the engine through the coolant (including low coolant) or an inability to transfer engine-generated heat to the outside air through the radiator.

For engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

- DTC P0217 (Engine Coolant Overtemperature Condition) - Indicates an engine overheat condition was sensed by the Cylinder Head Temperature (CHT) sensor.
- DTC P1285 (Cylinder Head Overtemperature Condition) - Indicates an engine overheat condition was sensed by the CHT sensor.
- DTC P1299 (Cylinder Head Overtemperature Protection Active) - Indicates an engine overheat condition was detected by the CHT sensor. A failure mode effects management strategy called fail-safe cooling was activated to cool the engine.

This pinpoint test is intended to diagnose the following:

- Low coolant level
- External engine coolant leak
- Airlock in system
- Pressure relief cap installation
- Restricted airflow through the A/C condenser/radiator
- Internal engine coolant leak
- Coolant condition/concentration
- Accessory drive components
- Non-OEM engine enhancement components

- Electric cooling fan
- Cylinder Head Temperature (CHT) sensor
- Heater core
- Coolant pump
- Coolant flow restriction

PINPOINT TEST B: THE ENGINE OVERHEATS

⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pr; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

Test Step	Result / Action to Take
B1 CARRY OUT INSPECTION AND VERIFICATION	
• Carry out the Inspection and Verification procedure in this section. • **Were any concerns found?**	**Yes** REPAIR as needed. TEST the system for normal operation. **No** GO to B2 .
B2 CHECK FOR DTCs	
• Check for DTC P0217, P1285 or P1299. • **Is DTC P0217, P1285 or P1299 present?**	**Yes** GO to B3 . **No** Actual engine overheating has not been verified. CHECK the Engine Coolant Temperature (ECT) gauge operation. REFER to Section 413-01 . If any other PCM DTCs are retrieved, REFER to Section 303-14D .
B3 CHECK FOR AN AIRFLOW OBSTRUCTION	
• Check the radiator or A/C condenser for an external obstruction such as leaves or cardboard. • **Is an obstruction present?**	**Yes** REMOVE the obstruction. TEST the system for normal operation. **No** GO to B4 .
B4 CHECK THE ENGINE COOLANT LEVEL	
NOTE: Allow the engine to cool before checking the coolant level. • Ignition OFF. • Visually check the engine coolant level in the degas bottle. • **Is the engine coolant level within specification?**	**Yes** GO to B5 . **No** ADJUST the engine coolant level as necessary. GO to B5 .

B5 PRESSURE TEST THE ENGINE COOLING SYSTEM	
• Pressure test the engine cooling system. Refer to Component Tests, Cooling System Pressure Test in this section. • **Does the engine cooling system leak externally?**	**Yes** REPAIR or INSTALL new components. TEST the system for normal operation. **No** GO to B6 .
B6 CHECK THE ENGINE COOLANT FOR AN INTERNAL LEAK	
• Inspect the engine coolant in the degas bottle for signs of engine oil. • **Is engine oil evident in the coolant?**	**Yes** If engine oil is evident, GO to Section 303-00 for engine diagnosis. **No** GO to B7 .
B7 CHECK THE ENGINE OIL FOR COOLANT	
• Remove the oil level indicator from the engine. • **Is coolant evident in the oil?**	**Yes** If coolant is in the engine oil, GO to Section 303-00 . **No** GO to B8 .
B8 CHECK THE COOLING SYSTEM FOR COMBUSTION GASES	
• **NOTE:** Use UView® Combustion Leak Tester, part No. UVU560000-R or equivalent. • Using a cooling system combustion gas leak tester, following the instructions supplied with the tester, check the coolant for combustion gases. • **Are combustion gases present?**	**Yes** GO to Section 303-00 for engine diagnosis. **No** GO to B9 .
B9 CHECK COOLANT CONDITION	
• Check the coolant for dirt, rust or contamination and check the coolant concentration. • **Is the coolant condition OK?**	**Yes** GO to B10 . **No** FLUSH the engine cooling system. REFER to Cooling System Flushing in this section. TEST the system for normal operation.
B10 CHECK THE ELECTRIC COOLING FAN OPERATION	
• Start the engine. • Place the climate control function selector in the MAX A/C position and the blower motor switch in the HI position.	**Yes** GO to B11 . **No** DIAGNOSE the electric cooling fan operation. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

• **Did the electric cooling fan operate?**	
B11 CHECK THE COOLANT PUMP OPERATION	
• Start the engine. • Allow the engine to run for 30 minutes. Place the climate control function selector in the MAX HEAT position. Feel the heater outlet hose. • **Is the heater outlet hose hot?**	**Yes** GO to B12 . **No** INSTALL a new coolant pump. TEST the system for normal operation.
B12 CHECK THE THERMOSTAT OPERATION	
• Start the engine. • Allow the engine to run for 30 minutes. Feel the lower radiator hose. • **Is the lower radiator hose hot?**	**Yes** CHECK the engine coolant temperature gauge operation. REFER to Section 413-01 . **No** GO to B13 .
B13 VISUALLY INSPECT THE THERMOSTAT	
• Carry out the Thermostat Visual Inspection in the Component Tests portion of this section. • **Is the thermostat damaged?**	**Yes** INSTALL a new thermostat. TEST the system for normal operation. **No** INSTALL a new thermostat. TEST the system for normal operation. If the engine still overheats, INSTALL a new radiator. TEST the system for normal operation.

Pinpoint Test C: The Engine Does Not Reach Normal Operating Temperature

Normal Operation

The engine cooling system maintains engine temperatures during operation. Correct coolant flow through the engine, radiator and remainder of cooling system passages and components is essential to maintaining a correct engine temperature.

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. From the coolant pump, coolant is sent through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The coolant pump, operated by engine rotation through a sprocket which is driven by the timing chain, circulates the coolant. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is opened, coolant flows through the radiator circuit to transfer engine generated heat to the outside air.

Concerns of engine inability to reach normal operating temperature typically occur when the rate of coolant flow through some coolant circuits (radiator, heater core) is more than expected given the conditions, or when the electric cooling fans operate all the time. Heat is not allowed to build in the engine because a heat exchanger is removing too much heat, including the radiator, heater core and oil cooler. In addition, perceived concerns that the engine does not reach normal operating temperature can be related to a low coolant level or trapped air which does not allow for hot coolant to be available at the heater core, an inoperative climate

control system, or for concerns perceived or related to an incorrect engine temperature gauge indication.

For engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

- DTC P0125 (Insufficient Coolant Temp for Closed Loop Fuel Control) - Indicates the Cylinder Head Temperature (CHT) sensor has not achieved the required temperature level to enter closed loop operating conditions within a specified amount of time after starting the engine.
- DTC P0128 (Coolant Thermostat [Coolant Temp Below Thermostat Regulating Temperature]) - Indicates that the thermostat monitor has not achieved the required engine operating temperature within a specified amount of time after starting the engine.

This pinpoint test is intended to diagnthe following:

- Low coolant level
- Thermostat
- Engine Coolant Temperature (ECT) gauge
- Engine cooling fan

PINPOINT TEST C: THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE

⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

Test Step	Result / Action to Take
C1 CARRY OUT INSPECTION AND VERIFICATION	
• Carry out the Inspection and Verification procedure in this section. • **Were any concerns found?**	**Yes** REPAIR as needed. TEST the system for normal operation. **No** GO to C2 .
C2 CHECK FOR DTC P0125 or P0128	
• Check for DTC P0125 or P0128. • **Is DTC P0125 or P0128 present?**	**Yes** GO to C3 . **No** The cooling system is operational. If an inoperative engine coolant temperature gauge is suspected, CHECK the engine coolant temperature gauge operation. REFER to Section 413-01 . If an inoperative climate control system is suspected, CHECK the climate control system operation. REFER to Section 412-00B . If any other PCM DTCs are retrieved, REFER to Section 303-14D .
C3 CHECK THE ELECTRIC COOLING	

FAN OPERATION	
• Allow the engine to cool. • Make sure the A/C switch is OFF. • Start the engine. • Check the electric cooling fan. • **Is the electric cooling fan on all the time?**	**Yes** DIAGNOSE the electric cooling fan operation. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to C4 .
C4 CHECK THE COOLANT LEVEL	
• **NOTE:** Allow the engine to cool before checking the coolant level. • Visually check the engine coolant level in the degas bottle. • **Is the engine coolant level within specification?**	**Yes** INSTALL a new thermostat. TEST the system for normal operation. **No** GO to Pinpoint Test A to diagnose a coolant leak.

Component Tests

Cooling System Pressure Test

⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

NOTICE: **The engine cooling system is filled with Motorcraft® Specialty Green Engine Coolant. Do not mix coolant types. Mixing coolant types degrades the corrosion protection of the coolant. Failure to follow these instructions may result in engine or cooling system damage.**

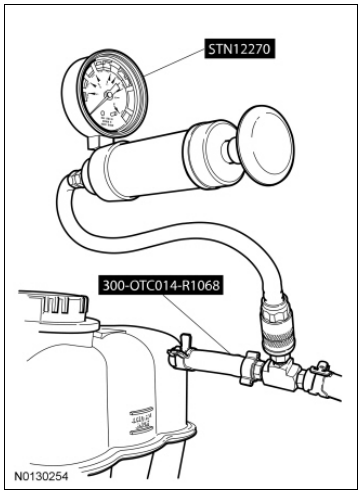
NOTICE: **Genuine Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

NOTE: Vehicles have the pressure relief cap on the degas bottle and no radiator cap.

1. Turn the engine OFF.

2. Check the engine coolant level. Adjust the coolant level as necessary.

3. Attach the D-Gas Adapter to the degas bottle nipple and overflow hose. Install the Radiator Tester to the quick connect fitting of the D-Gas Adapter.



4. *NOTICE:* **Do not pressurize the cooling system beyond the maximum pressure listed in the specifications table in this section or cooling system components may be damaged.**

   NOTE: If the plunger of the pressure tester is pressed too fast, an erroneous pressure reading will sult.

   Slowly press the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained. If the pressure reading exceeds the maximum cap pressure listed in the specifications table, install a new pressure relief cap.

5. If the system does not hold pressure, remove the pressure relief cap and wash in clean water to dislodge all the foreign material from the gasket. Check the sealing surface in the filler neck of the degas bottle for nicks or cuts. Install the pressure relief cap.

6. Pressurize the engine cooling system as described in Step 4. Observe the gauge reading for approximately 2 minutes. Pressure should not drop during this time. If the pressure drops within this time, inspect for leaks and repair as necessary.

7. If no leaks are found and the pressure drops, the pressure relief cap may be leaking. Install a new pressure relief cap and retest the system.

8. If no leaks are found after a new pressure relief cap is installed and the pressure drops, the leak may be internal to the radiator transmission cooler (if equipped). Inspect the coolant for transmission fluid and the transmission fluid for coolant. Repair as necessary.

9. If there is no contamination of the coolant or transmission fluid, the leak may be internal to the engine. Inspect the coolant for engine oil and the engine oil for coolant. Refer to Section 303-00 to diagnose the engine.

10. Release the system pressure by loosening the pressure relief cap. Check the coolant level and adjust as necessary.

Thermostat

A new thermostat should be installed only after the following tests and checks have been carried out:

- Pinpoint Test A, B or C
- Thermostat Visual Inspection

Thermostat Visual Inspection

1. Remove the thermostat.

2. Examine the thermostat for signs of damage including:
   - Valve not fully seated (light visible through the valve)
   - Foreign material lodged in the main valve
   - Bent or broken frame or flange
   - Bent or broken spring
   - Bent or broken valve or valve stem
   - Wax leaking from wax reservoir or a bulge in the reservoir
   - Any other damage or distortion

3. **NOTE:** If no damage is found during the inspection, do not attempt to open the thermostat using hot water or other heat sources. This method is not an accurate means to test the function of the thermostat and may damage the thermostat.

   If damage is found during the inspection, remove any foreign material or broken pieces and install a new thermostat.

4. If no damage is found during the inspection, continue troubleshooting the system concern. Go to the Symptom Chart for further instructions.

Radiator Leak Test, Removed From Vehicle

NOTICE: **Never leak test an aluminum radiator in the same water that copper/brass radiators are tested in. Flux and caustic cleaners may be present in the cleaning tank and they will damage aluminum radiators.**

NOTE: Always install plugs in the oil cooler fittings before leak testing or cleaning any radiator.

NOTE: Clean the radiator before leak testing to avoid contamination of tank.

Leak test the radiator in clean water with air pressurized to the maximum pressure listed in the Specifications.

Cooling System Draining, Filling and Bleeding

Special Tool(s)

 ST2818-A	Airlift Cooling System Tester UVU550000 or equivalent

Material

Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D

Draining

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. ⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

   NOTICE: **The coolant must be recovered in a suitable, clean container for reuse. If the coolant is contaminated it must be recycled or disposed of correctly. Using contaminated coolant may result in damage to the engine or cooling system components.**

   NOTICE: **The engine cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage t engine or cooling system.**

   NOTICE: **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and may damage the engine or cooling system.**

   NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure**

causes this product to degrade.

NOTICE: **Stop-leak style pellets/products must not be used as an additive in this engine cooling system. The addition of stop-leak style pellets/products may clog or damage the cooling system, resulting in degraded cooling system performance and/or failure.**

NOTE: Less than 80% of coolant capacity can be recovered with the engine in the vehicle. Dirty, rusty or contaminated coolant requires replacement.

Release the pressure in the cooling system by slowly turning the pressure relief cap one-half turn counterclockwise. When the pressure is released, remove the pressure relief cap.

3. Place a suitable container below the radiator draincock.
    - Open the draincock and allow to drain.
    - Close the draincock after draining.

Filling and Bleeding with a Vacuum Cooling System Filler

1. ***NOTICE:*** **The cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

   NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

   NOTICE: **Engine coolant provides boil protection, corrosion protection, freeze protection, and cooling efficiency to the engine and cooling components. In order to obtain these protections, maintain the engine coolant at the correct concentration and fluid level in the degas bottle.**

   To maintain the integrity of the coolant and the cooling system:

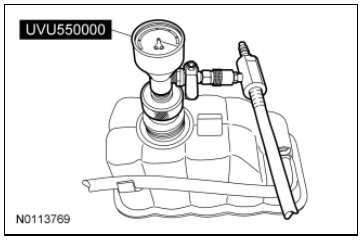
    - Add Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types.
    - Do not add or mix with any other type of engine coolant. Mixing coolants may degrade the coolant's corrosion protection.
    - Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
    - Ford Motor Company does NOT recommend the use of recycled engine coolant in vehicles originally equipped with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant since a Ford-approved recycling process is not yet available.

   NOTICE: **Stop-leak style pellets/products must not be used as an additive in this engine cooling system. The addition of stop-leak style pellets/products can clog or damage the cooling system resulting in degraded cooling system performance and/failure.**

   Install the vacuum cooling system filler and follow the manufacturer's instructions to fill and bleed the cooling system.

    - Recommended coolant concentration is 50/50 engine coolant to distilled water.

- For extremely cold climates (less than -37°C [-34°F]):
  - ♦ It may be necessary to increase the coolant concentration above 50%.
  - ♦ NEVER increase the coolant concentration above 60%.
  - ♦ Maximum coolant concentration is 60/40 for cold weather areas.
  - ♦ A coolant concentration of 60% provides freeze point protection down to -50°C (-58°F).
  - ♦ Engine coolant concentration above 60% decreases the overheat protection characteristics of the engine coolant and may damage the engine.
- For extremely hot climates:
  - ♦ It is still necessary to maintain the coolant concentration above 40%.
  - ♦ NEVER decrease the coolant concentration below 40%.
  - ♦ Minimum coolant concentration is 40/60 for warm weather areas.
  - ♦ A coolant concentration of 40% provides freeze point protection down to -26°C (-15°F).
  - ♦ Engine coolant concentration below 40% decreases the corrosion and freeze protection characteristics of the engine coolant and may damage the engine.
- Vehicles driven year-round in non-extreme climates should use a 50/50 mixture of engine coolant and distilled water for optimum cooling system and engine protection.



Filling and Bleeding without a Vacuum Cooling System Filler

NOTICE: **The cooling system is filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the manufacturer's specified coolant. Chemically flush the cooling system if a non-specified coolant has been used. Refer to Cooling System Flushing in this section. Failure to follow these instructions may damage the engine or cooling system.**

NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow this product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

NOTICE: **Engine coolant provides boil protection, corrosion protection, freeze protection, and cooling efficiency to the engine and cooling components. In order to obtain these protections, maintain the engine coolant at the correct concentration and fluid level in the degas bottle.**

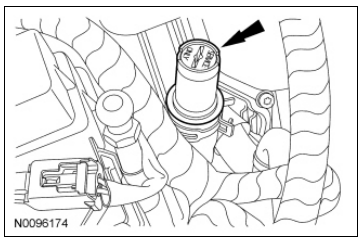
To maintain the integrity of the coolant and the cooling system:

- Add Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types.
- Do not add or mix with any other type of engine coolant. Mixing coolants may degrade the coolant's corrosion protection.
- Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol ohanol antifreeze. These can cause engine damage from overheating or freezing.
- Ford Motor Company does NOT recommend the use of recycled engine coolant in vehicles originally equipped with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine

Coolant since a Ford-approved recycling process is not yet available.

NOTICE: **Stop-leak style pellets/products must not be used as an additive in this engine cooling system. The addition of stop-leak style pellets/products can clog or damage the cooling system resulting in degraded cooling system performance and/or failure.**

1. Remove the degas bottle cap and the bleed valve on the top of the engine coolant outlet.



2. **NOTE:** Make sure the coolant flows from the radiator through the upper radiator hose and fills the engine. When full, coolant should flow from the bleed hole.

   Fill the degas bottle to the COLD FILL RANGE line.

   - Recommended coolant concentration is 50/50 engine coolant to distilled water.
   - For extremely cold climates (less than -37°C [-34°F]):
     - It may be necessary to increase the coolant concentration above 50%.
     - NEVER increase the coolant concentration above 60%.
     - Maximum coolant concentration is 60/40 for cold weather areas.
     - A coolant concentration of 60% provides freeze point protection down to -50°C (-58°F).
     - Engine coolant concentration above 60eases the overheat protection characteristics of the engine coolant and may damage the engine.
   - For extremely hot climates:
     - It is still necessary to maintain the coolant concentration above 40%.
     - NEVER decrease the coolant concentration below 40%.
     - Minimum coolant concentration is 40/60 for warm weather areas.
     - A coolant concentration of 40% provides freeze point protection down to -26°C (-15°F).
     - Engine coolant concentration below 40% decreases the corrosion and freeze protection characteristics of the engine coolant and may damage the engine.
   - Vehicles driven year-round in non-extreme climates should use a 50/50 mixture of engine coolant and distilled water for optimum cooling system and engine protection.

3. Install the degas bottle cap and the bleed valve leaving both loose.

4. Start the engine and let it idle A mixture of air and coolant should escape from the open bleed valve.

5. After all of the air has escaped from the bleed valve turn off the engine and close the bleed valve and the degas bottle cap.

NOTICE: **If the engine overheats or the fluid level drops below the minimum fill line, shut off the engine and add fluid to the degas bottle to the cold fill range line once the engine cools. Failure to follow these instructions may result in damage to the engine.**

6. Start the engine and let it idle for 30 minutes or until the engine reaches normal operating temperature.

7. Turn the heater to the MAX position

8. Carry out the following:
    1. Increase the engine speed to 3,000 rpm for 10 seconds.

   Idle engine for 50 seconds.

3. Repeat Steps 1 and 2 a total of 15 times.

9. ⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

   Check the engine coolant level in degas bottle and fill as necessary.

Cooling System Flushing

Material

Item	Specification
Motorcraft® Premium Cooling System Flush VC-1	ESR-M14P7-A

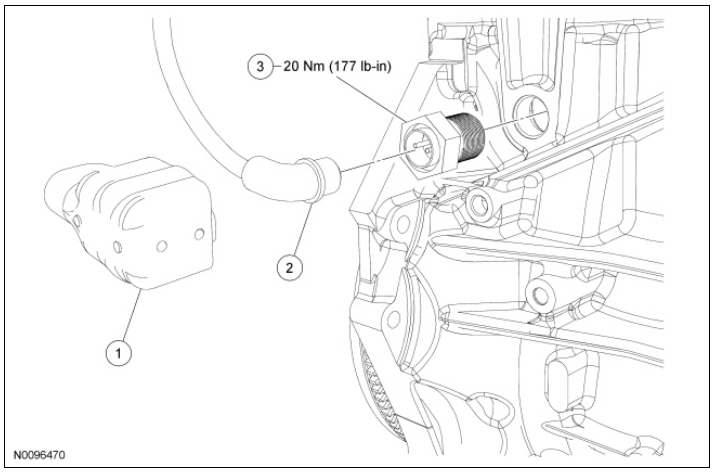
NOTE: To remove rust, sludge and other foreign material from the cooling system, use cooling system flush that is safe for use with aluminum radiators. For additional information, refer to Specifications in this section. This cleaning restores cooling system efficiency and helps prevent overheating. A pulsating or reversed direction of flushing water will loosen sediment more quickly than a steady flow in the normal coolant flow direction. In severe cases where cleaning solvents will not clean the cooling system efficiently, it will be necessary to use the pressure flushing method using cooling system flusher. Dispose of old coolant and flushing water contaminated with antifreeze and cleaning chemicals in accordance with local, state or federal laws.

1. Add Premium Cooling System Flu the cooling system and follow the directions on the package.
2. Remove the radiator. For additional information, refer to Radiator in this section.
3. ***NOTICE:*** **Radiator internal pressure must not exceed 138 kPa (20 psi). Damage to the radiator can result.**

   Backflush the radiator with the radiator in an upside-down position and a high-pressure hose in the lower hose location.
4. **NOTE:** Thermostat and housing are serviced as an assembly.

   Remove the thermostat housing. For additional information, refer to Thermostat Housing in this section.
5. Position a high-pressure water hose into the engine through the upper radiator hose and backflush the engine.

Block Heater



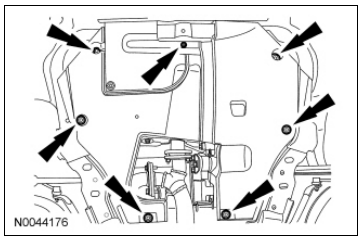
Item	Part Number	Description
1	-	Block heater electrical connector heat shield (part of 6B018)
2	6B018	Block heater electrical connector
3	6A051	Block heater

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

3. If equipped, remove the 7 screws and the underbody cover.



4. Position the block heater heat shield aside.

5. Remove the block heater heat shield.

6. ***NOTICE:*** **Make sure that the block heater wiring is routed and secured away from rotating or hot components, or damage to the wiring can occur.**

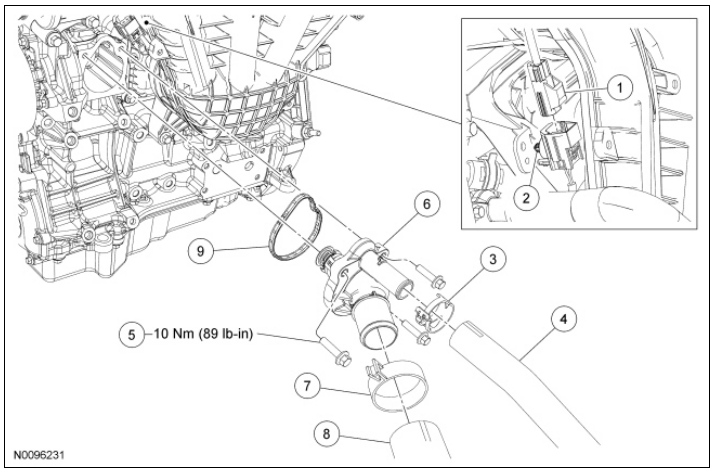
   Disconnect the block heater electrical connector.

7. Remove the block heater.
    - To install, tighten to 20 Nm (177 lb-in).

8. To install, reverse the removal procedure.

9. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Thermostat Housing



Item	Part Number	Description
1	14A464	Knock Sensor (KS) electrical connector (part of 12C508)
2	14A624	KS electrical connector pin-type retainer (part of 12C508)
3	W527362	Heater hose clamp
4	18C266	Heater hose
5	W500015	Thermostat housing bolt (3 required)
6	8575	Thermostat housing
7	W527372	Lower radiator hose clamp
8	8B273	Lower radiator hose
9	8K530	Gasket

Removal and Installation

NOTE: The thermostat and thermostat housing are serviced as an assembly.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

3. Remove the accessory drive belt tensioner. For additional information, refer to Section 303-05D .

4. Disconnect the Knock Sensor (KS) electrical connector and detach the wiring harness pin-type retainer.

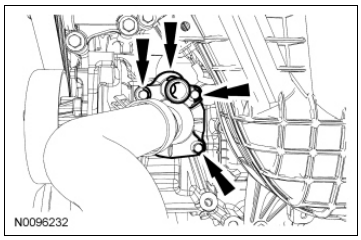
5. **NOTE:** Disconnecting the heater hose first will aid in the removal of the bottom thermostat housing bolt.

   Disconnect the heater hose at the thermostat housing.

6. **NOTE:** The view of the thermostat housing bolts is obstructed by A/C and engine components. However, the bolts can be removed using 1/4-in drive hand tools.

   Remove the 3 bolts and reposition the thermostat housing to gain access to the lower radiator hose clamp.

   - Remove and discard the gasket.
   - To install, tighten to 10 Nm (89 lb-in).

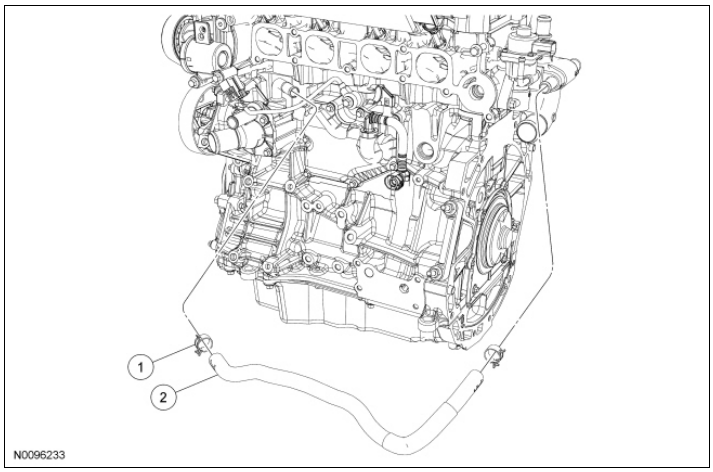


7. Disconnect the lower radiator hose at the thermostat housing.

8. To install, reverse the removal procedure.
   - Install a new gasket.

9. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Bypass Tube



Item	Part Number	Description
1	W525958	Hose clamp (2 required)
2	8548	Bypass tube

Removal and Installation

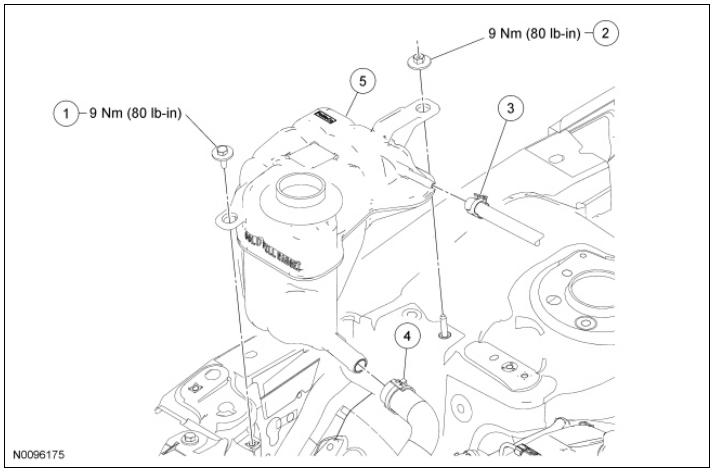
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to .
2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
3. Remove the intake manifold. For additional information, refer to Section 303-01D .
4. Disconnect the 2 hose clamps and remove the coolant bypass tube.
5. To install, reverse the removal procedure.
6. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Coolant Pump

Material

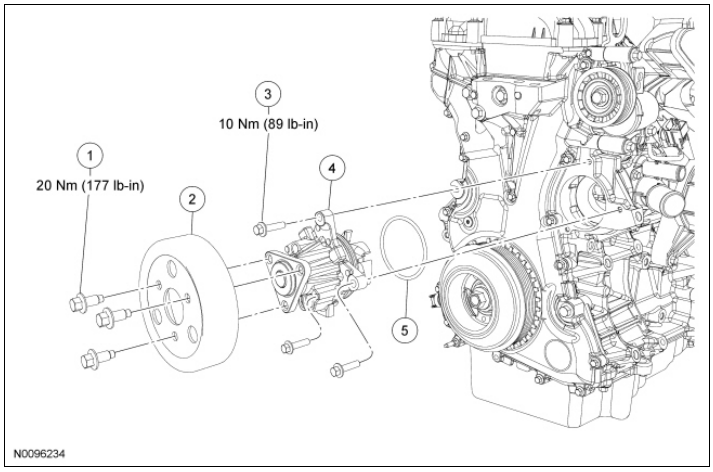
Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D

Degas Bottle



Item	Part Number	Description
1	W707398	Degas bottle-to-fender bolt
2	W709603	Degas bottle-to-fender nut
3	8276	Degas bottle-to-radiator hose
4	8B273	Lower radiator hose
5	8A080	Degas bottle

Coolant Pump



Item	Part Number	Description
1	W500221	Coolant pump pulley bolt (3 required)
2	8509	Coolant pump pulley
3	W500015	Coolant pump bolt (3 required)
4	8501	Coolant pump
5	8507	Coolant pump O-ring seal

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

3. Disconnect the degas bottle-to-radiator hose from the degas bottle.

4. Remove the nut, bolt and position the degas bottle for access to the lower degas bottle hose.
   - To install, tighten to 9 Nm (80 lb-in).

5. Disconnect the lower degas bottle hose and remove the degas bottle.

6. Loosen the 3 coolant pump pulley bolts.

7. Remove the accessory drive belt. For additional information, refer to Section 303-05D .

8. Remove the 3 bolts and the coolant pump pulley.
   - To install, tighten to 20 Nm (177 lb-in).

9. ***NOTICE:*** **Make sure the coolant pump is correctly seated to the engine block before installing and tightening the fasteners, or damage to the coolant pump may occur.**

   Remove the 3 bolts and the coolant pump.

   - Remove and discard the O-ring seal.
   - To install, tighten to 10 Nm (89 lb-in).

10. ***NOTICE:*** **Use Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Use the same type of coolant that was originally used to fill the cooling system. Do not mix coolant types. Mixing coolant types degrades the coolant corrosion protection and**

may damage the engine or cooling system.

NOTICE: **Motorcraft® Specialty Green Engine Coolant is very sensitive to light. Do NOT allow t product to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes this product to degrade.**

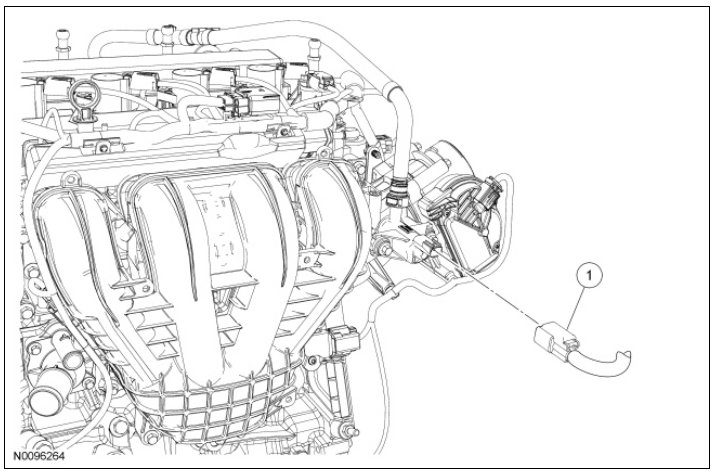
To install, reverse the removal procedure.

- Lubricate the O-ring seal with clean engine coolant.

11. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

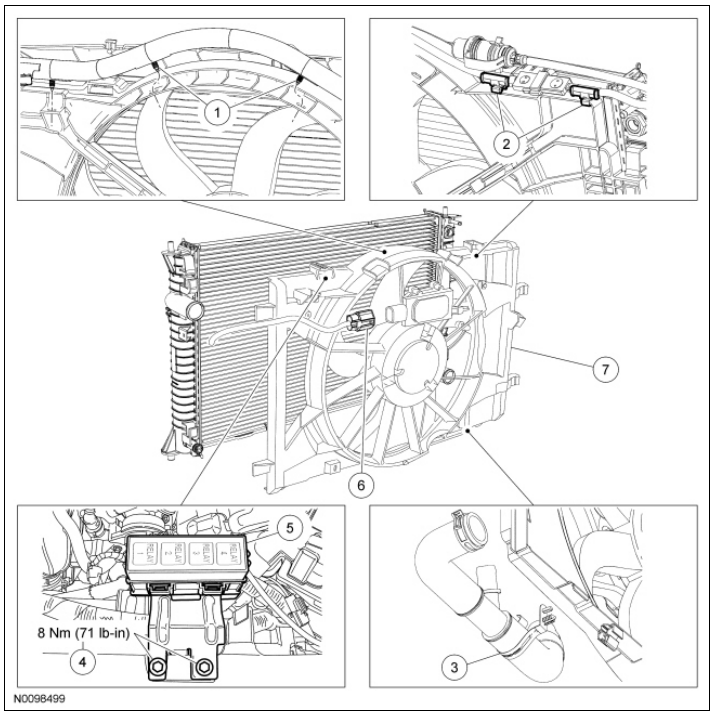
Cooling Fan Motor and Shroud

Cooling Fan and Shroud (View 1 of 2)



Item	Part Number	Description
1	14A464	Evaporative Emission (EVAP) canister purge valve electrical connector

Cooling Fan and Shroud (View 2 of 2)



Item	Part Number	Description
1	13A506	Wiring harness retainers

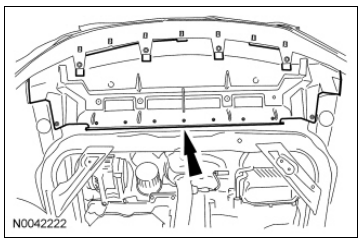
2	14A163	Block heater retainers (part of 6B018)
3	-	Lower radiator hose pin-type retainer
4	W500214	Auxiliary relay box bolts
5	14A464	Auxiliary relay box
6	14A464	Cooling fan motor electrical connector
7	8C607	Cooling fan motor and shroud

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. If equipped, detach the 2 block heater wiring retainers from the cooling fan motor and shroud.

3. Remove the splash shield.



4. Detach the lower radiator hose pin-type retainer from the cooling fan motor and shroud.

5. Remove the battery tray. For additional information, refer to Section 414-01 .

6. Remove the 2 bolts and position the auxiliary relay box aside.
   - To install, tighten to 8 Nm (71 lb-in).

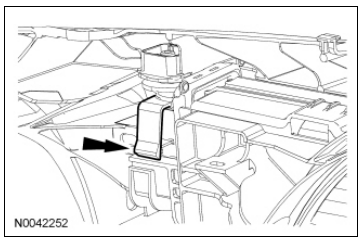
7. Detach all the wiring harness retainers from the cooling fan and shroud.

8. Disconnect the Evaporative Emission (EVAP) canister purge valve electrical connector.

9. Disconnect the cooling fan electrical connector.

10. **NOTE:** LH shown, RH similar.

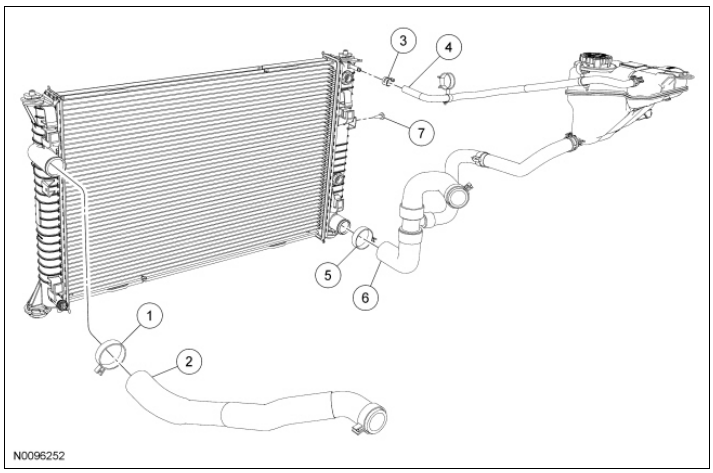
    Release the 2 tabs and remove the cooling fan motor and shroud.



11. To install, reverse the removal procedure.

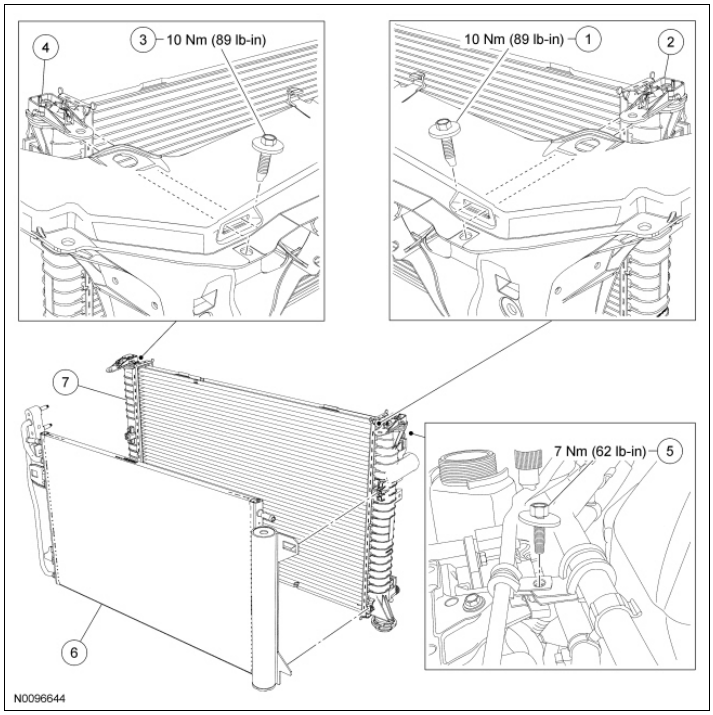
Radiator

Radiator (View 1 of 2)



Item	Part Number	Description
1	W527326	Upper radiator hose clamp
2	8B274	Upper radiator hose
3	W527351	Radiator-to-degas bottle hose clamp
4	8276	Radiator-to-degas bottle hose
5	W527326	Lower radiator hose clamp
6	8B273	Lower radiator hose
7	19710	A/C condenser-to-radiator pin-type reta

Radiator (View 2 of 2)



Item	Part Number	Description
1	W500214	LH upper radiator support bracket bolt
2	8A194	LH upper radiator support bracket
3	W500214	RH upper radiator support bracket bolt
4	8A194	RH upper radiator support bracket
5	W505422	A/C tubes retainer bolt
6	19710	A/C condenser
7	8005	Radiator

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the cooling fan motor and shroud. For additional information, refer to Cooling Fan Motor and Shroud in this section.

3. Disconnect the upper radiator hose from the radiator.

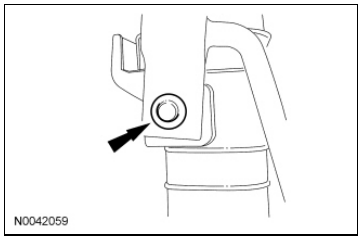
4. Disconnect the radiator-to-degas bottle hose from the radiator.

5. Disconnect the lower radiator hose from the radiator.

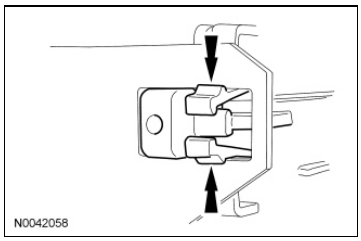
6. Remove the A/C tubes retainer bolt.
    - To install, tighten to 7 Nm (62 lb-in).

7. Remove the 2 bolts from the upper radiator support brackets and position the radiator towards the engine and remove the 2 upper radiator support bracket from the radiator.
    - To install, tighten to 10 Nm (89 lb-in).

8. Remove the A/C condensor-to-radiator pin-type retainer.



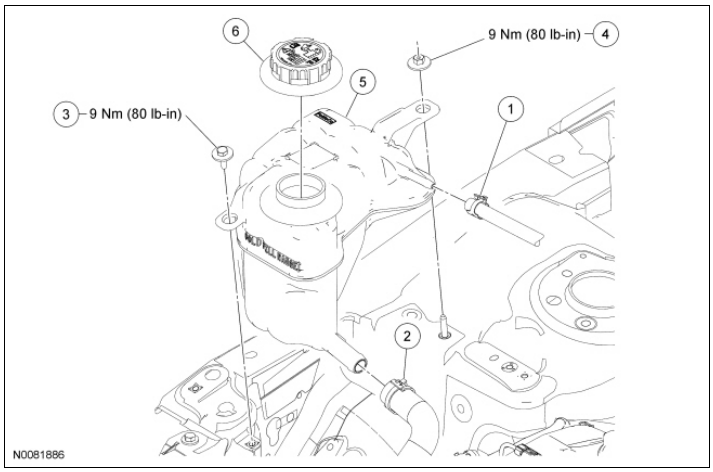
9. Squeeze the tabs and separate the A/C condenser from the radiator.
    - Remove the radiator.



10. To install, reverse the removal procedure.

11. Fill and bleed the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Degas Bottle



Item	Part Number	Description
1	8276	Degas bottle-to-radiator hose
2	8B273	Lower radiator hose
3	W707398	Degas bottle-to-fender bolt
4	W709603	Degas bottle-to-fender nut
5	8A080	Degas bottle
6	8100	Pressure relief cap

Removal and Installation

1. ⚠ **WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.**

   Release the pressure in the cooling system by slowly turning the pressure relief cap one-half turn counterclockwise. When the pressure is released, remove the pressure relief cap.

2. Using hose clamp pliers, clamp the lower degas bottle hose.

3. Using a suction device, siphon the coolant from the degas bottle.

4. Disconnect the degas bottle-to-radiator hose from the degas bottle.

5. Remove the nut, bolt and position the degas bottle for access to the lower degas bottle hose.
   - To install, tighten to 9 Nm (80 lb-in).

6. Disconnect the lower radiator hose and remove the degas bottle.

7. To install, reverse the removal procedure.

8. Fill the degas bottle. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Material

Item	Specification	Fill Capacity
Motorcraft SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel rail stud bolts	23	17	-
Radio capacitor nut	10	-	89
Throttle Body (TB) bolts	10	-	89

Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

The fuel charging and controls system consists of the:

- Throttle Body (TB).
- fuel injectors.
- Fuel Pump (FP) control module.
- fuel rail.

The fuel charging and controls system is:

- a Sequential Multi-Port Fuel Injection (SFI) system.
- Pulse Width Modulated (PWM).
- Mass Air Flow (MAF) controlled.

Fuel is metered into each intake port in a sequential firing order. Fuel injectors pulse to follow engine firing order in accordance with engine demand on a tuned intake manifold.

The basic fuel requirement of the engine is determined from the data supplied to the PCM by the MAF sensor, which measures the amount of air being drawn into the engine.

Other sensors are used to measure:

- air temperature.
- engine coolant temperature.
- engine speed.
- exhaust oxygen content.

The various sensors detect any changes in the operating conditions and send signals to the PCM. This permits the PCM to control the opening duration (pulse width) of the fuel injectors and maintain optimum exhaust emission control and engine performance for all operating conditions.

Throttle Body (TB)

The TB :

- controls air supply to the upper intake manifold by electronically positioning the throttle plate.
- is not adjustable.
- cannot be cleaned.
- is serviced as a complete assembly only.

Fuel Injectors

The fuel injectors:

- are electronically operated by the PCM.
- atomize the fuel as the fuel is delivered.
- each have an internal solenoid that opens a needle valve, which injects fuel into the intake port in the cylinder head.
- are deposit resistant.

Fuel Rail

The fuel rail:

- receives fuel from the fuel supply tube.
- delivers fuel to the fuel injectors.

Fuel Pump (FP) Control Module

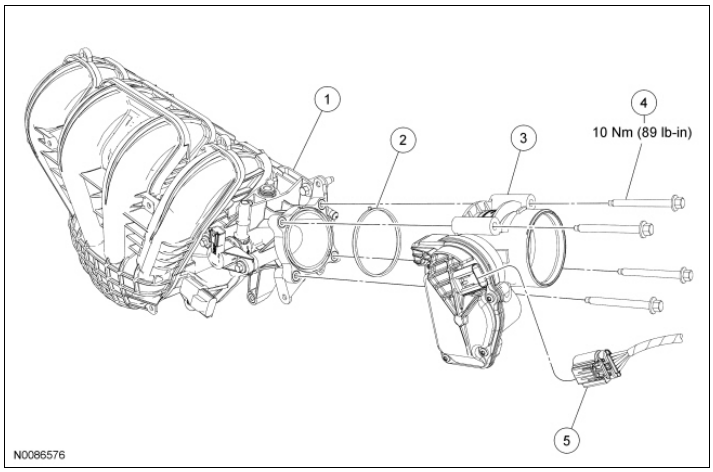
The FP control module:

- is electronically operated by the PCM.
- controls voltage (10 or 12 volts) to the FP module depending on load.

Fuel Charging and Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Throttle Body



Item	Part Number	Description
1	9424	Intake manifold
2	9E836	Throttle Body (TB) gasket
3	9E926	TB
4	W500305	TB bolt (4 required)
5	14A464	Elonic throttle control electrical connector

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12A .

2. Disconnect the electronic throttle control electrical connector.

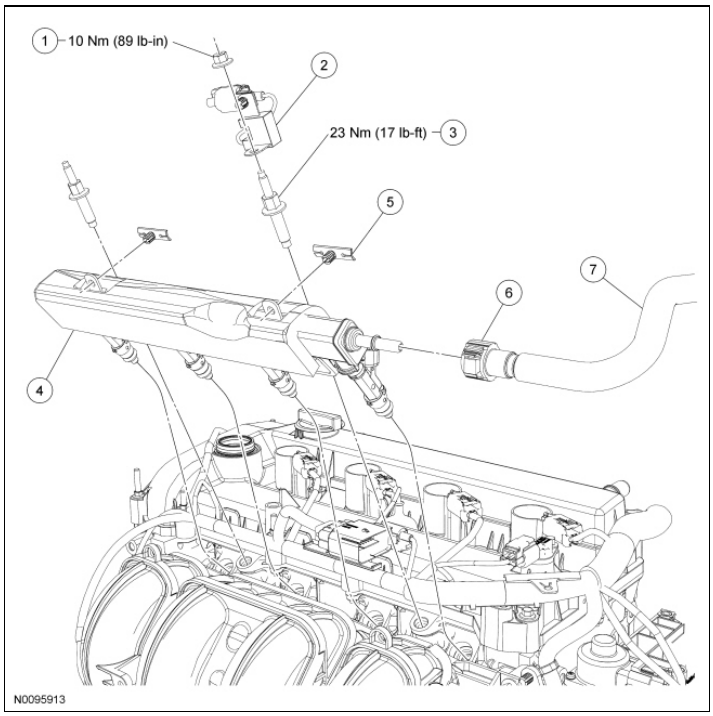
3. Remove the 4 bolts and the Throttle Body (TB).
   - Discard the TB gasket.
   - To install, tighten to 10 Nm (89 lb-in).

4. **NOTE:** Install a new TB gasket.

   To install, reverse the removal procedure.

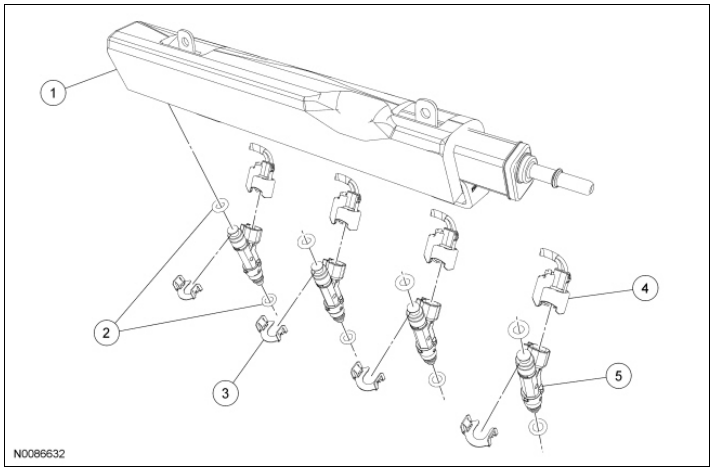
Fuel Rail and Fuel Injector - Exploded View

Fuel Rail



Item	Part Number	Description
1	W705790	Radio capacitor nut
2	18801	Radio capacitor
3	W711061	Fuel rail stud bolt (2 required)
4 d>9H487	Fuel rail	
5	-	Wire harness pin-type retainer (part of 12B637) (2 required)
6	-	Fuel supply tube-to-fuel rail quick connect coupling (part of 9288)
7	9288	Fuel supply tube

Fuel Injectors



Item	Part Number	Description
1	9H487	Fuel rail
2	9U509	Fuel injector O-ring seals (2 required per injector)
3	9C995	Fuel injector clip (4 required)
4	14A464	Fuel injector electrical connector (4 required)
5	9F593	Fuel injector (4 required)

1. For additional information, refer to the procedures in this section.

Fuel Rail

Material

Item	Specification
Motorcraft SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may gnited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Disconnect the fuel tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .
4. Detach the 2 wire harness pin-type retainers from the fuel rail.
5. Disconnect the 4 fuel injector electrical connectors.
6. Remove the nut and position the radio capacitor aside.
7. Remove the 2 fuel rail stud bolts.
8. Remove the fuel rail and fuel injectors as an assembly.
9. Remove the 4 fuel injector retainer clips and the fuel injectors.

- Remove and discard the 8 fuel injector O-ring seals.

Installation

1. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. Use of ordinary O-ring seals can cause the fuel system to leak. Do not reuse the O-ring seals.**

   NOTE: Install new fuel injector O-ring seals and lubricate them with clean engine oil.

   NOTE: Make sure the fuel rail retainer clips snap back into place.

   Install the 4 fuel injectors and the retainer clips into the fuel rail.

2. Install the fuel rail and fuel injectors as an assembly.

3. Install the 2 fuel rail stud bolts.
   - Tighten to 23 Nm (17 lb-ft).

4. Position the radio capacitor and install the nut.
   - Tighten to 10 Nm (89 lb-in).

5. Connect the 4 fuel injector electrical connectors.

6. Attach the 2 wire harness pin-type retainers.

7. Connect the fuel tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .

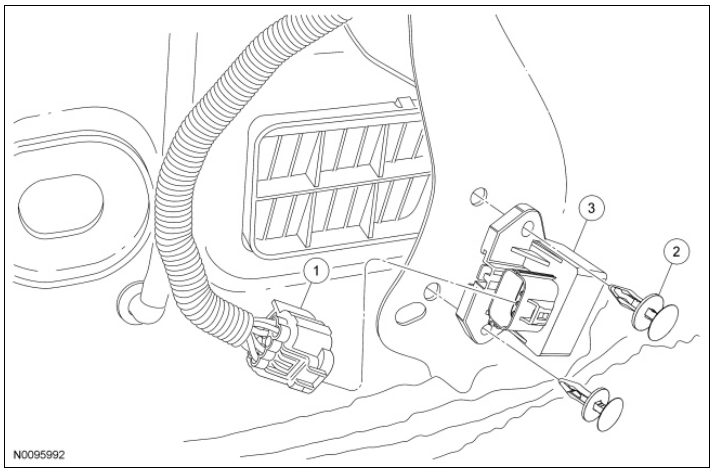
8. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Fuel Injectors

Removal and Installation

1. The fuel injectors are serviced with the fuel rail. For additional information, refer to Fuel Rail and Fuel Injector - Exploded View and Fuel Rail in this section.

Fuel Pump Control Module



Item	Part Number	Description
1	14A464	Fuel Pump (FP) control module electrical connector
2	W707373	FP control module pin-type retainer (2 required)
3	9345	FP control module

Removal and Installation

1. Position aside the LR quarter panel luggage compartment trim.
2. Disconnect the Fuel Pump (FP) control module electrical connector.
3. Remove the 2 pin-type retainers and the FP control module.
4. To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-

Torque Specifications

Description	Nm	lb-in
Fuel rail bolts	10	89
10	89	

Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

The fuel charging and controls system consists of the:

- Throttle Body (TB).
- fuel injectors.
- Fuel Pump (FP) control module.
- fuel rail.

The fuel charging and controls system is:

- a Sequential Multi-Port Fuel Injection (SFI) system.
- Pulse Width Modulated (PWM).
- Mass Air Flow (MAF) controlled.

Fuel is metered into each intake port in a sequential firing order. Fuel injectors pulse to follow engine firing order in accordance with engine demand on a tuned intake manifold.

The basic fuel requirement of the engine is determined from the data supplied to the PCM by the MAF sensor, which measures the amount of air being drawn into the engine.

Other sensors are used to measure:

- aimperature.
- engine coolant temperature.
- engine speed.
- exhaust oxygen content.

The various sensors detect any changes in the operating conditions and send signals to the PCM. This permits the PCM to control the opening duration (pulse width) of the fuel injectors and maintain optimum exhaust emission control and engine performance for all operating conditions.

Throttle Body (TB)

The TB :

- controls air supply to the upper intake manifold by electronically positioning the throttle plate.
- is not adjustable.
- cannot be cleaned.
- is serviced as a complete assembly only.

Fuel Injectors

The fuel injectors:

- are electronically operated by the PCM.
- atomize the fuel as the fuel is delivered.
- each have an internal solenoid that opens a needle valve, which injects fuel into the intake port in the cylinder head.
- are deposit resistant.

Fuel Rail

The fuel rail:

- receives fuel from the fuel supply tube.
- delivers fuel to the fuel injectors.
- has a Schrader valve on early build vehicles.

Fuel Pump (FP) Control Module

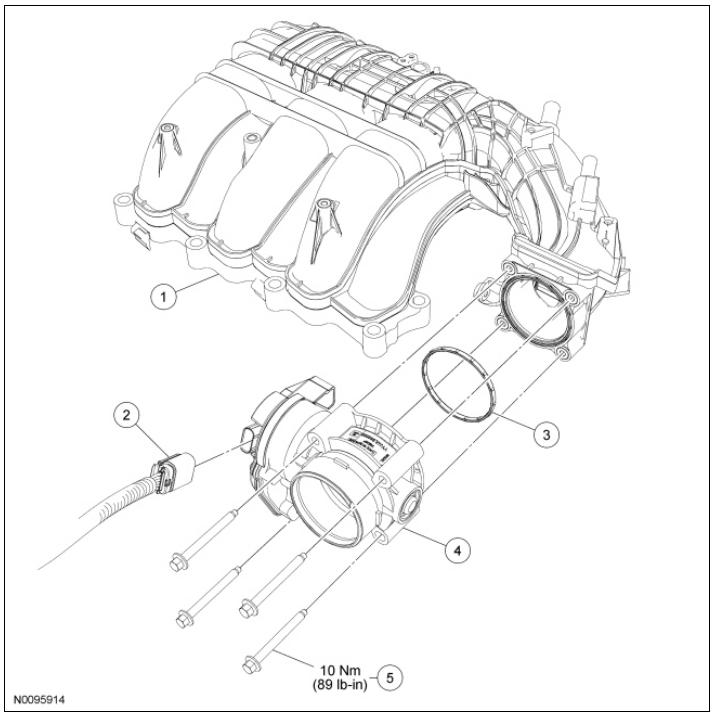
The FP control module:

- is electronically operated by the PCM.
- controls voltage (10 or 12 volts) to the FP module depending on load.

Fuel Charging and Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Throttle Body



Item	Part Number	Description
1	9424	Intake manifold
2	14A464	Electronic throttle control electrical connector
3	9E936	Throttle Body (TB) gasket
4	9E926	TB
5	W500305	TB bolt (4 required)

Removal and Installation

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12B .

2. Disconnect the electronic throttle control electrical connector.

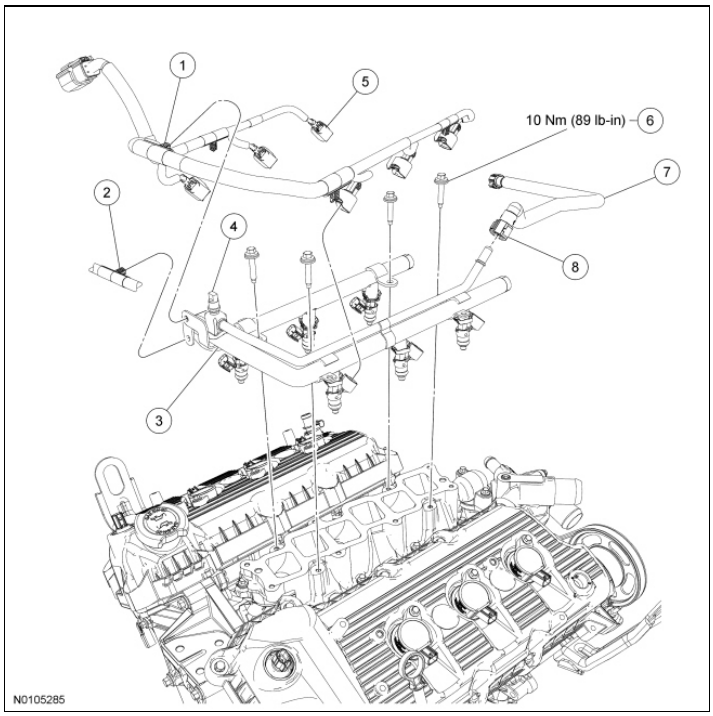
3. Remove the 4 bolts and the Throttle Body (TB).
   - Discard the TB gasket.
   - To install, tighten to 10 Nm (89 lb-in).

4. **NOTE:** Install a new TB gasket.

   To install, reverse the removal procedure.

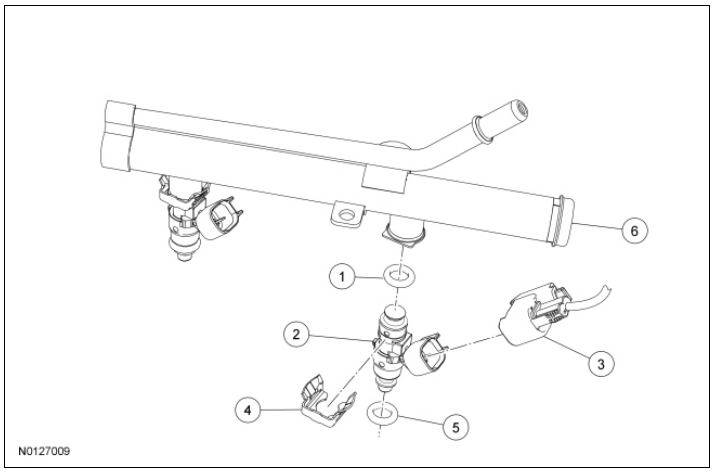
Fuel Rail and Fuel Injector - Exploded View

Fuel Rail



Item	Part Number	Description
1	-	Fuel charging wiring harness pin-type retainer (part of 9D930) (5 required)
2	-	Engine wiring harness pin-type retainer (part of 12A581)
3	9F792	Fuel rail
4	-	Fuel rail Schrader valve (part of 9F792)
5	-	Fuel injector electrical connector (part of 9D930) (6 required)
6	W503275	Fuel rail bolt (4 required)
7	9J285	Fuel jumper tube
8	-	Fuel jumper tube-to-fuel rail quick connect coupling (part of 9J285)

Fuel Injector



Item	Part Number	Description
1	9229	Upper fuel injector O-ring seal (6 required)
2	9F593	Fuel injector (6 required)
3	-	Fuel injector electrical connector (part of 14B485) (6 required)
4	9C995	Fuel injector clip (6 required)
5	9229	Lower fuel injector seal (6 required)
6	9F792	Fuel rail

1. For additional information, refer to the procedures in this section.

Fuel Rail

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the upper intake manifold. For additional information, refer to Section 303-01B .
4. Disconnect the fuel tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .
5. Release the 5 fuel charging wire harness pin-type retainers from the fuel rail.
6. Release the engine wire harness pin-type retainer from the fuel rail.
7. Disconnect the 6 fuel injector electrical connectors.
8. Remove the 4 fuel rail bolts.
9. Remove the fuel rail and injectors as an assembly.

10. Remove the 6 fuel injector clips and the 6 fuel injectors.
    - Remove and discard the 12 fuel injector O-ring seals.

Installation

1. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-ring seals can cause the fuel system to leak. Do not reuse the O-ring seals.**

   NOTE: Install new fuel injector O-ring seals and lubricate them with clean engine oil.

   Install the 6 fuel injectors and the 6 fuel injector clips into the fuel rail.

2. Install the fuel rail and fuel injectors as an assembly.

3. Install the 4 fuel rail bolts.
   - Tighten to 10 Nm (89 lb-in).

4. Connect the 6 fuel injector electrical connectors.

5. Attach the engine wire harness pin-retainer to the fuel rail.

6. Attach the 5 fuel charging wire harness pin-retainers to the fuel rail.

7. Connect the fuel tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .

8. Install the upper intake manifold. For additional information, refer to Section 303-01B .

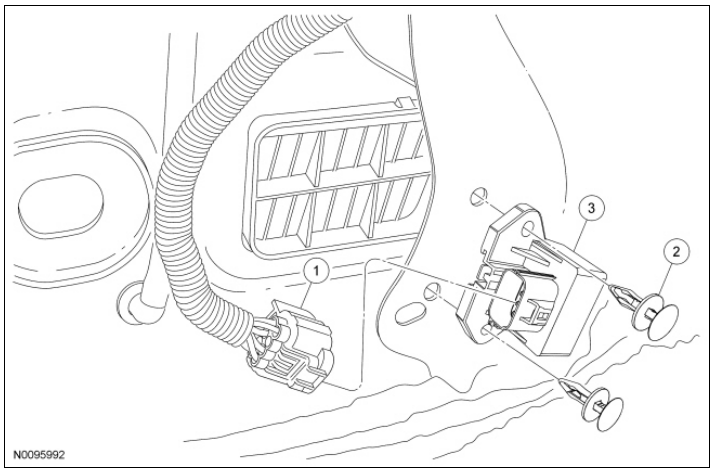
9. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Fuel Injectors

Removal and Installation

1. The fuel injectors are serviced with the fuel rail. For additional information, refer to Fuel Rail and Fuel Injector - Exploded View and Fuel Rail in this section.

Fuel Pump Control Module



Item	Part Number	Description
1	14A464	Fuel Pump (FP) control module electrical connector
2	W707373	FP control module pin-type retainer (2 required)
3	9345	FP control module

Removal and Installation

1. Position aside the LR quarter panel luggage compartment trim.
2. Disconnect the Fuel Pump (FP) control module electrical connector.
3. Remove the 2 pin-type retainers and the FP control module.
4. To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
Motorcraft SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-

Torque Specifications

Nm	lb-in	
Fuel rail bolts	10	89
Throttle Body (TB) bolts	10	89

Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

The fuel charging and controls system consists of the:

- Throttle Body (TB).
- fuel injectors.
- fuel rail.

The fuel charging and controls system is:

- a Sequential Multi-Port Fuel Injection (SFI) system.
- Pulse Width Modulated (PWM).
- Mass Air Flow (MAF) controlled.

Fuel is metered into each intake port isequential firing order. Fuel injectors pulse to follow engine firing order, in accordance with engine demand, on a tuned intake manifold.

The basic fuel requirement of the engine is determined from the data supplied to the PCM by the MAF sensor, which measures the amount of air being drawn into the engine.

The various sensors detect any changes in the operating conditions and send signals to the PCM. This permits the PCM to control the opening duration (pulse width) of the fuel injectors and maintain optimum exhaust emission control and engine performance for all operating conditions.

Throttle Body (TB)

The TB :

- controls air supply to the intake manifold by electronically positioning the throttle plate.
- is not adjustable.

Fuel Injectors

The fuel injectors:

- are electronically operated by the PCM.
- atomize the fuel as the fuel is delivered.
- each have an internal solenoid that opens a needle valve, which injects fuel into the intake port in the cylinder head.
- are deposit resistant.

Fuel Rail

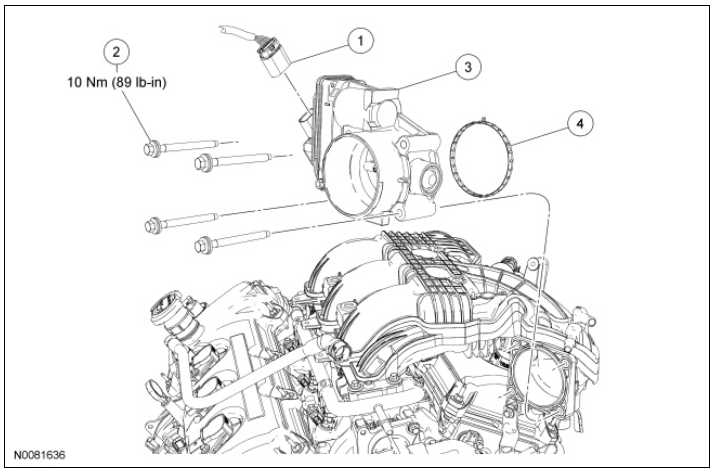
The fuel rail:

- receives fuel from the fuel supply tube.
- delivers fuel to the fuel injectors.

Fuel Charging and Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Throttle Body



Item	Part Number	Description
1	14A464	Electronic throttle control electrical connector (part of 12B637)
2	W503285	Throttle Body (TB) bolt (4 required)
3	9E926	TB
4	9E936	TB gasket

Removal and Installation

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12C .

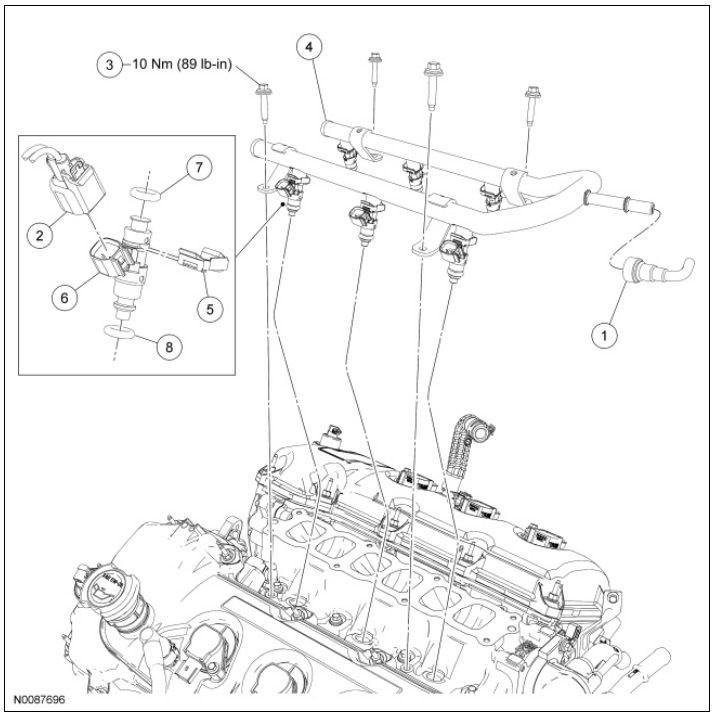
2. Disconnect the electronic throttle control electrical connector.

3. Remove the 4 bolts and the Throttle Body (TB).
   - Discard the TB gasket.
   - To install, tighten to 10 Nm (89 lb-in).

4. **NOTE:** Install a new TB gasket.

   To install, reverse the removal procedure.

Fuel Rail and Fuel Injector - Exploded View



Item	Part Number	Description
1	9J285	Fuel tube-to-fuel rail spring lock coupling
2	14A464	Fuel injector electrical connector (6 required) (part of 12B637)
3	W503279	Fuel rail bolt (4 required)
4	9F792	Fuel rail
5	9N976	
6	9F593	Fuel injector (6 required)
7	9229	Upper fuel injector O-ring seal (6 required)
8	9229	Lower fuel injector O-ring seal (6 required)

1. For additional information, refer to the procedures in this section.

Fuel Rail

Material

Item	Specification
Motorcraft SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may bnited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the upper intake manifold. For additional information, refer to Section 303-01C .
4. Disconnect the fuel tube-to-fuel rail spring lock coupling. For additional information, refer to Section 310-00 .
5. Disconnect the 6 fuel injector electrical connectors.
6. Remove the 4 fuel rail bolts.
7. Remove the fuel rail and injectors as an assembly.
8. Remove the 6 fuel injector clips and the 6 fuel injectors.
    - Remove and discard the 12 fuel injector O-ring seals.

Installation

1. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-ring seals can cause the fuel system to leak. Do not reuse the O-ring seals.**

   NOTE: The upper and lower fuel injector O-ring seals are similar in appearance, but are not interchangeable.

   NOTE: Install new fuel injector O-ring seals and lubricate them with clean engine oil.

   Install the 6 fuel injectors and the 6 fuel injector clips into the fuel rail.

2. Install the fuel rail and fuel injectors as an assembly.

3. Install the 4 fuel rail bolts.
   - Tighten to 10 Nm (89 lb-in).

4. Connect the 6 fuel injector electrical connectors.

5. Connect the fuel tube-to-fuel rail spring lock coupling. For additional information, refer to Section 310-00 .

6. Install the upper intake manifold. For additional information, refer to Section 303-01C .

7. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Fuel Injectors

Removal and Installation

1. The fuel injectors are serviced with the fuel rail. For additional information, refer to Fuel Rail and Fuel Injector - Exploded View and Fuel Rail in this section.

Material

Item	Specification	Fill Capacity
Motorcraft SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel rail stud bolts	23	17	-
Radio capacitor nut	10	-	89
Throttle Body (TB) bolts	10	-	89

Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

The fuel charging and controls system consists of the:

- Throttle Body (TB).
- fuel injectors.
- Fuel Pump (FP) control module.
- fuel rail.

The fuel charging and controls system is:

- a Sequential Multi-Port Fuel Injection (SFI) system.
- Pulse Width Modulated (PWM).
- Mass Air Flow (MAF) controlled.

Fuel is metered into each intake port in a sequential firing order. Fuel injectors pulse to follow engine firing order in accordance with engine demand on a tuned intake manifold.

The basic fuel requirement of the engine is determined from the data supplied to the PCM by the MAF sensor, which measures the amount of air being drawn into the engine.

Other sensors are used to measure:

- air temperature.
- engine coolant temperature.
- engine speed.
- exhaust oxygen content.

The various sensors detect any changes in the operating conditions and send signals to the PCM. This permits the PCM to control the opening duration (pulse width) of the fuel injectors and maintain optimum exhaust emission control and engine performance for all operating conditions.

Throttle Body (TB)

The TB :

- controls air supply to the upper intake manifold by electronically positioning the throttle plate.
- is not adjustable.
- cannot be cleaned.
- is serviced as a complete assembly only.

Fuel Injectors

The fuel injectors:

- are electronically operated by the PCM.
- atomize the fuel as the fuel is delivered.
- each have an internal solenoid that opens a needle valve, which injects fuel into the intake port in the cylinder head.
- are deposit resistant.

Fuel Rail

The fuel rail:

- receives fuel from the fuel supply tube.
- delivers fuel to the fuel injectors.

Fuel Pump (FP) Control Module

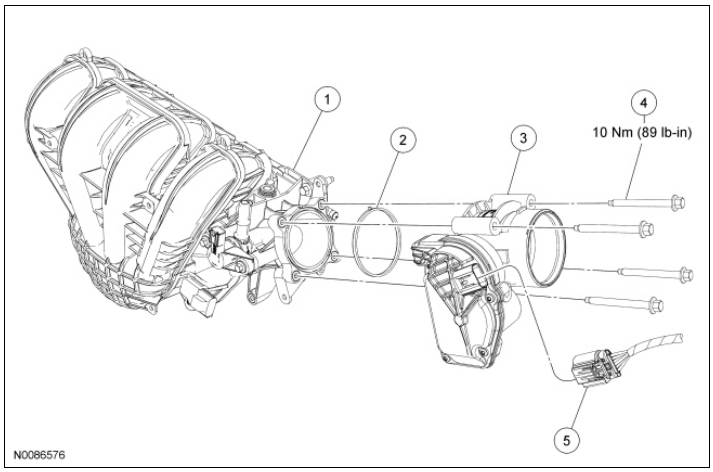
The FP control module:

- is electronically operated by the PCM.
- controls voltage (10 or 12 volts) to the FP module depending on load.

Fuel Charging and Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Throttle Body



Item	Part Number	Description
1	9424	Intake manifold
2	9E836	Throttle Body (TB) gasket
3	9E926	TB
4	W500305	TB bolt (4 required)
5	14A464	

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12D .

2. Disconnect the electronic throttle control electrical connector.

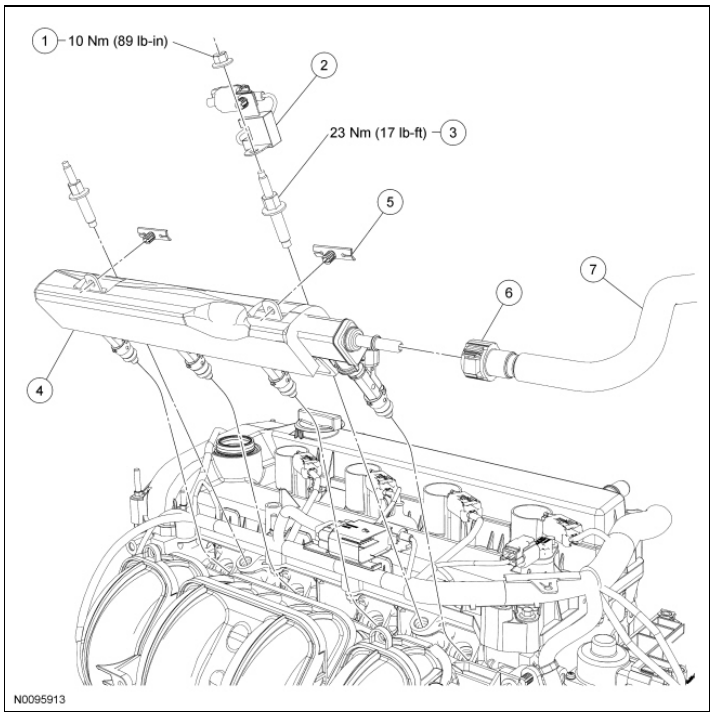
3. Remove the 4 bolts and the Throttle Body (TB).
   - Discard the TB gasket.
   - To install, tighten to 10 Nm (89 lb-in).

4. **NOTE:** Install a new TB gasket.

   To install, reverse the removal procedure.

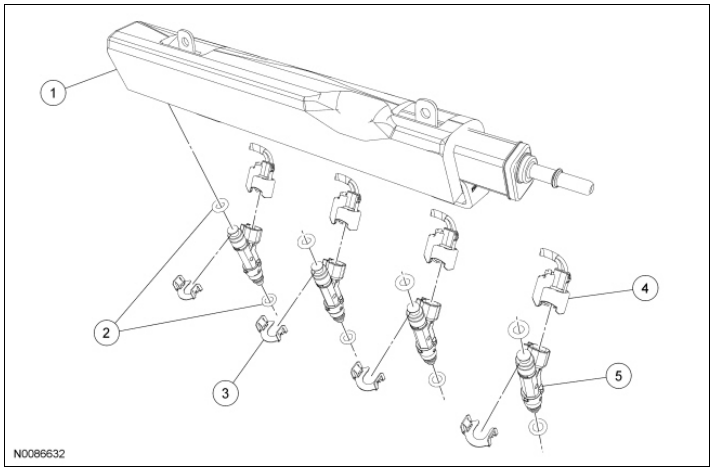
Fuel Rail and Fuel Injector - Exploded View

Fuel Rail



Item	Part Number	Description
1	W705790	Radio capacitor nut
2	18801	Radio capacitor
3	W711061	Fuel rail stud bolt (2 required)
	9H487	Fuel rail
5	-	Wire harness pin-type retainer (part of 12B637) (2 required)
6	-	Fuel supply tube-to-fuel rail quick connect coupling (part of 9288)
7	9288	Fuel supply tube

Fuel Injectors



Item	Part Number	Description
1	9H487	Fuel rail
2	9U509	Fuel injector O-ring seals (2 required per injector)
3	9C995	Fuel injector clip (4 required)
4	14A464	Fuel injector electrical connector (4 required)
5	9F593	Fuel injector (4 required)

1. For additional information, refer to the procedures in this section.

Fuel Rail

Material

Item	Specification
Motorcraft SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Disconnect the fuel tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .
4. Detach the 2 wire harness pin-type retainers from the fuel rail.
5. Disconnect the 4 fuel injector electrical connectors.
6. Remove the nut and position the radio capacitor aside.
7. Remove the 2 fuel rail stud bolts.
8. Remove the fuel rail and fuel injectors as an assembly.
9. Remove the 4 fuel injector retainer clips and the fuel injectors.

- Remove and discard the 8 fuel injector O-ring seals.

Installation

1. ***NOTICE:*** **Use O-ring seals that are made of special fuel-resistant material. Use of ordinary O-ring seals can cause the fuel system to leak. Do not reuse the O-ring seals.**

   NOTE: Install new fuel injector O-ring seals and lubricate them with clean engine oil.

   NOTE: Make sure the fuel rail retainer clips snap back into place.

   Install the 4 fuel injectors and the retainer clips into the fuel rail.

2. Install the fuel rail and fuel injectors as an assembly.

3. Install the 2 fuel rail stud bolts.
   - Tighten to 23 Nm (17 lb-ft).

4. Position the radio capacitor and install the nut.
   - Tighten to 10 Nm (89 lb-in).

5. Connect the 4 fuel injector electrical connectors.

6. Attach the 2 wire harness pin-type retainers.

7. Connect the fuel tube-to-fuel rail quick connect coupling. For additional information, refer to Section 310-00 .

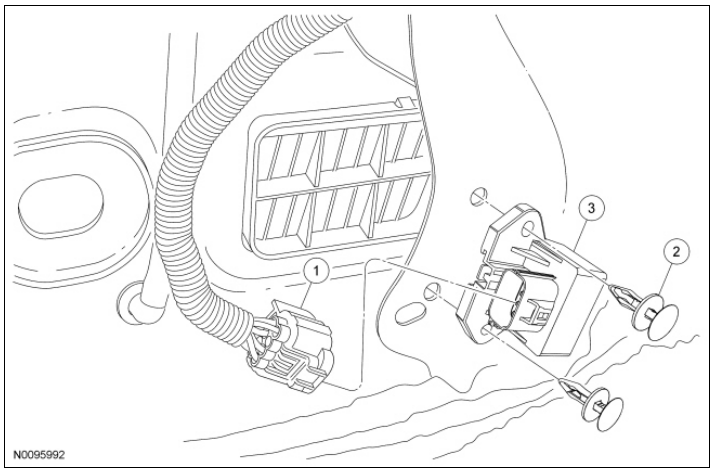
8. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Fuel Injectors

Removal and Installation

1. The fuel injectors are serviced with the fuel rail. For additional information, refer to Fuel Rail and Fuel Injector - Exploded View and Fuel Rail in this section.

Fuel Pump Control Module



Item	Part Number	Description
1	14A464	Fuel Pump (FP) control module electrical connector
2	W707373	FP control module pin-type retainer (2 required)
3	9345	FP control module

Removal and Installation

1. Position aside the LR quarter panel luggage compartment trim.
2. Disconnect the Fuel Pump (FP) control module electrical connector.
3. Remove the 2 pin-type retainers and the FP control module.
4. To install, reverse the removal procedure.

General Specifications

Item	Specification
Accessory drive belt	6 ribs

Torque Specifications

Description	Nm	lb-ft
Accessory drive belt idler pulley and bracket bolts	25	18
Accessory drive belt tensioner bolts	25	18
Accessory drive belt idler pulley bolt	25	18

p;

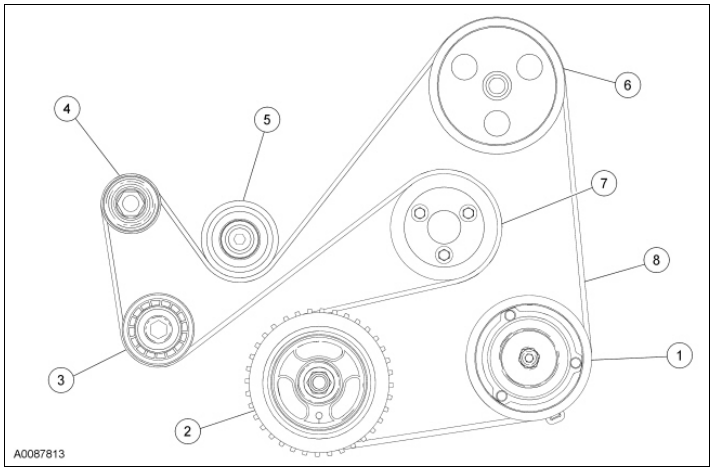
Accessory Drive

The accessory drive:

- has a single serpentine drive belt with 6 ribs.
- has automatic tensioning.
- is not adjustable.

The accessory drive system provides power to operate components which power other systems. These could include components such as the generator, power steering pump and A/C compressor. Each of these components is equipped with a pulley which is driven by the accessory drive belt. The accessory drive belt is driven by the engine crankshaft pulley. One or more idler pulleys may be provided to facilitate belt routing and alignment. The automatic belt tensioner maintains correct belt tension and compensates for component wear and changes in system load. System load changes can be caused by the A/C compressor clutch engaging or disengaging, or demand changes on other systems powered by the accessory drive belt. To maintain correct operation of this system, it is critical that the correct length drive belt be installed. The pulleys must also be correctly aligned and kept clean.

Accessoryve Belt Routing



Item	Part Number	Description
1	19D784	A/C compressor pulley
2	6316	Crankshaft pulley
3	6A228	Belt tensioner
4	10300	Generator pulley
5	8678	Idler pulley
6	8678	Idler pulley
7	8509	Coolant pump pulley
8	8620	Accessory drive belt

Belt Tensioner

NOTE: The accessory drive belt tensioner must be replaced as a complete unit.

Automatic tensioners are calibrated to provide the correct amount of tension to the belt for a given accessory drive system. Unless a spring or damping band within the tensioner assembly breaks, or some other mechanical part of the tensioner fails, there is no need to check the tensioner for correct tension.

Accessory Drive

Inspection and Verification

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or pulls have any fluids or belt dressing applied to them as damage to the belt material and tensioner damping mechanism may occur.**

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical damage.

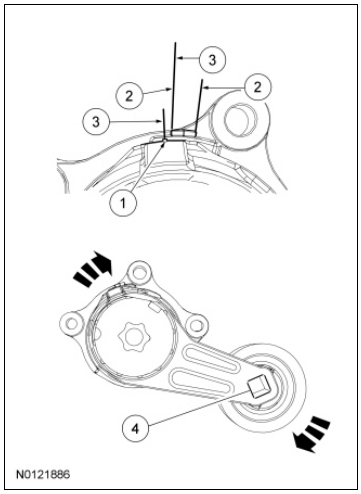
Visual Inspection Chart

Mechanical
• Drive belt cracking/chunking/wear • Belt/pulley contamination • Incorrect accessory drive belt • Incorrectly routed accessory drive belt • Pulley misalignment or excessive pulley runout • Loose or mislocated hardware • Incorrectly routed power steering tubes (rubbing) • Loose accessory drive belt • Damaged pulleys • Tensioner arm misalignment

Belt Tensioner With Belt Length Indicator

NOTE: Belt tensioner is shown in the free-state position against the arm travel stops.

NOTE: 6.2L engine accessory drive belt tensioner shown, other accessory drive belt tensioners similar.



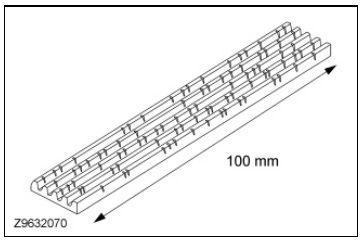
Item	Description
1	Belt length indicator
2	Acceptable belt installation and wear range
3	Belt replacement range
4	Belt tension relief point

3. Check that the belt length indicator, if equipped, on the belt tensioner is in the acceptable belt installation and wear range. If the indicator is in the belt replacement range, either an incorrect belt is installed or the belt is worn beyond the service limit. Install a new belt as necessary.

4. Eliminate all other non-belt related noises that could cause belt misdiagnosis, such as A/C compressor engagement chirp, A/C slugging noise, power steering cavitations at low temperatures, Variable Camshaft Timing (VCT) tick or generator whine.

5. If a concern is found, correct the condition before proceeding to the next step.

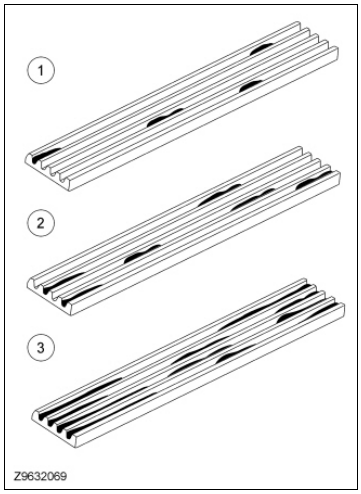
V-Ribbed Serpentine Drive Belt With Cracks Across Ribs



6. Check the belt for cracks. Up to 15 cracks in a rib over a distance of 100 mm (4.0 in) can be considered acceptable. If cracks exceed this standard, install a new belt.

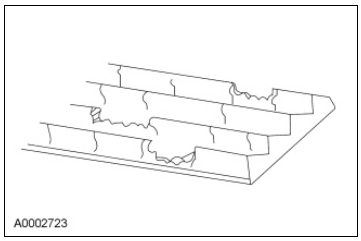
V-Ribbed Serpentine Belt With Piling

NOTE: Piling is an excessive buildup in the V-grooves of the belt.



7. The condition of the V-ribbed drive belt should be compared against the illustration and appropriate action taken.
    1. Small scattered deposits of rubber material. This is not a concern, therefore, installation of a new belt is not required.
    2. Longer deposit areas building up to 50% of the rib height. This is not considered a durability concern, but it can result in excessive noise. If noise is apparent, install a new belt.
    3. Heavy deposits building up along the grooves resulting in a possible noise and belt stability concern. If heavy deposits are apparent, install a new belt.

V-Ribbed Serpentine Belt With Chunks of Rib Missing



8. There should be no chunks missing from the belt ribs. If the belt shows any evidence of this, install a new accessory drive belt.

9. If the concern is not visually evident, verify the symptom and GO to Symptom Chart .

Symptom Chart

Symptom Chart

Component Tests

Drive Belt - Noise/Flutter

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or pulleys have any fluids or belt dressing applied to them as damage to the belt material and tensioner damping mechanism may occur.**

Drive belt chirp occurs due to pulley misalignment or excessive pulley runout. It can be the result of a damaged or incorrectly aligned grooved pulley.

To correct, determine the area where the noise comes from. Chec of the pulleys in that area with a straightedge to the crankshaft pulley. Look for accessory pulleys out of position in the fore/aft direction or at an angle to the straightedge.

Drive belt squeal may be an intermittent or constant noise that occurs when the drive belt slips on an accessory pulley under certain conditions.

A short intermittent squeal may occur during engine start up and shut down or during very rapid engine acceleration and decelerations, such as:

- Wide Open Throttle (WOT) 1-2 and 2-3 shifts or 2-3 and 3-4 back-out shifts on automatic transmissions.
- WOT 1-2 and 2-3 shifts and any combination of rapid downshifting on manual transmissions.

These special short-term transient events are expected, and are due to the higher system inertias required to meet the electrical and cooling demands on today's vehicle systems. Constant or reoccurring drive belt squeal can occur:

- if the A/C discharge pressure goes above specifications:
  - ♦ the A/C system is overcharged.
  - ♦ the A/C condenser core airflow is blocked.
  - ♦ the A/C anti-slugging strategy executes after a long hot heat soak.
- if the A/C off equalized pressure (the common discharged and suction pressure that occurs after several minutes) exceeds specifications.
- if any of the accessories or idler pulley(s) are damaged or have a worn or damaged bearing. All accessories should be rotatable by hand in the unloaded condition. If not, inspect the accessory.
- if there is evidence of fluid contamination on the accessory drive belt. When the drive belt has been exposed to fluid contamination during vehicle operation, such as leaks from the power steering system, A/C system or cooling system, clean all pulleys with soap and water, rinse with clean water and install a new accessory drive belt. If the drive belt has been exposed to fluids in a localized area during routine vehicle service, such as replacement of hoses or fluids, the drive belt and pulleys should be washed with soap and water immediately (prior to starting the engine), and rinsed with clean water.
- if the accessory drive belt is too long. A drive belt that is too long will allow the accessory drive belt tensioner arm to go all the way to the arm travel stop under certain load conditions, which will release tension to the drive belt. If the accessory drive belt tensioner indicator is outside the normal installation wear range window, install a new accessory drive belt.
- **NOTE:** The accessory drive belt tensioner arm should rotate freely without binding.

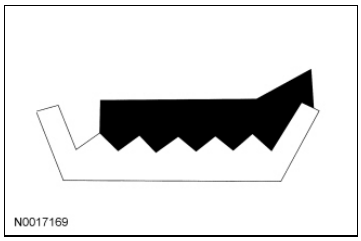
  Install a new accessory drive belt tensioner if the drive belt tensioner is worn or damaged.

Drive Belt - Incorrect Installation

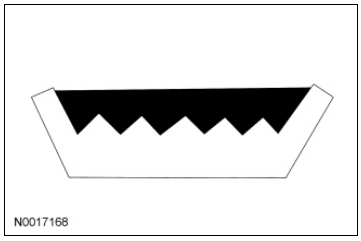
NOTICE: **Incorrect accessory drive belt installation will cause excessive drive belt wear and may cause the drive belt to come off the pulleys.**

Non-standard accessory drive belts can track differently or incorrectly. If an accessory drive belt tracks incorrectly, install a new accessory drive belt to avoid performance failure or loss of the drive belt.

Incorrect Installation



Correct Installation



With the engine running, check accessory drive belt tracking on all pulleys. If the edge of the accessory drive belt rides beyond the edge of the pulleys, noise and premature wear will occur. Make sure the accessory drive belt rides correctly on the pulley. If an accessory drive belt tracking condition exists, proceed with the following:

- Visually check the accessory drive belt tensioner for damage and wear, especially the mounting pad surface and arm alignment. If the accessory drive belt tensioner is not installed correctly, the mounting surface pad will be out of position. If the tensioner arm is worn, the arm will be out of alignment. Either of these conditions will result in chirp and squeal noises.
- With the engine running, visually observe the grooves in the pulleys (not the pulley flanges or the pulley forward faces) for excessive wobble. Install new components as necessary.
- Check all accessories, mounting brackets and the accessory drive belt tensioner for any interference that would prevent the component from mounting correctly. Correct any interference condition and recheck the accessory drive belt tracking.
- Tighten all accessories, mounting brackets and accessory drive belt tensioner retaining hardware to specification. Recheck the accessory drive belt tracking.

Belt Tensioner - Mechanical

The only mechanical check that needs to be made is a check for tensioner stick, grab or bind.

1. With the engine off, check routing of the accessory drive belt. Refer to the illustrations under Accessory Drive in the Description and Operation portion of this section.

2. **NOTE:** The accessory drive belt tensioner spring is very strong and requires substantial force to release.

   Release the tension on the belt and detach the accessory drive belt from the tensioner. Carry out the following tests:

   - Move the tensioner from its relaxed position, through its full stroke and back to the relaxed position to make sure there is no stick, grab or bind, and to make sure that there is tension on the tensioner spring.

- Rotate the tensioner pulley by hand and check for a binding, contaminated or seized condition.
- Inspect the area surrounding the accessory drive belt tensioner for oil leaks or contamination and repair any leaks.

3. If the accessory drive belt tensioner does not meet the criteria in the previous step, install a new tensioner. If the accessory drive belt tensioner meets the criteria in the previous step, proceed to testing the tensioner dynamically.

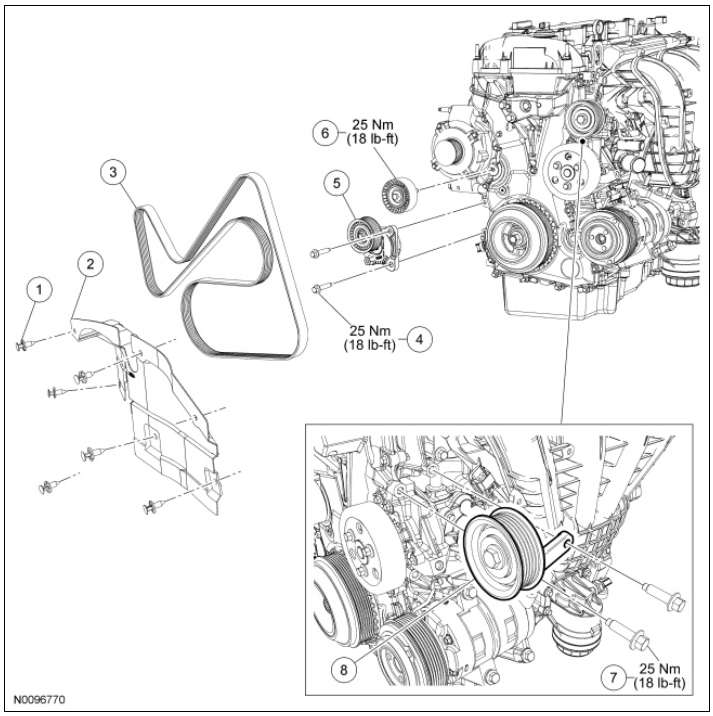
4. If the tensioner is saturated with oil and grease internally, install a new tensioner.

Belt Tensioner - Dynamics

The accessory drive belt tensioner can be checked dynamically as follows:

1. With the engine running, observe the accessory drive belt tensioner movement. The accessory drive tensioner should move (respond) when the A/C clutch cycles (if equipped), or when the engine is accelerated rapidly. If the accessory drive belt tensioner movement is excessive without A/C clutch cycling or engine acceleration, check belt rideout. Excessive belt rideout (uneven depth of grooves in the belt) can cause excessive accessory drive belt tensioner movement. Check rideout condition by installing a new belt. If excessive accessory drive belt tensioner mement still exists, install a new accessory drive belt tensioner.

Front End Accessory Drive (FEAD) - Exploded View



Item	Part Number	Description
1	N807389	Pin-type retainer (6 required)
2	010204	RH splash shield
3	8620	Accessory drive belt
4	W500314	Accessory drive belt tensioner bolt (2 required)
5	6A228	Accessory drive belt tensioner
6	19A216	Accessory drive belt idler pulley (smooth)
7	W500225	Accessory drive belt idler pulley and bracket bolt (2 required)
8	19A216	Accessory drive belt idler pulley (grooved) and bracket

1. For additional information, refer to the procedures in this section.

Accessory Drive Belt

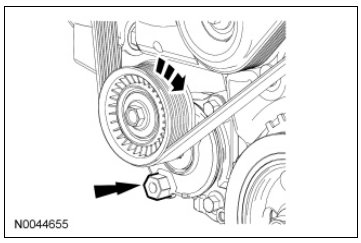
Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 4 screws and position the RH fender splash shield aside.

3. Remove the 6 pin-type retainers and the RH splash shield.

4. Using the hex feature, rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt from the coolant pump pulley.
    - Remove the accessory drive belt from the engine.



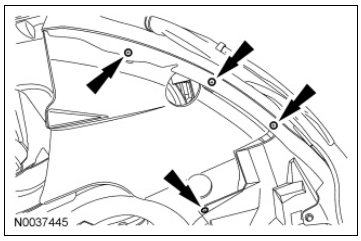
5. To install, reverse the removal procedure.

Accessory Drive Belt Tensioner

Removal and Installation

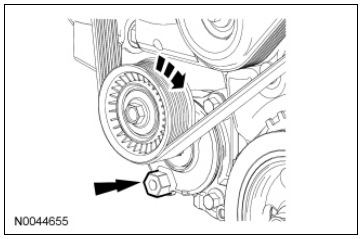
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 4 screws and position the RH fender splash shield aside.



3. Remove the 6 pin-type retainers and the RH splash shield.

4. Using the hex feature, rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt from the coolant pump pulley.



5. **NOTE:** The accessory drive belt tensioner must be replaced as a complete unit.

   Remove the 2 bolts and the accessory drive belt tensioner.

   - To install, tighten to 25 Nm (18 lb-ft).

6. To install, reverse the removal procedure.

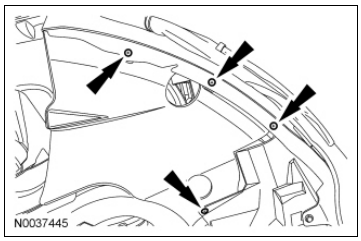
Accessory Drive Belt Idler Pulley

Removal and Installation

All idler pulleys

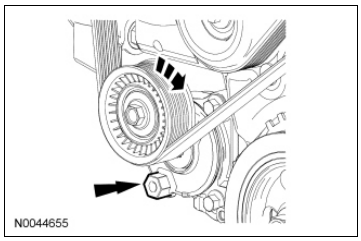
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 4 screws and position the RH fender splash shield aside.



3. Remove the 6 pin-type retainers and the RH splash shield.

Using the hex feature, rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt from the idler pulley.



Smooth idler pulley

5. Loosen the bolt and remove the accessory drive belt idler pulley.
    - To install, tighten to 25 Nm (18 lb-ft).

Grooved idler pulley

6. **NOTE:** The grooved accessory drive belt idler pulley and bracket must be replaced as a complete unit.

   Remove the 2 bolts and the grooved accessory drive belt idler pulley and bracket.

    - To install, tighten to 25 Nm (18 lb-ft).

7. To install, reverse the removal procedure.

General Specifications

Item	Specification
Accessory drive belt	6 ribs
Coolant pump belt	3 ribs

Torque Specifications

Description	Nm	lb-ft
Accessory drive belt tensioner bolts	25	18

Accessory Drive

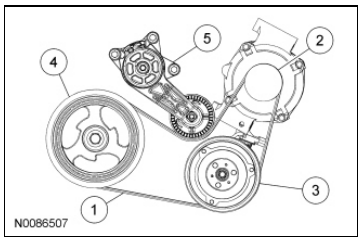
The accessory drive:

- has a single serpentine drive belt with 6 ribs.
- has an automatic drive belt tensioner.
- has a V-ribbed coolant pump belt.

The accessory drive system provides power to operate components which power other systems. These could include components such as the generator, power steering pump and A/C compressor. Each of these components is equipped with a pulley which is driven by the accessory drive belt. The accessory drive belt is driven by the engine crankshaft pulley. One or more idler pulleys may be provided to facilitate belt routing and alignment. The automatic belt tensioner maintains correct belt tension and compensates for component wear and changes in system load. System load changes can be caused by the A/C compressor clutch engaging or disengaging, or demand changes on other systpowered by the accessory drive belt. To maintain correct operation of this system, it is critical that the correct length drive belt be installed. The pulleys must also be correctly aligned and kept clean.

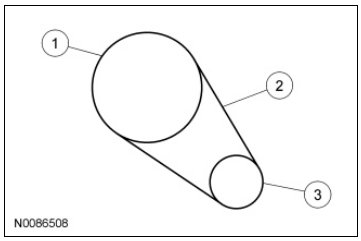
Accessory Drive Belt Routing

Accessory Drive Belt



Item	Part Number	Description
1	8620	Accessory drive belt
2	10344	Generator pulley
3	19D784	A/C clutch pulley
4	6316	Crankshaft pulley
5	6B209	Accessory drive belt tensioner

Coolant Pump Drive Belt



Item	Part Number	Description
1	6A359	Camshaft drive pulley
2	8620	Coolant pump drive belt
3	8A528	Coolant pump pulley

Belt Tensioner

Automatic tensioners are calibrated to provide the correct amount of tension to the belt for a given accessory drive system. Unless a spring or damping band within the tensioner assembly breaks, or some other mechanical part of the tensioner fails, there is no need to check the tensioner for correct tension.

Accessory Drive

Inspection and Verification

NOTICE: **Under no circumstances should the accessory drive belt, tension or pulleys have any fluids or belt dressing applied to them as damage to the belt material and tensioner damping mechanism may occur.**

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical damage.

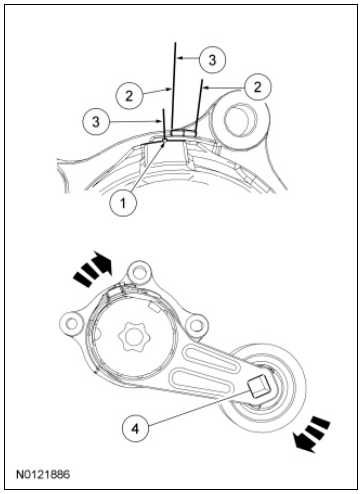
Visual Inspection Chart

Mechanical
• Drive belt cracking/chunking/wear • Belt/pulley contamination • Incorrect accessory drive belt • Incorrectly routed accessory drive belt • Pulley misalignment or excessive pulley runout • Loose or mislocated hardware • Incorrectly routed power steering tubes (rubbing) • Loose accessory drive belt • Damaged pulleys • Tensioner arm misalignment

Belt Tensioner With Belt Length Indicator

NOTE: Belt tensioner is shown in the free-state position against the arm travel stops.

NOTE: 6.2L engine accessory drive belt tensioner shown, other accessory drive belt tensioners similar.



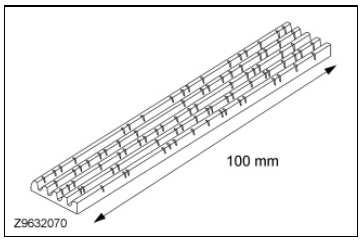
Item	Description
1	Belt length indicator
2	Acceptable belt installation and wear range
3	Belt replacement range
4	Belt tension relief point

3. Check that the belt length indicator, if equipped, on the belt tensioner is in the acceptable belt installation and wear range. If the indicator is in the belt replacement range, either an incorrect belt is installed or the belt is worn beyond the service limit. Install a new belt as necessary.

4. Eliminate all other non-belt related noises that could cause belt misdiagnosis, such as A/C compressor engagement chirp, A/C slugging noise, power steering cavitations at low temperatures, Variable Camshaft Timing (VCT) tick or generator whine.

5. If a concern is found, correct the condition before proceeding to the next step.

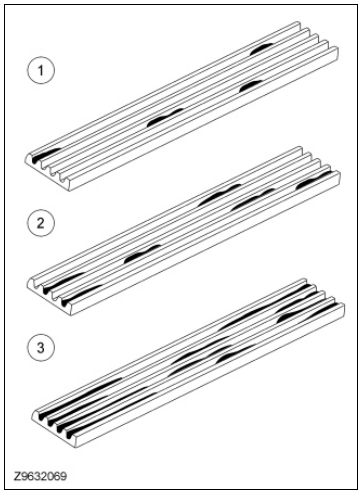
V-Ribbed Serpentine Drive Belt With Cracks Across Ribs



6. Check the belt for cracks. Up to 15 cracks in a rib over a distance of 100 mm (4.0 in) can be considered acceptable. If cracks exceed this standard, install a new belt.

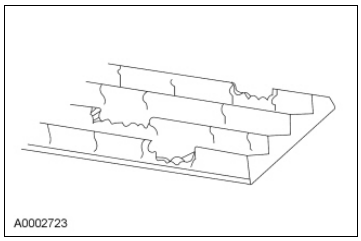
V-Ribbed Serpentine Belt With Piling

NOTE: Piling is an excessive buildup in the V-grooves of the belt.



7. The condition of the V-ribbed drive belt should be compared against the illustration and appropriate action taken.
    1. Small scattered deposits of rubber material. This is not a concern, therefore, installation of a new belt is not required.
    2. Longer deposit areas building up to 50% of the rib height. This is not considered a durability concern, but it can result in excessive noise. If noise is apparent, install a new belt.
    3. Heavy deposits building up along the grooves resulting in a possible noise and belt stability concern. If heavy deposits are apparent, install a new belt.

V-Ribbed Serpentine Belt With Chunks of Rib Missing



8. There should be no chunks missing from the belt ribs. If the belt shows any evidence of this, install a new accessory drive belt.

9. If the concern is not visually evident, verify the symptom and GO to Symptom Chart .

Symptom Chart

Symptom Chart

Component Tests

Drive Belt - Noise/Flutter

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or pulleys have any fluids or belt dressing applied to them as damage to the belt material and tensioner damping mechanism may occur.**

Drive belt chirp occurs due to pulley misalignment or excessive pulley runout. It can be the result of a damaged or incorrectly aligned grooved pulley.

To correct, determine the area where the noise comes Check each of the pulleys in that area with a straightedge to the crankshaft pulley. Look for accessory pulleys out of position in the fore/aft direction or at an angle to the straightedge.

Drive belt squeal may be an intermittent or constant noise that occurs when the drive belt slips on an accessory pulley under certain conditions.

A short intermittent squeal may occur during engine start up and shut down or during very rapid engine acceleration and decelerations, such as:

- Wide Open Throttle (WOT) 1-2 and 2-3 shifts or 2-3 and 3-4 back-out shifts on automatic transmissions.
- WOT 1-2 and 2-3 shifts and any combination of rapid downshifting on manual transmissions.

These special short-term transient events are expected, and are due to the higher system inertias required to meet the electrical and cooling demands on today's vehicle systems. Constant or reoccurring drive belt squeal can occur:

- if the A/C discharge pressure goes above specifications:
  - ♦ the A/C system is overcharged.
  - ♦ the A/C condenser core airflow is blocked.
  - ♦ the A/C anti-slugging strategy executes after a long hot heat soak.
- if the A/C off equalized pressure (the common discharged and suction pressure that occurs after several minutes) exceeds specifications.
- if any of the accessories or idler pulley(s) are damaged or have a worn or damaged bearing. All accessories should be rotatable by hand in the unloaded condition. If not, inspect the accessory.
- if there is evidence of fluid contamination on the accessory drive belt. When the drive belt has been exposed to fluid contamination during vehicle operation, such as leaks from the power steering system, A/C system or cooling system, clean all pulleys with soap and water, rinse with clean water and install a new accessory drive belt. If the drive belt has been exposed to fluids in a localized area during routine vehicle service, such as replacement of hoses or fluids, the drive belt and pulleys should be washed with soap and water immediately (prior to starting the engine), and rinsed with clean water.
- if the accessory drive belt is too long. A drive belt that is too long will allow the accessory drive belt tensioner arm to go all the way to the arm travel stop under certain load conditions, which will release tension to the drive belt. If the accessory drive belt tensioner indicator is outside the normal installation wear range window, install a new accessory drive belt.
- **NOTE:** The accessory drive belt tensioner arm should rotate freely without binding.

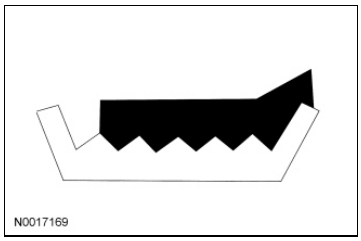
  Install a new accessory drive belt tensioner if the drive belt tensioner is worn or damaged.

Drive Belt - Incorrect Installation

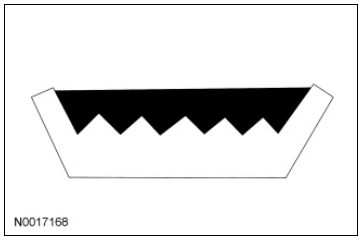
NOTICE: **Incorrect accessory drive belt installation will cause excessive drive belt wear and may cause the drive belt to come off the pulleys.**

Non-standard accessory drive belts can track differently or incorrectly. If an accessory drive belt tracks incorrectly, install a new accessory drive belt to avoid performance failure or loss of the drive belt.

Incorrect Installation



Correct Installation



With the engine running, check accessory drive belt tracking on all pulleys. If the edge of the accessory drive belt rides beyond the edge of the pulleys, noise and premature wear will occur. Make sure the accessory drive belt rides correctly on the pulley. If an accessory drive belt tracking condition exists, proceed with the following:

- Visually check the accessory drive belt tensioner for damage and wear, especially the mounting pad surface and arm alignment. If the accessory drive belt tensioner is not installed correctly, the mounting surface pad will be out of position. If the tensioner arm is worn, the arm will be out of alignment. Either of these conditions will result in chirp and squeal noises.
- With the engine running, visually observe the grooves in the pulleys (not the pulley flanges or the pulley forward faces) for excessive wobble. Install new components as necessary.
- Check all accessories, mounting brackets and the accessory drive belt tensioner for any interference that would prevent the component from mounting correctly. Correct any interference condition and recheck the accessory drive belt tracking.
- Tighten all accessories, mounting brackets and accessory drive belt tensioner retaining hardware to specification. Recheck the accessory drive belt tracking.

Belt Tensioner - Mechanical

The only mechanical check that needs to be made is a check for tensioner stick, grab or bind.

1. With the engine off, check routing of the accessory drive belt. Refer to the illustrations under Accessory Drive in the Description and Operation portion of this section.

2. **NOTE:** The accessory drive belt tensioner spring is very strong and requires substantial force to release.

   Release the tension on the belt and detach the accessory drive belt from the tensioner. Carry out the following tests:

   - Move the tensioner from its relaxed position, through its full stroke and back to the relaxed position to make sure there is no stick, grab or bind, and to make sure that there is tension on the tensioner spring.

- Rotate the tensioner pulley by hand and check for a binding, contaminated or seized condition.
- Inspect the area surrounding the accessory drive belt tensioner for oil leaks or contamination and repair any leaks.

3. If the accessory drive belt tensioner does not meet the criteria in the previous step, install a new tensioner. If the accessory drive belt tensioner meets the criteria in the previous step, proceed to testing the tensioner dynamically.

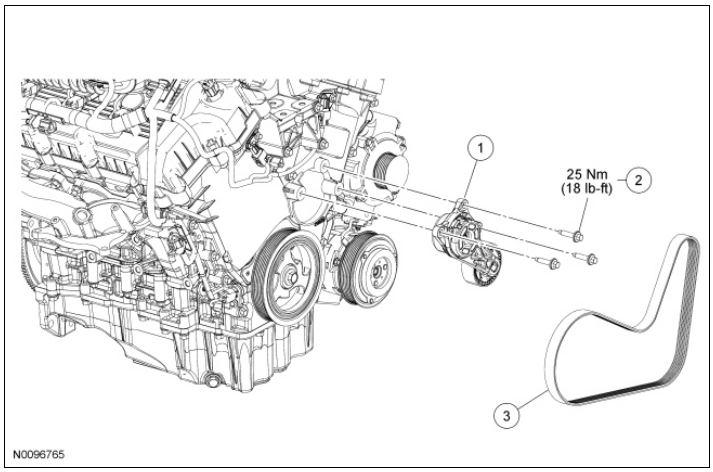
4. If the tensioner is saturated with oil and grease internally, install a new tensioner.

Belt Tensioner - Dynamics

The accessory drive belt tensioner can be checked dynamically as follows:

1. With the engine running, observe the accessory drive belt tensioner movement. The accessory drive tensioner should move (respond) when the A/C clutch cycles (if equipped), or when the engine is accelerated rapidly. If the accessory drive belt tensioner movement is excessive without A/C clutch cycling or engine acceleration, check belt rideout. Excessive belt rideout (uneven depth of grooves in the belt) can cause excessive accessory drive belt tensioner movement. Check rideout condition by installing a new belt. If excessive accessory drive belt tsioner movement still exists, install a new accessory drive belt tensioner.

Front End Accessory Drive (FEAD) - Exploded View



Item	Part Number	Description
1	6B209	Accessory drive belt tensioner
2	W503297	Accessory drive belt tensioner bolt (3 required)
3	8620	Accessory drive belt

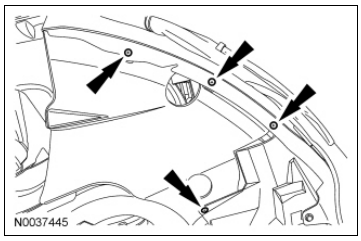
1. For additional information, refer to the procedures in this section.

Accessory Drive Belt

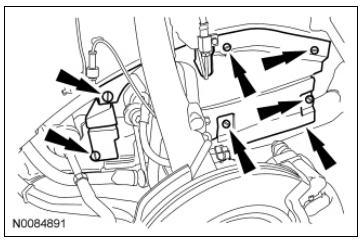
Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 4 screws and position the RH fender splash shield aside.



3. Remove the 6 pin-type retainers and the RH splash shield.



4. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.

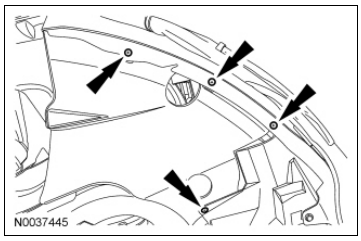
5. To install, reverse the removal procedure.

Accessory Drive Belt Tensioner

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 4 screws and position the RH fender splash shield aside.



3. Remove the 6 pin-type retainers and the RH splash shield.

.

4. Rotate the accessory drive belt tensioner counterclockwise and position the accessory drive belt off of the accessory drive belt tensioner.

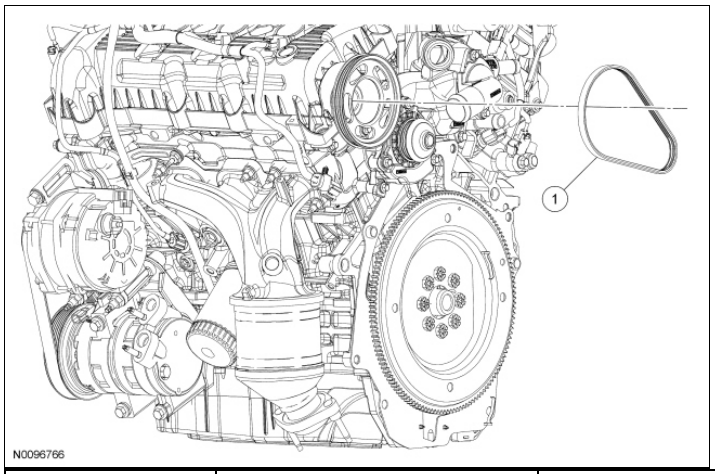
5. Remove the 3 bolts and the accessory drive belt tensioner.
   - To install, tighten to 25 Nm (18 lb-ft).

6. To install, reverse the removal procedure.

Coolant Pump Belt

Special Tool(s)

 ST3085-A	Remover, Stretchy Belt 303-1419

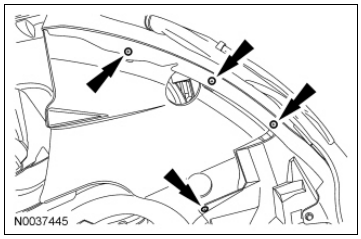


Item	Part Number	Description
1	8620	Coolant pump belt

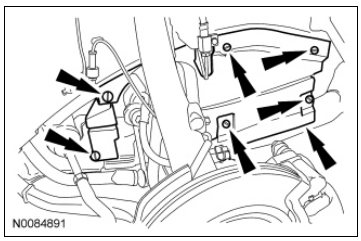
Ral

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

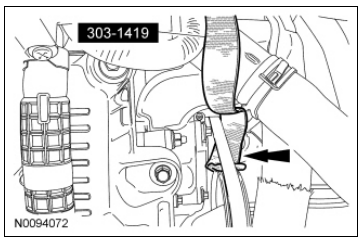
2. Remove the 4 screws and position the RH fender splash shield aside.



3. Remove the 6 pin-type retainers and the RH splash shield.

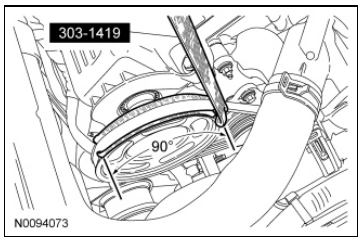


4. Position the Stretchy Belt Remover under the coolant pump belt as shown.

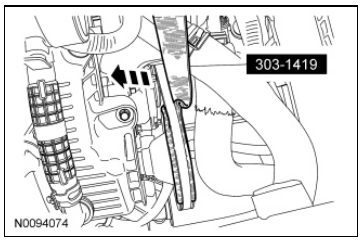


5. **NOTE:** Feed the Stretchy Belt Remover on to the camshaft coolant pump pulley approximately 90 degrees.

   With the help of an assistant, turn the crankshaft clockwise and feed the Stretchy Belt Remover evenly on the camshaft coolant pump pulley as shown.

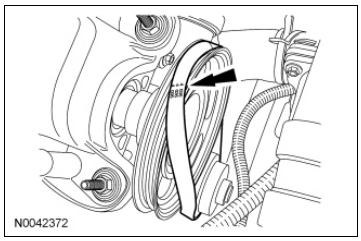


6. Remove the coolant pump belt.
   - Fold the Stretchy Belt Remover over the top of the coolant pump belt.
   - In one quick motion, pull the Stretchy Belt Remover up and toward the RH front of the vehicle removing the coolant pump belt.



Installation

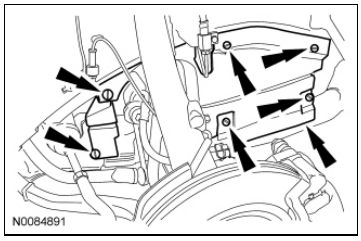
1. Install the coolant pump belt on the coolant pump pulley and position it on the camshaft pulley.



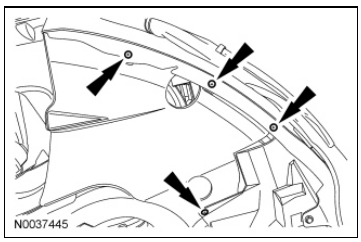
2. *NOTICE:* **Do not use any screwdrivers, pliers or other metal objects that could cause damage to the belt or camshaft pulley while installing the belt.**

   Rotate the crankshaft clockwise to seat the coolant pump belt on the camshaft pulley.

3. Install the RH splash shield and the 6 pin-type retainers.



4. Position the RH fender splash shield and install the 4 screws.



General Specifications

Item	Specification
Accessory drive belt	6 ribs
Power steering pump drive belt (if equipped)	4 ribs

Torque Specifications

Description	Nm	lb-in
Accessory drive belt tensioner bolts	11	97

Accessory Drive

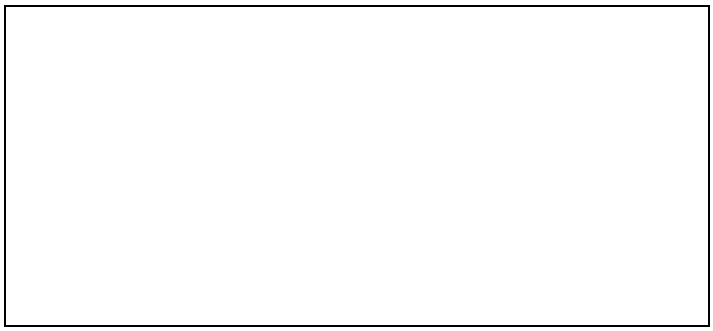
This vehicle is equipped with the following components:

- V-ribbed serpentine accessory drive belt
- Automatic drive belt tensioner
- V-ribbed power steering pump drive belt

The accessory drive system provides power to operate components which power other systems. These could include components such as the generator, power steering pump and A/C compressor. Each of these components is equipped with a pulley which is driven by the accessory drive belt. The accessory drive belt is driven by the engine crankshaft pulley. The automatic belt tensioner maintains correct belt tension and compensates for component wear and changes in system load. System load changes can be caused by the A/C compressor clutch engaging or disengaging or demand changes on other systems powered by the accessory drive belt. To maintain correct operation of this system, it is critical that the correct length drive belt be installed. The pulleys must also be correctly aligned and kept clean.

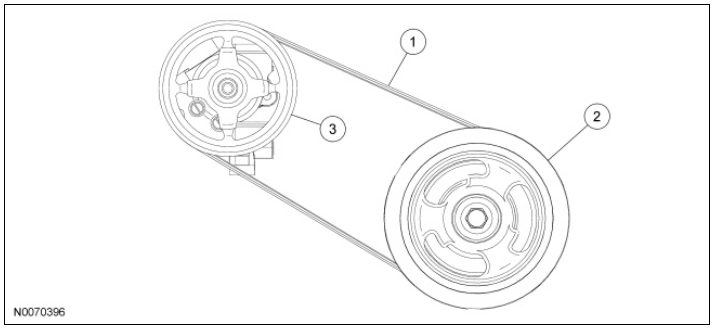
Accessory Drive Belt Routing

Front End Accessory Drive (FEAD) Belt



Item	Part Number	Description
1	6B209	Accessory drive belt tensioner pulley
2	10300	Generator pulley
3	19D784	A/C clutch pulley
4	8620	Accessory drive belt
5	6316	Crankshaft pulley

Power Steering Pump Belt



Item	Part Number	Description
1	6C301	Power steering pump drive belt
2	6316	Crankshaft pulley
3	3D639	Power steering pump pulley

Belt Tensioner

Automatic tensioners are calibrated to provide the correct amount of tension to the belt for a given accessory drive system. Unless a spring or damping band within the tensioner assembly breaks or some other mechanical part of the tensioner fails, there is no need to check the tensioner for correct tension.

Accessory Drive

Inspection and Verification

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or pulleys have any fluids or belt dressing applied to them as damage to the belt material and tensioner damping mechanism may occur.**

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical damage.

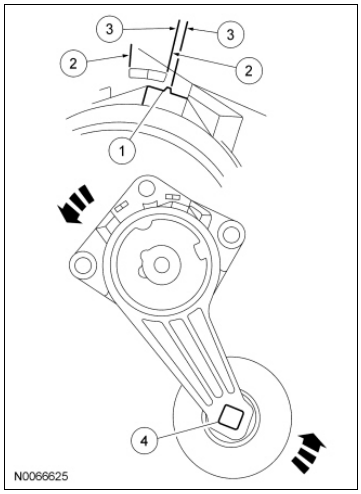
Visual Inspection Chart

Mechanical
• Drive belt cracking/chunking/wear • Belt/pulley contamination • Incorrect accessory drive belt • Incorrectly routed accessory drive belt • Pulley misalignment or excessive pulley runout • Loose or mislocated hardware • Incorrectly routed power steering tubes (rubbing) • Loose accessory drive belt • Damaged pulleys • Tensioner arm misalignment

Belt Tensioner With Belt Length Indicator

NOTE: Modular engine (without A/C) btensioner shown, others similar.

NOTE: Belt tensioner is shown in the free-state position against the arm travel stops.



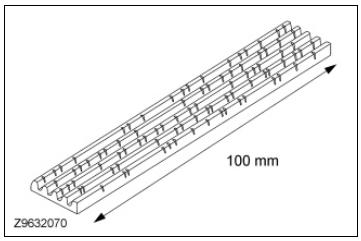
Item	Part Number	Description
1	-	Belt length indicator
2	-	Acceptable belt installation and wear range
3	-	Belt replacement range
4	-	Belt tension relief point

3. Check that the belt length indicator, if equipped, on the belt tensioner is in the acceptable belt installation and wear range. If the indicator is in the belt replacement range, either an incorrect belt is installed or the belt is worn beyond the service limit. Install a new belt as necessary.

4. Eliminate all other non-belt related noises that could cause belt misdiagnosis, such as A/C compressor engagement chirp, A/C slugging noise, power steering cavitations at low temperatures or generator whine.

5. If a concern is found, correct the condition before proceeding to the next step.

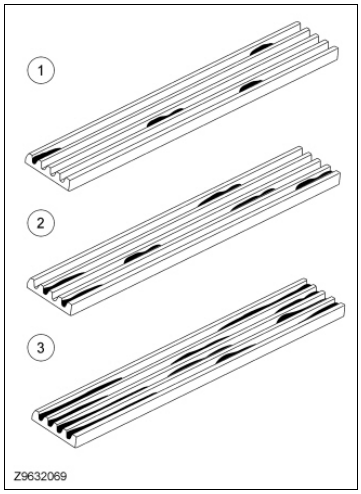
V-Ribbed Serpentine Drive Belt With Cracks Across Ribs



6. Check the belt for cracks. Up to 15 cracks in a rib over a distance of 100 mm (4.0 in) can be considered acceptable. If cracks exceed this standard, install a new belt.

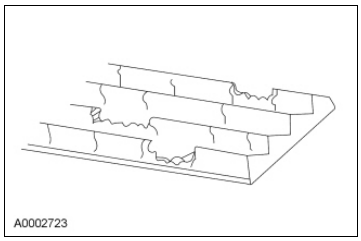
V-Ribbed Serpentine Belt With Piling

NOTE: Piling is an excessive buildup in the V-grooves of the belt.



7. The condition of the V-ribbed drive belt should be compared against the illustration and appropriate action taken.
    1. Small scattered deposits of rubber material. This is not a concern, therefore, installation of a new belt is not required.
    2. Longer deposit areas building up to 50% of the rib height. This is not considered a durability concern, but it can result in excessive noise. If noise is apparent, install a new belt.
    3. Heavy deposits building up along the grooves resulting in a possible noise and belt stability concern. If heavy deposits are apparent, install a new belt.

V-Ribbed Serpentine Belt With Chunks of Rib Missing



8. There should be no chunks missing from the belt ribs. If the belt shows any evidence of this, install a new accessory drive belt.

9. If the concern is not visually evident, verify the symptom and GO to Symptom Chart .

Symptom Chart

Symptom Chart

Component Tests

Drive Belt - Noise/Flutter

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or pulleys have any fluids or belt dressing applied to them as damage to the belt material and tensioner damping mechanism may occur.**

Drive belt chirp occurs due to pulley misalignment or excessive pulley runout. It can be the result of a damaged or incorrectly aligned grooved pulley.

To correct, determine the area where the noise comes from. Check each of the pulleys in that area with a straightedge to the crankshaft pulley. Look for accessory pulleys out of position in the fore/aft direction or at an angle to the straightedge.

Drive belt squeal may be an intermittent or constant noise that occurs when the drive belt slips on an accessory pulley under certain conditions.

A short intermittent squeal may occur during engine start up and shut down or during very rapid engine acceleration and decelerations, such as:

- Wide Open Throttle (WOT) 1-2 and 2-3 shifts or 2-3 and 3-4 back-out shifts on automatic transmissions.
- WOT 1-2 and 2-3 shifts and any combination of rapid downshifting on manual transmissions.

These special short-term transient events are expected, and are due to the higher system inertias required to meet the electrical and cooling demands on today's vehicle systems. Constant or reoccurring drive belt squeal can occur:

- if the A/C discharge pressure goes above specifications:
    - ♦ the A/C system is overcharged.
    - ♦ the A/C condenser core airfw is blocked.
    - ♦ the A/C anti-slugging strategy executes after a long hot heat soak.
- if the A/C off equalized pressure (the common discharged and suction pressure that occurs after several minutes) exceeds specifications.
- if any of the accessories or idler pulley(s) are damaged or have a worn or damaged bearing. All accessories should be rotatable by hand in the unloaded condition. If not, inspect the accessory.
- if there is evidence of fluid contamination on the accessory drive belt. When the drive belt has been exposed to fluid contamination during vehicle operation, such as leaks from the power steering system, A/C system or cooling system, clean all pulleys with soap and water, rinse with clean water and install a new accessory drive belt. If the drive belt has been exposed to fluids in a localized area during routine vehicle service, such as replacement of hoses or fluids, the drive belt and pulleys should be washed with soap and water immediately (prior to starting the engine), and rinsed with clean water.
- if the accessory drive belt is too long. A drive belt that is too long will allow the accessory drive belt tensioner arm to go all the way to the arm travel stop under certain load conditions, which will release tension to the drive belt. If the accessory drive belt tensioner indicator is outside the normal installation wear range window, install a new accessory drive belt.
- **NOTE:** The accessory drive belt tensioner arm should rotate freely without binding.

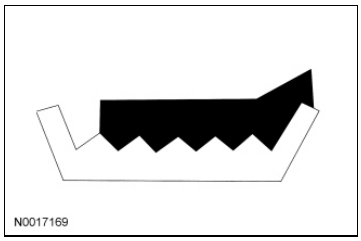
  Install a new accessory drive belt tensioner if the drive belt tensioner is worn or damaged.

Drive Belt - Incorrect Installation

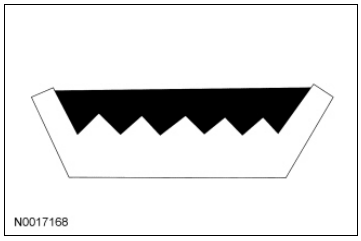
NOTICE: **Incorrect accessory drive belt installation will cause excessive drive belt wear and may cause the drive belt to come off the pulleys.**

Non-standard accessory drive belts can track differently or incorrectly. If an accessory dri belt tracks incorrectly, install a new accessory drive belt to avoid performance failure or loss of the drive belt.

Incorrect Installation



Correct Installation



With the engine running, check accessory drive belt tracking on all pulleys. If the edge of the accessory drive belt rides beyond the edge of the pulleys, noise and premature wear will occur. Make sure the accessory drive belt rides correctly on the pulley. If an accessory drive belt tracking condition exists, proceed with the following:

- Visually check the accessory drive belt tensioner for damage and wear, especially the mounting pad surface and arm alignment. If the accessory drive belt tensioner is not installed correctly, the mounting surface pad will be out of position. If the tensioner arm is worn, the arm will be out of alignment. Either of these conditions will result in chirp and squeal noises.
- With the engine running, visually observe the grooves in the pulleys (not the pulley flanges or the pulley forward faces) for excessive wobble. Install new components as necessary.
- Check all accessories, mounting brackets and the accessory drive belt tensioner for any interference that would prevent the component from mounting correctly. Correct any interference condition and recheck the accessory drive belt tracking.
- Tighten all accessories, mounting brackets and accessory drive belt tensioner retaining hardware to specification. Recheck the accessory drive belt tracking.

Belt Tensioner - Mechanical

The only mechanical check that needs to be made is a check for tensioner stick, grab or bind.

1. With the engine off, check routing of the accessory drive belt. Refer to the illustrations under Accessory Drive in the Description and Operation portion of this section.

2. **NOTE:** The accessory drive belt tensioner spring is very strong and requires substantial force to release.

   Using a suitable, commercially available serpentine belt tensioner release tool, release the tension on the belt and detach the accessory drive belt from the tensioner. Carry out the following tests:

   - Using the release tool, move the tensioner from its relaxed position, through its full stroke and back to the relaxed position to make sure there is no stick, grab or bind, and to make sure that there is tension on the tensioner spring.

- Rotate the tensioner pulley by hand and check for a binding, contaminated or seized condition.
- Inspect the area surrounding the accessory drive belt tensioner for oil leaks or contamination and repair any leaks.

3. If the accessory drive belt tensioner does not meet the criteria in the previous step, install a new tensioner. If the accessory drive belt tensioner meets the criteria in the previous step, proceed to testing the tensioner dynamically.

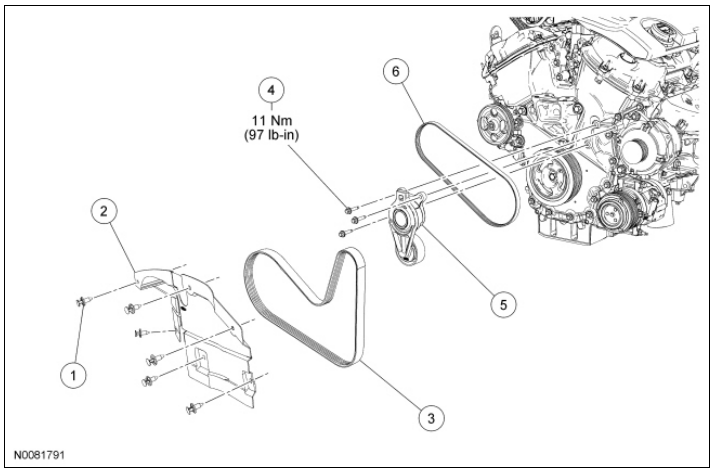
- If the tensioner is saturated with oil and grease internally, install a new tensioner.

Belt Tensioner - Dynamics

The accessory drive belt tensioner can be checked dynamically as follows:

1. With the engine running, observe the accessory drive belt tensioner movement. The accessory drive tensioner should move (respond) when the A/C clutch cycles (if equipped), or when the engine is accelerated rapidly. If the accessory drive belt tensioner movement is excessive without A/C clutch cycling or engine acceleration, check belt rideout. Excessive belt rideout (uneven depth of grooves in the belt) can cause excessive accessory drive belt tensioner movement. Check rideout condition by installing a new belt. If excessive accessory drive belt tensioner movement still exists, install a new accessory drive belt tensioner.

Front End Accessory Drive (FEAD) - Exploded View



Item	Part Number	Description
1	N807389	Pin-type retainer (6 required)
2	010204	RH splash shield
3	8620	Accessory drive belt
4	W503278	Accessory drive belt tensioner bolt (3 required)
5	6B209	Accessory drive belt tensioner
6	6C301	Power steering pump drive belt

1. For additional information, refer to the procedures in this section.

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Accessory Drive Belt

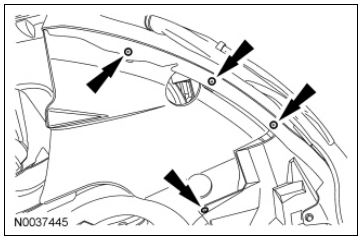
Removal

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or pulleys be lubricated as potential damage to the belt material and tensioner damping mechanism will occur. Do not apply any fluids or belt dressing to the accessory drive belt or pulleys.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Working from the top of the vehicle, rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt from the generator pulley.

3. Remove the 4 screws and position the RH fender splash shield aside.



4. Remove the 6 pin-type retainers and the RH splash shield.

5. Working from under the vehicle, remove the accessory drive belt.

Installation

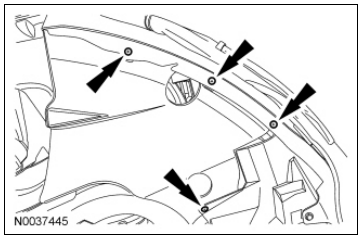
1. Working from under the vehicle, position the accessory drive belt on all pulleys, with the exception of the generator pulley.

2. **NOTE:** After installation, make sure the accessory drive belt is correctly seated on all pulleys.

   Working from the top of the vehicle, rotate the accessory drive belt tensioner clockwise and install the accessory drive belt on the generator pulley.

3. Install the RH splash shield and the 6 pin-type retainers.

4. Position the RH fender splash shield and install the 4 screws.



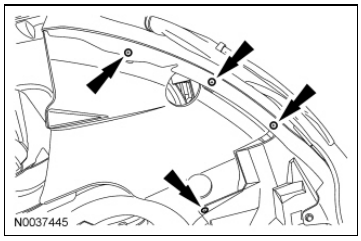
Accessory Drive Belt Tensioner

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Working from the top of the vehicle, rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt from the generator pulley.

3. Remove the 4 screws and position the RH fender splash shield aside.



4. Remove the 6 pin-type retainers and the RH splash shield.

5. Remove 3 bolts and the accessory drive belt tensioner.

Installation

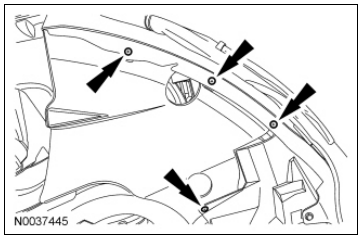
1. Install the accessory drive belt tensioner and the 3 bolts.
    - Tighten to 11 Nm (97 lb-in).

2. **NOTE:** After installation, make sure the accessory drive belt is correctly seated on all pulleys.

   Working from the top of the vehicle, rotate the accessory drive belt tensioner clockwise and install the accessory drive belt on the generator pulley.

3. Install the RH splash shield and the 6 pin-type retainers.

4. Position the RH fender splash shield and install the 4 screws.



Power Steering Pump Belt

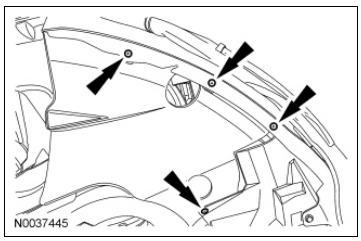
Special Tool(s)

 ST3085-A	Remover, Stretchy Belt 303-1419
 ST2974-A	Tool, Stretchy Belt Installer 303-1252/2

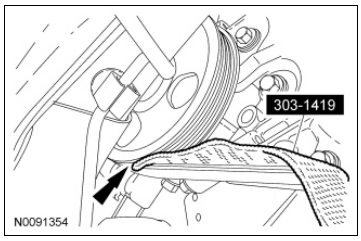
Removal

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or pulleys be lubricated as potential damage to the belt material and tensioner damping mechanism will occur. Do not apply any fluids or belt dressing to the accessory drive belt or pulleys.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Working from the top of the vehicle, rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt from the generator pulley.
3. Remove the 4 screws and position the RH fender splash shield aside.

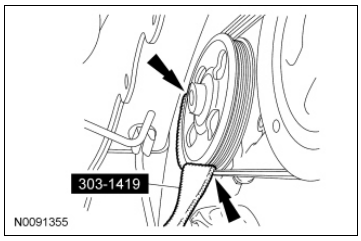


4. Remove the 6 pin-type retainers and the RH splash shield.
5. Position the accessory drive belt off the crankshaft pulley.
6. Position the Stretchy Belt Remover on the power steering pump pulley belt as shown.

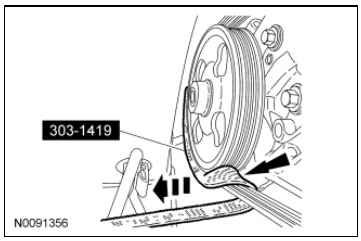


7. **NOTE:** Feed the Stretchy Belt Remover onto the power steering pump pulley approximately 90 degrees.

Turn the crankshaft clockwise and feed the Stretchy Belt Remover evenly on the power steering pump pulley as shown.



8. Remove the power steering pump belt.
    - Fold the Stretchy Belt Remover under the inside of the power steering pump belt as shown.
    - In one quick motion, firmly pull the Stretchy Belt Remover out of the RH fender well, removing the power steering pump belt.

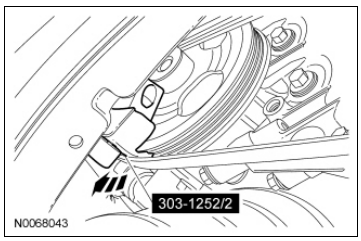


Installation

1. Install the power steering belt on the crankshaft pulley.

2. **NOTE:** After installation, make sure the belt is correctly seated on the crankshaft and power steering pulleys.

    Position the power steering belt around the Stretchy Belt Installer Tool and the power steering pulley. Make sure the belt is engaged with the power steering pulley and rotate the crankshaft clockwise to install the power steering belt.



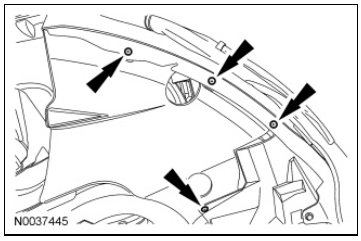
3. Position the accessory drive belt on the crankshaft pulley.

4. **NOTE:** After installation, make sure the accessory drive belt is correctly seated on all pulleys.

    Working from the top of the vehicle, rotate the accessory drive belt tensioner clockwise and install the accessory drive belt on the generator pulley.

5. Install the RH splash shield and the 6 pin-type retainers.

6. Position the RH fender splash shield and install the 4 screws.


N0037445

Torque Specifications

Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner bolts	25	18	-
A/C hose retainer bracket bolt	6	-	53

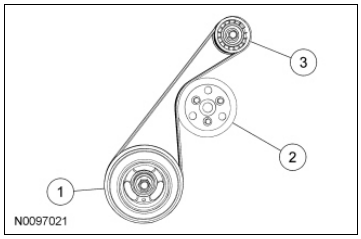
Accessory Drive

The accessory drive:

- has a single serpentine drive belt with 6 ribs.
- has automatic tensioning.
- is not adjustable.

The accessory drive system provides power to operate components which power other systems. The accessory drive system provides power to operate the coolant pump. The coolant pump is equipped with a pulley which is driven by the accessory drive belt. The accessory drive belt is driven by the engine crankshaft pulley. The automatic belt tensioner maintains correct belt tension and compensates for component wear and changes in system load. System load changes can be caused by the demand changes on other systems powered by the accessory drive belt. To maintain correct operation of this system, it is critical that the correct length drive belt be installed. The pulleys must also be properly aligned and kept clean.

Accessory Drive Belt Routing



Item	Part Number	Description
1	6316	Crankshaft pulley
2	8509	Coolant pump pulley
3	6A228	Belt tensioner

Belt Tensioner

NOTE: The accessory drive belt tensioner must be replaced as a complete unit.

Automatic tensioners are calibrated to provide the correct amount of tension to the belt for a given accessory drive system. Unless a spring or damping band within the tensioner assembly breaks, or some other mechanical part of the tensioner fails, there is no need to check the tensioner for correct tension.

Accessory Drive

Inspection and Verification

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or lleys have any fluids or belt dressing applied to them as damage to the belt material and tensioner damping mechanism may occur.**

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical damage.

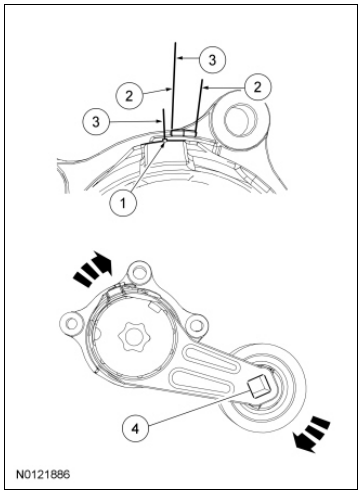
Visual Inspection Chart

Mechanical
• Drive belt cracking/chunking/wear • Belt/pulley contamination • Incorrect accessory drive belt • Incorrectly routed accessory drive belt • Pulley misalignment or excessive pulley runout • Loose or mislocated hardware • Incorrectly routed power steering tubes (rubbing) • Loose accessory drive belt • Damaged pulleys • Tensioner arm misalignment

Belt Tensioner With Belt Length Indicator

NOTE: Belt tensioner is shown in the free-state position against the arm travel stops.

NOTE: 6.2L engine accessory drive belt tensioner shown, other accessory drive belt tensioners similar.



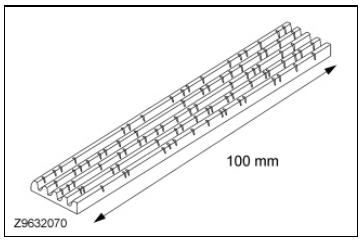
Item	Description
1	Belt length indicator
2	Acceptable belt installation and wear range
3	Belt replacement range
4	Belt tension relief point

3. Check that the belt length indicator, if equipped, on the belt tensioner is in the acceptable belt installation and wear range. If the indicator is in the belt replacement range, either an incorrect belt is installed or the belt is worn beyond the service limit. Install a new belt as necessary.

4. Eliminate all other non-belt related noises that could cause belt misdiagnosis, such as A/C compressor engagement chirp, A/C slugging noise, power steering cavitations at low temperatures, Variable Camshaft Timing (VCT) tick or generator whine.

5. If a concern is found, correct the condition before proceeding to the next step.

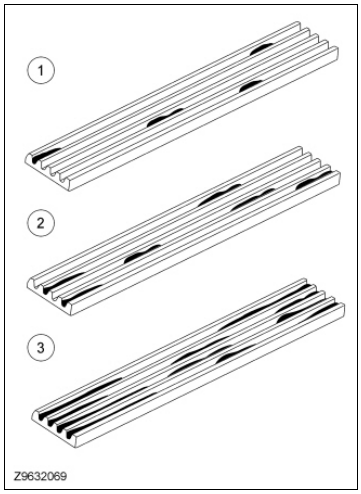
V-Ribbed Serpentine Drive Belt With Cracks Across Ribs



6. Check the belt for cracks. Up to 15 cracks in a rib over a distance of 100 mm (4.0 in) can be considered acceptable. If cracks exceed this standard, install a new belt.

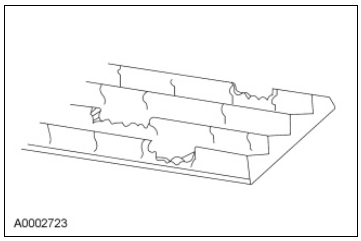
V-Ribbed Serpentine Belt With Piling

NOTE: Piling is an excessive buildup in the V-grooves of the belt.



7. The condition of the V-ribbed drive belt should be compared against the illustration and appropriate action taken.
    1. Small scattered deposits of rubber material. This is not a concern, therefore, installation of a new belt is not required.
    2. Longer deposit areas building up to 50% of the rib height. This is not considered a durability concern, but it can result in excessive noise. If noise is apparent, install a new belt.
    3. Heavy deposits building up along the grooves resulting in a possible noise and belt stability concern. If heavy deposits are apparent, install a new belt.

V-Ribbed Serpentine Belt With Chunks of Rib Missing



8. There should be no chunks missing from the belt ribs. If the belt shows any evidence of this, install a new accessory drive belt.

9. If the concern is not visually evident, verify the symptom and GO to Symptom Chart .

Symptom Chart

Symptom Chart

Component Tests

Drive Belt - Noise/Flutter

NOTICE: **Under no circumstances should the accessory drive belt, tensioner or pulleys have any fluids or belt dressing applied to them as damage to the belt material and tensioner damping mechanism may occur.**

Drive belt chirp occurs due to pulley misalignment or excessive pulley runout. It can be the result of a damaged or incorrectly aligned grooved pulley.

To correct, determine the area where the noise comes from. each of the pulleys in that area with a straightedge to the crankshaft pulley. Look for accessory pulleys out of position in the fore/aft direction or at an angle to the straightedge.

Drive belt squeal may be an intermittent or constant noise that occurs when the drive belt slips on an accessory pulley under certain conditions.

A short intermittent squeal may occur during engine start up and shut down or during very rapid engine acceleration and decelerations, such as:

- Wide Open Throttle (WOT) 1-2 and 2-3 shifts or 2-3 and 3-4 back-out shifts on automatic transmissions.
- WOT 1-2 and 2-3 shifts and any combination of rapid downshifting on manual transmissions.

These special short-term transient events are expected, and are due to the higher system inertias required to meet the electrical and cooling demands on today's vehicle systems. Constant or reoccurring drive belt squeal can occur:

- if the A/C discharge pressure goes above specifications:
    - ♦ the A/C system is overcharged.
    - ♦ the A/C condenser core airflow is blocked.
    - ♦ the A/C anti-slugging strategy executes after a long hot heat soak.
- if the A/C off equalized pressure (the common discharged and suction pressure that occurs after several minutes) exceeds specifications.
- if any of the accessories or idler pulley(s) are damaged or have a worn or damaged bearing. All accessories should be rotatable by hand in the unloaded condition. If not, inspect the accessory.
- if there is evidence of fluid contamination on the accessory drive belt. When the drive belt has been exposed to fluid contamination during vehicle operation, such as leaks from the power steering system, A/C system or cooling system, clean all pulleys with soap and water, rinse with clean water and install a new accessory drive belt. If the drive belt has been exposed to fluids in a localized area during routine vehicle service, such as replacement of hoses or fluids, the drive belt and pulleys should be washed with soap and water immediately (prior to starting the engine), and rinsed with clean water.
- if the accessory drive belt is too long. A drive belt that is too long will allow the accessory drive belt tensioner arm to go all the way to the arm travel stop under certain load conditions, which will release tension to the drive belt. If the accessory drive belt tensioner indicator is outside the normal installation wear range window, install a new accessory drive belt.
- **NOTE:** The accessory drive belt tensioner arm should rotate freely without binding.

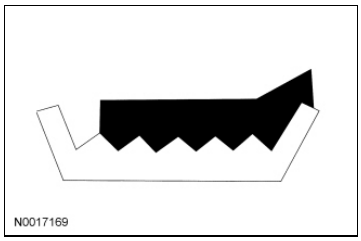
  Install a new accessory drive belt tensioner if the drive belt tensioner is worn or damaged.

Drive Belt - Incorrect Installation

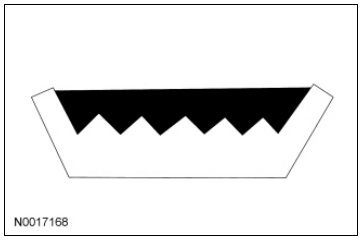
NOTICE: **Incorrect accessory drive belt installation will cause excessive drive belt wear and may cause the drive belt to come off the pulleys.**

Non-standard accessory drive belts can track differently or incorrectly. If an accessory drive belt tracks incorrectly, install a new accessory drive belt to avoid performance failure or loss of the drive belt.

Incorrect Installation



Correct Installation



With the engine running, check accessory drive belt tracking on all pulleys. If the edge of the accessory drive belt rides beyond the edge of the pulleys, noise and premature wear will occur. Make sure the accessory drive belt rides correctly on the pulley. If an accessory drive belt tracking condition exists, proceed with the following:

- Visually check the accessory drive belt tensioner for damage and wear, especially the mounting pad surface and arm alignment. If the accessory drive belt tensioner is not installed correctly, the mounting surface pad will be out of position. If the tensioner arm is worn, the arm will be out of alignment. Either of these conditions will result in chirp and squeal noises.
- With the engine running, visually observe the grooves in the pulleys (not the pulley flanges or the pulley forward faces) for excessive wobble. Install new components as necessary.
- Check all accessories, mounting brackets and the accessory drive belt tensioner for any interference that would prevent the component from mounting correctly. Correct any interference condition and recheck the accessory drive belt tracking.
- Tighten all accessories, mounting brackets and accessory drive belt tensioner retaining hardware to specification. Recheck the accessory drive belt tracking.

Belt Tensioner - Mechanical

The only mechanical check that needs to be made is a check for tensioner stick, grab or bind.

1. With the engine off, check routing of the accessory drive belt. Refer to the illustrations under Accessory Drive in the Description and Operation portion of this section.

2. **NOTE:** The accessory drive belt tensioner spring is very strong and requires substantial force to release.

   Release the tension on the belt and detach the accessory drive belt from the tensioner. Carry out the following tests:

   - Move the tensioner from its relaxed position, through its full stroke and back to the relaxed position to make sure there is no stick, grab or bind, and to make sure that there is tension on the tensioner spring.

- Rotate the tensioner pulley by hand and check for a binding, contaminated or seized condition.
- Inspect the area surrounding the accessory drive belt tensioner for oil leaks or contamination and repair any leaks.

3. If the accessory drive belt tensioner does not meet the criteria in the previous step, install a new tensioner. If the accessory drive belt tensioner meets the criteria in the previous step, proceed to testing the tensioner dynamically.

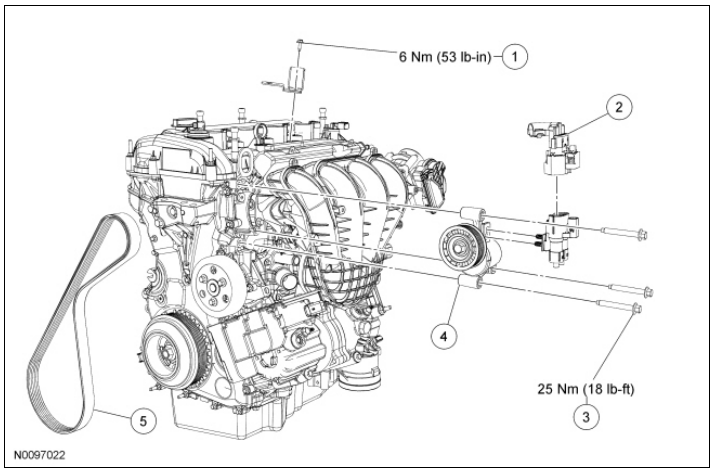
4. If the tensioner is saturated with oil and grease internally, install a new tensioner.

Belt Tensioner - Dynamics

The accessory drive belt tensioner can be checked dynamically as follows:

1. With the engine running, observe the accessory drive belt tensioner movement. The accessory drive tensioner should move (respond) when the A/C clutch cycles (if equipped), or when the engine is accelerated rapidly. If the accessory drive belt tensioner movement is excessive without A/C clutch cycling or engine acceleration, check belt rideout. Excessive belt rideout (uneven depth of grooves in the belt) can cause excessive accessory drive belt tensioner movement. Check rideout condition by installing a new belt. If excessive accessory drive belt tension movement still exists, install a new accessory drive belt tensioner.

Front End Accessory Drive (FEAD) - Exploded View



Item	Part Number	Description
1	W503924	A/C hose retainer bracket bolt
2	-	Vehicle high voltage electrical system electrical connector
3	W500314	Accessory drive belt tensioner bolt (3 required)
4	6A228	Accessory drive belt tensioner
5	6C301	Accessory drive belt

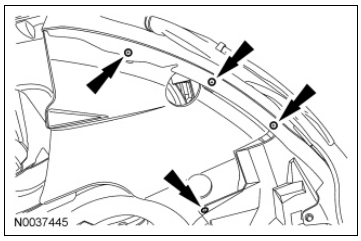
1. For additional information,the procedures in this section.

Accessory Drive Belt

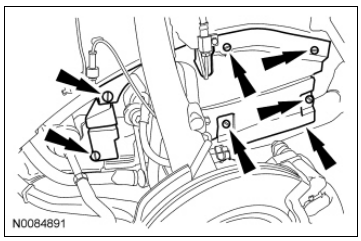
Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

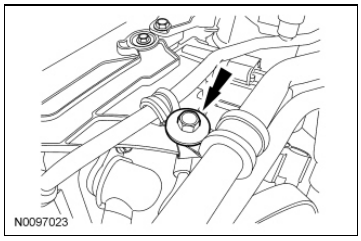
2. Remove the 4 screws and position the RH fender splash shield aside.



3. Remove the 6 pin-type retainers and the RH splash shield.



4. Remove the A/C hose retainer bracket bolt.
   - To install, tighten to 6 Nm (53 lb-in).



5. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.

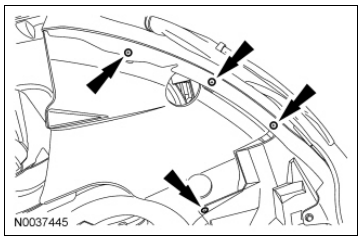
6. To install, reverse the removal procedure.

Accessory Drive Belt Tensioner

Removal and Installation

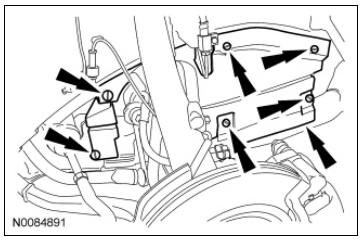
1. Depower the vehicle high voltage electrical system. For additional information, refer to Section 414-03 .

2. Remove the 4 screws and position the RH fender splash shield aside.

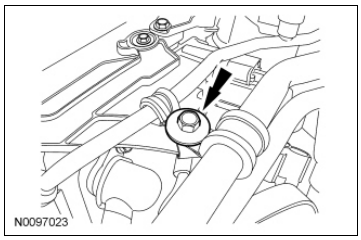


3. **NOTE:** RH front wheel and tire are removed for clarity.

   Remove the 6 pin-type retainers and the RH splash shi



4. Remove the A/C hose retainer bracket bolt.
   - To install, tighten to 6 Nm (53 lb-in).



5. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt from the tensioner pulley.

6. Disconnect the 2 vehicle high voltage electrical system electrical connectors.

7. Detach the vehicle high voltage electrical system electrical connector retainer from the accessory drive belt tensioner.

8. **NOTE:** The accessory drive belt tensioner must be replaced as a complete unit.

   Remove the 3 bolts and the accessory drive belt tensioner.

- To install, tighten to 25 Nm (18 lb-ft).

9. To install, reverse the removal procedure.

General Specifications

Item	Specification
Normal engine cranking speed	200-250 rpm
Starting circuit maximum voltage drop (engine at normal operating temperature)	0.5 volt
Starter motor maximum load current draw	800 amps
Starter motor no-load current draw	60-80 amps
Starter motor normal load current draw	130-190 amps

Torque Specifications

Description	Nm	lb-ft	lb-in
Ground wire nut - 2.5L	18	-	159
Ground wire nut - 3.0L	18	-	159
Starter motor bolt and stud bolt (2.5L)	25	18	-
Starter motor bolts (3.5L)	27	20	-
Starter motor solenoid battery cable nut	12	-	106
Starter motor solenoid wire nut	5	-	44
Starter motor stud bolts (3.0L)	27	20	-

Starting System

The starting system consists of the following components:

- Starter motor
- Starter motor relay
- Transmission Range (TR) sensor - automatic transmission
- Clutch cutoff switch - manual transmission
- Battery
- Ignition switch
- PCM
- Start diode

When the key is placed in the START position, the starter relay is energized and this sends current to the starter motor, and the drive pinion gear cranks the flexplate/flywheel to start the engine. When current flows to the starter motor, the starter solenoid pull-in coil is bypassed and the hold-in coil keeps the drive pinion gear engaged with the flywheel until the ignition switch is released from the START position.

An overrunning clutch in the starter drive protects the starter motor from excessive speeds during the brief period before the driver releases the ignition switch from the START position as the engine starts.

Vehicles equipped with an automatic transmission have a TR sensor mounted in the transaxle. The TR sensor prevents operation of the starter motor unless NEUTRAL or PARK is selected.

Vehicles equipped with a manual transaxle have a clutch cutoff switch mounted on the clutch pedal bracket. The clutch cutoff switch prevents operation of the starter motor unless the clutch is fully depressed.

One-Touch Integrated Start (OTIS)

The vehicle has One-Touch Integrated Start (OTIS), a computer-assisted cranking system. This feature assists in starting the engine. If the ignition key is turned to the START position and released when the engine begins cranking, the engine may continue cranking for up to 10 seconds or until the vehicle starts.

Once the ignition is turned to the START position and the vehicle is in NEUTRAL or PARK or the clutch p is depressed, the PCM reads starter motor request from the ignition switch and gains control of the starter engagement. The customer is no longer in the loop after the initial crank request, the customer may release the key to the RUN/START position. The PCM will disengage the starter motor based on the following events:

- The engine is started (rpm threshold)
- A set time has been exceeded (calibrated)
- The ignition key has been turned to the OFF position

Starting System

Special Tool(s)

 ST2574-A	Flex Probe Kit 105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Hybrid

For hybrid starting system diagnostics, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Principles of Operation

Starting System - Anti-Theft Intervention

The starting system is electronically controlled by the Passive Anti-Theft System (PATS). The PATS recognizes the correct electronically coded ignition key and signals the PCM to provide a ground for the starter relay. The energized relay provides voltage to the starter solenoid with the key in the START position, thereby allowing the starter motor to activate.

Inspection and Verification

⚠ WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.

NOTE: The anti-theft system must be functioning correctly before a logical starting system diagnosis can be carried out. Address anti-theft system concerns before continuing. Refer to Section 419-01B .

1. Verify the customer concern by operating the starting system to duplicate the conditions.

2. Remove the accessory drive belt. Refer to Section 303-05A for 2.3L engines, Section 303-05B for 3.0L (4V) or Section 303-05C for 3.5L engines. Verify the crankshaft and each of the components driven by the accessory drive belt rotate and are not seized or damaged.

3. Inspect to determine if any of the following mechanical or electrical concerns apply.

Visual Inspection Chart

Mechanical	Electrical
• Starter motor • Starter motor bolts • Flexplate • Flywheel	• Battery • Battery Junction Box (BJB) fuse 5 (30A) • Smart Junction Box (SJB) fuse 27 (20A) • Wiring harness • Starter motor relay • Anti-theft system • Loose or corroded connections

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

7. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

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

9. Clear the continuous DTCs and carry out the self-test diagnostics for the PCM.

10. If the DTCs retrieved are related to the concern, refer to the PCM DTC Chart. For all other DTCs, refer to Section 419-10 .

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

DTC Chart

PCM DTC Chart

DTC	Description	Action
P0512	Starter Request Circuit - Circuit has Power With the Ignition in the OFF Position	CARRY OUT the Ignition Switch Component Test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. If necessary, INSTALL a new ignition switch. If the ignition switch passed the component test, REPAIR circuit CDC35 (BU/WH) for a short to power.
P0706	TR Sensor A Circuit Range/Performance	Refer to the appropriate section in Group 307 for the procedure.
P0707	TR Sensor A Circuit Low	Refer to the appropriate section in Group 307 for the procedure.
P0708	TR Sensor A Circuit High	Refer to the appropriate section in Group 307 for the procedure.
P0830	Clutch Pedal Switch A Circuit	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0833	Clutch Pedal Switch B Circuit	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1260	Theft Detected, Vehicle Immobilized	REFER to DTC Chart in Section 419-01B .

Symptom Chart

NOTE: For hybrid starting system diagnostics, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The Engine Does Not Crank

Refer to Wiring Diagrams Cell 20 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Starting System for schematic and connector information.

Normal Operation

Under normal operation, constant power is supplied to the starter relay on circuit SBB05 (GY/RD), the starter on circuit SBB02 (RD) and to the ignition switch on circuit SBP27 (BU/RD). When the key is placed in the START position, with the vehicle in PARK or NEUTRAL or with the clutch pedal depressed, power flows to the starter motor relay through CE336 (GN/WH). Inputs from the Transmission Range (TR) sensor and clutch cutoff switch to the PCM provide a ground to the starter relay on circuit CDC12 (YE). When the coil of the relay is energized, it sends power to the starter motor on circuit CDC25 (BN/GN).

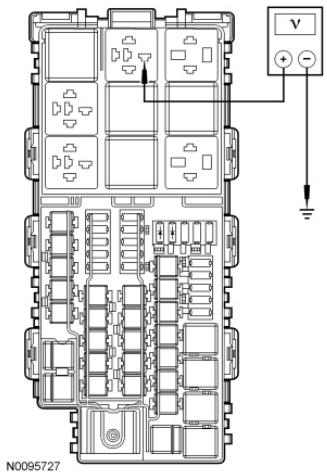
This pinpoint test is intended to diagnose the following:

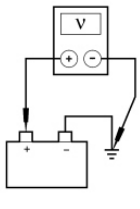
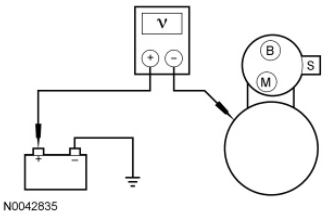
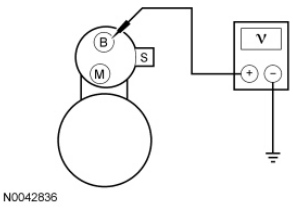
- Battery
- Fuse(s)
- Ignition switch
- Starter motor relay
- PCM
- TR sensor

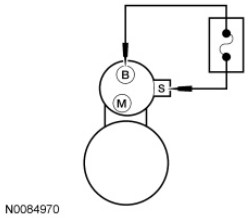
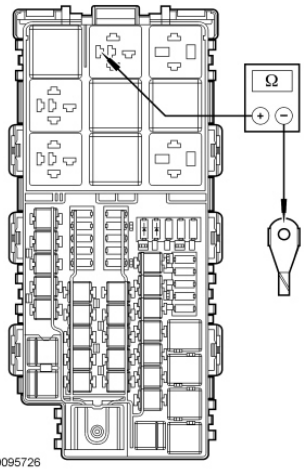
- Clutch cutoff switch
- Circuitry
- Start diode
- Anti-theft system

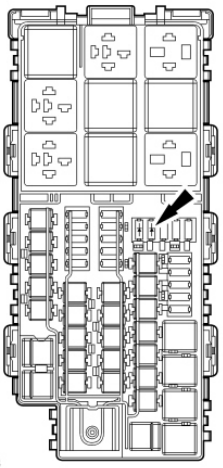
PINPOINT TEST A: THE ENGINE DOES NOT CRANK

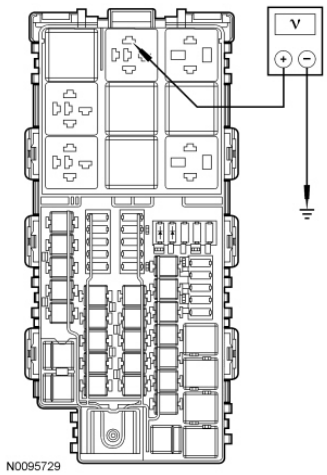
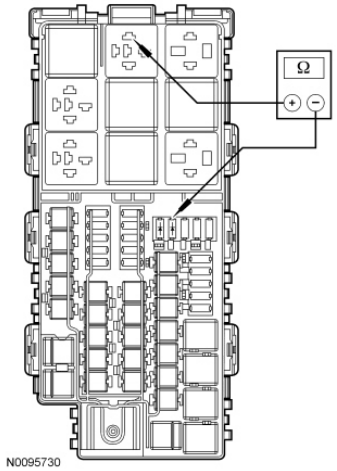
Test Step	Result / Action to Take
A1 CHECK THE BATTERY	
• Check the battery condition and charge. Refer to Section 414-01 . • **Is the battery OK?**	**Yes** GO to A2 . **No** CHARGE or INSTALL a new battery as necessary. REFER to Section 414-01 . TEST the system for normal operation.
A2 CHECK THE PCM FOR DTCs	
• Check for PCM DTCs. • **Were any PCM DTCs retrieved?**	**Yes** If PCM DTC P1260 is retrieved, REFER to Section 419-01B . All other PCM DTCs, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** For automatic transmission, GO to A3 . For manual transmission, GO to A4 .
A3 CHECK THE AUTOMATIC TR SENSOR	
• Enter the following diagnostic mode on the scan tool: TCM DataLogger PID. • While observing the Transmission Control Module (TCM) TR sensor PID, place the vehicle in PARK and NEUTRAL. • **Does the PID match the gear selection?**	**Yes** GO to A5 . **No** GO to the appropriate automatic transmission section to diagnose the TR sensor.
A4 CHECK THE CLUTCH CUTOFF SWITCH (CPP_ BOT) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - PCM. • While observing the CPP_ BOT PID, fully disengage the clutch. • **Does the PID change from NO to YES?**	**Yes** GO to A5 . **No** GO to A28 .
A5 CHECK THE STARTER MOTOR CONTROL OUTPUT DETECTED (SMC_MON) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - PCM. • **NOTE:** For manual transaxle, fully disengage the clutch.	**Yes** GO to A6 . **No** GO to A13 .

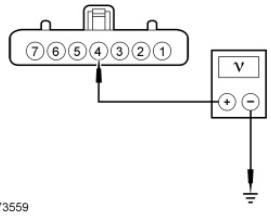
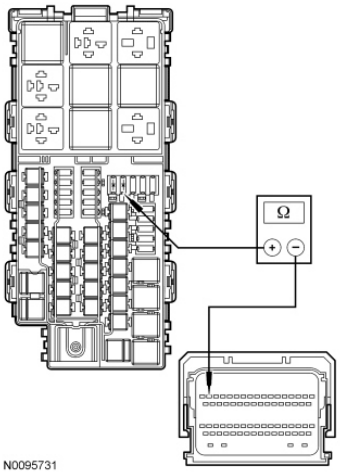
• Monitor the PCM PID SMC_MON with the ignition switch in the START position. • **Does the PID change from OFF to ON?**	
A6 CHECK THE STARTER MOTOR RELAY ENABLE (STRT_RLY) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - PCM. • **NOTE:** For manual transaxle, fully disengage the clutch. • Monitor the PCM PID STRT_RLY with the ignition switch in the START position. • **Does the PID change from DISABLED to ENABLED?**	**Yes** GO to A7 . **No** GO to A24 .
A7 CHECK STARTER MOTOR RELAY POWER	
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.** • Disconnect: Starter Motor Relay. • Measure the voltage between Battery Junction Box (BJB) starter motor relay pin 30, circuit SBB05 (GY/RD), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to A8 . **No** VERIFY BJB fuse 5 (30A) is OK. If OK, REPAIR circuit SBB05 (GY/RD). TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
A8 CHECK THE BATTERY GROUND CABLE	
• Measure the voltage between the positive battery post and the battery ground cable connection at the engine.	**Yes** GO to A9 . **No** INSTALL a new battery ground cable. REFER to Section 414-01 . TEST the system for normal operation.

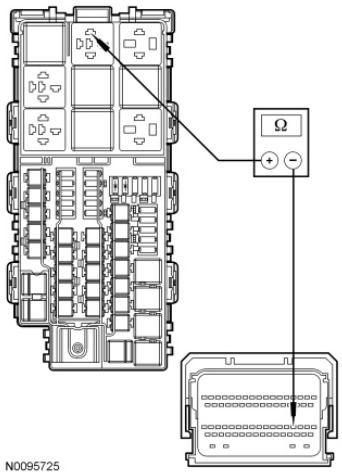
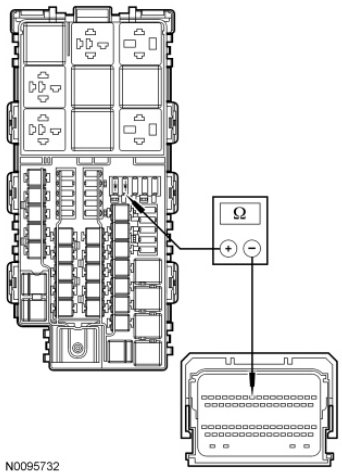
 AJ0280-A • **Is the voltage greater than 10 volts?**	
A9 CHECK THE STARTER MOTOR GROUND	
• Measure the voltage between the positive battery post and the starter motor case.  N0042835 • **Is the voltage greater than 10 volts?**	**Yes** GO to A10 . **No** CLEAN the starter motor mounting flange and make sure the starter motor is correctly mounted. TEST the system for normal operation.
A10 CHECK THE POWER SUPPLY TO THE STARTER MOTOR	
• Measure the voltage between starter motor C197A, circuit SDC02 (RD) and ground.  N0042836 • **Is the voltage greater than 10 volts?**	**Yes** GO to A11 . **No** INSTALL a new positive battery cable. REFER to Section 414-01 . TEST the system for normal operation.
A11 CHECK THE STARTER MOTOR B-PIN	
• Connect one end of a fused (30A) jumper wire to starter motor solenoid 197A, circuit SDC02 (RD). Momentarily connect the other end of the jumper to starter motor C197B, circuit CDC25 (BN/GN).	**Yes** GO to A12 . **No** INSTALL a new starter motor. REFER to Starter Motor - 2.5L , Starter Motor - 3.0L or Starter Motor - 3.5L in this section. TEST the system for normal operation.

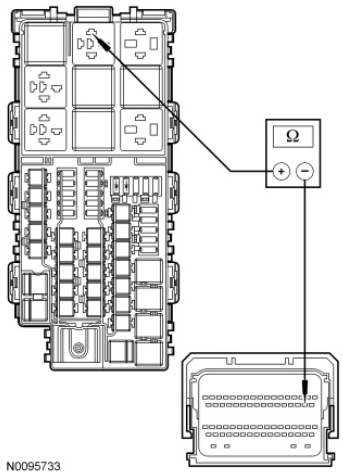
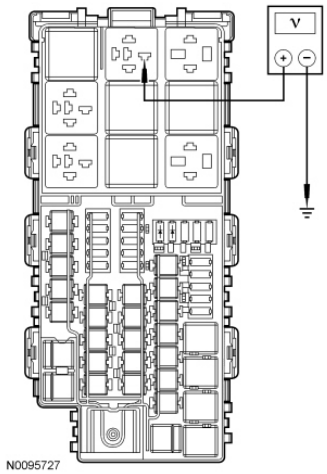
 N0084970 • **Did the starter motor engage and the engine crank?**	
A12 CHECK THE CIRCUIT TO THE STARTER MOTOR	
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.** • Ignition OFF. • Disconnect: Starter Motor Relay. • Disconnect: Starter Motor Solenoid C197B. • Measure the resistance between starter motor solenoid S-terminal C197B, circuit CDC25 (BN/GN), harness side and the BJB starter motor relay pin 87, circuit CDC25 (BN/GN), harness side.  N0095726 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new starter motor relay. TEST the system for normal operation. **No** REPAIR circuit CDC25 (BN/GN). TEST the system for normal operation.
A13 CHECK STARTER MOTOR RELAY POWER	
Yes GO to A14 . **No** VERIFY BJB fuse 5 (30A) is OK. If OK, REPAIR circuit SBB05 (GY/RD). TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.	

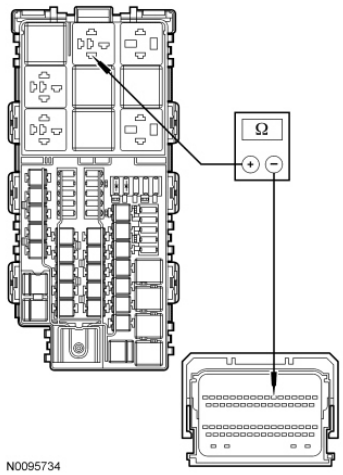
A14 CHECK THE STARTER MOTOR RELAY	
• Carry out the Starter Motor Relay Component Test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the starter motor relay pass the component test?**	**Yes** GO to A15 . **No** INSTALL a new starter motor relay. TEST the system for normal operation.
A15 CHECK THE START DIODE	
• Disconnect: Start Diode. • Check the start diode for an open or shorted condition.  N0095728 • **Is the start diode OK?**	**Yes** GO to A16 . **No** INSTALL a new start diode. TEST the system for normal operation.
A16 CHECK THE START SIGNAL TO THE STARTER MOTOR RELAY	
• Connect: Start Diode. • **NOTE:** For manual transaxle, fully disengage the clutch. • Measure the voltage between the BJB starter motor relay pin 86, circuit CE336 (GN/WH), harness side and ground with the ignition switch in the START position.	**Yes** For 2.5L and 3.0L vehicles, GO to A20 . For 3.5L vehicles, GO to A22 . **No** GO to A17 .

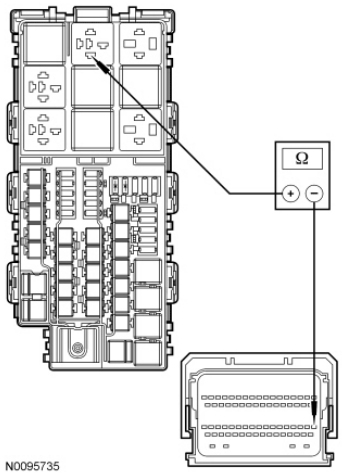
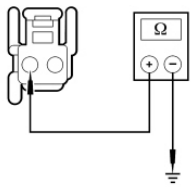
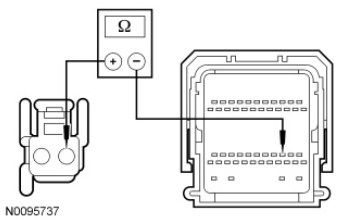
 • **Is the voltage greater than 10 volts?**	
A17 CHECK CIRCUIT CE336 (GN/WH) FOR AN OPEN BETWEEN START DIODE AND STARTER RELAY	
• Disconnect: Start Diode. • Measure the resistance between the start diode, circuit CE336 (GN/WH), harness side and BJB starter motor relay pin 86, circuit CE336 (GN/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to A18 . **No** REPAIR circuit CE336 (GN/WH) for an open. TEST the system for normal operation.
A18 CHECK CIRCUIT SBP27 (BU/RD) FOR VOLTAGE	
• Connect: Starter Motor Relay. • Connect: Start Diode. • Disconnect: Ignition Switch C250. • Measure the voltage between ignition switch C250-4, circuit SBP27 (BU/RD), harness side and ground.	**Yes** GO to A19 . **No** VERIFY SJB fuse 27 (20 A) is OK. If OK, REPAIR circuit SBP27 (BU/RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

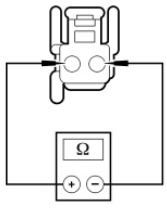
 • **Is the voltage greater than 10 volts?**	
A19 CHECK THE IGNITION SWITCH	
• Carry out the Ignition Switch Component Test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the ignition switch pass the component test?**	**Yes** REPAIR circuit CDC35 (BU/WH) for an open. TEST the system for normal operation. **No** INSTALL a new ignition switch. REFER to Section 211-05 . TEST the system for normal operation.
A20 CHECK CIRCUIT CDC35 (BU/WH) FOR AN OPEN	
• Connect: Starter Motor Relay. • Disconnect: PCM C175B. • Disconnect: Start Diode. • Measure the resistance between the start diode cell, circuit CDC35 (BU/WH), harness side and PCM C175B-16, circuit CDC35 (BU/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to A21 . **No** REPAIR circuit CDC35 (BU/WH) for an open. TEST the system for normal operation.
A21 CHECK THE CIRCUIT CE336 (GN/WH) BETWEEN THE BJB AND THE PCM	

• Connect: Start Diode. • Ignition OFF. • Measure the resistance between the BJB starter motor relay pin 86, circuit CE336 (GN/WH), harness side and PCM C175B-37, circuit CE336 (GN/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** REPAIR circuit CE336 (GN/WH). TEST the system for normal operation.
A22 CHECK CIRCUIT CDC35 (BU/WH) FOR AN OPEN	
• Connect: Starter Motor Relay. • Disconnect: PCM C175B. • Disconnect: Start Diode. • Measure the resistance between the start diode cell, circuit CDC35 (BU/WH), harness side and PCM C175B-10, circuit CDC35 (BU/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to A23 . **No** REPAIR circuit CDC35 (BU/WH) for an open. TEST the system for normal operation.
A23 CHECK CIRCUIT CE336 (GN/WH) BETWEEN THE BJB AND THE PCM	

• Ignition OFF. • Connect: Start Diode. • Measure the resistance between the BJB starter motor relay pin 86, circuit CE336 (GN/WH), harness side and PCM C175B-19, circuit CE336 (GN/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** REPAIR circuit CE336 (GN/WH). TEST the system for normal operation.
A24 CHECK STARTER MOTOR RELAY POWER	
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.** • Disconnect: Starter Motor Relay. • Measure the voltage between BJB starter motor relay pin 30, circuit SBB05 (GY/RD), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to A25 . **No** VERIFY BJB fuse 5 (30A) is OK. If OK, REPAIR circuit SBB05 (GY/RD). TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

A25 CHECK THE STARTER MOTOR RELAY	
• Carry out the Starter Motor Relay Component Test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the starter motor relay pass the component test?**	**Yes** For 2.5L and 3.0L vehicles, GO to A26 . For 3.5L vehicles, GO to A27 . **No** INSTALL a new starter motor relay. TEST the system for normal operation.
A26 CHECK CIRCUIT CDC12 (YE) FOR AN OPEN	
• Disconnect: PCM C175B. • Measure the resistance between the BJB starter relay pin 85, circuit CDC12 (YE), harness side and PCM C175B-7, circuit CDC12 (YE), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** REPAIR circuit CDC12 (YE). TEST the system for normal operation.
A27 CHECK CIRCUIT CDC12 (YE) FOR AN OPEN	
• Disconnect: PCM C175B. • Measure the resistance between the BJB starter relay pin 85, circuit CDC12 (YE), harness side and PCM C175B-34, circuit CDC12 (YE), harness side.	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** REPAIR circuit CDC12 (YE). TEST the system for normal operation.

 N0095735 • **Is the resistance less than 5 ohms?**	
A28 CHECK CIRCUIT GD120 (BK/GN) FOR AN OPEN	
• Ignition OFF. • Disconnect: Clutch Cutoff Switch C2072. • Measure the resistance between clutch cutoff switch C2072-2, circuit GD120 (BK/GN), harness side and ground.  N0095736 • **Is the resistance less than 5 ohms?**	**Yes** GO to A29 . **No** REPAIR circuit GD120 (BK/GN). TEST the system for normal operation.
A29 CHECK CIRCUIT CE903 (BU/OG) FOR AN OPEN	
• Ignition OFF. • Disconnect: PCM C175T. • Measure the resistance between clutch cutoff switch C2072-1, circuit CE903 (BU/OG), harness side and PCM C175T-26, circuit CE903 (BU/OG), harness side.  N0095737 • **Is the resistance less than 5 ohms?**	**Yes** GO to A30 . **No** REPAIR circuit CE903 (BU/OG). TEST the system for normal operation.

A30 CHECK CPP SWITCH FOR AN OPEN	
• Measure the resistance between clutch cutoff switch C2072-2 and C2072-1, component side, fully disengage the clutch.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** REPLACE the clutch cutoff switch. TEST the system for normal operation.

Pinpoint Test B: One-Touch Integrated Start (OTIS) Does Not Operate Correctly

Refer to Wiring Diagrams Cell 20 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Starting System for schematic and connector information.

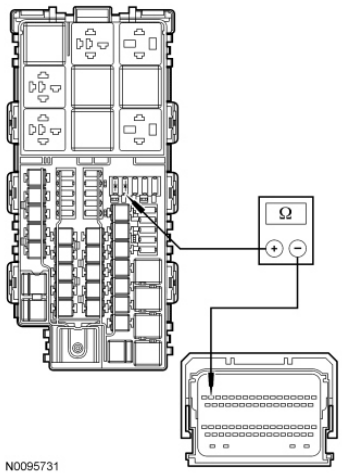
Normal Operation

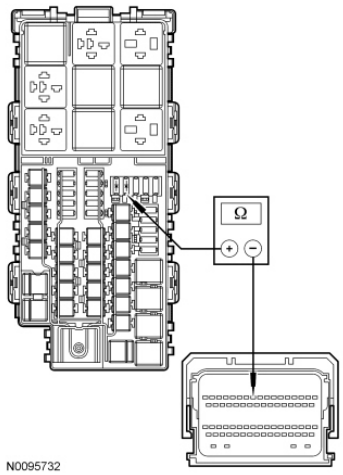
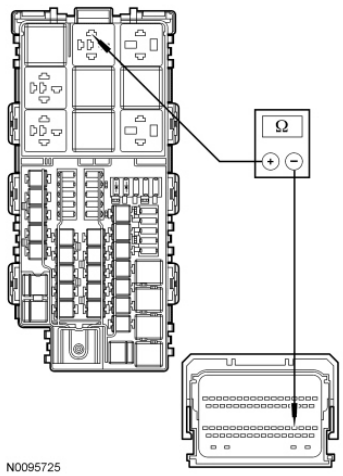
When the ignition switch is turned to the START position and released, the PCM receives a starter motor request signal through circuit CDC35 (BU/WH). With the vehicle in PARK or NEUTRAL or with the clutch pedal depressed, power flows from the PCM to the starter motor relay through circuit CE336 (GN/WH). A ground is supplied through circuit CDC12 (YE) from the PCM causing the starter motor relay coil to energize and the relay contacts close. This allows power from starter motor relay through circuit CDC25 (BN/GN) to the starter solenoid. The solenoid is grounded at the starter motor. Energizing the starter solenoid will engage the starter drive into the ring gear and closes the solenoid contacts, allowing power directly from the battery through circuit SDC02 (RD) to the starter motor to start the engine. The customer is no longer in the loop after the initial crank request, the customer may release the key to the RUN/START position. The PCM will disengage the starter motor based on engine running (rpm threshold), a set crank time has been exceeded or the ignition switch has been turned to the OFF position.

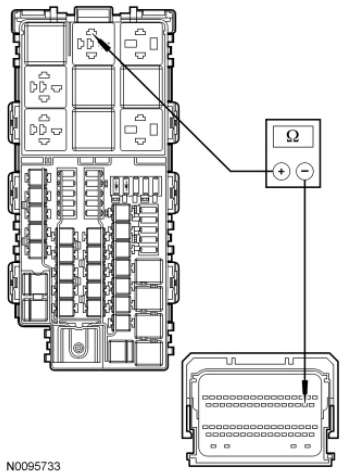
This pinpoint test is intended to diagnose the following:
- Circuitry
- PCM

PINPOINT TEST B: ONE-TOUCH INTEGRATED START (OTIS) DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
B1 CHECK THE STATUS OF OTIS (OTS_STAT) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - PCM. • Monitor the PCM PID OTS_STAT with the ignition switch in the RUN position. • **Is the OTIS PID enabled?**	**Yes** GO to B2 . **No** ENABLE One-Touch Integrated Start (OTIS). TEST the system for normal operation. If OTIS

	will not enable, INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation.
B2 CHECK THE KEY POSITION FOR START INDICATED (START_KEY) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - PCM. • **NOTE:** For manual transaxle, fully disengage the clutch. • Monitor the PCM PID START_KEY with the ignition switch in the START position. • **Does the PID change from OFF to ON?**	**Yes** GO to B5 . **No** For 2.5L and 3.0L vehicles, GO to B3 . For 3.5L vehicles, GO to B4 .
B3 CHECK CIRCUIT CDC35 (BU/WH)	
• Disconnect: Start Diode. • Disconnect: PCM C175B. • Measure the restance between start diode cell, circuit CDC35 (BU/WH), harness side and PCM C175B-16, circuit CDC35 (BU/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** REPAIR circuit CDC35 (BU/WH). TEST the system for normal operation.
B4 CHECK CIRCUIT CDC35 (BU/WH)	
• Disconnect: Start Diode. • Disconnect: PCM C175B. • Measure the resistance between start diode cell, circuit CDC35 (BU/WH), harness side and PCM C175B-10, circuit CDC35 (BU/WH), harness side.	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** REPAIR circuit CDC35 (BU/WH). TEST the system for normal operation.

 • **Is the resistance less than 5 ohms?**	
B5 CHECK THE STARTER MOTOR CONTROL OUTPUT DETECTED (SMC_MON) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger -CM. • **NOTE:** For manual transaxle, fully disengage the clutch. • Monitor the PCM PID SMC_MON with the ignition switch in the START position. • **Does the PID change from OFF to ON?**	**Yes** GO to B8 . **No** For 2.5L and 3.0L vehicles, GO to B6 . For 3.5L vehicles, GO to B7 .
B6 CHECK THE CIRCUIT CE336 (GN/WH) BETWEEN THE BJB AND THE PCM	
• Ignition OFF. • Disconnect: PCM C175B. • Measure the resistance between the Battery Junction Box (BJB) starter motor relay pin 86, circuit CE336 (GN/WH), harness side and PCM C175B-37, circuit CE336 (GN/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** REPAIR circuit CE336 (GN/WH). TEST the system for normal operation.

B7 CHECK THE CIRCUIT CE336 (GN/WH) BETWEEN THE BJB AND THE PCM	
• Ignition OFF. • Disconnect: PCM C175B. • Measure the resistance between the BJB starter motor relay pin 86, circuit CE336 (GN/WH), harness side and PCM C175B-19, circuit CE336 (GN/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** REPAIR circuit CE336 (GN/WH). TEST the system for normal operation.
B8 CHECK THE STARTER MOTOR RELAY ENABLE (STRT_RLY) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - PCM. • **NOTE:** For manual transaxle, fully disengage the clutch. • Monitor the PCM PID STRT_RLY with the ignition switch in the START position. • **Does the PID change from DISABLED TO ENABLED?**	**Yes** REPAIR circuit CDC12 (YE). TEST the system for normal operation. **No** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation.

Pinpoint Test C: Unusual Starter Noise

This pinpoint test is intended to diagnose the following:

- Starter motor mounting
- Starter motor mounting bolts
- Starter motor drive
- Flywheel or flexplate ring gear
- Starter motor

PINPOINT TEST C: UNUSUAL STARTER NOISE

Test ep	Result / Action to Take
C1 CHECK THE STARTER MOUNTING	
• Inspect the starter motor mounting bolts for looseness. • **Is the starter motor mounted correctly?**	**Yes** GO to C2 . **No** INSTALL the starter motor correctly. REFER to Starter Motor - 2.5L , Starter Motor - 3.0L or Starter Motor - 3.5L in this section. TEST the system for normal operation.
C2 CHECK FOR ENGINE NOISE	
• Turn the ignition switch to the OFF position. • Connect a fused jumre from the B-terminal to the S-terminal of the starter motor. Engage the starter motor and verify that the noise is due to the starter operation. • **Is the noise due to the starter motor engagement?**	**Yes** GO to C3 . **No** REFER to Section 303-00 to continue the diagnosis.
C3 CHECK FOR UNUSUAL WEAR	
• Remove the starter motor. Refer to Starter Motor - 2.5L , Starter Motor - 3.0L or Starter Motor - 3.5L in this section. • Inspect the ring gear for damaged or worn teeth. • **Is the noise due to flexplate/flywheel ring gear tooth damage?**	**Yes** INSTALL a new flexplate/flywheel ring gear. EXAMINE the starter pinion teeth. If damaged, INSTALL a new starter motor. REFER to Starter Motor - 2.5L , Starter Motor - 3.0L or Starter Motor - 3.5L in this section. TEST the system for normal operation. **No** INSTALL a new starter motor. REFER to Starter Motor - 2.5L , Starter Motor - 3.0L or Starter Motor - 3.5L in this section. TEST the system for normal operation.

Component Tests

⚠ WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.

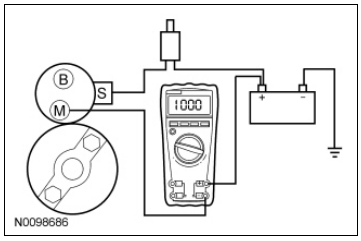
Connect the Fluke 77-IV Digital Multimeter at the component terminal rather than at the wiring end connector. Making a connection at the wiring end connector could result in false readings because the meter will not pick up a high resistance between the wiring connector and the component.

Starter Motor - Motor Feed Circuit

1. Make sure the battery is fully charged. Carry out a battery load test. Refer to Section 414-01 .

2. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive (+) terminal.

3. Connect the Fluke 77-IV Digital Multimeter positive lead to the battery positive (+) post. Connect the negative lead to the M-terminal.



4. Engage the remote starter switch. Read and record the voltage. The voltage reading should be 0.8 volt or less.

5. If the voltage reading is 0.8 volt or less, go to the Starter Motor - Ground Circuit Component Test.

6. If the voltage reading is greater than 0.8 volt, this is an indication of excessive resistance in the connections, the positive battery cable or in the starter solenoid. Move the Fluke 77-IV Digital Multimeter negative lead to the starter solenoid B-terminal and repeat the test. If the voltage reading at the B-terminal is lower than 0.8 volt, the concern is either in the connections at the starter solenoid or in the solenoid contacts.

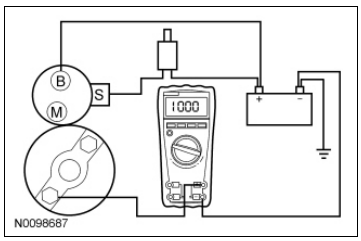
7. Remove the cables from solenoid B-, S- and M-terminals. Clean the cables and connections and reinstall the cables to the correct terminals. Repeat Steps 3 through 6. If the voltage drop reading is still greater than 0.8 volt when checked at the M-terminal and less than 0.8 volt when checked at the B-terminal, the concern is in the solenoid contacts. Install a new starter motor. Refer to Starter Motor - 2.5L , Starter Motor - 3.0L or Starter Motor - 3.5L in this section.

8. If the voltage reading taken at the solenoid B-terminal is still greater than 0.8 volt after cleaning the cables and the connections at the solenoid, the concern is either in the positive (+) battery cable connection or in the positive battery cable itself. Clean the positive (+) battery cable connection. If this does not solve the problem, install a new positive battery cable. Refer to Section 414-01 .

Starter Motor - Ground Circuit

A slow cranking condition can be caused by resistance in the ground or return portion of the cranking circuit. Check the voltage drop in the ground circuit as follows:

1. Connect the Fluke 77-IV Digital Multimeter positive lead to the starter motor housing (the connection clean and free of rust or grease). Connect the negative lead to the negative (-) battery terminal.



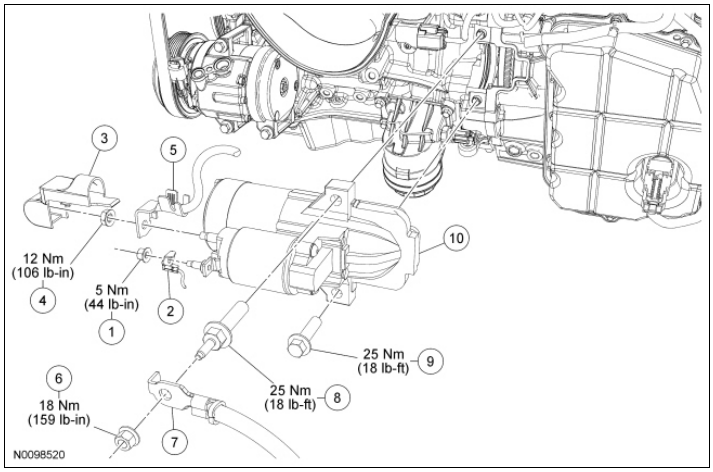
2. Engage the remote starter switch and crank the engine. Read and record the voltage reading. The reading should be 0.5 volt or less.

3. If the voltage is more than 0.5 volt, clean the negative cable connections at the battery, the body ground connections and the starter ground connections. Retest.

4. If the voltage is more than 0.5 volt, install a new cable. If the voltage reading is less than 0.5 volt and the engine still cranks slowly, install a new starter motor. Refer to Starter Motor - 2.5L , Starter Motor - 3.0L or Starter Motor - 3.5L in this section.

&nbP>

Starter Motor - 2.5L



Item	Part Number	Description
1	N805320	Starter motor solenoid wire nut
2	14463	Starter motor solenoid wire (part of 14B060)
3	14603	Starter motor solenoid battery cable terminal cover
4	W706414	Starter motor solenoid battery cable nut
5	14463	Starter motor solenoid battery cable (part of 14B060)
6	W705790	Ground wire nut
7	14463	Ground wire (part of 14B060)
8	W706194	Starter motor stud bolt
9	W705877	Starter motor bolt
10	11000	Starter motor

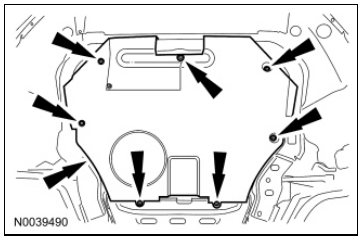
Removal and Installation

⚠ WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at ttarter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. If equipped, remove the 7 screws and the underbody cover.



4. Remove the starter motor solenoid wire nut and position the wire aside.
    - To install, tighten to 5 Nm (44 lb-in).

5. Position the starter motor solenoid battery cable terminal cover aside.

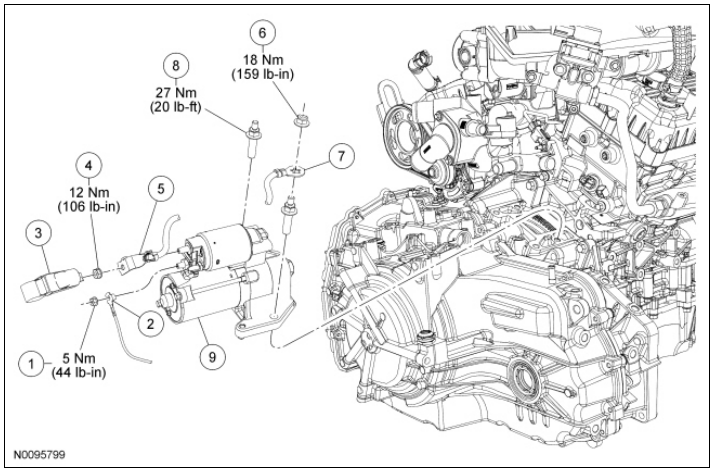
6. Remove the starter motor solenoid battery cable nut and position the cable aside.
    - To install, tighten to 12 Nm (106 lb-in).

7. Remove the ground wire nut from the starter motor stud bolt and position the ground wire aside.
    - To install, tighten to 18 Nm (159 lb-in).

8. Remove the starter motor bolt, stud bolt and the starter motor.
    - To install, tighten to 25 Nm (18 lb-ft).

9. To install, reverse the removal procedure.

Starter Motor - 3.0L



Item	Part Number	Description
1	N805320	Starter motor solenoid wire nut
2	14463	Starter motor solenoid wire (part of 12B637)
3	14603	Starter motor solenoid battery cable terminal cover
4	W706414	Starter motor solenoid battery cable nut
5	14463	Starter motor solenoid battery cable (part of 14B060)
6	-	Ground wire nut
7	14463	Ground wire (part of 14A280)
8	W503297	Starter motor stud bolt (2 required)
9	11000	Starter motor

⚠ WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this ction may result in serious personal injury.

1. Remove the battery tray. For additional information, refer to Section 414-01 .

2. Remove the starter motor solenoid wire nut and position the wire aside.
   - To install, tighten to 5 Nm (44 lb-in).

3. Position the starter motor solenoid terminal battery cable cover aside.

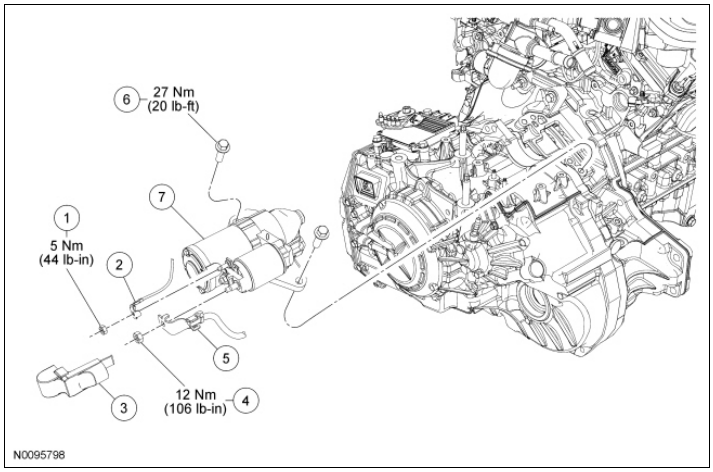
4. Remove the starter motor solenoid battery cable nut and position aside the cable.
   - To install, tighten to 12 Nm (106 lb-in).

5. Remove the ground wire nut from the starter motor stud bolt and position the ground wire aside.
   - To install, tighten to 18 Nm (159 lb-in).

6. Remove the 2 starter motor stud bolts and the starter motor.
   - To install, tighten to 27 Nm (20 lb-ft).

7. To install, reverse the removal procedure.

Starter Motor - 3.5L



Item	Part Number	Description
1	N805320	Starter motor solenoid wire nut
2	14463	Starter motor solenoid wire (part of 14B060)
3	14603	Starter motor solenoid battery cable terminal cover
4	W706414	Starter motor solenoid battery cable nut
5	14463	Starter motor solenoid battery cable (part of 14B060)
6	W503297	Starter motor bolt (2 required)
7	11000	Starter motor

⚠ WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.

1. Remove the battery tray. For additional information, refer to Section 414-01 .

2. Remove the starter motor solenoid wire nut and position the wire aside.
   - To install, tighten to 5 Nm (44 lb-in).

3. Position the starter motor solenoid terminal battery cable cover aside.

4. Remove the starter motor solenoid battery cable nut and position aside the cable.
   - To install, tighten to 12 Nm (106 lb-in).

5. Remove the 2 starter motor bolts and the starter motor.
   - To install, tighten to 27 Nm (20 lb-ft).

6. To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	-

General Specifications

Item	Specification
Firing order	1-3-4-2
Spark plug	6M8G-12405-BB
Spark plug gap	1.25-1.35 mm (0.049-0.053 in)

Torque Specifications

Description	Nm	l
Ignition coil-on-plug bolts	10	89
Spark plugs	12	106

Engine Ignition

The Electronic Ignition (EI) system is a coil-on-plug ignition system. The coil-on-plug ignition system consists of the:

- ignition coil-on-plugs.
- spark plugs.
- Crankshaft Position (CKP) sensor.
- Camshaft Position (CMP) sensor.

The ignition coil-on-plugs:

- change low voltage signals from the PCM to high voltage pulses.
- supply the high voltage pulses to the spark plugs.
- are connected directly to each spark plug.
- have replaceable coil boots.

The spark plugs:

- change high voltage pulses into a spark which ignites the fuel and air mixture.

The CKP sensor:

- is a variable reluctance sensor.
- is triggered by a 36-minus-1 tooth trigger wheel mounted on the crankshaft.
- provides base timing and crankshaft speed (rpm) to the PCM.
- is essential for calculating spark ng.

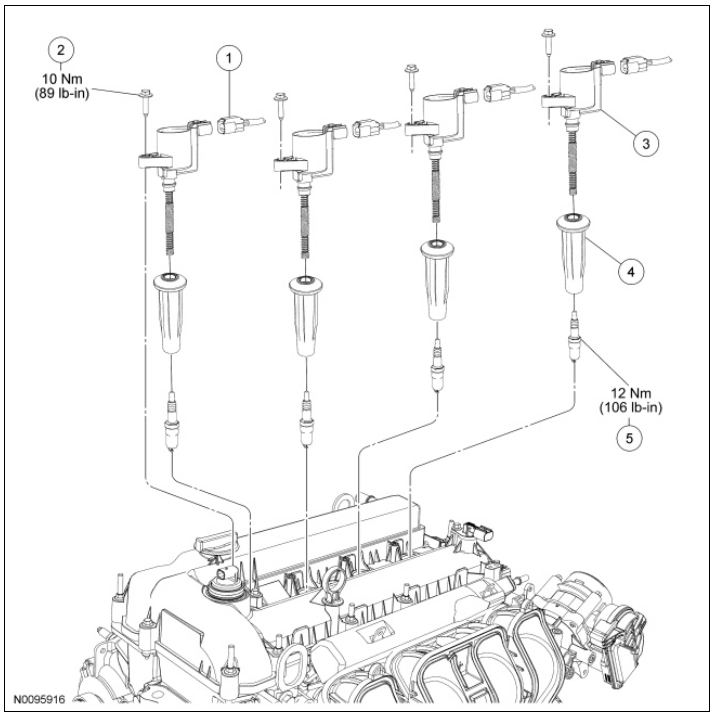
The CMP sensor:

- is a Hall-effect sensor.
- provides camshaft rotational location information to the PCM.
- sends the PCM a signal indicating camshaft position used for fuel synchronization.

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Engine Ignition Components - Exploded View



Item	Part Number	Description
1	14A464	Ignition coil-on-plug electrical connector (part of 12B637) (4 required)
2	W500215	Ignition coil-on-plug bolt (4 required)
3	12A366	Ignition coil-on-plug (4 required)
4	12A402	Ignition coil-on-plug boot (4 required)
5	12405	Spark plug (4 required)

1. For additional inforrefer to the procedures in this section.

Ignition Coil-On-Plug

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Removal and Installation

1. Disconnect the 4 ignition coil-on-plug electrical connectors.

2. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

   Remove the 4 bolts and the ignition coil-on-plugs.

   - To install, tighten to 10 Nm (89 lb-in).

3. Inspect the ignition coil-on-plug boots for rips, nicks or tears. Remove and discard any damaged ignition coil-on-plug boots.
   - To install, slide the new coil-on-boot onto the coil until fully seated at the top of the coil.

4. To install, reverse the removal procedure.
   - Apply a small amouf dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs.

Spark Plugs

Removal and Installation

1. Remove the 4 ignition coil-on-plugs. For additional information, refer to Ignition Coil-On-Plug in this section.

2. *NOTICE:* **Only use hand tools when removing or installing the spark plugs, or damage can occur to the cylinder head or spark plug.**

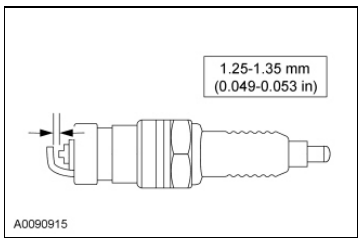
   NOTE: Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

   Remove the 4 spark plugs.

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

3. Inspect the 4 spark plugs. For additional information, refer to Section 303-00 .

4. To install, reverse the removal procedure.
   - Adjust the spark plug gap as necessary.



Material

Item	Specification	Fill Capacity
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	-

General Specifications

Item	Specification
Firing order	1-4-2-5-3-6
Spark plug	CGSF-22N
Spark plug gap	1.15-1.25 mm (0.045-0.049 in)

Torque Specifications

Description	Nm	lb-in
Ignition coil-on-plug bolts	7	62
Spark plugs	15	133

Engine Ignition

The Electronic Ignition (EI) system is a coil-on-plug ignition system. The coil-on-plug ignition system consists of the:

- Camshaft Position (CMP) sensor.
- Crankshaft Position (CKP) sensor.
- ignition coil-on-plugs.
- spark plugs.

The CMP sensor:

- is a Hall-effect sensor.
- is mounted in the front cover.
- is triggered by the high point mark on the LH exhaust camshaft.
- sends the PCM a signal indicating camshaft position used for fuel synchronization.

The CKP sensor:

- is a variable reluctance sensor.
- is triggered by a 36-minus-1 tooth trigger wheel mounted on the crankshaft.
- provides base timing and crankshaft speed (rpm) to the PCM.
- is essential falculating spark timing.

The ignition coil-on-plugs:

- change low voltage signals from the PCM to high voltage pulses.
- produce the high voltage pulses to the spark plugs.
- are connected directly to each spark plug.

The spark plugs:

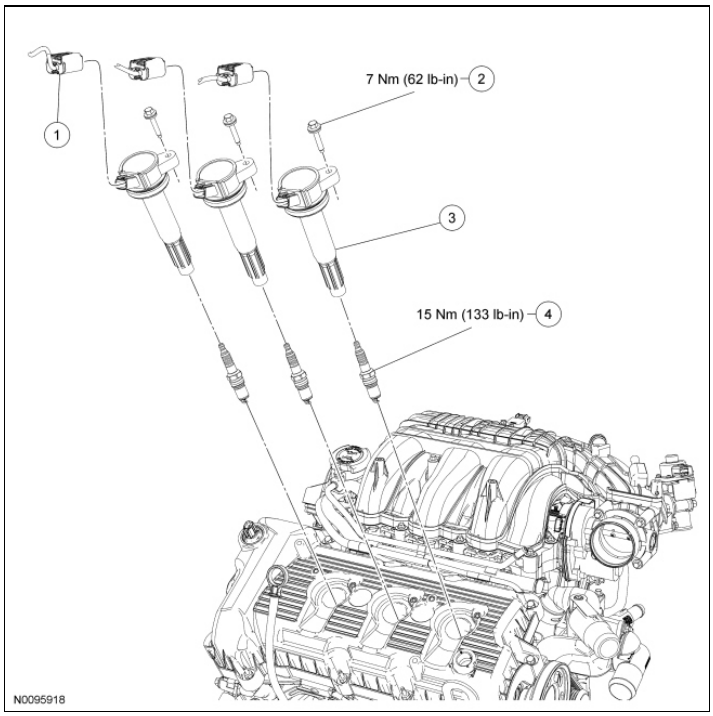
- change high voltage pulses into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle have a fine wire design platinum-enhanced active electrode for long life.

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

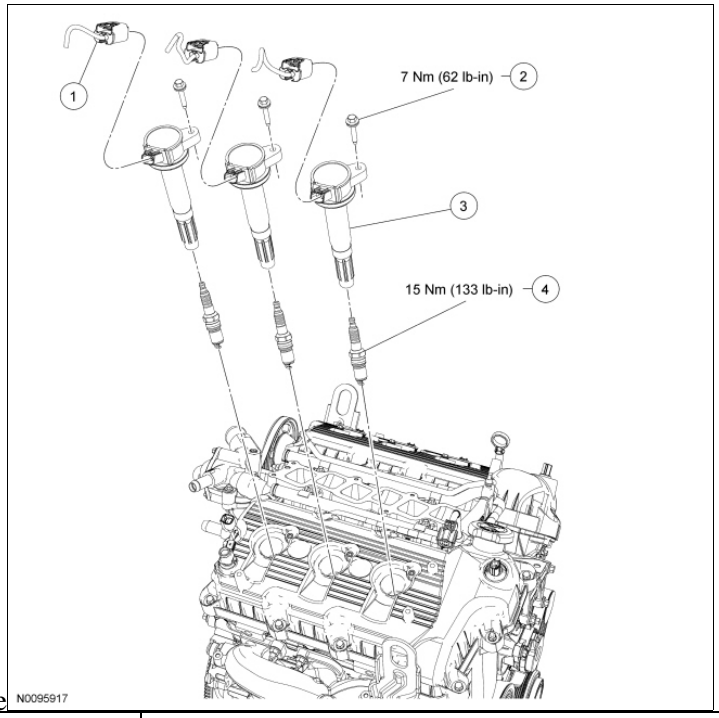
Engine Ignition Components - Exploded View

LH Side



Item	Part Number	Description
1	14A464	LH ignition coil-on-plug electrical connector (part of 12B637) (3 required)
2	W708833	LH ignition coil-on-plug bolt (3 required)
3	12A375	LH ignition coil-on-plug (3 required)
4	12405	Spark plug (3 required)

RH Side



Item	Part Number	Description
1	14A464	RH ignition coil-on-plug electrical connector (part of 12B637) (3 required)
2	W708833	RH ignition coil-on-plug bolt (3 required)
3	12A375	RH ignition coil-on-plug (3 required)
4	12405	Spark plug (3 required)

1. For additional information, refer to the procedures in this section.

Ignition Coil-On-Plug

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Removal and Installation

RH side

1. **NOTE:** The upper intake manifold must be removed to access the RH ignition coil-on-plugs only.

   Remove the upper intake manifold. For additional information, refer to Section 303-01B .

Both sides

2. Disconnect the 6 ignition coil-on-plug electrical connectors.

3. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

   Remove the 6 bolts and the 6 ignition coil-on-plugs.

   - To install, tighten to 7 Nm (62 lb-in).

4. To install, reverse the removal procedure.
   - Apply a small amount of dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs.

Spark Plugs

Removal and Installation

1. Remove the 6 ignition coil-on-plugs. For additional information, refer to Ignition Coil-On-Plug in this section.

2. *NOTICE:* **Only use hand tools when removing or installing the spark plugs, or damage can occur to the cylinder head or spark plug.**

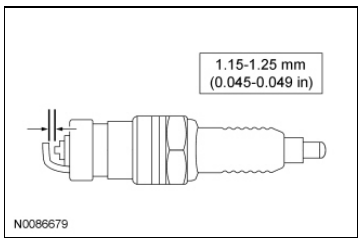
   NOTE: Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

   Remove the 6 spark plugs.

   - To install, tighten to 15 Nm (133 lb-in).

3. Inspect the 6 spark plugs. For additional information, refer to Section 303-00 .

4. To install, reverse the removal procedure.
   - Adjust the spark plug gap as necessary.



Material

Item	Specification	Fill Capacity
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	-

General Specifications

Item	Specification
Engine Ignition	
Spark plug	AYFS-22FM
Spark plug gap	1.29-1.45 mm (0.051-0.057 in)

Torque Specifications

Description	Nm	lb-in
Ignition coil-on-plug bolts	7	62
Spark plugs	15	133

Engine Ignition

The Electronic Ignition (EI) system is a coil-on-plug ignition system. The coil-on-plug ignition system consists of:

- Camshaft Position (CMP) sensors.
- a Crankshaft Position (CKP) sensor.
- ignition coil-on-plugs.
- spark plugs.

The CMP ors:

- are variable reluctance sensors.
- are mounted in the rear of the cylinder head.
- are triggered by a 3-plus-1 timing wheel on each intake camshaft.
- provides camshaft rotational location information to the PCM.

The CKP sensor:

- is a variable reluctance sensor.
- is triggered by a 36-minus-1 tooth trigger wheel mounted on the crankshaft, at the rear of the engine.
- provides base timing and crankshaft speed (rpm) to the PCM.

The ignition coil-on-plugs:

- change low voltage signals from the PCM to high voltage pulses.
- produce the high voltage pulses to the spark plugs.
- are connected directly to each spark plug.
- have replaceable coil seals.

The spark plugs:

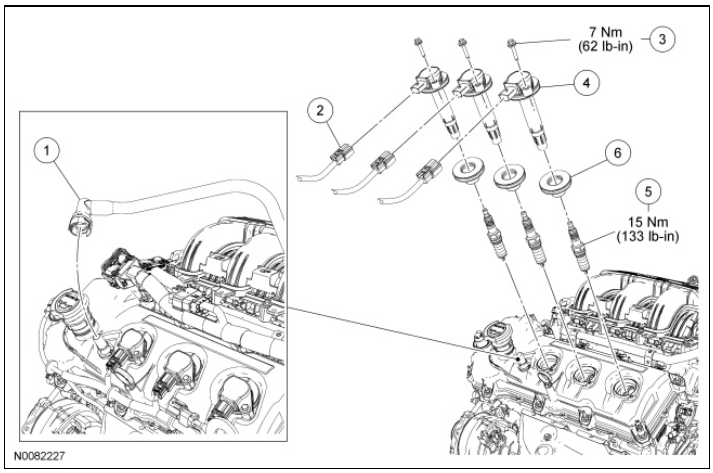
- change high voltage pulses into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle have a platinum-enhanced fine wire electrode for long life.

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

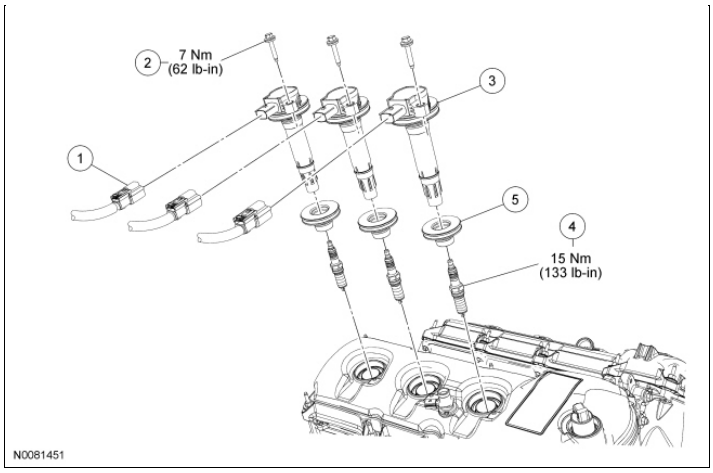
Engine Ignition Components - Exploded View

LH Side



Item	Part Number	Description
1	6758	Crankcase ventilation tube-to-valve cover fitting quick connect coupling
2	-	Ignition coil-on-plug electrical connector (part of 12A581) (3 required)
3	W708833	Ignition coil-on-plug bolt (3 required)
4	12A375	Ignition coil- required)
5	12405	Spark plug (3 required)
6	12A384	Coil seal (3 required)

RH Side



Item	Part Number	Description
1	-	Ignition coil-on-plug electrical connector (part of 12A581) (3 required)
2	W708833	Ignition coil-on-plug bolt (3 required)
3	12A375	Ignition coil-on-plug (3 required)
4	12405	Spark plug (3 required)
5	12A384	Coil seal (3 required)

1. For additional information, refer to the procedures in this section.

Ignition Coil-On-Plug

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Removal and Installation

LH side

1. Disconnect the crankcase ventilation tube-to-valve cover quick connect coupling and position aside. For additional information, refer to Section 310-00 .

RH side

1. **NOTE:** The upper intake manifold must be removed to access the RH ignition coil-on-plugs.

   Remove the upper intake manifold. For additional information, refer to Section 303-01C .

Both sides

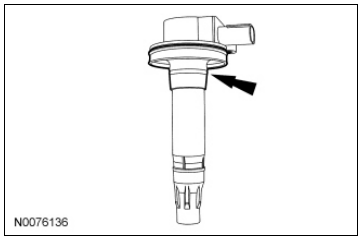
3. Disconnect the 6 ignition coil-on-plug electrical connectors.

4. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

   Remove the 6 bolts and the 6 ignition coil-on-plugs.

   - To install, tighten to 7 Nm (62 lb-in).

5. Inspect the coil seals for rips, nicks or tears. Remove and discard any damaged coil seals.
   - To install, slide the new coil seal onto the coil until it is fully seated at the top of the coil.



6. To install, reverse the removal procedure.
   - Apply a small amount of dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs.

Spark Plugs

Removal and Installation

1. Remove the 6 ignition coil-on-plugs. For additional information, refer to Ignition Coil-On-Plug in this section.

2. *NOTICE:* **Only use hand tools when removing or installing the spark plugs, or damage can occur to the cylinder head or spark plug.**

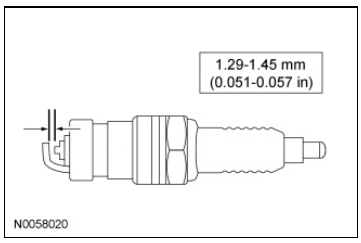
   NOTE: Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

   Remove the 6 spark plugs.

   - To install, tighten to 15 Nm (133 lb-in).

3. Inspect 6 spark plugs. For additional information, refer to Section 303-00 .

4. To install, reverse the removal procedure.
   - Adjust the spark plug gap as necessary.



Material

Item	Specification	Fill Capacity
Motorcraft® Metal Surface Prep ZC-31-A	-	-

Torque Specifications

Description	Nm	lb-in
Crankcase vent oil separator bolts	10	89
EGR valve bolts	20	177

Engine Emission Control

NOTE: Do not permanently remove or render inoperative any part of the vehicle emission control system including related hardware. Failure to comply may violate applicable state and federal laws.

NOTE: The vehicle emission vacuum routing diagrams are contained in the Description and Operation subsection of the Engine Emissions Control section. For additional information, refer to Section 303-13A .

The engine emission control system consists of the:

- EGR system.
- PCV system.

EGR system

The EGR system returns a small amount of exhaust gas into the intake manifold. This reduces the overall combustion temperature. Cooler combustion temperatures provide a significant reduction of the Nitrogen Ox (NOx) in the exhaust emissions.

The engine incorporates a stepper motor-controlled EGR valve which receives its signal from the PCM. Engine coolant is used to cool the EGR valve. The EGR valve and stepper motor are serviced as an assembly.

The amount of recirculated exhaust gas depends on:

- engine rpm.
- intake manifold vacuum.
- exhaust backpressure.
- Engine Coolant Temperature (ECT).
- Throttle Position (TP).

PCV system

The PCV system uses intake manifold vacuum to ventilate blow-by vapors from the crankcase and return the vapors to the intake manifold for combustion. The PCV valve varies the amount of blow-by vapors returned to the intake manifold based on available engine vacuum. The PCV valve also prevents entry of combustion backfiring into the crankcase. The PCV valve is serviced as part of the crankcase vent oil separator.

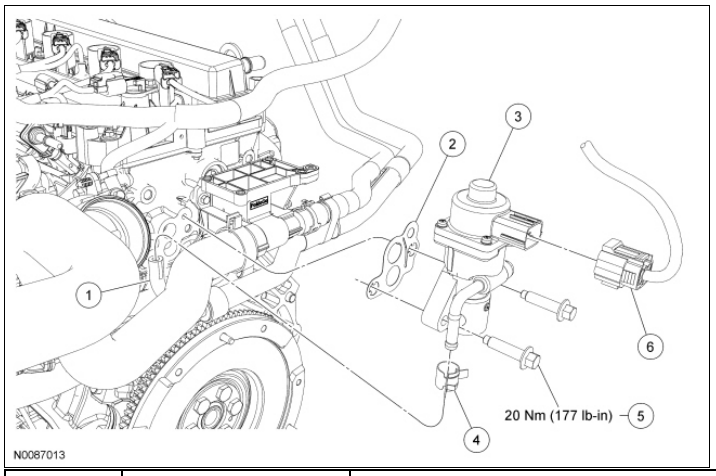
Engine Emission Control

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Exhaust Gas Recirculation (EGR) Valve

Material

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



Item	Part Number	Description
1	-	EGR valve coolant hose (part of 18C266)
2	9D476	EGR valve gasket
3	9D475	EGR valve
4	W525952	EGR valve cose clamp
5	W500225	EGR valve bolt
6	14A464	EGR valve electrical connector

Removal and Installation

1. Drain the cooling system. For additional information, refer to Section 303-03A .
2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12A .
3. Disconnect the EGR valve electrical connector.
4. Release the clamp and remove the EGR coolant outlet hose from the EGR valve.
5. Remove the 2 bolts and the EGR valve.
   - Discard the gasket.
   - To install, tighten to 20 Nm (177 lb-in).
6. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the Exhaust Gas Recirculation (EGR) valve gasket.**

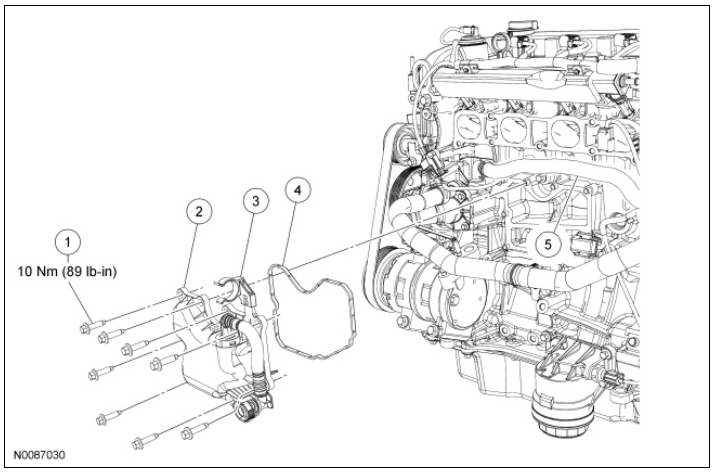
NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the mating surfaces.

Clean the mating surfaces of any residual gasket material.

7. To install, reverse the removal procedure.

8. Fill and bleed the cooling system. For additional information, refer to Section 303-03A .

Crankcase Vent Oil Separator



Item	Part Number	Description
1	W500214	Crankcase vent oil separator bolt (8 required)
2	6A785	Crankcase vent oil separator
3	-	Coolant bypass hose clip (part of 9A785)
4	6A785	Crankcase vent oil separator gasket
5	8A582	Coolant bypass hose

Removal and Installation

1. Remove the intake manifold. For additional information, to Section 303-01A .

2. Release the coolant bypass hose from the clip.

3. Remove the 8 bolts and the crankcase vent oil separator and gasket.
   - To install, tighten to 10 Nm (89 lb-in).

4. To install, reverse the removal procedure.
   - Clean the engine block mating surface.

Material

Item	Specification	Fill Capacity
Motorcraft® Metal Surface Prep ZC-31-A	-	-

Torque Specifications

Description	Nm	lb-ft
EGR valve bolts	25	18
Exhaust manifold-to-EGR valve tube fittings	40	30 <

Engine Emission Control

NOTE: Do not permanently remove or render inoperative any part of the vehicle emission control system including related hardware. Failure to comply may violate applicable state and federal laws.

NOTE: The vehicle emission vacuum routing diagrams are contained in the Description and Operation subsection of the Engine Emissions Control section. For additional information, refer to Section 303-13A .

The engine emission control system consists of the:

- EGR system.
- PCV system.

EGR system

The EGR system returns a small amount of exhaust gas into the intake manifold. This reduces the overall combustion temperature. Cooler combustion temperatures provide a significant reduction of the Ngen Oxides (NOx) in the exhaust emissions.

The EGR valve:

- is electronically controlled by the PCM.
- is connected to the exhaust manifold by the EGR valve-to-exhaust manifold tube.
- controls recirculated exhaust gas flow to the intake manifold.
- monitors the flow of recirculated exhaust gases through the EGR valve-to-exhaust manifold tube.
- returns a signal to the PCM.

The amount of recirculated exhaust gas depends upon:

- engine rpm.
- intake manifold vacuum.
- exhaust back pressure.
- engine coolant temperature.
- Throttle Position (TP).

PCV system

The PCV system:

- uses intake manifold vacuum to ventilate blow-by vapors from the crankcase.
- returns the vapors to the intake manifold for combustion.

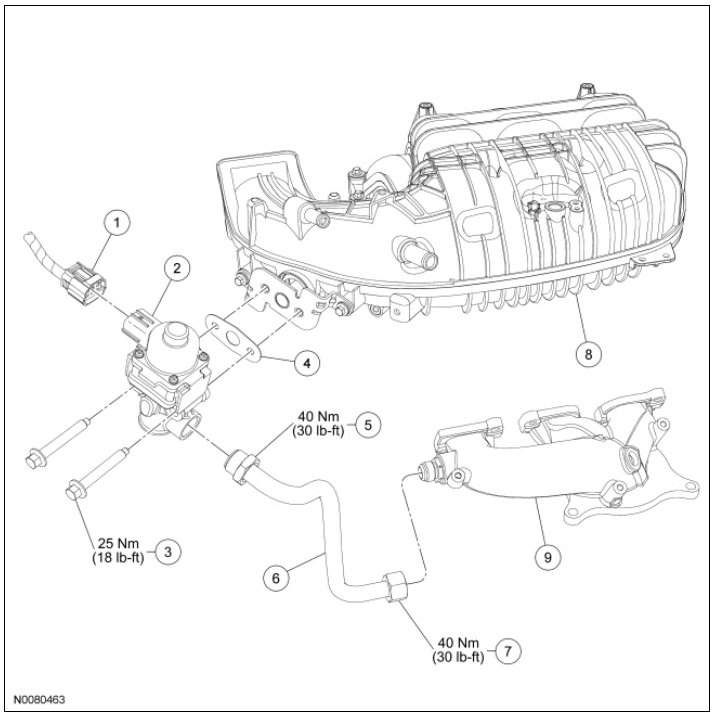
The PCV system consists of the:

- crankcase ventilation tube.
- PCV valve.

Engine Emission Control

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Exhaust Gas Recirculation (EGR) System Components - Exploded View



Item	Part Number	Description
1	14A464	EGR valve electrical connector
2	9D475	EGR valve
3	W500313	EGR valve bolts (2 required)
4	9D476	EGR valve gasket
5	-	Exhaust manifold-to-EGR valve tube fitting (part of 9D477)
6	9D477	Exhaust manGR valve tube
7	-	Exhaust manifold-to-EGR valve tube fitting (part of 9D477)
8	9424	Intake manifold
9	9430	RH exhaust manifold

1. For additional information, refer to the procedures in this section.

Exhaust Gas Recirculation (EGR) Valve

Material

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

Removal and Installation

1. Disconnect the EGR valve electrical connector.

2. Disconnect the exhaust manifold-to-EGR valve tube fitting from the EGR valve.
   - To install, tighten to 40 Nm (30 lb-ft).

3. Remove the 2 bolts and the EGR valve.
   - Discard the gasket.
   - To install, tighten to 25 Nm (18 lb-ft).

4. i>NOTICE: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the Exhaust Gas Recirculation (EGR) system module gasket.

   NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

   Clean the mating surfaces of any residual gasket material.

5. To install, reverse the removal procedure.
   - Install a new EGR valve gasket.

Exhaust Manifold to Exhaust Gas Recirculation (EGR) Valve Tube

Removal

All-Wheel Drive (AWD) vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

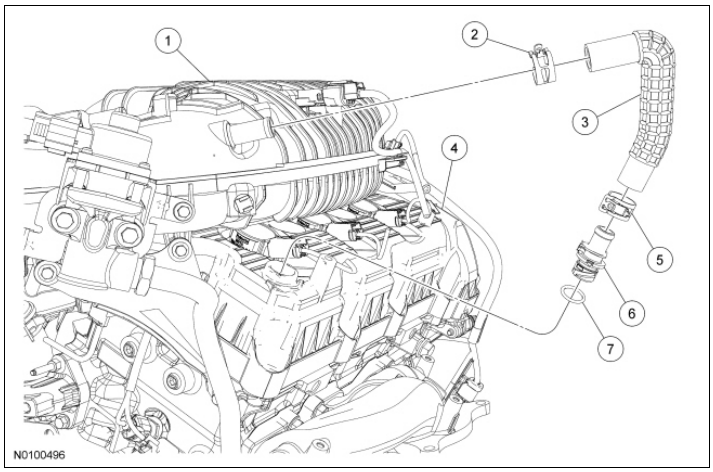
All vehicles

2. Disconnect the exhaust manifold-to-EGR valve tube fitting from the EGR valve.
3. Disconnect the exhaust manifold-to-EGR valve tube fitting from the exhaust manifold.
4. Remove the exhaust manifold-to-EGR valve tube.

Installation

1. Install the exhaust manifold-to-EGR valve tube.
2. Hand start txhaust manifold-to-EGR valve tube fitting to the exhaust manifold.
3. Hand start the exhaust manifold-to-EGR valve tube fitting to the EGR valve.
4. Tighten the exhaust manifold-to-EGR valve tube fittings to 40 Nm (30 lb-ft).

Positive Crankcase Ventilation (PCV) Valve



Item	Part Number	Description
1	9424	Intake manifold
2	W527382	Crankcase ventilation tube clamp
3	6K817	Crankcase ventilation tube
4	6582	RH valve cover
5	W527382	Crankcase ventilation tube clamp
6	6A666	PCV valve
7	-	PCV valve O-ring seal of 6A666)

Removal and Installation

1. Release the clamp and disconnect the crankcase ventilation tube from the PCV valve.

2. ***NOTICE:*** **A new Positive Crankcase Ventilation (PCV) valve must be installed if removed from the valve cover. Damage will occur to the locking mechanism on the PCV valve.**

   NOTE: To install, apply clean engine oil to the O-ring seal.

   Rotate counterclockwise and remove the PCV valve from the valve cover.

   - Discard the PCV valve.

3. To install, reverse the removal procedure.
   - Install a new PCV valve.

Material

Item	Specification	Fill Capacity
Motorcraft SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-

Engine Emission Control

NOTE: Do not permanently remove or render inoperative any part of the vehicle emission control system including related hardware. Failure to comply may violate applicable state and federal law.

NOTE: The vehicle emission vacuum routing diagrams are contained in the Description and Operation subsection of the Engine Emissions Control section. For additional information, refer to Section 303-13A .

The engine emission control system consists of the PCV system:

PCV System

The PCV system:

- uses intake manifold vacuum to ventilate blow-by vapors from the crankcase.
- returns the vapors to the intake manifold for combustion.

The PCV system consists of the:

- crankcase ilation tube.
- PCV valve.

The PCV valve:

- varies the amount of blow-by vapors returned to the intake manifold based on available engine vacuum.
- prevents combustion gases backfiring into the crankcase.

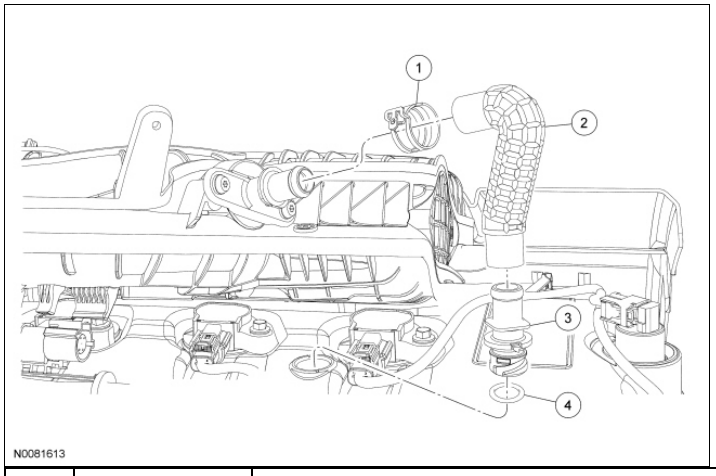
Engine Emission Control

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Positive Crankcase Ventilation (PCV) Valve

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



Item	Part Number	Description
1	-	Crankcase ventilation tube spring clamp (part of 6A664)
2	6K817	Craentilation tube
3	6A666	PCV valve
4	-	PCV valve O-ring seal (part of 6A666)

Removal and Installation

1. Disconnect the crankcase ventilation tube from the PCV valve.

2. ***NOTICE:*** **A new Positive Crankcase Ventilation (PCV) valve must be installed if removed from the valve cover. Damage will occur to the locking mechanism on the PCV valve.**

   NOTE: To install, apply clean engine oil to the O-ring seal.

   Rotate the PCV valve counterclockwise and remove from the valve cover.

   - Discard the PCV valve.

3. To install, reverse the removal procedure.
   - Install a new PCV valve.

Material

Item	Specification	Fill Capacity
Motorcraft Metal Surface Prep ZC-31-A	-	-

Torque Specifications

Description	Nm	lb-in
Coolant outlet adapter bolts	10	89
Crankcase vent oil separator bolts	10	89
EGR valve bolts	20	177
High-voltage wire harness bolt	9	80
Motor Electronics Cooling System (MECS) coolant expansion tank bolt	9	80
MECS coolant expansion tank nut	9	80

Engine Emission Control

NOTE: Do not permanently remove or render inoperative any part of the vehicle emission control system including related hardware. Failure to comply may violate applicable state and federal law.

NOTE: The vehicle emission vacuum routing diagrams are contained in the Description and Operation subsection of the Engine Emissions Control section. For additional information, refer to Section 303-13B .

The engine emission control system consists of the:

- EGR system.
- PCV system.

EGR System

The EGR system returns a small amount of exhaust gas into the intake manifold. This reduces the overall combustion temperature. Cooler combustion temperatures provide a significant reduction of the Nitrogendes (NOx) in the exhaust emissions.

The engine incorporates a stepper motor-controlled EGR valve which receives its signal from the PCM. Engine coolant is used to cool the EGR valve. The EGR valve and stepper motor are serviced as an assembly.

The amount of recirculated exhaust gas depends on:

- engine rpm.
- intake manifold vacuum.
- exhaust backpressure.
- Engine Coolant Temperature (ECT).
- Throttle Position (TP).

PCV system

The PCV system uses intake manifold vacuum to ventilate blow-by vapors from the crankcase and return the vapors to the intake manifold for combustion. The PCV valve varies the amount of blow-by vapors returned to the intake manifold based on available engine vacuum. The PCV valve also prevents entry of combustion backfiring into the crankcase. The PCV valve is serviced as part of the crankcase vent oil separator.

Engine Emission Control

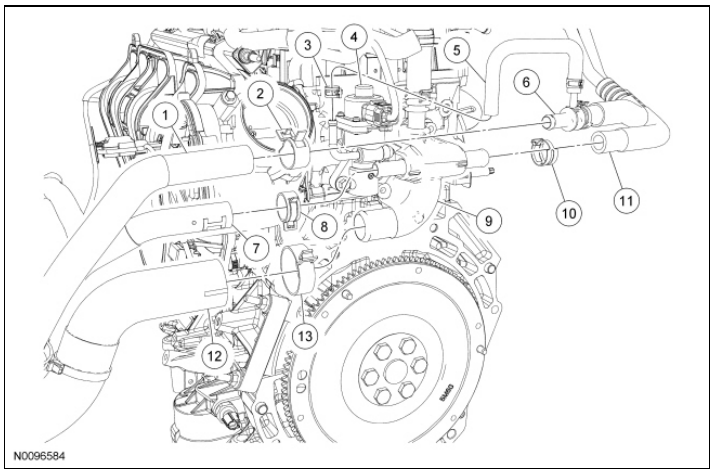
Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Exhaust Gas Recirculation (EGR) Valve

Material

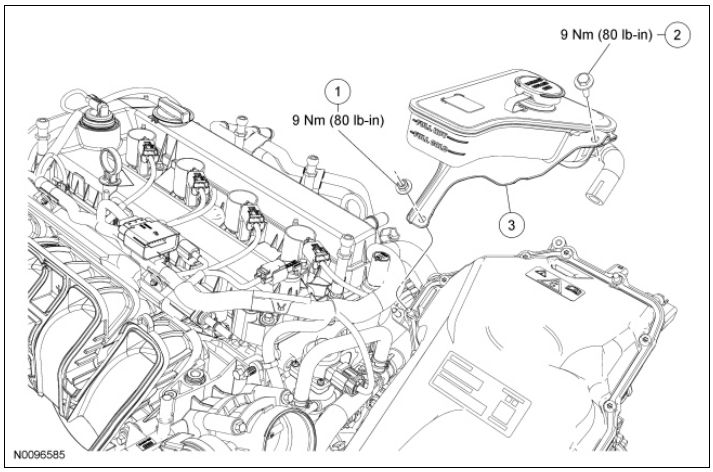
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-

Coolant Hoses



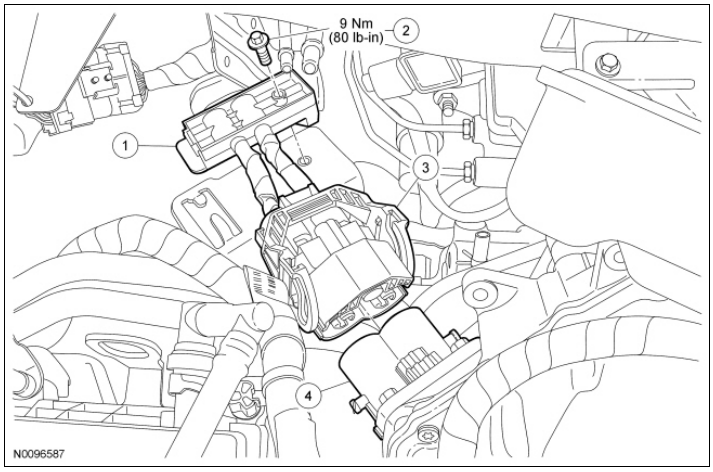
Item	Part Number	Description
1	18C266	Heater hose
2	-	Heater hose clamp (part of 18C266)
3	-	Heater hose clf 18C266)
4	9D475	EGR valve
5	-	Heater hose (part of 18C266)
6	-	Heater hose tee (part of 18C266)
7	8548	Coolant bypass hose
8	W525958	Coolant bypass hose clamp
9	8K556	Coolant outlet adapter
10	-	Heater hose clamp (part of 18C266)
11	-	Heater hose (part of 18C266)
12	8B274	Upper radiator hose
13	-	Upper radiator hose clamp (part of 8B274)

Motor Electronics Cooling System (MECS) Expansion Tank



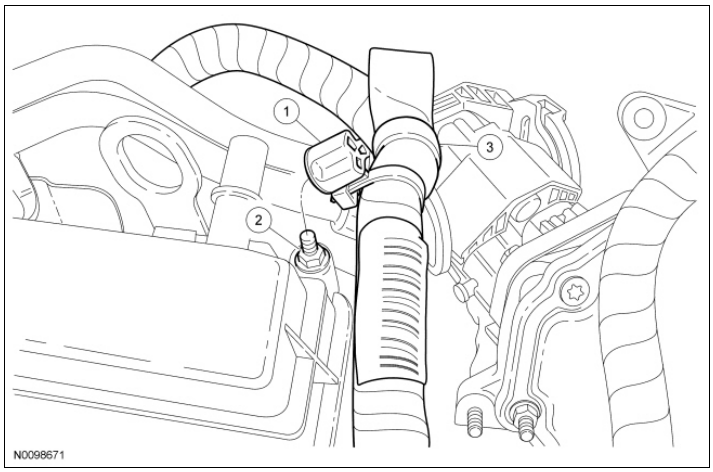
Item	Part Number	Description
1	W701152	Motor Electronics Cooling System (MECS) coolant expansion tank nut
2	W505424	MECS coolant expansion tank bolt
3	8C045	MECS coolant expansion tank

Transaxle High-Voltage Electrical Wire Harness



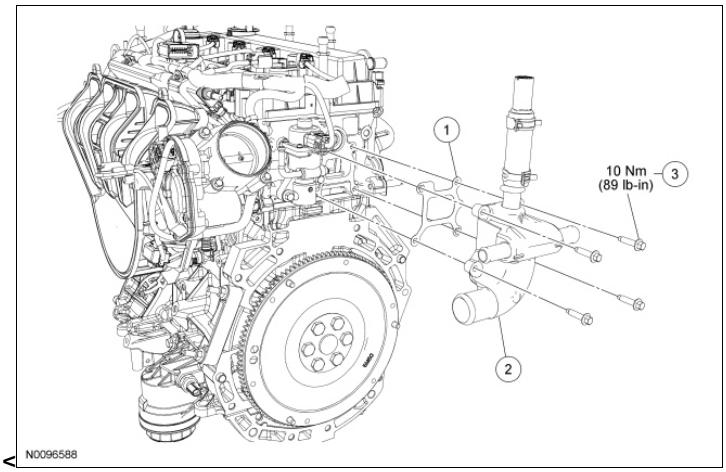
Item	Part Number	Description
1	14B322	High-voltage wire harness
2	W704683	High-voltage wire harness bolt
3	-	High-voltage wire harness electrical connector (part of 14B322)
4	7000	Transaxle

Engine Wire Harness



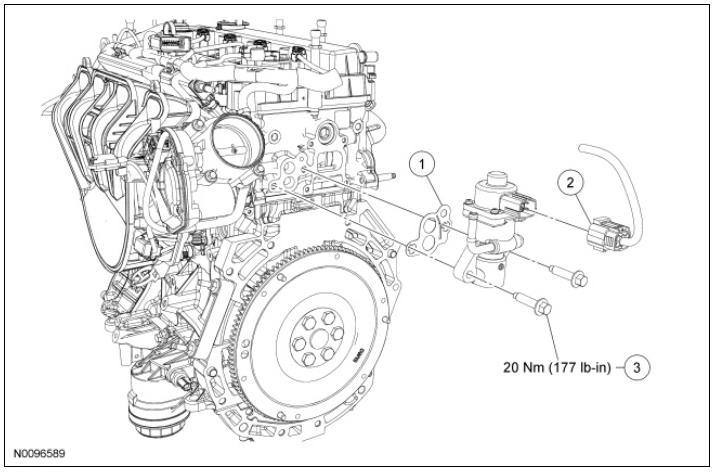
Item	Part Number	Description
1	-	Engine wire harness retainer (part of 12C508)
2	6C295	Valve cover stud
3	12C508	Engine wire harness

Coolant Outlet Adapter <



Item	Part Number	Description
1	8255	Coolant outlet adapter gasket
2	8K556	Coolant outlet adapter
3	W500015	Coolant outlet adapter bolt (4 required)

EGR Valve



Item	Part Number	Description
1	9D476	EGR valve gasket
2	14A464	EGR valve electrical connector
3	W500225	EGR valve bolt (2 required)

Removal and Installation

1. Depower the High Voltage Traction Battery (HVTB) system. For additional information, refer to Section 414-03 .
2. Drain the cooling system. For additional information, refer to Section 303-03B .
3. Remove the Throttle Body (TB). For additional information, refer to Section 303-04D .
4. Release the clamp and separate the upper heater hose.
5. Release the clamp and remove the bypass hose from the coolant outlet adapter.
6. Release the clamp and remove the upper radiator hose from the coolant outlet adapter.
7. Release the clamp and remove the heater hose from the EGR valve.
8. Remove the bolt and the nut and position the Motor Electronics Cooling System (MECS) coolant expansion tank aside.
    - To install, tighten to 9 Nm (80 lb-in).
9. Disconnect the EGR valve electrical connector.
10. Release the engine wire harness retainer from the valve cover stud.
11. Remove the high-voltage wire harness bolt.
    - To install, tighten to 9 Nm (80 lb-in).
12. Disconnect the transaxle high-voltage electrical connector.
13. Carefully position the upper heater hose aside.
14. Release the clamp and remove the lower heater hose from the coolant outlet adapter.
15. Remove the 4 bolts and position the coolant outlet adapter aside.

- To install, tighten to 10 Nm (89 lb-in).

16. Remove the 2 bolts and the EGR valve.
    - To install, tighten to 20 Nm (177 lb-in).

17. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the coolant outlet adapter gasket.**

    Remove the coolant outlet adapter and discard the gasket.

    - Clean and inspect the coolant outlet adapter mating surfaces.

18. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the Exhaust Gas Recirculation (EGR) valve gasket.**

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces

    NOTE: Do not reuse the EGR valve gasket.

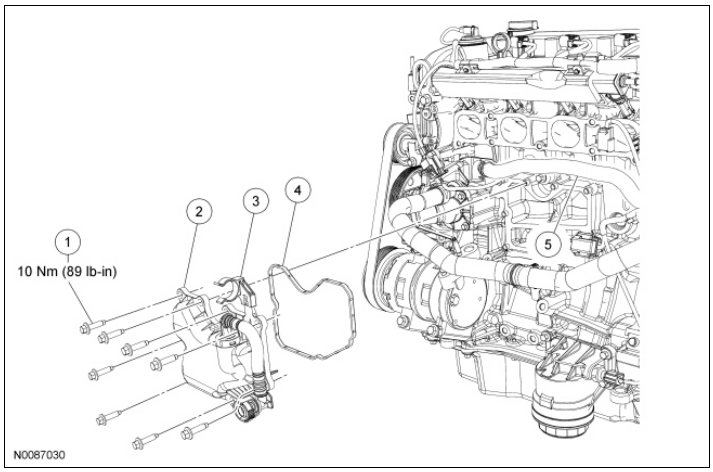
    Remove and discard the EGR valve gasket.

    - Clean and inspect the EGR gasket mating surfaces.

19. To install, reverse the removal procedure.

20. Fill and bleed the cooling system. For additional information, refer to Section 303-03B .

Crankcase Vent Oil Separator



Item	Part Number	Description
1	W500214	Crankcase vent oil separator bolt (8 required)
2	6A785	Crankcase vent oil separator
3	-	Coolant bypass hose clip (part of 9A785)
4	6A785	Crankcase vent oil separator gasket
5	8A582	Coolant bypass hose

Removal and Installation

1. Remove the intake manifold. For additional informatifer to Section 303-01D .

2. Release the coolant bypass hose from the clip.

3. Remove the 8 bolts and the crankcase vent oil separator and gasket.
   - To install, tighten to 10 Nm (89 lb-in).

4. To install, reverse the removal procedure.
   - Clean the engine block mating surface.

Torque Specifications

Description	Nm	lb-ft	lb-in
Air Cleaner (ACL) insulator support bracket bolt	25	18	-
ACL outlet pipe-to- ACL housing cover clamp	4	-	35
ACL outlet pipe-to-Throttle Body (TB) clamp	4	-	35
Intake air resonator nut	15	-	133
Mass Air Flow (MAF) sensor screw	2	-	18

Intake Air Distribution and Filtering

The air intake system consists of the:

- Air Cleaner (ACL) outlet pipe.
- ACL element.
- Mass Air Flow (MAF) sensor.
- ACL housing assembly.
- intake air resonator.

The air intake system:

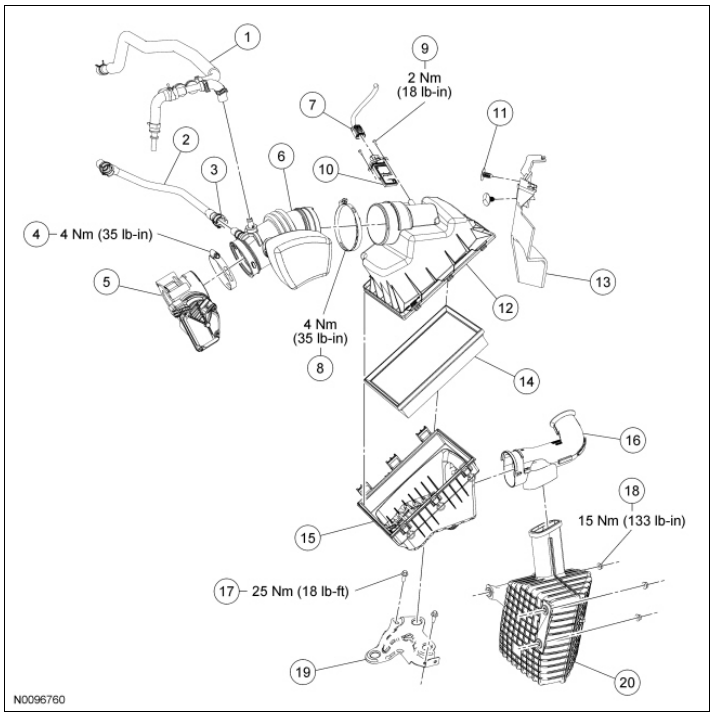
- cleans intake air with a replaceable, dry-type ACL element.
- measures airflow and air temperatwith the MAF sensor.

The engine ACL contains an ACL element made of treated, pleated paper, which must be replaced periodically as scheduled. Engine performance and fuel economy are adversely affected when maximum restriction of the ACL element is reached.

Intake Air Distribution and Filtering

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Intake Air System Components - Exploded View



Item	Part Number	Description
1	9C490	Vacuum hose
2	6853	Crankcase ventilation tube
3	-	Crankcase ventilation tube-to-Air Cleaner (ACL) outlet pipe quick connect coupling (part of 6853)
4	-	ACL outlet pipe-to-Throttle Body (TB) clamp (part otd>
5	9F991	TB
6	9F805	ACL outlet pipe
7	14A464	Mass Air Flow (MAF) sensor electrical connector
8	-	ACL outlet pipe-to- ACL housing cover clamp (part of 9F805)
9	W711655	MAF sensor screw (2 required)
10	12B579	MAF sensor
11	-	Snow shield pin-type retainer (part of 16A554) (2 required)
12	-	ACL housing cover (part of 9C662)
13	16A554	Snow shield
14	9601	ACL element
15	9C662	ACL housing
16	-	ACL inlet pipe (part of 9C662)
17	W707375	ACL insulator support bracket bolt (2 required)

18	W520413	Intake air resonator nut (3 required)
19	9647	ACL insulator support bracket
20	9F763	Intake air resonator

1. For additional information, refer to the procedures in this section.

Air Cleaner

Removal and Installation

1. Disconnect the Mass Air Flow (MAF) sensor electrical connector.

2. Loosen the clamp and disconnect the Air Cleaner (ACL) outlet pipe from the ACL housing cover.
   - To install, tighten to 4 Nm (35 lb-in).

3. **NOTE:** No tools are needed to remove the ACL assembly. Removal should be carried out using hands only.

   Separate the 3 ACL feet from the rubber grommets and the ACL inlet pipe and remove the ACL assembly.

4. **NOTE:** Make sure that the 3 ACL feet are seated into the rubber grommets under the ACL assembly.

   NOTE: The ACL outlet pipe should be securely sealed to prevent unmetered air from entering the engine.

   To install, reverse the removal procedure.

Air Cleaner Outlet Pipe

Removal and Installation

1. Disconnect the crankcase ventilation tube-to-Air Cleaner (ACL) outlet pipe quick connect coupling. For additional information, refer to Section 310-00 .

2. Remove the vacuum tube to ACL outlet pipe.

3. Loosen the clamp and remove the ACL outlet pipe from the Throttle Body (TB).
   - To install, tighten to 4 Nm (35 lb-in).

1. Loosen the ACL outlet pipe-to- ACL housing cover clamp.
   - Remove the ACL outlet pipe.
   - To install, tighten to 4 Nm (35 lb-in).

5. **NOTE:** The ACL outlet pipe should be securely sealed to prevent unmetered air from entering the engine.

   To install, reverse the removal procedure.

Intake Air Resonator

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the LH fender splash shield. For additional information, refer to Section 501-02 .

3. Remove the 3 nuts and the intake air resonator.
   - To install, tighten to 15 Nm (133 lb-in).

4. **NOTE:** Make sure that the ACL inlet pipe is securely seated to the intake air resonator.

   To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Air Cleaner (ACL) insulator support bracket bolt	25	18	-
ACL outlet pipe-to- ACL housing cover clamp	4	-	35
ACL outlet pipe-to-Throttle Body (TB) clamp	4	-	35
Intake air resonator nuts	15	-	133
Mass Air Flow (MAF) sensor screw	2	-	18

Intake Air Distribution and Filtering

The air intake system consists of the:

- Air Cleaner (ACL) outlet pipe.
- ACL element.
- Mass Air Flow (MAF) sensor.
- ACL housing assembly.
- intake air resonator.

The air intake system:

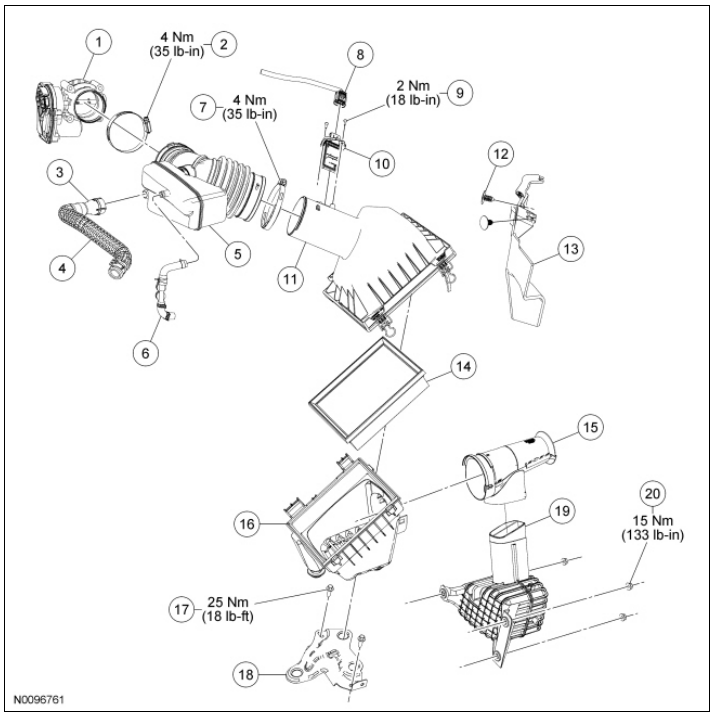
- cleans intake air with a replaceable, dry-type ACL element.
- measures airflow and air temperature with the MAF sensor.

The engine ACL contains an ACL element made of treated, pleated paper, which must be replaced periodically as scheduled. Engine performance and fuel economy are adversely affected when maximum restriction of the ACL element is reached.

Intake Air Distribution and Filtering

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Intake Air System Components - Exploded View



Item	Part Number	Description
1	9F991	Throttle Body (TB)
2	-	Air Cleaner (ACL) outlet pipe-to- TB clamp (part of 9F805)
3	-	Crankcase ventilation tube-to- outlet pipe quick connect coupling (part of 6758)
4	6758	Crankcase ventilation tube
5	9C805	ACL outlet pipe
6	9C490	Vacuum hose (All-Wheel Drive (AWD) only)
7	-	ACL outlet pipe-to- ACL housing cover clamp (part of 9C805)
8	14A464	Mass Air Flow (MAF) sensor electrical connector
9	W711655	MAF sensor screw (2 required)
10	12B579	MAF sensor
11	9C662	ACL housing cover
12	-	Snow shield pin-type retainer (part of 16A554) (2 required)
13	16A554	Snow shield
14	9601	ACL element
15	-	ACL inlet pipe (part of 9C662)
16	9C662	ACL housing
17	W707375	ACL insulator support bracket bolt (2 required)

18	9647	ACL insulator support bracket
19	9F763	Intake air resonator
20	W520413	Intake air resonator nut (3 required)

1. For additional information, refer to the procedures in this section.

Air Cleaner

Removal and Installation

1. Disconnect the Mass Air Flow (MAF) sensor electrical connector.

2. Loosen the clamp and disconnect the Air Cleaner (ACL) outlet pipe-to- ACL housing cover.
   - To install, tighten to 4 Nm (35 lb-in).

3. **NOTE:** No tools are needed to remove the ACL assembly. Removal should be carried out using hands only.

   Separate the 3 ACL feet from the rubber grommets and the ACL inlet pipe and remove the n title="Air Cleaner" class="popup" onmouseover="this.className='popupnounderline';" onmouseout="this.className='popup';">ACL assembly.

4. **NOTE:** Make sure that the 3 ACL feet are seated into the rubber grommets under the ACL assembly.

   NOTE: The ACL outlet pipe should be securely sealed to prevent unmetered air from entering the engine.

   To install, reverse the removal procedure.

Air Cleaner Outlet Pipe

Removal and Installation

All-Wheel Drive (AWD) vehicles

1. Disconnect the vacuum hose from the Air Cleaner (ACL) outlet pipe.

All vehicles

2. Disconnect the crankcase ventilation tube-to- ACL outlet pipe quick connect coupling. For additional information, refer to Section 310-00 .

3. Loosen the ACL outlet pipe-to-Throttle Body (TB) clamp.
   To install, tighten to 4 Nm (35 lb-in).

4. Loosen the ACL outlet pipe-to- ACL housing cover clamp.
   - Remove the ACL outlet pipe.
   - To install, tighten to 4 Nm (35 lb-in).

5. **NOTE:** The ACL outlet pipe should be securely sealed to prevent unmetered air from entering the engine.

   To install, reverse the removal procedure.

Intake Air Resonator

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the LH fender splash shield. For additional information, refer to Section 501-02 .

3. Remove the 3 nuts and the air intake resonator.
   - To install, tighten to 15 Nm (133 lb-in)/li>

4. **NOTE:** Make sure that the Air Cleaner (ACL) inlet pipe is securely seated to the intake air resonator.

   To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Air Cleaner (ACL) housing bolt	4	35
ACL inlet pipe bolts	4	35
ACL insulator support bracket bolt	20	177
ACL outlet pipe-to- ACL housing cover clamp	4	35
ACL outlet pipe-to-Throttle Body (TB) clamp	4	35
Intake air resonator nuts	15	133
Mass Air Flow (MAF) sensor screws	2	18

Intake Air Distribution and Filtering

The air intake system consists of the:

- Air Cleaner (ACL) outlet pipe.
- ACL element.
- Mass Air Flow (MAF) sensor.
- ACL housing assembly.
- intake air resonator.

The air intake system:

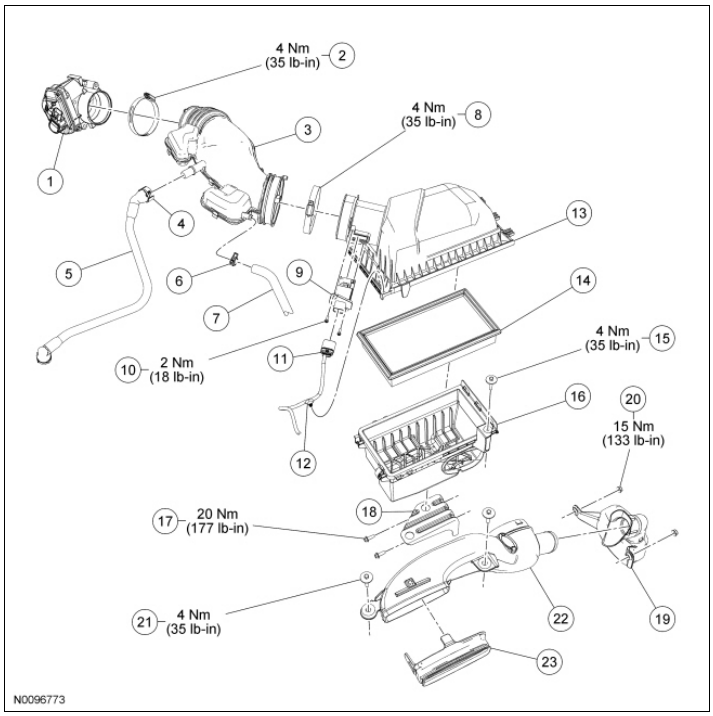
- cleans intake air with a replaceable, dry-type ACL element.
- measures airflow and air temperature with the MAF sensor.

The engine ACL contains an ACL element made of treated, pleated paper, which must be replaced periodically as scheduled. Engine performance and fuel economy are adversely affected when maximum restriction of the ACL element is reached.

Intake Air Distribution and Filtering

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Intake Air System Components - Exploded View



Item	Part Number	Description
1	9F991	Throttle Body (TB)
2	-	Air Cleaner (ACL) outlet pipe-to- TB clamp (part of 9F805)
3	9F805	ACL outlet pipe
4	-	Crankcase ventilation tube-to- ACL outlet pipe quick connect coupling (part of 6758)
5	6758	Crankcase ventilation tube
6	-	Vacuum hose clamp (part of 9C482)
7	9C482	Vacuum hose
8	-	ACL outlet pipe-to- ACL housing cover clamp (part of 9F805)
9	12B579	Mass Air Flow (MAF) sensor
10	W711655	MAF sensor screw (2 required)
11	14A464	MAF electrical connector
12	-	Wire harness pin-type retainer (part of 14A464)
13	-	ACL housing cover (part of 9C662)
14	9601	ACL element
15	W710317	ACL housing bolt
16	9C662	ACL housing
17	W707375	ACL insulator support bracket bolt (2 required)

18	9647	ACL insulator support bracket
19	9F763	Intake air resonator
20	W520413	Intake air resonator nut (2 required)
21	W710317	ACL inlet pipe bolt (2 required
22	9C675	ACL inlet pipe
23	9E931	ACL inlet pipe seal

1. For additional information, refer to the procedures in this section.

Air Cleaner

Removal and Installation

1. Disconnect the Mass Air Flow (MAF) sensor electrical connector and release the wiring harness pin-type retainer from the Air Cleaner (ACL) housing.

2. Loosen the clamp and disconnect the ACL outlet pipe from the ACL housing cover.
   - To install, tighten to 4 Nm (35 lb-in).

3. Remove the ACL housing bolt.
   - To install, tighten to 4 Nm (35 lb-in).

4. Remove the 2 AC/span> inlet pipe bolts.
   - To install, tighten to 4 Nm (35 lb-in).

5. **NOTE:** No tools are needed to remove the ACL assembly. Removal should be carried out using hands only.

   Separate the 2 ACL feet from the rubber grommets and remove the ACL and the ACL inlet pipe as an assembly.

6. **NOTE:** Make sure that the 2 ACL feet are seated into the rubber grommets under the ACL assembly.

   NOTE: The ACL outlet pipe should be securely sealed to prevent unmetered air from entering the engine.

   To install, reverse the removal procedure.

Air Cleaner Outlet Pipe

Removal and Installation

1. Disconnect the crankcase ventilation tube-to-Air Cleaner (ACL) outlet pipe quick connect coupling. For additional information, refer to Section 310-00 .

2. Release the clamp and disconnect the vacuum hose from the ACL outlet pipe.

3. Loosen the ACL outlet pipe-to- ACL housing cover clamp.
   - To install, tighten to 4 Nm (35 lb-in).

4. Loosen the ACL outlet pipe-to-Throttle Body (TB) clamp.
   - Remove the ACL outlet pipe.
   - To install, tighten to 4 Nm (35 lb-in).

5. **NOTE:** The ACL outlet pipe should be securely sealed to prevent unmetered air from entering the engine.

   To install, reverse the removal procedure.

Intake Air Resonator

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the LH fender splash shield. For additional information, refer to Section 501-02 .

3. Remove the 2 nuts and the air intake resonator.
   - To install, tighten to 15 Nm (133 lb-in).

4. **NOTE:** Make sure that the Air Cleaner (ACL) inlet pipe is securely seated to the intake air resonator.

   To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Air Cleaner (ACL) assembly nut	15	133
ACL outlet pipe-to- ACL assembly clamp	4	35
ACL outlet pipe-to-intake air resonator clamp	4	ACL outlet pipe-to-Throttle Body (TB) clamp 4 35
Intake air resonator bolt	4	35
Mass Air Flow (MAF) sensor screw	2	18

Intake Air Distribution and Filtering

The air intake system consists of the:

- Air Cleaner (ACL) outlet pipe.
- ACL assembly.
- Mass Air Flow (MAF) sensor.
- intake air resonator assembly.

The air intake system:

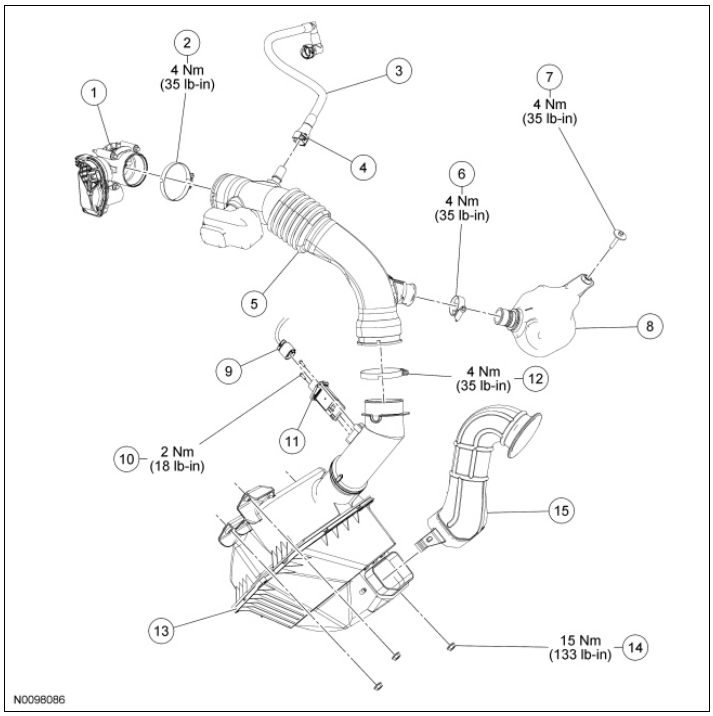
- cleans intake air with a long life ACL assembly.
- measures airflow and air temperature with the MAF sensor.

The vehicle utilizes a long life ACL assembly designed to last the life of the vehicle. The ACL is serviced as a complete ACL assembly.

Intake Air Distribution and Filtering

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Intake Air System Components - Exploded View



Item	Part Number	Description
1	9F991	Throttle Body (TB)
2	-	Air Cleaner (ACL) outlet pipe-to- TB clamp (part of 9F805)
3	6853	Crankcase ventilation tube
4	-	Crankcase ventilation tube-to- ACL outlet pipe quick connect coupling (part of 6853)
5	9F805	ACL outlet pipe
6	-	ACL outlet pipe-to-intake air resonator clamp (part of 9F805)
7	W710317	Intake air resonator bolt
8	9F763	Intake air resonator
9	14A464	Mass Air Flow (MAF) sensor electrical connector
10	W711655	MAF sensor screw (2 required)
11	12B579	MAF sensor
12	-	ACL outlet pipe-to- ACL assembly clamp (part of 9F805)
13	9600	ACL assembly
14	W520413	ACL assembly nut (3 required)
15	-	ACL intake pipe (part of 9600)

1. For additional information, refer to the procedures in this section.

Air Cleaner

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the LH fender splash shield. For additional information, refer to Section 501-02 .

3. Disconnect the Mass Air Flow (MAF) sensor electrical connector.

4. Loosen the clamp and disconnect the Aieaner (ACL) outlet pipe from the ACL assembly.
   - To install, tighten to 4 Nm (35 lb-in).

5. Remove the 3 nuts, release the ACL intake pipe and remove the ACL assembly.
   - To install, tighten to 15 Nm (133 lb-in).

6. To install, reverse the removal procedure.

Air Cleaner Outlet Pipe

Removal and Installation

1. Disconnect the crankcase ventilation tube -to-Air Cleaner (ACL) outlet pipe quick connect coupling. For additional information, refer to Section 310-00 .

2. Loosen the ACL outlet pipe-to-Throttle Body (TB) clamp.
   - To install, tighten to 4 Nm (35 lb-in).

3. Loosen the ACL outlet pipe-to- ACL assembly clamp.
   - Remove the ACL outlet pipe.
   - To install, tighten to 4 Nm (35 lb-in).

4. **NOTE:** The ACL outlet pipe should be securely sealed to prevent unmetered air from entering the engine.

   To install, reverse the removal procedure.

Intake Air Resonator

Removal and Installation

1. Loosen the Air Cleaner (ACL) outlet pipe-to-intake air resonator clamp.
   - To install, tighten to 4 Nm (35 lb-in).

2. Remove the bolt and the air intake resonator.
   - To install, tighten to 4 Nm (35 lb-in).

3. **NOTE:** Make sure that the intake air resonator is securely seated to the ACL outlet pipe.

   To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Evaporative Emission (EVAP) canister bolts	6	-	53
EVAP canister nuts	6	-	53
EVAP canister purge valve bolts	10	-	89
Fuel tank filler pipe heat shield nuts	10	-	89
Fuel tank filler pipe hose clamp	4	-	35
Fuel tank strap bolts	40	30	-

Evaporative Emissions

The Evaporative Emission (EVAP) system consists of the:

- EVAP canister purge valve.
- EVAP canister (includes the dust separator and the vent solenoid).
- fuel vapor tube assembly (includes the Fuel Tank Pressure (FTP) sensor).
- Easy FuelTM (capless) fuel tank filler pipe.

The EVAP system:

- prevents hydrocarbon emissions from reaching the atmosphere.
- stores fuel vapors in the EVAP canister, that are generated during vehicle operation or hot soak, until they can be consumed by the engine during normal engine operation.
- routes the stored fuel vapors to the engine during engine operation.
- is controlled by the PCM which, using various sensor inputs, calculates the desired amount of purge flow. The PCM regulates the purge flow, induced by the application of intake manifold vacuum, by varying the duty cycle applied to the EVAP canister purge valve.

The fuel vapors are routed:

- from the fuel tank through the fuel vapor vent valve.
- to the EVAP canisters through a vapor tube.
- from the EVAP canister to the engine when the EVAP canister purge valve is opened by the PCM.

The FTP sensor (part of fuel vapor tube assembl):

- monitors the pressure levels in the fuel tank.
- communicates the pressure reading to the PCM during the OBD II leak test.

The fuel vapor tube assembly:

- is located under the rear of the vehicle.
- is used to control the flow of fuel vapors entering the EVAP system.
- includes the FTP sensor.

The EVAP canister:

- is located under the rear of the vehicle.
- includes the dust separator and vent solenoid.
- contains activated carbon.
- stores fuel vapors.

The Easy Fuel TM capless fuel tank filler pipe:

- relieves system vacuum below -3.5 kPa (-16.00 in H_2O).

The EVAP canister vent solenoid:

- is normally open.

- seals the EVAP system for the inspection and maintenance (I/M 240) test and OBD II leak and pressure tests.
- is serviced as part of the EVAP canister.

The EVAP canister purge valve:

- is normally closed.
- regulates the purging of the EVAP canister.
- is controlled by the PCM.
- is repaired as a separate item.
- is mounted to the intake manifold on the 2.5L and 3.0L.
- is mounted below the lower cowl panel on the 3.5L.

The dust separator:

- is attached to the EVAP canister vent solenoid.
- prevents suspended dust and dirt particles from entering the EVAP system.
- is serviced as part of the EVAP canister.

The EVAP system monitor:

- is a self-test strategy within the PCM which tests the integrity of the EVAP system.
- monitors the EVAP system for leaks.
- monitors electronic EVAP components for irrationally high or low voltages.
- monitors for correct EVAP system operation.
- uses negative and positive leak test methods to test and activate the EVAP system.

The engine ON EVAP leak-check monitor:

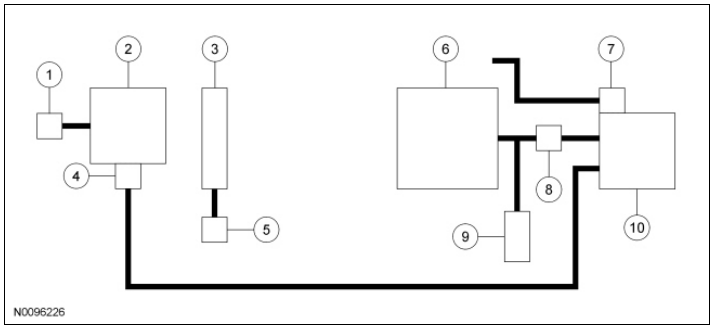
- is executed by the individual components of the enhanced EVAP system. Intake manifold vacuum is utilized to reach a target vacuum on the EVAP system. The FTP sensor is used by the engine ON EVAP leak-check monitor to determine if the target vacuum necessary to carry out the leak-check on the EVAP system has been reached. Once target vacuum on the EVAP system is achieved, the change in EVAP system vacuum over a calibrated period of time determines if a leak exists.

The Engine Off Natural Vacuum (EONV) EVAP leak-check monitor is executed:

- once the engine ON EVAP leak-check monitor is completed and the key is turned OFF. The EONV EVAP leak-check monitor determines if a leak is present when the naturally occurring change in the fuel tank pressure or vacuum does not exceed a calibrated limit during a calibrated amount of time. A separate, low-power consuming microprocessor in the PCM manages the EONV leak-check. The engine OFF EVAP leak-check monitor is executed by the individual components of the enhanced EVAP system.

Vehicle Emission Vacuum Routing

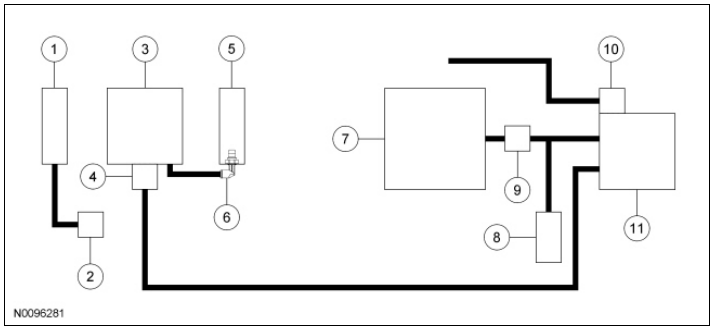
2.5L



Item	Part Number	Description
1	-	PCV valve (part of 6A785)
2	9424	Intake manifold
3	6582	Valve cover
4	9C915	Evaporative Emission (EVAP) canister purge valve
5	9B659	Air Cleaner (ACL) outlet pipe
6	9002	Fuel tank
7	-	Fuel vapor solenoid separator assembly (part of 9E857)
8	-	Fuel Tank Pressure (FTP) sensor (part of 9A228)
9	9034	Fuel tank filler pipe
10	9E857	EVAP canister

3.0L (4V)

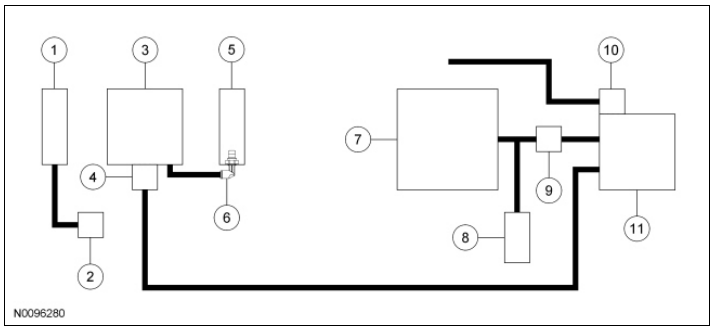
All-Wheel Drive (AWD) Vehicles



Item	Part Number	Description
1	6582	LH valve cover
2	9B659	Air Cleaner (ACL) outlet pipe
3	9424	Intake manifold
4	9C915	Evaporative Emission (EVAP) canister purge valve
5	6582	RH valve cover
6	6A666	PCV valve
7	9002	Fuel tank
8	9034	Fuel tank filler pipe
9	-	Fuel tank pressure sensor (part of 9A228)
10	-	

		Fuel vapor solenoid separator assembly (part of 9E857)
11	9E857	EVAP canister

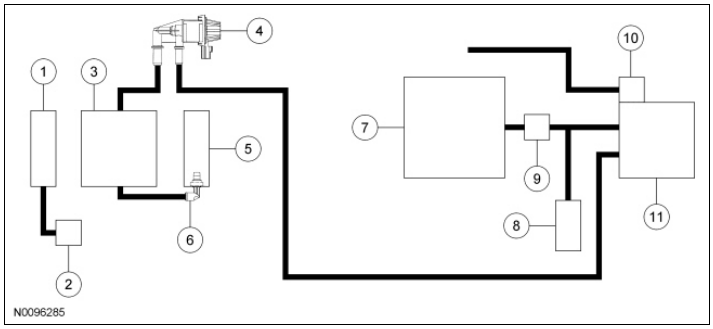
Front Wheel Drive (FWD) Vehicles



Item	Part Number	ription
1	6582	LH valve cover
2	9B659	Air Cleaner (ACL) outlet pipe
3	9424	Intake manifold
4	9C915	Evaporative Emission (EVAP) canister purge valve
5	6582	RH valve cover
6	6A666	PCV valve
7	9002	Fuel tank
8	9034	Fuel tank filler pipe
9	-	Fuel tank pressure sensor (part of 9A228)
10	-	Fuel vapor solenoid separator assembly (part of 9E857)
11	9E857	EVAP canister

3.5L

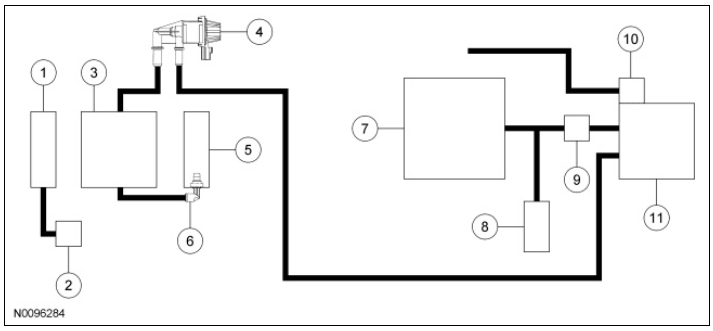
All-Wheel Drive (AWD) Vehicles



Item	Part Number	Description
1	6582	LH valve cover
2	9B659	Air Cleaner (ACL) outlet pipe

3	9S455	Intake manifold
4	9C915	Evaporative Emission (EVAP) canister purge valve
5	6582	RH valve cover
6	6A666	PCV valve
7	9002	Fuel tank
8	9034	Fuel tank filler pipe
9	-	Fuel Tank Pressure (FTP) sensor (part of 9A228)
10	-	Fuel vapor solenoid separator assembly (part of 9E857)
11	9E857	EVAP canister

Front Wheel Drive (FWD) Vehicles



Item	Part Number	Description
1	6582	LH valve cover
2	9B659	Air Cleaner (ACL) outlet pipe
3	9S455	Intake manifold
4	9C915	Evaporative Emission (EVAP) canister purge valve
5	6582	RH valve cover
6	6A666	PCV valve
7	9002	Fuel tank
9	-	Fuel Tank Pressure (FTP) sensor (part of 9A228)
10	-	Fuel vapor solenoid separator assembly (part of 9E857)
11	9E857	EVAP canister

Evaporative Emissions

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Evaporative Emission System Leak Test

Special Tool(s)

 ST2817-A	VACUTEC Smoke Machine Fuel Evaporative Emission System Tester 218-0002 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Phase 1 - Leak Verification

All vehicles

1. Run the EVAP Test with the scan tool.
2. **NOTE:** Some small leaks may not be detected using the EVAP Test. If the system has passed the test but a leak is still suspected, then proceed to Phase 2.

   If the Evaporative Emission (EVAP) system failed the EVAP Test, then proceed to Phase 2.

Phase 2 - System Leak Check

2.5L and 3.0L vehicles

1. Disconnect the fuel vapor tube-to- EVAP canister purge valve quick connect coupling. For additional information, refer to Section 310-00 .
2. Connect the VACUTEC Smoke Machine Fuel Evaporative Emission System Tester to the fuel vapor tube quick connect coupling. For additional information, refer to the manufacturer's instructions.

3.5L vehicle

1. Disconnect the upper vapor tube-to- EVAP canister purge valve quick connect coupling. For additional information, refer to Section 310-00 .
2. Connect the VACUTEC Smoke Machine Fuel Evaporative Emission System Tester to the upper EVAP canister purge valve fitting. For additional information, refer to the manufacturer's instructions.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** The battery ground cable was previously disconnected in the vapor tube quick connect coupling disconnect procedure.

   Connect the battery ground cable. For additional information, refer to Section 414-01 .

3.5L vehicle

1. **NOTE:** In the scan tool, the EVAP canister purge valve is referred to as the EVAP vapor management valve.

   Open the EVAP canister purge valve with the scan tool.

All vehicles

1. Close the canister vent solenoid with the scan tool.

2. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter into the Easy Fuel ™ (capless) fuel tank filler pipe assembly.

3. **NOTE:** If smoke does not exit the fuel tank filler pipe neck area after the system is pressurized, open the canister vent solenoid with the scan tool to allow the air to purge. Once smoke is seen at the canister vent solenoid, close the canister vent solenoid with the scan tool.

   Introduce smoke from the VACUTEC Smoke Machine Fuel Evaporative Emission System Tester into the EVAP system and verify that smoke is exiting the fuel tank filler pipe neck area. For additional information, refer to the manufacturer's instructions.

4. Remove the supplemental refueling adapter once smoke is observed exiting the fuel tank filler pipe neck area.

5. Continue to enter smoke into the system for 60 seconds to obtain pressure.

6. Press and release the remote start button in intervals of 15 seconds ON and 15 seconds OFF while checking for exiting smoke.

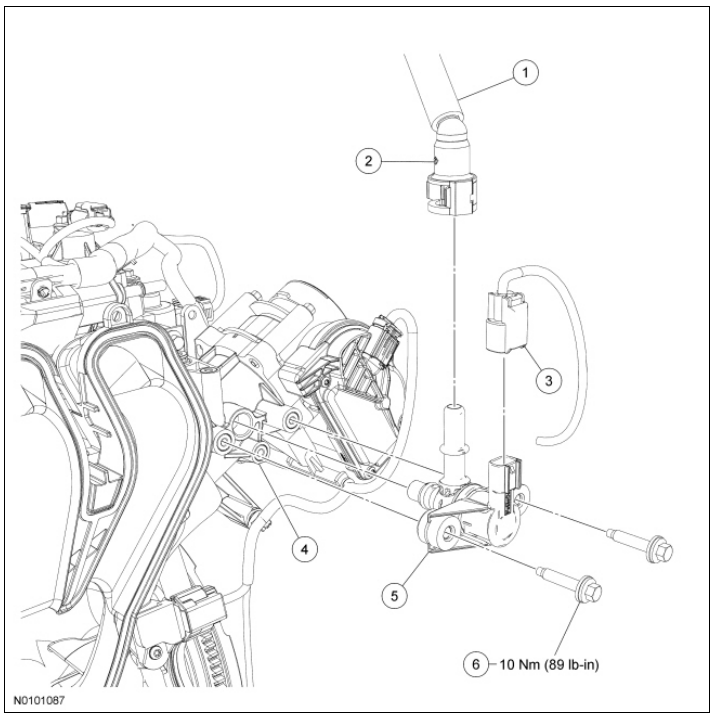
7. Use the halogen light provided with the VACUTEC Smoke Machine Fuel Evaporative Emission System Tester to follow the EVAP system path and look for smoke exiting at the source of the leak(s).

8. Repair any leaks as necessary.

9. Repeat the leak test until the system passes.

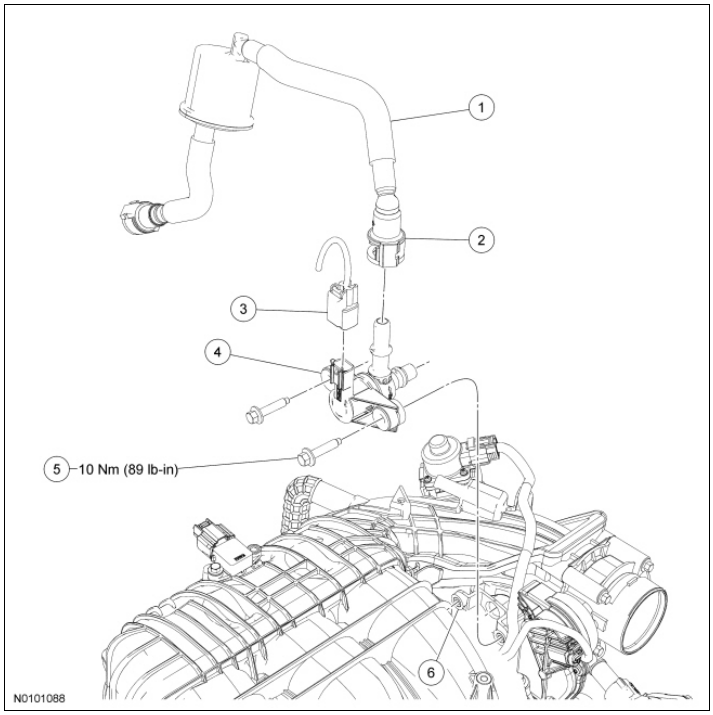
Evaporative Emission Canister Purge Valve

2.5L Vehicles



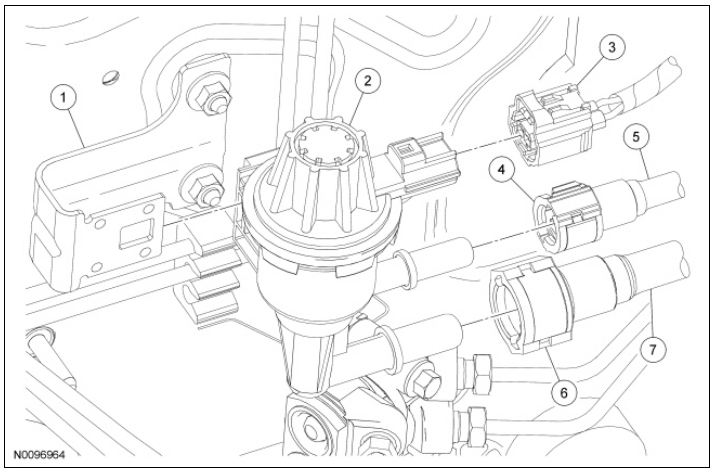
Item	Part Number	Description
1	9G271	Vapor tube
2	-	Vapor tube-to-Evaporative Emission (EVAP) canister purge valve quick connect coupling (part of 9G271)
3	14A464	EVAP canister purge valve electrical connector
4	9424	Intake manifold
5	9G866	EVAP canister purge valve
6	W503278	EVAP canister purge valve bolt (2 required)

3.0L Vehicles



Item	Part Number	Description
1	9G271	Vapor tube
2	-	Vapor tube-to-Evaporative Emission (EVAP) canister purge valve quick connect coupling (part of 9G271)
3	14A464	EVAP canister purge valve electrical connector
4	9G866	EVAP canister purge valve
5	W500215	EVAP canister purge valve bolt (2 required)
6	9424	Intake manifold

3.5L Vehicles



Item	Part Number	Description
1	9F931	

		Evaporative Emission (EVAP) canister purge valve bracket
2	9G641	EVAP canister purge valve
3	14A464	EVAP canister purge valve electrical connector
4	-	Vapor tube-to- EVAP canister purge valve quick connect coupling (part of 9G271)
5	9G271	Vapor tube
6	-	Vapor tube-to- EVAP canister purge valve quick connect coupling (part of 9G279)
7	9G279	Vapor tube

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

All vehicles

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2.5L and 3.0L vehicles

2. Disconnect the Evaporative Emission (EVAP) canister purge valve electrical connector.

3. Disconnect the vapor tube-to- EVAP canister purge valve quick connect coupling. For additional information, refer to Section 310-00 .

4. Remove the 2 bolts and the EVAP canister purge valve.
   - To install, tighten to 10 Nm (89 lb-in).

3.5L vehicles

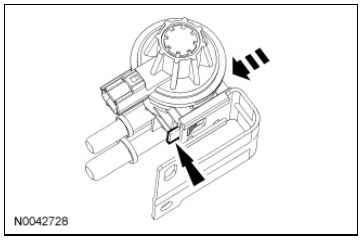
5. **NOTE:** The lower cowl panel grille must be removed to access the EVAP canister purge valve.

   Remove the lower cowl panel grille. For additional information, refer to the Cowl Panel Grille procedure in Section 501-02 .

6. Disconnect the EVAP canister purge valve electrical connector.

7. Disconnect the 2 vapor tube-to- EVAP canister purge valve quick connect couplings. For additional information, refer to Section 310-00 .

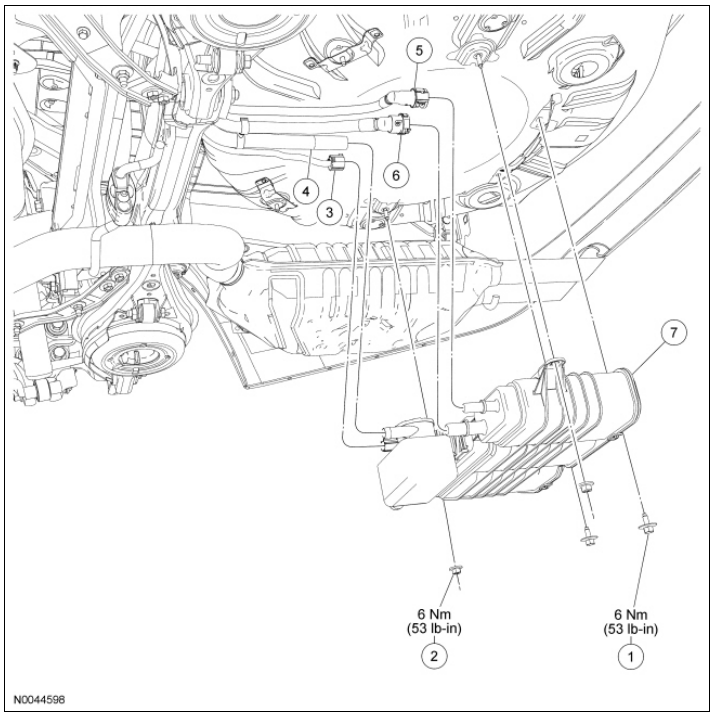
8. Depress the tab and remove the EVAP canister purge valve from the bracket.



All vehicles

9. To install, reverse the removal procedure.
    - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

Evaporative Emission Canister



Item	Part Number	Description
1	W708029	Evaporative Emission (EVAP) canister bolt (2 required)
2	W707142	EVAP canister nut (2 required)
3	14A464	EVAP canister vent solenoid electrical connector (part of 14A005)
4	-	Fresh air hose (part of 9034)
5	-	Vapor tube-to- EVAP canister quick connect coupling (part of 9J279)
6	-	Fuel vapor tube assembly-to- EVAP canister quick connect coupling (part of 9A228)
7	9E857	EVAP canister assembly

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failurollow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always

present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. **NOTE:** Clean the Evaporative Emission (EVAP) canister vent solenoid electrical connector and the immediate surrounding area of any dirt or foreign material.

   Disconnect the EVAP canister vent solenoid electrical connector.

4. Disconnect the fresh air hose from the dust separator.

5. Disconnect the fuel vapor tube assembly-to- EVAP canister quick connect couplings. For additional information, refer to Section 310-00 .

6. Disconnect the vapor tube-to- EVAP canister quick connect couplings. For additional information, refer to Section 310-00 .

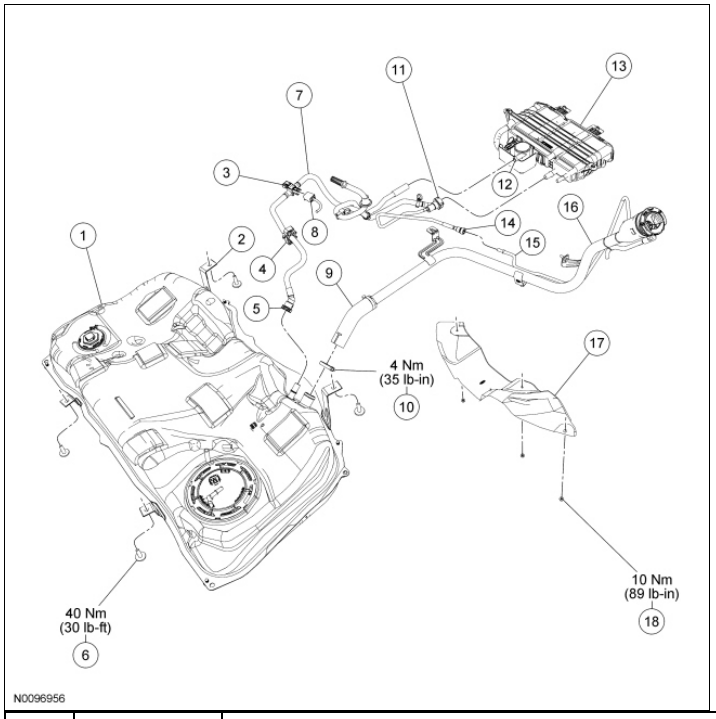
7. Remove the 2 nuts, 2 bolts and the EVAP canister assembly.
   - To install, tighten to 6 Nm (53 lb-in).

8. To install, reverse the removal procedure.
   - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

Fuel Vapor Tube Assembly - All Wheel Drive (AWD)

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent



Item	Part Number	Description
1	9002	Fuel tank
2	9092	Fuel tank strap (2 required)
3	9C052	Fuel Tank Pressure (FTP) sensor (part of 9A228)
4	-	Retainer clip (part of 9A228) (3 required)
5	-	Fuel vapor tube assembly-to-fuel tankonnect coupling (part of 9A228)
6	W505444	Fuel tank strap bolt (4 required)
7	9A228	Fuel vapor tube assembly
8	14A464	FTP sensor electrical connector
9	-	Fuel tank filler pipe hose (part of 9034)
10	W525937	Fuel tank filler pipe hose clamp
11	-	

		Fuel vapor tube assembly-to-Evaporative Emission (EVAP) canister quick connect coupling (part of 9A228)
12	9G676	Fuel vapor separator and solenoid assembly (part of 9E857)
13	9E857	EVAP canister assembly
14	-	Fuel vapor tube assembly-to-recirculation tube quick connect coupling (part of 9A228)
15	-	Fuel tank filler pipe recirculation tube (part of 9034)
16	9034	Fuel tank filler pipe
17	5411268	Fuel tank filler pipe heat shield
18	W707142	Fuel tank filler pipe heat shield nut (3 required)

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

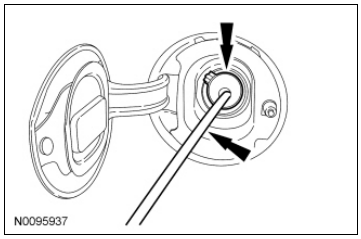
⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Using the supplemental refueling adapter and the Fuel Storage Tanker, drain any residual fuel from the fuel tank filler pipe.



4. Remove the 3 nuts and the fuel tank filler pipe heat shield.
   - To install, tighten to 10 Nm (89 lb-in).

5. Disconnect the fuel vapor tube assembly-to-Evaporative Emission (EVAP) canister quick connect coupling. For additional information, refer to Section 310-00 .

6. Disconnect the fuel vapor tube assembly from the fuel vapor separator and solenoid assembly.

7. Disconnect the fuel vapor tube assembly-to-recirculation tube quick connect coupling. For additional information, refer to Section 310-00 .

8. Release the 3 retainer clips.

9. Install the Powertrain Lift under the fuel tank.

10. Remove the 4 bolts and the fuel tank straps.
    - To install, tighten to 40 Nm (30 lb-ft).

11. Partially lower the fuel tank enough to access the fuel tank filler pipe hose clamp.

12. **NOTE:** Some residual fuel may remain in the fuel tank filler pipe. When removing the filler pipe, carefully drain the fuel into a suitable container.

    Release the clamp and disconnect the fuel tank filler pipe hose from the fuel tank.

    - To install, tighten to 4 Nm (35 lb-in).

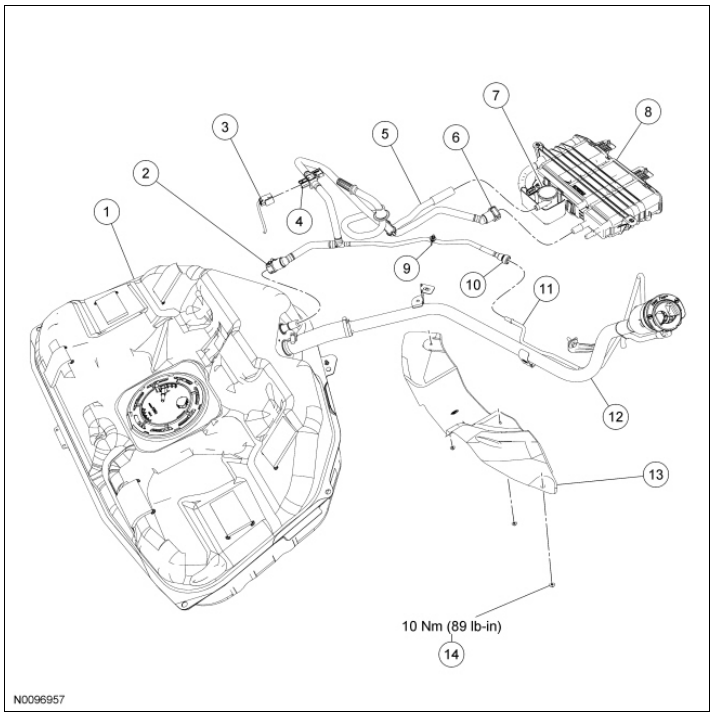
13. Disconnect the Fuel Tank Pressure (FTP) sensor electrical connector.

14. Disconnect the fuel vapor tube assembly-to-fuel tank quick connect coupling. For additional information, refer to Section 310-00 .

15. Remove the fuel vapor tube assembly.

16. To install, reverse the removal procedure.
    - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

Fuel Vapor Tube Assembly â Front Wheel Drive (FWD)



Item	Part Number	Description
1	9002	Fuel tank
2	â	Fuel vapor tube assembly-to-fuel tank quick connect coupling (part of 9A228)
3	14A464	Fuel Tank Pressure (FTP) sensor electrical connector
4	9C052	FTP sensor (part of 9A228)
5	9A228	Fuel vapor tube assembly
6	â	Fuel vapor tube assembly-to-Evaporative Emission (EVAP) canister quick connect coupling (part of 9A228)
7	9G676	Fuel vapor solenoid and separator assembly (part of 9E857)
8	9E857	EVAP canister assembly
9	â	Fuel vapor tube assembly pin-type retainer (part of 9A228)
10	â	Fuel vapor tube-to-recirculation tube quick connect coupling (part of 9A228)
11	â	Fuel tank filler pipe recirculation tube (part of 9034)
12	9034	Fuel tank filler pipe
13	5411268	Fuel tank filler pipe heat shield
14	W707142	Fuel tank filler pipe heat shield nut (3 required)

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the 3 nuts and the fuel tank filler pipe heat shield.
   - To install, tighten to 10 Nm (89 lb-in).

4. Disconnect the Fuel Tank Pressure (FTP) sensor electrical connector.

5. Disconnect the fuel vapor tube assembly-to-fuel tank quick connect coupling. For additional information, refer to Section 310-00 .

6. Disconnect the fuel vapor tube assembly-to-Evaporative Emission (EVAP) canister quick connect coupling. For additional information, refer to Section 310-00 .

7. Disconnect the fuel vapor tube assembly from the fuel vapor separator and solenoid assembly.

8. Release the pin-type retainer.

9. Disconnect the fuel vapor tube assembly-to-recirculation tube quick connect coupling. For additional information, refer to Section 310-00 .

10. Remove the fuel vapor tube assembly.

11. To install, reverse the removal procedure.
    - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

Torque Specifications

Description	Nm	lb-in
Evaporative Emission (EVAP) canister bolts	6	53
EVAP canister nuts	6	53
EVAP canister purge valve bolts	10	89
Fuel tank filler pipe heat shield nuts	10	89

Evaporative Emissions

The Evaporative Emission (EVAP) system consists of the:

- EVAP canister purge valve.
- EVAP canister (includes the dust separator and the vent solenoid).
- fuel vapor tube assembly (includes the Fuel Tank Pressure (FTP) sensor and the vapor blocking valve).
- Easy FuelTM (capless) fuel tank filler pipe.

The EVAP system:

- prevents hydrocarbon emissions from reaching the atmosphere.
- stores fuel vapors in the EVAP canister, that are generated during vehicle operation or hot soak, until they can be consuy the engine during normal engine operation.
- routes the stored fuel vapors to the engine during engine operation.
- is controlled by the PCM which, using various sensor inputs, calculates the desired amount of purge flow. The PCM regulates the purge flow, induced by the application of intake manifold vacuum, by varying the duty cycle applied to the EVAP canister purge valve.

The fuel vapors are routed:

- from the fuel tank through the fuel vapor vent valve.
- to the EVAP canisters through a vapor tube.
- from the EVAP canister to the engine when the EVAP canister purge valve is opened by the PCM.

The FTP sensor (part of fuel vapor tube assembly):

- monitors the pressure levels in the fuel tank.
- communicates the pressure reading to the PCM during the OBD II leak test.

The fuel vapor tube assembly:

- is located under the rear of the vehicle.
- is used to monitor fuel pressure and relay information to the PCM.
- includes the FTP sensor and the vapor blocking valve.

The EVAP canister:

- is located under the rear of the vehicle.
- includes the dust separator and vent solenoid.
- contains activated carbon.
- stores fuel vapors.

The Easy FuelTM (capless) fuel tank filler pipe:

- relieves system vacuum below -3.5 kPa (-16.00 in H_2O).

The EVAP canister vent solenoid:

- is normally open.
- seals the EVAP system for the inspection and maintenance (I/M 240) test and OBD II leak and pressure tests.
- is serviced as part of the EVAP canister.

The EVAP canister purge valve:

- is normally closed.
- regulates the purging of the EVAP canisters.
- is controlled by the PCM.
- is repaired as a separate item.
- is mounted to the intake manifld.

The dust separator:

- is attached to the EVAP canister vent solenoid.
- prevents suspended dust and dirt particles from entering the EVAP system.
- is serviced as part of the EVAP canister.

The EVAP system monitor:

- is a self-test strategy within the PCM which tests the integrity of the EVAP system.
- monitors the EVAP system for leaks.
- monitors electronic EVAP components for irrationally high or low voltages.
- monitors for correct EVAP system operation.
- uses negative and positive leak test methods to test and activate the EVAP system.

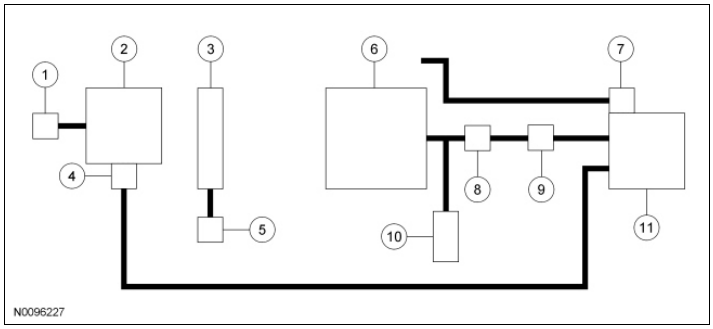
The engine ON EVAP leak-check monitor:

- is executed by the individual components of the enhanced EVAP system. Intake manifold vacuum is utilized to reach a target vacuum on the EVAP system. The FTP sensor is used by the engine ON EVAP leak-check monitor to determine if the target vacuum necessary to carry out the leak-check on the EVAP system has been reached. Once target vacuum on the EVAP system is achieved, the change in EVAP system vacuum over a calibrated period of time determines if a leak exists.

The Engine Off Natural Vacuum (EONV) EVAP leak-check monitor is executed:

- once the engine ON EVAP leak-check monitor is completed and the key is turned OFF. The EONV EVAP leak-check monitor determines if a leak is present when the naturally occurring change in the fuel tank pressure or vacuum does not exceed a calibrated limit during a calibrated amount of time. A separate, low-power consuming microprocessor in the PCM manages the EONV leak-check. The engine OFF EVAP leak-check monitor is executed by the individual components of the enhanced EVAP system.

Vehicle Emission Vacuum Routing



Item	Part Number	Description
1	-	PCV valve (part of 6A785)
2	9424	Intake manifold
6582	Valve cover	
4	9C915	Evaporative Emission (EVAP) canister purge valve
5	9B659	Air Cleaner (ACL) outlet pipe
6	9002	Fuel tank
7	-	Fuel vapor solenoid separator assembly (part of 9E857)
8	-	Fuel Tank Pressure (FTP) sensor (part of 9A228)
9	9G712	Fuel vapor vent valve
10	9034	Fuel tank filler pipe
11	9E857	EVAP canister

Evaporative Emissions

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Evaporative Emission System Leak Test

Special Tool(s)

 ST2817-A	VACUTEC Smoke Machine Fuel Evaporative Emission System Tester 218-0002 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Phase 1 â Leak Verification

1. Run the EVAP Test with the scan tool.

2. **NOTE:** Some small leaks may not be detected using the EVAP Test. If the system has passed the test but a leak is still suspected, then proceed to Phase 2.

   If the Evaporative Emission (EVAP) system failed the EVAP Test, then proceed to Phase 2.

Phase 2 â System Leak Check

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the fuel vapor tube-to- EVAP canister purge valve quick connect coupling. For additional information, refer to Section 310-00 .

3. Connect the VACUTEC Smoke Machine Fuel Evaporative Emissions System Tester to the fuel vapor tube quick connect coupling. For additional information, refer to the manufacturer's instructions.

4. **NOTE:** The battery ground cable was previously disconnected in the vapor tube quick connect coupling disconnect procedure.

   Connect the battery ground cable. For additional information, refer to Section 414-01 .

5. Close the canister vent solenoid with the scan tool.

6. **NOTE:** The supplemental refueling adapter is located in the luggage compartment

   Install the supplemental refueling adapter into the Easy Fuel ™ (capless) fuel tank filler pipe assembly.

7. **NOTE:** If smoke does not exit the fuel tank filler pipe neck area after the system is pressurized, open the canister vent solenoid with the scan tool to allow the air to purge. Once smoke is seen at the canister vent solenoid, close the canister vent solenoid with the scan tool.

Introduce smoke from the VACUTEC Smoke Machine Fuel Evaporative Emission System Tester into the EVAP system and verify that smoke is exiting the fuel tank filler pipe neck area. For additional information, refer to the manufacturer's instructions.

8. Remove the supplemental refueling adapter once smoke is observed exiting the fuel tank filler pipe neck area.

9. Continue to enter smoke into the system for 60 seconds to obtain pressure.

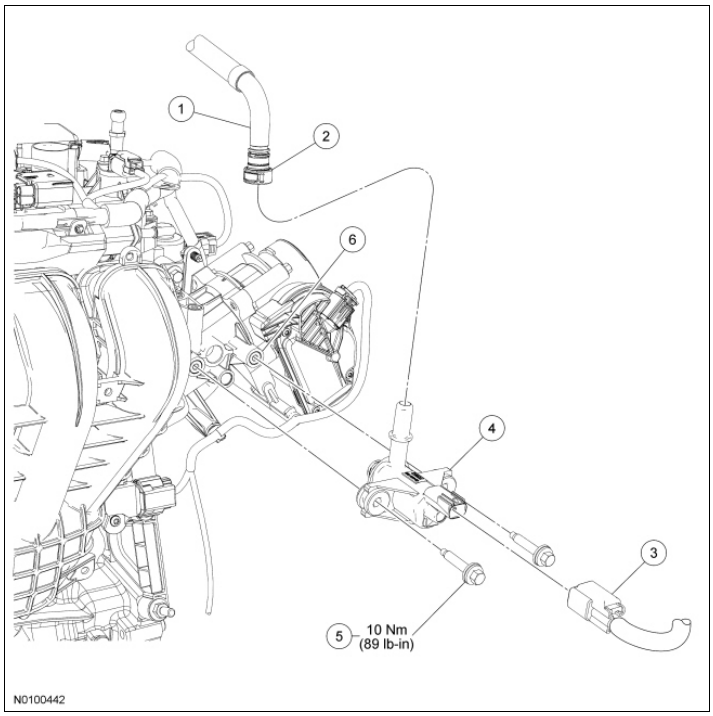
10. Press and release the remote start button in intervals of 15 seconds ON and 15 seconds OFF while checking for exiting smoke.

11. Use the halogen light provided with the VACUTEC Smoke Machine Fuel Evaporative Emission System Tester to follow the EVAP system path and look for smoke exiting at the source of the leak(s).

12. Repair any leaks as necessary.

13. Repeat the leak test until the system passes.

Evaporative Emission Canister Purge Valve



Item	Part Number	Description
1	9G271	Vapor tube
2	-	Vapor tube-to-Evaporative Emission (EVAP) canister purge valve quick connect coupling (part of 9G271)
3	14A464	EVAP canister purge valve electrical connector
4	9G866	EVAP canister purge valve
5	W503278	EVAP canister purge valve bolt (2 required)
6	9424	Intake manifold

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

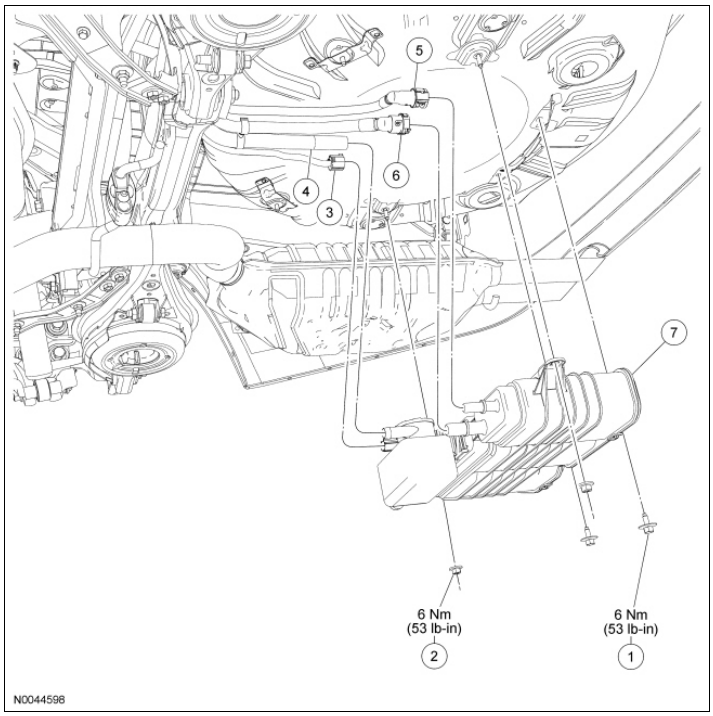
2. Disconnect the Evaporative Emission (EVAP) canister purge valve electrical connector.

3. Disconnect the vapor tube-to- EVAP canister purge valve quick connect coupling. For additional information, refer to Section 310-00 .

4. Remove the 2 bolts and the EVAP canister purge valve.
    - To install, tighten to 10 Nm (89 lb-in).

5. To install, reverse the removal procedure.
    - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

Evaporative Emission Canister



Item	Part Number	Description
1	W708029	Evaporative Emission (EVAP) canister bolt (2 required)
2	W713475	EVAP canister nut (2 required)
3	14A464	EVAP canister vent solenoid electrical connector >
4	-	Fresh air tube (part of 9034)
5	-	Vapor tube-to- EVAP canister quick connect coupling (part of 9J279)
6	-	Vapor tube-to- EVAP canister quick connect coupling (part of 9A228)
7	9E857	EVAP canister

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may beed. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. **NOTE:** Clean the Evaporative Emission (EVAP) canister vent solenoid electrical connector and the immediate surrounding area of any dirt or foreign material.

   Disconnect the EVAP canister vent solenoid electrical connector.

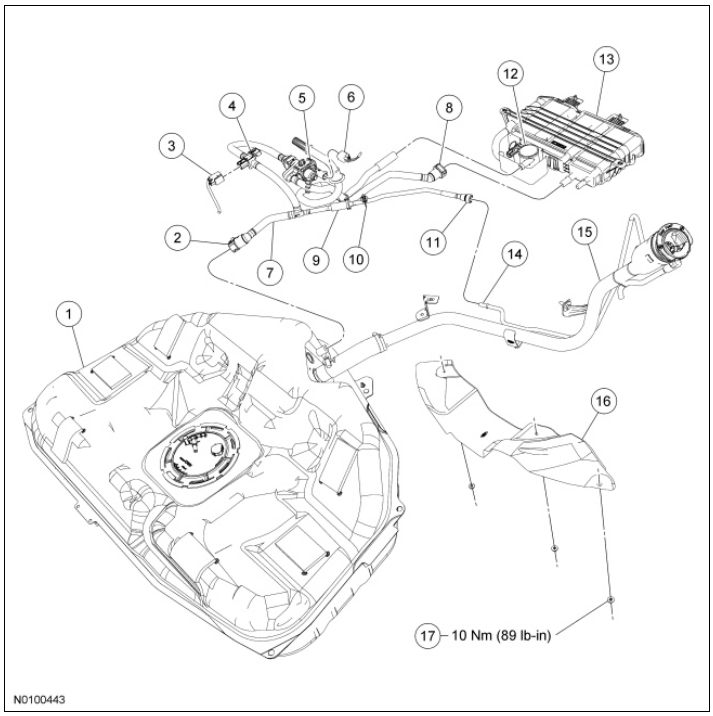
4. Disconnect the fresh air tube from the EVAP canister.

5. Disconnect the vapor tube assembly-to- EVAP canister quick connect couplings. For additional information, refer to Section 310-00 .

6. Remove the 2 nuts, 2 bolts and the EVAP canister assembly.
   - To install, tighten to 6 Nm (53 lb-in).

7. To install, reverse the removal procedure.
   - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

Fuel Vapor Tube Assembly



Item	Part Number	Description
1	9002	Fuel tank
2	-	Fuel vapor tube assembly-to-fuel tank quick connect coupling (part of 9A228)
3	14A464	Fuel Tank Pressure (FTP) sensor electrical connector
4	9C052	FTP sensor (part of 9A228)
5	9G712	Vapor blockive (part of 9A228)
6	14A464	Vapor blocking valve electrical connector
7	9A228	Fuel vapor tube assembly
8	-	Fuel vapor tube assembly-to-Evaporative Emission (EVAP) canister quick connect coupling (part of 9A228)
9	-	Two-stage recirculation orifice (part of 9A228)
10	-	Fuel vapor tube assembly pin-type retainer (part of 9A228)
11	-	Fuel vapor tube-to-recirculation tube quick connect coupling (part of 9A228)
12	9G676	Fuel vapor solenoid and separator assembly (part of 9E857)
13	9E857	EVAP canister assembly
14	-	Fuel tank filler pipe recirculation tube (part of 9034)
15	9034	Fuel tank filler pipe
16	5411268	Fuel tank filler pipe heat shield

17	W707142	Fuel tank filler pipe heat shield nut (3 required)

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present aignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the 3 nuts and the fuel tank filler pipe heat shield.
   - To install, tighten to 10 Nm (89 lb-in).
4. Disconnect the Fuel Tank Pressure (FTP) sensor electrical connector.
5. Disconnect the vapor blocking valve electrical connector.
6. Disconnect the fuel vapor tube assembly-to-fuel tank quick connect coupling. For additional information, refer to Section 310-00 .
7. Disconnect the fuel vapor tube assembly-to-Evaporative Emission (EVAP) canister quick connect coupling. For additional information, refer to Section 310-00 .
8. Disconnect the fresh air tube (part of the fuel vapor tube assembly) from the fuel vapor separator and solenoid assembly.
9. Release the pin-type retainer.
10. Disconnect the fuel vapor tube assembly-to-recirculation tube quick connect coupling. For additional information, refer to Section 310-00 .
11. Remove the fuel vapor tube assembly.
12. To install, reverse the removal procedure.
    - Carry out the Evaporative Emission System Leak Test. For additional information, refer to Evaporative Emission System Leak Test in this section.

Material

Item	Specification	Fill Capacity
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-	-

Torque Specifications

Description	Nm	lb-in
Camshaft Position (CMP) sensor bolt	7	Catalyst Monitor Sensor (CMS) [a] - -
Crankshaft Position (CKP) sensor bolts [a]	-	-
Cylinder block plug	20	177
Cylinder Head Temperature (CHT) sensor	12	106
Heated Oxygen Sensor (HO2S) [a]	-	-
Knock Sensor (KS) bolt	20	177
Manifold Absolute Pressure (MAP) sensor screw	3	27
Mass Air Flow (MAF) sensor screws	10	89
PCM bolts	11	97
Variable Camshaft Timing (VCT) oil control solenoid bolt	10	89

[a] Refer to the procedure in this section.

Electronic Engine Controls

The electronic engine controls consist of the following:

- PCM
- Camshaft Position (CMP) sensor
- Crankshaft Position (CKP) sensor
- Mass Air Flow (MAF) sensor
- Heated Oxygen Sensor (HO2S)
- Catalyst Monitor Sensor (CMS)
- Cylinder Head Temperature (CHT) sensor
- Knock Sensor (KS)
- Variable Camshaft Timing (VCT) oil control solenoid
- Manifold Absolute Pressure (MAP) sensor

The PCM:

- accepts input from various engine sensors to compute the fuel flow rate necessary to maintain a prescribed air/fuel ratio throughout the entire engine operational range.
- outputs a command to the fuel injectors to meter the appropriate quantity of fuel.

The CMP sensor:

- sends the PCM a signal indicating camshaft position used for fuel synchronization.

The CKP sensor:

- sends the PCM a signal indicating crankshaft position.
- is essential for calculating spark timing.

The MAF sensor:

- uses a hot wire sensing element to measure the amount of air entering the engine. Air passing over the hot wire causes it to cool.

The HO2S :

- creates a voltage signal dependent on exhaust oxygen content.
- provides feedback information to the PCM used to calculate fuel delivery.

The CMS :

- monitors oxygen content after it flows through the catalytic converter.
- provides feedback information to the PCM used to calculate fuel delivery.

The CHT sensor:

- sends the PCM a signal indicating cylinder head temperature.
- resistance decreases as coolant temperature increases.

The KS :

- is used to detect engine detonation.
- sends a voltage signal to the PCM.
- is able to provide a signal which retards the ignition timing, as necessary.

The VCT oil control solenoid:

- is an electrically controlled hydraulic valve that directs engine oil to the variable camshaft. Once the PCM transmits a signal, the solenoid moves a valve spool, directing oil into the camshaft phaser cavity. This action changes valve timing by either inducing an advance or retard condition. The camshaft is, thereby repositioned in relation to crankshaft timing and allows for optimum engine performance and lower emissions.

The MAP sensor:

- measures manifold vacuum and converts it to an electrical signal. This provides the PCM information on engine load.

Electronic Engine Controls

DTC Charts

PCM DTC Chart

DTC	Description	Action to Take
P0125	Insufficient Coolant Temp For Closed Loop Fuel Control	REFER to Section 03A .
P0128	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature)	REFER to Section 303-03A .
P0217	Engine Coolant Overtemperature Condition	REFER to Section 303-03A .
P0512	Starter Request Circuit	REFER to Section 303-06 .
P0532	A/C Refrigerant Pressure Sensor A Circuit Low	REFER to Section 412-00A .
P0533	A/C Refrigerant Pressure Sensor A Circuit High	REFER to Section 412-00A .
P0563	System Voltage High	REFER to Section 414-00 .
P0572	Brake Switch "A" Circuit Low	REFER to Section 419-03 .
P0573	Brake Switch "A" Circuit High	REFER to Section 419-03 .
P0579	Cruise Control Multi-Function Input A Circuit Range/Performance	REFER to Section 419-03 .
P0581	Cruise Control Multi-Function Input A Circuit High	REFER to Section 419-03 .
P0602	Powertrain Control Module Programming Error	REFER to Section 418-01 .
P0605	Internal Control Module Read Only Memory (ROM) Error	REFER to Section 418-01 .
P0620	Generator Control Circuit	REFER to Section 414-00 .
P0625	Generator Field Terminal Circuit Low	REFER to Section 414-00 .
P0626	Generator Field Terminal Circuit High	REFER to Section 414-00 .
P0645	A/C Clutch Relay Control Circuit	REFER to Section 412-00A .
P0657	Actuator Supply Voltage A Circuit/Open	REFER to Section 307-01B .
P065B	Generator Control Circuit Range/Performance	REFER to Section 414-00 .
P0701	Transmission Control System Range/Performance	REFER to Section 307-01B .
P0706	Transmission Range Sensor "A" Circuit Range/Performance	REFER to Section 307-01B .
P0707	Transmission Range Sensor "A" Circuit Low	REFER to Section 307-01B .
P0708	Transmission Range Sensor "A" Circuit High	REFER to Section 307-01B .
P0710	Transmission Fluid Temperature Sensor "A" Circuit	REFER to Section 307-01B .
P0711	Transmission Fluid Temperature Sensor "A" Circuit Range/Performance	REFER to Section 307-01B .
P0712	Transmission Fluid Temperature Sensor "A"	REFER to Section 307-01B .

	Circuit Low	
P0713	Transmission Fluid Temperature Sensor "A" Circuit High	REFER to Section 307-01B .
P0715	Turbine/Input Shaft Speed Sensor "A" Circuit	REFER to Section 307-01B .
P0717	Turbine/Input Shaft Speed Sensor "A" Circuit No Signal	REFER to Section 307-01B .
P0718	Turbine/Input Shaft Speed Sensor "A" Circuit Intermittent	REFER to Section 307-01B .
P0720	Output Shaft Speed Sensor Circuit	REFER to Section 307-01B .
P0721	Output Shaft Speed Sensor Circuit Range/Performance	REFER to Section 307-01B .
P0722	Output Shaft Speed Sensor Circuit No Signal	REFER to Section 307-01B .
P0729	Gear 6 Incorrect Ratio	REFER to Section 307-01B .
P0731	Gear 1 Incorrect Ratio	REFER to Section 307-01B .
P0732	Gear 2 Incorrect Ratio	REFER to Section 307-01B .
P0733	Gear 3 Incorrect Ratio	REFER to Section 307-01B .
P0734	Gear 4 Incorrect Ratio	REFER to Section 307-01B .
P0735	Gear 5 Incorrect Ratio	REFER to Section 307-01B .
P0740	Torque Converter Clutch Solenoid Circuit/Open	REFER to Section 307-01B .
P0741	Torque Converter Clutch Solenoid Circuit Performance/Stuck Off	REFER to Section 307-01B .
P0742	Torque Converter Clutch Solenoid Circuit Stuck On	REFER to Section 307-01B .
P0743	Torque Converter Clutch Solenoid Circuit Electrical	REFER to Section 307-01B .
P0744	Torque Converter Clutch Solenoid Circuit Intermittent	REFER to Section 307-01B .
P0748	Pressure Control Solenoid "A" Electrical	REFER to Section 307-01B .
P0750	Shift Solenoid "A"	REFER to Section 307-01B .
P0751	Shift Solenoid "A" Performance/Stuck Off	REFER to Section 307-01B .
P0752	Shift Solenoid "A" Stuck On	REFER to Section 307-01B .
P0753	Shift Solenoid "A" Electrical	REFER to Section 307-01B .
P0754	Shift Solenoid "A" Intermittent	REFER to Section 307-01B .
P0755	Shift Solenoid "B"	REFER to Section 307-01B .
P0756	Shift Solenoid "B" Performance/Stuck Off	REFER to Section 307-01B .
P0757	Shift Solenoid "B" Stuck On	REFER to Section 307-01B .
P0758	Shift Solenoid "B" Electrical	REFER to Section 307-01B .
P0759	Shift Solenoid "B" Intermittent	REFER to Section 307-01B .
P0760	Shift Solenoid "C"	REFER to Section 307-01B .
P0761	Shift Solenoid "C" Performance/Stuck Off	REFER to Section 307-01B .
P0762	Shift Solenoid "C" Stuck On	REFER to Section 307-01B .
P0763	Shift Solenoid "C" Electrical	REFER to Section 307-01B .
P0764	Shift Solenoid "C" Intermittent	REFER to Section 307-01B .
P0765	Shift Solenoid "D"	REFER to Section 307-01B .
P0766	Shift Solenoid "D" Performance/Stuck Off	REFER to Section 307-01B .

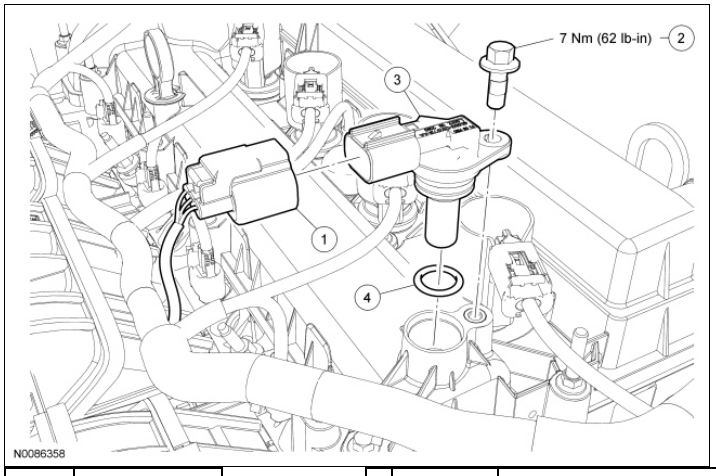
P0767	Shift Solenoid "D" Stuck On	REFER to Section 307-01B .
P0768	Shift Solenoid "D" Electrical	REFER to Section 307-01B .
P0769	Shift Solenoid "D" Intermittent	REFER to Section 307-01B .
P0770	Shift Solenoid "E"	REFER to Section 307-01B .
P0771	Shift Solenoid "E" Performance/Stuck Off	REFER to Section 307-01B .
P0772	Shift Solenoid "E" Stuck On	REFER to Section 307-01B .
P0773	Shift Solenoid "E" Electrical	REFER to Section 307-01B .
P0774	Shift Solenoid "E" Intermittent	REFER to Section 307-01B .
P07A5	Transmission Friction Element "B" Stuck On	REFER to Section 307-01B .
P07A8	Transmission Friction Element "D" Performance/Stuck Off	REFER to Section 307-01B .
P07A9	Transmission Friction Element "D" Stuck On	REFER to Section 307-01B .
P07AA	Transmission Friction Element "E" Performance/Stuck Off	REFER to Section 307-01B .
P0867	Transmission Fluid Pressure	REFER to Section 307-01B .
P0960	Pressure Control Solenoid A Control Circuit/Open	REFER to Section 307-01B .
P0961	Pressure Control Solenoid "A" Control Circuit Range/Performance	REFER to Section 307-01B .
P0962	Pressure Control Solenoid "A" Control Circuit Low	REFER to Section 307-01B .
P0963	Pressure Control Solenoid "A" Control Circuit High	REFER to Section 307-01B .
P0973	Shift Solenoid "A" Control Circuit Low	REFER to Section 307-01B .
P0974	Shift Solenoid "A" Control Circuit High	REFER to Section 307-01B .
P0976	Shift Solenoid "B" Control Circuit Low	REFER to Section 307-01B .
P0977	Shift Solenoid "B" Control Circuit High	REFER to Section 307-01B .
P0979	Shift Solenoid "C" Control Circuit Low	REFER to Section 307-01B .
P0980	Shift Solenoid "C" Control Circuit High	REFER to Section 307-01B .
P0982	Shift Solenoid "D" Control Circuit Low	REFER to Section 307-01B .
P0983	Shift Solenoid "D" Control Circuit High	REFER to Section 307-01B .
P0984	Shift Solenoid "E" Control Circuit Range/Performance	REFER to Section 307-01B .
P1260	Theft Detected, Vehicle Immobilized	REFER to Section 419-01B .
P1285	Cylinder Head Overtemperature Condition	REFER to Section 303-03A .
P1299	Cylinder Head Overtemperature Protection Active	REFER to Section 303-03A .
P1464	A/C Demand Out Of Self Test Range	REFER to Section 412-00A .
P1602	Immobilizer/ECM Communication Error	REFER to Section 419-01B .
P1622	Immobilizer ID Does Not Match	REFER to Section 419-01B .
P1636	Inductive Signature Chip Communication Error	REFER to Section 307-01B .
P1639	Vehicle ID Block Corrupted, Not Programmed	REFER to Section 418-01 .
P163E	Transmission Control Module Programming Error	REFER to Section 307-01B .
P163F	Transmission ID Block Corrupted, Not Programmed	REFER to Section 307-01B .
P1702	Transmission Range Sensor Circuit Intermittent	REFER to Section 307-01B .
P1703	Brake Switch Out Of Self Test Range	REFER to Section 419-03 .

P1705	Transmission Range Circuit Not Indicating Park/Neutral During Self Test	REFER to Section 307-01B .
P1711	Transmission Fluid Temperature Sensor Out Of Self Test Range	REFER to Section 307-01B .
P1714	Shift Solenoid "A" Inductive Signature	REFER to Section 307-01B .
P1744	Torque Converter Clutch Solenoid Circuit Performance	REFER to Section 307-01B .
P1780	Transmission Control Switch (O/D Cancel) Circuit Out Of Self Test Range	REFER to Section 307-01B .
P1783	Transmission Overtemperature Condition	REFER to Section 307-01B .
P1910	Reverse Lamp Control Circuit/Open	REFER to Section 417-01 .
P2700	Transmission Friction Element "A" Apply Time Range/Performance	REFER to Section 307-01B .
P2701	Transmission Friction Element "B" Apply Time Range/Performance	REFER to Section 307-01B .
P2702	Transmission Friction Element "C" Apply Time Range/Performance	REFER to Section 307-01B .
P2703	Transmission Friction Element "D" Apply Time Range/Performance	REFER to Section 307-01B .
P2704	Transmission Friction Element "E" Apply Time Range/Performance	REFER to Section 307-01B .
P2705	Transmission Friction Element "F" Apply Time Range/Performance	REFER to Section 307-01B .
P2760	Torque Converter Clutch Pressure Control Solenoid Intermittent	REFER to Section 307-01B .
P2783	Torque Converter Temperature Too High	REFER to Section 307-01B .
U0300	Internal Control Module Software Incompatibility	REFER to Section 418-01 .
All Other DTCs	-	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Camshaft Position (CMP) Sensor

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



Item	Part Number				
			1	14A464	Camshaft Position (CMP) sensor electrical connector (part of 12B637)
2	W701219	CMP sensor bolt			
3	12K073	CMP			
4	-	CMP O-ring seal			

Removal and Installation

1. Disconnect the Camshaft Position (CMP) sensor electrical connector.

2. Remove the bolt and the CMP .
   - To install, tighten to 7 Nm (62 lb-in).

3. **NOTE:** Lubricate the CMP O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

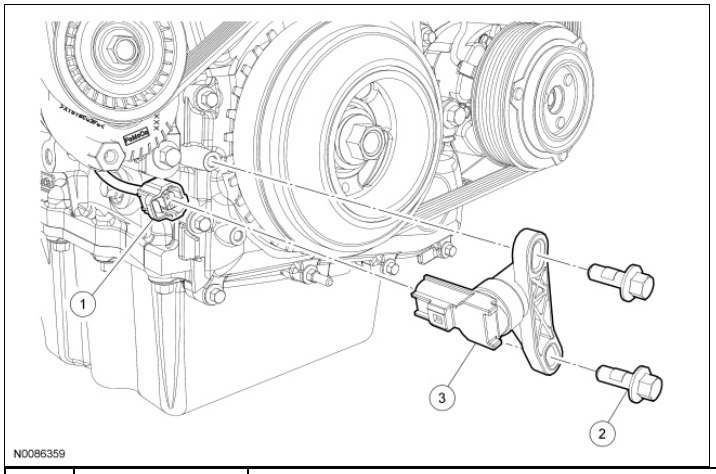
Crankshaft Position (CKP) Sensor

Special Tool(s)

 ST3055A	Aligner, Crankshaft Sensor 303-1417
 ST2638-A	Timing Peg, Crankshaft TDC 303-507
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

General Equipment

6 mm x 18 mm bolt

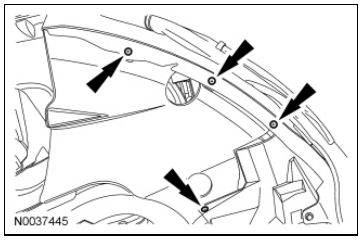


Item	Part Number	Description
1	14A464	Crankshaft Position (CKP) sensor electrical connector (part of 12B637)
2	W701219-S	CKP sensor bolt (2 required)
3	6C315	CKP sensor

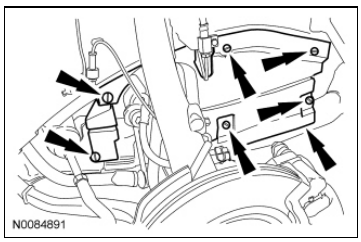
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

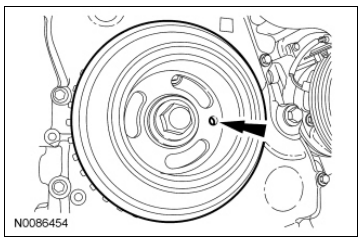
2. Remove the 4 screws and position the RH fender splash shield aside.



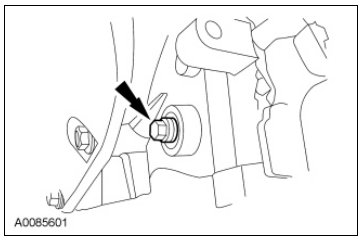
3. Remove the 6 pin-type retainers and the RH splash shield.



4. Turn the crankshaft clockwise until the hole in the crankshaft pulley is in the 3 o'clock position.

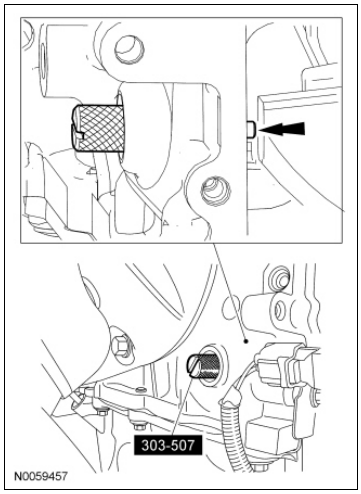


5. Remove the cylinder block plug.



6. **NOTE:** When the crankshaft contacts the Crankshaft TDC Timing Peg, the No. 1 cylinder will be at Top Dead Center (TDC).

   Install the Crankshaft TDC Timing Peg and turn the crankshaft clockwise until the crankshaft contacts the Crankshaft TDC Timing Peg.



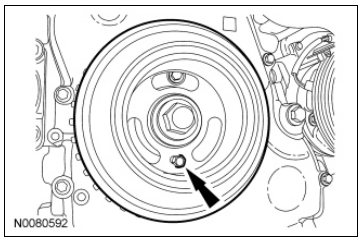
7. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

8. Remove the bolts and discard the CKP sensor.

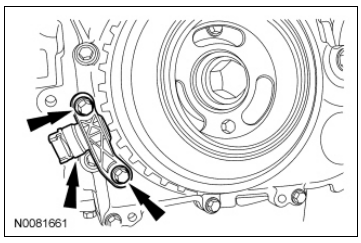
Installation

1. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

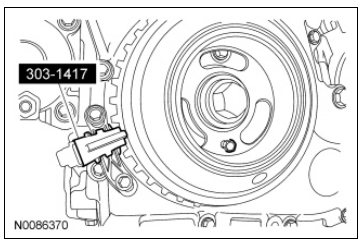
   Install a 6 mm (0.23 in) x 18 mm (0.7 in) standard bolt in the crankshaft pulley.



2. Install the CKP sensor and the 2 bolts.
   - Do not tighten the bolts at this time.



3. Adjust the CKP sensor with the Crankshaft Sensor Aligner.
   - Tighten the 2 CKP bolts to 7 Nm (62 lb-in).

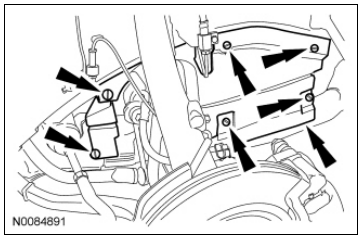


4. Connect the CKP sensor electrical connector.

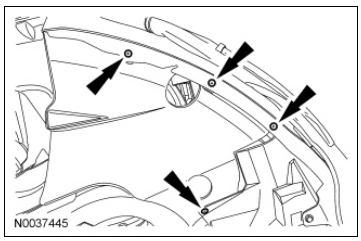
5. Remove the 6 mm (0.23 in) bolt from the crankshaft pulley.

6. Install the cylinder block plug.
   - Tighten to 20 Nm (177 lb-in).

7. Install the 6 pin-type retainers and the RH splash shield.

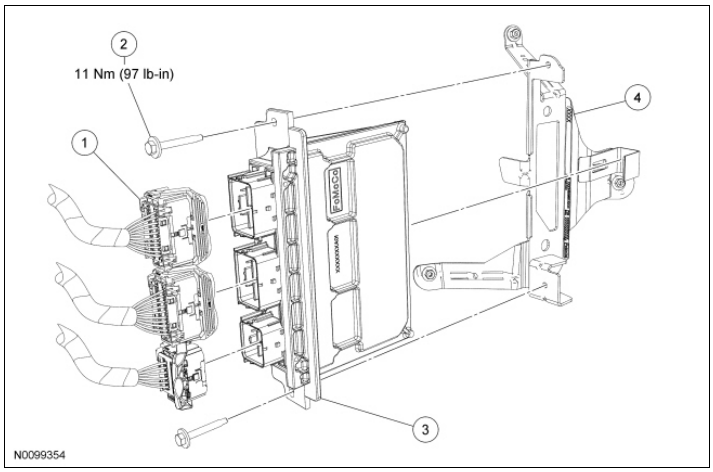


8. Install the 4 screws and position the RH fender splash shield aside.



9. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Powertrain Control Module (PCM)



Item	Part Number	Description
1	14A464	PCM electrical connector (3 required)
2	W505428	PCM bolt (2 required)
3	12A650	PCM
4	12A659	PCM bracket

Removal

1. **NOTE:** PCM replacement DOES NOT require new keys or programming of keys.

   Retrieve the module configuration. Carry out the module configuration retrieval steps of the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

2. Remove the battery tray. For additional information, refer to Section 414-01 .

3. Disconnect the 3 PCM electrical connectors.

4. Remove the 2 bolts and the PCM.

Installation

1. Install the PCM and the 2 bolts.
   - Tighten to 11 Nm (97 lb-in).

2. Connect the 3 PCM electrical connectors.

3. Install the battery tray. For additional information, refer to Section 414-01 .

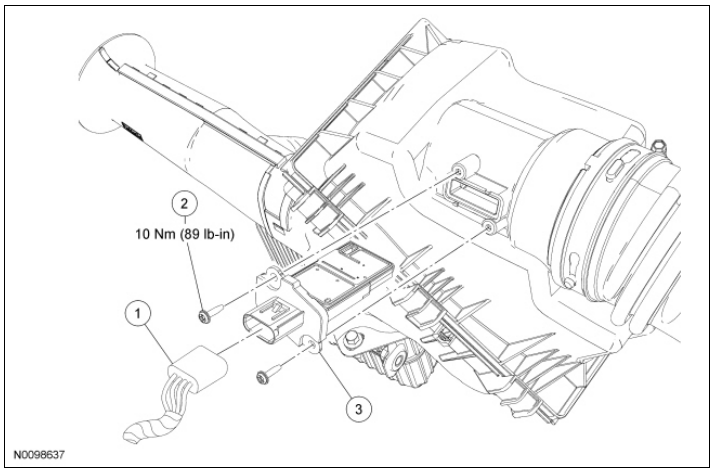
4. **NOTE:** If the Programmable Module Installation (PMI) procedure was not successful in downloading the data from the vehicles original PCM, then the oil life data of the vehicle is lost. If this occurs, and the oil life cannot be determined through service history or customer interview, it is recommended the vehicle engine oil and filter be changed and the oil change minder reset.

Restore the module configuration. Carry out the module configuration restore steps of the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

5. Reprogram the Passive Anti-Theft System (PATS). Carry out the Parameter Reset procedure. For additional information, refer to Section 419-01B .

6. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

Mass Air Flow (MAF) Sensor



Item	Part Number	Description
1	14A464	Mass Air Flow (MAF) sensor electrical connector (part of 12B637)
2	W709287-S	MAF sensor sc(2 required)
3	12B579	MAF sensor

Removal and Installation

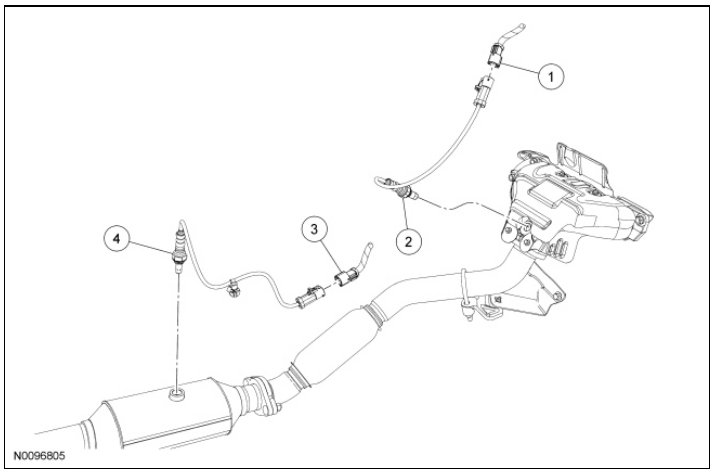
1. Disconnect the Mass Air Flow (MAF) sensor electrical connector.

2. Remove the 2 screws and the MAF sensor.
   - To install, tighten to 10 Nm (89 lb-in).

3. To install, reverse the removal procedure.

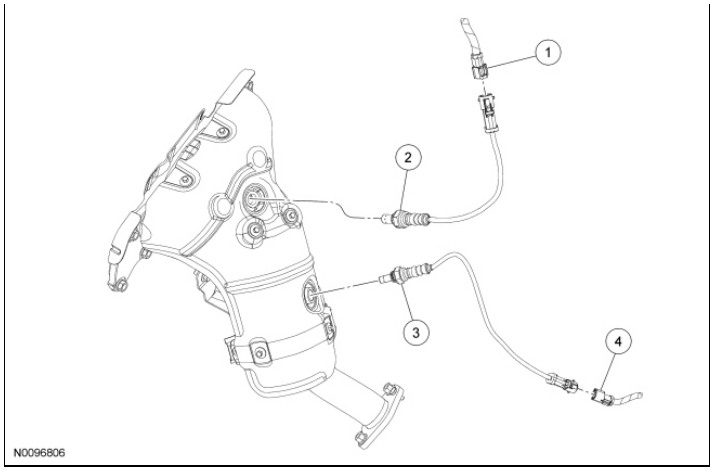
Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor - Exploded View

Non-Partial Zero Emissions Vehicle (PZEV)



Item	Part Number	Description
1	14A64	Heated Oxygen Sensor (HO2S) electical connector (part of 12B637)
2	9F472	HO2S sensor
3	14A464	Cataitor Sensor (CMS) electrical connector
4	9G444	CMS sensor

Partial Zero Emissions Vehicle (PZEV)



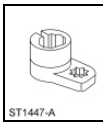
Item	Part Number	Description
1	14A64	Heated Oxygen Sensor (HO2S) electical connector (part

		of 12B637)
2	9F472	HO2S sensor
3	14A464	Catalyst Monitor Sensor (CMS) electrical connector
4	9G444	CMS sensor

1. For additional information, refer to the procedures in this section.

Heated Oxygen Sensor (HO2S)

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-

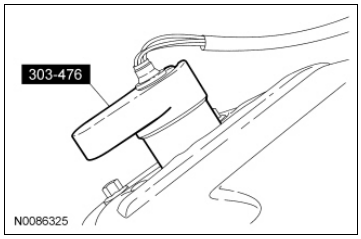
Removal and Installation

1. Disconnect the Heated Oxygen Sensor (HO2S) electconnector.

2. **NOTE:** If necessary, lubricate the sensor threads with penetrating and lock lubricant to assist in removal.

   Using the Exhaust Gas Oxygen Sensor Socket, remove the HO2S .

   - Calculate the correct torque wrench setting for the following torque. Refer to the Torque Wrench Adapter Formulas in the Appendix .
   - To install, tighten to 48 Nm (35 lb-ft).

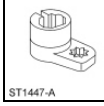


3. **NOTE:** Apply a light coat of anti-seize lubricant to the threads of the HO2S .

   To install, reverse the removal procedure.

Catalyst Monitor Sensor

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

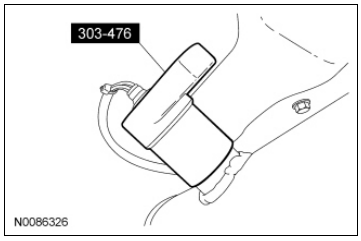
Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. Fotional information, refer to Section 100-02 .
2. Disconnect the Catalyst Monitor Sensor (CMS) electrical connector.
3. **NOTE:** If necessary, lubricate the sensor threads with penetrating and lock lubricant to assist in removal.

   Using the Exhaust Gas Oxygen Sensor Socket, remove the CMS .

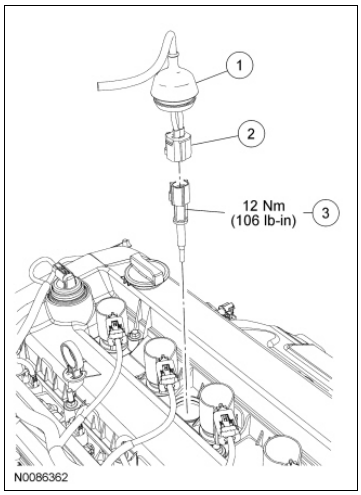
   - Calculate the correct torque wrench setting for the following torque. Refer to the Torque Wrench Adapter Formulas in the Appendix .
   - To install, tighten to 48 Nm (35 lb-ft).



4. **NOTE:** Apply a light coat of anti-seize lubricant to the threads of the CMS .

   To install, reverse the removal procedure.

Cylinder Head Temperature (CHT) Sensor



Item	Part Number	Description
1	14603	Cylinder Head Temperature (CHT) sensor cover (part of 12C508)
2	14A464	CHT sensor electrical connector (part of 12C508)
3	6G004	CHT sensor

Removal and Installation

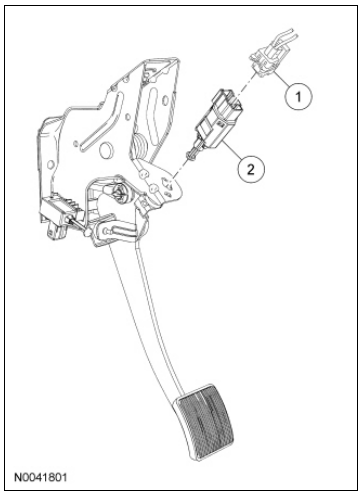
1. Detach the Cylinder Head Temperature (CHT) sensor cover and position aside.

2. Disconnect the CHT sensor electrical connector.

3. Remove the CHT sensor.
   - To install, tighten to 12 Nm (106 lb-in).

4. To install, reverse the removal procedure.

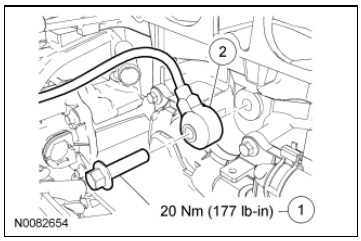
Clutch Pedal Position (CPP) Switch



Item	Part Number	Description
1	-	Clutch Pedal Position (CPP) switch electrical connector (part of 14290)
2	7C534	

1. Disconnect the Clutch Pedal Position (CPP) switch electrical connector.
2. Rotate the CPP switch clockwise and remove the CPP switch.
3. To install, reverse the removal procedure.

Knock Sensor (KS)



Item	Part Number	Description
1	W5000025	Knock Sensor (KS) bolt
2	12A699	KS

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

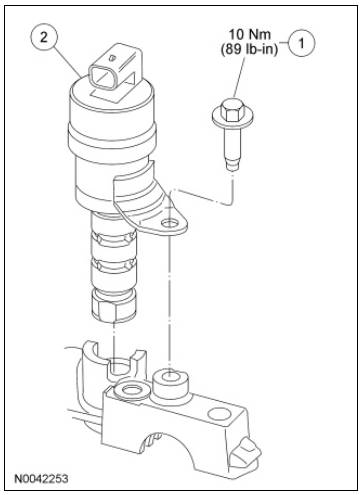
2. Remove the intake manifold. For additional information, refer to Section 303-01A .

3. Remove the bolt and the Knock Sensor (KS).
   - To install, tighten to 20 Nm (177 lb-in).

4. **NOTE:** The KS must not touch the crankcase vent oil separator.

   To install, reverse the removal procedure.

Variable Camshaft Timing (VCT) Oil Control Solenoid



Item	Part Number	Description
1	W500211	Variable Camshaft Timing (VCT) oil control solenoid bolt
2	6M280	VCT oil control solenoid

Removal and Installation

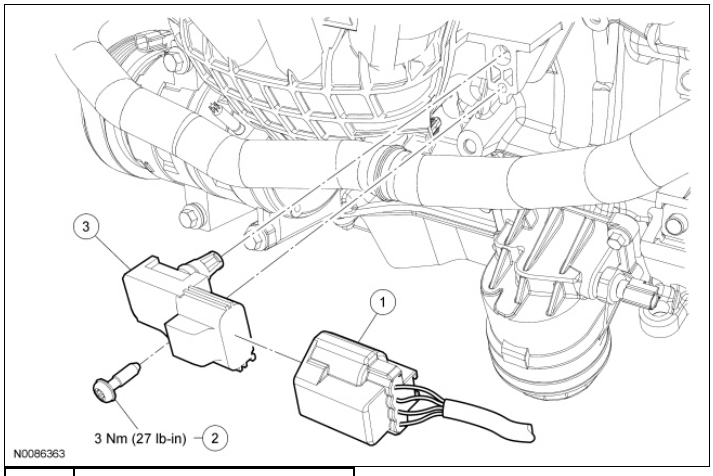
1. Remove the valve cover. For additional information, refer to
2. Remove the bolt and the Variable Camshaft Timing (VCT) oil control solenoid.
    - To install, tighten to 10 Nm (89 lb-in).

3. To install, reverse the removal procedure.

Manifold Absolute Pressure (MAP) Sensor

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



Item	Part Number Description	
1	14A464	Manifold Absolute Pressure (MAP) sensor electrical connector
2	W701459	MAP sensor screw
3	9F479	MAP sensor

Removal and Installation

1. Disconnect the Manifold Absolute Pressure (MAP) sensor electrical connector.

2. Remove the screw and the MAP sensor.
   - To install, tighten to 3 Nm (27 lb-in).

3. **NOTE:** Lubricate the MAP sensor O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-	-

Torque Specifications

Description	Nm	lb-ft	lb-in
Camshaft Position (CMP) sensor bolt	10	-	89
Catalyst Monitor Sensor (CMS) [a]	-	-	-
Crankshaft Position (CKP) sensor bolt	10	-	89
Cylinder Head Temperature (CHT) sensor	11	-	97
Heated Oxygen Sensor (HO2S) [a]	-	-	-
Knock Sensor (KS) bolt (cylinder-block mounted)	25	18	-
Knock Sensor (KS) bolt (cylinder-head mounted)	25	18	-
Manifold Absolute Pressure (MAP) sensor bolt	6	-	53
Mass Air Flow (MAF) sensor screws	2	-	18
PCM bolts	8	-	71
Radio frequency interference capacitor 6	-	53	
Variable Camshaft Timing (VCT) oil control solenoid bolt	10	-	89

[a] Refer to the procedure in this section.

Electronic Engine Controls

The electronic engine controls consist of the:

- PCM.
- Camshaft Position (CMP) sensor.
- Crankshaft Position (CKP) sensor.
- Mass Air Flow (MAF) sensor.
- Cylinder Head Temperature (CHT) sensor.
- Heated Oxygen Sensor (HO2S).
- Catalyst Monitor Sensor (CMS).
- Variable Camshaft Timing (VCT) oil control solenoid.
- Knock Sensor (KS) (cylinder-block mounted).
- KS (cylinder-head mounted).
- Manifold Absolute Pressure (MAP) sensor.

The PCM carries out the following functions:

- accepts input from various engine sensors to compute the fuel flow rate necessary to mainta prescribed air/fuel ratio throughout the entire engine operational range.
- outputs a command to the fuel injectors to meter the appropriate quantity of fuel.

The CMP sensor:

- sends the PCM a signal indicating camshaft position used for fuel synchronization.

The CKP sensor:

- sends the PCM a signal indicating crankshaft position.
- is essential for calculating spark timing.

The MAF sensor:

- uses a hot wire sensing element to measure the amount of air entering the engine. Air passing over the hot wire causes it to cool.

The CHT sensor:

NOTE: If the cylinder head is being replaced, the CHT must be replaced.

- sends the PCM a signal indicating engine temperature.
- resistance decreases as coolant temperature increases.

The HO2S :

- creates a voltage signal dependent on exhaust oxygen content.
- provides feedback information to the PCM used to calculate fuel delivery.

The CMS :

- monitors oxygen content after it flows through the catalytic converter.
- provides a voltage to the PCM used to calculate catalytic converter integrity.

The VCT oil control solenoid:

- is an electrically controlled hydraulic valve that directs engine oil to the variable camshaft. Once the PCM transmits a signal, the solenoid moves a valve spool, directing oil into the camshaft phaser cavity. This action changes valve timing by either inducing an advance or retard condition. The camshaft is, thereby repositioned in relation to crankshaft timing and allows for optimum engine performance and lower emissions.

The KS :

NOTE: There are 2 KS , one is located on the RH cylinder head and one is mounted on the engine block in the intake manifold valley.

- is used to detect engine detonation.
- sends a voltage signal to the PCM.
- is able to provide a signal which retards the ignition timing, as necessary.

The MAP sensor:

- measures manifold vacuum and converts it to an electrical signal. This provides the PCM information on engine load.

Electronic Engine Controls

DTC Charts

PCM DTC Chart

DTC	Description	Action to Take
P0125	Insufficient Coolant Temp For Closed Loop Fuel Control	REFER to .
P0128	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature)	REFER to Section 303-03A .
P0217	Engine Coolant Overtemperature Condition	REFER to Section 303-03A .
P0512	Starter Request Circuit	REFER to Section 303-06 .
P0532	A/C Refrigerant Pressure Sensor A Circuit Low	REFER to Section 412-00A .
P0533	A/C Refrigerant Pressure Sensor A Circuit High	REFER to Section 412-00A .
P0563	System Voltage High	REFER to Section 414-00 .
P0572	Brake Switch "A" Circuit Low	REFER to Section 419-03 .
P0573	Brake Switch "A" Circuit High	REFER to Section 419-03 .
P0579	Cruise Control Multi-Function Input A Circuit Range/Performance	REFER to Section 419-03 .
P0581	Cruise Control Multi-Function Input A Circuit High	REFER to Section 419-03 .
P0602	Powertrain Control Module Programming Error	REFER to Section 418-01 .
P0605	Internal Control Module Read Only Memory (ROM) Error	REFER to Section 418-01 .
P0620	Generator Control Circuit	REFER to Section 414-00 .
P0625	Generator Field Terminal Circuit Low	REFER to Section 414-00 .
P0626	Generator Field Terminal Circuit High	REFER to Section 414-00 .
P0645	A/C Clutch Relay Control Circuit	REFER to Section 412-00A .
P0657	Actuator Supply Voltage A Circuit/Open	REFER to Section 307-01B .
P065B	Generator Control Circuit Range/Performance	REFER to Section 414-00 .
P0701	Transmission Control System Range/Performance	REFER to Section 307-01B .
P0706	Transmission Range Sensor "A" Circuit Range/Performance	REFER to Section 307-01B .
P0707	Transmission Range Sensor "A" Circuit Low	REFER to Section 307-01B .
P0708	Transmission Range Sensor "A" Circuit High	REFER to Section 307-01B .
P0710	Transmission Fluid Temperature Sensor "A" Circuit	REFER to Section 307-01B .
P0711	Transmission Fluid Temperature Sensor "A" Circuit Range/Performance	REFER to Section 307-01B .
P0712	Transmission Fluid Temperature Sensor "A"	REFER to Section 307-01B .

	Circuit Low	
P0713	Transmission Fluid Temperature Sensor "A" Circuit High	REFER to Section 307-01B .
P0715	Turbine/Input Shaft Speed Sensor "A" Circuit	REFER to Section 307-01B .
P0717	Turbine/Input Shaft Speed Sensor "A" Circuit No Signal	REFER to Section 307-01B .
P0718	Turbine/Input Shaft Speed Sensor "A" Circuit Intermittent	REFER to Section 307-01B .
P0720	Output Shaft Speed Sensor Circuit	REFER to Section 307-01B .
P0721	Output Shaft Speed Sensor Circuit Range/Performance	REFER to Section 307-01B .
P0722	Output Shaft Speed Sensor Circuit No Signal	REFER to Section 307-01B .
P0729	Gear 6 Incorrect Ratio	REFER to Section 307-01B .
P0731	Gear 1 Incorrect Ratio	REFER to Section 307-01B .
P0732	Gear 2 Incorrect Ratio	REFER to Section 307-01B .
P0733	Gear 3 Incorrect Ratio	REFER to Section 307-01B .
P0734	Gear 4 Incorrect Ratio	REFER to Section 307-01B .
P0735	Gear 5 Incorrect Ratio	REFER to Section 307-01B .
P0740	Torque Converter Clutch Solenoid Circuit/Open	REFER to Section 307-01B .
P0741	Torque Converter Clutch Solenoid Circuit Performance/Stuck Off	REFER to Section 307-01B .
P0742	Torque Converter Clutch Solenoid Circuit Stuck On	REFER to Section 307-01B .
P0743	Torque Converter Clutch Solenoid Circuit Electrical	REFER to Section 307-01B .
P0744	Torque Converter Clutch Solenoid Circuit Intermittent	REFER to Section 307-01B .
P0748	Pressure Control Solenoid "A" Electrical	REFER to Section 307-01B .
P0750	Shift Solenoid "A"	REFER to Section 307-01B .
P0751	Shift Solenoid "A" Performance/Stuck Off	REFER to Section 307-01B .
P0752	Shift Solenoid "A" Stuck On	REFER to Section 307-01B .
P0753	Shift Solenoid "A" Electrical	REFER to Section 307-01B .
P0754	Shift Solenoid "A" Intermittent	REFER to Section 307-01B .
P0755	Shift Solenoid "B"	REFER to Section 307-01B .
P0756	Shift Solenoid "B" Performance/Stuck Off	REFER to Section 307-01B .
P0757	Shift Solenoid "B" Stuck On	REFER to Section 307-01B .
P0758	Shift Solenoid "B" Electrical	REFER to Section 307-01B .
P0759	Shift Solenoid "B" Intermittent	REFER to Section 307-01B .
P0760	Shift Solenoid "C"	REFER to Section 307-01B .
P0761	Shift Solenoid "C" Performance/Stuck Off	REFER to Section 307-01B .
P0762	Shift Solenoid "C" Stuck On	REFER to Section 307-01B .
P0763	Shift Solenoid "C" Electrical	REFER to Section 307-01B .
P0764	Shift Solenoid "C" Intermittent	REFER to Section 307-01B .
P0765	Shift Solenoid "D"	REFER to Section 307-01B .
P0766	Shift Solenoid "D" Performance/Stuck Off	REFER to Section 307-01B .

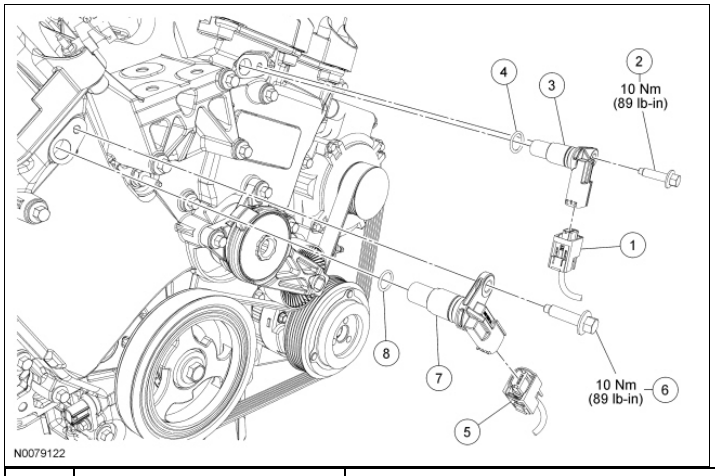
P0767	Shift Solenoid "D" Stuck On	REFER to Section 307-01B .
P0768	Shift Solenoid "D" Electrical	REFER to Section 307-01B .
P0769	Shift Solenoid "D" Intermittent	REFER to Section 307-01B .
P0770	Shift Solenoid "E"	REFER to Section 307-01B .
P0771	Shift Solenoid "E" Performance/Stuck Off	REFER to Section 307-01B .
P0772	Shift Solenoid "E" Stuck On	REFER to Section 307-01B .
P0773	Shift Solenoid "E" Electrical	REFER to Section 307-01B .
P0774	Shift Solenoid "E" Intermittent	REFER to Section 307-01B .
P07A5	Transmission Friction Element "B" Stuck On	REFER to Section 307-01B .
P07A8	Transmission Friction Element "D" Performance/Stuck Off	REFER to Section 307-01B .
P07A9	Transmission Friction Element "D" Stuck On	REFER to Section 307-01B .
P07AA	Transmission Friction Element "E" Performance/Stuck Off	REFER to Section 307-01B .
P0867	Transmission Fluid Pressure	REFER to Section 307-01B .
P0960	Pressure Control Solenoid A Control Circuit/Open	REFER to Section 307-01B .
P0961	Pressure Control Solenoid "A" Control Circuit Range/Performance	REFER to Section 307-01B .
P0962	Pressure Control Solenoid "A" Control Circuit Low	REFER to Section 307-01B .
P0963	Pressure Control Solenoid "A" Control Circuit High	REFER to Section 307-01B .
P0973	Shift Solenoid "A" Control Circuit Low	REFER to Section 307-01B .
P0974	Shift Solenoid "A" Control Circuit High	REFER to Section 307-01B .
P0976	Shift Solenoid "B" Control Circuit Low	REFER to Section 307-01B .
P0977	Shift Solenoid "B" Control Circuit High	REFER to Section 307-01B .
P0979	Shift Solenoid "C" Control Circuit Low	REFER to Section 307-01B .
P0980	Shift Solenoid "C" Control Circuit High	REFER to Section 307-01B .
P0982	Shift Solenoid "D" Control Circuit Low	REFER to Section 307-01B .
P0983	Shift Solenoid "D" Control Circuit High	REFER to Section 307-01B .
P0984	Shift Solenoid "E" Control Circuit Range/Performance	REFER to Section 307-01B .
P1260	Theft Detected, Vehicle Immobilized	REFER to Section 419-01B .
P1285	Cylinder Head Overtemperature Condition	REFER to Section 303-03A .
P1299	Cylinder Head Overtemperature Protection Active	REFER to Section 303-03A .
P1464	A/C Demand Out Of Self Test Range	REFER to Section 412-00A .
P1602	Immobilizer/ECM Communication Error	REFER to Section 419-01B .
P1622	Immobilizer ID Does Not Match	REFER to Section 419-01B .
P1636	Inductive Signature Chip Communication Error	REFER to Section 307-01B .
P1639	Vehicle ID Block Corrupted, Not Programmed	REFER to Section 418-01 .
P163E	Transmission Control Module Programming Error	REFER to Section 307-01B .
P163F	Transmission ID Block Corrupted, Not Programmed	REFER to Section 307-01B .
P1702	Transmission Range Sensor Circuit Intermittent	REFER to Section 307-01B .
P1703	Brake Switch Out Of Self Test Range	REFER to Section 419-03 .

P1705	Transmission Range Circuit Not Indicating Park/Neutral During Self Test	REFER to Section 307-01B .
P1711	Transmission Fluid Temperature Sensor Out Of Self Test Range	REFER to Section 307-01B .
P1714	Shift Solenoid "A" Inductive Signature	REFER to Section 307-01B .
P1744	Torque Converter Clutch Solenoid Circuit Performance	REFER to Section 307-01B .
P1780	Transmission Control Switch (O/D Cancel) Circuit Out Of Self Test Range	REFER to Section 307-01B .
P1783	Transmission Overtemperature Condition	REFER to Section 307-01B .
P1910	Reverse Lamp Control Circuit/Open	REFER to Section 417-01 .
P2700	Transmission Friction Element "A" Apply Time Range/Performance	REFER to Section 307-01B .
P2701	Transmission Friction Element "B" Apply Time Range/Performance	REFER to Section 307-01B .
P2702	Transmission Friction Element "C" Apply Time Range/Performance	REFER to Section 307-01B .
P2703	Transmission Friction Element "D" Apply Time Range/Performance	REFER to Section 307-01B .
P2704	Transmission Friction Element "E" Apply Time Range/Performance	REFER to Section 307-01B .
P2705	Transmission Friction Element "F" Apply Time Range/Performance	REFER to Section 307-01B .
P2760	Torque Converter Clutch Pressure Control Solenoid Intermittent	REFER to Section 307-01B .
P2783	Torque Converter Temperature Too High	REFER to Section 307-01B .
U0300	Internal Control Module Software Incompatibility	REFER to Section 418-01 .
All Other DTCs	-	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Camshaft Position (CMP) Sensor

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



Item	Part Number	Description
1	14A464	LH Camshaft Position (CMP) sensor electrical connector (part of 12C508)
2	W500214 LH CMP sensor bolt	
3	12K073	LH CMP sensor
4	-	LH CMP sensor O-ring seal
5	14A464	RH CMP sensor electrical connector (part of 12C508)
6	W500214	RH CMP sensor bolt
7	12K073	RH CMP sensor
8	-	RH CMP sensor O-ring seal

1. Disconnect the Camshaft Position (CMP) electrical connector.

2. Remove the bolt and the CMP sensor.
   - To install, tighten to 10 Nm (89 lb-in).

3. **NOTE:** Lubricate the CMP O-ring seal with clean engine oil.

To install, reverse the removal procedure.

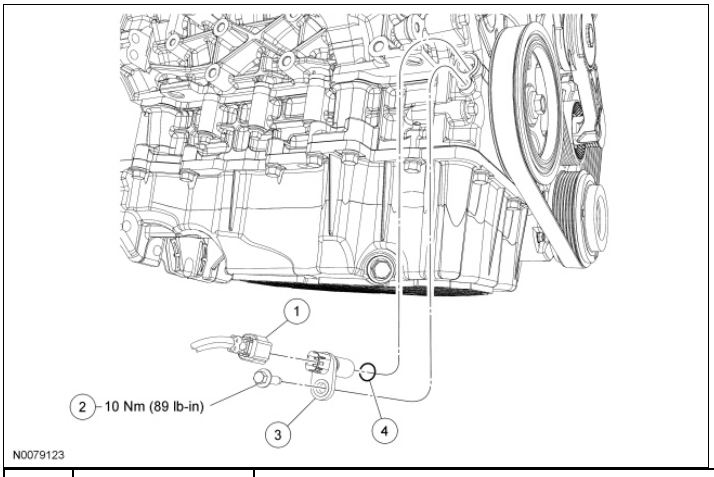
Crankshaft Position (CKP) Sensor

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



Item	Part Number	Description
1	14A464	Crankshaft Position (CKP) sensor electrical connector
2	W500214	CKP sensor bolt
3	6C315	CKP sensor
4	-	CKP sensor O-ring seal

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

3. Remove the bolt and the CKP .
   - ♦ To install, tighten to 10 Nm (89 lb-in).

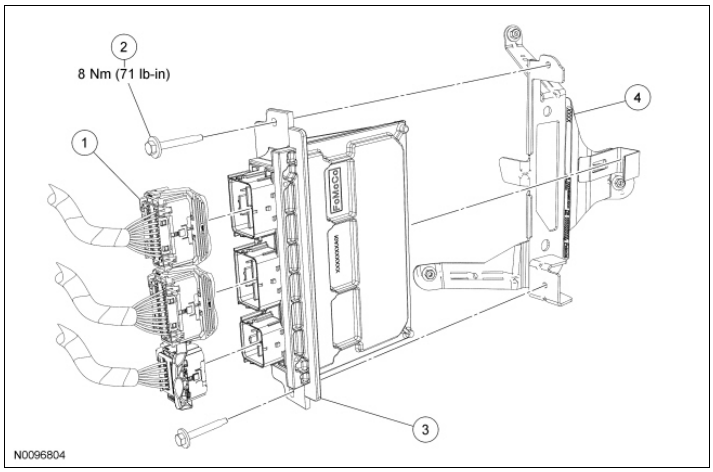
- Inspect the O-ring seal and install new as necessary.

4. **NOTE:** Lubricate the CKP O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

5. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Powertrain Control Module (PCM)



Item	Part Number	Description
1	14A464	PCM electrical connector (3 required)
2	W505428	PCM bolt (2 required)
3	12A650	PCM
4	12A659	PCM bracket

Removal

1. **NOTE:** PCM replacement DOES NOT require new keys or programming of keys.

   Retrieve the module configuration. Carry out the module configuration retrieval steps of the Programmable Module Installation (PMI) procedure. For additional information, refer Section 418-01 .

2. Remove the battery tray. For additional information, refer to Section 414-01 .

3. Disconnect the 3 PCM electrical connectors.

4. Remove the 2 bolts and the PCM.

Installation

1. Install the PCM and the 2 bolts.
   - Tighten to 8 Nm (71 lb-in).

2. Connect the 3 PCM electrical connectors.

3. Install the battery tray. For additional information, refer to Section 414-01 .

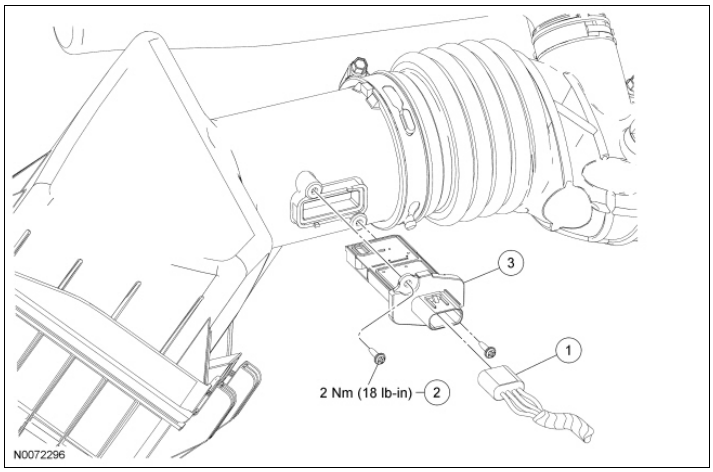
4. **NOTE:** If the Programmable Module Installation (PMI) procedure was not successful in downloading the data from the vehicles original PCM, then the oil life data of the vehicle is lost. If this occurs, and the oil life cannot be determined through service history or customer interview, it is recommended the vehicle engine oil and filter be changed and the oil change minder reset.

Restore the module configuration. Carry out the module configuration restore steps of the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

5. Reprogram the Passive Anti-Theft System (PATS). Carry out the Parameter Reset procedure. For additional information, refer to Section 419-01B .

6. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

Mass Air Flow (MAF) Sensor



Item	Part Number	Description
1	14A464	Mass Air Flow (MAF) sensor electrical connector
2	W709287	MAF sensor screw (2 reed)
3	12B579	MAF sensor

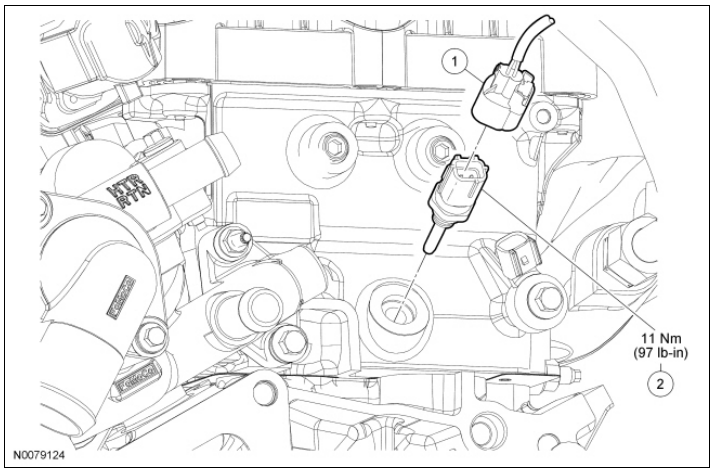
Removal and Installation

1. Disconnect the Mass Air Flow (MAF) sensor electrical connector.

2. Remove the 2 screws and the MAF sensor.
   - To install, tighten to 2 Nm (18 lb-in).

3. To install, reverse the removal procedure.

Cylinder Head Temperature (CHT) Sensor



Item	Part Number	Description
1	14A464	Cylinder Head Temperature (CHT) sensor electrical connector (part of 12C508)
2	6G004	CHT sensor

NOTE: If the cylinder head is being replaced, the Cylinder Head Temperature (CHT) sensor must be replaced.

1. Remove the battery tray. For additional informationfer to Section 414-01 .

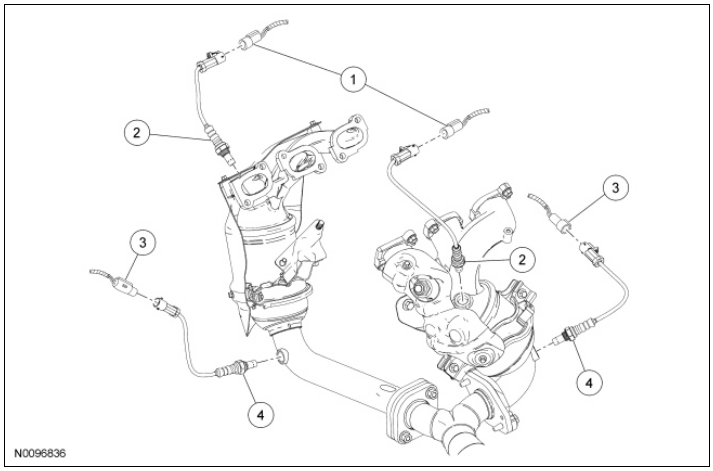
2. Disconnect the CHT sensor electrical connector.

3. Remove the CHT sensor.
   - To install, tighten to 11 Nm (97 lb-in).

4. To install, reverse the removal procedure.

Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor - Exploded View

NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.

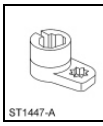


Item	Part Number	Description
1	14A464	Heated Oxygen Sensor (HO2S) electrical connectors
2	9F472	HO2S
3	14A464	Catalyst Monitor Sensor (CMS) eleconnectors
4	9G444	CMS

1. For additional information, refer to the procedures in this section.

Heated Oxygen Sensor (HO2S)

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-

Removal and Installation

Rear sensor

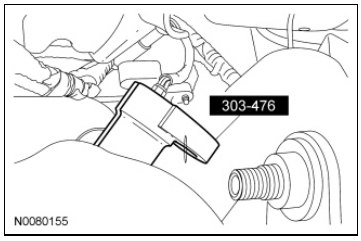
1. With the e in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

Both sensors

2. Disconnect the Heated Oxygen Sensor (HO2S) electrical connector.
3. **NOTE:** If necessary, lubricate the sensor threads with penetrating and lock lubricant to assist in removal.

   Using the Exhaust Gas Oxygen Sensor Socket, remove the HO2S .

   - Calculate the correct torque wrench setting for the following torque. Refer to the Torque Wrench Adapter Formulas in the Appendix.
   - To install, tighten to 48 Nm (35 lb-ft).

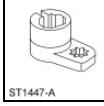


4. **NOTE:** Apply a light coat of anti-seize lubricant to the threads of the HO2S .

   To install, reverse the removal procedure.

Catalyst Monitor Sensor

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

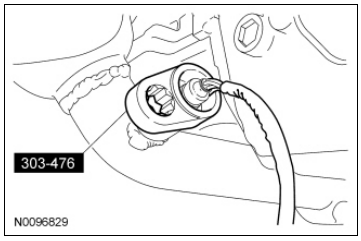
Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a. For additional information, refer to Section 100-02 .
2. Disconnect the Catalyst Monitor Sensor (CMS) electrical connector.
3. **NOTE:** If necessary, lubricate the sensor threads with penetrating and lock lubricant to assist in removal.

   Using the Exhaust Gas Oxygen Sensor Socket, remove the CMS sensor.

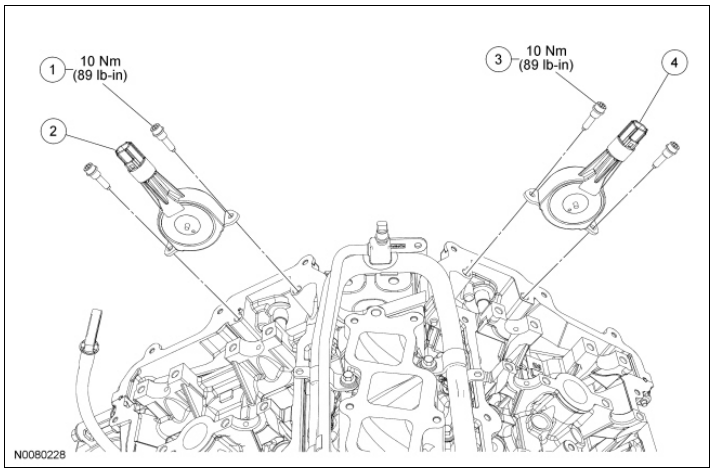
   - Calculate the correct torque wrench setting for the following torque. Refer to the Torque Wrench Adapter Formulas in the Appendix.
   - To install, tighten to 48 Nm (35 lb-ft).



4. **NOTE:** Apply a light coat of anti-seize lubricant to the threads of the CMS sensor.

   To install, reverse the removal procedure.

Variable Camshaft Timing (VCT) Oil Control Solenoid



Item	Part Number	Description
1	W713305	Variable Camshaft Timing (VCT) oil control solenoid bolt (2 required) (part of 6B297)
2	6B297	VCT oil control solenoid
3	W713305	VCT oil control solenoid bolt (2 required) (part of 6B297)
4	6B297	VCT oil control solenoid

Removal and Installation

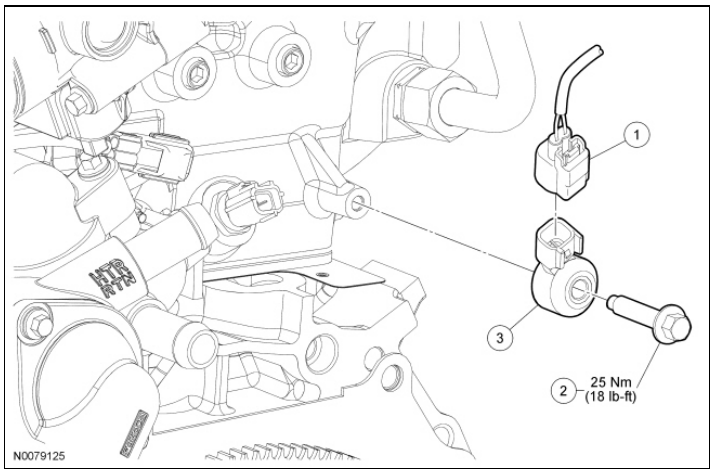
1. Remove the LH or RH valve cover. For additional information, refer to Section 303-01B .

2. Remove the 2 bolts and the Variable Camshaft Timing (VCT) oil control solenoid.
   - To install, tighten to 10 Nm (89 lb-in).

3. To install, reverse the removal procedure.

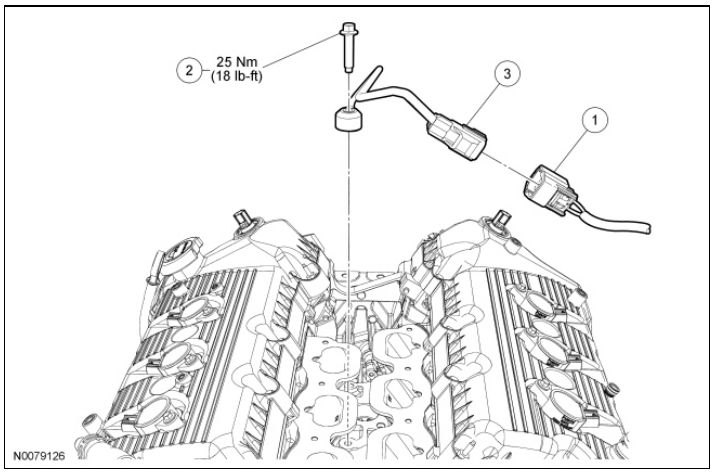
Knock Sensor (KS)

Cylinder-Head Mounted Knock Sensor (KS)



Item	Part Number	Description
1	14A464	Knock Sensor (KS) electrical connector
2	W500310	KS bolt
3	12A699	KS

Cylinder-Block Mounted Knock Sensor (KS)



Item	Part Number	Description
1	14A464	Knock Sensor (KS) electrical connector
2	W500310	KS bolt
3	12A699	KS

Removal

Cylinder head-mounted

1. Disconnect the Knock Sensor (KS) electrical connector.

2. Remove the bolt and the KS .

Engine block-mounted

3. Remove the lower intake manifold. For additional information, refer to Section 303-01B .

4. Disconnect the KS electrical connector.

5. Remove the bolt and the KS .

Installation

Engine block-mounted

1. Install the KS and the bolt.
   - To install, tighten to 25 Nm (18 lb-ft).

2. Connect the KS electrical connector.

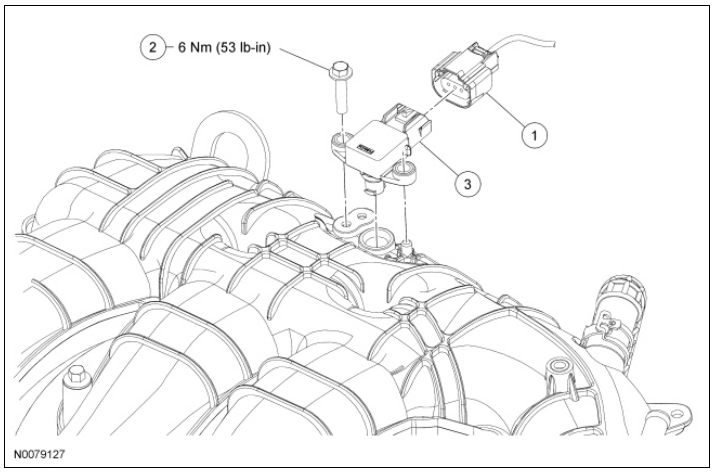
3. Install the lower intake manifold. For additional information, refer to Section 303-01B .

Cylinder head-mounted

4. Install the KS and the bolt.
   - To install, tighten to 25 Nm (18 lb-ft).

5. Connect the KS electrical connector.

Manifold Absolute Pressure (MAP) Sensor



Item	Part Number	Description
1	14A464	Manifold Absolute Pressure (MAP) sensor electrical connector (part of 12C508)
2	W710652	MAP sensor bolt
3	9F479	MAP

Removal and Installation

1. Disconnect the Manifold Absolute Pressure (MAP) sensor electrical connector.

2. Remove the bolt and the MAP sensor.
   - To install, tighten to 6 Nm (53 lb-in).
   - When installing the sensor, if the bolt fails to hold specified torque, relocate the sensor and retain, using the auxiliary bolt hole in the intake manifold.

3. **NOTE:** Clean and inspect the sealing surface.

   To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
High Temperature Nickel Anti-Seize Lubricant XL-2	-	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada) [a]	WSS-M97B55-A	-
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-	-

[a] Genuine Mazda® Extended Life Coolant and Motorcraft® Specialty Green Engine Coolant are very sensitive to light. Do NOT allow these products to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes these products to degrade.

Description	Nm	lb-in
Camshaft Position (CMP) sensor bolts	10	89
Catalyst Monitor Sensor (CMS) [a]	-	-
Crankshaft Position (CKP) sensor bolt	10	89
Cylinder Head Temperature (CHT) sensor	10	89
Heat shield bolt and nut	10	89
Heated Oxygen Sensor (HO2S) [a]	-	-
Knock Sensor (KS) bolt	20	177
Mass Air Flow (MAF) sensor screws	2	18
PCM bolts	8	71
Variable Camshaft Timing (VCT) oil control solenoid bolts	10	89

[a] Refer to the procedure for specification.

p;

Electronic Engine Controls

The electronic engine controls consist of the:

- PCM.
- Cylinder Head Temperature (CHT) sensor.
- Camshaft Position (CMP) sensor.
- Crankshaft Position (CKP) sensor.
- Mass Air Flow (MAF) sensor.
- Heated Oxygen Sensor (HO2S).
- Catalyst Monitor Sensor (CMS).
- Variable Camshaft Timing (VCT) oil control solenoid.
- Knock Sr (KS).

The PCM:

- accepts input from various engine sensors to compute the fuel flow rate necessary to maintain a prescribed air/fuel ratio throughout the entire engine operational range.
- outputs a command to the fuel injectors to meter the appropriate quantity of fuel.

The CHT sensor:

- sends the PCM a signal indicating cylinder head temperature.
- resistance decreases as cylinder head temperature increases.

The CMP sensor:

- sends the PCM a signal indicating camshaft position used for fuel synchronization.

The CKP sensor:

- sends the PCM a signal indicating crankshaft position.
- is essential for calculating spark timing.

The MAF sensor:

- uses a hot wire sensing element to measure the amount of air entering the engine. Air passing over the hot wire causes it to cool.

The HO2S :

- creates a voltage signal dependent on exhaust oxygen content.
- provides feedback information to the PCM used to calculate fuel delivery.

The CMS :

- monitors oxygen content after it flows through the catalytic converter.
- provides a voltage to the PCM used to calculate catalytic converter integrity.

The VCT oil control solenoid:

- is an electrically controlled hydraulic valve that directs engine oil to the variable camshaft. Once the PCM transmits a signal, the solenoid moves a valve spool, directing oil into the camshaft phaser cavity. This action changes valve timing by either inducing an advance or retard condition. The camshaft is, thereby repositioned in relation to crankshaft timing and allows for optimum engine performance and lower emissions.

The KS :

- is used to detect engine detonation.
- sends a voltage signal to the PCM.
- is able to provide a signal which retards the ignition timing, as necessary.

Electronic Engine Controls

DTC Charts

PCM DTC Chart

DTC	Description	Action to Take
P0125	Insufficient Coolant Temp For Closed Loop Fuel Control	REFER to Section 03A .
P0128	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature)	REFER to Section 303-03A .
P0217	Engine Coolant Overtemperature Condition	REFER to Section 303-03A .
P0512	Starter Request Circuit	REFER to Section 303-06 .
P0532	A/C Refrigerant Pressure Sensor A Circuit Low	REFER to Section 412-00A .
P0533	A/C Refrigerant Pressure Sensor A Circuit High	REFER to Section 412-00A .
P0563	System Voltage High	REFER to Section 414-00 .
P0572	Brake Switch "A" Circuit Low	REFER to Section 419-03 .
P0573	Brake Switch "A" Circuit High	REFER to Section 419-03 .
P0579	Cruise Control Multi-Function Input A Circuit Range/Performance	REFER to Section 419-03 .
P0581	Cruise Control Multi-Function Input A Circuit High	REFER to Section 419-03 .
P0602	Powertrain Control Module Programming Error	REFER to Section 418-01 .
P0605	Internal Control Module Read Only Memory (ROM) Error	REFER to Section 418-01 .
P0620	Generator Control Circuit	REFER to Section 414-00 .
P0625	Generator Field Terminal Circuit Low	REFER to Section 414-00 .
P0626	Generator Field Terminal Circuit High	REFER to Section 414-00 .
P0645	A/C Clutch Relay Control Circuit	REFER to Section 412-00A .
P0657	Actuator Supply Voltage A Circuit/Open	REFER to Section 307-01B .
P065B	Generator Control Circuit Range/Performance	REFER to Section 414-00 .
P0701	Transmission Control System Range/Performance	REFER to Section 307-01B .
P0706	Transmission Range Sensor "A" Circuit Range/Performance	REFER to Section 307-01B .
P0707	Transmission Range Sensor "A" Circuit Low	REFER to Section 307-01B .
P0708	Transmission Range Sensor "A" Circuit High	REFER to Section 307-01B .
P0710	Transmission Fluid Temperature Sensor "A" Circuit	REFER to Section 307-01B .
P0711	Transmission Fluid Temperature Sensor "A" Circuit Range/Performance	REFER to Section 307-01B .
P0712	Transmission Fluid Temperature Sensor "A"	REFER to Section 307-01B .

	Circuit Low	
P0713	Transmission Fluid Temperature Sensor "A" Circuit High	REFER to Section 307-01B .
P0715	Turbine/Input Shaft Speed Sensor "A" Circuit	REFER to Section 307-01B .
P0717	Turbine/Input Shaft Speed Sensor "A" Circuit No Signal	REFER to Section 307-01B .
P0718	Turbine/Input Shaft Speed Sensor "A" Circuit Intermittent	REFER to Section 307-01B .
P0720	Output Shaft Speed Sensor Circuit	REFER to Section 307-01B .
P0721	Output Shaft Speed Sensor Circuit Range/Performance	REFER to Section 307-01B .
P0722	Output Shaft Speed Sensor Circuit No Signal	REFER to Section 307-01B .
P0729	Gear 6 Incorrect Ratio	REFER to Section 307-01B .
P0731	Gear 1 Incorrect Ratio	REFER to Section 307-01B .
P0732	Gear 2 Incorrect Ratio	REFER to Section 307-01B .
P0733	Gear 3 Incorrect Ratio	REFER to Section 307-01B .
P0734	Gear 4 Incorrect Ratio	REFER to Section 307-01B .
P0735	Gear 5 Incorrect Ratio	REFER to Section 307-01B .
P0740	Torque Converter Clutch Solenoid Circuit/Open	REFER to Section 307-01B .
P0741	Torque Converter Clutch Solenoid Circuit Performance/Stuck Off	REFER to Section 307-01B .
P0742	Torque Converter Clutch Solenoid Circuit Stuck On	REFER to Section 307-01B .
P0743	Torque Converter Clutch Solenoid Circuit Electrical	REFER to Section 307-01B .
P0744	Torque Converter Clutch Solenoid Circuit Intermittent	REFER to Section 307-01B .
P0748	Pressure Control Solenoid "A" Electrical	REFER to Section 307-01B .
P0750	Shift Solenoid "A"	REFER to Section 307-01B .
P0751	Shift Solenoid "A" Performance/Stuck Off	REFER to Section 307-01B .
P0752	Shift Solenoid "A" Stuck On	REFER to Section 307-01B .
P0753	Shift Solenoid "A" Electrical	REFER to Section 307-01B .
P0754	Shift Solenoid "A" Intermittent	REFER to Section 307-01B .
P0755	Shift Solenoid "B"	REFER to Section 307-01B .
P0756	Shift Solenoid "B" Performance/Stuck Off	REFER to Section 307-01B .
P0757	Shift Solenoid "B" Stuck On	REFER to Section 307-01B .
P0758	Shift Solenoid "B" Electrical	REFER to Section 307-01B .
P0759	Shift Solenoid "B" Intermittent	REFER to Section 307-01B .
P0760	Shift Solenoid "C"	REFER to Section 307-01B .
P0761	Shift Solenoid "C" Performance/Stuck Off	REFER to Section 307-01B .
P0762	Shift Solenoid "C" Stuck On	REFER to Section 307-01B .
P0763	Shift Solenoid "C" Electrical	REFER to Section 307-01B .
P0764	Shift Solenoid "C" Intermittent	REFER to Section 307-01B .
P0765	Shift Solenoid "D"	REFER to Section 307-01B .
P0766	Shift Solenoid "D" Performance/Stuck Off	REFER to Section 307-01B .

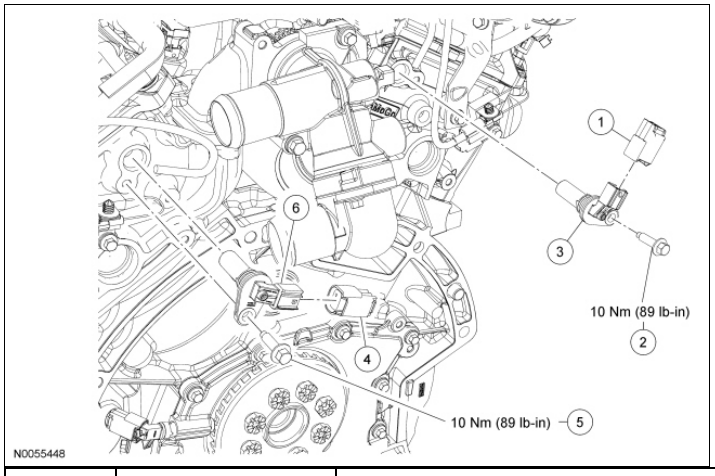
P0767	Shift Solenoid "D" Stuck On	REFER to Section 307-01B .
P0768	Shift Solenoid "D" Electrical	REFER to Section 307-01B .
P0769	Shift Solenoid "D" Intermittent	REFER to Section 307-01B .
P0770	Shift Solenoid "E"	REFER to Section 307-01B .
P0771	Shift Solenoid "E" Performance/Stuck Off	REFER to Section 307-01B .
P0772	Shift Solenoid "E" Stuck On	REFER to Section 307-01B .
P0773	Shift Solenoid "E" Electrical	REFER to Section 307-01B .
P0774	Shift Solenoid "E" Intermittent	REFER to Section 307-01B .
P07A5	Transmission Friction Element "B" Stuck On	REFER to Section 307-01B .
P07A8	Transmission Friction Element "D" Performance/Stuck Off	REFER to Section 307-01B .
P07A9	Transmission Friction Element "D" Stuck On	REFER to Section 307-01B .
P07AA	Transmission Friction Element "E" Performance/Stuck Off	REFER to Section 307-01B .
P0867	Transmission Fluid Pressure	REFER to Section 307-01B .
P0960	Pressure Control Solenoid A Control Circuit/Open	REFER to Section 307-01B .
P0961	Pressure Control Solenoid "A" Control Circuit Range/Performance	REFER to Section 307-01B .
P0962	Pressure Control Solenoid "A" Control Circuit Low	REFER to Section 307-01B .
P0963	Pressure Control Solenoid "A" Control Circuit High	REFER to Section 307-01B .
P0973	Shift Solenoid "A" Control Circuit Low	REFER to Section 307-01B .
P0974	Shift Solenoid "A" Control Circuit High	REFER to Section 307-01B .
P0976	Shift Solenoid "B" Control Circuit Low	REFER to Section 307-01B .
P0977	Shift Solenoid "B" Control Circuit High	REFER to Section 307-01B .
P0979	Shift Solenoid "C" Control Circuit Low	REFER to Section 307-01B .
P0980	Shift Solenoid "C" Control Circuit High	REFER to Section 307-01B .
P0982	Shift Solenoid "D" Control Circuit Low	REFER to Section 307-01B .
P0983	Shift Solenoid "D" Control Circuit High	REFER to Section 307-01B .
P0984	Shift Solenoid "E" Control Circuit Range/Performance	REFER to Section 307-01B .
P1260	Theft Detected, Vehicle Immobilized	REFER to Section 419-01B .
P1285	Cylinder Head Overtemperature Condition	REFER to Section 303-03A .
P1299	Cylinder Head Overtemperature Protection Active	REFER to Section 303-03A .
P1464	A/C Demand Out Of Self Test Range	REFER to Section 412-00A .
P1602	Immobilizer/ECM Communication Error	REFER to Section 419-01B .
P1622	Immobilizer ID Does Not Match	REFER to Section 419-01B .
P1636	Inductive Signature Chip Communication Error	REFER to Section 307-01B .
P1639	Vehicle ID Block Corrupted, Not Programmed	REFER to Section 418-01 .
P163E	Transmission Control Module Programming Error	REFER to Section 307-01B .
P163F	Transmission ID Block Corrupted, Not Programmed	REFER to Section 307-01B .
P1702	Transmission Range Sensor Circuit Intermittent	REFER to Section 307-01B .
P1703	Brake Switch Out Of Self Test Range	REFER to Section 419-03 .

P1705	Transmission Range Circuit Not Indicating Park/Neutral During Self Test	REFER to Section 307-01B .
P1711	Transmission Fluid Temperature Sensor Out Of Self Test Range	REFER to Section 307-01B .
P1714	Shift Solenoid "A" Inductive Signature	REFER to Section 307-01B .
P1744	Torque Converter Clutch Solenoid Circuit Performance	REFER to Section 307-01B .
P1780	Transmission Control Switch (O/D Cancel) Circuit Out Of Self Test Range	REFER to Section 307-01B .
P1783	Transmission Overtemperature Condition	REFER to Section 307-01B .
P1910	Reverse Lamp Control Circuit/Open	REFER to Section 417-01 .
P2700	Transmission Friction Element "A" Apply Time Range/Performance	REFER to Section 307-01B .
P2701	Transmission Friction Element "B" Apply Time Range/Performance	REFER to Section 307-01B .
P2702	Transmission Friction Element "C" Apply Time Range/Performance	REFER to Section 307-01B .
P2703	Transmission Friction Element "D" Apply Time Range/Performance	REFER to Section 307-01B .
P2704	Transmission Friction Element "E" Apply Time Range/Performance	REFER to Section 307-01B .
P2705	Transmission Friction Element "F" Apply Time Range/Performance	REFER to Section 307-01B .
P2760	Torque Converter Clutch Pressure Control Solenoid Intermittent	REFER to Section 307-01B .
P2783	Torque Converter Temperature Too High	REFER to Section 307-01B .
U0300	Internal Control Module Software Incompatibility	REFER to Section 418-01 .
All Other DTCs	-	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Camshaft Position (CMP) Sensor

Material

Item	Specification
Motorcraft SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



Item	Part Number	Destion
1	14A464	RH Camshaft Position (CMP) sensor electrical connector
2	W503279	RH CMP sensor bolt
3	6B288	RH CMP sensor
4	14A464	LH CMP sensor electrical connector
5	W503279	LH CMP sensor bolt
6	6B288	LH CMP sensor

Removal and Installation

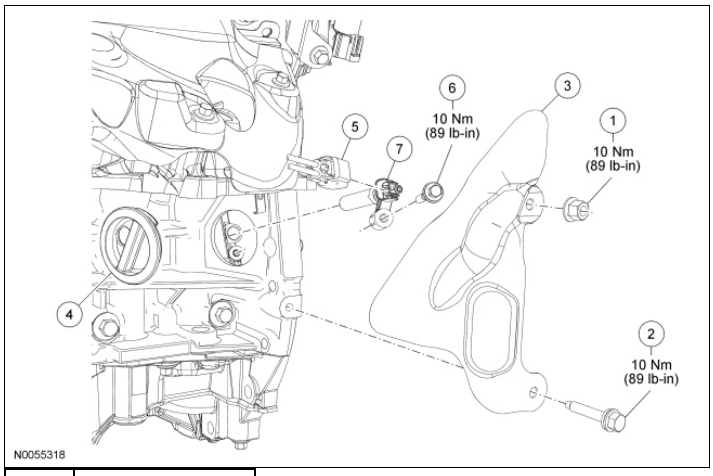
1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12C .
2. Disconnect the Camshaft Position (CMP) sensor electrical connector.
3. Remove the bolt and the CMP sensor.
   - To install, tighten to 10 Nm (89 lb-in).
4. **NOTE:** Lubricate the CMP sensor O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

Crankshaft Position (CKP) Sensor

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool



Item	Part Number	
1	W701542	Heat shield nut
2	W701669	Heat shield bolt
3	6K342	Heat shield
4	6C070	Rubber grommet cover
5	14A464	Crankshaft Position (CKP) sensor electrical connector
6	6D327	CKP sensor bolt
7	6C315	CKP sensor

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the LH catalytic converter. For additional information, refer to Section 309-00 .

3. Remove the bolt, nut and the heat shield.
   - To install, tighten to 10 Nm (89 lb-in).

4. Remove the rubber grommet cover.

5. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

6. Remove the bolt and the CKP sensor.
   - To install, tighten to 10 Nm (89 lb-in).

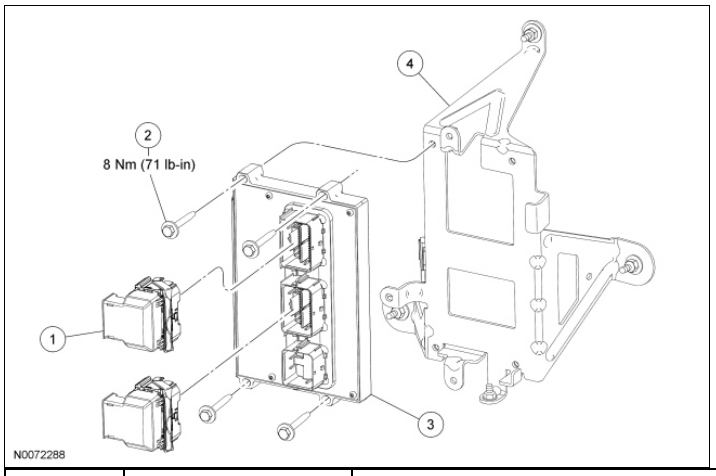
7. To install, reverse the removal procedure.

8. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Powertrain Control Module (PCM)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool



Item	Part Number	Description
1	14A464	PCM electrical connector (part of 12B637) (2 required)
2	W505428	PCM bolt (4 required)
3	12A650	PCM
4	12A659	PCM bracket

Removal

1. **NOTE:** PCM replacement DOES NOT require new keys or programming of keys.

   Retrieve the module configuration. Carry out the module configuration retrieval steps of the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

2. Remove the battery tray. For additional information, refer to Section 414-01 .

3. Disconnect the 2 PCM electrical connectors.

4. Remove the 4 bolts and the PCM.

Installation

1. Install the PCM and the bolts.
   - Tighten to 8 Nm (71 lb-in).

2. Connect the 2 PCM electrical connectors.

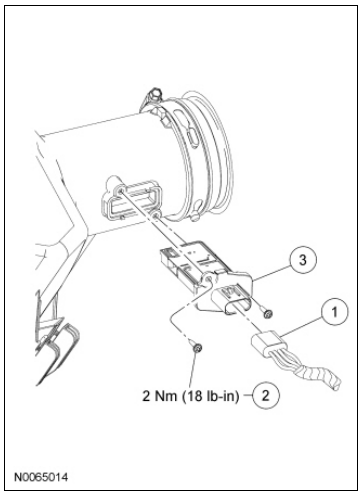
3. Install the battery tray. For additional information, refer to Section 414-01 .

4. Restore the module configuration. Carry out the module configuration restore steps of the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

5. Reprogram the Passive Anti-Theft System (PATS). Carry out the Parameter Reset procedure. For additional information, refer to Section 419-01B .

6. Using the scan tool, perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Mass Air Flow (MAF) Sensor



Item	Part Number	Description
1	14A464	Mass Air Flow (MAF) sensor electrical connector
2	W709287	MAF sensor screw (2 required)
3	12B579	MAF sensor

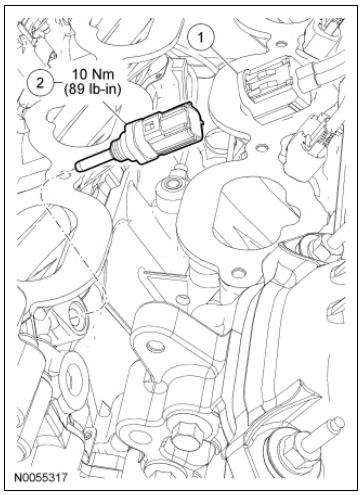
Removal and Installation

1. Disconnect the Mass Air Flow (MAF) sensor electrical connector.

2. Remove the 2 screws and the MAF span> sensor.
   - To install, tighten to 2 Nm (18 lb-in).

3. To install, reverse the removal procedure.

Cylinder Head Temperature (CHT) Sensor



Item	Part Number	Description
1	14A464	Cylinder Head Temperature (CHT) sensor electrical connector
2	6G004	CHT sensor

Section 303-01C .

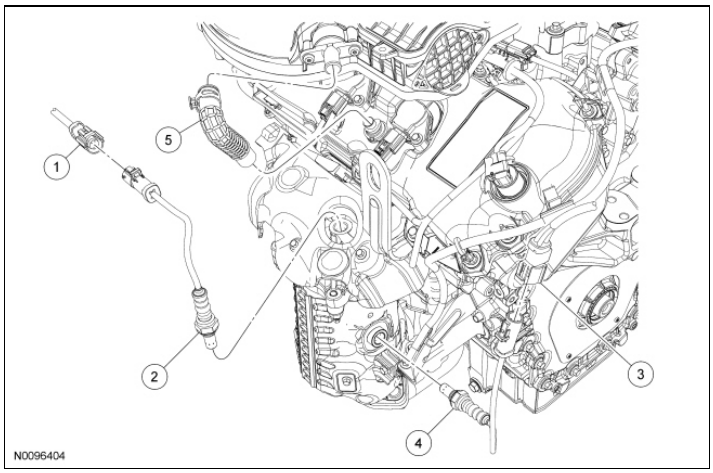
2. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.

3. Remove and discard the CHT sensor.
   - To install, tighten to 10 Nm (89 lb-in).

4. To install, reverse the removal procedure.
   - Do not reuse the CHT sensor, install a new sensor.

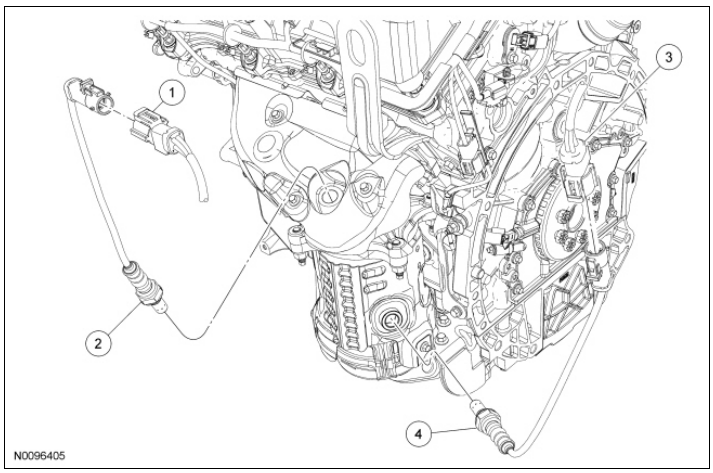
Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor - Exploded View

RH Sensors



Item	Part Number	Description
1	14A464	Heated Oxygen Sensor (HO2S) electrical connector
2	9F472	
3	14A464	Catalyst Monitor Sensor (CMS) electrical connector
4	9G444	CMS
5	6A664	PCV hose

LH Sensors



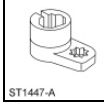
Item	Part Number	Description
1	14A464	Heated Oxygen Sensor (HO2S) electrical connector
2	9F472	HO2S
3	14A464	Catalyst Monitor Sensor (CMS) electrical connector

4	9G444	CMS

1. For additional information, refer to the procedures in this section.

Heated Oxygen Sensor (HO2S)

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A

Removal and Installation

RH sensor

1. Remove the PCV hose.

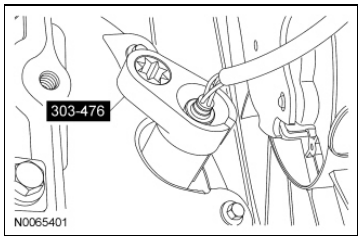
Both sensors

2. Disconnect the Heated Oxygen Sensor (HO2S) electrical connector.

3. **NOTE:** If necessary, lubricate the sensor threads with penetrating and lock lubricant to assist in removal.

   Using the Exhaust Gas Oxygen Sensor Socket, remove the HO2S .

   - Calculate the correct torque wrench setting for the following torque. Refer to the Torque Wrench Adapter Formulas in the Appendix.
   - To install, tighten to 48 Nm (35 lb-ft).



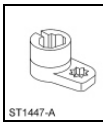
4. **NOTE:** Apply a light coat of anti-seize lubricant to the threads of the HO2S .

   To install, reverse the removal procedure.

&nbs

Catalyst Monitor Sensor

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

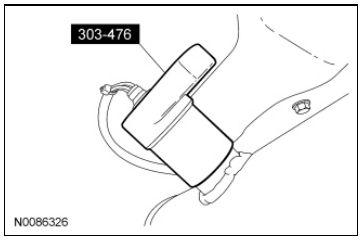
2. Disconnect the Catalyst Monitor Sensor (CMS) electrical connector.

3. **NOTE:** If necessary, lubricate the sensor threads with penetrating and lock lubricant to assist in removal.

   Using the Exhaust Gas Oxygen Sensor Socket, remove the CMS .

   - Calculate the correct torque wrench setting for the following torque. Refer to the Torque Wrench Adapter Formulas in the Appendix.

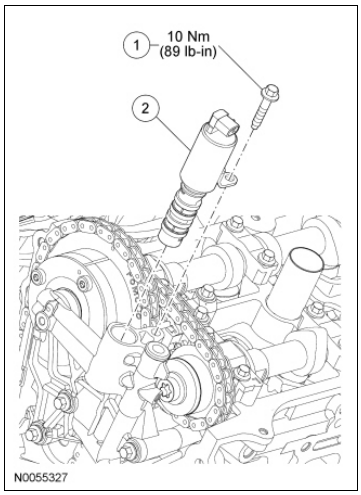
   To install, tighten to 48 Nm (35 lb-ft).



4. **NOTE:** Apply a light coat of anti-seize lubricant to the threads of the CMS .

   To install, reverse the removal procedure.

Variable Camshaft Timing (VCT) Oil Control Solenoid



Item	Part Number	Description
1	W500215	Variable Camshaft Timing (VCT) oil control solenoid bolt
2	6B297	VCT oil control solenoid

Removal and Installation

1. Remove the LH or RH valve cover. For additional information, refer to Section 303-01C .

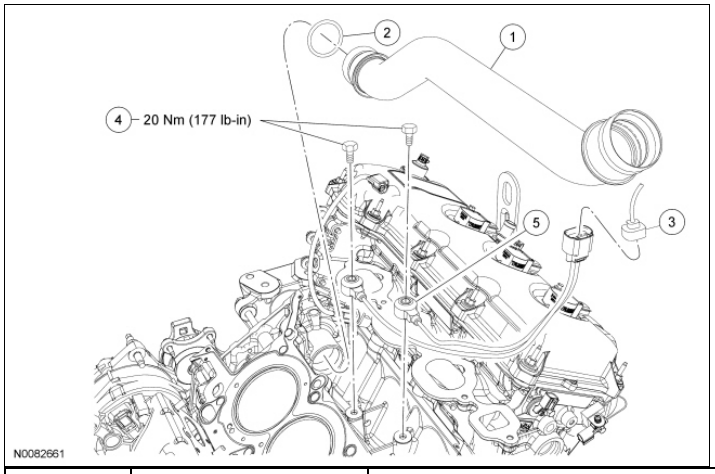
2. Remove the bolt and the Variable Camshaft Timing (VCT) oil control solenoid.
   - To install, tighten to 10 Nm (89 lb-in).

3. To install, reverse the removal procedure.

Knock Sensor (KS)

Material

Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A



Item	Part Number	Description
1	9N271	Coolant tube
2	8565	O-ring seal
3	14A464	Knock Sensor (KS) electrical connector
4	W704749	KS bolts (2 required)
5	12A699	KS

Removal and Installation

1. Remove the thermostat housing. For additional information, refer to Section 303-03A .

2. Remove the lower intake manifold. For additional information, refer to Section 303-01C .

3. Remove the coolant tube.
   - Discard the O-ring seal.

4. Disconnect the Knock Sensor (KS) electrical connector.

5. ***NOTICE:*** **Only use hand tools when removing or installing the Knock Sensor (KS) or damage to the KS can occur.**

   Remove the 2 bolts and the KS .

   - To install, tighten to 20 Nm (177 lb-in).

6. To install, reverse the removal procedure.
    - **NOTE:** Genuine Mazda® Extended Life Coolant and Motorcraft® Specialty Green Engine Coolant are very sensitive to light. Do NOT allow these products to be exposed to ANY LIGHT for more than a day or two. Extended light exposure causes these products to degrade.

      Lubricate the new O-ring seal with clean engine coolant.

Material

Item	Specification	Fill Capacity
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-	-

Torque Specifications

Description gn="bottom" align="center">Nm	lb-in	
Camshaft Position (CMP) sensor bolt	7	62
Catalyst Monitor Sensor (CMS) [a]	-	-
Crankshaft Position (CKP) sensor bolts [a]	-	-
Cylinder Head Temperature (CHT) sensor	12	106
Engine plug bolt	20	177
Heated Oxygen Sensor (HO2S) [a]	-	-
Knock Sensor (KS) bolt	20	177
Manifold Absolute Pressure (MAP) sensor screw	3	27
Mass Air Flow (MAF) sensor screws	10	89
PCM bolts	8	71
Variable Camshaft Timing (VCT) oil control solenoid bolt	10	89

[a] Refer to the procedure for specification.

P>

Electronic Engine Controls

The electronic engine controls consist of the following:

- PCM
- Camshaft Position (CMP) sensor
- Crankshaft Position (CKP) sensor
- Mass Air Flow (MAF) sensor
- Heated Oxygen Sensor (HO2S)
- Catalyst Monitor Sensor (CMS)
- Cylinder Head Temperature (CHT) sensor
- Knock Sensor (KS)
- Variable Camshaft Timing (VCT) oil control solenoid
- Manifold Absolute Pressure (MAP) sensor

The PCM:

- accepts input from various engine sensors to compute the fuel flow rate necessary to maintain a prescribed air/fuel ratio throughout the entire engine operating range.
- outputs a command to the fuel injectors to meter the appropriate quantity of fuel.

The CMP sensor:

- provides camshaft position information which is used by the PCM for fuel synchronization. Refer to Section 303-14A .

The CKP sensor:

- sends the PCM a signal indicating crankshaft position.
- is essential for calculating spark timing.

The MAF sensor:

- uses a hot wire sensing element to measure the amount of air entering the engine.
- sends the PCM a signal to determine the intake air mass. The PCM will then calculate the required fuel injector pulse width in order to provide the desired air/fuel ratio.

The HO2S :

- has the ability to create a voltage signal dependent on exhaust oxygen content.
- provides feedback information to the PCM used to calculate fuel delivery.

The CMS :

- monitors oxygen content after it flows through the catalytic converter.
- provides feedback information to the PCM used to calculate fuel delivery.

The CHT sensor:

- sends the PCM a signal indicating cylinder head temperature.

- resistance decreases as coolant temperature increases. Refer to Section 303-14A .

The KS :

- is used to detect engine detonation.
- sends a voltage signal to the PCM.
- is able to provide a signal which retards the ignition timing, as necessary.

The VCT oil control solenoid:

- is an electrically controlled hydraulic valve that directs engine oil to the variable camshaft. Once the PCM transmits a signal, the solenoid moves a valve spool, directing oil into the camshaft phaser cavity. This action changes valve timing by either inducing an advance or retard condition. The camshaft is, thereby repositioned in relation to crankshaft timing and allows for optimum engine performance and lower emissions.

The MAP sensor:

- measures manifold vacuum and converts it to an electrical signal. This provides the PCM information on engine load.

Electronic Engine Controls

DTC Charts

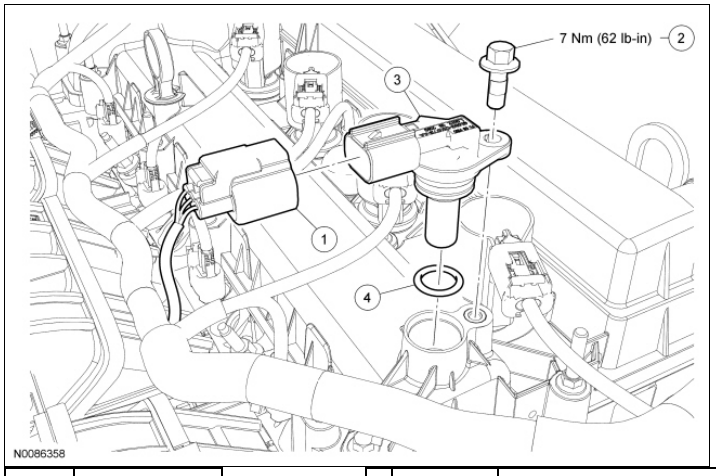
PCM DTC Chart

DTC	Description	Action to Take
P0125	Insufficient Coolant Temp For Closed Loop Fuel Control	REFER to Section 303-03B .
P0128	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature)	REFER to Section 303-03B .
P0217	Engine Coolant Overtemperature Condition	REFER to Section 303-03B .
P0532	A/C Refrigerant Pressure Sensor A Circuit Low	REFER to Section 412-00A .
P0533	A/C Refrigerant Pressure Sensor A Circuit High	REFER to Section 412-00A .
P0562	System Voltage Low	REFER to Section 414-05 .
P0563	System Voltage High	REFER to Section 414-05 .
P0572	Brake Switch "A" Circuit Low	REFER to Section 419-03 .
P0573	Brake Switch "A" Circuit High	REFER to Section 419-03 .
P0579	Cruise Control Multi-Function Input A Circuit Range/Performance	REFER to Section 419-03 .
P0581	Cruise Control Multi-Function Input A Circuit High	REFER to Section 419-03 .
P0602	Powertrain Control Module Programming Error	REFER to Section 418-01 .
P0605	Internal Control Module Read Only Memory (ROM) Error	REFER to Section 418-01 .
P1260	Theft Detected, Vehicle Immobilized	REFER to Section 419-01B .
P1285	Cylinder Head Overtemperature Condition	REFER to Section 303-03B .
P1299	Cylinder Head Overtemperature Protection Active	REFER to Section 303-03B .
P1602	Immobilizer/ECM Communication Error	REFER to Section 419-01B .
P1622	Immobilizer ID Does Not Match	REFER to Section 419-01B .
P1639	Vehicle ID Block Corrupted, Not Programmed	REFER to Section 418-01 .
P1703	Brake Switch Out Of Self Test Range	REFER to Section 419-03 .
P1910	Reverse Lamp Control Circuit/Open	REFER to Section 417-01 .
P2600	Coolant Pump "A" Control Circuit/Open	REFER to Section 412-00B .
U0300	Internal Control Module Software Incompatibility	REFER to Section 418-01 .
All Other DTCs	-	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Camshaft Position (CMP) Sensor

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



Item	Part Number				
			1	14A464	Camshaft Position (CMP) sensor electrical connector (part of 12B637)
2	W701219	CMP sensor bolt			
3	12K073	CMP			
4	-	CMP O-ring seal			

Removal and Installation

1. Disconnect the Camshaft Position (CMP) sensor electrical connector.

2. Remove the bolt and the CMP .
   - To install, tighten to 7 Nm (62 lb-in).

3. **NOTE:** Lubricate the CMP O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

Crankshaft Position (CKP) Sensor

Special Tool(s)

 ST3055A	Aligner, Crankshaft Sensor 303-1417
 ST2638-A	Timing Peg, Crankshaft TDC 303-507

General Equipment

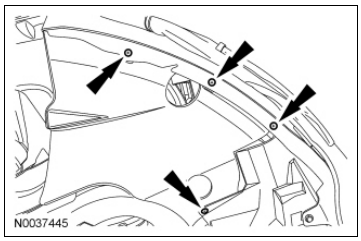
6 mm x 18 mm bolt

Item	Part Number	Description
1	14A464	Crankshaft Position (CKP) sensor electrical connector (part of 12B637)
2	W701219-S	CKP sensor bolt (2 required)
3	6C315	CKP sensor

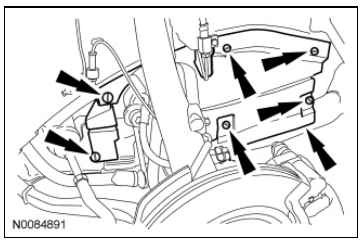
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

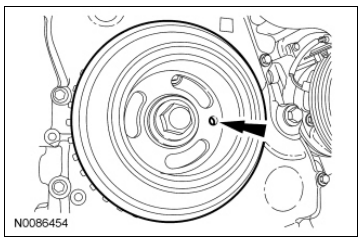
2. Remove the 4 screws and position the RH fender splash shield aside.


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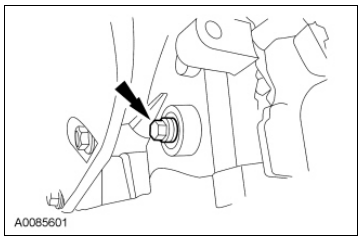
3. Remove the 6 pin-type retainers and the RH splash shield.


N0084891

4. Turn the crankshaft clockwise until the hole in the crankshaft pulley is in the 3 o'clock position.

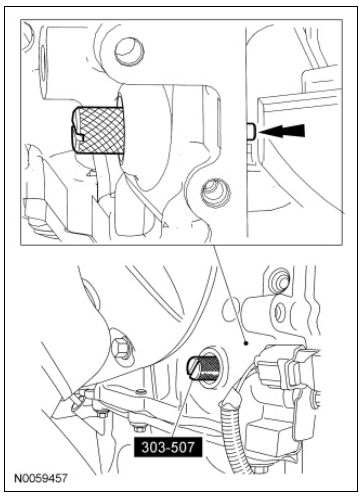


5. Remove the cylinder block plug.



6. **NOTE:** When the crankshaft contacts the Crankshaft TDC Timing Peg, the No. 1 cylinder will be at Top Dead Center (TDC).

   Install the Crankshaft TDC Timing Peg and turn the crankshaft clockwise until the crankshaft contacts the Crankshaft TDC Timing Peg.



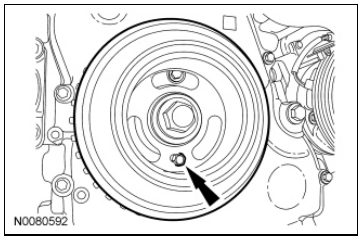
7. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

8. Remove the bolts and discard the CKP sensor.

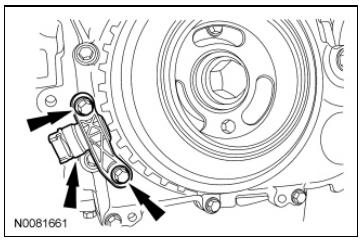
Installation

1. ***NOTICE:*** **Only hand-tighten the bolt or damage to the front cover can occur.**

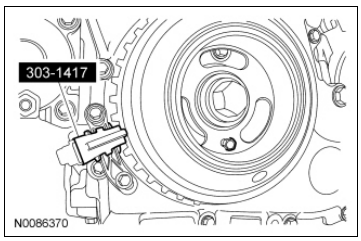
   Install a 6 mm (0.23 in) x 18 mm (0.7 in) standard bolt in the crankshaft pulley.



2. Install the CKP sensor and the 2 bolts.
    - Do not tighten the bolts at this time.



3. Adjust the CKP sensor with the Crankshaft Sensor Aligner.
    - Tighten the 2 CKP bolts to 7 Nm (62 lb-in).

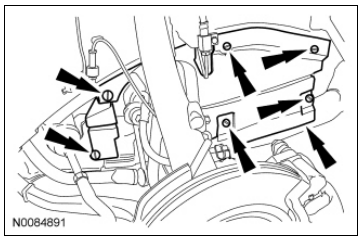


4. Connect the CKP sensor electrical connector.

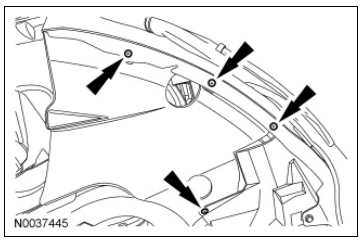
5. Remove the 6 mm (0.23 in) bolt from the crankshaft pulley.

6. Install the cylinder block plug.
    - Tighten to 20 Nm (177 lb-in).

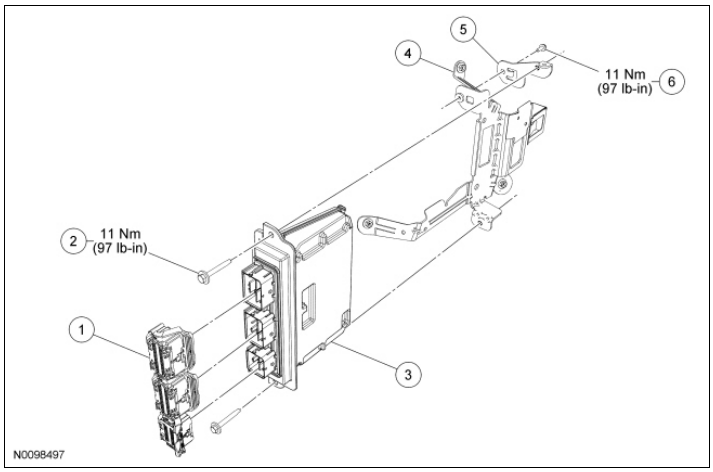
7. Install the 6 pin-type retainers and the RH splash shield.



8. Install the 4 screws and position the RH fender splash shield aside.



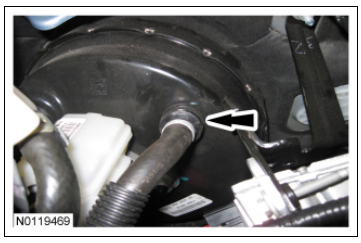
Powertrain Control Module (PCM)



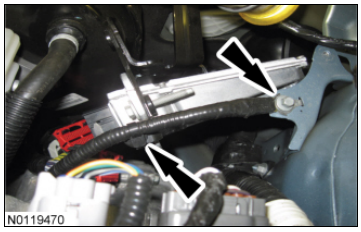
Item	Part Number	Description
1	14A464	PCM electrical connector (3 required)
2	W5505428	PCM bolt (2 required)
3	12A650	PCM
4	12A692	PCM bracket
5	-	Upper PCM bracket (part of 12A692)
6	-	Upper PCM bracket bolt (part of 12A692)

Removal

1. With the in NEUTRAL, position on a hoist. For additional information, refer to Section 100-02 .
2. Retrieve the module configuration. Carry out the module configuration retrieval steps of the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .
3. Remove the cowl panel grille. For additional information, refer to Section 501-02 .
4. Disconnect the vacuum hose from the vacuum brake booster.



5. Disconnect the 3 PCM electrical connectors.
6. Remove the ground strap bolt and disconnect the ground strap retainer.



7. Remove the two LH splash shield pin-type retainers and position the LH splash shield aside.



8. Remove the lower PCM bolt and the upper PCM bracket bolt.
    - Remove the PCM.

9. Remove the upper PCM bolt and the PCM bracket from the PCM.

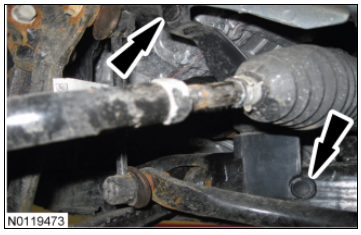
Installation

1. Install the PCM bracket and the upper PCM bolt to the PCM.
    - Tighten to 11 Nm (97 lb-in).

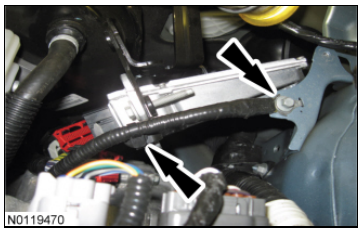
2. Install the PCM and the lower PCM bolt.
    - Tighten to 11 Nm (97 lb-in).

3. Install the upper PCM bracket bolt.
    - Tighten to 11 Nm (97 lb-in).

4. Position the LH splash shield and install the two LH splash shield pin-type retainers.

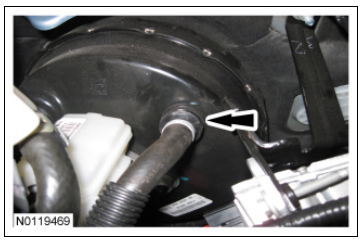


5. Connect the ground strap retainer and install the ground strap bolt .
    - Tighten to 10 Nm (89 lb-in)



6. Connect the 3 PCM electrical connectors.

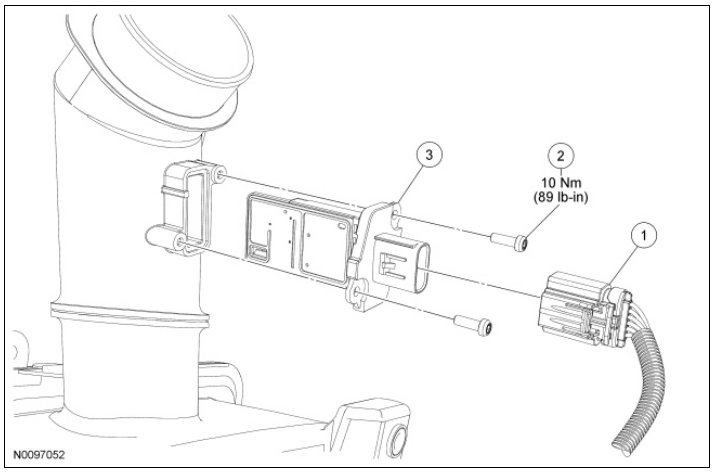
7. Connect the vacuum hose to the vacuum brake booster.



8. Install the cowl panel grille. For additional information, refer to Section 501-02 .

9. Restore the module configuration. Carry out the module configuration restore steps of the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

Mass Air Flow (MAF) Sensor



Item	Part Number	Description
1	14A464	Mass Air Flow (MAF) sensor electrical connector
2	W709287	MAF sensor screw (2 required)
3	12B579	MAF sensor

Removal and Installation

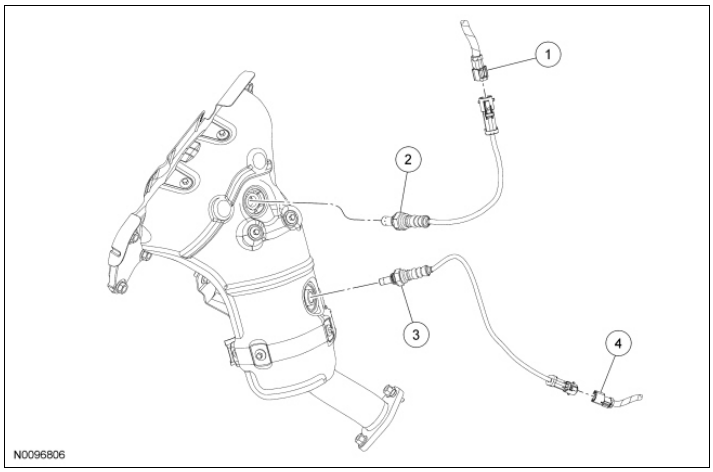
ol start="1">
- Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12D .

2. Disconnect the Mass Air Flow (MAF) sensor electrical connector.

3. Remove the 2 screws and the MAF sensor.
   - To install, tighten to 10 Nm (89 lb-in).

4. To install, reverse the removal procedure.

Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor - Exploded View

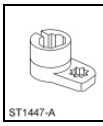


Item	Part Number	Description
1	14A464	Heated Oxygen Sensor (HO2S) electrical connector (part of 12C508)
2	9F472	HO2S
3	9G444	Catalyst Monitor Sensor (CMS)
4	14A464	CMS electrical connector (part of 12C508)

1. For additional information, refer to the procedures in this section.

Heated Oxygen Sensor (HO2S)

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-

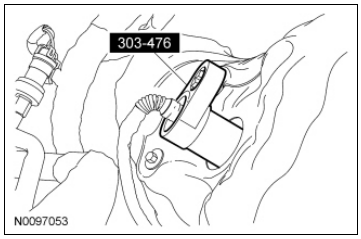
Removal and Installation

1. Disconnect the Heated Oxygen Sensor (HO2S) ecal connector.

2. **NOTE:** If necessary, lubricate the sensor threads with penetrating and lock lubricant to assist in removal.

   Using the Exhaust Gas Oxygen Sensor Socket, remove the HO2S .

   - Calculate the correct torque wrench setting for the following torque. Refer to the Torque Wrench Adapter Formulas in the Appendix.
   - To install, tighten to 48 Nm (35 lb-ft).

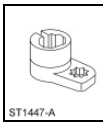


3. **NOTE:** Apply a light coat of anti-seize lubricant to the threads of the HO2S .

   To install, reverse the removal procedure.

Catalyst Monitor Sensor

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

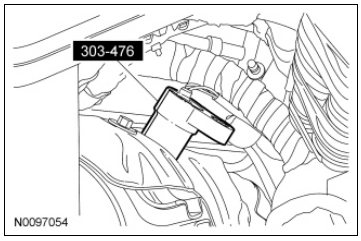
Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	-

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoistadditional information, refer to Section 100-02 .
2. Disconnect the Catalyst Monitor Sensor (CMS) electrical connector.
3. **NOTE:** If necessary, lubricate the sensor threads with penetrating and lock lubricant to assist in removal.

   Using the Exhaust Gas Oxygen Sensor Socket, remove the CMS .

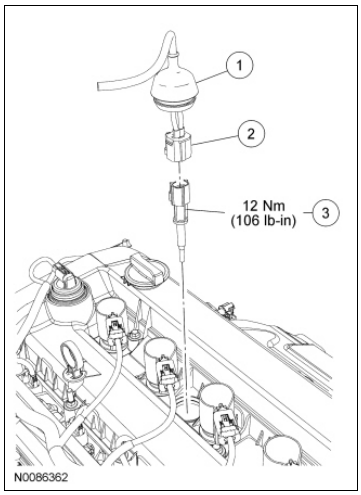
   - Calculate the correct torque wrench setting for the following torque. Refer to the Torque Wrench Adapter Formulas in the Appendix.
   - To install, tighten to 48 Nm (35 lb-ft).



4. **NOTE:** Apply a light coat of anti-seize lubricant to the threads of the CMS .

   To install, reverse the removal procedure.

Cylinder Head Temperature (CHT) Sensor



Item	Part Number	Description
1	14603	Cylinder Head Temperature (CHT) sensor cover (part of 12C508)
2	14A464	CHT sensor electrical connector (part of 12C508)td>
3	6G004	CHT sensor

Removal and Installation

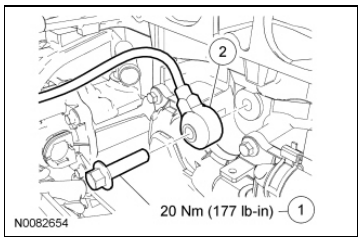
1. Detach the Cylinder Head Temperature (CHT) sensor cover and position aside.

2. Disconnect the CHT sensor electrical connector.

3. Remove the CHT sensor.
   - To install, tighten to 12 Nm (106 lb-in).

4. To install, reverse the removal procedure.

Knock Sensor (KS)



Item	Part Number	Description
1	W5000025	Knock Sensor (KS) bolt
2	12A699	KS

Removal and Installation

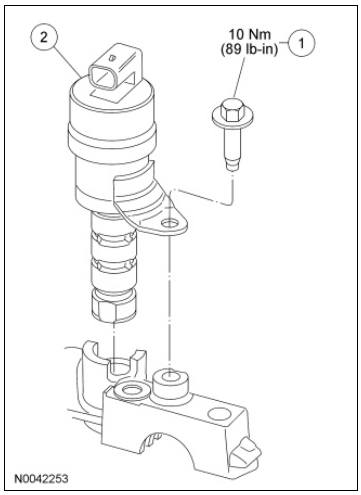
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the intake manifold. For additional information, refer to Section 303-01D .

3. Remove the bolt and the Knock Sensor (KS).
   - To install, tighten to 20 Nm (177 lb-in).

4. To install, reverse the removal procedure.

Variable Camshaft Timing (VCT) Oil Control Solenoid



Item	Part Number	Description
1	W500211	Variable Camshaft Timing (VCT) oil control solenoid bolt
2	6M280	VCT oil control solenoid

Removal and Installation

1. Remove the valve cover. For additional information, refer to Section 303-01D .

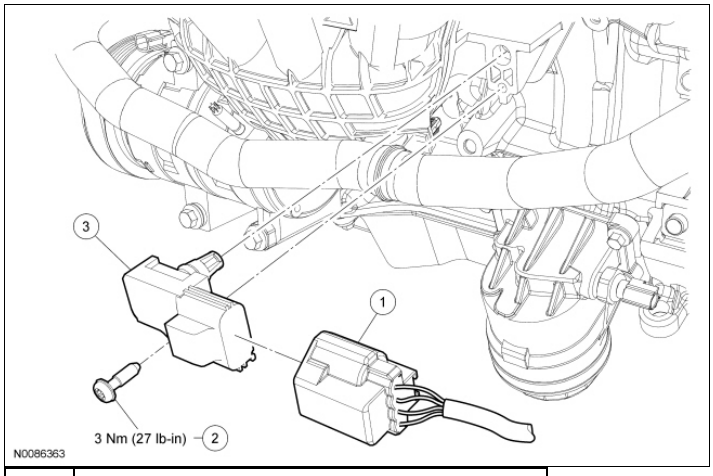
2. Remove the bolt and the Variable Camshaft Timing (VCT) oil control solenoid.
   - To install, tighten to 10 Nm (89 lb-in).

3. To install, reverse the removal procedure.

Manifold Absolute Pressure (MAP) Sensor

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



Item	Part Number th valign="bottom">Description	
1	14A464	Manifold Absolute Pressure (MAP) sensor electrical connector
2	W701459	MAP sensor screw
3	9F479	MAP sensor

Removal and Installation

1. Disconnect the Manifold Absolute Pressure (MAP) sensor electrical connector.

2. Remove the screw and the MAP sensor.
   - To install, tighten to 3 Nm (27 lb-in).

3. **NOTE:** Lubricate the MAP sensor O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

Alignment Specifications

Item	LH	RH	Total/Split
Front			
Camber	-0.03° ± -0.75°	-0.03° ± -0.75°	0° ± 1.0°
Caster	3.88° ± 1.0°	4.13° ± 1.0°	-0.25° ± 1.0°
Toe	-	-	0.20° ± 0.20°
Rear			
Camber	-1.25° ± 0.75°	0°	
Thrust angle	-	-	0° ± 0.10°
Toe	0.12° ± 0.12°	0.12° ± 0.12°	0.24° ± 0.20°

Clear Vision @ Straight Drive Specification

Location	Nominal	Tolerance
Front	0.50	+/-2.00
Rear	Not applicable	Not applicable

General Specifications

Item	Specification
Ball Joint Deflection	
Lower	0-0.4 mm (0-0.016 in)
Upper	0-0.2 mm (0-0.008 in)
Bushing Fastener Tightening Height	
Front [a]	402 mm (15.82 in)
Rear [a]	395 mm (15.55 in)
Front - All-Wheel Drive (AWD)	68 mm (2.677 in) ± 19 mm (0.748 in)
Front - Front Wheel Drive (FWD)	68 mm (2.677 in) ± 19 mm (0.748 in)
Rear - AWD	42 mm (1.653 in)

	± 23 mm (0.905 in)
Rear - FWD	60 mm (2.362 in) ± 23 mm (0.905 in)

[a] Curb conditioning, full fluids (including fuel).

Torque Specifications

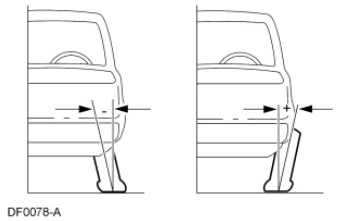
Description	Nm	lb-ft
Front tie-rod jam nuts	80	59
Rear camber adjustment nuts	101	74
Rear toe link jam nuts	102	75

Wheel Alignment Angles

Front toe is adjusted through the use of adjustable tie-rod ends. Front caster is adjusted by installing new upper control arms with offset bushings. The upper arms can adjust caster angles ± 0.4 degrees and have separate part numbers. Front camber is not adjustable on the vehicle. Rear toe is adjusted through the use of adjustable toe links. Rear caster is not adjustable on the vehicle. Rear camber is adjusted through the use of a cam bolt that attaches the rear lower control arm to the rear subframe.

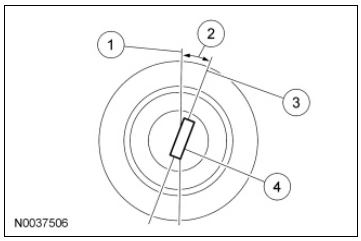
Camber

Negative and Positive Camber



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

Caster

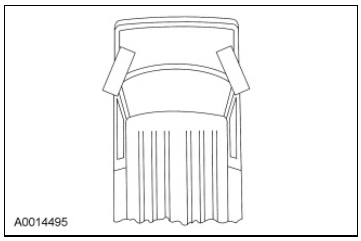


Item	Description
1	True vertical
2	Positive caster angle
3	Shock-to-ball joint centerline
4	Pivot centerline

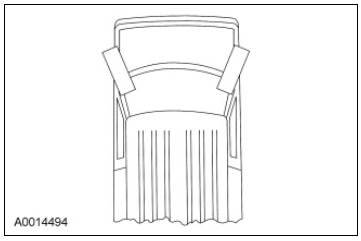
Caster is the deviation from vertical of an imaginary line drawn through the ball joints when viewed from the side. The caster specifications in this section will give the vehicle the best directional stability characteristics when loaded and driven. The caster setting is not related to tire wear.

Toe

Positive Toe (Toe In)

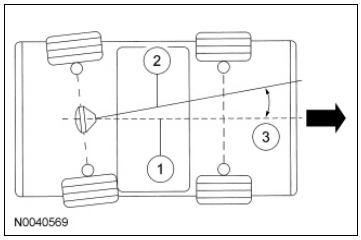


Negative Toe (Toe Out)



The vehicle toe setting affects tire wear and directional stability.

Incorrect Thrust Angle (Dogtracking)



Item	Description
1	Vehicle centerline
2	Axle centerline
3	Thrust angle

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

Wander

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

Shimmy

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

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

Nibble

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

Poor Returnability/Sticky Steering

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

Drift/Pull

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

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

- A vehicle-related drift/pull, on a flat road, will cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect.
- Drift/pull may be induced by conditions external to the vehicle (for example, wind, road crown).
- A drift or pull condition may exist even if the front alignment is within specifications. To aid in correcting this condition, there are 4 additional upper control arms available with off-set bushings (2 for LH, 2 for RH). These upper control arms will allow the caster to be adjusted ±0.4 degrees. Refer to Caster Adjustment - Front in this section.

Poor Groove Feel

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

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

Suspension System

Inspection and Verification

1. Road test the vehicle.
   - If any suspension alignment or ride height concerns are present, GO to Symptom Chart - Suspension System .
   - Verify the customer concern by carrying out a road test on a smooth road. If any vibrations are present, GO to Symptom Chart - NVH .
2. Inspect the tires.
3. Check the tire pressures with all normal loads in the vehicle and the tires cold. Refer to the Vehicle Certification (VC) label.
   - Verify that all tires are sized to specification. Refer to the VC label.
   - Inspect the tires for incorrect wear and damage. Install new tires as necessary.
3. Inspect the chassis and underbody.
   - Remove any excessive accumulation of mud, dirt or road deposits from the chassis and underbody.
4. Inspect for aftermarket equipment.
   - Check for aftermarket changes to the steering, suspension, and wheel and tire components (such as competition or heavy duty). The specifications shown in this manual do not apply to vehicles equipped with aftermarket equipment.

Visual Inspection Chart

Mechanical
• Front or rear suspension components • Suspension fastener(s) • Incorrect spring usage • Spring(s) • Shock absorber(s) • Strut(s) • Suspension bushing(s) • Steering system components • Wheel bearing(s) • Non-OEM parts or modifications

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

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

Symptom Chart - Suspension System

Symptom Chart - Suspension System

Symptom Chart - NVH

Symptom Chart - NVH

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

ConditionPossible SourcesAction

- Squeak or grunt - noise from the front suspension, occurs more in cold ambient temperatures. More noticeable over rough roads or when turning
- Front stabilizer bar insulators
- Under these conditions, the noise is accepta
- Clunk - noise from the front suspension, occurs in and out of turns
- Loose front suspension
- INSPECT for loose nuts or bolts. TIGHTEN to specifications. REFER to Section 204-01 for front suspension and Section 204-02 for rear suspension.
- Clunk - noise from the rear suspension, occurs when shifting from REVERSE to drive
- Loose rear suspension components
- INSPECT for loose or damaged rear suspension components. REPAIR or INSTALL new components as necessary. REFER to Section 204-02 .
- Click or pop - noise from the front suspension. More noticeable over rough roads or over bumps
- Worn or damaged ball joint(s) /ul>
- CARRY OUT a ball joint inspection. INSTALL new ball joint(s) or control arm(s) as necessary. REFER to Ball Joint Inspection in this section.
- Front suspension noise - a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads
- Shock absorber jounce bumper(s)

- LUBRICATE shock absorber jounce bumper(s). REFER to Disassembly and Assembly - Shock Absorber and Spring Assembly in Section 204-01 .

- Loose or damaged front struts, shock absorber(s) or shock absorber bushing(s)
- Damaged spring or spring mount(s)
- Damaged or worn control/radius arm bushing(s)
- Worn or damaged stabilizer bar bushings or link(s)

- INSPECT the front suspension. INSTALL new components as necessary. REFER to Section 204-01 .

- Rear suspension noise - a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads

- Loose or damaged rear shock absorber(s) or shock absorber bushing(s)
- Damaged spring or sprint(s)
- Damaged or worn control arm bushing(s)
- Worn or damaged stabilizer bar bushing(s) or link(s)

- INSPECT the rear suspension. INSTALL new components as necessary. REFER to Section 204-02 .

- Shudder - occurs during acceleration from a slow speed or stop

- Incorrect ride height causing incorrect driveline angle

- REFER to Section 205-00 for driveline angle diagnosis.

- Shimmy

- Loose wheel nut(s)

- TIGHTEN the nut(s) to specification. REFER to Section 204-04 .

- Loose front suspension fastener(s)

- TIGHTEN the fastener(s) to specification. REFER to Section 204-01 .

- Loose front wheel bearing(s)

- INSPECT the front wheel bearing(s). INSTALL new bearing(s) as necessary. REFER to Section 204-01 .

- Strut(s) or shock absorber(s)

- INSTALL new struts or shock absorbers as necessary. REFER to Section 204-01 for front suspension or Section 204-02 for rear suspension.

- Shimmy - most noticeable on coast/deceleration. Also hard steering condition

- Excessive positive caster

- CHECK the wheel alignment. REFER to Caster Adjustment - Front in this section. ADJUST as necessary.

- Rough/harsh ride

- Incorrect tire pressure
- ADJUST the tire pressure. REFER to the Vehicle Certification (VC) label.
- Strut(s) or shock absorber(s)
- INSTALL new struts or shock absorbers as necessary. REFER to Section 204-01 for front suspension or Section 204-02 for rear suspension.
- Spring(s)
- MEASURE the ride height. REFER to Ride Height Measurement in this section. INSTALL new springs as necessary. REFER to Section 204-01 for front suspension or Section 204-02 for rear suspension.
- Loose, worn or damaged suspension component(s)
- INSTALL new suspension component(s) as necessary. REFER to Section 204-01 for front suspension or Section 204-02 for rear suspension.

Pinpoint Tests

Pinpoint Test A: Vehicle Drifts/Pulls

This pinpoint test is intended to diagnose the following:
- Unevenly loaded vehicle
- Tire pressure
- Tire forces
- Brake drag
- Incorrect vehicle alignment
- Steering system

PINPOINT TEST A: VEHICLE DRIFTS/PULLS

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

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

Component Tests

Ball Joint Inspection

1. Prior to inspecting the ball joints for wear, inspect the wheel bearings. Install a new wheel bearing as necessary. Refer to Section 204-01 .

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

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

3. Inspect the ball joint and ball joint boot for damage.

- If the ball joint or ball joint boot is damaged, install a new ball joint as necessary. Refer to Section 204-01 .

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

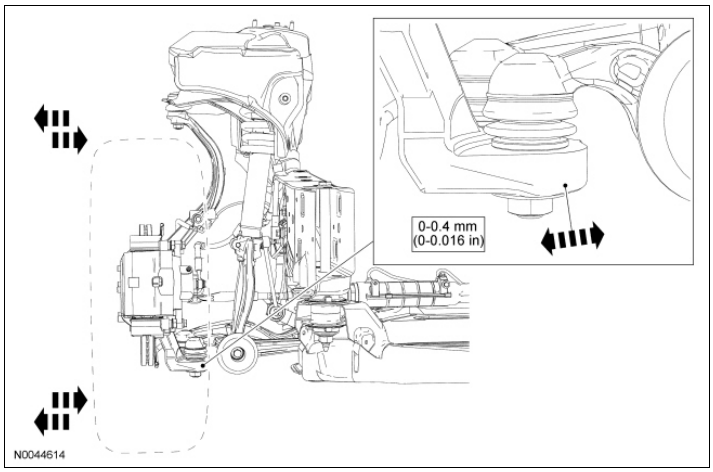
   NOTE: To avoid lateral movement of the steering linkage and steering components, make sure to apply hand force only at the 12 o'clock and 6 o'clock positions of the wheel and tire assembly.

   Inspect the ball joint for relative movement by alternately pulling outward and pushing inward on the wheel and tire assembly, at the 12 o'clock and 6 o'clock positions, by hand. Note any relative movement between the wheel knuckle and both lower arms at the lower ball joints.

   - If relative movement is not felt or seen, the ball joints are OK. Do not install new ball joints.
   - If relative movement is found, continue with Step 5.

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

   To measure ball joint deflection, attach a suitable dial indicator with a flexible arm between the forward front lower arm and the wheel knuckle at the forward front lower ball joint.



6. Measure the ball joint deflection while an assistant alternately pulls outward and pushes inward on the wheel and tire assembly, at the 12 o'clock and 6 o'clock positions, by hand.
   - If the deflection exceeds the specification, install a new forward and rearward lower ball joint. Refer to Section 204-01 .
   - If the deflection meets the specification, continue with the procedure.

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

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

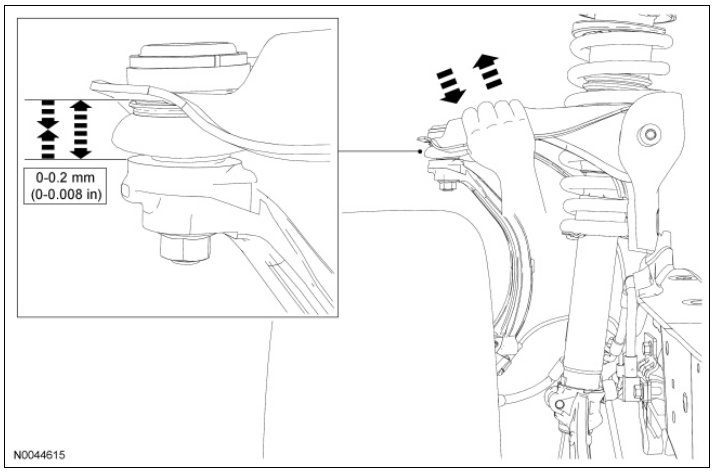
   - If relative movement is not felt or seen, the ball joint is OK. Do not install a new ball joint.

- If relative movement is found, continue with Step 8.

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

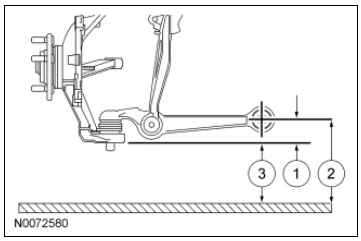
   To measure ball joint deflection, attach a suitable dial indicator with a flexible arm between the upper arm and the wheel knuckle or ball joint stud.

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



Ride Height Measurement

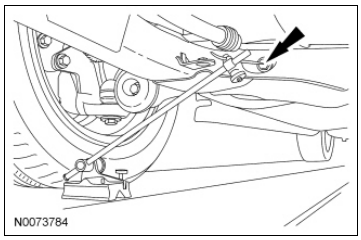
Front Ride Height Measurement



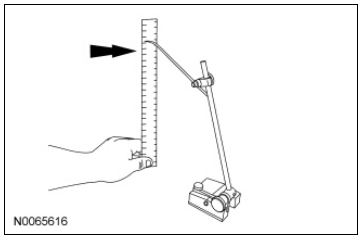
Item	Description
1	Ride height = 2 - 3
2	Measurement 2
3	Measurement 3

NOTE: Make sure that the vehicle is posied on a flat, level surface and the tires are inflated to the correct pressure. Vehicle should have a full tank of fuel.

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

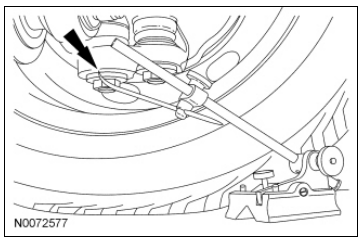


2. With the surface gauge positioned on a flat, level surface, record the measurement of the surface gauge position (measurement 2).

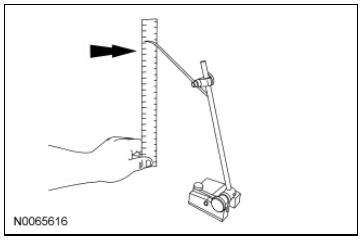


3. Position the surface gauge on the same flat, level surface as used in Step 1, adjust the gauge's arm until the scriber point is located at the lowest part of the wheel knuckle, next to the front lower arm ball joint nut.

- Lock the surface gauge in this position.

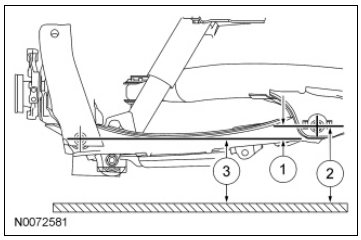


4. With the surface gauge positioned on a flat, level surface, record the measurement of the surface gauge position (measurement 3).



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

Rear Ride Height Measurement



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

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

1. Measure the distance between the flat level surface and center of the lower arm inboard cam bolt (measurement 2).

2. Measure the distance between the flat level surface and the center of the lower arm outboard bolt (measurement 3).

3. Subtract measurement 3 from measurement 2 to obtain the rear ride height.

Caster Adjustment - Front

NOTE: If caster adjustment is necessary to resolve a vehicle alignment issue, then installing a revised upper control arm(s) is an acceptable method. This procedure should not be routinely performed with all alignments and only after all other possible sources have been inspected and corrected as necessary.

1. Using alignment equipment and the manufacturer's instructions, measure the caster.

2. **NOTE:** The revised upper control arms have the same base part number, but they are identified by the amount of caster they change (for example: + 0.4 degrees or - 0.4 degrees).

   Use the following table and the measurements taken in Step 1 to determine which front upper control arm should be installed.

Part Number	Degree of Change
3084 RH	+ 0.4 degree
3084 RH	- 0.4 degree
3091 LH	+ 0.4 degree
3091 LH	- 0.4 degree

3. Install a revised front upper control arm(s) as necessary. For additional information, refer to Section 204-01 .

4. Recheck the front caster settings and adjust as necessary.

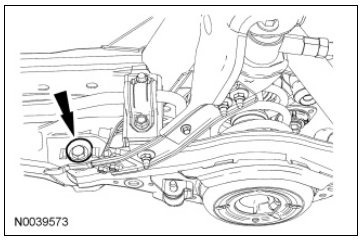
5. Check and, if necessary, adjust the front toe. For additional information, refer to Toe Adjustment - Front in this section.

Camber Adjustment - Rear

NOTE: Before carrying out a camber adjustment, check the tires for the correct pressure. Inspect the tires for incorrect wear or damage. Inspect the front suspension components for wear or damage.

1. Using alignment equipment and the manufacturer's instructions, measure the rear camber.

2. Loosen the rear camber adjustment nut.



3. Rotate the camber adjustment bolt until the camber setting is within specifications.

NOTE: Do not allow the camber adjustment bolt to rotate while tightening the nut.

Tighten the camber adjustment nut to 101 Nm (74 lb-ft).

5. Recheck the rear camber and adjust as necessary.

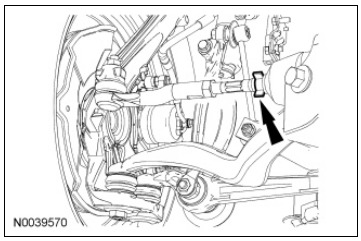
Toe Adjustment - Front

1. Start the engine and center the steering wheel.

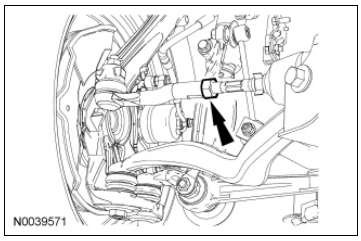
2. Turn the engine OFF and, using a suitable steering wheel holding device, lock the steering wheel in the straight ahead position.

3. Using alignment equipment and the manufacturer's instructions, measure the front toe.

4. Remove the steering gear bellows clamps.

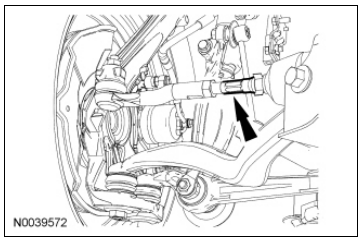


5. Loosen the tie-ruts.



6. **NOTE:** Do not allow the steering gear bellows to twist when the tie rod is rotated.

   Rotate the tie rods until the toe setting is within specifications.



7. Tighten the jam nuts to 80 Nm (59 lb-ft).

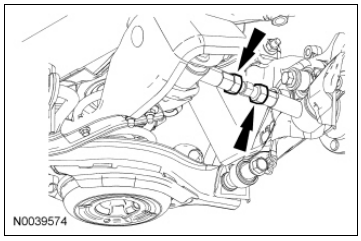
8. Install the steering gear bellows clamps.

9. Recheck the front toe settings and adjust as necessary.

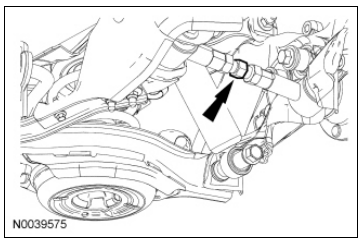
Toe Adjustment - Rear

1. Using alignment equipment and the manufacturer's instructions, measure the rear toe.

2. Loosen the toe link jam nuts.



3. Rotate the toe link adjusting rod until the toe setting is within specifications.



4. **NOTE:** llow the adjusting rod to rotate while tightening the jam nuts.

   Tighten the toe link jam nuts to 102 Nm (75 lb-ft).

5. Recheck the rear toe and adjust as necessary.

Material

Item	Specification	Fill Capacity
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	-

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake caliper anchor plate bolt	90	66	-
Brake disc bolt	20	-	177
Brake flexible hose bracket-to-wheel knuckle bolt	20	-	177
Catalytic converter nuts	40	30	-
Damper fork-to-front lower arm bolt	103	76	-
Front lower arm-to-subframe bolt [a]	-	-	-
Lower ball joint nut	200	148	-
Rear driveshaft-to-Power Transfer Unit (PTU) bolts	70	52	-
Rear lower arm-to-subframe bD>	-	-	-
Shock absorber rod nut	40	30	-
Shock absorber-to-damper fork bolt	48	35	-
Shock absorber upper mount nut	30	22	-
Stabilizer bar bracket nut	48	35	-
Stabilizer bar link nuts	42	31	-
Steering column shaft bolt (vehicles with Hydraulic Power Assist Steering (HPAS))	25	18	-
Steering column shaft bolt (vehicles with Electronic Power Assist Steering (EPAS))	20	-	177
Steering gear-to-subframe bolt	107	79	-
Subframe bracket-to-body bolt	103	76	-
	150	111	-
Tie-rod end nut	48	35	-
Underbody cover shield bolts	7	-	62
Upper arm-to-body bolt	55	41	-
Upper ball joint nut	48	35	-
Wheel hub nut	255	189	-
Wheel speed sensor bolt	23	17	-
Wheel speed sensor harness bolt	23	17	-

[a] Refer to the procedure in this section.

Front Suspension

The front suspension consists of the following components:

- Wheel bearings
- Wheel hubs
- Wheel studs
- Front and rear lower arms
- Upper arms
- Stabilizer bar
- Stabilizer bar bushings
- Stabilizer bar links
- Shock and spring assemblies
- Wheel knuckles

The front suspension is an independent suspension design. This front suspension uses 3 parallel arms (one upper arm and 2 lower arms). Each arm has a mounting position to the chassis and a ball joint attachment at the wheel knuckle. The shock absorber mounts to the lower arm and along with the spring, controls vertical movement. A stabilizer bar and links are included to control suspension lean/sway during turns. The multiple arm design allows for carefully controlled motion of the wheel throughout suspension travel, controlling such parameters as camber angle, caster angle and toe.

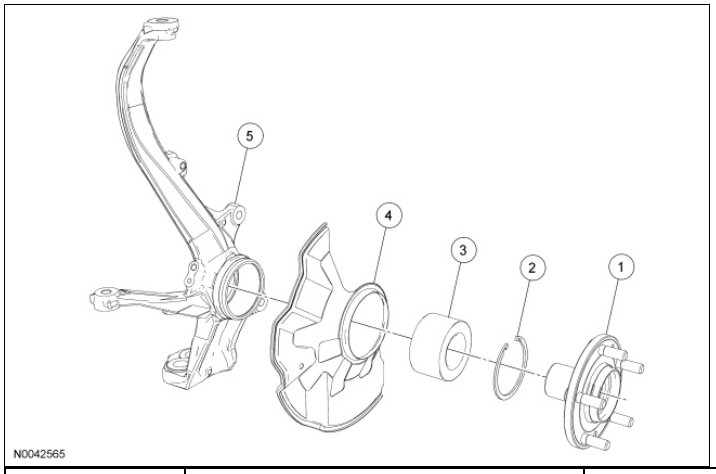
Front Suspension

Refer to Section 204-00 .

Wheel Bearing and Wheel Hub

Special Tool(s)

 ST2330-A	Remover, Front Hub 205-D070 (D93P-1175-B) or equivalent
 ST2138-A	Installer, Halfshaft 204-161 (T97P-1175-A)
 ST2945-A	Ball Joint Separator 204-592
 ST2446-A	Installer, Wheel Hub Bearing Cup 205-147
 ST1895-A	Remover, Drive Pinion Bearing Cone 205-D002 (D79L-4621-A) or equivalent
 ST2446-A	Remover/Installer, Wheel Hub Cup 204-020
 ST2446-A	Step Plate 205-117
 ST3272-A	Installer, Axle Bearing Cup. 205-225
 ST3273-A	Remover/Installer, Drive Pinion Oil Seal 205-440



Item	Part Number	Description
1	1104	Wheel hub
2	3B625	Snap ring
3	1215	Wheel bearing
4	2K005 LH/ 2K004 RH	Disc brake shield
5	3K171 LH/ 3K170 RH	Wheel knuckle

Removal

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

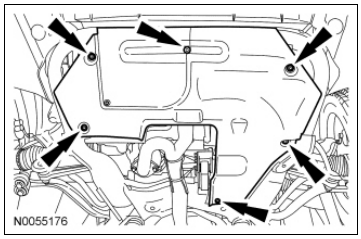
NOTE: This procedure is shown for the LH side, the RH side is similar.

NOTE: If removing the wheel hub, a new wheel bearing must be installed.

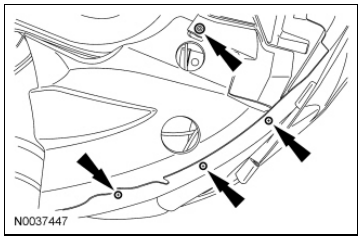
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the wheel and tire. For additional information, refer to Section 204-04 .

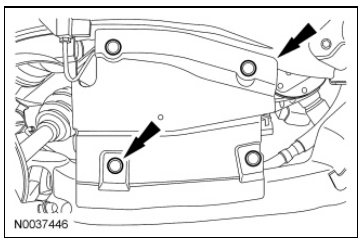
3. Remove the bolts and the underbody shield, if equipped.



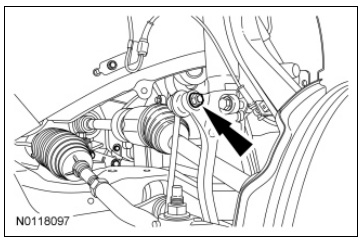
4. Remove the 4 screws position the fender splash shield aside.



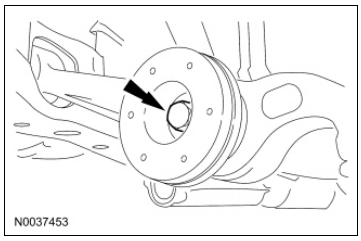
5. Remove the 6 pin-type retainers (4 shown) from the splash shield.



6. Remove the upper stabilizer bar link nut and separate from the stabilizer bar.



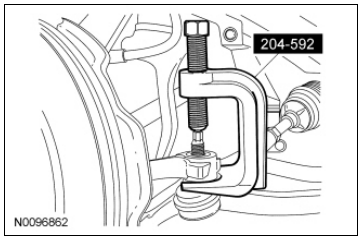
7. Remove the lower control arm-to-strut through bolt and flagnut.



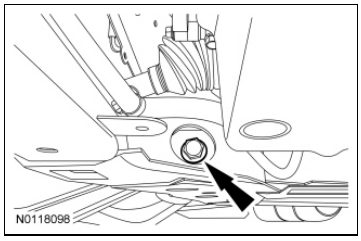
8. Remove the outer tie-rod end cotter pin and nut.
   - Discard the cotter pin.

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

   Using the Ball Joint Separator, separate the outer tie-rod end from the knuckle.



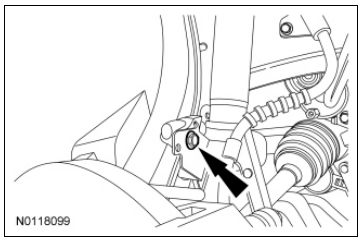
10. Remove the front lower arm-to-subframe bolt.
    - Discard the bolt.



11. If equipped, remove the wheel speed sensor bolt.

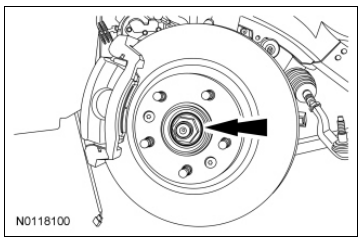
12. If equipped, remove the wheel speed sensor harness bolt and position the wheel speed sensor aside.

13. Remove the brake flexible hose bracket-to wheel knuckle bolt and position the hose and bracket aside.



14. **NOTE:** Apply the brake to keep the halfshaft from rotating.

    Remove and discard the wheel hub nut.



15. ***NOTICE:*** **Do not allow the caliper and anchor plate assembly to hang from the brake hose or damage to the hose can occur.**

    Remove the bolts and position the caliper and anchor plate assembly aside.

    - Support the caliper and anchor plate assembly using mechanic's wire.

16. Remove the 2 brake disc bolts and the brake disc.

17. Using a wax pencil (or equivalent) apply witness marks to the vehicle and subframe to aid in installation.

18. Position a suitable jackstand under the subframe.

19. Remove the 4 front subframe support bracket bolts.

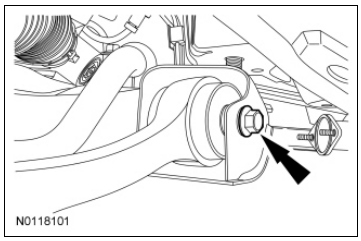
20. Remove the 2 front subframe rear nuts and remove the front subframe support bracket.

21. **NOTE:** Do not remove the front subframe forward bolts, loosen to allow the front subframe to be lowered.

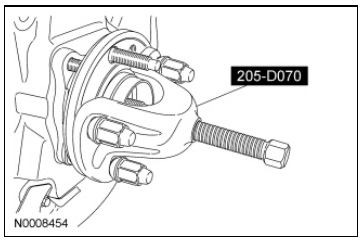
    Loosen the 2 front subframe forward nuts

22. Partially lower the subframe, to allow removal of the rear lower arm-to subframe bolt.

23. Remove the rear lower arm-to subframe bolt.
    - Discard the bolt and washer.

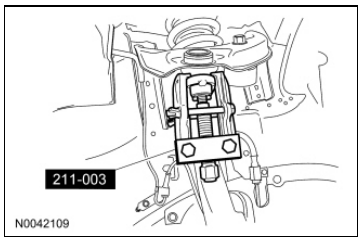


24. Using the Front Hub Remover, separate the halfshaft from the wheel hub.
    - Using mechanics wire or equivalent, support the halfshaft.

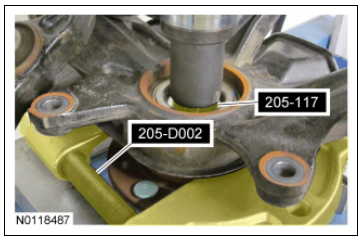


25. Remove and discard the upper ball joint nut.

26. Using the Steering Arm Remover, separate the upper ball joint from the wheel knuckle and remove the wheel knuckle assembly.

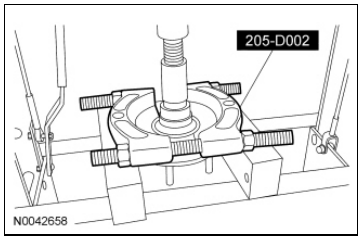


27. Using the Step Plate, press the wheel hub from the wheel bearing.

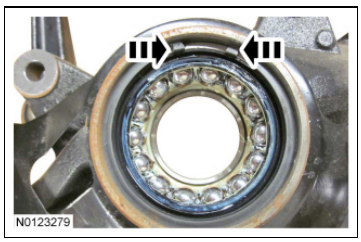


28. **NOTE:** This step may not be necessary if the inner wheel bearing race remains on the wheel bearing after removing the wheel hub.

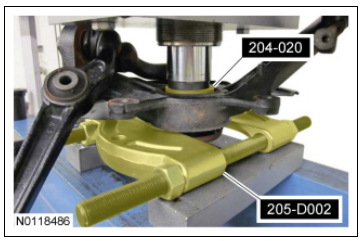
    If necessary, using the Drive Pinion Bearing Cone Remover, press the inner wheel bearing race from the wheel hub.



29. Remove the snap ring.

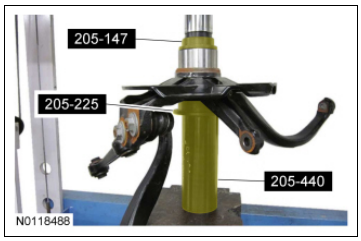


30. Using the Wheel Hub Cup Remover/Installer, press the wheel bearing from the wheel knuckle.



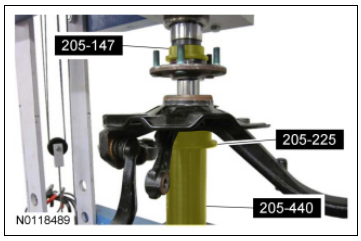
Installation

1. Using the Wheel Hub Bearing Cup Installer, press the wheel bearing into the wheel knuckle.



2. Install the snap ring.

3. Using the Step Plate and Wheel Hub Bearing Cup Installer, press the wheel hub into the wheel bearing.



4. Position the wheel knuckle and install the new upper ball joint nut.
   - Tighten to 48 Nm (35 lb-ft).

5. Partially raise the subframe.

6. Position the halfshaft to the wheel hub.

7. Position the lower control arms to the subframe.
   - Loosely install a new rear lower arm-to-subframe bolt.
   - Loosely install a new front lower arm-to-subframe bolt.

8. Raise the subframe and align to the witness marks made during removal.

9. Position the front subframe support bracket and tighten the 2 new front subframe rear nuts.
   - Tighten to 150 Nm (111 lb-ft).

10. Tighten the 4 front subframe bracket bolts.
    - Tighten to 103 Nm 76 lb-ft).

11. Tighten the 2 new front subframe forward nuts.
    - Tighten to 150 Nm (111 lb-ft).

12. Remove the jackstand.

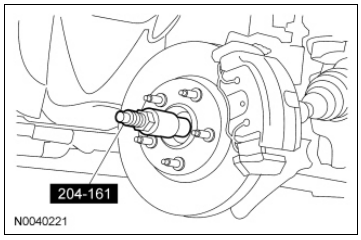
13. If equipped, position the wheel speed sensor and install the bolt.
    - Tighten to 23 Nm (17 lb-ft).

14. If equipped, install the wheel speed sensor harness bolt.
    - Tighten to 23 Nm (17 lb-ft).

15. Install the brake disc and the 2 brake disc bolts.
    - Tighten to 20 Nm (177 lb-in).

16. Position the brake caliper and anchor plate assembly and install the 2 bolts.
    - Tighten to 90 Nm (66 lb-ft).

17. Using the Halfshaft Installer, in the halfshaft Into the wheel hub.

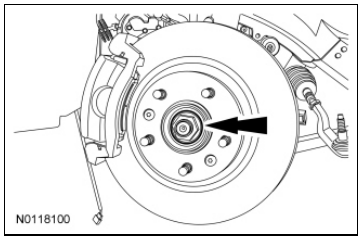


18. ***NOTICE:*** **Do not tighten the halfshaft nut with the vehicle on the ground. The nuts must be tightened to specification before the vehicle Is lowered onto the wheels. Wheel bearing damage will occur If the wheel bearing Is loaded with the weight of the vehicle applied.**

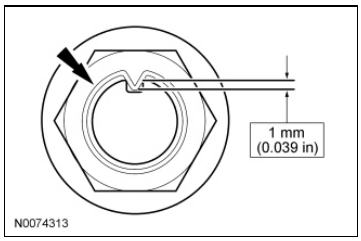
    NOTE: Apply the brake to keep the halfshaft from rotating.

    Install the wheel hub nut.

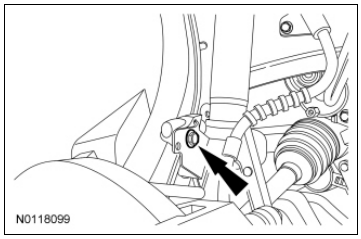
    - Tighten to 255 Nm (189 lb-ft).



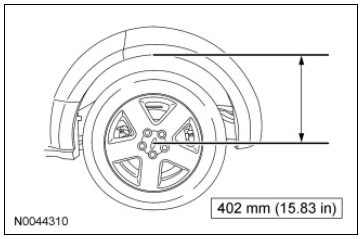
19. Stake the new nut in line with the keyway to a recommended minimum depth of 1 mm (0.039 in) below the keyway diameter to engage the locking feature.



20. Position the brake flexible hose and bracket and install the bolt.
    - Tighten to 23 Nm (17 lb-ft).



21. Before tightening any suspension busing fasteners, the suspension must be at 402 mm (15.826 in) between the center of the hub and the lip of the fender. This will prevent incorrect clamp load and bushing damage.
    - Use a suitable jack to raise the suspension to specification.



22. Tighten the front lower arm-to-subframe bolt.
    1. Tighten to 110 Nm (81 lb-ft).
    2. Tighten an additional 90° with the suspension at the bushing fastener tightening position.

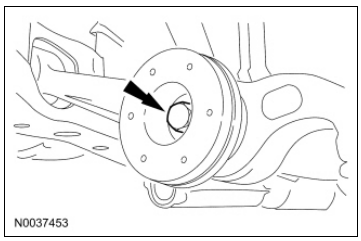
23. Tighten the rear lower arm-to-subframe bolts to 110 Nm (81 lb-ft).

24. Install the outer tie-rod end to the control arm.
    1. Position to the wheel hub.
    2. Install the nut.
    3. Tighten to 48 Nm (35 lb-ft).

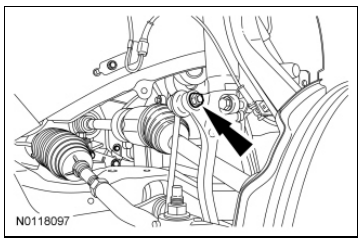
    li>Install new cotter pin.

25. Install the lower control arm-to-strut through bolt and flagnut.

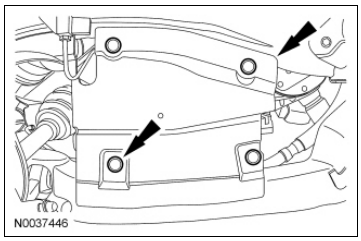
- Tighten to 103 Nm (76 lb-ft).



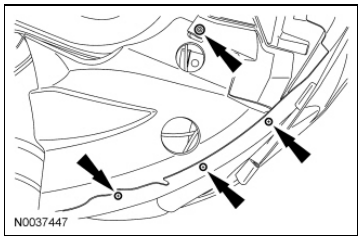
26. Position the stabilizer bar link and install the nut.
    - Tighten to 42 Nm (31 lb-ft).



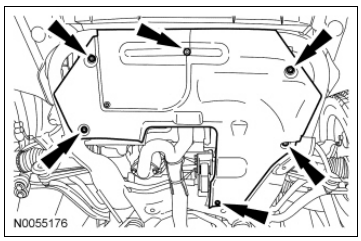
27. Install the splash shield and 6 pin-type retainers, (4 shown).



28. Position the fender splash shield and Install the screws.

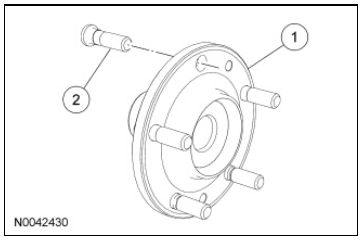


29. Install the underbody shield and bolts (if equipped).
    - Tighten to 7 Nm (62 lb-in).



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

Wheel Studs

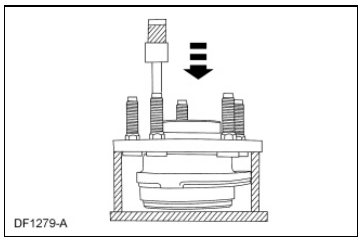


Item	Part Number	Description
1	1104	Wheel hub
2	1107	Wheel stud

Removal

1. Remove the wheel hub. For additional information, refer to Wheel Bearing and Wheel Hub in this section.

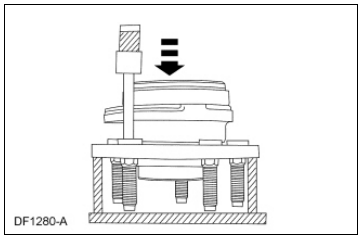
2. Using a press, remove the wheel stud from the wheel bearing and hub assembly.



Installation

1. Position the new wheel stud in the wheel hub, aligning the serrations in the wheel hub flange made by the original wheel stud.

2. Using a press, install a new wheel stud.

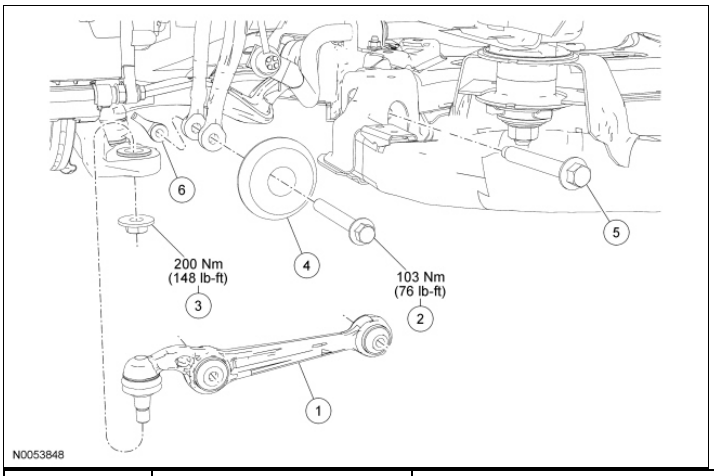


3. Install the wheel hub. For additional information, refer to Wheel Bearing and Wheel Hub in this section.

Lower Arm - Front

Special Tool(s)

 ST2646-A	Adapter for 204-592 204-592/1
 ST2945-A	Separator, Ball Joint 204-592



Item	Part Number	Description
1	3A423	Lower arm (front)
2	W500550	Damper fork-to-lower arm bolt
3	3C499	Lower ball joint nut (front)
4	3C156	Damper
5	W712840	Front lower arm-to-subframe bolt
6	3C347	Damper fork-to-lower arm flagnut

Removal Installation

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

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Using a suitable jack, support the front wheel knuckle at the rear lower ball joint.

3. Remove the front lower arm-to-subframe bolt.

- Discard the bolt.
- To install, tighten the new bolt to 110 Nm (81 lb-ft), then tighten an additional 90 degrees with the suspension at the bushing fastener tightening position.

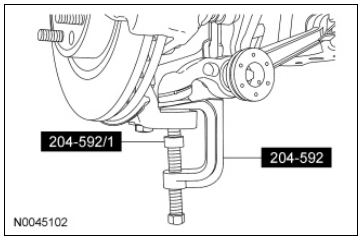
4. Remove the damper fork-to-lower arm bolt flagnut and damper.
   - Discard the bolt and flagnut.
   - To install, tighten the new bolt and flagnut to 103 Nm (76 lb-ft) with the suspension at the bushing fastener tightening position.

5. Remove and discard the front lower ball joint nut.
   - To install, tighten the new nut to 200 Nm (148 lb-ft).

6. ***NOTICE:*** **When the lower ball joint is separated from the wheel knuckle, the lower arm may strike the outer Constant Velocity (CV) joint boot with enough force to damage the boot clamp. This will result in a loss of grease from the outer CV joint. Place a block of wood, or similar item, between the lower arm and the outer CV joint to prevent the lower arm from striking the outer CV joint.**

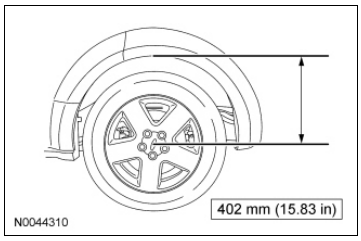
   NOTE: Once pressure is applied to the ball joint with the Ball Joint Separator and Adapter, it may be necessary to tap the wheel knuckle at the ball joint area to separate the ball joint from the wheel knuckle.

   Using the Ball Joint Separator and Adapter, separate the front lower ball joint from the wheel knuckle and remove the front lower arm.



7. ***NOTICE:*** **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 402 mm (15.83 in). This will prevent incorrect clamp load and bushing damage.**

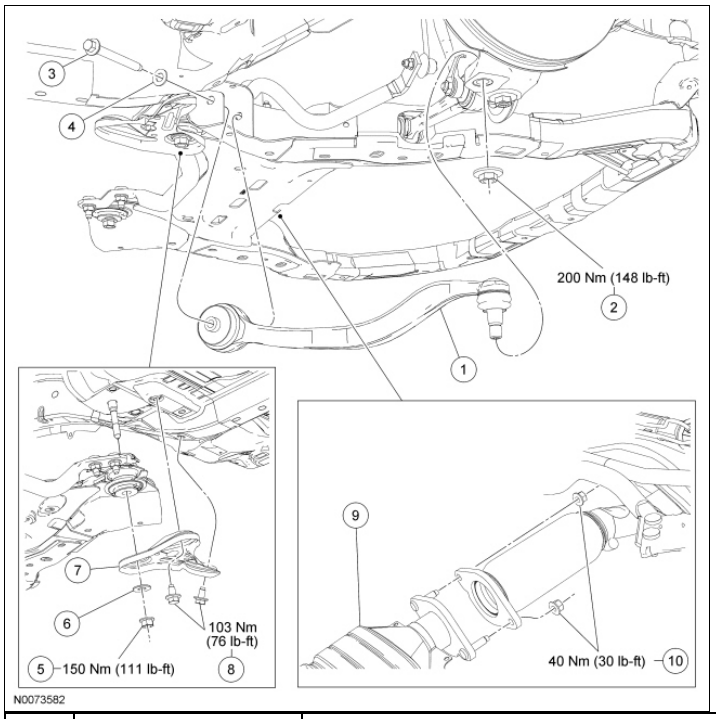
   To install, reverse the removal procedure.



Lower Arm - Rear

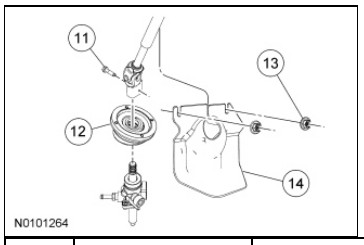
Special Tool(s)

 ST2646-A	Adapter for 204-592 204-592/1
 ST2945-A	Separator, Ball Joint 204-592



Item	Part Number	Description
1	3079 LH/ 3078 RH	Lower arm (rear)
2	3C499	Lower ball joint nut (rear)
3	W500752	Rear lower arm-to-subframe bolt
4	999581222	Washer
5	W520416	Subframe bracket-to-subframe nut (2 required)
6	5A552	Subframe bracket-to-subframe washer (2 ired)
7	3B155 LH/ 3B154 RH	Subframe bracket (2 required)
8	3C496	Subframe bracket-to-body bolts (4 required)
9	5E212	Catalytic converter
10	W705443	

		Catalytic converter manifold-to-exhaust flexible pipe nuts (2 required)



Item	Part Number	Description
11	3R827	Steering column shaft bolt
12	3C611B	Steering column shaft-to-dash seal
13	5801691	Lower steering column shaft joint cover nut (2 required)
14	3C611A	Lower steering column shaft joint cover

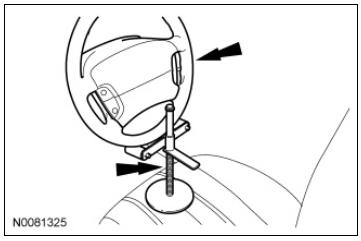
Removal and Installation

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

1. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected or damage to the clockspring may result. If there is evidence that the lower shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   NOTE: Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.



2. Remove the 2 lower steering column shaft joint cover nuts and cover.

3. ***NOTICE:*** **Do not allow the steering column shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the steering column shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   NOTE: If equipped with Hydraulic Power Assist Steering (HPAS), index-mark the steering column shaft position to the steering gear for reference during installation.

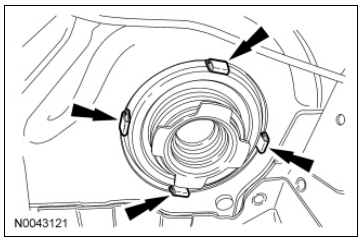
   Remoe the bolt and disconnect the steering column shaft from the steering gear.

- To install on HPAS vehicles, align the index marks and tighten to 25 Nm (18 lb-ft).
- To install on Electronic Power Assist Steering (EPAS) vehicles, tighten to 20 Nm (177 lb-in).

4. ***NOTICE:*** **Remove the steering column shaft-to-dash seal or damage to the seal can occur.**

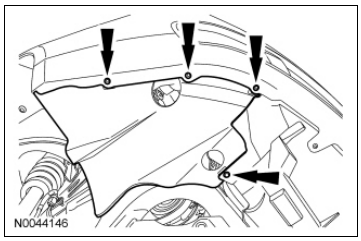
   NOTICE: **When installing, make sure that the dash seal is correctly positioned on the steering gear and the retaining clips are fully engaged into the body or damage to the steering gear can result.**

   Remove the steering column shaft-to-dash seal.

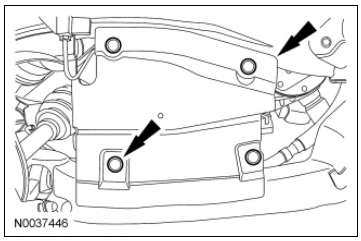


5. Remove the wheel and tire. For additional information, refer to Section 204-04 .

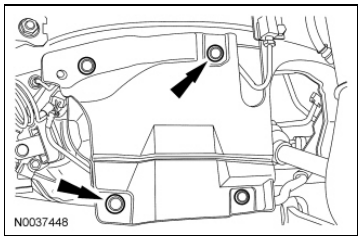
6. Remove the 8 screws and position the LH and RH splash shields aside.



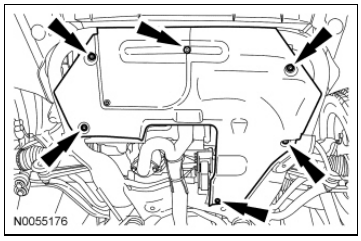
7. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



8. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.



9. If equipped, remove the 7 screws and the underbody cover shield.
   - To install, tighten 7 Nm (62 lb-in).



10. Remove and discard the 2 catalytic converter manifold-to-exhaust flexible pipe nuts and separate the exhaust flexible pipe.
    - To install, tighten the new nuts to 40 Nm (30 lb-ft).

11. Using 2 suitable jack stands, support the rear of the subframe assembly.

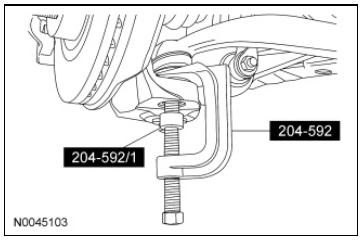
12. Remove and discard the 4 subframe bracket-to-body bolts, the 2 subframe bracket-to-subframe nuts and washers. Lower the rear of the subframe.
    - To install, tighten the new bolts to 103 Nm (76 lb-ft).
    - To install, tighten the new nuts to 150 Nm (111 lb-ft).

13. Remove and discard the rear lower ball joint nut.
    - To install, tighten the new nut to 200 Nm (148 lb-ft).

14. ***NOTICE:*** **When the lower ball joint is separated from the wheel knuckle, the lower arm may strike the outer Constant Velocity (CV) joint boot with enough force to damage the boot clamp. This will result in a loss of grease from the outer CV joint. Place a block of wood, or similar item, between the lower arm and the outer CV joint to prevent the lower arm from striking the outer CV joint.**

    NOTE: Once pressure is applied to the ball joint with the Ball Joint Separator and Adapter, it may be necessary to tap the wheel knuckle at the ball joint area to separate the ball joint from the wheel knuckle.

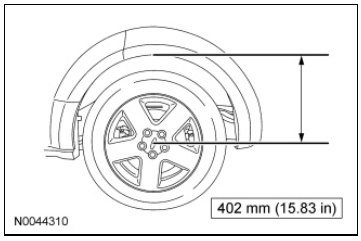
    Using the Ball Joint Separator and Adapter, separate the rear lower ball joint from the wheel knuckle.



15. Remove the rear lower arm-to-subframe bolt and washer and remove the rear lower arm.
    - Discard the bolt and washer.
    - To install, tighten the new bolt to 65 Nm (48 lb-ft), then tighten an additional 90 degrees.

16. ***NOTICE:*** **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 402 mm (15.83 in). This will prevent incorrect clamp load and bushing damage.**

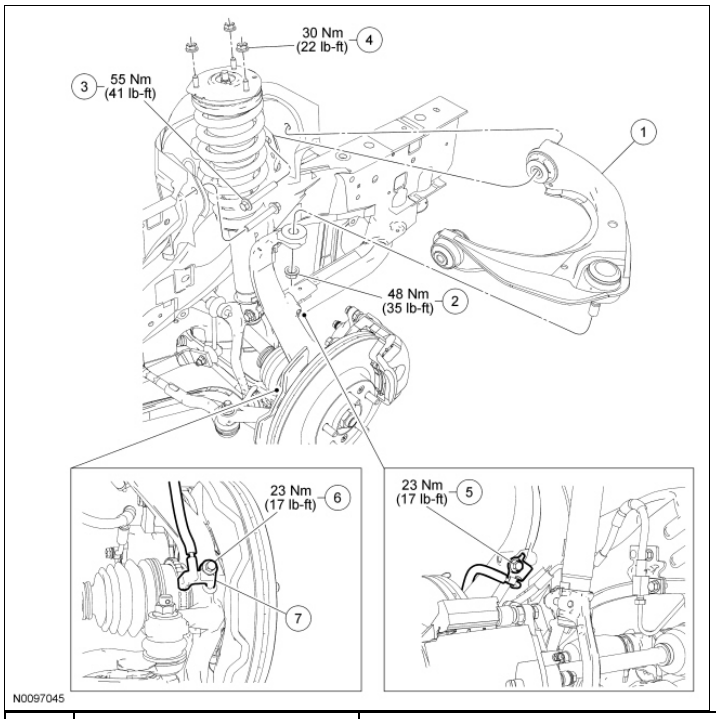
    To install, reverse the removal procedure.


402 mm (15.83 in)
N0044310

Upper Arm

Special Tool(s)

 ST1263-A	Remover, Steering Arm 211-003 (T64P-3590-F)



Item	Part Number	Description
1	3091 LH/ 3084 RH	Upper arm
2	3C498	Upper ball joint nut
3	W500525	Upper arm-to-body bolt (2 required)
4	5B800	Shock absorber upper mount nut (3 required)
5	W500020	Wheel speed sensor harness bolt
6	W500222	Wheel speed sensor bolt
7	2C204 RH/ 2C205 LH	Wheel speed sensor

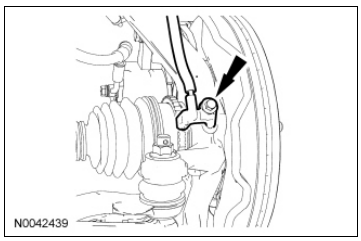
Removal

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

1. Remove and discard the 3 shock absorber upper mount nuts.

2. Remove the wheel and tire. For additional information, refer to Section 204-04 .

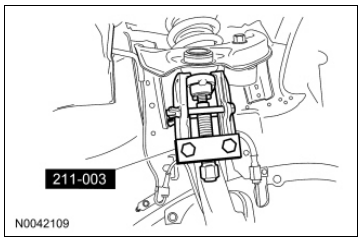
3. Remove the wheel speed sensor bolt.



4. Remove the wheel speed sensor harness bolt and position the wheel speed sensor aside.

5. Remove and discard the upper ball joint nut.

6. Using the Steering Arm Remover, separate the upper ball joint from the wheel knuckle.



7. Position the shock absorber and spring assembly toward the wheel knuckle to access the upper arm-to-body bolts.

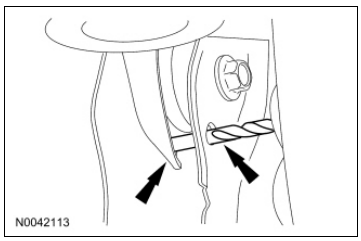
8. Remove the 2 upper arm-to-body bolts and the upper arm.
   - Discard the bolts.

Installation

1. **NOTE:** Do not tighten the upper arm-to-body bolts at this time.

   Position the upper arm and install the 2 new upper arm-to-body bolts.

2. Set the upper arm bushing fastener tightening position by aligning the hole in the upper arm with the hole in the body bracket and inserting a 6.35 mm (0.25 in) drill bit through both holes.



3. Tighten the upper arm-to-body bolts to 55 Nm (41 lb-ft) and remove the drill bit.

4. Position the shock and spring assembly and install the 3 new shock upper mount nuts.
   - Tighten to 30 Nm (22 lb-ft).

5. Position the upper ball joint and install a new nut.
   - Tighten to 48 Nm (35 lb-ft).

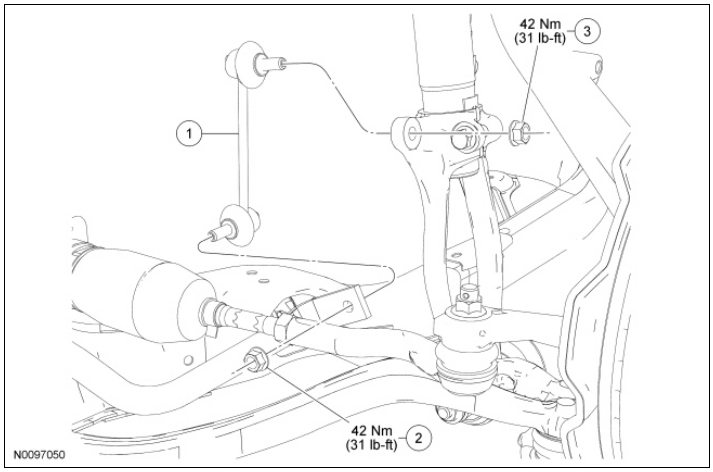
6. Position the wheel speed sensor harness and install the bolt.
    - Tighten to 23 Nm (17 lb-ft).

7. Position the wheel speed sensor and install the bolt.
    - Tighten to 23 Nm (17 lb-ft).

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

9. Check and, if necessary, align the front end. For additional information, refer to Section 204-00 .

Stabilizer Bar Link



Item	Part Number	Description
1	3053 LH/ 3052 RH	Stabilizer bar link
2	3C494	Stabilizer bar link lower nut
3	3C494	Stabilizer bar link upper nut

Removal and Installation

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

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

2. **NOTE:** Use the hex-holding feature to prevent the ball stud from turning while removing or installing the stabilizer bar link nut.

   Remove and discard the stabilizer bar link upper nut.

   - To install, tighten the new nut to 42 Nm (31 lb-ft).

3. **NOTE:** Use the hex-holding feature to prevent the ball stud from turning while removing or installing the stabilizer bar link nut.

   Remove and discard the stabilizer bar link lower nut and remove the stabilizer bar link.

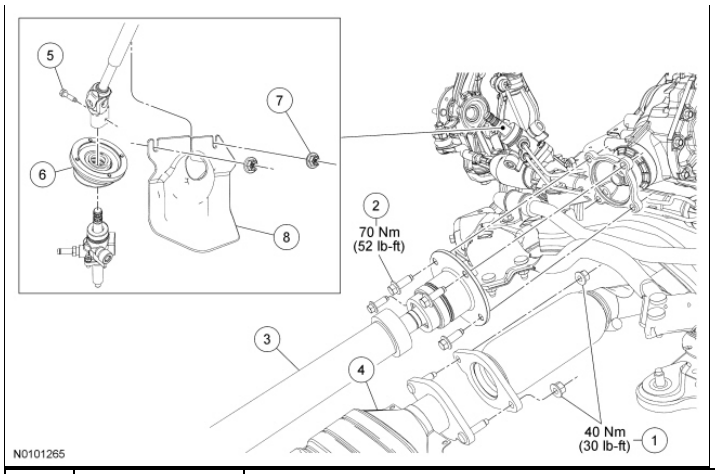
   - To install, tighten the new nut to 42 Nm (31 lb-ft).

4. To install, reverse the removal procedure.

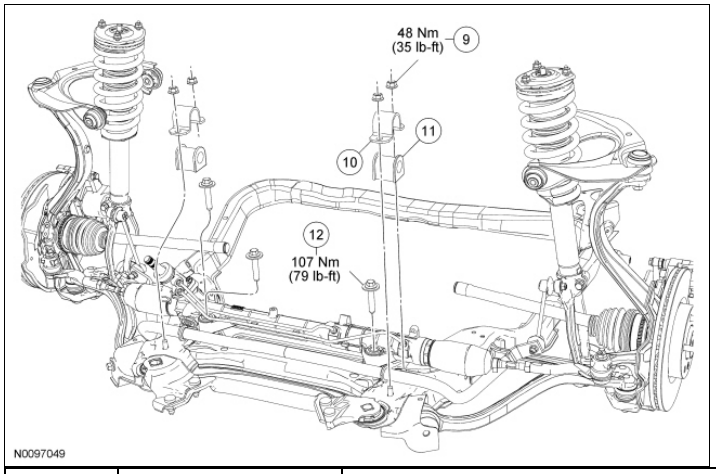
Stabilizer Bar Bushing

Special Tool(s)

 ST1408-A	Remover, Tie-Rod End 211-105 (T85M-3395-A)



Item	Part Number	Description
1	W705443	Catalytic converter-to-exhaust flexible pipe nuts (2 required)
2	W711918	Rear driveshaft-to-Power Transfer Unit (PTU) bolt (4 required)
3	5006930	Rear driveshaft assembly
4	5E212	Catalytic converter
5	3R827	Steering column shaft bolt
6	3C611B	Steering column shaft-to-dash seal
7	5801691	Lower steering column shaft joint cover nut (2 required)
8	3C611A	Lower steering column shaft joint cover



Item	Part Number	Description
9	W520414	Stabilizer bar bracket nut (4 required)
10	5486	Stabilizer bar bushing bracket (2 required)
11	5484	Stabilizer bar bushing (2 required)
12	3C497	Steering gear-to-subframe bolt (3 required)

Removal and Installation

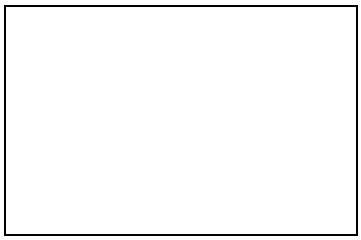
NOTICE: **Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure may result in major service expense. New parts must be installed with the same part numbers or equivalent part, if replacement is necessary. Do not use a replacement part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

All vehicles

1. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected or damage to the clockspring may result. If there is evidence that the lower shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   NOTE: Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.



2. Remove the 2 lower steering column shaft joint cover nuts and cover.

3. ***NOTICE:*** **Do not allow the steering column shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the steering column shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   NOTE: If equipped with Hydraulic Power Assist Steering (HPAS), index-mark the steering column shaft position to the steering gear for reference during installation.

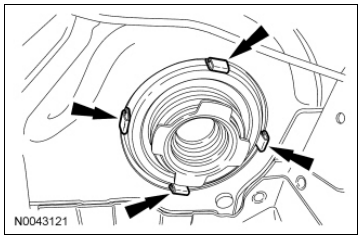
Remove the bolt and disconnect the steering column shaft from the steering gear.

- To install on HPAS vehicles, align the index marks and tighten to 25 Nm (18 lb-ft).
- To install on Electronic Power Assist Steering (EPAS) vehicles, tighten to 20 Nm (177 lb-in).

4. ***NOTICE:*** **Remove the steering column shaft-to-dash seal or damage to the seal can occur.**

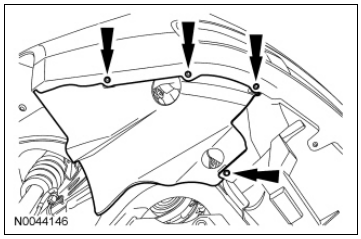
   NOTICE: **When installing, make sure that the dash seal is correctly positioned on the steering gear and the retaining clips are fully engaged into the body or damage to the steering gear can result.**

   Remove the steering column shaft-to-dash seal.

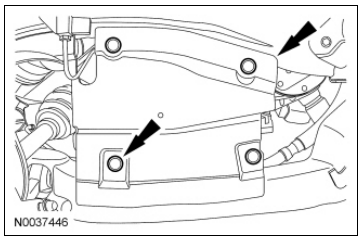


5. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

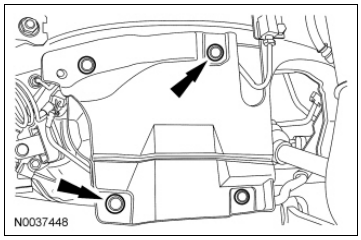
6. Remove the 8 screws and position the LH and RH splash shields aside.



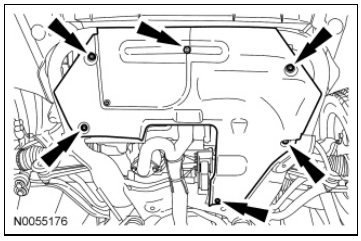
7. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



8. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.



9. If equipped, remove the 7 screws and the underbody cover shield.
   - To install, tighten 7 Nm (62 lb-in).

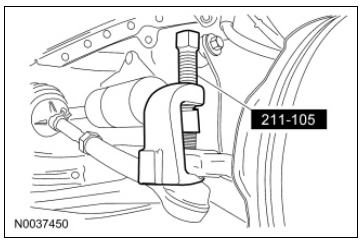


10. Remove and discard the 2 tie-rod end cotter pins and nuts.
    - To install, tighten the new nuts to 48 Nm (35 lb-ft).
    - Install new cotter pins.

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

    NOTE: RH shown, LH similar.

    Using the Tie-Rod End Remover, separate the 2 tie-rod ends from the wheel knuckles.



12. Remove and discard the 2 catalytic converter-to-exhaust flexible pipe nuts and separate the exhaust flexible pipe.
    - To install, tighten the new nuts to 40 Nm (30 lb-ft).

All-Wheel Drive (AWD) vehicles

13. Index the rear driveshaft-to-Power Transfer Unit (PTU).
    - Remove and discard the 4 bolts and position the driveshaft aside.
    - To install, tighten the new bolts to 70 Nm (52 lb-ft).

All vehicles

14. Remove RH steering gear-to-subframe bolt.
    - To install, tighten to 107 Nm (79 lb-ft).

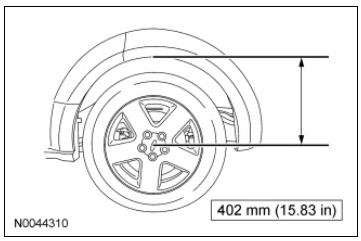
15. Remove the 2 LH steering gear-to-subframe bolts and position the steering gear to access the stabilizer bar LH bracket front nut.
    - To install, tighten to 107 Nm (79 lb-ft).

16. Remove and discard the 4 stabilizer bar bracket nuts and remove the 2 stabilizer bar brackets.
    - To install, tighten the new bracket nuts to 48 Nm (35 lb-ft).

17. Remove the 2 stabilizer bar bushings.

18. ***NOTICE:*** **Before tightening the stabilizer bar bracket nuts, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 402 mm (15.83 in). This will prevent incorrect clamp load and bushing damage.**

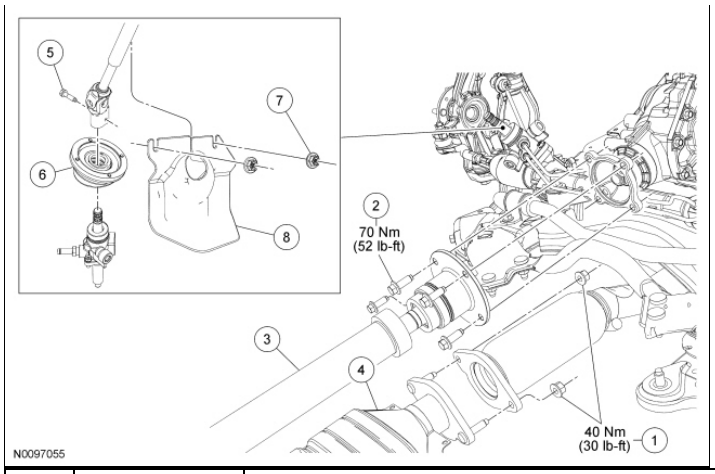
To install, reverse the removal procedure.



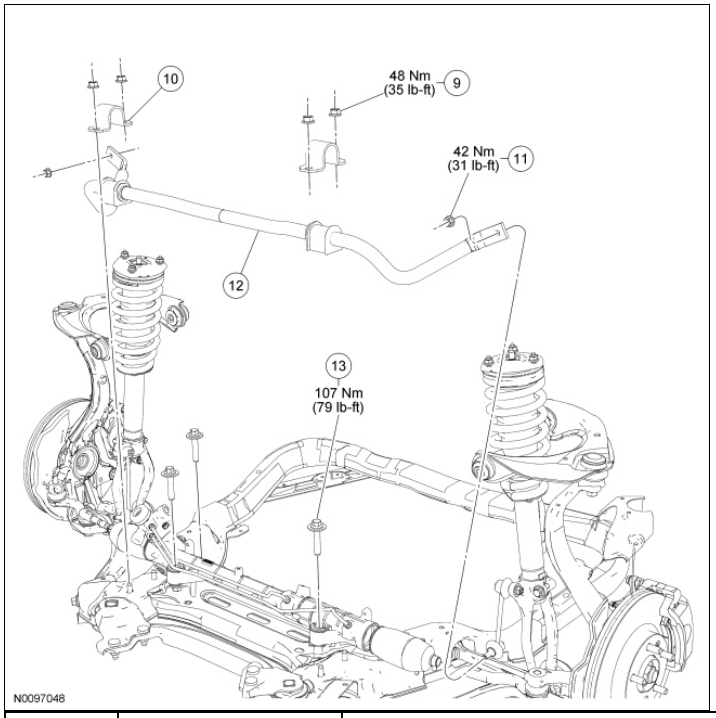
Stabilizer Bar

Special Tool(s)

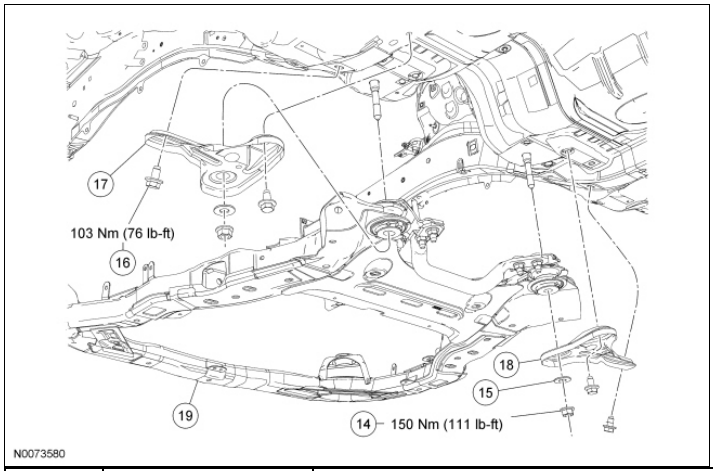
 ST1408-A	Remover, Tie-Rod End 211-105 (T85M-3395-A)



Item	Part Number	Description
1	W705443	Catalytic converter-to-exhaust flexible pipe nuts (2 required)
2	W711918	Rear driveshaft-to-Power Transfer Unit (PTU) bolt (4 required)
3	5006930	Rear driveshaft assembly
4	5E212	Catalytic converter
5	3R827	Steering column shaft bolt
6	3C611B	Steering column shaft-to-dash seal
7	5801691	Lower steering column shaft joint cover nut (2 required)
8	3C611A	Lower steering column shaft joint cover



Item	Part Number	Description
9	W520414	Stabilizer bar bracket nut (4 required)
10	5486	Stabilizer bar bracket (2 required)
11	3C494	Stabilizer bar link lower nut (2 required)
12	5494	Stabilizer bar
13	3C497	Steering gear-to-subframe bolt (3 required)



Item	Part Number	Description
14	W520416	Subframe bracket-to-subframe nut (4 required)
15	5A552	Front subframe washer (4 required)
16	3C496	Subframe-to-body bolt (4 required)
17	3B154	RH front subframe support bracket
18	3B155	LH front subframe support bracket
19	5C145	Front subframe

Removal and Installation

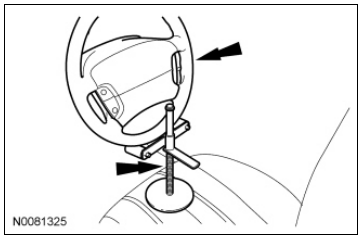
NOTICE: **Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure may result in major service expense. New parts must be installed with the same part numbers or equivalent part, if replacement is necessary. Do not use a replacement part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

All vehicles

1. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected or damage to the clockspring may result. If there is evidence that the lower shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   NOTE: Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.



2. Remove the 2 lower steering column shaft joint cover nuts and cover.

3. ***NOTICE:*** **Do not allow the steering column shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the steering column shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   NOTE: If equipped with Hydraulic Power Assist Steering (HPAS), index-mark the steering column shaft position to the steering gear for reference during installation.

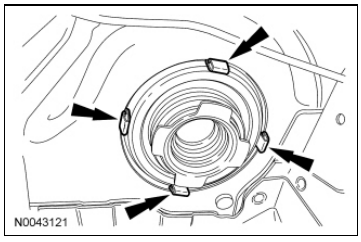
   Remove the bolt and disconnect the steering column shaft from the steering gear.

   - To install on HPAS vehicles, align the index marks, tighten to 25 Nm (18 lb-ft).
   - To install on Electronic Power Assist Steering (EPAS) vehicles, tighten to 20 Nm (177 lb-in).

4. ***NOTICE:*** **Remove the steering column shaft-to-dash seal or damage to the seal can occur.**

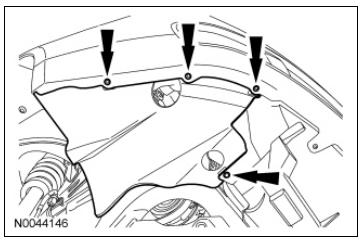
   NOTICE: **When installing, make sure that the dash seal is correctly positioned on the steering gear and the retaining clips are fully engaged into the body or damage to the steering gear can result.**

   Remove the steering column shaft-to-dash seal.

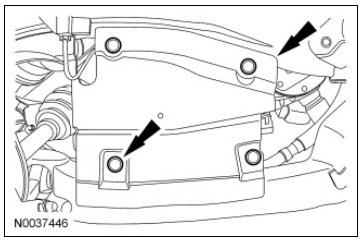


5. Remove the wheel and tire. For additional information, refer to Section 204-04 .

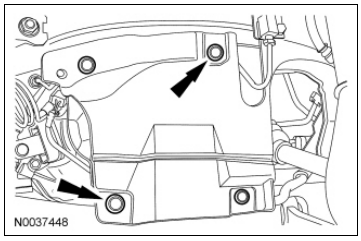
6. Remove the 8 screws and position the LH and RH splash shields aside.



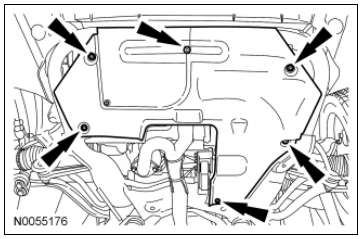
7. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



8. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.



9. If equipped, remove the 7 screws and the underbody cover shield.
   - To install, tighten 7 Nm (62 lb-in).

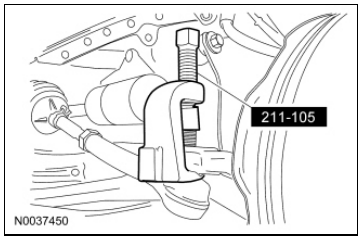


10. Remove and discard the 2 tie-rod end cotter pins and nuts.
    - To install, tighten the new nuts to 48 Nm (35 lb-ft) and install new cotter pins.

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

    NOTE: RH shown, LH similar.

    Using the Tie-Rod End Remover, separate the tie-rod ends from the wheel knuckles.



12. **NOTE:** Use the hex-holding feature to prevent the ball stud from turning while removing or installing the stabilizer bar link nuts.

    Remove and discard the 2 stabilizer bar link lower nuts and disconnect both stabilizer bar links from the stabilizer bar.

    - To install, tighten the new nuts to 42 Nm (31 lb-ft).

13. Remove and discard the 2 catalytic converter-to-exhaust flexible pipe nuts and separate the exhaust flexible pipe.
    - To install, tighten the new nuts to 40 Nm (30 lb-ft).

All-Wheel Drive (AWD) vehicles

14. Index-mark the rear driveshaft-to-Power Transfer Unit (PTU).
    - Remove and discard the 4 bolts and position the driveshaft aside.
    - To install, tighten the new bolts to 70 Nm (52 lb-ft).

All vehicles

15. Using 2 suitable jackstands, support the rear of the subframe assembly.

16. Remove and discard the 4 subframe bracket-to-body bolts, the 2 subframe bracket-to-subframe nuts and lower the rear of the subframe.
    - To install, tighten the new bolts to 103 Nm (76 lb-ft).
    - To install, tighten the new nuts to 150 Nm (111 lb-ft).

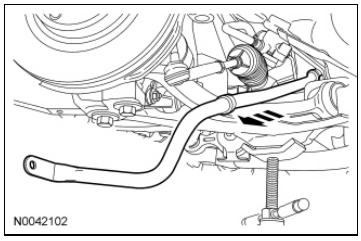
17. Remove the RH steering gear-to-subframe bolt.
    - To install, tighten to 107 Nm (79 lb-ft).

18. Remove the 2 LH steering gear-to-subframe bolts and position the steering gear to access the stabilizer bar LH bracket front nut.
    - To install, tighten to 107 Nm (79 lb-ft).

19. Remove and discard the 4 stabilizer bar bracket nuts and remove the 2 stabilizer bar brackets.
    - To install, tighten the new bracket nuts to 48 Nm (35 lb-ft).

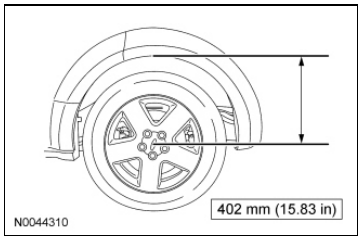
20. Remove the 2 stabilizer bar bushings.

21. Remove the stabilizer bar through the LH wheel opening.



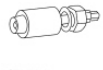
22. ***NOTICE:*** **Before tightening the stabilizer bar bracket nuts, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 402 mm (15.83 in). This will prevent incorrect clamp load and bushing damage.**

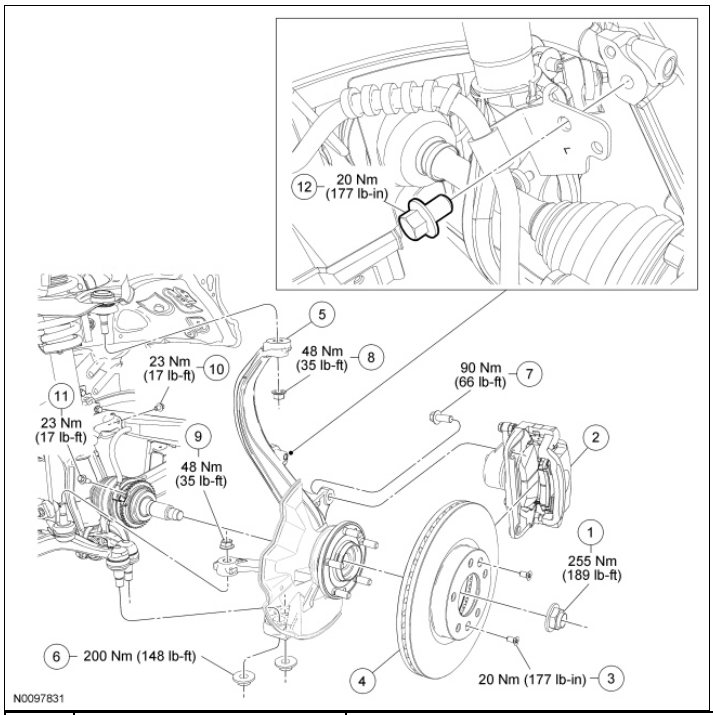
    To install, reverse the removal procedure.



Wheel Knuckle

Special Tool(s)

 ST2646-A	Adapter for 204-592 204-592/1
 ST2138-A	Installer, Halfshaft 204-161 (T97P-1175-A)
 ST2330-A	Remover, Front Hub 205-D070 (D93P-1175-B) or equivalent
 ST1263-A	Remover, Steering Arm 211-003 (T64P-3590-F)
 ST1408-A	Remover, Tie-Rod End 211-105 (T85M-3395-A)
 ST2945-A	Separator, Ball Joint 204-592



Item	Part Number	Description
1	3N405	Wheel hub nut

2	-	Brake caliper and anchor plate assembly
3	W505741	Brake disc bolt (2 required)
4	1032	Brake disc
5	3K171 LH/ 3K170 RH	Wheel knuckle
6	3C499	Lower ball joint nut (2 required)
7	W711241	Brake caliper anchor plate bolt (2 required)
8	3C498	Upper ball joint nut
9	3D000	Tie-rod end nut
10	W500020	Wheel speed sensor harness bolt
11	W500222	Wheel speed sensor bolt
12	W505263	Brake flexible hose bracket-to-wheel knuckle bolt

Removal

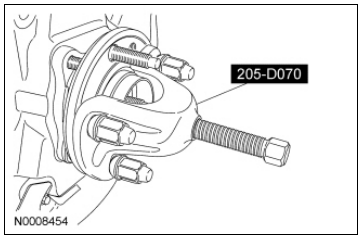
NOTICE: **Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure may result in major service expense. New parts must be installed with the same part numbers or equivalent part, if replacement is necessary. Do not use a replacement part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

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .
2. If equipped, remove the wheel speed sensor bolt.
3. If equipped, remove e wheel speed sensor harness bolt and position the wheel speed sensor aside.
4. Remove the brake flexible hose bracket-to-wheel knuckle bolt and position the hose and bracket aside.
5. **NOTE:** Apply the brake to keep the halfshaft from rotating.

   Remove and discard the wheel hub nut.
6. ***NOTICE:*** **Do not allow the caliper and anchor plate assembly to hang from the brake hose or damage to the hose can occur.**

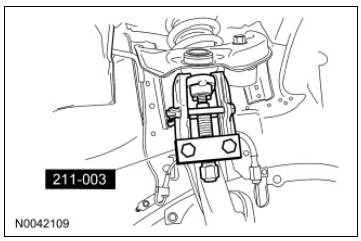
   Remove the bolts and position the caliper and anchor plate assembly aside.

   - Support the caliper and anchor plate assembly using mechanic's wire.
7. Remove the 2 brake disc bolts and the brake disc.
8. Using the Front Hub Remover, separate the halfshaft from the wheel hub.



9. Remove and discard the upper ball joint nut.

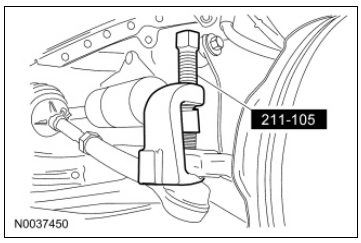
10. Using the Steering Arm Remover, separate the upper ball joint from the wheel knuckle.



11. Remove and discard the tie-rod end cotter pin and nut.

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

    Using the Tie-Rod End Remover, separate the tie-rod end from the wheel knuckle.

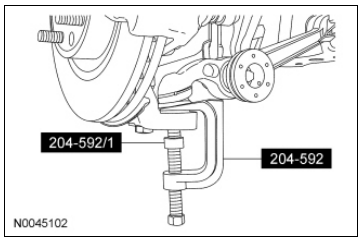


13. Remove and discard the 2 lower ball joint nuts.

14. ***NOTICE:*** **When the lower ball joint is separated from the wheel knuckle, the lower arm may strike the outer Constant Velocity (CV) joint boot with enough force to damage the boot clamp. This will result in a loss of grease from the outer CV joint. Place a block of wood, or similar item, between the lower arm and the outer CV joint to prevent the lower arm from striking the outer CV joint.**

    NOTE: Once pressure is applied to the ball joint with the Ball Joint Separator and Adapter, it may be necessary to tap the wheel knuckle at the ball joint area to separate the ball joint from the wheel knuckle.

    Using the Ball Joint Separator and Adapter, separate the 2 lower ball joints from the wheel knuckle and remove the wheel knuckle.



Installation

1. Position the wheel knuckle and install the 2 new lower ball joint nuts.
   - Tighten to 200 Nm (148 lb-ft).

2. Position the tie-rod end and install the new nut and cotter pin.

- Tighten to 48 Nm (35 lb-ft).

3. Position the upper ball joint and install the new nut.
   - Tighten to 48 Nm (35 lb-ft).

4. If equipped, position the wheel speed sensor and install the bolt.
   - Tighten to 23 Nm (17 lb-ft).

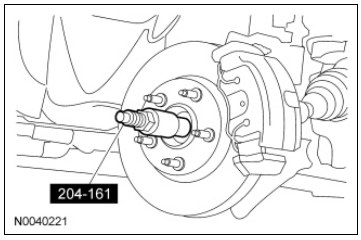
5. If equipped, install the wheel speed sensor harness bolt.
   - Tighten to 23 Nm (17 lb-ft).

6. Position the brake flexible hose bracket and install the bolt.
   - Tighten to 20 Nm (177 lb-in).

7. Position the brake caliper and anchor plate assembly and install the 2 bolts.
   - Tighten to 90 Nm (66 lb-ft).

8. Install the brake disc and the 2 brake disc bolts.
   - Tighten to 20 Nm (177 lb-in).

9. Using the Halfshaft Installer, install the halfshaft into the wheel hub.



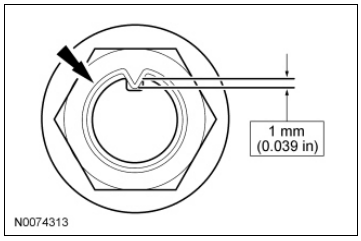
10. ***NOTICE:*** **Do not tighten the halfshaft nut with the vehicle on the ground. The nut must be tightened to specification before the vehicle is lowered onto the wheels. Wheel bearing damage will occur if the wheel bearing is loaded with the weight of the vehicle applied.**

    NOTE: Apply the brake to keep the halfshaft from rotating.

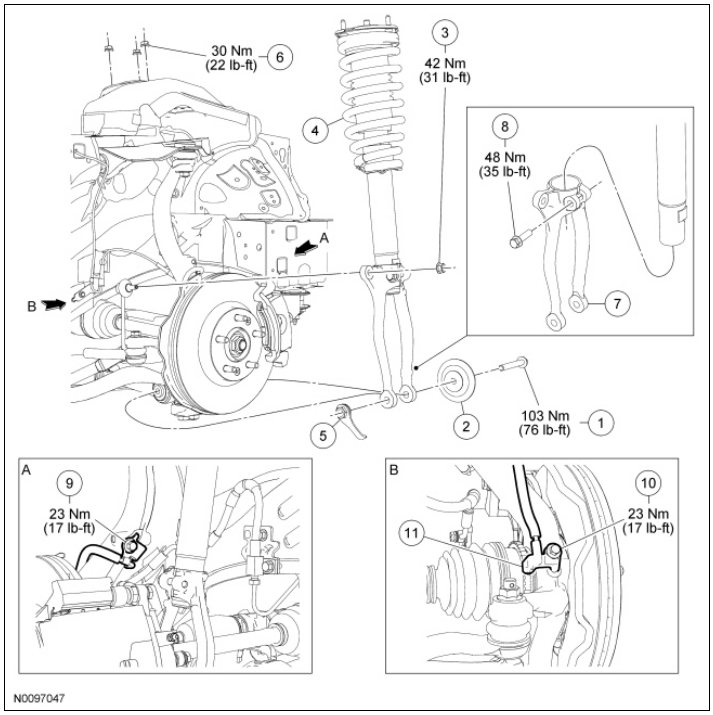
    Install the wheel hub nut.

    - Tighten to 255 Nm (189 lb-ft).

11. Stack the new nut in line with the keyway to a recommended depth of 1 mm (0.039 in) below the keyway diameter to engage the locking feature.



Shock Absorber and Spring Assembly



Item	Part Number	Description
1	W500550	Damper fork-to-lower arm bolt
2	3C156	Damper
3	3C494	Stabilizer bar link upper nut
4	-	Shock absorber and spring assembly
5	W302117	Damper fork-to-lower arm flagnut
6	W302128	Shock absorber upper mount nut (3 required)
7	3462	Damper fork
8	W302119	Shock absorber-to-damper fork bolt
9	W500020	Wheel speed sensor harness bolt
10	W500222	Wheel speed sensor bolt
11	2C204 RH/ 2C205 LH	Wheel speed sensor

Removal and Installation

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

1. Remove and discard the 3 shock absorber upper mount nuts.
    - To install, tighten the new nuts to 30 Nm (22 lb-ft).

2. Remove the wheel and tire. For additional information, refer to Section 204-04 .

3. Remove the wheel speed sensor bolt.
   - To install, tighten to 23 Nm (17 lb-ft).

4. Remove the wheel speed ssor harness bolt and position the wheel speed sensor aside.
   - To install, tighten to 23 Nm (17 lb-ft).

5. Using a suitable jack, support the wheel knuckle at the lower ball joints.

6. **NOTE:** Use the hex-holding feature to prevent the ball stud from turning while removing or installing the stabilizer bar link nut.

   Remove and discard the stabilizer bar link upper nut.

   - To install, tighten the new nut to 42 Nm (31 lb-ft).

7. Remove the damper fork-to-front lower arm bolt, flagnut and damper.
   - Discard the bolt and flagnut.
   - To install, tighten the new bolt and flagnut to 103 Nm (76 lb-ft) with the suspension at the bushing fastener tightening position.

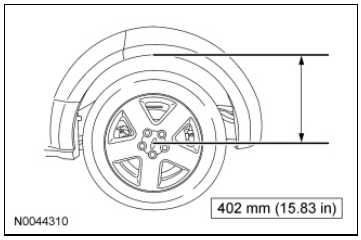
8. Remove and discard the shock absorber-to-damper fork bolt and separate the damper fork from the shock absorber and spring assembly.
   - To install, tighten the new bolt to 48 Nm (35 lb-ft).

9. Lower the wheel knuckle and remove the shock absorber and spring assembly.

10. ***NOTICE:*** **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 402 mm (15.83 in). This will prevent incorrect clamp load and bushing damage.**

    To install, reverse the removal procedure.

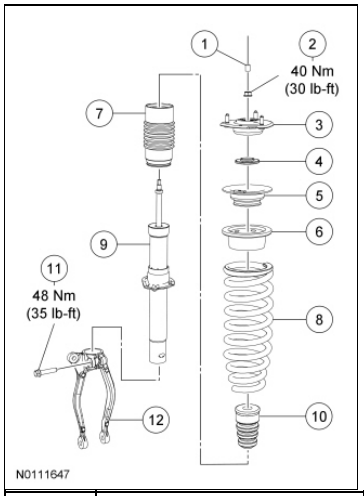
11. For additional information on the disassembly and assembly of the shock absorber and spring assembly, refer to Shock Absorber and Spring Assembly in this section.



Shock Absorber and Spring Assembly

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A



Item	Part Number	Description
1	18A179	Shock absorber rod protective cap
2	18A161	Shock absorber rod nut
3	18183	Shock absorber upper mount
4	-	Strut bearing (part of 18183)
5	-	Spring seat (part of 18183)
6	5793	Spring seat - rubber
7	3C239	Dust boot
8	5310	Spring
9	18184	Shock absorber and lower mount assembly
10	18198	Jounce bumper
11	W302119	Shock absorber-to-damper fork bolt
12	3463 LH/ 3462 RH	Damper fork

Disassembly and Assembly

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

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

⚠ **WARNING: The coil spring is under extreme load. Care must be taken at all times when removing or installing a loaded spring. Failure to follow this instruction may result in serious personal injury.**

NOTICE: **The coil spring is coated with long-term corrosion protective paint. Do not damage the paint during component servicing or damage to the coil spring may occur.**

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

1. Remove the shock absorber and spring assembly. For additional information, refer to Shock Absorber and Spring Assembly in this section.

2. ⚠ **WARNING: Always wear eye protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.**

   Position the shock and spring assembly in a suitable spring compressor.

3. Compress the spring enough to relieve the tension on the shock and spring assembly.

4. Remove the shock rod protective cap.

5. *NOTICE:* **Do not use an impact wrench on the shock absorber rod nut or damage to the shock absorber may occur.**

   NOTE: Use the hex-holding feature to prevent the shock absorber rod from turning while removing or installing the nut.

   While holding the shock absorber rod, remove and discard the nut.

   - To install, tighten the new nut to 40 Nm (30 lb-ft).

6. Remove the shock absorber and lower mount assembly.

7. Remove the shock absorber upper mount, spring upper seat and dust boot.

8. Carefully release the tension on the spring compressor and remove the spring.

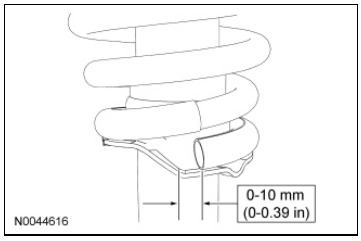
9. Remove and discard the shock absorber-to-damper fork bolt, then separate the shock and damper fork.
   - To install, tighten the new bolt to 48 Nm (35 lb-ft).

10. **NOTE:** Before installing the jounce bumper, apply silicone brake caliper grease and dielectric compound 360 degrees around the upper and lower contact surfaces.

    Remove the jounce bumper.

11. **NOTE:** Before tightening the shock absorber rod nut, position the end of the spring within 0-10 mm (0-0.39 in) of the step on the spring mount.

    To assemble, reverse the disassembly procedure.


0-10 mm
(0-0.39 in)
N0044616

Material

Item	Specification	Fill Capacity
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	-

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake caliper anchor plate bolt	70	52	-
Brake disc bolt	20	-	177
Brake disc shield bolt	23	17	-
Jounce stop	55	41	-
Lower arm cam adjuster nut	101	74	-
Lower arm outboard nut	103	76	-
Parking brake cable bracket bolt	10	-	89
Shock absorber bracket bolt	40	30	-
Shock absorber lower bolt - All-Wheel Drive (AWD)	90		

Rear Suspension

The rear suspension consists of the following components:

- Wheel bearing and wheel hub assemblies
- Wheel studs
- Upper arms
- Lower arms
- Toe links
- Stabilizer bar
- Stabilizer bar bushings
- Stabilizer bar links
- Trailing arms
- Wheel knuckles
- Wheel spindles
- Shock absorbers
- Coil springs

The rear suspension utilizes an independent short/long arm design. This suspension system incorporates a separate wheel knuckle for each wheel and allows the wheels to react to road imperfections independent of each other. This independent action offers improved isolation from the effects of jounce and rebound.

Rear Suspension

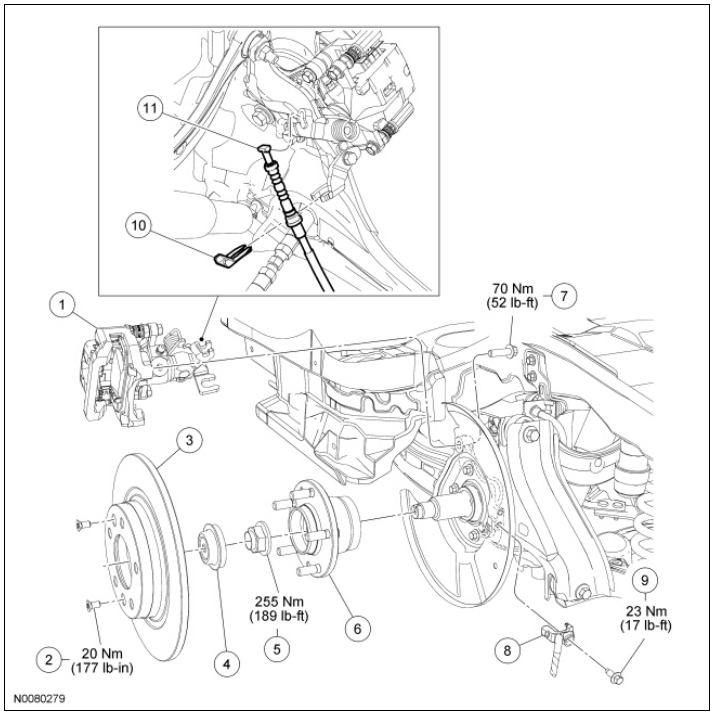
Refer to Section 204-00 .

Wheel Bearing and Wheel Hub

Special Tool(s)

 ST2446-A	Installer, Wheel Bearing Cup 205-147
 ST1895-A	Remover, Drive Pinion Bearing Cone 205-D002 (D79L-4621-A) or equivalent
 ST2446-A	Remover/Installer, Wheel Bearing Cup 204-020
 ST2446-A	Step Plate 205-117

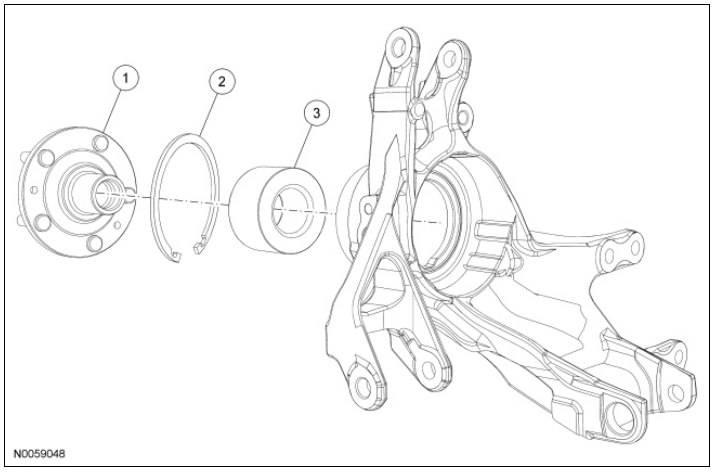
Front Wheel Drive (FWD) Vehicles



Item	Part Number	Description
1	-	Brake caliper and anchor plate assembly
2	W505741	Brake disc bolt (2 required)
3	2C026	Brake disc

4	1N135	Grease cap
5	W712435	Wheel hub nut
6	1104	Wheel hub and bearing assembly
7	W711240	Brake caliper anchor plate bolt (2 required)
8	2C187	Wheel speed sensor
9	W500222	Wheel speed sensor bolt
10	2860	Parking brake cable clip
11	2A815	Rear parking brake cable assembly

All-Wheel Drive (AWD) Vehicles



Item	Part Number	Description
1	1104	Wheel hub
2	W303280	Snap ring
3	1215	Wheel bearing

Removal

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

Front Wheel Drive (FWD) vehicles

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

2. Remove the wheel speed sensor bolt and position the sensor aside.

3. Disconnect the parking brake cable from the brake caliper in the following sequence.
    1. Remove the clip.
    2. Disconnect the parking brake cable from the brake caliper.

4. ***NOTICE:*** **Do not allow the brake caliper and anchor plate assembly to hang from the brake hose or damage to the hose can occur.**

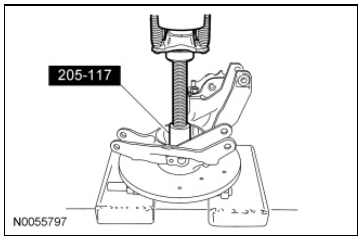
Remove the anchor plate bolts and position the brake caliper and anchor plate assembly aside.

- Support the brake caliper and anchor plate assembly using mechanic's wire.

5. Remove the 2 brake disc bolts and the brake disc.
6. Remove and discard the grease cap.
7. Remove and discard the wheel hub nut and remove the wheel hub and bearing assembly.

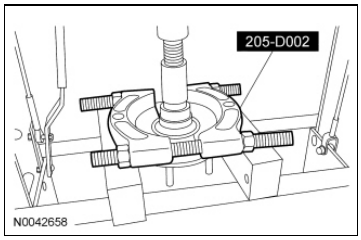
All-Wheel Drive (AWD) vehicles

8. Remove the wheel knuckle. For additional information, refer to Wheel Knuckle in this section.
9. Using the Step Plate, press the wheel hub from the wheel bearing.

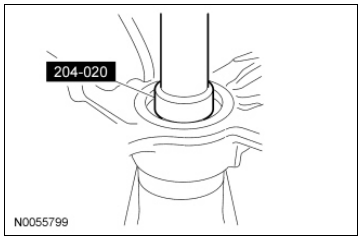


10. **NOTE:** This step may be necessary if the inner wheel bearing race remains in the wheel knuckle after removing the wheel hub.

    Install the Drive Pinion Bearing Cone Remover, position in a suitable press and press the inner wheel bearing race from the wheel hub.



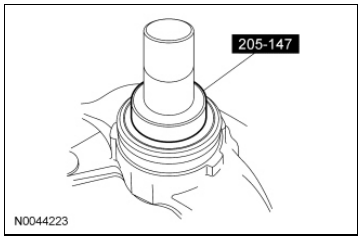
11. Remove the snap ring.
12. Using the Wheel Bearing Cup Remover/Installer, press the outer wheel bearing race from the wheel knuckle.



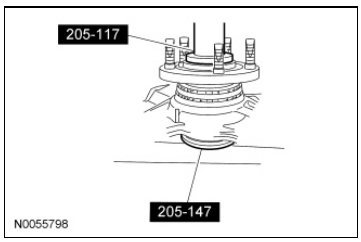
Installation

AWD vehicles

1. Using the Wheel Bearing Cup Installer, press the wheel bearing into the wheel knuckle.



2. Using the Wheel Bearing Cup Installer and Step Plate, press the wheel hub into the wheel bearing.



3. Install the wheel knuckle. For additional information, refer to Wheel Knuckle in this section.

FWD vehicles

4. Position the wheel speed sensor and install the bolt.
   - Tighten to 23 Nm (17 lb-ft).

5. Install the brake disc and the 2 brake disc bolts.
   - Tighten to 20 Nm (177 lb-in).

6. Position the brake caliper and install the brake caliper anchor plate bolts.
   - Tighten to 70 Nm (52 lb-ft).

7. ***NOTICE:*** **Do not tighten the rear wheel hub nut with the vehicle on the ground. The nut must be tightened to specification before the vehicle is lowered onto the wheels. Wheel bearing damage will occur if the bearing is loaded with the weight of the vehicle applied.**

   Install the new wheel hub and bearing and a new wheel hub nut.

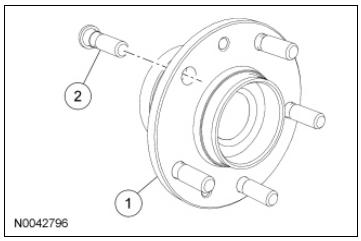
   - While applying the brakes to keep the halfshaft from rotating, tighten to 255 Nm (189 lb-ft).

8. Connect the parking brake cable to the brake caliper in the following sequence.
   1. Install the clip.
   2. Connect the parking brake cable to the brake caliper.

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

Wheel Studs

NOTE: Front Wheel Drive (FWD) vehicle shown, All-Wheel Drive (AWD) similar.



Item	Part Number	Description
1	1104	Wheel bearing and wheel hub assembly
2	1107	Wheel stud

Removal

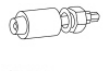
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the wheel bearing and wheel hub. For additional information, refer to Wheel Bearing and Wheel Hub in this section.
3. Using a press, remove the wheel stud from the wheel hub.

Installation

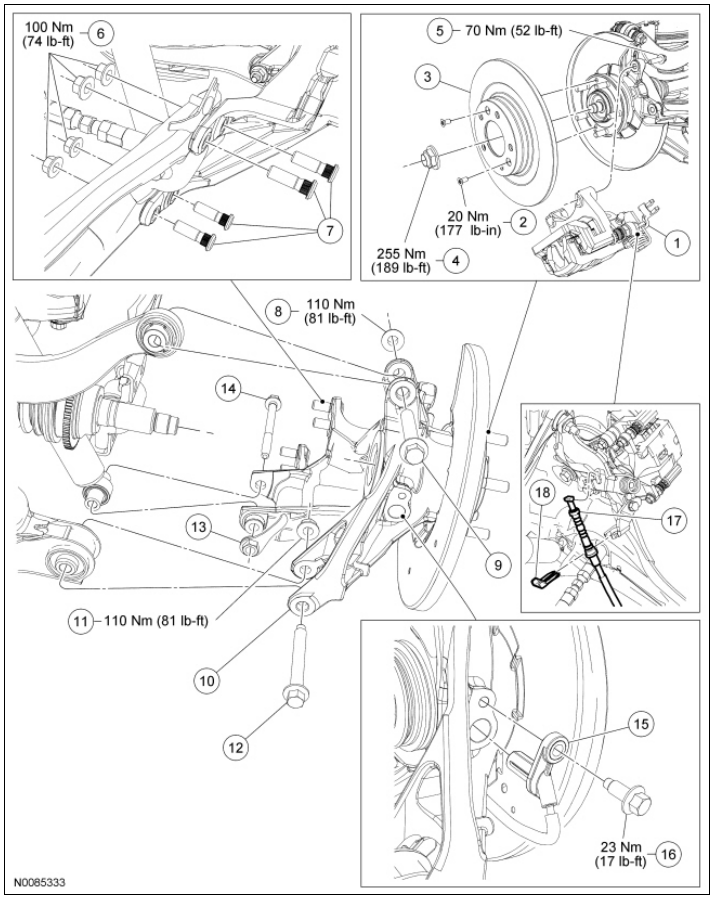
1. Position the new wheel stud in the wheel hub, aligning the serrations in the wheel hub flange made by the original wheel stud.
2. Using a press, install the new wheel stud.
3. Install the wheel bearing and wheel hub. For additional information, refer to Wheel Bearing and Wheel Hub in this section.

Wheel Knuckle

Special Tool(s)

 ST2138-A	Installer, Halfshaft 204-161 (T97P-1175-4)
 ST2330-A	Remover, Front Wheel Hub 205-D070 (D93P-1175-B) or equivalent

NOTE: All-Wheel Drive (AWD) MKZ vehicle shown, other vehicles similar.



Item	Part Number	Description
1	-	Brake caliper and anchor plate assembly
2	W505741	Brake disc bolt (2 required)
3	2C026	Brake disc
4	W712435	Wheel hub nut

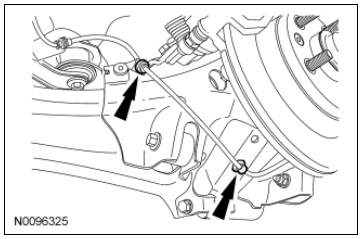
5	W711240	Brake caliper anchor plate bolt (2 required)
6	W520515	Trailing arm-to-wheel knuckle nuts (4 required)
7	5B860	Trailing arm-to-wheel knuckle bolts (4 required)
8	W520515	Upper arm outboard nut
9	W500547	Upper arm outboard bolt
10	5A968	Wheel knuckle
11	W520215	Lower arm outboard nut
12	W513798	Lower arm outboard bolt
13	W302116	Shock absorber lower flagnut
14	W704586	Shock absorber lower bolt
15	2C187 LH/ 2C187 RH	Wheel speed sensor
16	W500222	Wheel speed sensor bolt
17	2A815	Parking brake cable assembly
18	2860	Parking brake cable clip

Removal

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

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Detach the 2 wheel speed sensor harness retainers.



3. Remove the wheel speed sensor bolt and position the sensor aside.

4. Disconnect the parking brake cable from the brake caliper in the following sequence.
    1. Remove the clip.
    2. Disconnect the parking brake cable from the brake caliper.

5. **NOTE:** Apply the brake to keep the halfshaft from rotating.

   Remove and discard the wheel hub nut.

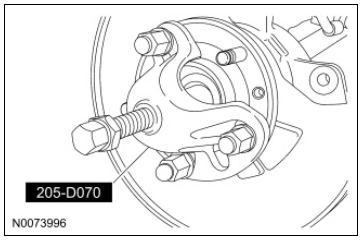
6. ***NOTICE:*** **Do not allow the brake caliper and anchor plate assembly to hang from the brake hose or damage to the hose can occur.**

   Remove the anchor plate bolts and position the brake caliper and anchor plate assembly aside.

- Support the brake caliper and anchor plate assembly using mechanic's wire.

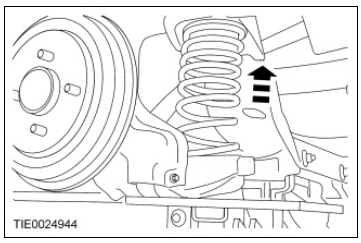
7. Remove the 2 brake disc bolts and the brake disc.

8. Using the Front Wheel Hub Remover, separate the halfshaft from the wheel hub.



9. Remove and discard the shock absorber lower bolt and flagnut.
   - If equipped, remove the shock absorber damper.

10. Using a suitable jack, raise the lower arm.



11. Remove and discard the upper arm outboard bolt.

12. Remove and discard the lower arm outboard bolt.

13. Remove the 4 trailing arm-to-knuckle nuts and the wheel knuckle.
    - Discard the nuts.

Installation

NOTICE: **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 395 mm (15.55 in). This will prevent incorrect clamp load and bushing damage.**

1. Position the wheel knuckle and loosely install the 4 new trailing arm-to-knuckle nuts.

2. Loosely install the new lower arm outboard bolt.

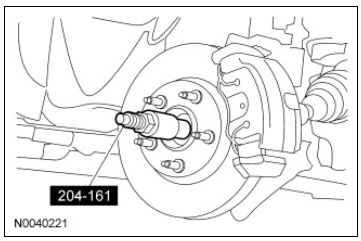
3. Loosely install the new upper arm outboard bolt.

4. Loosely install the new shock absorber lower bolt and flagnut.

5. Install the brake disc and the 2 brake disc bolts.
   - Tighten to 20 Nm (177 lb-in).

6. Position the brake caliper and anchor plate assembly and install the 2 bolts.
   - Tighten to 70 Nm (52 lb-ft).

7. Using the Halfshaft Installer, install the halfshaft into the wheel hub.

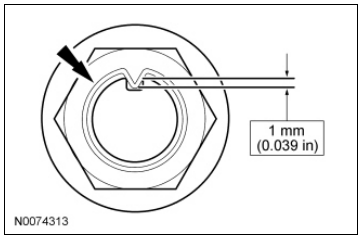


8. ***NOTICE:*** **Do not tighten the wheel hub nut with the vehicle on the ground. The nut must be tightened to specification before the vehicle is lowered onto the wheels. Wheel bearing damage will occur if the wheel bearing is loaded with the weight of the vehicle applied.**

   Install a new wheel hub nut.

   - While applying the brakes to prevent the wheel hub nut from turning, tighten to 255 Nm (189 lb-ft).

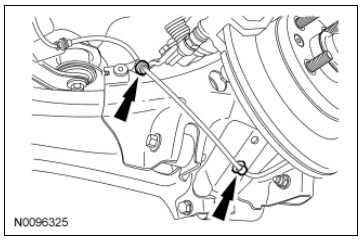
9. Stake the new nut in line with the keyway to a recommended depth of 1 mm (0.039 in) below the keyway diameter to engage the locking feature.



10. Connect the parking brake cable to the brake caliper in the following sequence.
    1. Install the clip.
    2. Connect the parking brake cable to the brake caliper.

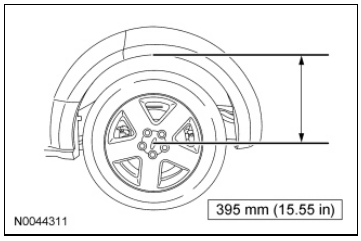
11. Install the wheel speed sensor and the bolt.
    - Tighten to 23 Nm (17 lb-ft).

12. Attach the 2 wheel speed sensor harness retainers.



13. ***NOTICE:*** **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 395 mm (15.55 in). This will prevent unequal clamp load and bushing damage.**

    Using the positioned suitable jack, raise the lower arm to bushing fastener tightening position.



14. Tighten the 4 trailing arm-to-knuckle nuts to 100 Nm (74 lb-ft).

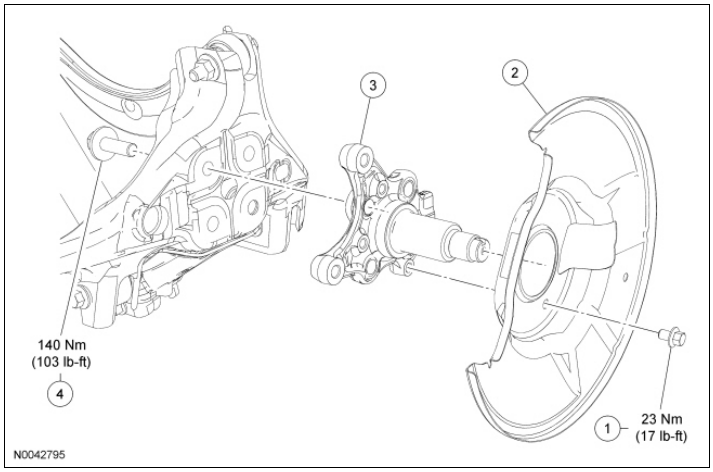
15. Tighten the lower arm outboard bolt to 103 Nm (76 lb-ft).

16. Tighten the upper arm outboard bolt to 110 Nm (81 lb-ft).

17. Tighten the shock absorber lower bolt.
    - Tighten to 90 Nm (66 lb-ft), All-Wheel Drive (AWD) vehicles.
    - Tighten to 115 Nm (85 lb-ft), Front Wheel Drive (FWD) vehicles.

18. Lower and remove the jack.

Wheel Spindle



Item	Part Number	Description
1	W500020	Brake disc shield bolt (3 required)
2	2K046 LH/ 2K045 RH	Brake disc shield
3	4A013	Wheel spindle
4	W715590	Wheel spindle bolt (4 required)

Removal and Installation

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

1. Remove the wheel bearing and wheel hub assembly. For additional information, refer to Wheel Bearing and Wheel Hub in this section.

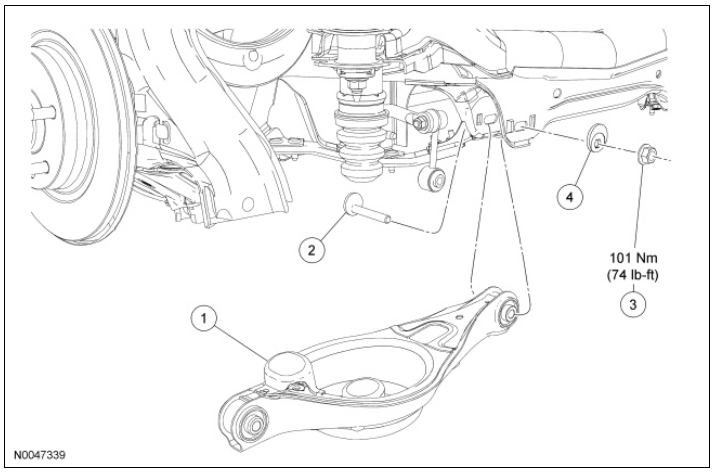
2. Remove the 3 brake disc shield bolts and remove the brake disc shield.
   - To install, tighten to 23 Nm (17 lb-ft).

3. Remove and discard the 4 wheel spindle bolts and remove the wheel spindle.
   - To install, tighten the new bolts to 140 Nm (103 lb-ft).

4. To install, reverse the removal procedure.

Lower Arm

NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.



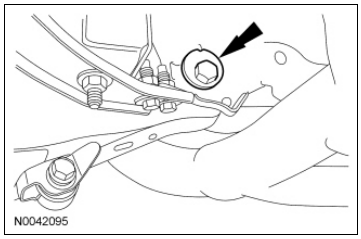
Item	Part Number	Description
1	5A649	Lower arm
2	5K751	Cam bolt
3	W520515	Cam adjuster nut
4	6269	Cam adjuster

Removal and Installation

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

1. Remove the spring. For additional information, refer to Spring in this section.

2. Remove the cam adjuster nut, cam adjuster, cam bolt and the lower arm.
   - Discard the nut.
   - To install, tighten the new nut to 101 Nm (74 lb-ft) with the suspension at the bushing fastener tightening position.



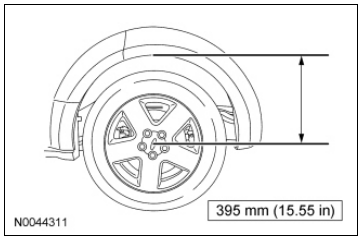
3. ***NOTICE:*** **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the**

distance between the center of the hub and the lip of the fender is equal to 395 mm (15.55 in). This will prevent incorrect clamp load and bushing damage.

NOTE: Do not fully tighten the cam adjuster nut until the rear alignment has been checked and, if necessary, adjusted.

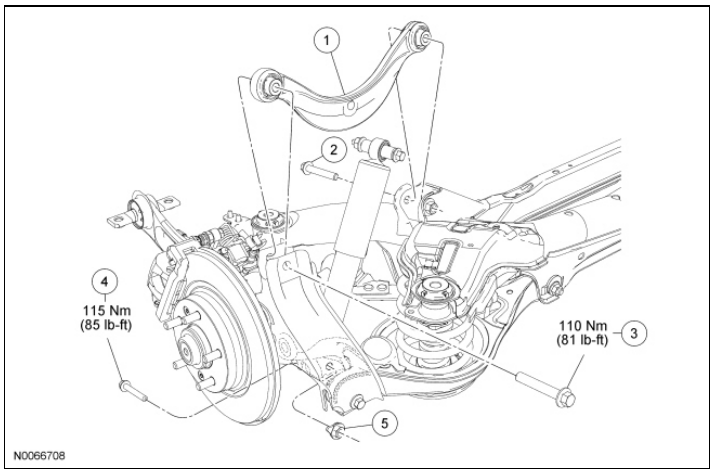
NOTE: Install the cam bolt and the cam adjuster with the cam facing upward.

To install, reverse the removal procedure.



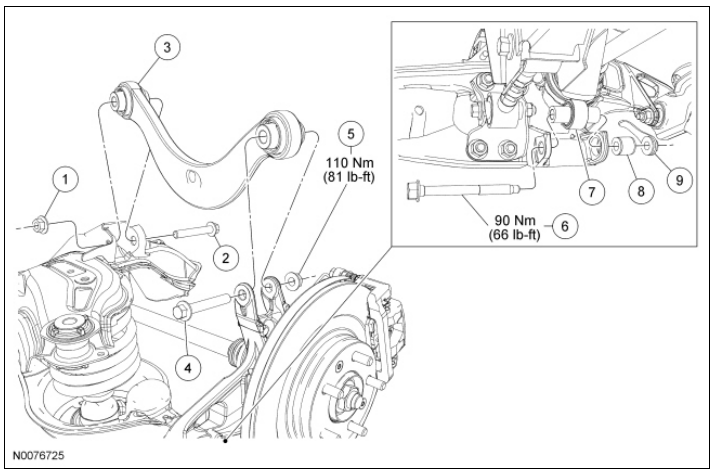
Upper Arm

Front Wheel Drive (FWD) Vehicles



Item	Part Number	Description
1	5500	Upper arm
2	W712769	Upper arm inboard bolt
3	W500546	Upper arm outboard bolt
4	W704586	Shock absorber lower bolt
5	W302116	Shock absorber lower flagnut

All-Wheel Drive (AWD) Vehicles



Item	Part Number	Description
1	W520215	Upper arm inboard nut
2	W712769	Upper arm inboard bolt
3	5500	Upper arm

4	W500547	Upper arm outboard bolt
5	W520215	Upper arm outboard nut
6	W712880	Shock absorber lower bolt
7	18080	Shock absorber
8	-	Shock absorber lower mount bushing
9	W302116	Shock absorber lower flagnut

Removal and Installation

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

All vehicles

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

2. Using a suitable jack, support the trailing arm.

3. ***NOTICE:*** **Do not fully tighten the shock absorber lower nut until the suspension is at the bushing fastener tightening position. This will prevent incorrect clamp load and bushing damage.**

   Remove and discard the shock absorber lower bolt and flagnut.

   - To install, tighten the new bolt and flagnut to 90 Nm (66 lb-ft), All-Wheel Drive (AWD) vehicles.
   - To install, tighten the new bolt and flagnut to 115 Nm (85 lb-ft), Front Wheel Drive (FWD) vehicles.

Front Wheel Drive (FWD) vehicles

4. Remove and discard the upper arm outboard bolt.
   - To install, tighten the new bolt to 110 Nm (81 lb-ft) with the suspension at the bushing fastener thtening position.

All-Wheel Drive (AWD) vehicles

5. Remove and discard the upper arm outboard bolt and nut.
   - To install, tighten the new nut and bolt to 110 Nm (81 lb-ft) with the suspension at the bushing fastener tightening position.

All vehicles

6. Carefully lower the trailing arm and remove the jack.

7. **NOTE:** Position the shock absorber as necessary to remove the upper arm.

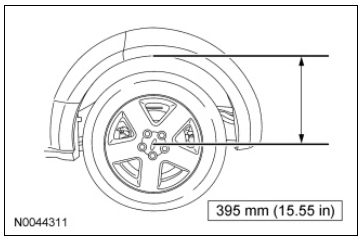
   NOTE: When tightening the upper arm inboard bolt, the suspension must be at the bushing fastener tightening position.

   Remove and discard the upper arm inboard bolt and remove the upper arm.

- To install, tighten the new bolt to 100 Nm (74 lb-ft) and then rotate an additional 90 degrees.

8. ***NOTICE:*** **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 395 mm (15.55 in). This will prevent incorrect clamp load and bushing damage.**

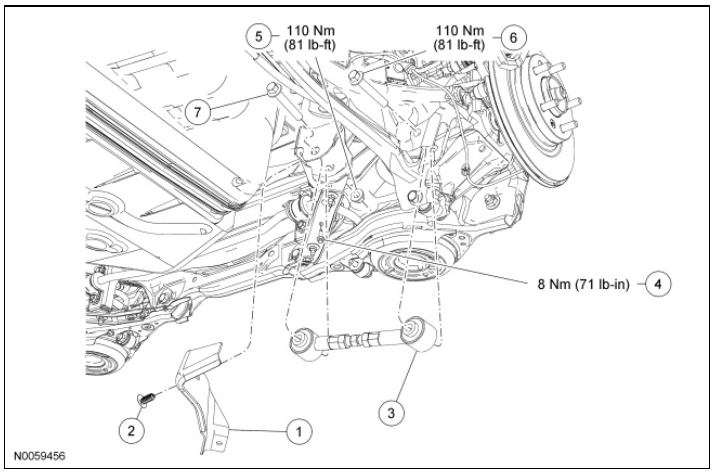
   To install, reverse the removal procedure.



9. Check and, if necessary, adjust the rear camber. For additional information, refer to Section 204-00 .

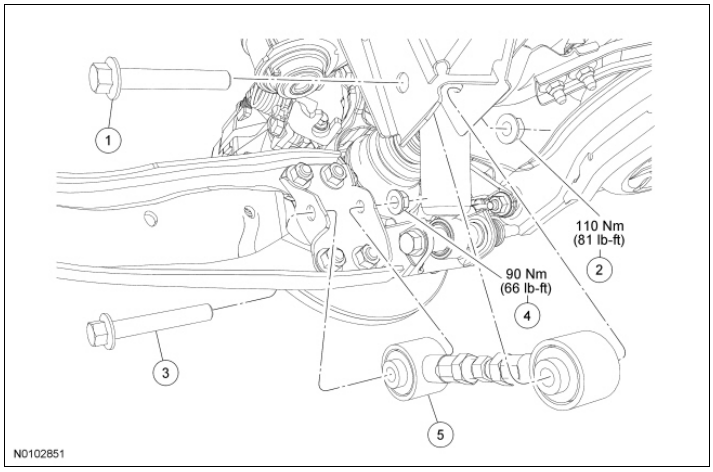
Toe Link

Front Wheel Drive (FWD) Vehicles



Item	Part Number	Description
1	5G095	Toe link shield
2	W709453	Pushpin
3	5B674	Toe link
4	W500214	Toe link shield bolt
5	W520515	Toe link inboard nut
6	W500547	Toe link outboard bolt
7	W500547	Toe link inboard bolt

All-Wheel Drive (AWD) Vehicles



Item	Part Number	Description
1	W500547	Toe link inboard bolt

2	W520515	Toe link inboard nut
3	W500547	Toe link outboard bolt
4	W520515	Toe link outboard nut
5	5B674	Toe link

Removal and Installation

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

All vehicles

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

Front Wheel Drive (FWD) vehicles

2. Remove the toe link shield bolt.
   - To install, tighten to 8 Nm (71 lb-in).

3. Remove the pushpin and the shield.

All vehicles

4. Remove and discard the toe link inboard nut and bolt.
   - To install, tighten the new nut to 110 Nm (81 lb-ft) with the suspension at the bushing fastener tightening position.

All-Wheel Drive (AWD) vehicles

5. Remove and discard the toe link outboard nut and bolt and remove the toe link.
   - To install, tighten the new nut to 90 Nm (66 lb-ft) with the suspension at the bushing fastener tightening position.

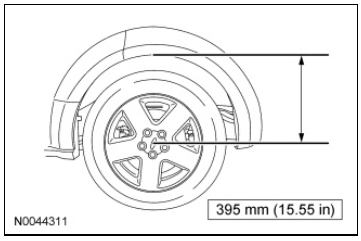
FWD vehicles

6. Remove the toe link outboard bolt and remove the toe link.
   - To install, tighten the new bolt to 110 Nm (81 lb-ft) with the suspension at the bushing fastener tightening position.

All vehicles

7. *NOTICE:* **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 395 mm (15.55 in). This will prevent incorrect clamp load and bushing damage.**

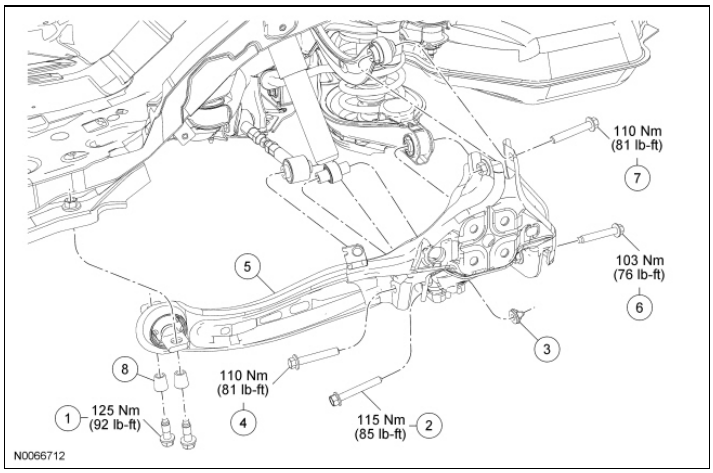
   To install, reverse the removal procedure.



8. Check and, if necessary, adjust the rear toe. For additional information, refer to Section 204-00 .

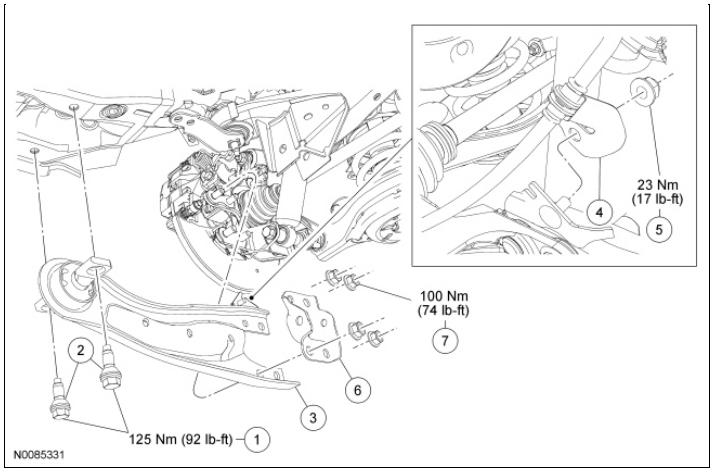
Trailing Arm

Front Wheel Drive (FWD) Vehicles



Item	Part Number	Description
1	W711493	Trailing arm-to-frame bolt (2 required)
2	W704586	Shock absorber lower bolt
3	W302116	Shock absorber lower flagnut
4	W500546	Toe link outboard bolt
5	5A995 LH/ 5A994 RH	Trailing arm
6	W513798	Lower arm outboard bolt
7	W500546	Upper arm outboard bolt
8	6C028	Cone washer (2 required)

All-Wheel Drive (AWD) Vehicles



Item	Part Number	Description

1	W711493	Trailing arm-to-frame bolts (2 required)
2	6C028	Cone washers (2 required)
3	5A995 LH/ 5A994 RH	Trailing arm
4	-	Wheel speed sensor bracket (part of 2C186 RH/2C187 LH)
5	W520102	Wheel speed sensor bracket nut
6	5A757	Trailing arm toe link bracket
7	5B860	Trailing arm-to-knuckle nut (4 required)

Removal and Installation

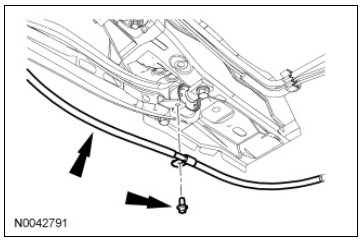
NOTICE: **Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure may result in major service expense. New parts must be installed with the same part numbers or equivalent part, if replacement is necessary. Do not use a replacement part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

All-Wheel Drive (AWD) vehicles

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

All vehicles

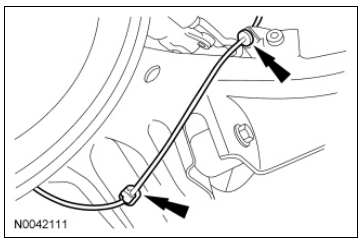
2. Remove the parking brake cable bracket bolt and position the parking brake cable aside.
   - To install, tighten to 10 Nm (89 lb-in).



Front Wheel Drive (FWD) vehicles

3. Remove the wheel spine. For additional information, refer to Wheel Spindle in this section.

4. If equipped, detach the wheel speed sensor harness from the trailing arm.



5. Using a suitable jack, support the trailing arm.

6. ⚠ **WARNING: The coil spring is under extreme load. Care must be taken at all times when removing or installing a loaded spring. Failure to follow this instruction may result in serious personal injury.**

Remove and discard the lower arm outboard bolt.

- To install, tighten the new bolt to 103 Nm (76 lb-ft) with the suspension at the bushing fastener tightening position.

7. Remove and discard the upper arm outboard bolt.
   - To install, tighten the new bolt to 110 Nm (81 lb-ft) with the suspension at the bushing fastener tightening position.

8. Carefully lower the trailing arm and remove the jack.

9. Remove and discard the shock absorber lower bolt and flagnut.
   - To install, tighten the new bolt and flagnut to 115 Nm (85 lb-ft) with the suspension at the bushing fastener tightening position.

10. Remove and discard the toe link outboard bolt.
    - To install, tighten the new bolt to 110 Nm (81 lb-ft) with the suspension at the bushing fastener tightening position.

AWD vehicles

11. Remove the wheel speed sensor harness bracket nut and position aside the bracket.
    - To install, tighten to 23 Nm (17 lb-ft).

12. Remove the toe link. For additional information, refer to Toe Link in this section.

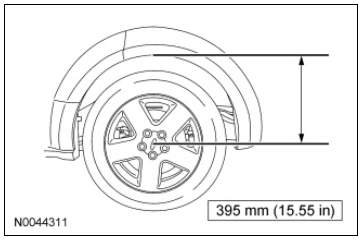
13. Remove the 4 trailing arm-to-wheel knuckle nuts and the trailing arm toe link bracket.
    - Discard the nuts.
    - To install, tighten the new nuts to 100 Nm (74 lb-ft).

All vehicles

14. Remove the 2 trailing arm-to-frame bolts, cone washers and the trailing arm.
    - Discard the bolts.
    - To install, tighten the new bolts to 125 Nm (92 lb-ft).

15. ***NOTICE:*** **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 395 mm (15.55 in). This will prevent incorrect clamp load and bushing damage.**

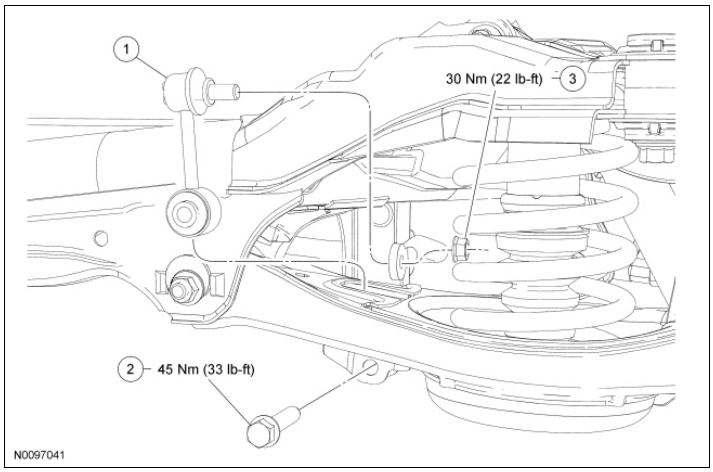
    To install, reverse the removal procedure.



16. Check and, if necessary, align the rear end. For additional information, refer to Section 204-00 .

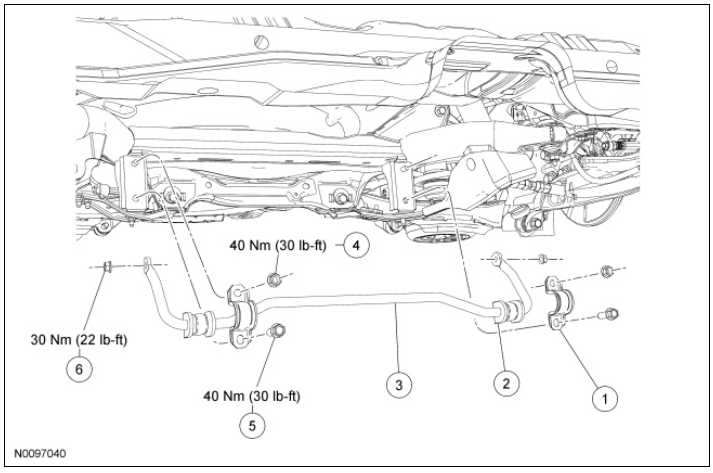
Stabilizer Bar and Link

NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.



Item	Part Number	Description
1	5A486	Stabilizer bar link
2	W302134	Stabilizer bar link lower bolt
3	3C494	Stabilizer bar link upper nut

NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.



Item	Part Number	Description
1	5B498	Stabilizer bar bracket (2 required)
2	5493	Stabilizer bar bushing (2 required)
3	5A772	Stabilizer bar
4	W302118	Stabilizer bar bracket nut (2 required)

5	W302131	Stabilizer bar bracket bolt (2 required)
6	3C494	Stabilizer bar link upper nut (2 required)

Removal and Installation

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

All-Wheel Drive (AWD) vehicles

1. Remove the rear halfshafts. For additional information, refer to Section 205-05 .

2. Remove the RH side spring.

Front Wheel Drive (FWD) vehicles

3. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

All vehicles

4. Remove and discard the 2 stabilizer bar link upper nuts.
   - To install, tighten the new nuts to 30 Nm (22 lb-ft).

5. Remove the 2 stabilizer bar link lower bolts and the stabilizer bar links.
   - Discard the bolts.
   - To install, tighten the new bolts to 45 Nm (33 lb-ft) with the suspension at the bushing fastener tightening position.

6. Remove and discard the stabilizer bar bracket nuts.
   - To install, tighten the new nuts to 40 Nm (30 lb-ft) with the suspension at the bushing fastener tightening position.

7. Remove the stabilizer bar bracket bolts and the brackets.
   - Discard the bolts.
   - To install, tighten the new bolts to 40 Nm (30 lb-ft) with the suspension at the bushing fastener tightening position.

FWD vehicles

8. Remove the stabilizer bar.

AWD vehicles

9. ***NOTICE:*** **Be careful not to contact the fuel lines or wiring harness when removing and installing the stabilizer bar or damage to the wiring harness or fuel lines may occur.**

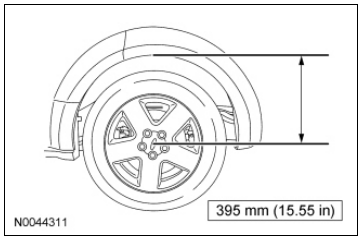
   Remove the stabilizer bar from the RH side of the vehicle.

All vehicles

10. Inspect the stabilizer bar bushings and install a new bushing(s), if necessary.

11. ***NOTICE:*** **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. This will prevent incorrect clamp load and bushing damage.**

    To install, reverse the removal procedure.

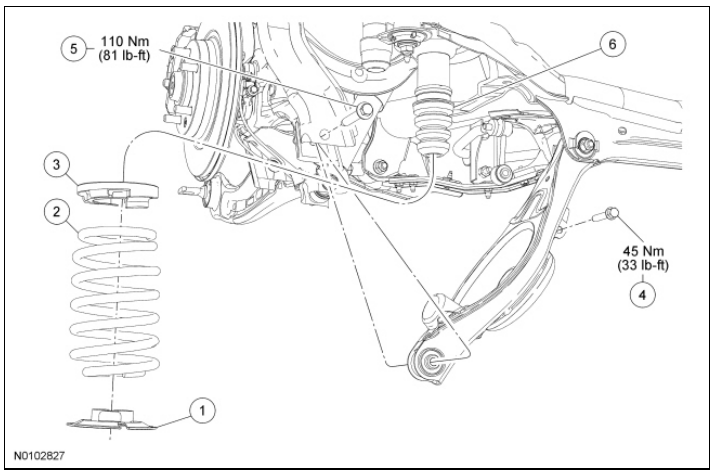


Spring

Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B

NOTE: Front Wheel Drive (FWD) shown, AWD similar.



Item	Part Number	Description
1	5536A	Spring lower seat
2	5560	Spring
3	5536B	Spring upper seat
4	W302134	Stabilizer bar link lower bolt
5	W302125	Lower arm outboard bolt
6	5K570	Jounce bumper

Removal

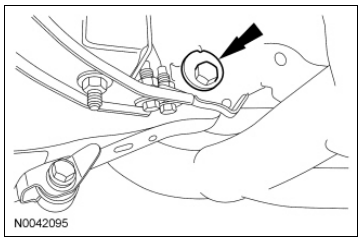
NOTICE: **The coil spring is coated with long-term corrosion protective paint. Do not damage the paint during component servicing or spring damage may occur.**

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

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

2. **NOTE:** Do not fully tighten the cam adjuster nut until the rear alignment has been checked and, if necessary, adjusted.

   Index-mark the cam bolt and cam adjuster and then loosen the cam adjuster nut.



3. Remove and discard the stabilizer bar link lower bolt.

4. Using a suitable jack, support the lower arm.

5. ⚠ **WARNING: The coil spring is under extreme load. Care must be taken at all times when removing or installing a loaded spring. Failure to follow this instruction may result in serious personal injury.**

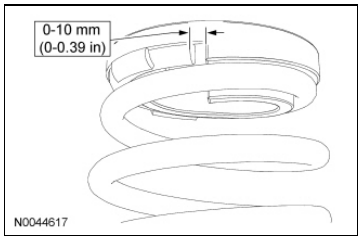
   Remove and discard the lower arm outboard bolt.

6. Lower the lower arm and remove the spring.
   - Inspect the spring upper and lower seats and install new seats as necessary.

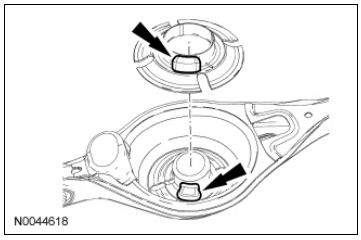
Installation

1. Inspect and if necessary, install a new jounce bumper.
   - Lubricate the top of the new jounce bumper with grease.

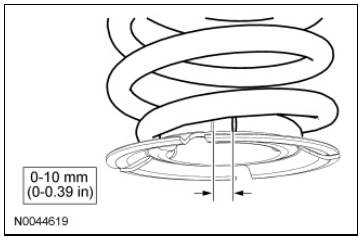
2. Position the spring upper seat onto the spring with the end of the spring 0-10 mm (0-0.39 in) from the step on the seat.



3. If removed, position the spring lower seat into the lower arm aligning the recess in the seat with the projection on the lower arm.



4. Position the spring onto the lower arm with the end of the spring 0-10 mm (0-0.39 in) from the step on the spring seat.

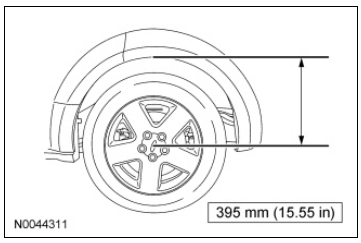


5. **NOTE:** Do not tighten the bolt at this time.

   Using the jack, raise the lower arm and install a new lower arm outboard bolt.

6. ***NOTICE:*** **Before tightening any suspension bushing fasteners, the suspension must be at the bushing fastener tightening position. This will prevent incorrect clamp load and bushing damage.**

   Using the jack, raise the suspension until the distance between the center of the hub and the lip of the fender is equal to 395 mm (15.55 in).



7. Tighten the lower arm outboard bolt to 110 Nm (81 lb-ft).

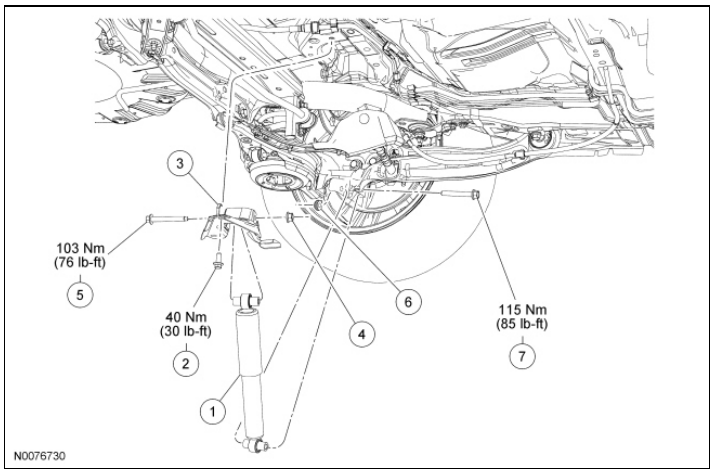
8. Install a new stabilizer bar link lower bolt.
   - Tighten to 45 Nm (33 lb-ft).

9. Align the index mark on the cam bolt and cam adjuster with the index mark on the lower arm and tighten the cam adjuster nut to 101 Nm (74 lb-ft).

10. Check and, if necessary, align the rear end. For additional information, refer to Section 204-00 .

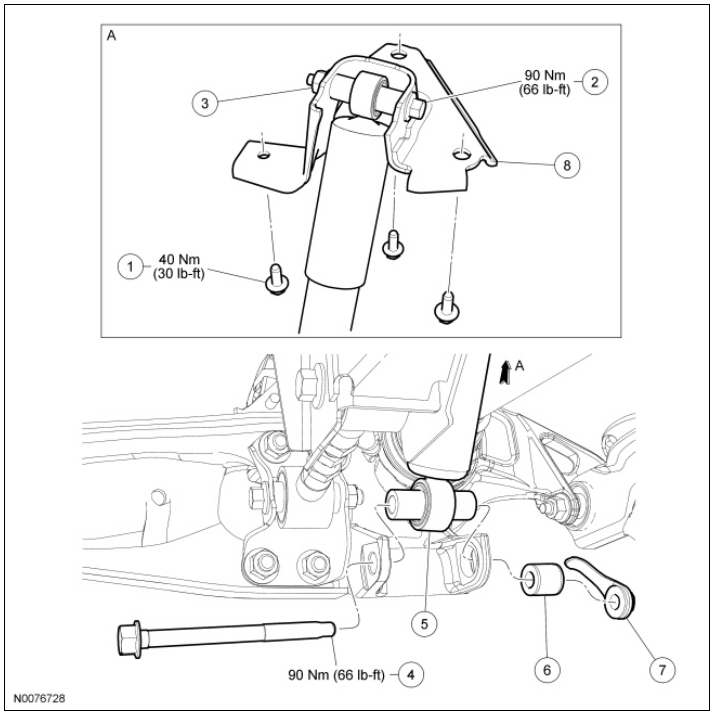
Shock Absorber

Front Wheel Drive (FWD) Vehicles



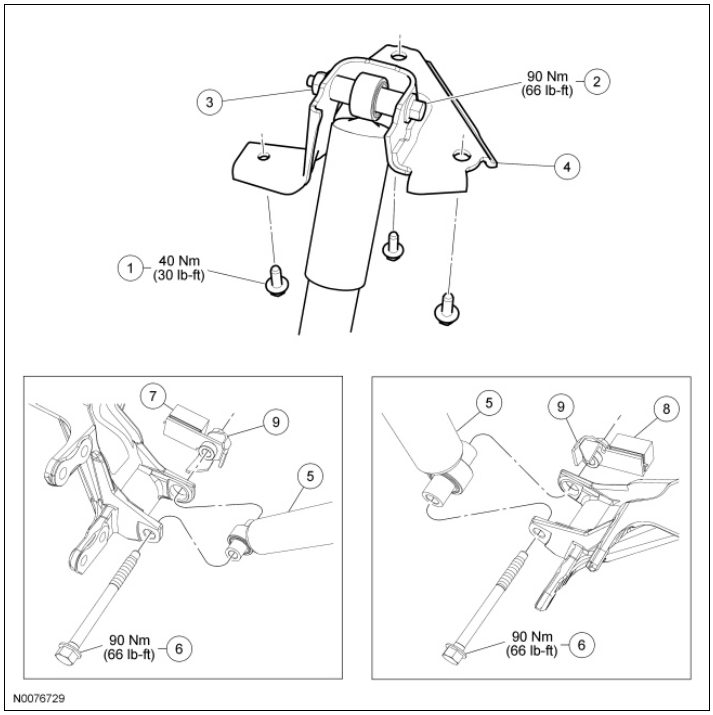
Item	Part Number	Description
1	18125	Shock absorber
2	W302277	Shock absorber bracket bolt (3 required)
3	18165 LH/ 18164 RH	Shock absorber bracket
4	W520515	Shock absorber upper nut
5	W500748	Shock absorber upper bolt
6	W302116	Shock absorber lower flagnut
7	W704586	Shock absorber lower bolt

All-Wheel Drive (AWD) MKZ Vehicles



Item	Part Number	Description
1	W302277	Shock absorber bracket bolt (3 required)
2	W500748	Shock absorber upper bolt
3	W520515	Shock absorber upper nut
4	W704586	Shock absorber lower bolt
5	18125	Shock absorber
6	18199	Shock absorber lower mount bushing
7	W302117	Shock absorber lower flagnut
8	18165 LH/ 18164 RH	Shock absorber bracket

All-Wheel Drive (AWD) Fusion/Milan Vehicles



Item	Part Number	Description
1	W302277	Shock absorber bracket bolt (3 required)
2	W500748	Shock absorber upper bolt
3	W520515	Shock absorber upper nut
4	18165 LH/ 18164 RH	Shock absorber upper bracket
5	18125	Shock absorber
6	W712880	Shock absorber lower bolt
7	5B695	Shock absorber damper LH side
8	5B695	Shock absorber damper RH side
9	W712848	Shock absorber lower flagnut (with 17-in wheel)
9	W302117	Shock absorber lower flagnut (with 16-in wheel)

Removal

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

NOTE: The new shock absorber is shipped with a strap securing it in the compressed position. Do not remove this strap until the shock absorber and bracket assembly are in position and the 3 bracket bolts have been installed.

1. Remove the upper arm. For additional information, refer to Upper Arm in this section.

2. Compress the shock absorber and secure it in the compressed position using tie straps or a similar item.

3. Remove the 3 shock absorber bracket bolts and remove the shock absorber and upper bracket.

- Discard the bolts.

4. Index-mark the shock absorber to the bracket.

5. Remove the shock absorber upper bolt, nut and the bracket.

Installation

1. Copy the index mark from the shock absorber that was removed to the shock absorber that is being installed.

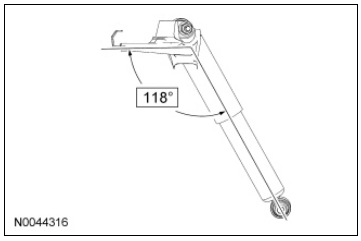
2. **NOTE:** Do not fully tighten the shock absorber upper bolt and nut at this time.

   Position the shock absorber into the bracket and loosely install a new shock absorber upper bolt and nut.

3. ***NOTICE:*** **Do not allow the angle between the shock absorber and bracket to change while tightening the shock absorber upper nut or damage to the shock absorber may occur.**

   Align the index marks so the center line of the shock absorber is approximately 118 degrees from the alignment tab on the bracket and tighten the shock absorber upper bolt.

   - For All-Wheel Drive (AWD) vehicles, tighten to 90 Nm (66 lb-ft).
   - For Front Wheel Drive (FWD) vehicles, tighten to 103 Nm (76 lb-ft).



4. Position the shock absorber and bracket assembly and install the 3 new bracket bolts.
   - Tighten to 40 Nm (30 lb-ft).

5. Install the upper arm. For additional information, refer to Upper Arm in this section.

Material

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

General Specifications

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

Torque Specifications

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

[a] Refer to the procedure in this section.

Wheels And Tires

Safety Precautions

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

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

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

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

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

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

⚠ WARNING: Always wear eye protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.

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

⚠ WARNING: Only use replacement tires that are the same size, load index, speed rating and type (such as P-metric versus LT-metric or all-season versus all-terrain) as those originally provided by Ford. The recommended tire and wheel size may be found on either the Safety Compliance Certification Label or the Tire Label, which is located on the B-pillar or edge of the driver's door. If the information is not found on these labels, consult a Ford dealer. Use of any tire or wheel not recommended by Ford can affect the safety and performance of the vehicle, which could result in an increased risk of loss of vehicle control, vehicle rollover, personal injury and death. Additionally, the use of non-recommended tires and wheels could cause steering, suspension, axle or transfer case/power transfer unit failure.

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

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

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

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

Tire Pressure Monitoring System (TPMS)

NOTE: The Smart Junction Box (SJB) is also identified as the Generic Electronic Module (GEM).

The Tire Pressure Monitoring System (TPMS) includes:

- the SJB , TPMS functionality is integrated within the SJB .
- four valve stem mounted tire pressure sensors.
- an Instrument Cluster (IC) indicator.
- a message center (if equipped).

Tire Pressure Monitoring System (TPMS) Module

The SJB contains the TPMS functionality. Refer to Tire Pressure Monitoring System (TPMS) in Diagnosis and Testing for TPMS fault diagnosis and repair.

The SJB compares the information of each tire pressure sensor transmission against a pressure limit. If the SJB determines that the tire pressure has fallen below the low limit, the SJB communicates this to the IC on the vehicle communication bus.

Tire Pressure Monitoring System (TPMS) Pressure Sensor

The SJB monitors the air pressure in the 4 road tires with tire pressure sensors. The sensors transmit radio frequency signals to the SJB approximately every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph).

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

Instrument Cluster (IC) and Message Center

The IC illuminates the TPMS indicator when it receives a message from the TPMS to do so and displays the appropriate message(s) in the message center (if equipped).

The IC and message center are diagnosed and serviced in their own respective workshop manual sections. Refer to the appropriate section in Group 413 for the procedure.

Wheels And Tires

Special Tool(s)

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

Inspection and Verification

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

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

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

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

Replacement tires must follow the recommended:

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

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

- ride.
- handling.
- speedometer/odometer calibration.
- vehicle ground clearance.
- tire clearance between the body and chassis.
- wheel bearing life.
- braking performance.

New wheels need to be installed when the vehicle wheels:

- are bent.
- are cracked.
- are dented.

- are heavily corroded.
- are leaking.
- have elongated wheel hub bolt holes.
- have excessive lateral or radial runout.

It is mandatory to use only the tire sizes recommended on the tire label located on the driver door or door pillar attached to the vehicle. Larger or smaller tires can damage the vehicle, affect durability and require changing the speedometer calibration. Make sure wheel size and offsets match those recommended for the tire in use.

1. Inspect the tires for signs of uneven wear. Refer to the following descriptions to identify the type of wear and GO to Symptom Chart - Tire Wear for the appropriate repair action to be carried out.

2. Check the tires for:
   - cuts.
   - stone bruises.
   - abrasions.
   - blisters.
   - embedded objects.

3. Check the valve stems for:
   - cracks.
   - cuts.

Install a new valve stem when damage is found or anytime a new tire is installed.

4. Tread wear indicators are molded into the bottom of the tread grooves. Install a new tire when the indicator bands become less than 2/32 inch.

Tire Wear

Tire wear is commonly defined as a loss of tread depth. Tire tread wear occurs due to friction with the contact surface (road/pavement). The tread should wear down uniformly all the way around the circumference of the tire and all the way across the tread face. When this does not occur, the tire may have abnormal/incorrect wear.

Normal Tire Wear

Normal tire wear is identified as even wear around and across the tread. Because there are many factors (driving style, road surfaces, type of vehicle, type of tire) that can affect tire wear, there is no absolute mileage expectation for a normal wear condition. A tire is considered worn-out when the tread has worn to the level of the tread-wear indicators.

Abnormal/Incorrect Tire Wear

Abnormal/incorrect tire wear is identified as tire wear that is not even around or across the tread and that creates performance-related issues.

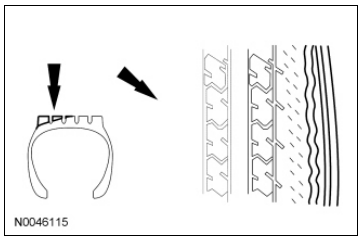
Abnormal/incorrect wear can be caused by numerous factors, some of which include driving style (aggressive, passive), climate (hot, cold), road conditions, vehicle loading and maintenance (correct tire pressure, rotation intervals and balance). It is important to determine the root cause of wear on a vehicle before carrying out repair. Tires exhibiting abnormal/incorrect tire wear may still be serviceable provided that the minimum tread depth is greater than 2/32 inch and the tire is not causing a vehicle performance (noise/vibration) concern.

Some abnormal/incorrect wear patterns look the same all the way around the tread of the tire, other wear patterns are not consistent and can occur in various spots on the tread area. The underlying causes of the 6 wear categories are different. Refer to the following descriptions to identify the type of wear and GO to Symptom Chart - Tire Wear for the appropriate repair action to be carried out.

Inner Edge/Shoulder Wear

Inner edge (or shoulder) wear occurs on the inside edge of the tire and is usually caused by excessive toe out and/or excessive negative camber. If the tread depth of the outer shoulder is at least 50% greater than the tread depth of the inner shoulder, the tire is experiencing inner edge/shoulder wear. To determine whether tires have this type of wear, visually inspect the tires. In some instances, it may be necessary to measure the tread depth of each rib and compare it to that of the shoulder.

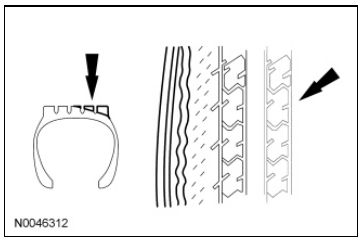
NOTE: RF tire shown, others similar.



Outer Edge/Shoulder Wear

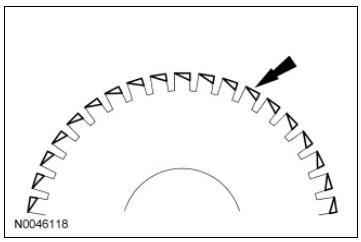
Outer edge (or shoulder) wear occurs on the outside edge of the tire and is usually caused by excessive toe in and/or excessive positive camber. If the tread depth of the inner shoulder is at least 50% greater than the tread depth of the outer shoulder, the tire is experiencing outer edge/shoulder wear. To determine whether tires have this type of wear, visually inspect the tires. In some instances, it may be necessary to measure the tread depth of each rib and compare it to that of the shoulder.

NOTE: RF tire shown, others similar.



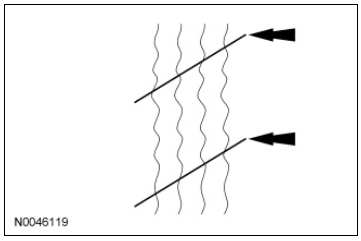
Heel/Toe Wear

Heel/toe wear (also known as feathering) occurs along the outside or inside edge/shoulder of the tire. To determine whether tires have this type of wear, visually inspect the tires in both the inside and outside shoulder ribs. In some instances, it may be necessary to measure the difference in tread depth of leading versus trailing edge of each lug in the inside and outside shoulder rib.



Diagonal Wear

Diagonal wear occurs diagonally across the tread area and around the circumference of the tire. To determine whether tires have this type of wear, visually inspect the tires to determine if the wear pattern runs diagonally across the tread and around the circumference of the tire. In some instances, the difference in tread depth along the diagonal wear pattern may need to be measured.



Symptom Chart - Tire Wear

Symptom Chart - Tire Wear
NOTE: For suspension system and additional alignment diagnosis, refer to Section 204-00 .

Condition	Possible Sources	Action
• Inner edge/shoulder wear	• Excessive toe out and/or negative camber	• GO to Pinpoint Test A .
• Incorrect wheel and tire assembly rotation intervals		• GO to Pinpoint Test A .
• High-speed cornering		• GO to Pinpoint Test A .
• Outer edge/shoulder wear	• Excessive toe in and/or positive camber	• GO to Pinpoint Test B .
• Incorrect wheel and tire assembly rotation intervals		• GO to Pinpoint Test B .
• High-speed cornering		• GO to Pinpoint Test B .
• Heel/toe wear		

- Excessive toe in/out
- Incorrect wheel and tire assembly rotation intervals

- ROTATE the wheel and tire assemblies. CHECK the alignment, ADJUST as necessary.

- Diagonal wear

- Excessive toe in/out

- GO to Pinpoint Test C .

- Incorrect tire rotation intervals

- GO to Pinpoint Test C .

- Loose, worn or damaged suspension components

- REFER to Section 204-00 .

Symptom Chart - NVH

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

ConditionPossible SourcesAction

- Wobble or shimmy

- Bent wheel

- INSTALL a new wheel as necessary.

- Damaged tire

- INSTALL a new tire as necessary.

- Loose wheel nuts

- TIGHTEN to specification.

- High-speed shake

- Tires/wheels

- REFER to Wheel and Tire Runout Component Tests in this section.

- Vehicle vibration

- Tires/wheels
- REFER to Wheel and Tire Runout Component Tests in this section.

Pinpoint Tests

For a description of the various tire wear patterns, refer to Inspection and Verification.

Pinpoint Test A: Inner Edge/Shoulder Wear

This pinpoint test is intended to diagnose the following:
- Excessive toe out
- Incorrect wheel and tire rotation

PINPOINT TEST A: INNER EDGE/SHOULDER WEAR

Test Step	Result / Action to Take
A1 MEASURE THE TREAD DEPTH	
• Using a tread depth gauge or similar tool, measure the inside edge/shoulder tread depth. • **Is the tread depth greater than 2/32 inch?**	**Yes** ROTATE the wheel and tire assemblies. CHECK and ADJUST the toe to nominal +0.15 degrees (toe in). CHECK and ADJUST caster and camber to nominal. REFER to Section 204-00 . **No** INSTALL a new tire(s). CHECK and ADJUST the toe to nominal. CHECK and ADJUST caster and camber to nominal. REFER to Section 204-00 .

Pinpoint Test B: Outer Edge/Shoulder Wear

This pinpoint test is intended to diagnose the following:
- Excessive toe in
- Incorrect wheel and tire rotation

PINPOINT TEST B: OUTER EDGE/SHOULDER WEAR

Test Step	Result / Action to Take
B1 MEASURE THE TREAD DEPTH	
• Using a tread depth gauge or similar tool, measure the outside edge/shoulder tread depth.	**Yes** ROTATE the wheel and tire assemblies. CHECK and ADJUST the toe to nominal -0.15 degrees (toe

• **Is the tread depth greater than 2/32 inch?**	out). CHECK and ADJUST caster and camber to nominal. REFER to Section 204-00 . **No** INSTALL a new tire(s). CHECK and ADJUST the toe to nominal. CHECK and ADJUST caster and camber to nominal. REFER to Section 204-00 .

Pinpoint Test C: Diagonal Wear

This pinpoint test is intended to diagnose the following:
- Incorrect wheel and tire rotation
- Excessive toe in/out
- Incorrect tire inflation
- Loose, worn or damaged suspension components

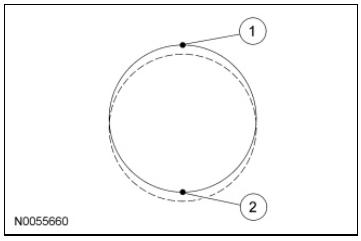
PINPOINT TEST C: DIAGONAL WEAR

Test Step	Result / Action to Take
C1 MEASURE THE TREAD DEPTH	
• Using a tread depth gauge or similar tool, measure the tread depth of the wear pattern. • **Is the tread depth greater than 2/32 inch?**	**Yes** If no performance concerns (noise/vibration) are present, the tire can remain in service. CHECK the air pressure in the tires, ADJUST as necessary. ROTATE the wheel and tire assemblies. INSPECT for loose, worn or damaged suspension components. INSTALL new components as necessary. CHECK the alignment and ADJUST as necessary. REFER to Section 204-00 . **No** INSTALL a new tire(s). CHECK the air pressure in the tires, ADJUST as necessary. ROTATE the wheel and tire assemblies. INSPECT for loose, worn or damaged suspension components. INSTALL new components as necessary. CHECK the alignment and ADJUST as necessary. REFER to Section 204-00 .

Component Tests

Radial Runout

Radial runout is the egg-shaped deviation from a perfect circle and is measured perpendicular to the circumference. On a wheel and tire assembly, this means measuring the center tire tread rib. The center rib is indicative of the condition of the tire as a whole. Total runout is the difference between the maximum-to-minimum gauge reading. The high spot is the location of maximum runout.



Item	Description
1	High spot
2	Low spot

Loaded Runout Measurement (Hunter Road Force® 9700 Series Wheel Balancer)

NOTE: Diagnosis of tire/wheel vibration should not be performed on tires with less than 320 km (200 mi). Some initial tire/wheel vibration issues (such as flat spotting) may correct themselves after the tires have been in service for 320 km (200 mi).

This procedure is intended to assist with the diagnosis of wheel and tire assembly runout and/or force variation issues.

The Hunter Road Force® 9700 Series Wheel Balancer measures the wheel and tire assembly's loaded runo and the tire's radial spring rate. The balancer then converts the runout into pounds of force (termed as Road Force®). Measuring loaded runout (Road Force®) is more effective than measuring unloaded runout using a dial indicator.

1. Using a tire crayon, record the vehicle position on the inward sidewall of all 4 tires.

2. Remove the wheel and tire assemblies. Refer to Wheel and Tire in this section.

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

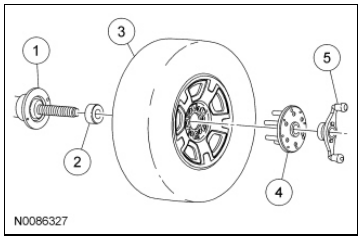
   Make sure that the tire pressures are set to the correct pressure as indicated on the Vehicle Certification (VC) label.

4. ***NOTICE:*** **Make sure that the correct wheel balancer adapters are used when mounting the assembly to the wheel balancer or damage to the wheel may occur.**

   NOTE: Make sure that the wheel and tire assembly is clean and free of foreign material prior to installation on the balancer.

   NOTE: The wheel balancer inflation station must be turned OFF for tires with inflation pressures of 414 kPa (60 psi) or above.

   Mount the wheel and tire assembly on a suitable wheel balancer using the correct wheel balancer adapters as shown. Refer to the list of recommended wheel bancer adapters on the PTS website.



Item	Description
1	Wheel balancer
2	Cone
3	Wheel and tire assembly
4	Finger plate
5	Balancer wing nut

5. Measure the Road Force®.
    - Temporarily mark the high spot and the Road Force® value on the sidewall of the tire. If the wheel and tire assembly Road Force® value is greater than 9 kg (20 lb), carry out the Match Mounting procedure to optimize the wheel and tire assembly.
    - If the wheel and tire assembly Road Force® value is 9 kg (20 lb) or less, permanently mark the high spot and the Road Force® value on the inward sidewall of the tire for reference during future wheel and tire service. Balance the assembly and install the wheel and tire on the vehicle using the Wheel-to-Hub Optimization procedure.

Runout Measurement (Dial Indicator)

NOTE: Diagnosis of tire/wheel vibration should not be performed on tires with less than 320 km (200 mi). Some initial tire/wheel vibration issues (such as flat sng) will correct themselves after the tires have been in service for 320 km (200 mi).

NOTE: Loaded run-out measurements are the preferred method for verifying tire serviceability. While a dial indicator can be used to optimize the position of the tire on the wheel, the unloaded run-out measurement cannot accurately determine if the tire should be removed from service.

The following procedures should be used if normal diagnostics leads to a potential runout issue.

Some vehicles may exhibit a wheel and tire vibration caused by excessive runout. Radial runout measurements can be taken using a dial indicator and should be measured with the wheel and tire assembly mounted on a suitable wheel balancer. The dial indicator should be mounted securely to eliminate gauge movement when measuring runout.

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

   Make sure that the tire pressures are set to the correct pressure as indicated on the VC label.

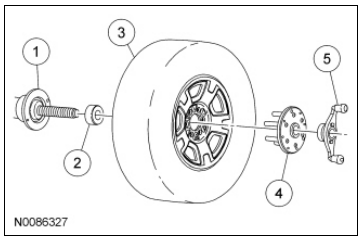
2. Using a tire crayon, record the vehicle position on the inward sidewall of all 4 tires.

3. Remove the wheel and tire assemblies. Refer to Wheel and Tire in this section.

4. ***NOTICE:*** **Make sure that the correct wheel balancer adapters are used when mounting the assembly to the wheel balancer or damage to the wheel may occur.**

   NOTE: Make sure that the wheel and tire assembly is clean and free of foreign material prior to installation on the balancer.

   Mount the wheel and tire assembly on a suitable wheel balancer using the correct wheel balancer adapters as shown. Refer to the list of recommended wheel balancer adapters on the PTS website.

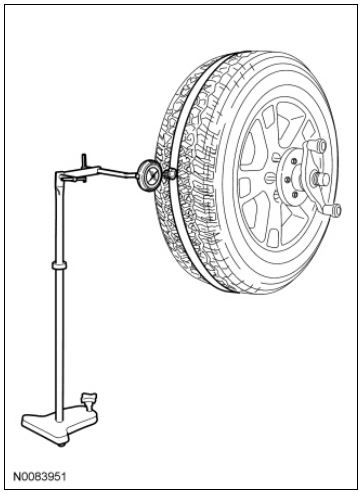


Item	Description
1	Wheel balancer
2	Cone
3	Wheel and tire assembly
4	Finger plate
5	Balancer wing nut

5. **NOTE:** Masking tape can be applied on the center tread rib to allow for a smoother measuring surface. Some fluctuation of the gauge reading is expected. Observe the overall sweep of the gauge from the highest to the lowest spot on the tire.

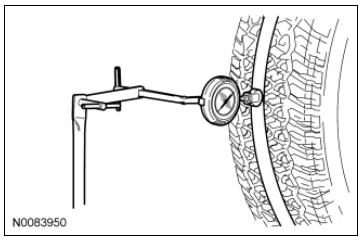
   Position a suitable dial indicator and stand with the dial indicator on the center tread rib.

   - Rotate the wheel and tire assembly (or wheel) to locate the low spot.
   - Adjust the runout gauge to read 0.
   - Rotate the wheel and tire assembly one complete revolution to make sure that the low spot has been found and that the dial indicator returns to a 0 reading.



6. While slowly and constantly rotating the wheel and tire assembly (or wheel), measure the radial runout.

- Note the variance (runout) from 0 on the dial of the gauge.
- If the runout reading of a wheel and tire assembly is greater than 1.14 mm (0.045 in), locate and temporarily mark the high spot and runout reading on the sidewall of the tire and carry out the Match Mounting procedure to optimize the wheel and tire assembly.
- If the runout reading of a wheel and tire assembly is 1.14 mm (0.045 in) or less, permanently mark the high spot and the runout reading on the inward sidewall of the tire for reference during future wheel and tire service. Balance the assembly and install the wheel and tire on the vehicle using the Wheel-to-Hub Optimization procedure.

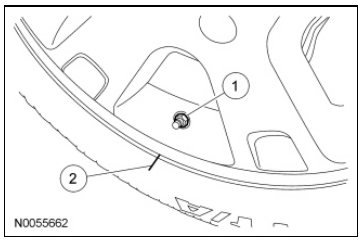


Match Mounting

NOTE: Road Force® values in illustrations are shon in pounds.

Match mounting is a technique used to reduce radial runout or road force on wheel and tire assemblies. Excessive runout is a source of ride quality complaints and match mounting can be used to minimize the runout. Match mounting can be accomplished by changing the position of the tire on the wheel.

1. Position the wheel and tire assembly on a tire machine and put a reference mark on the tire sidewall at the valve stem position.



Item	Description
1	Valve stem
2	Reference mark

2. ***NOTICE:*** **For vehicles equipped with a Tire Pressure Monitoring System (TPMS), the sensor may be damaged by incorrect tire mounting or dismounting. Dismount the tire from the wheel as instructed in the Disassembly and Assembly procedure. Failure to follow these instructions may result in TPMS component damage.**

   NOTE: Always make sure that the final high spot and measurement values are permanently marked on the inward sidewall of the tire for reference during future wheel and tire service.

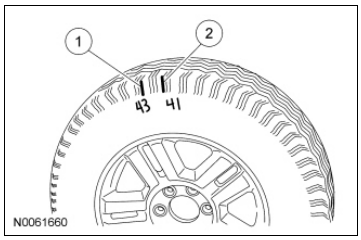
   Using a suitable tire machine, separate the tire beads from the wheel.

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

- Position the tire 180 degrees (half-way around) on the rim so the valve stem reference mark is now opposite the valve stem.

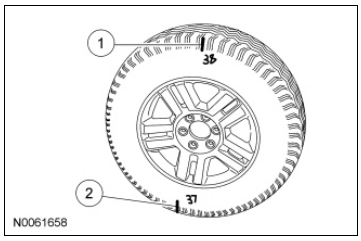
3. Re-inflate the wheel and tire assembly to the specified air pressure and measure the assembly again using a suitable dial indicator or Hunter Road Force® 9700 Series Wheel Balancer. Mark the second high spot on the tire.
    - If the runout or Road Force® is reduced to within specifications, the concern has been resolved. Balance the assembly and install on the vehicle using the Wheel-to-Hub Optimization procedure.

4. If the second runout or Road Force® measurement is still not within specification and both high spots are close to each other (within 101.6 mm [4 in]), the root cause is probably the tire (the high spot followed the tire).
    - To be **SURE** that the tire is causing the high runout, it is necessary to have 2 runout or Road Force® measurements that are not within specification and the high spots must be in approximately the same location on the tire's sidewall. If the tire is the cause, install a new tire, balance the assembly and install on the vehicle using the Wheel-to-Hub Optimization procedure.
    - If the second high spot is not within 101.6 mm (4 in) of the first high spot, proceed to the next step.



Item	Description
First high spot on the tire	
2	Second high spot on the tire

5. If the second high spot is still above specification and is within 101.6 mm (4 in) of being opposite the first high spot on the wheel, the root cause is probably the wheel (the high spot followed the wheel). Dismount the tire from the wheel, mount the wheel on a balancer and check the wheel runout. If the wheel runout exceeds 1.14 mm (0.045 in), install a new wheel, balance the assembly and install on the vehicle using the Wheel-to-Hub Optimization procedure.

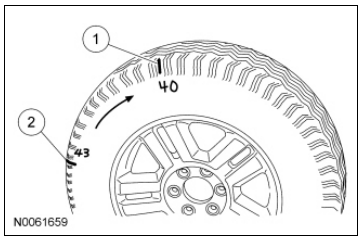


Item	Description
1	First high spot on the tire
2	Second high spot on the tire

6. **NOTE:** If the second high spot did not follow the wheel or the tire and the runout is still not within specification, improvements may be made by rotating the tire 90 degrees (one-fourth turn).

   Draw an arrow on the tire sidewall from the second high spot towards the first high spot (in the shortest direction).

   - Separate the tire beads from the wheel and rotate the tire 90 degrees (one-fourth turn) in the direction of the arrow.

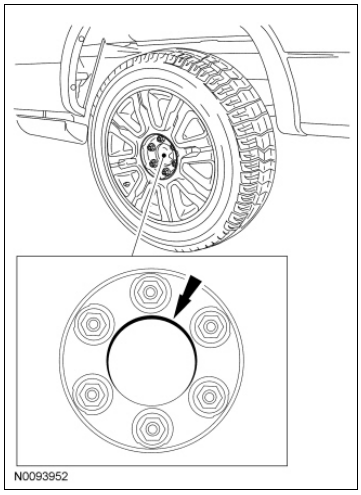


Item	Description
1	First high spot on the tire
2	Second high spot on the tire

Wheel-to-Hub Optimization

Wheel-to-hub optimization is important. Clearance between the wheel and hub can be used to offset or neutralize the Road Force® or run-out of the wheel and tire assembly. For every 0.001 inch of wheel-to-hub clearance, the Road Force® can be affected between 1 and 3 pounds depending on the tire stiffness.

NOTE: The example below illustrates how the clearance between the wheel and the hub can be used to offset the high spot of radial run-out or Road Force®. Following the procedure will make sure of the best optimization.



1. Position the wheel and tire assembly on the vehicle so that the high spot location of radial run-out or Road Force® is at the 6 o'clock position and install the wheel nuts by hand until snug.

2. **NOTE:** Do not allow the full weight of the vehicle to rest on the tires while tightening the wheel nuts.

   Lower the vehicle until the tires make contact with the ground, sliy loading the suspension. Tighten

the wheel nuts as described in Wheel and Tire in this section.

Tire Pressure Monitoring System (TPMS)

Special Tool(s)

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

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also referred to as the Generic Electronic Module (GEM).

The Tire Pressure Monitoring System (TPMS) monitors the air pressure of all 4 road tires. The wheel-mounted tire pressure sensors transmit via radio frequency signals, to the SJB . TPMS functionality is integral to the SJB . These transmissions are sent approximately every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph). The TPMS function compares each tire pressure sensor transmission against a low-pressure limit. If it has been determined that the tire pressure has fallen below this limit, the SJB communicates this on the vehicle communication bus to the Instrument Cluster (IC). The IC then illuminates the TPMS indicator and displays the appropriate message(s) in the message center (if equipped).

For vehicles with different front and rear tire pressures (such as the E-Series and certain F-Series), the tire pressures must be adjusted and the tire pressure sensors must be trained following a tire rotation. Failure to train the sensors will cause the TPMS indicator to illuminate.

For vehicles with the same tire pressures for front and rear tires, tire rotation will not affect the system.

Ambient Temperature Change and Tire Pressure

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

NOTICE: **Do not inflate tire higher than maximum pressure stamped on tire sidewall. Premature tire wear or damage to the tire may result.**

Tire pressures fluctuate with temperature changes. For this reason, tire pressure must be set to specification when tires are at outdoor ambient temperatures. If the vehicle is allowed to warm up to shop temperatures, and the outside temperature is less than shop temperature, the tire inflation pressure must be adjusted accordingly.

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

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

Table 1. Use Table to Adjust Tire Pressure Inside Garage for Colder Outside Temperature[1]
** Do Not Inflate Tire Higher than Maximum Pressure Stamped on Tire Sidewall. **

Table is based on a Garage Temperature of 70˚F. Max Pressure Adjustment is 7 psi.

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

Table 2. Use Table to Adjust Tire Pressure Inside Garage for Colder Outside Temperature (Metric Units)[1]
** Do Not Inflate Tire Higher than Maximum Pressure Stamped on Tire Sidewall. **

Table is based on a Garage Temperature of 21˚C. Max Pressure Adjustment is 50 kPa.

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

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

N0057700

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

The TPMS indicator and vehicle message center (if equipped) sometimes displays faults that cannot be resolved by the customer. Treat these messages as TPMS faults that must be serviced.

>

Tire Pressure Monitoring System (TPMS) Indicator Illuminates Continuously

NOTE: If the spare tire is in use, the damaged road tire must be repaired and installed on the vehicle to restore complete TPMS functionality before carrying out any diagnosis.

NOTE: For vehicles with different front and rear tire pressures (such as E-Series and certain F-Series), the tire pressure sensors must be trained following a tire rotation. Failure to train the sensors will result in a false low tire pressure event, which will cause the TPMS indicator to illuminate.

1. The TPMS indicator remains on continuously for the following condition:
    - Low Tire Pressure - The TPMS indicator is illuminated solid and the message center displays LOW TIRE PRESSURE (if equipped). This is displayed when any of the tire pressures are

low. When this condition exists, the tire pressure must be adjusted to the recommended cold pressure as indicated on the VC label.

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

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

Tire Pressure Monitoring System (TPMS) Indicator Flashes

The TPMS indicator flashes for 70 seconds, then remains ON solid when the ignition swch is turned to the ON position, for the following conditions:

1. Tire Pressure Sensor Fault - If equipped, the message center will display TIRE PRESSURE SENSOR FAULT when a tire pressure sensor is malfunctioning. GO to Symptom Chart .

2. No communication with the SJB (TPMS is integral to the SJB) - The TPMS indicator is illuminated when the IC has not received any signals from the SJB for more than 5 seconds. If equipped, the message center displays TIRE PRESSURE MONITOR FAULT. GO to Som Chart .

3. Tire Pressure Monitor Fault - If equipped, the message center will display TIRE PRESSURE MONITOR FAULT when the TPMS is malfunctioning or communication with the IC has been lost. GO to Symptom Chart .

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

TPMS Status PID

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

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

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

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

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

TPMS Last Warning Event PID Definitions

The TPMS uses the TPMS last warning event PIDs to store detailed information about the last 5 times the

TPMS warning indicator was activated. These PIDs can be used to acquire more information about a particular TPMS event.

EVT1_IGN through EVT5_IGN

The number of key cycles since the TPMS warning indicator was activated. This PID cycles from zero to 255 and then starts over from zero again. This can be used to determine how long ago a TPMS event occurred and the time (in key cycles) between events.

EVT1_TLOC through EVT5_TLOC

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

EVT1_PSI through EVT5_PSI

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

EVT1_STAT through EVT5_STAT

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

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

EVT1_TxID through EVT5_TxID

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

Wheel Rotation and Sensor Training Techniques

Moving a Problem Sensor/Wheel to a Different Position

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

Training Sensors in a Different Order

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

Training Known Good Sensors From Another Vehicle

Training known good sensors from another vehicle cannot differentiate between a faulted module and Radio Frequency Interference (RFI), as some noise source could be preventing the module from receiving the tire pressure status from the original sensors as well as the known good sensors. This technique that can be used to

differentiate between a sensor and module issue. If the module in the vehicle cannot train any of its own sensors, and likewise cannot train known good sensors from another vehicle, then the issue is with the module or the RFI , and not with the original sensors. The original sensors should not be replaced.

Items That Cause RFI

Non-OEM Equipment

The following equipment has been found to sometimes cause RFI :

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

OEM Modules

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

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

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

Options for Eliminating Intermittent TPMS Conditions Caused by RFI

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

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

Inspection and Verification

1. **NOTE:** The tire pressure sensors are not designed to be used with aftermarket wheels.

   NOTE: The use of run-flat tires (tires with steel body cord plies in the tire sidewall) where not originally equipped, may cause the TPMS to malfunction and is therefore not recommended.

Verify the customer concern by inspecting the vehicle and observing the message center (if equipped) and the TPMS indicator.

2. **NOTE:** The valve-mounted TPMS sensors and the strap-mounted TPMS sensors are not compatible. Swapping wheels from one vehicle to another with the different systems will adversely affect TPMS operation.

   NOTE: Swapping wheels between vehicles with the same TPMS will cause a TPMS fault to be set if the sensors are not trained. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.

   NOTE: Non-OEM modifications made to the vehicle may result in false TPMS warnings.

   Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
• Low tire pressure • Tire Pressure Monitoring System (TPMS) sensor damaged or missing • Spare tire installed as a road wheel • Incorrect TPMS sensor installed • TPMS sensor installed incorrectly • Sensors not trained after a tire rotation on vehicles with different front and rear tire pressures • Non-OEM wheels installed (aftermarket rims) • Non-OEM equipped run-flat tires installed • Other non-OEM modifications (roll cages, service barriers, part racks, ladder racks)	• Wiring, terminals or connectors • Smart Junction Box (SJB) • Aftermarket electronic accessories

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.

- refer to Section 418-00 to diagnose no response from the PCM.

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

8. Clear the CMDTCs and carry out the self-test diagnostics for the SJB (the TPMS is part of the SJB).

9. If the DTCs retrieved are related to the concern, go to the Tire Pressure Monitoring System (TPMS) DTC Chart. For all other DTCs, refer to the Master DTC Chart in Section 419-10 .

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

DTC Charts

Tire Pressure Monitoring System (TPMS) DTC Chart

DTC	Description	Source	Action
B106B	Tire Pressure Sensor Low Battery	Smart Junction Box (SJB)	DTC B106B can be set during SJB configuration. GO to Pinpoint Test G .
B106D	Tire Pressure Monitoring System (TPMS) Initiators Not Configured	SJB	DTC B106D is only present when a new SJB is installed, the SJB is incorrectly flashed or the SJB is incorrectly configured. Successfully configuring the SJB is the only way to clear this DTC. VERIFY the SJB is correctly configured. If DTC B106D is still present, REFER to Section 418-01 .
B2477	Module Configuration Failure/Mismatch	SJB	DTC B2477 is only present when a new SJB is installed, the SJB is incorrectly flashed or the SJB is incorrectly configured. Successfully configuring the SJB is the only way to clear this DTC. MAKE SURE the SJB is configured correctly. If DTC B2477 is still present, REFER to Section 418-01 .
B2868	LF Tire Pressure Sensor Fault	SJB	DTC B2868 is only present when a new SJB is installed, the SJB is flashed or the SJB is reconfigured. TRAIN the tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
B2869	RF Tire Pressure Sensor Fault	SJB	DTC B2869 is only present when a new SJB is installed, the SJB is flashed or the SJB is reconfigured. TRAIN the tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
B2870	RR Tire Pressure Sensor Fault	SJB	DTC B2870 is only present when a new SJB is installed, the SJB is flashed or the SJB is reconfigured. TRAIN the tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
B2871	LR Tire Pressure Sensor Fault	SJB	DTC B2871 is only present when a new SJB is installed, the SJB is flashed or the SJB is reconfigured. TRAIN the tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
B2872		SJB	

	Tire Pressure Sensor Fault		**NOTE:** If the vehicle has been stationary for more than 30 minutes, the sensors will go into a "sleep mode" to conserve battery power. It will be necessary to wake them up so they will transmit the latest tire pressure information to the SJB . ACTIVATE the TPMS sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Activation in this section. GO to Pinpoint Test F .
B287A	Tire Pressure System Fault	SJB	GO to Pinpoint Test F .
C2780	ECU in Manufacturing Mode	SJB	DTC C2780 is only present when a new SJB is installed, the SJB is flashed or the SJB is reconfigured. TRAIN the tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
U0155	Lost Communication with Instrument Cluster (IC)	SJB	REFER to Section 418-00 to diagnose the no communication problem.
All other SJB DTCs	-	SJB	REFER to the Master DTC Chart in Section 419-10 .

Symptom Chart

Symptom Chart
NOTE: For vehicles with different front and rear tire pressures (such as E-Series and certain F-Series), the tire pressures must be adjusted and the tire pressure sensors must be trained following a tire rotation. Failure to train the sensors will result in a false low tire pressure event, which will cause the Tire Pressure Monitoring System (TPMS) indicator to illuminate.

For vehicles with the same tire pressure for front and rear tires, tire rotation will not affect the system.

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

ConditionPossible SourcesAction

- Tire Pressure Monitoring System (TPMS) indicator ON solid and message center (if equipped) displays LOW TIRE PRESSURE
- Spare tire currently in use
- INSTALL the repaired road wheel/tire in place of the spare tire.
- Air pressure not set to specifications listed on the Vehicle Certification (VC) label
- GO to Pinpoint Test D .
- Sensors not trained following tire rotation

- ADVISE customer that on vehicles with different front and rear tire pressure, the sensors must be trained as directed in the Owner's Literature.

- Smart Junction Box (SJB) will not enter sensor training mode when using the TPMS sensor training procedure

- Brake ON/OFF switch
- Ignition switch
- Vehicle communication bus
- SJB

- GO to Pinpoint Test E .

- TPMS indicator FLASHES for 70 seconds and then remains ON solid when the ignition key is turned to the ON position, the message center (if equipped) displays TIRE PRESSURE SENSOR FAULT and DTC B2872 is present

- Intermittent TPMS operation due to Radio Frequency Interference (RFI)
- TPMS sensors not trained
- Not all TPMS sensors are installed
- TPMS sensor(s)
- SJB

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

  ACTIVATE the TPMS sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Activation in this section. GO to Pinpoint Test F .

- TPMS indicator FLASHES for 70 seconds and then remains ON solid when the ignition key is turned to the ON position, the message center (if equipped) displays TIRE PRESSURE MONITOR FAULT and DTC B287A is present

- TPMS sensors not trained
- Not all TPMS sensors are installed

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

  ACTIVATE the TPMS sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Activation in this section. GO to Pinpoint Test F .

- TPMS indicator FLASHES for 70 seconds and then remains ON solid when the ignition key is turned to the ON position, the message center (if equipped) displays TIRE PRESSURE MONITOR FAULT and there are no DTCs present

- Vehicle communication issue between the SJB and the Instrument Cluster (IC)

- REFER to Section 418-00 to diagnose the no communication concern.

- SJB

- REFER to Section 419-10 to diagnose the SJB .

- One or more sensors will not train

- TPMS sensor(s)
- Vehicle communication issue
- SJB

- RETRIEVE and RECORD DTCs. REFER to Tire Pressure Monitoring System (TPMS) DTC Chart in this section.

- One or more sensors will not train and no DTCs are present

- TPMS sensor(s)
- Attempting to install a banded TPMS sensor that is not compatible with a valve mounted sensor

- TRAIN all 4 tire pressure sensors. REFER to Tire Pressure Monitoring System (TPMS) Sensor Training in this section.
- If a sensor does not respond to the Tire Pressure Monitor Activation Tool, MOVE the vehicle to rotate the wheels at least one-fourth of a turn and ATTEMPT to activate the same sensor again. If the sensor still does not respond, ATTEMPT to activate the same sensor again using the customer activation tool (if available). If the sensor still fails to train, ATTEMPT to train the sensor with the vehicle doors open.
- If the sensor(s) fails to train a second time, INSTALL a new sensor(s). REFER to Tire Pressure Monitoring System (TPMS) Sensor in this section.

Pinpoint Tests

Pinpoint Test D: Tire Pressure Monitoring System (TPMS) Indicator ON Solid and Message Center (if equipped) Displays LOW TIRE PRESSURE

Normal Operation

The Tire Pressure Monitoring System (TPMS) monitors the air pressure of all 4 road tires. The wheel-mounted tire pressure sensors transmit via radio frequency signals, to the Smart Junction Box (SJB). TPMS functionality is integral to the SJB . These transmissions are sent approximately every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph). The TPMS function (integral to the SJB) compares each tire pressure sensor transmission against a low-pressure limit. If it has been determined that the tire pressure has fallen below this limit, the SJB communicates this on the vehicle communication bus to the Instrument Cluster (IC). The IC then illuminates the TPMS indicator and displays the appropriate message(s) in the message center (if equipped).

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

This pinpoint test is intended to diagnose the following:

- Low air pressure in tire(s)
- Tire pressure sensor(s)

PINPOINT TEST D: TIRE PRESSURE MONITORING SYSTEM (TPMS) INDICATOR ON SOLID AND MESSAGE CENTER (IF EQUIPPED) DISPLAYS LOW TIRE PRESSURE

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

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

Test Step	Result / Action to Take
D1 CHECK THE TIRE PRESSURE	
• Using the Digital Tire Gauge, measure and record the air pressure in all 4 road tires. • Adjust the air pressure for those found to be below the specification listed on the Vehicle Certification (VC) label. • **NOTE:** If the vehicle has been stationary for more than 30 minutes, activate each TPMS sensor. Refer to Tire Pressure Monitoring System (TPMS) Sensor Activation in this section. The TPMS sensor does not transmit when the vehicle is stationary. • Verify system operation. • **Have the TPMS indicator and the message center (if equipped) warnings gone out?**	**Yes** The system is functioning normally, diagnosis is complete. INFORM the customer of correct tire pressure maintenance as instructed in the scheduled maintenance guide and the Owner's Literature. **No** GO to D2 .
D2 CHECK THE SYSTEM COMPONENTS	
• Train all 4 tire pressure sensors. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Read and record the following PIDs: ♦ Left Front Tire Pressure (LF_PRES) ♦ Right Front Tire Pressure (RF_PRES) ♦ Left Rear Outer Tire Pressure (LRO_PRES) ♦ Right Rear Outer Tire Pressure (RRO_PRES)	**Yes** The system is functioning normally, diagnosis complete. **No** **Before installing a new sensor(s):** If a sensor does not respond to the Tire Pressure Monitor Activation Tool, MOVE the vehicle to rotate the wheels at least one-fourth of a turn and ATTEMPT to activate the same sensor again. If the sensor still does not respond, ATTEMPT to activate the same sensor again using the customer activation tool (if available). If the sensor still fails to train, ATTEMPT to train the sensor with the vehicle doors open. INSTALL new tire pressure sensors for those with discrepancies or those that fail to activate. REFER to Tire Pressure Monitoring System (TPMS) Sensor in this section.

• Compare the air pressure readings recorded from the function test to those recorded in D1. • **Do the compared tire pressure values match within ±5 psi, and have the TPMS indicator and the message center (if equipped) warnings gone out?**	

Pinpoint Test E: Smart Junction Box (SJB) Will Not Enter Sensor Training Mode When Using the Tire Pressure Monitoring System (TPMS) Sensor Training Procedure

Normal Operation

For the Smart Junction Box (SJB) to enter Tire Pressure Monitoring System (TPMS) sensor training mode, the SJB must receive valid inputs from the brake ON/OFF switch (OFF-ON-OFF) and ignition switch (both OFF and RUN), and it must receive valid vehicle speed sensor input (0 km/h [0 mph]) from the Instrument Cluster (IC). Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section for the complete sensor training procedure.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Brake ON/OFF switch
- Ignition switch
- SJB

PINPOINT TEST E: SMART JUNCTION BOX (SJB) WILL NOT ENTER SENSOR TRAINING MODE WHEN USING THE TIRE PRESSURE MONITORING SYSTEM (TPMS) SENSOR TRAINING PROCEDURE

Test Step	Result / Action to Take
E1 CHECK THE SJB BRAKE ON/OFF (GEM_BOO) PID	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the GEM_BOO PID (SJB reads the brake switch directly). • Press and release the brake pedal while monitoring the PID. • **Do the brake pedal PID values match the brake pedal positions?**	**Yes** GO to E2 . **No** REFER to Section 417-01 to continue diagnosis of the stoplamp switch.
E2 CHECK THE SJB IGNITION SWITCH PIDs	
• Monitor the following ignition switch PIDs: ♦ Ignition Switch Off (IGN_O_ECU)	**Yes** GO to E3 . **No** REFER to Section 211-05 to continue diagnosis of the ignition switch.

♦ Ignition Switch RUN (IGN_R_ECU) • Cycle the ignition switch to the RUN and OFF position while monitoring the PIDs (SJB reads the ignition switch directly). • **Do the ignition switch status PID values match the ignition switch positions?**	
E3 CHECK THE SJB VEHICLE SPEED SENSOR (VSS_GEM) PID	
• Monitor the VSS_GEM PID (SJB receives vehicle speed from the IC). • **Is the vehicle speed less than 5 km/h (3 mph)?**	**Yes** GO to E4 . **No** REFER to Section 413-01 to continue diagnosis of the IC /vehicle speed concern.
E4 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check the connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect all the SJB connectors and make sure that they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test F: TPMS Indicator FLASHES for 70 Seconds and Then Remains ON Solid When the Ignition Key is Turned to the ON Position, the Message Center (if equipped) Displays TIRE PRESSURE SENSOR or MONITOR FAULT and DTC B2872 or B287A is Present

Normal Operation

If there is a fault with 1, 2 or 3 of the Tire Pressure Monitoring System (TPMS) sensors, DTC B2872 sets. The TPMS warning indicator flashes for 70 seconds and then remains ON continuously when the ignition switch is turned to the ON position and the message center (if equipped) displays TIRE PRESSURE SENSOR FAULT.

If the Smart Junction Box (SJB) does not get a response from **all** 4 of the TPMS sensors, DTC B287A sets and the message center (if equipped) displays TIRE PRESSURE MONITOR FAULT.

It should be noted that TPMS communication can be interrupted by Radio Frequency Interference (RFI), which can cause intermittent issues. RFI is generated by electrical motors and appliance operation, cellular telephones, remote transmitters, power inverters and portable entertainment equipment. Anytime the TPMS sensor training procedure is performed successfully, the warning indicator is extinguished and the vehicle must be driven for 18-20 minutes before the SJB initiates a self test to verify system operation.

- DTC B2872 (Tire Pressure Sensor Fault) - set by the SJB when 1, 2 or 3 of the tire pressure sensors

are faulted, not responding or when data is not received by the SJB .
- DTC B287A (Tire Pressure Monitor Fault) - When **all** 4 of the tire pressure sensors are faulted, not responding or when data is not received by the SJB .
- TP_STAT PID = SYSTEM FAULT is displayed if the SJB does not receive a signal transmission from **all** 4 TPMS sensors for 20 minutes and the vehicle speed is above 32 km/h (20 mph).
- TP_STAT PID = SENSOR FAULT is displayed if the SJB does not receive a signal transmission from 1, 2, or 3 TPMS sensors for 20 minutes and the vehicle speed is above 32 km/h (20 mph).

This pinpoint test is intended to diagnose the following:
- Intermittent TPMS operation due to RFI
- TPMS sensor(s) not trained
- Not all TPMS sensors are installed
- TPMS sensor(s)
- SJB

PINPOINT TEST F: TPMS INDICATOR FLASHES FOR 70 SECONDS AND THEN REMAINS ON SOLID WHEN THE IGNITION KEY IS TURNED TO THE ON POSITION, THE MESSAGE CENTER (IF EQUIPPED) DISPLAYS TIRE PRESSURE SENSOR OR MONITOR FAULT AND DTC B2872 OR B287A IS PRESENT

Test Step	Result / Action to Take
F1 CHECK THE HORN OPERATION	
• Press the steering wheel horn pad for 2 seconds. • **Does the horn sound?**	**Yes** GO to F2 . **No** For horn diagnosis, REFER to Section 413-06 .
F2 CHECK THE TPMS STATUS (TP_STAT) PID	
NOTE: Make sure that all aftermarket electronic equipment has been disconnected (if possible) and that the customer has been questioned about the kinds of electronic equipment they may have been using in the vehicle when this issue was identified. • Connect the scan tool. • **NOTE:** A spare tire cannot be programmed to the vehicle, even if equipped with a TPMS sensor. If a damaged road wheel is located in the trunk and the SJB cannot communicate with it, or if the damaged wheel has been dropped off at a dealership or repair shop, the SJB sets a TPMS sensor fault. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the TP_STAT PID.	**Yes** GO to F3 . **No** If the TP_STAT PID displays **SYSTEM** FAULT, GO to F5 .

• **Does the PID display SENSOR FAULT?**	
F3 CARRY OUT THE SENSOR TRAINING PROCEDURE	
• Train all 4 tire pressure sensors. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section. • **Did all of the tire pressure sensors transmit correctly and did the horn sound when each TPMS sensor transmitted to the SJB ?**	**Yes** The system is operating correctly at this time. The concern may have been caused by RFI . CLEAR the DTCs. REPEAT the self-test. TEST for normal operation. REFER to PID Definitions and Intermittent Troubleshooting in this section for information on locating sources of RFI . **No** GO to F4 .
F4 CHECK FOR CORRECT TPMS OPERATION	
• Move the vehicle to rotate the wheels at least one-fourth of a turn. Leave the vehicle doors open. Start the sensor training procedure at a different wheel. • Train all 4 tire pressure sensors. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section. • **Did any of the tire pressure sensors transmit correctly and did the horn sound when each TPMS sensor transmitted to the SJB ?**	**Yes** If some of the TPMS sensors trained, INSTALL a new TPMS sensor for the TPMS sensor(s) that failed to train. REFER to Wheel and Tire in this section. If all of the TPMS sensors trained, the concern may have been cause by RFI . CLEAR the DTCs. REPEAT the self-test. TEST for normal operation. REFER to PID Definitions and Intermittent Troubleshooting in this section for information on locating sources of RFI . **No** GO to F5 .
F5 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB electrical connectors. • Check the connectors for: ♦ corrosion ♦ pushed-out pins ♦ bent pins ♦ spread terminals • Connect all the SJB connectors and make sure that they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** **NOTE:** The sensors may not be present. DISMOUNT the tire. REFER to Wheel and Tire in this section. VERIFY the sensors are present and mounted to the wheels. If missing, INSTALL new sensors. If the sensors are present, INSTALL a new SJB . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test G: DTC B106B

Normal Operation

If there is a fault in the Tire Pressure Monitoring System (TPMS), such as a damaged or missing sensor(s), damaged module or a communication issue within the vehicle, DTCs are set in the Smart Junction Box (SJB), the TPMS warning indicator will flash for 70 seconds and then remain ON solid when the ignition switch is turned to the ON position and the message center (if equipped) will display TIRE PRESSURE SENSOR FAULT.

The tire pressure sensor is battery powered.

This DTC may be set when attempting to train a tire pressure sensor(s) with a low battery.

This pinpoint test is intended to diagnose the following:

- Tire pressure sensor battery
- Tire pressure sensor(s)

PINPOINT TEST G: DTC B106B

Test Step	Result / Action to Take
G1 DETERMINE WHICH SENSOR HAS A LOW BATTERY	
• Train all 4 tire pressure sensors. Refer to Tire Pressure Monitoring System (TPMS) Sensor Training in this section. • **Did all of the tire pressure sensors transmit correctly and did the horn sound when each tire pressure sensor transmitted to the SJB ?**	**Yes** CLEAR the DTCs. REPEAT the self-test. VERIFY system operation. **No** **Before installing a new sensor(s)** : If a sensor does not respond to the Tire Pressure Monitor Activation Tool, MOVE the vehicle to rotate the wheels at least one-fourth of a turn and ATTEMPT to activate the same sensor again. If the sensor still does not respond, ATTEMPT to activate the same sensor again using the customer activation tool (if available). If the sensor still fails to train, ATTEMPT to train the sensor with the vehicle doors open. If the sensor(s) fails to train a second time, INSTALL a new tire pressure sensor(s). REFER to Tire Pressure Monitoring System (TPMS) Sensor in this section.

Tire Pressure Monitoring System (TPMS) Sensor Training

Special Tool(s)

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

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

NOTE: The Tire Pressure Monitoring System (TPMS) Training procedure must be done on a single vehicle, in an area without radio frequency noise and at least 1 m (3 ft) away from other vehicles equipped with a Tire Pressure Monitoring System (TPMS).

Radio frequency noise is generated by electrical motors and appliance operation, cellular telephones, remote transmitters, power inverters and portable entertainment equipment.

NOTE: If a sensor does not respond to the Tire Pressure Monitor Activation Tool, move the vehicle to rotate the wheels at least one-fourth of a turn and attempt to activate the same sensor again. If the sensor still does not respond, attempt to activate the same sensor again using the customer activation tool (if available). If the sensor still fails to train, attempt to train the sensor with the vehicle doors open.

NOTE: The BCM has a 2-minute time limit between sensor responses. If the BCM does not recognize any 1 of the 4 tire pressure sensors during this time limit, the horn will sound twice and the message center (if equipped) will display TIRE NOT TRAINED REPEAT and the entire procedure must be repeated.

NOTE: For vehicles with different front and rear tire pressures (such as the E-Series and certain F-Series), the tire pressure sensors must be trained following a tire rotation. Failure to train the sensors will cause the TPMS indicator to illuminate. For vehicles with the same tire pressure for front and rear tires, tire rotation will not affect the system.

1. **NOTE:** An animated version of this procedure is available on-line.

   Turn the ignition switch to the OFF position, then press and release the brake pedal.

2. Cycle the ignition switch from the OFF position to the RUN position 3 times, ending in the RUN position.

3. Press and release the brake pedal.

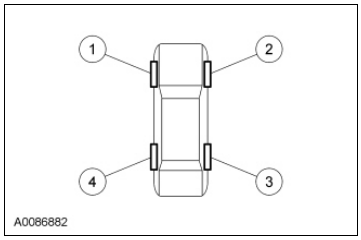
4. Turn the ignition switch to the OFF position.

5. Turn the ignition switch from the OFF position to the RUN position 3 times, ending in the RUN position.
    - The horn will sound once and the TPMS indicator will flash if the training mode has been entered successfully. If equipped, the message center will display TRAIN LF TIRE.

6. **NOTE:** It may take up to 6 seconds to activate a tire pressure sensor. During this time, the Tire Pressure Monitor Activation Tool must remain in place at the valve stem.

   Place the Tire Pressure Monitor Activation Tool on the LF tire sidewall at the valve stem. Press and release the test button on the Tire Pressure Monitor Activation Tool. The horn will sound briefly to indicate that the tire pressure sensor has been recognized by the BCM .

7. Within 2 minutes of the horn sounding, place the Tire Pressure Monitor Activation Tool on the RF tire sidewall at the valve stem and press and release the test button to train the RF tire pressure sensor.



8. **NOTE:** Do not wait more than 2 minutes between training each sensor or the BCM will time out and the entire procedure must be repeated.

   Repeat Step 7 for the RR and LR tires.
   The procedure is completed after the last tire has been trained. When the training procedure is complete, the message center (if equipped) will display TIRE TRAINING COMPLETE.
   For vehicles not equipped with a message center, successful completion of the training procedure will be verified by turning the ignition switch to the OFF position without the horn sounding. If the horn sounds twice when the switch is turned to the OFF position, the training procedure was not successful.

9. Using the scan tool, locate the updated TPMS sensor identifiers trained to the BCM and document them on the applicable warranty claim.

10. **NOTE:** This step is required to clear DTC C2780, cause the BCM to exit the manufacturing mode and to make sure there are no other concerns with a newly programmed BCM .

    If the sensors are being trained due to the installation of a new BCM , clear any DTCs and carry out the BCM On-Demand Self Test.

Tire Pressure Monitoring System (TPMS) Sensor Activation

Special Tool(s)

 ST2941-A	Activation Tool, Tire Pressure Monitor 204-363, or Customer Activation Tool, Tire Pressure Monitor

NOTE: The tire pressure sensors will go into a "sleep mode" when a vehicle is stationary to conserve battery power. The sensors do not transmit information while in sleep mode. It will be necessary to wake them up so they will transmit the latest tire pressure information.

1. Turn the ignition switch to the ON position.

2. Position the Tire Pressure Monitor Activation Tool against the LF tire sidewall at the tire valve stem.

3. **NOTE:** The Tire Pressure Monitor Activation Tool will provide feedback in the form of a flashing green light and a beep sound for each successful response from a tire pressure sensor. This feedback may not always be present, do not rely on it as a confirmation that the module heard a particular sensor.

   NOTE: If a sensor does not respond to the Tire Pressure Monitor Activation Tool, move the vehicle to rotate the wheels at least one-fourth of a turn and attempt to activate the same sensor again. If the sensor still does not respond, attempt to activate the same sensor again using the customer activation tool (if available). If the sensor still fails to train, attempt to train the sensor with the vehicle doors open.

   Press the test button on the Tire Pressure Monitor Activation Tool to activate the sensor. Activate the sensor at least 2 times.

4. Repeat Steps 2 and 3 for the remaining tires.

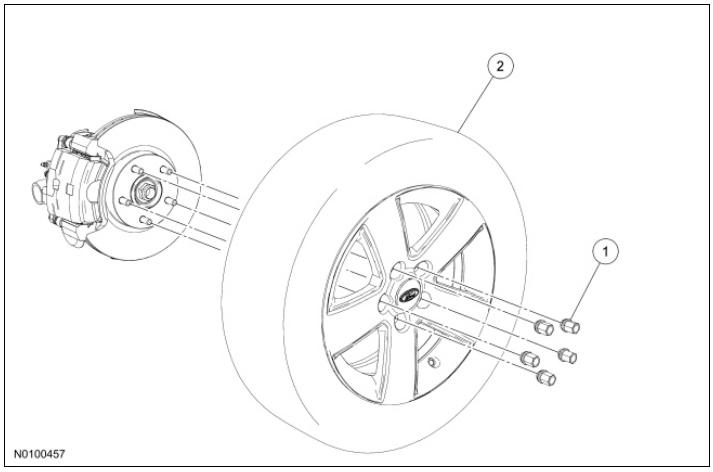
5. If the Tire Pressure Monitoring System (TPMS) indicator remains illuminated after adjusting and activating each sensor, refer to the Symptom Chart in Diagnosis and Testing in this section.

Wheel and Tire

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	-

NOTE: Typical 5 lug wheel shown.



Item	Part Number	Description
1	1012	Wheel nut (5 required)
2	-	Wheel and tire assembly

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. ***NOTICE:*** **Do not use heat to loosen a seized wheel nut or damage to the wheel and wheel bearing can occur.**

   NOTICE: **If equipped with full wheel cover with exposed wheel nuts, the wheel nuts must be removed prior to removing the wheel cover or damage to the wheel cover will occur.**

   Remove the 5 wheel nuts.
3. Remove the wheel and tire assembly.

Installation

1. ⚠ **WARNING: When a wheel is installed, always remove any corrosion, dirt or foreign material present on the mounting surface of the wheel and the mounting surface of the wheel hub, brake drum or brake disc. Make sure that any fasteners that attach the rotor to the hub are secured so they do not interfere with the mounting surfaces of the wheel. Failure to follow these instructions when installing wheels may result in the wheel nuts loosening and the wheel coming off while the vehicle is in motion, which could result in loss of control, leading to serious injury or death to vehicle occupant(s).**

   NOTICE: **Make sure to apply a thin coat of anti-seize lubrication only to the interface between the wheel pilot bore and the hub pilot. Do not allow the anti-seize to make contact with the wheel-to-brake disc/drum mounting surface, wheel studs, wheel nuts, brake pads or brake disc friction surfaces or damage to components may occur.**

   Clean the wheel mounting surfaces and apply a thin coat of anti-seize to the wheel hub pilot surface (wheel only).

2. Install the wheel and tire assembly.

3. ⚠ **WARNING: Retighten wheel nuts within 160 km (100 mi) after a wheel is reinstalled. Wheels can loosen after initial tightening. Failure to follow this instruction may result in serious injury to vehicle occupant(s).**

   NOTICE: **Failure to tighten the wheel nuts in a star/cross pattern can result in high brake disc runout, which will speed up the development of brake roughness, shudder and vibration.**

   NOTE: The wheel nut torque specification is for clean, dry wheel stud and wheel nut threads.

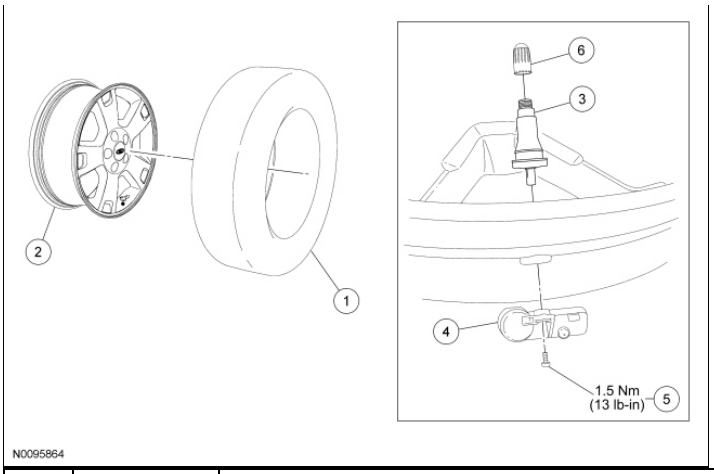
   Install the 5 wheel nuts by hand.

   - Tighten the wheel nuts in a star/cross pattern to 135 Nm (100 lb-ft).

Wheel and Tire

Special Tool(s)

 ST2669-A	Digital Tire Pressure Gauge 204-354



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

Disassembly

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

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

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

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

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

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

   Remove the valve stem core and fully deflate all air from the tire.

   - If a new Tire Pressure Monitoring System (TPMS) sensor is being installed, remove and discard the valve stem-to-sensor screw and the sensor.

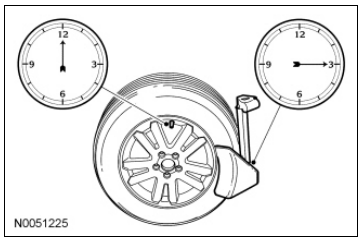
NOTICE: **Do not allow the tire beads to move beyond the wheel mid-plane (middle of the wheel) when separating the beads from the wheels, damage to the Tire Pressure Monitoring System (TPMS) sensor may occur.**

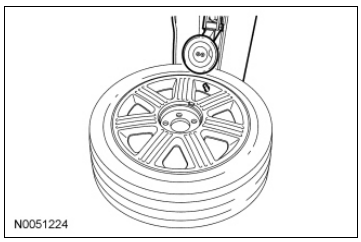
3. ***NOTICE:*** **Tire and valve stem position is critical to prevent damage to the Tire Pressure Monitoring System (TPMS) sensor when using a paddle-type bead separator.**

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

   Position the wheel and tire assembly on a suitable tire machine and separate both beads of the tire from the wheel.

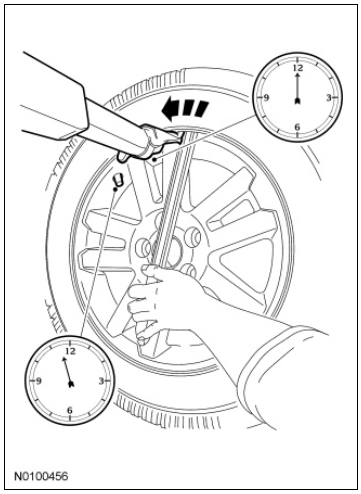
   - For a paddle-type tire machine, position the valve stem at the 12 o'clock or 6 o'clock position and the paddle at the 3 o'clock position.
   - For a roller-type tire machine, align the valve stem with the roller at any position.





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

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

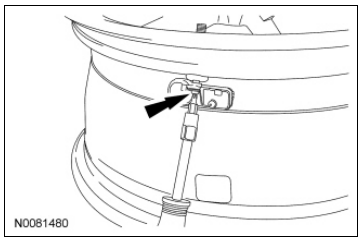


5. Reset the wheel and tire assembly on the turntable of the tire machine with the valve stem at the 11:30 position and the machine arm at the 12 o'clock position and dismount the inner bead from the wheel.

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

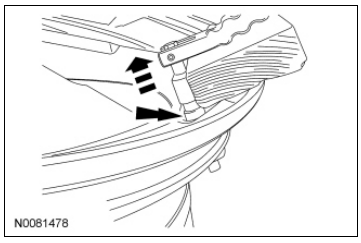
   Remove the TPMS sensor in the following sequence.

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



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

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



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

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

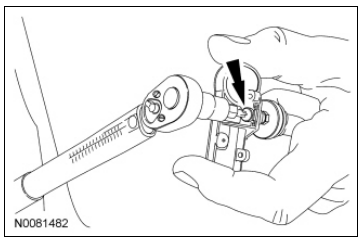
Assembly

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

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

   Install a new valve stem onto the TPMS sensor.

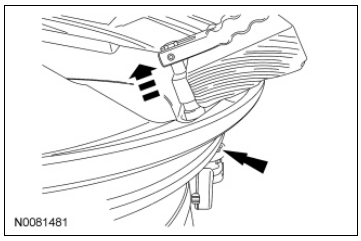
   - Tighten the new valve stem-to- TPMS sensor screw to 1.5 Nm (13 lb-in).



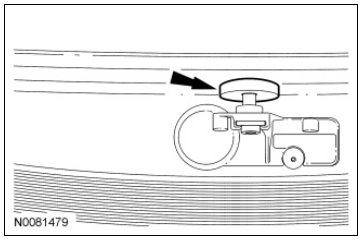
2. ***NOTICE:*** **It is important to pull the valve stem and Tire Pressure Monitoring System (TPMS) sensor assembly through the wheel rim hole in a direction parallel to the valve stem hole axis. If the assembly is pulled through at an angle, damage to the valve stem and sensor assembly may occur.**

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

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



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

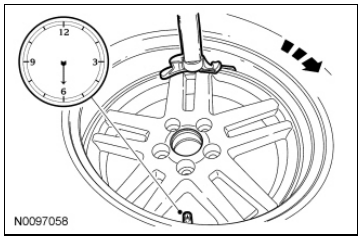


4. **NOTE:** Lubricate the tire beads using a suitable fast-drying, corrosion-inhibiting tire bead lubricant.

   NOTE: Do not mount the tire at this time.

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

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



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

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

   Inflate the tire to the pressure specified on the Vehicle Certification (VC) label located on the driver door or door pillar.

   - Proceed to Step 8 if the tire beads do not seat at the specified inflation pressure.

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

   The following steps should only be carried out if the tire beads cannot be seated by inflating the tire up to the maximum inflation pressure listed on the tire sidewall.

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

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

Tire Pressure Monitoring System (TPMS) Sensor

Disassembly

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

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

Material

Item	Specification	Fill Capacity
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A	1.15L (2.43 pt)

General Specifications

Item	Specification
End play	
Wheel bearing end play	0.00 mm (0.000 in) maximum
Runout	
Driveshaft runout	0.89 mm (0.035 in)
Pilot runout	0.15 mm (0.006 in) maximum
Wheel hub face runout	0.254 mm (0.010 in) maximum
Wheel hub flange bolt circle runout	0.38 mm (0.015 in) maximum

Driveline System

The driveline system consists of the following components:

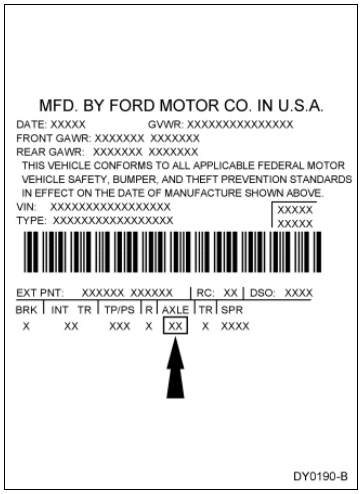
- Center support bearing
- Driveshaft assembly
- Front halfshafts
- Rear halfshafts
- Active torque coupling/rear axle

On Front Wheel Drive (FWD) vehicles, the transaxle transmits power from the engine to the halfshafts.

On All-Wheel Drive (AWD) vehicles, power is transmitted from the engine through the transaxle to the Power Transfer Unit (PTU). The PTU transfers engine power from the transaxle to the front halfshafts, and through the driveshaft to the active torque coupling/rear axle and halfshafts. For information on the PTU , refer to Section 308-07A or Section 308-07B .

The engine angle is built into the engine mounts. If the engine angle is out of specification, the engine mounts must be inspected for damage. Refer to Section 303-01A , Section 303-01B or Section 303-01C .

Vehicle Certification (VC) Label Example



The Vehicle Certification (VC) label is located in the driver door jamb. The axle code is on the VC label. Refer to Section 100-01 .

The axle ratio is 2.93 and the ring gear has a diameter of 174 mm (6.85 in).

The wheel speed sensor rings for FWD vehicles are located on the front halfshafts and are mounted to the rear inner spindles.

The wheel speed sensor rings are located on the front and rear halfshafts for AWD vehicles.

Driveshaft

The driveshaft is a 3-piece shaft with rubber-isolated center bearings.

The driveshaft has traditional balance weights attached (spot-welded) by the manufacturer.

U-joints

The CV and U-joints are installed new with the driveshaft.

The front CV joint is:

- lubricated with a special lubricant and requires no additional lubrication.

The center U-joints are:

- a lubed-for-life design that requires no periodic lubrication.
- equipped with nylon thrust washers located at the base of each bearing cup which control end play, position the needle bearings and improve grease movement.

Rear Drive Unit

The active torque coupling/Rear Drive Unit (RDU) is serviced as an assembly.

The RDU housing cover uses a silicone sealant rather than a gasket.

Each halfshaft is held in the RDU case by a halfshaft circlip that is located on the inner CV joint stub shaft pilot bearing housing. When each halfshaft is installed, the halfshaft circlip engages a slot in the differential side gear.

The RDU operates as follows:

- The RDU pinion receives power from the engine through the transaxle, PTU , driveshaft and active torque coupling, and is always engaged.
- The pinion gear rotates the differential case, which is bolted to the differential case outer flange.
- Inside the differential case, 2 differential pinion gears are mounted on a differential pinion shaft that is pinned to the differential case.
- These differential pinion gears are engaged with the differential side gears, to which the halfshafts are splined.
- As the differential case turns, it rotates the halfshafts and rear wheels.
- When it is necessary for one wheel and halfshaft to rotate faster than the other, the faster turning differential side gear causes the differential pinion gears to roll on the slower turning differential side gear. This allows differential action between the 2 halfshafts.

Halfshafts

The drive halfshafts consist of the following components:

- Inner CV joints
- Outer CV joints
- CV joint boot clamps
- CV joint boots
- Tripod joint housings
- Retainer circlips
- Front intermediate shaft bearing

The front intermediate shaft bearing is pressed on and is only serviced as an assembly with the intermediate shaft.

NOTICE: **An inspection of the outer and inner Constant Velocity (CV) joint boots is necessary so that if damage or grease leakage is evident, installation of a new halfshaft can take place immediately. Continued operation with damage or grease leakage will result in CV joint wear and noise due to contamination and loss of the CV joint grease.**

- The inner and outer CV joints connect to a splined shaft. A circlip holds the cross groove inner race assembly (inner CV joint) together.
- A circlip retains the splined inner CV joint. Install a new axle circlip each time the halfshaft is removed from the vehicle.
- A wheel hub nut secures the side shaft assembly (interconnecting shaft and outer CV joint) to the wheel hub. Install a new wheel hub nut each time the halfshaft is removed from the vehicle.

Halfshaft Handling

NOTICE: **Handle the halfshaft only by the interconnecting shaft to avoid pull-apart and potential damage to the Constant Velocity (CV) joints. Damage will occur to an assembled inner CV joint if it is over-plunged outward from the joint housing or over angled.**

Handle all halfshaft components carefully during removal and installation procedures. Never use a hammer to remove or install the halfshafts. Never use the halfshaft assembly as a lever to position other components. Always support the free end of the halfshaft. Do not allow the boots to contact sharp edges or hot exhaust components. Do not drop assembled halfshafts. The impact may cut the boots from the inside without evidence of external damage.

Driveline System

Material

Item	Specification
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A

Principals of Operation

Driveline System - General Information

The driveline system enables the power generated by the engine and transferred through the transmission in Front Wheel Drive (FWD), or the transmission and the Power Transfer Unit (PTU) in All-Wheel Drive (AWD) to place the vehicle in motion. Rotational torque received from the transmission or PTU is delivered to the front wheels by halfshafts or the rear axle by way of the driveshaft(s). The U-joints or CV joints at the ends of the shafts allow the shafts to rotate smoothly in an allowable angle plane. The rotational torque is introduced into the axle drive pinion which drives the differential ring gear. The ring gear is bolted to the axle differential which divides the torque between the left and right axle shafts, while permitting the shafts to turn at different speeds when required, such as when cornering.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• U-joints • CV joints • Center bearings • Driveshaft tubes • Mounting brackets • Flanges • Housing and cover damage • Differential bearings

- Differential gearsets
- Pinion bearings

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

4. If the cause is not visually evident, verify the symptom and GO to Symptom Chart - NVH .

Driveshaft Center U-Joint and CV Joint Inspection

With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . Rotate the driveshaft by hand. Check for rough operation or seizure of the U-joints or CV joints. Install a new driveshaft if it shows signs of seizure, excessive wear or incorrect seating. Refer to Section 205-01 .

Driveshaft Center Bearing

With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . Rotate the driveshaft by hand. If the bearing shows signs of roughness or is noisy, install a new driveshaft assembly. Refer to Section 205-01 .

Symptom Charts - NVH

Symptom Charts - NVH

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

ConditionPossible SourcesAction

- Axle howling or whine - front or rear axle
- Axle lubricant low
- CHECK the lubricant level. FILL the axle to specification.
- Axle housing damage
- INSPECT the axle housing for damage. INSTALL a new axle as necessary. REFER to Section 205-02 .
- Damaged or worn wheel hub bearings
- CHECK for abnormal wheel hub bearing play or roughness. REFER to Section 204-01 or Section 204-02 .
- Damaged or worn differential ring and pinion

- INSPECT and INSTALL a new axle assembly as necessary. REFER to Section 205-02 .
- Damaged or worn differential side or pinion bearings
- INSPECT and INSTALL a new axle assembly as necessary. REFER to Section 205-02 .
- Driveline clunk - loud clunk when shifting from reverse to drive
- Incorrect axle lubricant level
- CHECK the lubricant level. FILL the axle to specification.
- Excessive backlash in the axle
- CHECK the axle backlash. INSPECT and INSTALL a new axle assembly as necessary. REFER to Section 205-02 .
- Damaged or worn pinion bearings
- INSPECT and INSTALL a new axle assembly as necessary. REFER to Section 205-02 .
- Damaged or worn U-joints
- INSPECT the U-joints for wear or damage. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
- Driveline clunk - occurs as the vehicle starts to move forward following a stop
- Worn driveshaft CV joint or U-joints with excessive play
- INSPECT the CV joint and U-joints for a worn condition. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
- Loose rear axle mount
- CHECK the axle for loose bolts. TIGHTEN to specification. REFER to Section 205-02 .
- Driveline clunk (Front Wheel Drive (FWD) vehicles) - occurs during acceleration or from cruise to coast/deceleration
- Damaged or worn inner CV joint
- INSPECT the inner CV joint and boot. INSTALL a new CV joint as necessary. REFER to Section 205-04 .
- Clicking, popping or grinding - occurs while the vehicle is turning
- Inadequate or contaminated lubrication in the CV joints
- CHECK the CV boots and joints for wear or damage. INSTALL new components as necessary. REFER to Section 205-04 .
- Loose wheel end nut

- CHECK wheel hub nut torque. REPAIR as necessary. REFER to Section 205-04 .
- Another component contacting the halfshaft
- CHECK the halfshafts and the area around the halfshafts. REPAIR as necessary.
- High pitched chattering - noise from the rear axle when the vehicle is turning
- Incorrect or contaminated lubricant
- CHECK the vehicle by driving in tight circles (5 clockwise, 5 counterclockwise). DRAIN and REFILL with the specified rear axle lubricant and friction modifier as necessary.
- Damaged or worn differential (differential side gears and pinion gears)
- INSPECT and INSTALL a new axle assembly as necessary. REFER to Section 205-02 .
- Buzz - buzzing noise is the same at cruise or coast/deceleration
- Incorrect driveline angles
- CHECK for correct driveline angles. REPAIR as necessary. REFER to Driveline Angle Measurement in this section.
- Rumble or boom - noise occurs at coast/deceleration, usually driveshaft speed-related and noticeable over a wide range of speeds
- Driveshaft is out-of-balance
- CHECK the driveshaft for damage, missing balance weights or undercoating. REFER to Driveshaft Runout and Balancing in this section.
- U-joints are binding or seized
- ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
- Grunting - normally associated with a shudder experienced during acceleration from a complete stop
- Driveshaft CV joint binding
- INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
- Loose rear axle mount bolts or suspension fasteners
- INSPECT the rear suspension and axle. TIGHTEN the fasteners to specification. REFER to Section 205-02 .
- Howl - can occur at various speeds and driving conditions. Affected by acceleration and deceleration
- Incorrect ring and pinion contact, incorrect bearing preload or gear damage
- INSPECT and INSTALL a new axle assembly as necessary. REFER to Section 205-02 .

- Chuckle - heard at coast/deceleration. Also described as a knock
- Incorrect ring and pinion contact or damaged teeth on the coast side of the ring and pinion
- INSPECT and INSTALL a new axle assembly as necessary. REFER to Section 205-02 .
- Knock - noise occurs at various speeds. Not affected by acceleration or deceleration
- Gear tooth damage to the drive side of the ring and pinion
- INSPECT and INSTALL a new axle assembly as necessary. REFER to
- Scraping noise - a continuous low pitched noise starting at low speeds
- Worn or damaged pinion bearings
- INSTALL a new axle assembly as necessary. REFER to Section 205-02 .
- Driveline shudder - occurs during acceleration from a slow speed or stop
- Rear drive axle assembly mispositioned
- CHECK the axle mounts and the rear suspension for damage or wear. REPAIR as necessary. REFER to Section 205-02 .
- Loose rear axle bolts
- CHECK the rear axle for loose bolts. TIGHTEN the bolts to specification. REFER to Section 205-02 .
- Driveline angles out of specification
- CHECK for correct driveline angles. REFER to Driveline Angle Measurement in this section.
- U-joints binding or seized
- ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
- Binding or damaged driveshaft CV joint
- INSPECT the driveshaft CV joint and coupling shaft for wear or damage. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
- Driveline vibration - occurs at cruising speeds
- Worn U-joints
- CHECK for wear or incorrect seating. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
- Worn or damaged driveshaft center bearing support
- CHECK the insulator for damage or wear. ROTATE the driveshaft and CHECK for rough operation. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .

- Loose axle pinion flange bolts
- INSPECT the axle pinion flange. TIGHTEN the pinion flange bolts to specification. REFER to Section 205-01 .
- Excessive axle pinion flange runout
- CARRY OUT a runout check. REPAIR as necessary. REFER to Section 205-02 .
- Driveshaft is out-of-balance
- CHECK the driveshaft for damage, missing balance weights or undercoating. CHECK the driveshaft balance. CARRY OUT a driveline vibration test. REFER to Driveshaft Runout and Balancing in this section.
- Binding or damaged driveshaft CV joint
- INSPECT the driveshaft CV joint for wear or damage. INSTALL a new driveshaft as necessary. REFER to Section 205-01 .
- Excessive driveshaft runout
- CARRY OUT a runout check. REFER to Driveshaft Runout and Balancing in this section.
- Driveline angles out of specification
- CHECK for correct driveline angles. REPAIR as necessary. REFER to Driveline Angle Measurement in this section.
- Incorrectly seated CV joint in the wheel hub
- CHECK the outer CV joint for correct seating into the hub. REPAIR as necessary. REFER to Section 205-04 for the front CV joints or Section 205-05 for the rear CV joints.

Analysis of Leakage

Clean up the leaking area enough to identify the exact source.

A plugged Rear Drive Unit (RDU) housing vent can cause excessive pinion seal lip wear due to internal pressure buildup.

Verify the RDU lubricant level is at least 3-5 mm (1/8-3/16 in) below the bottom of the fill hole.

Axle Vent

A plugged vent will cause excessive seal lip wear due to internal pressure buildup. If a leak occurs, check the vent. If the vent cannot be cleared, install a new vent.

Drive Pinion Seal

Leaks at the drive pinion seal originate from the following causes:

- Damaged seal

- Worn seal journal surface

Any damage to the seal bore (dings, dents, gouges or other imperfections) distorts the seal casing and allows leakage past the outer edge of the drive pinion seal.

The drive pinion seal can be torn, cut or gouged if it is not installed correctly. The spring that holds the drive pinion seal against the pinion flange may be knocked out and allow fluid to pass the lip.

Metal chips trapped at the sealing lip can cause oil leaks. These can cause a wear groove on the drive pinion flange and result in pinion seal wear.

When a seal leak occurs, install a new drive pinion seal and check the vent to make sure it is clean and free of foreign material.

A new drive pinion flange must be installed if any of these conditions exist.

Drive Pinion Nut

NOTICE: **Install the drive pinion nut to the correct torque specifications or damage to the differential components may occur.**

On some high-mileage vehicles, oil may leak through the threads of the drive pinion nut. This condition can be corrected by installing a new nut.

Differential Seals

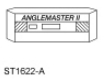
NOTICE: **When installing shafts, do not allow splines to contact seals during installation or damage to the seals may occur.**

Halfshaft pilot bearing housing seals are susceptible to the same types of damage as drive pinion seals if incorrectly installed. The seal bore must be clean and the lip handled carefully to avoid cutting or tearing it. The seal journal surface must be free of nicks, gouges and rough surface texture.

For information on differential seals, refer to Section 205-02 .

Driveline Angle Measurement

Special Tool(s)

 ST1622-A	Anglemaster II Driveline Inclinometer/Protractor 164-R2402 or equivalent

NOTE: This procedure does not apply to CV joints, flex couplers or double cardan joints that are used in some driveshafts. This check is for single-cross and roller-style joints found in the driveshafts.

NOTE: Prior to checking driveline angularity, inspect the U-joints for correct operation.

NOTE: An incorrect driveline angle can cause a vibration or shudder. For additional information, refer to Section 100-04 .

NOTE: Driveline angularity is the angular relationship between the engine crankshaft, the driveshaft and the rear axle pinion. Factors determining driveline angularity include ride height, rear spring and engine mounts.

All vehicles

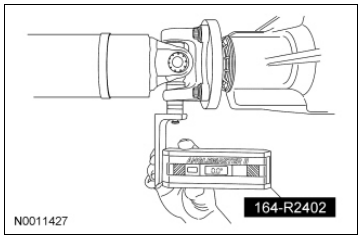
1. Carry out the following preliminary setup steps:
   - Inspect the U-joints for correct operation.
   - Park the vehicle on a level surface such as a drive-on hoist, or back onto a front end alignment rack.
   - Verify the curb position ride height is within specifications with the vehicle unloaded and all of the tires are inflated to their normal operating pressures.
   - Calibrate the Anglemaster II Driveline Inclinometer/Protractor by placing it on a clean, flat level section of the frame rail and press the ALT-ZERO button.

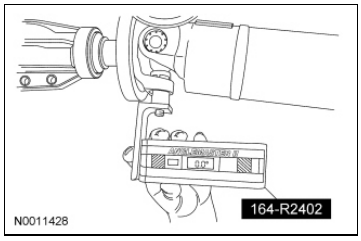
Vehicles with flat-flanged, split-pin or slip-flanged U-joints

2. **NOTE:** If equipped, remove the snap ring to allow access to the base of the U-joint cup. Make sure the Anglemaster II Driveline Inclinometer/Protractor is seated against the U-joint cup.

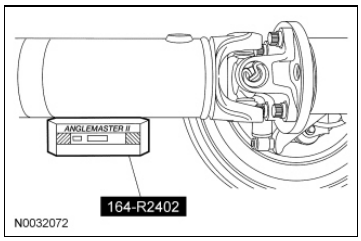
   NOTE: Rotate the driveshaft until the flange U-joint cup is parallel with the floor. This will simplify taking measurements.

   To check the U-joint operating angle, install the Anglemaster II Driveline Inclinometer/Protractor. Check and record the flange angle as angle A.





3. Using the Anglemaster II Driveline Inclinometer/Protractor, measure the slope of the connecting component. Record the measurement of the component angle as angle B.

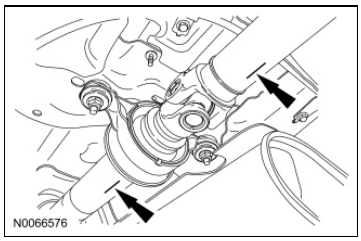


Multiple piece driveshafts

4. **NOTE:** Repeat this step for each center support bearing on the driveshaft.

   NOTE: It is not necessary to remove the U-joint snap ring, if equipped, for these measurements.

   Using the Anglemaster II Driveline Inclinometer/Protractor, measure the slope of the components in front and behind the center support bearing U-joint in the area indicated. Record the front component as angle A and the rear component as angle B.



All vehicles

5. **NOTE:** When 2 connected components slope in the same direction, subtract the smallest number from the larger number to find the U-joint operating angle. When 2 connected components slope in the opposite direction, add the measurements to find the U-joint operating angle.

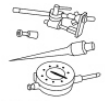
   Calculate the difference in the slope of the components to determine the U-joint operating angle.

   - The U-joint operating angle is the angle formed by 2 yokes connected by a cross and bearing kit. Ideally, the operating angles on each connection of the driveshaft must:
     - be equal or within one degree of each other.
     - have a 3 degree maximum operating angle.
     - have at least one-half of one degree continuous operating angle.

6. If the angle is not within specifications, repair or adjust to obtain the correct angle. Inspect the engine mounts, transmission mounts, center support bearing mounting, rear suspension, rear axle, rear axle mounting or the frame for wear or damage.

Driveshaft Runout and Balancing

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST3025-A	Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) 257-00018 or equivalent

Driveshaft Inspection

NOTE: Driveline vibration exhibits a higher frequency and lower amplitude than high-speed shake. Drivee vibration is directly related to the speed of the vehicle and is noticed at various speeds. Driveline vibration can be perceived as a tremor in the floorpan or heard as a rumble, hum or boom.

NOTE: Refer to Specifications in this section for all runout specifications.

1. **NOTE:** Do not make any adjustments before carrying out a road test. Do not change the tire pressure or the vehicle load.

   Carry out a visual inspection of the vehicle. Operate the vehicle and verify the condition by reproducing it during the road test.

   - The concern should be directly related to vehicle road speed, not affected by acceleration or deceleration or could not be reduced by coasting in NEUTRAL.

2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
   - The driveshaft should be kept at an angle equal to or close to the curb-weighted position. Use a twin-post hoist or a frame hoist with jackstands.

3. Inspect the driveshaft for damage, undercoating or incorrectly seated U-joints. Rotate the driveshaft slowly by hand and feel for binding or end play in the U-joint trunnions. Remove the driveshaft. For additional information, refer to Section 205-01 . Inspect the slip yoke splines for any galling, dirt, rust or incorrect lubrication. Clean the driveshaft or install new U-joints as necessary. Install a new driveshaft if damaged. After any corrections or new components are installed, recheck for the vibration at the road test speed.
   - If the vibration is gone, test drive the vehicle.
   - If the vibration persists or the driveshaft passes visual inspection, measure the driveshaft runout.

Driveshaft Runout

1. Install the Dial Indicator Gauge with Holding Fixture. Rotate the driveshaft by turning the axle and measure the runout at the front, the center and the rear of the driveshaft.

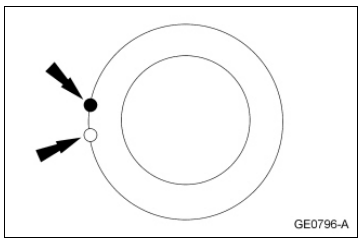
- If the runout exceeds 1 mm (0.040 in) at the front or center, install a new driveshaft.
- If the front and center is within 1 mm (0.040 in), but the rear runout is not, index-mark the rear runout high point and proceed to Step 2.
- If the runout is within 1 mm (0.040 in) at all points, recheck for vibration at road test speed. If the vibration persists, balance the driveshaft. For additional information, refer to Driveshaft Balancing in this procedure.

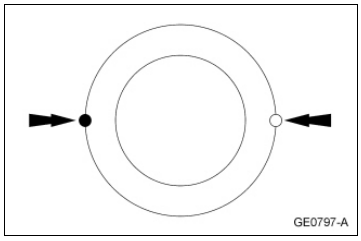
2. **NOTE:** Circular pinion flanges can be turned in 90 degree or one-fourth increments. Half-round pinion flanges are limited to 2 positions.

   Index-mark the driveshaft to the pinion flange. Disconnect the driveshaft and rotate it 180 degrees. Reconnect the driveshaft. Recheck the runout at the rear of the driveshaft.

   - If the runout is still over specification, mark the high point and proceed to Step 3.
   - If the runout is within specification, check for the vibration at the road test speed. If the vibration is still present, balance the driveshaft. For additional information, refer to Driveshaft Balancing in this procedure.

3. Excessive driveshaft runout can originate in the driveshaft itself or from the pinion flange. To find the source, compare the 2 high points previously determined.
   - If the index marks are close together, within 25 mm (1 in), the driveshaft is eccentric. Install a new driveshaft.
   - If the marks are on opposite sides of the driveshaft, 180 degrees apart, the slip yoke or pinion flange is responsible. Check the pinion flange runout. If the pinion flange runout exceeds specifications, a bent pinion is indicated.
   - If the pinion flange and pinion runouts are within specifications, road test and check for the vibration at the road test speed. If the vibration persists, balance the driveshaft. For additional information, refer to Driveshaft Balancing in this procedure.





Driveshaft Balancing - Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix)

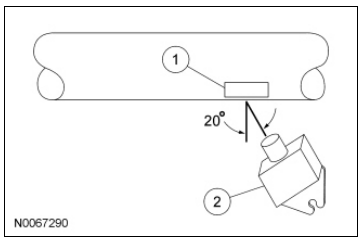
All vehicles

1. Install the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) to the vehicle.

2. Working under the vehicle, install ccelerometer. The accelerometer can be attached and mounted near

either the transmission or differential end of the driveshaft.

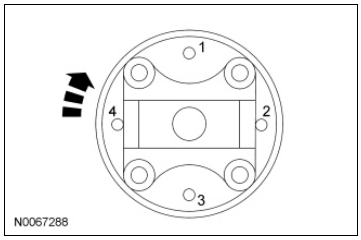
3. Clean an area of the driveshaft and install the reflective tape, then install the photo-tachometer sensor. The sensor should be placed at approximately a 20-degree angle from perpendicular to the surface of the reflective tape. Make sure the sensor does not get moved during the balance procedure.
    1. Reflective tape.
    2. Photo-tachometer sensor.



4. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a driveshaft balance test with the driveshaft unmodified.

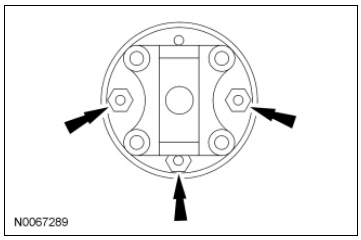
Vehicles with tapped pinion flanges

5. Label the tapped holes in the pinion flange numerically, starting at the top hole as 1. Mark the remaining holes 2, 3 and 4. Label in the direction of rotation.



6. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a second test with the 12 mm (0.47 in) test weight set screw in the No. 1 hole, previously marked on the pinion flange.

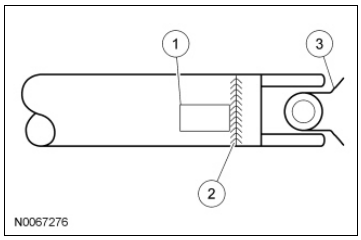
7. Remove the test weight, then install the weight combination directed by the Maertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix).



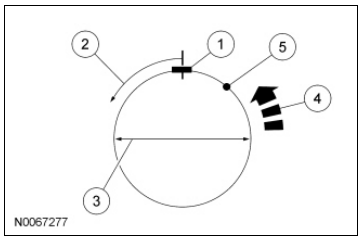
Vehicles without tapped pinion flanges

8. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a second test with a test weight. Using a metal band, secure the test weight to the end of the driveshaft. The weight should be placed at the end of the driveshaft tube, as close to the tube-to-yoke weld seam as possible. Mark the location of the test weight on the driveshaft, as shown in the figure below.
    1. Test weight.
    2. Tube-to-yoke weld seam.
    3. Driveshaft pinion flange.

- Select the test weight based on driveshaft size. Larger driveshafts use 10 g (0.353 oz). Smaller driveshafts use 5 g (0.176 oz).



9. Remove the test weight, then install the recommended weight at the position directed by the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix). Using a metal band and epoxy, secure the test weight to the driveshaft, as shown in the figure below.
    1. Test weight.
    2. Measure in this direction.
    3. Driveshaft diameter.
    1. Directional rotation.
    5. Balance weight relative to test weight centerline.
    - The results are displayed with respect to the location to where the test weight was placed.



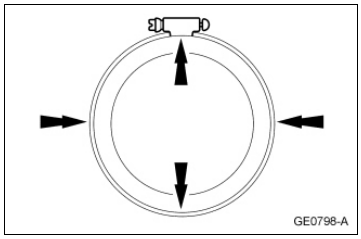
All vehicles

10. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a third test to verify the repair.

Driveshaft Balancing - Hose Clamp Method

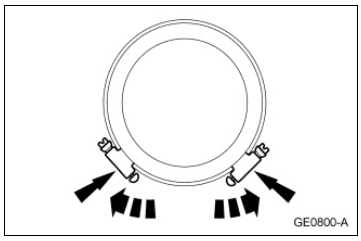
1. Install 1 or 2 hose clamps on the driveshaft, near the rear. Position of the hose clamp head(s) can be determined through trial and error.

2. Mark the rear of the driveshaft into 4 approximately equal sectors and number the marks 1 through 4. Install a hose clamp on the driveshaft with its head at position No. 1, as shown in the figure below. Check for vibration at road speed. Recheck with the clamp at each of the other positions to find the position that shows minimum vibration. If 2 adjacent positions show equal improvement, position the clamp head between them.



3. If the vibration persists, add a second clamp at the same position and recheck for vibration.

4. If no improvement is noted, rotate the clamps in opposite directions, equal distances from the best position determined in Step 2. Separate the clamp heads about 13 mm (1/2 in) and recheck for vibration at the road speed.



5. Repeat the process with increasing separation until the best combination is found or the vibration is reduced to an acceptable level.

Torque Specifications

Description	Nm	lb-ft
Center bearing support nuts	55	41
Exhaust flex pipe nuts	40	30
Front driveshaft-to-Power Transfer Unit (PTU) flange bolts	70	52
Rear driveshaft-to-pinion flange bolts	70	52

Driveshaft

NOTE: All driveshaft assemblies are balanced. If undercoating the vehicle, protect the driveshaft to prevent overspray of any undercoating material.

The driveshaft assembly consists of the following:

- Rubber isolated center support bearings
- CV joint at the Power Transfer Unit (PTU)
- U-joints at the center support and pinion flange
- Assembly balanced with traditional balance weights
- Lubed-for-life joints requiring no periodic lubrication

The driveshaft transfers torque from the PTU to the rear axle. It is attached to the PTU flange with a CV joint. The driveshaft is connected by a staked U-joint at the center bearing and attached to the rear pinion flange. The driveshaft joints allow the smooth continuous rotation of the driveshaft through the allowable angle planes and length variations required in normal vehicle operation. The driveshaft is always turning at front wheel speed. The driveshaft is not serviceable. A new driveshaft must be installed if worn or damaged.

Universal Joints

The U-joints consist of the following:

- A single spider (cross)
- Lubed-for-life design and require no periodic lubrication
- Nylon thrust washers, located at each base of the bearing cup, which control end play, position the needle bearing and improve grease movement
- Grease seals located at the opening of each bearing cup to retain the grease for the bearing lubrication
- Bearing cups that retain the needle bearings and locate the spider on the centerline of the shaft bore to control shaft runout and balance

The U-joints are staked in place and are not serviced individually. If worn or damaged, install a new driveshaft assembly.

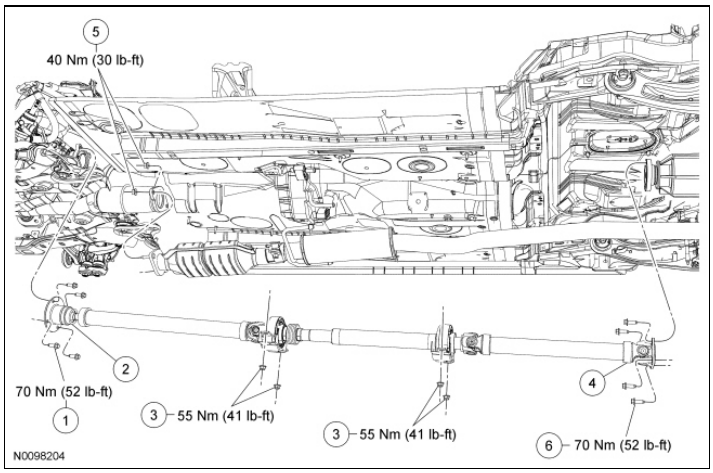
The U-joints in this driveshaft assembly allow the driveshaft tubes to rotate smoothly through the varying angles of the Power Transfer Unit (PTU), the center support bearings and the Rear Drive Unit (RDU). The angles that cause the U-joints to accelerate and decelerate may cause vibration in the driveshaft assembly if the angles are either too great or too small. Refer to Section 205-00 .

Driveshaft

Refer to Section 205-00 .

Driveshaft

Driveshaft



Item	Part Number	Description
1	W711960	Front driveshaft-to-Power Transfer Unit (PTU) Driveshaft flange bolt (4 required)
2	-	Front driveshaft flange
3	W520113	Center bearing support nuts (4 required)
4	-	Rear driveshaft flange
5	W705443	Exhaust flex pipe flange nuts (2 required)
6	W711960	Rear driveshaft-to-pinion flange bolt (4 required)

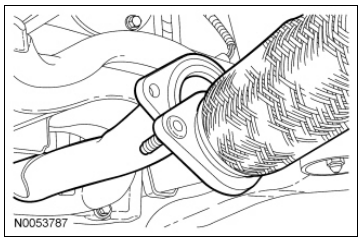
Removal and Installation

NOTE: Index-mark both the driveshaft flanges.

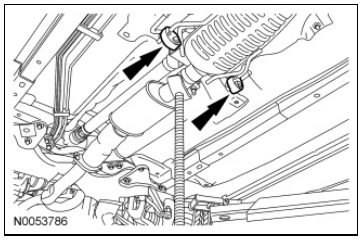
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

NOTICE: **Make sure to adequately support the exhaust flex pipe or damage may occur.**

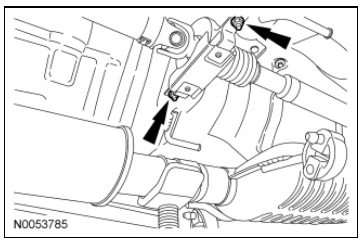
2. Remove and discard the 2 nuts and separate the exhaust system at the flex pipe.
   - Install new nuts and tighten to 40 Nm (30 lb-ft).



3. Support the exhaust system and disconnect the 2 front exhaust hangers from the exhaust system.



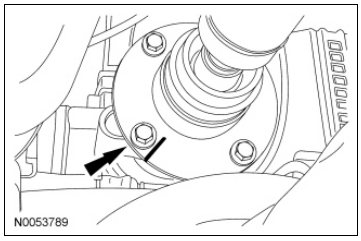
4. Carefully lower the exhaust system to allow clearance for removal of the driveshaft.



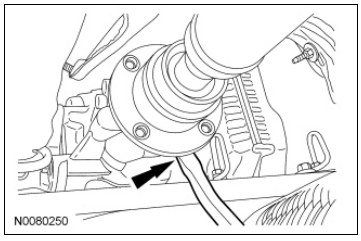
5. **NOTE:** Do not reuse the CV joint bolts.

   Remove and discard the 4 front driveshaft-to-Power Transfer Unit (PTU) flange bolts.

   - Install new bolts and tighten to 70 Nm (52 lb-ft).



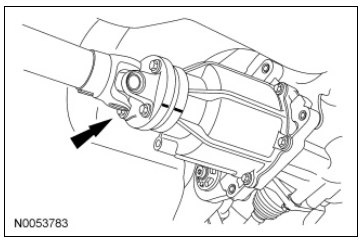
6. Using a suitable pry bar as shown, separate the driveshaft flange from the PTU flange.



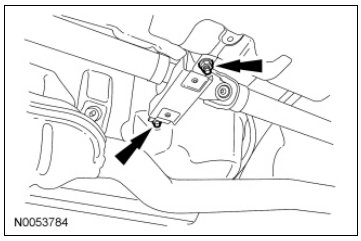
7. ***NOTICE:*** **Do not reuse the bolts for the rear U-joint flange. Install new bolts or damage to the component may occur.**

   Remove and discard the 4 rear driveshaft-to-pinion flange bolts.

   - Install new bolts and tighten to 70 Nm (52 lb-ft).



8. With the help of an assistant, remove the 4 center bearing support nuts and the driveshaft.
    - To install, tighten to 55 Nm (41 lb-ft).



9. **NOTE:** If a driveshaft is installed and driveshaft vibration is encountered after installation, index the driveshaft. For additional information, refer to Section 205-00 .

    To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
Clear Silicone Rubber TA-32	ESB-M4G92-A	-
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A	1.15L (2.43 pt)
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	-

Torque Specifications

Description	Nm	lb-ft
Differential housing cover bolts	23	17
Differential housing-to-front insulator bracket bolts	90	66
Filler plug	29	21
Pinion nut	244	180
Side insulator bracket-to-rear axle differential bolts	90	66

Rear Drive Axle and Differential

The rear drive axle consists of the following components:

- Dished circular flange
- Full-time fluid drive coupling
- Aluminum housing with steel housing cover
- Matched ring and pinion
- Conventional open differential
- Rubber bushing isolated mounting points
- Cover mounted axle vent
- Silicone sealant rather than a gasket

The rear drive axle is serviced as follows:

- The active torque coupling is installed new as an assembly with the rear axle
- The pinion seal and the differential halfshaft seals are the only serviced components of the rear drive axle. If other components of the rear drive axle are worn or damaged, the assembly must be installed new

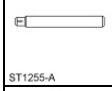
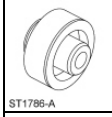
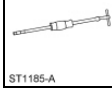
The rear axle drive pinion receives power from the engine through the transaxle, Power Transfer Unit (PTU), driveshaft and active torque coupling, and is engaged ON DEMAND. The pinion gear rotates the differential ring gear, which is bolted to the differential case outer flange. Inside the differential case, 2 differential pinion gears are mounted on a differential pinion shaft, which is pinned to the case. These differential pinion gears are engaged with the splined differential side gears. The halfshafts are held in the differential side gears by a retainer circlip that is located on the inboard CV joint stub shaft. When each halfshaft is installed, the retainer circlip engages a step in the differential side gear. There are no stub shaft bearings in the differential housing. As the differential case turns, it rotates the halfshafts and rear wheels. When it is necessary for one wheel and halfshaft to rotate faster than the other, the faster turning differential side gear causes the differential pinion gears to roll on the slower turning differential side gear. This allows differential action between the 2 halfshafts.

Rear Drive Axle and Differential

Refer to Section 205-00 .

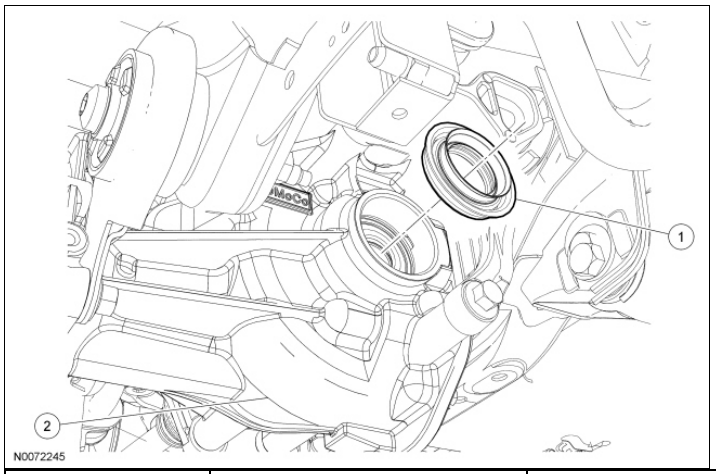
Stub Shaft Seal

Special Tool(s)

 ST1255-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1786-A	Installer, Front Axle Oil Seal 205-350 (T95T-3010-A)
 ST1846-A	Remover, Torque Converter Fluid Seal 307-309 (T94P-77001-BH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



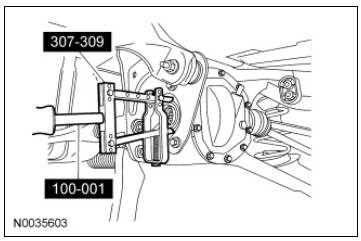
Item	Part Number	Description
1	4B416	Stub shaft seal
2	4010	Differential housing

Removal

NOTE: The Rear Drive Unit (RDU) does not have stub shaft pilot bearings. It has stub shaft seals only.

1. Remove the halfshaft. For additional information, refer to Section 205-05 .

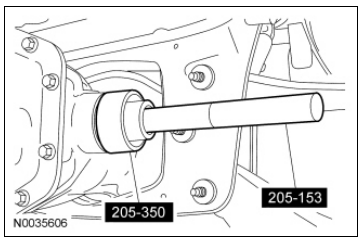
2. Using the Torque Converter Fluid Seal Remover and Slide Hammer, remove the stub shaft seal.



Installation

1. **NOTE:** Lubricate the new stub shaft seal with grease.

   Using the Front Axle Oil Seal Installer and Adapter Handle, install the stub shaft pilot bearing housing seal.



2. Install the halfshaft assembly. For additional information, refer to Section 205-05 .

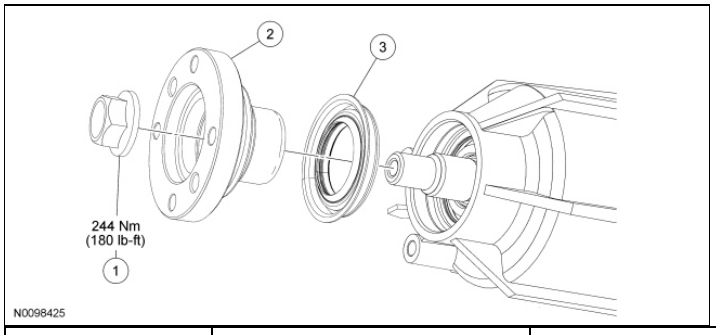
Drive Pinion Seal

Special Tool(s)

 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1758-A	Converter Seal Remover 307-309 (T94P-77001-BH)
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1957-A	Pinion Seal Replacer 205-133 (T79P-4676-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



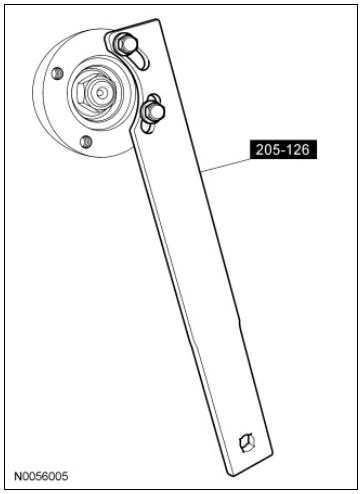
Item	Part Number	Description
1	4320	Drive pinion nut
2	4858	Drive pinion flange
3	4N299	Drive pinion seal

Removal

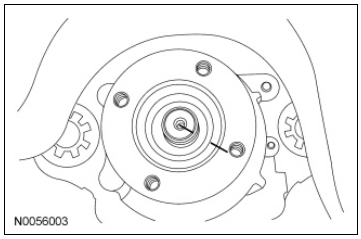
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the driveshaft. For additional information, refer to Section 205-01 .

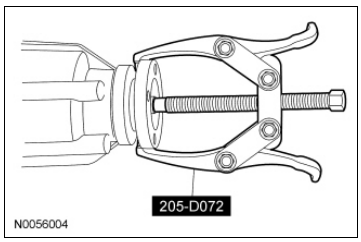
3. Using the Drive Pinion Flange Holding Fixture, hold the pinion flange and remove the pinion flange nut.
    - Discard the nut.



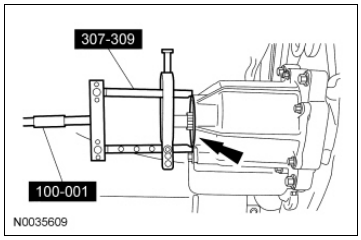
4. Index-mark the location of the pinion flange to the yoke.



5. Using the 2 Jaw Puller, remove the pinion flange.



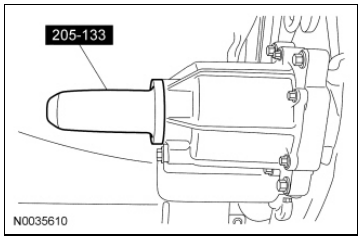
6. Using the Converter Seal Remover and Slide Hammer, remove and discard the drive pinion seal.



Installation

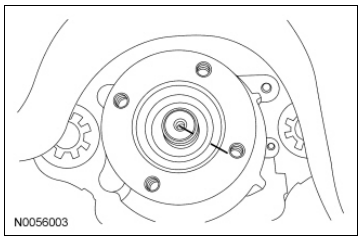
1. **NOTE:** Make sure that the mating surface is clean before installing the new seal.

   Using the Pinion Seal Replacer, install the drive pinion seal.

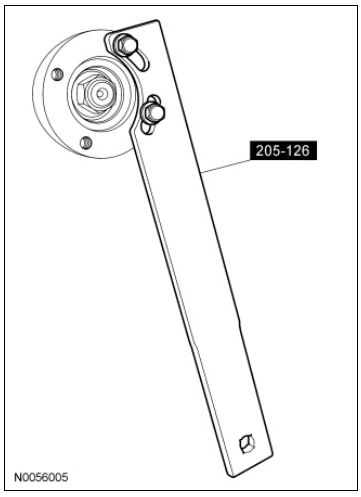


2. **NOTE:** Lubricate the pinion flange splines with grease.

   Line up the index marks and position the pinion flange.



3. Using the Drive Pinion Flange Holding Fixture, install the new pinion flange nut.
   - Tighten to 244 Nm (180 lb-ft).

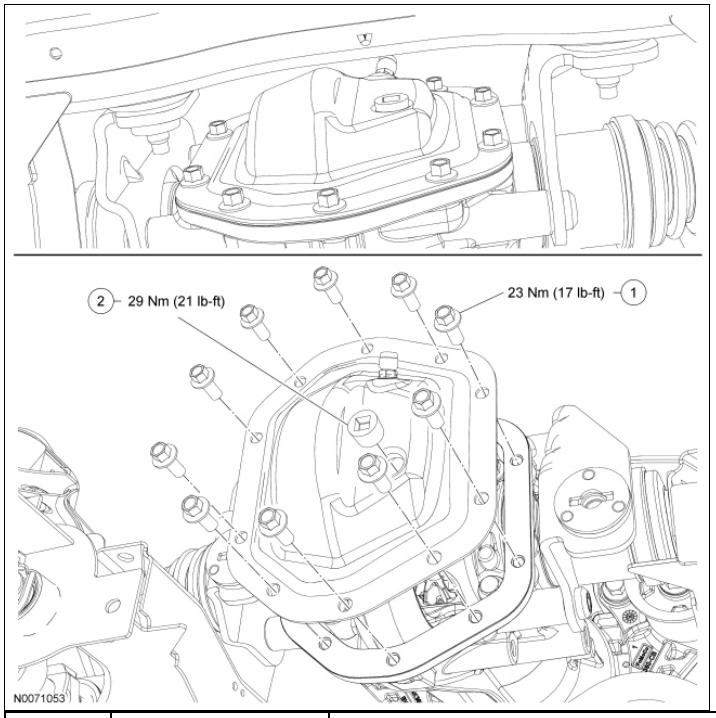


4. Install the driveshaft. For additional information, refer to Section 205-01 .

Differential Housing Cover

Material

Item	Specification
Clear Silicone Rubber TA-32	ESB-M4G92-A
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A

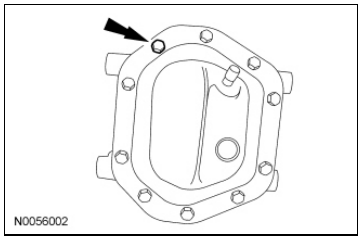


Item	Part Number	Description
1	W505262	Differential housing cover bolt (10 required)
2	4N282	Filler plug

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 10 bolts and the differential housing cover.
   - Drain the differential fluid from the housing.



Installation

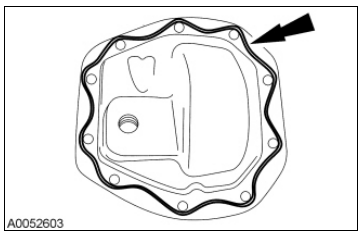
1. *NOTICE:* **Make sure the machined surfaces on the rear axle housing and the differential housing cover are clean and free of oil before installing the new silicone rubber. The inside of the rear axle must be covered when cleaning the machined surface to prevent damage to the component.**

   NOTE: Make sure the differential vent located on the rear cover is free of obstruction.

   Clean the gasket mating surfaces of the differential housing and the differential housing cover.

2. **NOTE:** The differential housing cover must be installed within 15 minutes of application of the silicone rubber, or new silicone rubber must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone rubber has correctly cured.

   Apply a continuous bead of clear silicone rubber as shown in the illustration.

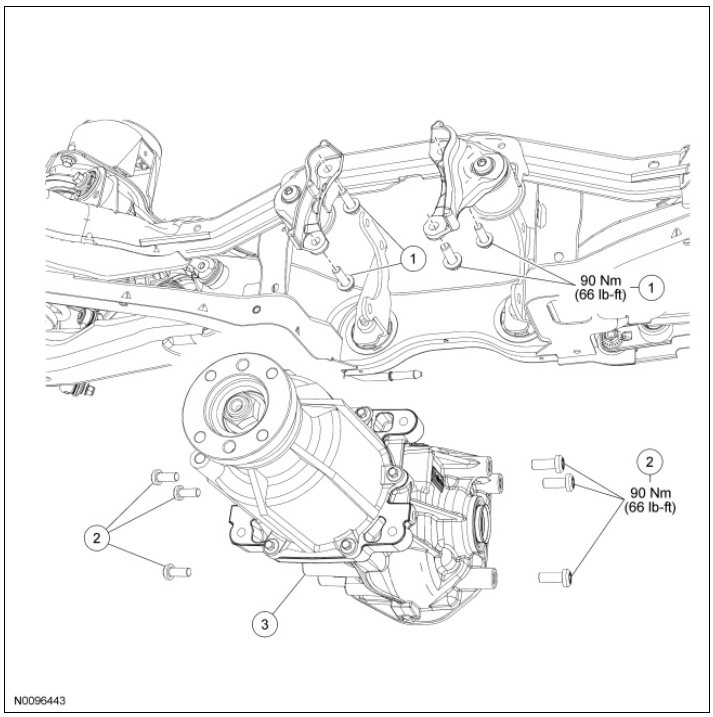


3. Install the differential housing cover and the 10 bolts.
   - Tighten to 23 Nm (17 lb-ft).

4. Remove the filler plug, fill the rear axle with 1.15L (2.43 pt) of rear axle lubricant, 3-5 mm (0.118-0.196 in) below the bottom of the filler hole and install the filler plug.
   - Tighten to 29 Nm (21 lb-ft).

Axle Assembly

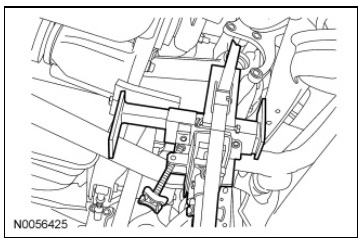
Axle Assembly



Item	Part Number	Description
1	W500442	Differential housing-to-front insulator bracket bolts (4 required)
2	W500444	Side insulator bracket-to-rear axle differential bolts (6 required)
3	4000	Rear axle assembly

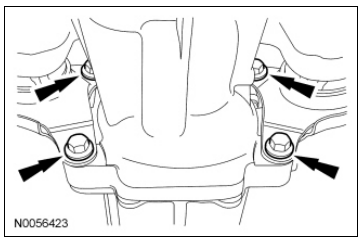
Removal and Installation

1. Remove the driveshaft. For additional information, refer to Section 205-01 .
2. Remove the rear halfshafts. For additional information, refer to Section 205-05 .
3. Position a suitable transmission hydraulic jack to the axle housing. Securely strap the jack to the housing.

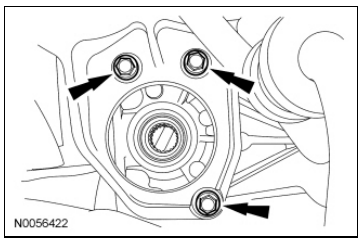


4. Remove the 4 differential housing-to-front insulator bracket bolts.

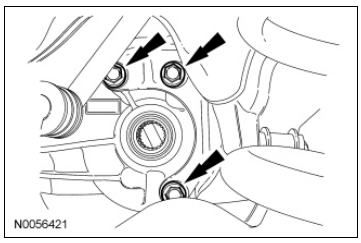
- To install, tighten to 90 Nm (66 lb-ft).



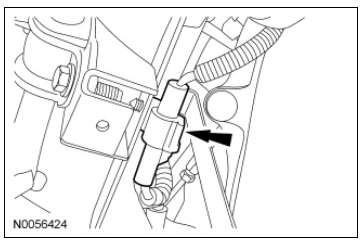
5. Remove the 3 RH side insulator bracket-to-rear axle differential bolts.
   - To install, tighten to 90 Nm (66 lb-ft).



6. Remove the 3 LH side insulator or bracket-to-rear axle differential bolts.
   - To install, tighten to 90 Nm (66 lb-ft).



7. Lower the axle to gain clearance and disconnect the active torque coupling electrical connector.



8. Remove the rear axle assembly.

9. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake flexible hose bracket -to-wheel knuckle bolt	23	17	-
Catalytic converter support bracket bolts	20	-	177
Catalytic converter support bracket nuts	23	17	-
Damper fork-to-front lower arm bolt	103	76	-
Halfshaft support bracket bolts	40	30	-
Intermediate shaft bearing support bolts	40	30	-
Upper ball joint nut	48	35	-
Wheel hub nut	255	185	-
Wheel speed sensor bolt	23	17	-
Wheel speed sensor harness bracket-to-wheel knuckle bolt	23	17	-

Front Drive Halfshafts

The halfshaft and intermediate shaft consist of the following components:

- Inner CV joints
- Outer CV joints
- Interconnecting shafts

The halfshafts are splined on the outboard stub shaft to drive the wheel hubs. They are retained in the wheel hubs by special wheel hub nuts which also control the wheel bearing preload. The LH halfshaft is splined on the inboard stub shaft and is retained in the differential side gear in the transaxle by a circlip. The RH halfshaft has internal splines which are driven by the intermediate shaft. The intermediate shaft has a circlip on the outboard end and is retained inside the inboard stub shaft. The circlips must be installed new whenever they are removed. The intermediate shaft is retained in the transaxle differential side gear by bolts that go through the intermediate shaft support bearing. The intermediate shaft also goes through the Power Transfer Unit (PTU) on All-Wheel Drive (AWD) vehicles. The outer seal of the PTU must be installed new whenever the intermediate shaft is removed.

The front drive halfshaft CV joints consist of the following components:

- CV joint boot clamps
- Convoluted CV joint boots
- Tripod joint housings
- Ball and cage housings
- Special CV high-temperature grease

Halfshaft handling consists of the following:

- On the LH side, the inboard CV joint is retained in the differential side gear with a unique retainer circlip. Install a new circlip every time the halfshaft is disconnected
- On the RH side, a unique driveshaft bearing retainer circlip retains the splined inboard CV joint to the intermediate shaft. Install a new circlip every time the halfshaft is disconnected from the intermediate shaft
- A staked front axle wheel hub retainer secures the splined outboard CV joint to the wheel hub
- Do not overangle the CV joints
- Damage will occur to an assembled inboard CV joint if it is overplunged outward from the joint housing
- Never use a hammer to remove or install the halfshafts from the front hub
- Never use the halfshaft assembly as a lever to position other components. Always support the free end of the halfshaft
- Do not allow the boots to contact sharp edges or hot exhaust components
- Handle the halfshaft only by the interconnecting shaft to avoid pull-apart and potential damage to the CV joints
- Do not drop assembled halfshafts. The impact will cut the boots from the inside without evidence of external damage
- Do not remove the outer CV joint by pulling on the interconnecting shaft
- Inspect all machined surfaces and splines for damage

The CV joint mates the interconnecting shaft with the stub shaft. The joint allows for smooth rotation of the interconnecting shaft and the stub shafts. They also adjust for length variances and angle requirements as the

vehicle goes through jounce and rebound.

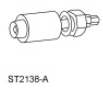
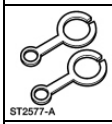
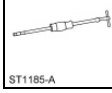
The halfshaft joints are not repairable and are serviced as assemblies only.

Front Drive Halfshafts

Refer to Section 205-00 .

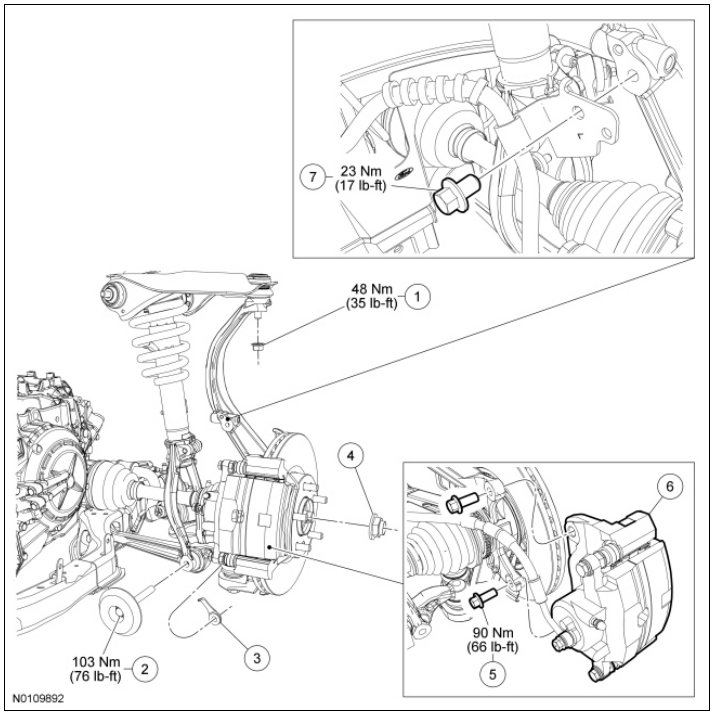
Halfshaft

Special Tool(s)

 ST2934-A	Halfshaft Remover 205-832
 ST2138-A	Installer, Halfshaft 204-161 (T97P-1175-A)
 ST2577-A	Protector, Differential Oil Seal (pair) 205-461
 ST2272-A	Remover, Front Wheel Hub 205-D070 (D93P-1175-B) or equivalent
 ST1263-A	Remover, Steering Arm 211-003 (T64P-3596-F)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Halfshaft (View 1 of 2)

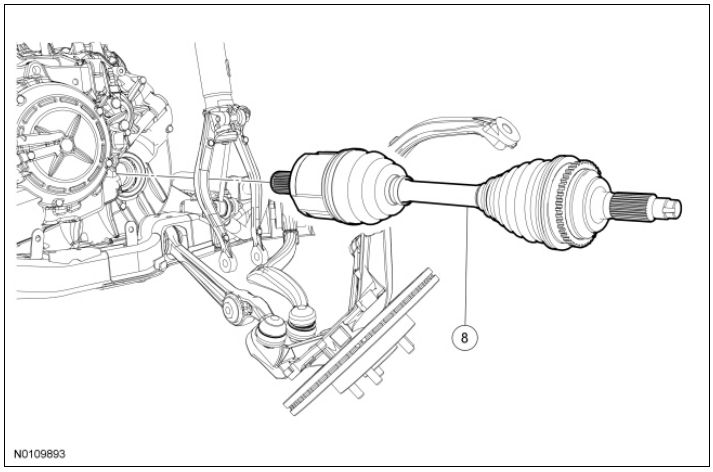
NOTE: LH halfshaft shown, RH similar.



Item	Part Number	Description
1	W302122	Upper ball joint nut
2	W500550	Damper fork-to-front lower arm bolt
3	W302117	Damper fork-to-front lower arm flagnut
4	3B477	Wheel hub nut
5	W711241	Brake caliper anchor plate bolt
6	-	Brake caliper and anchor plate assembly
7	W500020	Brake flexible hose-to-wheel knuckle bolt

Halfshaft (View 2 of 2)

NOTE: LH halfshaft shown, RH similar.



Item	Part Number	Description
8	3A427/3A428	LH/RH halfshaft

Removal

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

RH and LH halfshafts

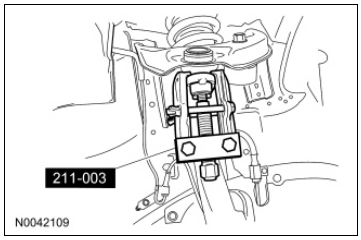
1. Remove the wheel and tire. For additional information, refer to Section 204-04 .
2. **NOTE:** Apply the brake to keep the halfshaft from rotating.

   Remove and discard the wheel hub nut.
3. Remove wheel speed ssor harness bracket-to-wheel knuckle bolt.
4. Remove the wheel speed sensor bolt and position the wheel speed sensor aside.
5. Remove the brake flexible hose bracket-to-wheel knuckle bolt.
6. ⚠ **WARNING: Do not breathe dust or use compressed air to blow dust from storage containers or friction components. Remove dust using government-approved techniques. Friction component dust may be a cancer and lung disease hazard. Exposure to potentially hazardous components may occur if dusts are created during repair of friction components, such as brake pads and clutch discs. Exposure may also cause irritation to skin, eyes and respiratory tract, and may cause allergic reactions and/or may lead to other chronic health effects. If irritation persists, seek medical attention or advice. Failure to follow these instructions may result in serious personal injury.**

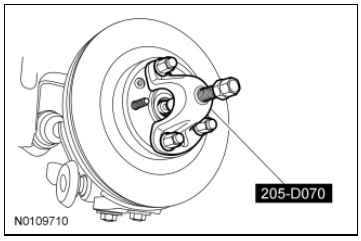
   NOTICE: **Do not allow the brake caliper to hang from the brake hose or damage to the hose can occur.**

   Remove the 2 brake caliper anchor plate bolts and position the caliper and anchor plate assembly aside.

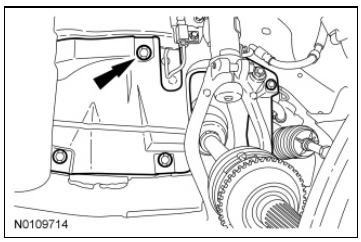
   - Support the caliper using mechanic's wire.
7. Remove and discard the upper ball joint nut.
8. Using the Steering Arm Remover, separate the upper ball joint from the wheel knuckle.



9. Remove and discard the damper fork-to-front lower arm bolt and flagnut.
10. Using the Front Wheel Hub Remover, separate the halfshaft from the wheel hub.

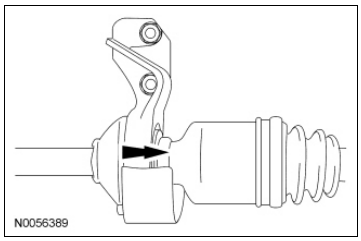


11. Remove the pin-type retainers and position the splash shield aside.



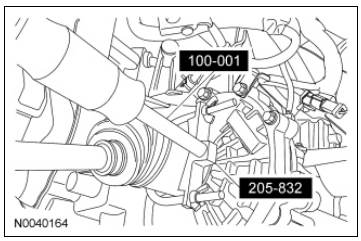
RH halfshaft

12. Use a brass drift to strike the RH halfshaft in the indicated area and separate the RH halfshaft from the intermediate shaft.



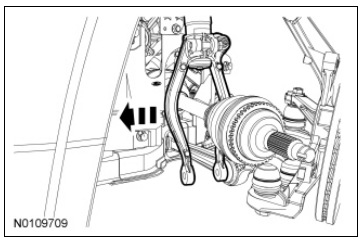
LH halfshaft

13. Using the Halfshaft Remover and Slide Hammer, separate the halfshaft from the transmission.



RH and LH halfshafts

14. Position the damper fork and halfshaft forward of the front lower arm and remove the halfshaft.



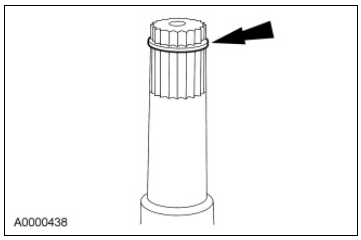
15. Remove and discard the stub shaft circlip (LH) or the intermediate shaft circlip (RH).

Installation

RH and LH halfshafts

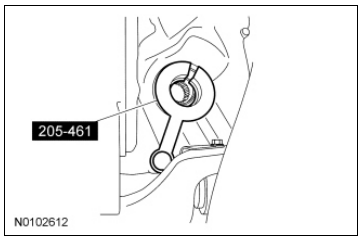
1. *NOTICE:* **Make sure to install the correct circlip for each application. Failure to use the correct diameter circlip may result in shaft removal concerns or shaft damage during vehicle operation.**

   Install a new circlip.



LH halfshaft

2. Install the Differential Oil Seal Protector.



3. *NOTICE:* **The sharp edges on the stub shaft splines can slice or puncture the oil seal. Use care when inserting the stub shaft into the transmission or damage to the seal may occur.**

   Push the stub shaft into the transmission so the circlip locks into the differential side gear.

   - After insertion, pull the halfshaft inner end to make sure the circlip is locked.

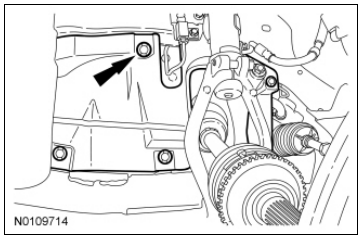
RH halfshaft

4. Align the splines on the RH halfshaft with the intermediate shaft and push the stub shaft in until the circlip locks the shafts together.
   - After insertion, pull the halfshaft inner end to make sure the circlip is locked.

RH and LH halfshafts

5. Position the damper fork and install a new damper fork-to-front lower arm bolt and flagnut.
   - Tighten to 103 Nm (76 lb-ft).

6. Position the splash shield and install the pin-type retainers.



7. Insert the halfshaft into the wheel hub.

8. Insert the upper ball joint into the wheel knuckle and install a new nut.
   - Tighten to 48 Nm (35 lb-ft).

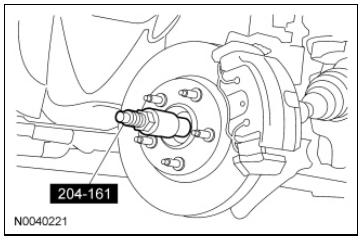
9. Position the brake caliper and anchor plate assembly and install the 2 bolts.
   - Tighten to 90 Nm (66 lb-ft).

10. Position the brake flexible hose bracket and install the bolt.
    - Tighten to 23 Nm (17 lb-ft).

11. Position the wheel speed sensor and install the bolt.
    - Tighten to 23 Nm (17 lb-ft).

12. Position the wheel speed sensor harness bracket and install the bolt.
    - Tighten to 23 Nm (17 lb-ft).

13. Using the Halfshaft Installer, seat the halfshaft into the wheel hub.



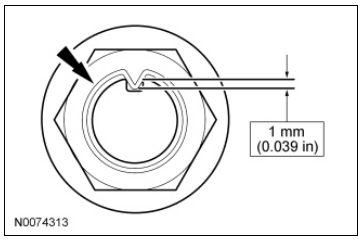
14. ***NOTICE:*** **Do not tighten the front wheel hub nut with the vehicle on the ground. The nut must be tightened to specification before the vehicle is lowered onto the wheels. Wheel bearing damage will occur if the wheel bearing is loaded with the weight of the vehicle applied.**

    NOTE: Apply the brake to keep the halfshaft from rotating.

    Install a new front wheel hub nut.

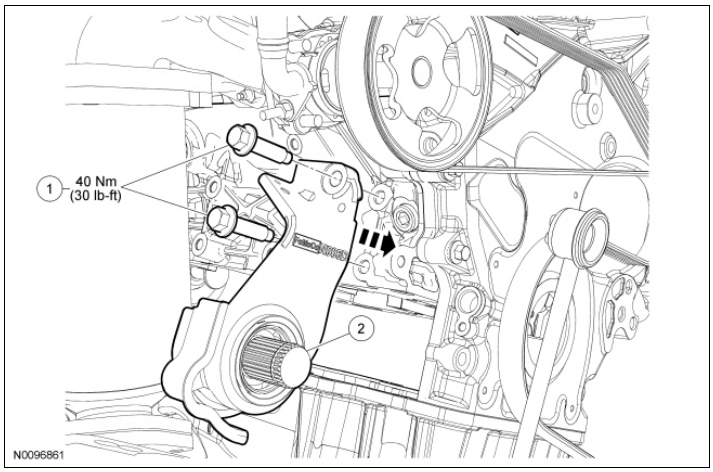
    - Tighten to 255 Nm (185 lb-ft).

15. Stake the new nut in line with the keyway to a recommended minimum depth of 1 mm (0.039 in) below the keyway diameter to engage the locking feature.



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

Intermediate Shaft - Front Wheel Drive (FWD)



Item	Part Number	Description
1	W500235	Halfshaft support bracket bolts (2 required)
2	3A329	Intermediate shaft assembly

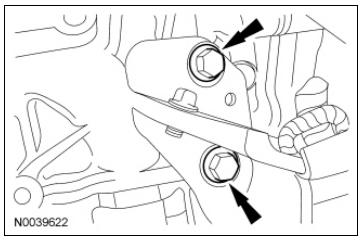
Removal

All vehicles

1. Remove the RH halfshaft. For additional information, refer to Halfshaft in this section.

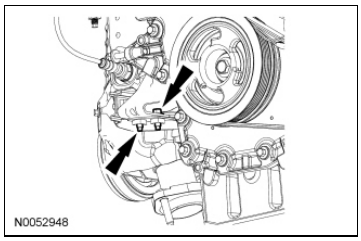
3.0L vehicles

2. Remove the 2 halfshaft support bracket bolts.

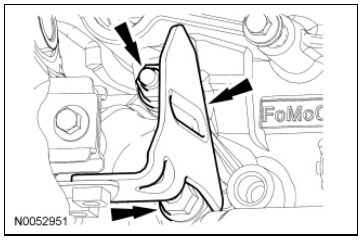


3.5L vehicles

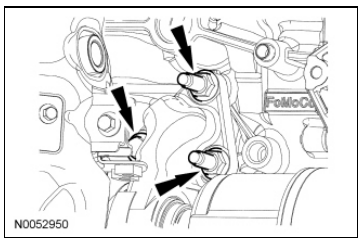
3. Remove the 2 catalytic converter bracket bolts.



4. Remove the 2 nuts and the catalytic converter support bracket.



5. Remove the 3 halfshaft support bracket bolts.

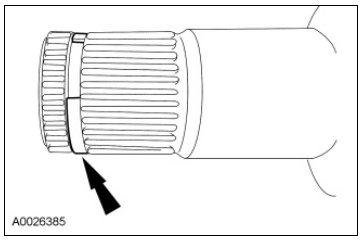


All vehicles

6. ***NOTICE:*** **Use care when removing the intermediate shaft or damage to the transaxle seals may occur.**

   Carefully remove the intermediate shaft while supporting both ends of the intermediate shaft.

7. Remove and discard the circlip from the outboard end of the intermediate shaft.

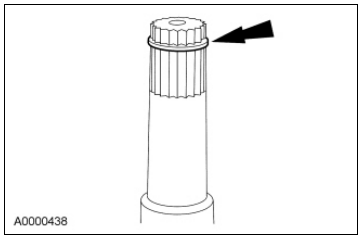


Installation

All vehicles

1. ***NOTICE:*** **Make sure to install the correct circlip for each application. Failure to use the correct diameter circlip may result in shaft removal concerns or shaft damage during vehicle operation.**

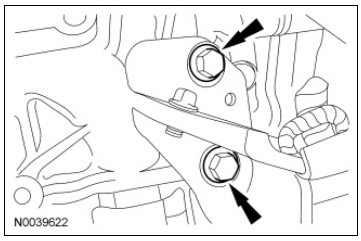
   Install a new circlip on the outboard end of the intermediate shaft.



2. Position the intermediate shaft in the transaxle and engage the intermediate shaft splines with the transaxle side gears. Make sure the circlip is locked in the gear.

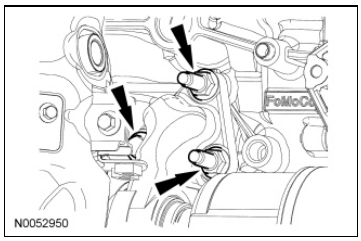
3.0L vehicles

3. Install the 2 halfshaft support bracket bolts.
    - Tighten to 40 Nm (30 lb-ft).

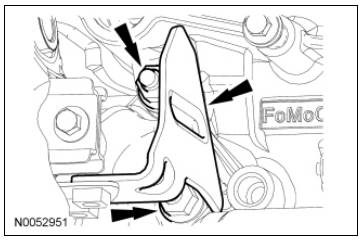


3.5L vehicles

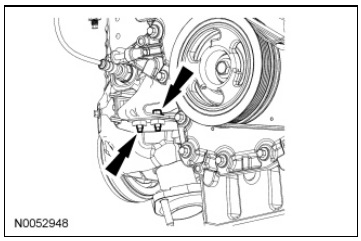
4. Install the 3 halfshaft support bracket bolts.
    - Tighten to 40 Nm (30 lb-ft).



5. Install the catalytic converter support bracket and the 2 nuts.
    - Tighten to 23 Nm (17 lb-ft).



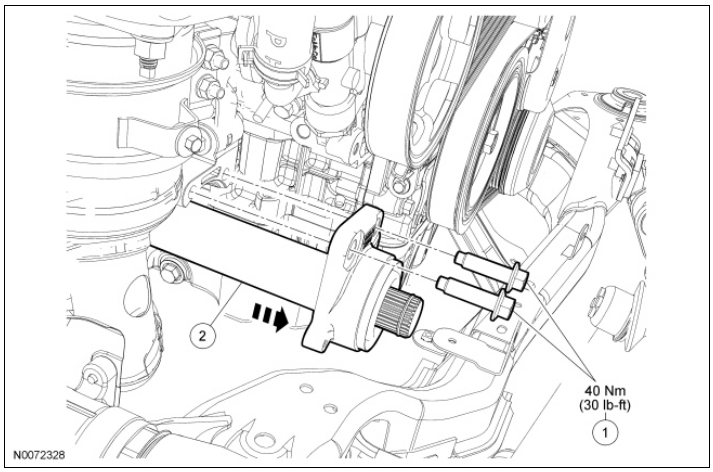
6. Install the 2 catalytic converter bracket bolts.
    - Tighten to 20 Nm (177 lb-in).



All vehicles

7. Install the RH halfshaft. For additional information, refer to Halfshaft in this section.

Intermediate Shaft - All Wheel Drive (AWD)



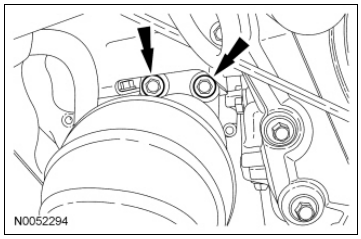
Item	Part Number	Description
1	W500235	Intermediate shaft bearing support bolts (2 required)
2	3A329	Intermediate shaft assembly

Removal

NOTICE: **A new intermediate shaft seal in the Power Transfer Unit (PTU) must be installed whenever the intermediate shaft is removed or damage to the seal may occur. For additional information, refer to Section 308-07B .**

1. Remove the RH halfshaft. For additional information, refer to Halfshaft in this section.

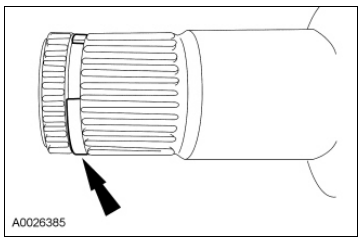
2. Remove the 2 intermediate shaft bearing support bolts.



3. **NOTE:** Do not damage the transaxle seals when removing the intermediate shaft.

   Carefully remove the intermediate shaft while supporting both ends of the intermediate shaft.

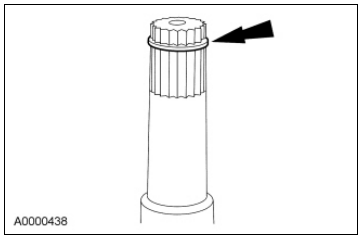
4. Remove and discard the circlip from the outboard end of the intermediate shaft.



Installation

1. ***NOTICE:*** **Make sure to install the correct circlip for each application. Failure to use the correct diameter circlip may result in shaft removal concerns or shaft damage during vehicle operation.**

   Install a new circlip on the outboard end of the intermediate shaft.



2. Install a new intermediate shaft seal. For additional information, refer to Section 308-07B .

3. Position the intermediate shaft in the transaxle and engage the intermediate shaft splines with the transaxle side gears. Make sure the circlip is locked in the gear.

4. Install the 2 intermediate shaft bearing support bolts.
   - Tighten to 40 Nm (30 lb-ft).

5. Install the RH halfshaft. For additional information, refer to Halfshaft in this section.

Material

Item	Specification	Fill Capacity
Motorcraft SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A	1.15L (2.43 pt)

Torque Specifications

Description	Nm	lb-ft
ABS wheel speed sensor bolt	23	17
Shock absorber lower bolt	115	85
Tie-rod bracket nuts	90	66
Toe link bracket nut	90	66
Upper arm bolt	110	81
Wheel hub nut	255	188

Rear Drive Halfshafts

The halfshafts consist of the following components:

- Inner CV joints
- Outer CV joints
- Interconnecting shafts

The halfshafts are splined on the outboard stub shaft to drive the wheel hubs. They are retained in the wheel hubs by special wheel hub nuts which also control the wheel bearing preload. The halfshafts are splined on the inboard stub shaft and are retained by circlips. New circlips must be installed whenever the old circlips are removed.

Halfshaft Joint

CV joints consist of the following components:

- CV joint boot clamps
- Convoluted CV joint boots
- Tripod joint housings
- Ball and cage housings
- Retainer circlips
- Special CV high-temperature grease

The CV joints mate the interconnecting shaft with the stub shaft. The joints allow for smooth rotation of the interconnecting shaft and the stub shafts. They also adjust for length variances and angle requirements as the vehicle goes through jounce and rebound.

The halfshaft joints are not repairable and are serviced as assemblies only.

Halfshaft Handling

Handle all halfshaft components carefully during removal and installation and during various component disassembly and assembly procedures.

- Never pick up or hold the halfshaft only by the inboard or outboard CV joint.
- Do not overangle the CV joints.
- Damage will occur to an assembled inboard CV joint if it is overplunged outward from the joint housing.
- Never use a hammer to remove or install the halfshafts from the rear hub.
- Never use the halfshaft assembly as a lever to position other components. Always support the free end of the halfshaft.
- Do not allow the boots to contact sharp edges or hot exhaust components.
- Handle the halfshaft only by the interconnecting shaft to avoid pull-apart and potential damage to the CV joints.
- Excessive pulling force on the interconnecting shaft between joints of the halfshaft will result in internal joint damage. Axial loads used in assisting removal must be applied through the inboard joint housing only.

- Do not drop assembled halfshafts. The impact will cut the boots from the inside without evidence of external damage.
- Do not remove the outer CV joint by pulling on the interconnecting shaft.
- Inspect all machined surfaces and splines for damage.

Rear Drive Halfshafts

Refer to Section 205-00 .

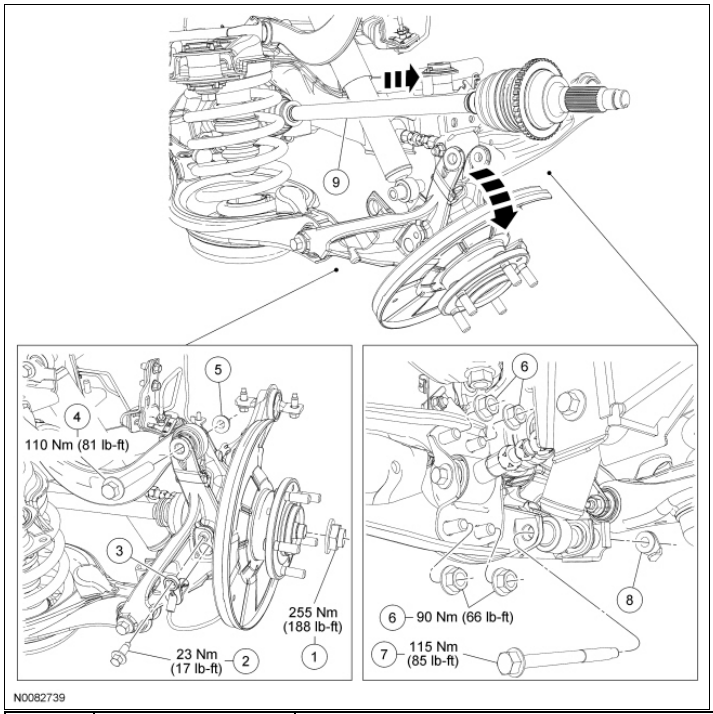
Halfshaft

Special Tool(s)

 ST2828-A	Axle Seal Protector 205-816
 ST2330-A	Front Hub Remover 205-D070 (D93P-1175-B) or equivalent
 ST2138-A	Halfshaft Installer 204-161 (T97P-1175-A)

Material

Item	Specification
Motorcraft SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A

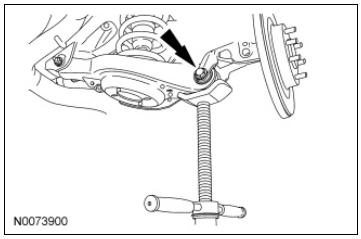


Item	Part Number	Description
1	3N405	Wheel hub nut
2	W500547	ABS wheel speed sensor bolt
3	2C187	ABS wheel speed sensor

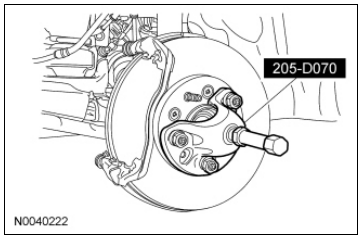
4	W500547	Upper arm bolt
5	W520515	Upper arm nut
6	W520515	Tie-rod bracket nuts (4 required)
7	W712880	Lower shock absorber bolt
8	W712848	Shock absorber lower flagnut (with 17-in wheel)
8	W302117	Shock absorber lower flagnut (with 16-in wheel)
9	4B402	Halfshaft assembly

Removal

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .
2. Remove and discard the wheel hub nut.
3. Remove the bolt and position the ABS wheel speed sensor aside.
4. Remove the shock absorber lower bolt and flagnut.
5. Support the lower arm.

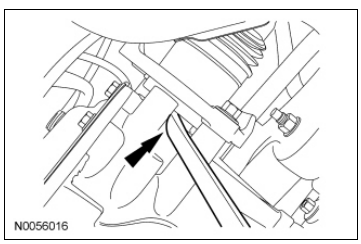


6. Remove the upper arm nut and bolt.
7. Remove the 4 toe link bracket nuts.
8. Using the Front Hub Remover, separate the halfshaft from the wheel hub.

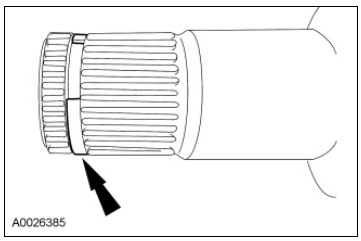


9. ***NOTICE:*** **Do not damage the oil seal protector when removing the axle halfshaft from the differential.**

   Using a suitable pry bar, remove the halfshaft.



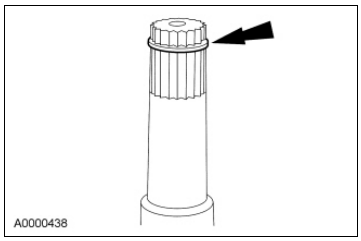
10. Remove and discard the circlip from the stub shaft.



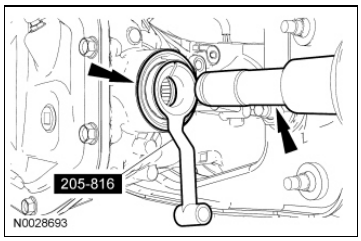
Installation

1. ***NOTICE:*** **Make sure to install the correct circlip for each application. Failure to use the correct diameter circlip may result in shaft removal concerns or shaft separation during vehicle operation.**

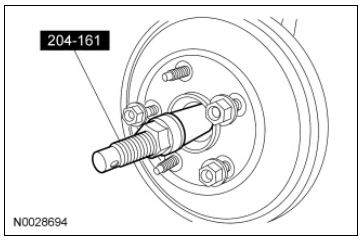
   Install a new circlip on the stub shaft.



2. Using the Axle Seal Protector, install the halfshaft into the differential.
   - Make sure the circlip locks in the side gear.



3. Using the Halfshaft Installer, install the halfshaft into the hub assembly.



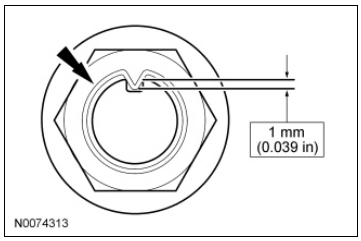
4. Install the upper arm bolt and nut.
   - Tighten to 110 Nm (81 lb-ft).

5. ***NOTICE:*** **Do not tighten the rear wheel hub nut with the vehicle on the ground. The nut must be tightened to specification before the vehicle is lowered to the ground. Wheel bearing damage will occur if the wheel bearing is loaded with the weight of the vehicle applied.**

   Install the new wheel hub nut.

- To install, tighten to 255 Nm (188 lb-ft).

6. Stake the new nut in line with the keyway to a recommended minimum depth of 1 mm (0.039 in) below the keyway diameter to engage the locking feature.



7. Install the 4 rear toe link bracket nuts.
   - Tighten to 90 Nm (66 lb-ft).

8. Install the shock absorber lower bolt and flagnut.
   - Tighten to 115 Nm (85 lb-ft).

9. Position the ABS wheel speed sensor and install the bolt.
   - Tighten to 23 Nm (17 lb-ft).

10. Fill the axle with the specified quantity of the specified lubricant.

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

Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	590-790 ml (1.24-1.66 pt) [a]
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	-	-
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	-

[a] Actual brake fluid capacity will vary depending on vehicle options.

General Specifications

Item	Specification
Front Disc Brake	
Brake disthickness	23.0 mm (0.905 in)
Brake pad maximum taper wear (in any direction)	3.0 mm (0.118 in)
Brake pad minimum thickness	3.0 mm (0.118 in)
Rear Disc Brake	
Brake disc minimum thickness	8.0 mm (0.314 in)
Brake pad maximum taper wear (in any direction)	3.0 mm (0.118 in)
Brake pad minimum thickness	3.0 mm (0.118 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Bleeder screw	8	-	71
Brake caliper guide pin bolts	26	19	-
Master cylinder brake tubes	28	21	-

Brake System

The brake system has the following components:

- Brake master cylinder and fluid reservoir
- Cable/caliper actuated parking brake system
- Clevis pin
- Electric vacuum pump (hybrid vehicles)
- Fixed position brake pedal (non-hybrid vehicles)
- Fixed position brake pedal with integrated brake-by-wire system (hybrid vehicles)
- Four-wheel ABS
- Front and rear disc brake systems
- Vacuum-assisted power brake booster (non-hybrid vehicles)
- Vacuum-assisted active booster (hybrid vehicles)
- Red brake light indicator

Conventional Brake System (Non-Hybrid Vehicles)

The brake pedal is connected to the vacuum power brake booster, which is connected to the brake master cylinder. When the brake pedal is applied, brake fluid is pushed through the double-walled steel tubes and flexible hoses to the disc brake calipers. The brake fluid enters the disc brake calipers, forcing the caliper pistons and brake pads outward against theke disc friction surfaces, slowing or stopping wheel rotation. When the brake pedal is released, brake fluid pressure is relieved, returning the disc brake systems to the unapplied position.

Regenerative Braking System (Hybrid Vehicles)

During braking, the regenerative brake system utilizes the electric motor portion of the hybrid electric power train as a generator to create electrical current. This recharges the High Voltage Traction Battery (HVTB) in combination with the vehicle's conventional friction brakes while slowing the vehicle. The amount of brake torque provided by the electric motor is dependent upon the state of charge of the HVTB . When the HVTB is almost fully charged, the amount of regenerative braking is limited to avoid overcharging, and the requested deceleration is produced by conventional friction braking alone.

For information on the following components:

- Front disc brakes, refer to Section 206-03
- Rear disc brakes, refer to Section 206-04
- Parking brake actuation, refer to Section 206-05
- Hydraulic brake actuation, refer to Section 206-06
- Vacuum-assisted power brake booster, refer to Section 206-07
- ABS, refer to Section 206-09
- Vacuum-assisted active brake booster, refer to Section 206-09
- Electric vacuum pump, refer to Section 206-09

Principles of Operation

Conventional Brake System

Applying the brake pedal produces hydraulic pressure in the master cylinder. Using engine vacuum, the brake booster increases the pressure applied to the master cylinder. The pressure builds in the master cylinder and brake tubes as the brake pedal is applied further. The pressure between the primary and secondary piston forces the secondary piston to compress, building pressure in its circuit. The hydraulic pressure is transmitted by brake fluid through the brake tubes to the ABS Hydraulic Control Unit (HCU), which then distributes that pressure to the individual brake calipers. The brake calipers use hydraulic pressure to apply the pads. The application of the brake pads will cause the rotation of the wheels to slow or stop, depending on how murake pressure is applied. The parking brakes carry out the same function except that they are mechanically actuated by a cable that only connects to the rear brakes.

Brake Master Cylinder Compensator Ports

The purpose of the compensator ports in the brake master cylinder is to supply additional brake fluid from the master cylinder reservoir when needed by the brake system due to brake lining wear and allow brake fluid to return to the master cylinder reservoir when the brakes are released. The returning brake fluid creates a slight turbulence in the master cylinder reservoir. This is a normal condition and indicates that the compensator ports are not clogged. Clogged compensator ports may cause the brakes to hang up or not fully release.

Red Brake Warning Indicator

The red brake warning indicator alerts the driver to certain conditions that exist in the brake system. The Instrument Cluster (IC) performs a bulb check when the ignition key is turned to the RUN position. The conditions that cause the indicator to illuminate are low brake fluid level, the parking brake is applied or there is a fault in the brake system. To diagnose red brake warning indicator concerns, refer to Section 413-01 .

For information on the following hybrid systems, refer to Section 206-09 .

- Regenerative brake system
- Brake-by-wire
- Electric vacuum pump

Inspection And Verification

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Blistering or swelling of rubber brake components can indicate contamination of the brake fluid by a petroleum-based substance. The entire hydraulic brake system must be flushed with clean, specified brake fluid and contaminated rubber components must be replaced to prevent recontamination.**

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

On a conventional brake system, the first indication that something may be wrong in the brake system is a change in the feel through the brake pedal. The brake warning indicator in the Instrument Cluster (IC) and the brake fluid level in the brake master cylinder reservoir are also indicators of system concerns.

If a wheel is locked and the vehicle must be moved, open a bleeder screw at the locked wheel to let out enough fluid to relieve the pressure. Close the bleeder screw. If multiple wheels are locked, check the brake pedal free play to verify brake pedal is not partially applied. These operations may release the brakes, but will not correct the concern. If this does not relieve the locked wheel condition, repair the locked components before proceeding.

1. Verify the customer concern.

- For parking brake concerns, refer to Section 206-05 .
- For vacuum pump (hybrid vehicles) concerns, refer to Section 206-09 .
- For ABS concerns, refer to Section 206-09 .
- For brake-by-wire (hybrid vehicles) concerns, refer to Section 206-09 .
- For active brake booster (hybrid vehicles) concerns, refer to Section 206-09 .
- For vacuum sensor (3.0L AWD and 3.5L) concerns, refer to Section 206-09 .

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

Visual Inspection Chart

Mechanical	Electrical
• Brake fluid level and condition • Brake master cylinder • Brake master cylinder reservoir • Brake booster • Brake booster check valve • Brake booster vacuum hose • Brake hoses and tubes • Brake caliper, guide pins and anchor plate • Brake discs • Brake pads • Brake pedal, bracket and booster linkage • Electric vacuum pump (hybrid vehicles) • Aftermarket modifications	• Active brake booster sensors (hybrid vehicles) ♦ Brake booster travel sensor ♦ Vacuum pressure sensor • Battery Junction Box (BJB) fuse(s): ♦ 3 (40A) ♦ 7 (40A) ♦ 8 (50A) ♦ 10 (30A) ♦ 37 (5A) ♦ 47 (10A) • Electric vacuum pump mechanical relay (hybrid vehicles) • Electric vacuum pump solid state relay (hybrid vehicles) • PCM relay • Active brake booster solenoid (hybrid vehicles) • Brake pedal cut off valve (hybrid vehicles) • Brake-by-wire pedal sensors (hybrid vehicles) ♦ Brake pedal angle sensor ♦ Brake pedal simulator pressure sensor • Brake fluid level switch • Parking brake switch • Vacuum sensor (3.0L All-Wheel Drive (AWD) and 3.5L) • Wiring, terminals or connectors

3. If brake system concern is not evident, visually inspect the suspension system and tires for obvious signs of wear or damage.

- For suspension system concerns, refer to Section 204-00 .
- For tire concerns, refer to Section 204-04 .

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

5. If the cause is not visually evident, refer to Symptom Chart in this section.

Symptom Chart

Symptom Chart - Brake System (Non-Hybrid Vehicles)

Symptom Chart - Brake System (Non-Hybrid Vehicles)

Symptom Chart - Brake System (Hybrid Vehicles)

Symptom Chart - Brake System (Hybrid Vehicles)

Symptom Chart - NVH

Symptom Chart - NVH

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

Condition	Possible Sources	Action
• Vibration when the brakes are applied	• Brake disc(s) • Suspension components	• GO to Pinpoint Test A .
• Brake vibration/shudder - occurs when the brake pedal is released		
• Brake drag		• GO to Symptom Chart - Brake System .
• Rattling noise	• Caliper guide pins or guide pin bolts	• CHECK the caliper guide pins and guide pin bolts. REFER to Brake System Inspection in this section.
	• Missing or damaged anti-rattle clips or springs	

- CHECK the brake pads for missing clips or broken springs. INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
- Loose brake disc shield
- TIGHTEN the brake disc shield bolts to specification. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
- Squealing noise - occurs on first (morning) brake application
- Brake pads
- Acceptable condition. Caused by humidity and low brake pad temperature.
- Squealing noise - a continuous squeal
- Brake pads
- INSPECT the brake pads/shoes. REFER to Brake System Inspection in this section.
- Squealing noise - an intermittent squeal
- Brake pads
- Acceptable condition. Caused by cold, heat, water, mud or snow.
- Groaning noise - occurs at low speeds with brake lightly applied (creeping)
- Brake pads
- Grinding/moaning noise - continuous
- Brake pads
- Brake disc
- INSPECT the brake pads/discs and attaching hardware for damage. VERIFY brake components are within specifications. REFER to Brake System Inspection in this section.
- Excessive vacuum pump noise (above 60-70 dB)
- Vacuum pump
- INSTALL new vacuum pump as necessary.

Pinpoint Tests

Pinpoint Test A: Vibration When the Brakes are Applied

Normal Operation

During moderate to heavy braking, noise from the Hydraulic Control Unit (HCU) and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct functioning of the ABS. Pedal pulsation or steering wheel nibble when the brakes are applied (frequency is proportioned to the vehicle speed) indicates a concern with a brake or suspension component.

PINPOINT TEST A: VIBRATION WHEN THE BRAKES ARE APPLIED

Test Step	Result / Action to Take
A1 ROAD TEST THE VEHICLE - LIGHT BRAKING	
• Road test the vehicle. Warm the brakes by slowing the vehicle from 80 to 32 km/h (50 to 20 mph) using light brake force. At highway speeds of 89-97 km/h (55-60 mph), apply the brake using light pedal force. • **Is there a vibration/shudder felt in the steering wheel, seat or brake pedal?**	**Yes** GO to A4 . **No** GO to A2 .
A2 ROAD TEST THE VEHICLE - MODERATE TO HEAVY BRAKING	
• Road test the vehicle. At highway speeds of 89-97 km/h (55-60 mph), apply the brake using a moderate to heavy pedal force. • **Is there a vibration/shudder?**	**Yes** GO to A3 . **No** The concern is not present at this time.
A3 CHECK ABS OPERATION	
• **NOTE:** During moderate to heavy braking, noise from the HCU and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct operation of the ABS. Pedal pulsation or steering wheel nibble with the frequency proportional to vehicle speed indicates a concern with a brake or suspension component. • Road test the vehiclend apply the brakes on a dry, firm surface, then apply the brakes on a wet, snowy or loose surface (such as gravel). • **Is the vibration/shudder only present on a wet, snowy or loose surface?**	**Yes** This is a normal operating condition of the ABS. **No** GO to A5 .
A4 ISOLATE BRAKE VIBRATION	

• **NOTE:** This test is not applicable to vehicles with drum-in-hat type parking brakes. For vehicles with drum-in-hat parking brakes, proceed to the next test step. For all other vehicles, apply the parking brake to identify if the problem is in the front or rear brake. • Apply the parking brake to identify if the problem is in the front or rear brake. At highway speeds of 89-97 km/h (55-60 mph), lightly apply the parking brake until the vehicle slows down. Release the parking brake immediately after the test. • **Is there a vibration/shudder?**	**Yes** GO to A7 . **No** GO to A5 .
A5 CHECK THE FRONT SUSPENSION	
• Check the front suspension. Refer to Section 204-00 . • **Are all the suspension components in satisfactory condition?**	**Yes** GO to A6 . **No** REPAIR or INSTALL new components as necessary. TEST the system for normal operation.
A6 CHECK THE FRONT BRAKE DISCS	
• Inspect the front brake discs. Refer to Brake System Inspection in this section. • Road test the vehicle. • **Is the vibration/shudder present?**	**Yes** GO to A7 . **No** The concern has been repaired.
A7 CHECK THE REAR SUSPENSION	
• Check the rear suspension. Refer to Section 204-00 . • **Are all the suspension components in satisfactory condition?**	**Yes** INSPECT the rear brake discs. REFER to Brake System Inspection in this section. **No** REPAIR or INSTALL new components as necessary. TEST the system for normal operation.

Component Tests

Brake Booster (Non-Hybrid Vehicles)

1. Inspect the brake booster. For additional information, refer to Brake System Inspection in this section.

2. Disconnect the check valve/vacuum hose from the brake booster and connect a suitable vacuum/pressure tester to the booster side of the check valve/vacuum hose.

3. Apply the parking brake, start the engine and place the transmission in NEUTRAL.
   - Allow the engine to reach normal operating temperature.

4. **NOTE:** Subtract approximately 3.38 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 ft) of elevation above sea level.

   Verify that vacuum iailable at the check valve/vacuum hose with engine running at normal idle speed.

   - The vacuum gauge should read between 51-74 kPa (15-22 in-Hg).
   - If specified vacuum is available, stop the engine, connect the check valve/vacuum hose and continue with Step 5.
   - On vehicles equipped with a check valve, if specified vacuum is not available, continue with Step 4.
   - On vehicles not equipped with a check valve, if specified vacuum is not available, stop the engine, connect the vacuum hose to the check valve and refer to Section 303-00 to diagnose the no/low vacuum condition.

5. Disconnect the check valve from the vacuum hose and verify that the specified vacuum is available at the hose with the engine at idle speed and the transmission in NEUTRAL.
   - If specified vacuum is available, stop the engine, install a new check valve and continue with Step 5.
   - If specified vacuum is not available, stop the engine, connect the vacuum hose to the check valve and refer to Section 303-00 to diagnose the no/low vacuum condition.

6. Apply the brake pedal several times to exhaust all vacuum from the system.

7. Apply the brake pedal and hold it in the applied position. Start the engine and verify that the brake pedal moves downward after the engine starts.
   - If the brake pedal moves, the brake booster is operating correctly.
   - If the brake pedal does not move, install a new brake booster. Refer to Section 206-07 .

8. Operate the engine a minimum of 20 seconds at idle. Stop the engine and let the vehicle stand for 10 minutes, then apply the brake pedal. The brake pedal feel should be the same as that noted with the engine operating.
   - If the brake pedal feels hard (no power assist), install a new brake booster check valve and retest.
   - If condition still exists, install a new brake booster. Refer to Section 206-07 .
   - If the brake pedal feels the same as noted with the engine operating, the check valve is functioning properly.

Brake Master Cylinder - Bypass Condition

1. Disconnect the brake tubes from the master cylinder.

2. Plug the outlet ports of the master cylinder.

3. **NOTE:** Make sure the outlet port plugs do not show signs of leakage.

   Lightly apply the brakes d hold for 10 seconds. Release the brakes and then reapply with heavy force. If brake pedal height cannot be maintained, the brake master cylinder has an internal leak and a new brake master cylinder must be installed.

Brake Master Cylinder - Compensator Port

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

2. Apply and release the brakes.

3. With the brakes released, attempt to rotate each wheel and check for any brake drag.
   - If an excessive amount of brake drag exists at multiple wheels, continue to Step 4.
   - If an excessive amount of brake drag exists at only one wheel, it indicates a possible seized brake caliper, brake wheel cylinder or parking brake component. Repair or install new components as necessary.

4. Check the brake stoplamp switch and the brake pedal free play to verify that the brake pedal is not partially applied.

5. Loosen the brake master cylinder nuts and position the brake master cylinder away from the brake booster.

6. With the brakes released, attempt to rotate each wheel and check for any brake drag.
   - If the brake drag is no longer present, install a new brake booster. Refer to Section 206-07 .
   - If the brake drag is still present, install a new master cylinder. Refer to Section 206-06 .

Brake System Inspection

Material

Item	Specification
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	-
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Brake Pads

NOTE: It is not required to install new brake pads when the brake discs are machined.

1. Inspect the brake pad friction material for contamination.
   - If the friction material shows evidence of contamination, install new brake pads. For additional information, refer to Section 206-03 for front brake pads or Section 206-04 for rear brake pads.

2. Inspect and measure the thickness of the brake pad friction material. For additional information, refer to Specifications in this section.
   - Minor surface cracks do not require pad replacement, however, if there are missing chunks or cracks in the lining through to the backing plate, install new brake pads. For additional information, refer to Section 206-03 for front brake pads or Section 206-04 for rear brake pads.
   - If the thickness of the friction material is less than the specified thickness, install new brake pads. For additional information, refer to Section 206-03 for front brake pads or Section 206-04 for rear brake pads.
   - If the friction material shows taper wear that is not within specifications, install new brake pads and verify the caliper guide pins are functioning correctly. For additional information, refer to Brake Caliper Guide Pins inspection in this section.

Brake Discs

NOTICE: **Using an impact tool without a torque socket will lead to unevenly tightened wheel nuts. This causes brake disc on-vehicle lateral runout and brake roughness.**

1. Inspect the brake discs and measure the brake disc thickness. Record the measurements. Refer to Specifications in this section.
   - If the brake disc is cracked or otherwise damaged, install a new brake disc. For additional information, refer to Section 206-03 for front brakes or Section 206-04 for rear brakes.
   - If the measurement is below the minimum thickness specification, install a new brake disc. For additional information, refer to Section 206-03 for front brakes or Section 206-04 for rear brakes.

- If the diagnosis has revealed vibration in the steering wheel, seat or pedal while braking that varies with vehicle speed, machine the brake disc. Heavily scored brake discs, similar to that caused by pads worn down to the backing plate, should also be machined. In order to machine, discs must be above the minimum thickness specification. For additional information, refer to Specifications and Brake Disc Machining in this section.

Brake Calipers

1. Inspect the brake calipers for leaks, damage to seals and piston corrosion or binding.
    - If the brake caliper is leaking or otherwise damaged, install a new brake caliper. For additional information, refer to Section 206-03 for front brake calipers or Section 206-04 for rear brake calipers.

Brake Caliper Guide Pins

1. The guide pins should slide with a reasonable amount of hand force. If the brake pads show taper wear or the guide pins are difficult to move, carry out the following steps.
    - Disassemble the brake caliper guide pins and inspect the guide pins and guide pin bores for wear, damage and corrosion. If bore is worn or damaged, replace the damaged component.
    - Use a wire brush, rolled-up sandpaper or emery cloth to remove all corrosion and foreign material from the caliper guide pin bores. Clean any remaining foreign material from the bores with brake parts cleaner and compressed air.
    - Assemble the caliper seals, boots and guide pins. Use an ample amount of the specified grease to lubricate the bores and guide pins.
    - Inspect the brake pads. For additional information, refer to Brake Pads inspection in this section.

Brake Flexible Hoses and Tubes

NOTICE: **Never use copper tubing. It is subject to fatigue, cracking and corrosion, which may result in brake tube failure.**

NOTE: Double-wall steel tubing is used throughout the brake hydraulic system. All brake tube fittings must be correctly double flared to provide strong, leakproof connections. When bending tubing to fit the underbody or rear axle contours, be careful not to kink or crack the tube.

1. Inspect brake tubes for corrosion, cracks, leaks or any other signs of damage.
    - If a section of the brake tube is damaged, the entire section must be installed with a new tube of the same type, size, shape and length.
    - When installing the hydraulic brake tubing, hoses or connectors, tighten all connections to specifications. After installation, bleed the brake system. For additional information, refer to Brake System Bleeding in this section.

2. Inspect the brake flexible hoses for cracks, leaks and swelling during brake application or any other signs of damage.
    - Install a new brake flexible hose if the hose shows signs of softening, cracking or other damage. For additional information, refer to Section 206-03 for the front brake flexible hose or Section 206-04 for the rear brake flexible hose.

Brake Master Cylinder

NOTE: During normal operation of the brake master cylinder, the fluid level in the brake master cylinder reservoir will fall during brake application and rise during release. The returning brake fluid creates a slight turbulence in the master cylinder reservoir. This is a normal condition and indicates that the compensator ports are not clogged. Clogged compensator ports may cause the brakes to hang up or not fully release. The net fluid level (such as after brake application and release) will remain unchanged. Fluid level will decrease with pad wear.

NOTE: A trace of brake fluid will exist on the booster shell below the master cylinder mounting flange. This results from the normal lubricating action of the master cylinder bore and seal.

1. Inspect the brake master cylinder for fluid leaks.
    - Install a new master cylinder or brake fluid reservoir if signs of excessive leaking are present. For additional information, refer to Section 206-06 .
    - To check for correct brake master cylinder operation, refer to Component Tests in this section.

Brake Booster (Non-Hybrid Vehicles)

1. Inspect the brake booster for excessive corrosion or damage. Inspect the vacuum hoses for leaks and kinks.
    - Install a new brake booster if signs of excessive corrosion or damage is found. For additional information, refer to Section 206-07 .
    - Repair or replace vacuum hoses as necessary.
    - To check for correct brake booster operation, refer to Component Tests in this section.

Brake Booster (Hybrid Vehicles)

1. Inspect the brake booster for excessive corrosion or damage. Inspect the vacuum hoses for leaks and kinks.
    - Install a new brake booster if signs of excessive corrosion or damage are found. For additional information, refer to Section 206-07 .
    - Repair or replace vacuum hoses as necessary.

2. Check all electrical connections by wiggling connectors and flexing the wire harnesses.
    - Repair the connectors, terminals or wire harnesses as necessary.

3. Retrieve any ABS module DTCs. For additional information, refer to Section 206-09 .

Brake Disc Machining

NOTE: Do not use a bench lathe to machine the brake discs. Use an on-vehicle brake lathe only. Read the entire operating manual and/or view the video shipped with the lathe before installing, operating or repairing the lathe.

NOTE: An on-vehicle brake lathe with an automatic runout adjustment feature is preferred. However, if the lathe is not self adjusting, the lathe oscillation must be adjusted using a dial indicator. The total indicated runout target is 0.000 mm (0.000 i. The maximum indicated runout should be no more than 0.050 mm (0.002 in). If the runout adjustment (automatic or manual) is carried out correctly prior to machining, then the final brake disc runout will be within specification and a runout measurement is not necessary after machining.

NOTE: Lateral runout and disc thickness variation measurements are not required because correct adjustment of the on-vehicle brake lathe will make sure that these dimensions are within specification.

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

2. ***NOTICE:*** **Do not allow the caliper to hang from the brake hose or damage to the hose may occur.**

   Remove the bolts and position the brake caliper or brake caliper and anchor plate assembly aside, as required.

   - Support the brake caliper using mechanic's wire.

3. Install the hub adapter using:
   - four wheel nuts on a 4-stud wheel hub.
   - five wheel nuts on a 5-stud wheel hub.
   - six wheel nuts on a 6-stud wheel hub.
   - four wheel nuts on a 7- or 8-stud wheel hub.
   - five wheel nuts on a 10-stud wheel hub.

4. Install the cutting lathe.

5. If the lathe is not self adjusting, adjust the lathe oscillation using a dial indicator. The total indicated runout target is 0.000 mm (0.000 in). The maximum indicated runout should be no more than 0.050 mm (0.002 in).

6. Center the cutting head, adjust the cutting bits and install the chip deflector/silencer.

7. **NOTE:** The depth of the cut should be between 0.10 and 0.40 mm (0.004 and 0.015 in). Lighter cuts will cause the bit to heat up and wear faster. Heavier cuts will cause poor brake disc surface finish.

   Machine the brake disc.

8. Remove the lathe and the silencer.

9. Remove the wheel nuts and hub adapter.

10. Remove the metal shavings.

11. Measure the brake disc thickness.
    - If the measurement is below the minimum specification, install a new brake disc. For additional information, refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

12. **NOTE:** It is not required to install new brake pads if friction material is within specifications. For additional information, refer to Specifications in this section.

    Position the brake caliper or brake caliper and anchor plate assembly.

    - Install the bolts.
    - For fastener torque specifications, refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

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

Brake System Bleeding

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

Pressure Bleeding

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: Due to the complexity of the fluid path within the hydraulic system, it is necessary to pressure bleed the system.

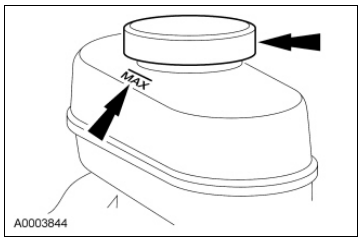
NOTE: When any part of the hydraulic system has been disconnected for repair or installation of new components, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected.

NOTE: Due to the complexity of the fluid path within the rear integral parking brake calipers, it is necessary to press and release the parking brake during the bleed procedure.

NOTE: The Hydraulic Control Unit (HCU) bleeding procedure must be carried out if the HCU or any components upstream of the HCU are installed new.

All vehicles

1. Clean all the dirt from around the brake fluid reservoir cap and remove the cap. Fill the brake master cylinder reservoir with clean, specified brake fluid.



2. **NOTE:** Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adapter.

   Install the bleeder adapter to the brake master cylinder reservoir and attach the bleeder tank hose to the fitting on the adapter.

3. **NOTE:** Make sure the bleeder tank contains enough specified brake fluid to complete the bleeding operation.

   Open the valve on the bleeder tank.

   - Apply 207-345 kPa (30-50 psi) to the brake system.

4. Remove the RH rear bleeder cap and place a box-end wrench on the bleeder screw. Attach a rubber drain tube to the RH rear bleeder screw and submerge the free end of the tube in a container partially filled with clean, specified brake fluid.

5. Loosen the RH rear bleeder screw. Leave open until clear, bubble-free brake fluid flows, then tighten the RH rear bleeder screw.
   - Press and release the parking brake 5 times.
   - Repeat until clear, bubble-free fluid comes out.

6. Tighten the RH rear bleeder screw to specifications, refer to Specifications in this section. Remove the rubber hose and install the bleeder screw cap.

7. Repeat Steps 4 through 6 for the LH rear brake caliper.

8. Remove the RH front bleeder cap and place a box-end wrench on the bleeder screw. Attach a rubber drain tube to the RH front bleeder screw and submerge the free end of the tube in a container partially filled with clean, specified brake fluid.

9. Loosen the RH front bleeder screw. Leave open until clear, bubble-free brake fluid flows, then tighten the RH front bleeder screw.

10. Tighten the LH rear bleeder screw to specifications, refer to Specifications in this section. Remove the rubber hose and install the bleeder screw cap.

11. Repeat Steps 8 through 10 for the LH front brake caliper.

12. Close the bleeder tank valve and release the pressure. Remove the tank hose from the adapter and remove the adapter. Fill the reservoir with clean, specified brake fluid and install the reservoir cap.

Hybrid vehicles

13. **NOTE:** On hybrid vehicles, the brake booster push rod has an elongated slot that attaches to the brake pedal with a clevis pin. The elongated slot allows for a small amount of pedal travel (free play) to occur without the brake pedal applying pressure on the booster push rod. When performing a bleed procedure, it is important to push the pedal through the air gap, so that the clevis pin is contacting the brake booster push rod. Except when required by the scan tool, the ignition key must remain off during the bleed procedure to allow minimal force required to push through the gap.

    With the ignition off, press the brake pedal through the gap to seat the clevis pin against the brake booster push rod and then confirm the pedal is firm.

    - If the brake pedal is spongy (soft), repeat the Pressure Bleeding procedure to remove any remaining air from the system.

Non-hybrid vehicles

14. Apply the brakes several times to verify correct brake operation.
    - If the brake pedal is spongy (soft), repeat the Pressure Bleeding procedure to remove any remaining air from the system.

Hydraulic Control Unit (HCU) Bleeding

⚠ **WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.**

⚠ **WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.**

⚠ **WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.**

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: When any part of the hydraulic system is disconnected for repair or installation of new components, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it is correctly connected.

All vehicles

1. Use the Pressure Bleeding procedure to bleed the system. For additional information, refer to Brake System Bleeding in this section.

2. Connect the scan tool and follow the ABS HCUHydraulic Control Unit (HCU) bleeding instructions.

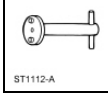
3. Repeat the Pressure Bleeding procedure to bleed the system.

Hybrid vehicles

4. Following the scan tool instructions, carry out the Multi-Calibration Routine.

Component Bleeding

Special Tool(s)

 ST1112-A	Adjuster, Rear Caliper Piston 206-026 (T87P-2588-A)

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

Master Cylinder

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

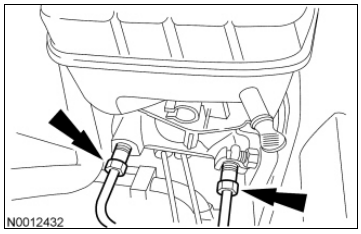
⚠ WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

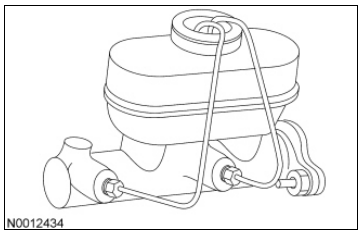
NOTE: When any part of the hydraulic system is disconnected for repair or installation of new components, air can enter the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it is correctly connected.

NOTE: When a new brake master cylinder has been installed, or the system is emptied or partially emptied, it should be primed to prevent air from entering the system.

1. Disconnect the brake tubes from the master cylinder.



2. Install short brake tubes onto the primary and secondary ports with the ends submerged in the brake master cylinder reservoir.



3. Fill the brake master cylinder reservoir with clean, specified brake fluid.

4. **NOTE:** On hybrid vehicles, the brake booster push rod has an elongated slot that attaches to the brake pedal with a clevis pin. The elongated slot allows for a small amount of pedal travel (free play) to occur without the brake pedal applying pressure on the booster push rod. When performing a bleed procedure, it is important to push the pedal through the air gap, so that the clevis pin is contacting the brake booster push rod. Except when required by the scan tool, the ignition key must remain off during the bleed procedure to allow minimal force required to push through the gap.

   Have an assistant slowly pump the brake pedal until clear fluid flows from the brake tubes, without air bubbles.

5. Remove the short brake tubes and install the master cylinder brake tubes.
   - Tighten to specifications, refer to Specifications in this section.

6. Bleed the brake system, refer to Brake System Bleeding in this section.

Front Brake Caliper

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

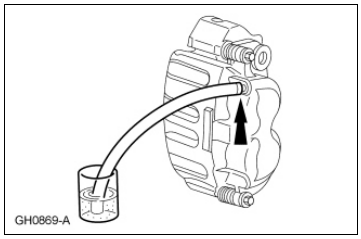
⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: It is not necessary to do a complete brake system bleed if only the brake caliper was disconnected or installed new.

1. Remove the brake caliper bleeder screw cap and place a box-end wrench on the bleeder screw. Attach a rubber drain hose to the bleeder screw and submerge the free end of the hose in a container partially filled with clean, specified brake fluid.



2. **NOTE:** On hybrid vehicles, the brake booster push rod has an elongated slot that attaches to the brake pedal with a clevis pin. The elongated slot allows for a small amount of pedal travel (free play) to occur without the brake pedal applying pressure on the booster push rod. When performing a bleed procedure, it is important to push the pedal through the air gap, so that the clevis pin is contacting the brake booster push rod. Except when required by the scan tool, the ignition key must remain off during the bleed procedure to allow minimal force required to push through the gap.

   Have an assistant pump the brake pedal at least 2 times and then hold firm pressure on the brake pedal.

3. Loosen the bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the bleeder screw.
   - Repeat until clear, bubble-free fluid comes out.
   - Refill the brake master cylinder reservoir as necessary.

4. Tighten the bleeder screw to specifications, refer to Specifications in this section. Remove the rubber hose and install the bleeder screw cap.

Rear Brake Caliper

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: When any part of the hydraulic system is disconnected for repair or installation of new components, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it is correctly connected. The hydraulic system can be bled manually or with pressure bleeding

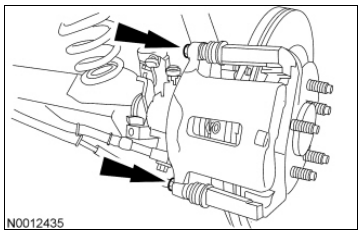
equipment.

NOTE: Due to the complexity of the fluid path within the rear integral parking brake calipers, it may be necessary to follow this procedure when new calipers are installed.

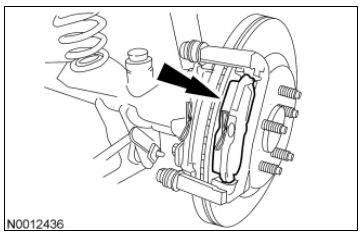
1. **NOTE:** This procedure is necessary only when installing a new rear brake caliper. To bleed the brake system, refer to Brake System Bleeding in this section.

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

2. Remove the 2 brake caliper guide pin bolts and position the brake caliper aside.



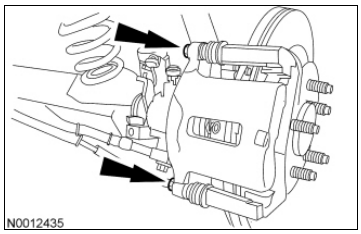
3. Remove the outer brake pad.



4. **NOTE:** Place a shop towel between the caliper and the brake disc.

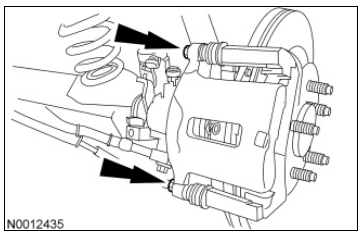
   Install the brake caliper using the 2 guide pin bolts.

   - Tighten to specifications, refer to Specifications in this section.

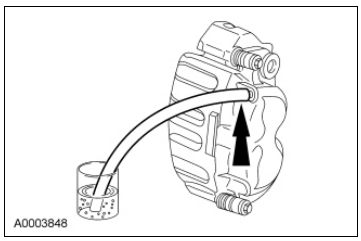


5. Slowly apply the brake pedal to extend the brake caliper piston outward.

6. Remove the 2 guide pin bolts and position the brake caliper aside.

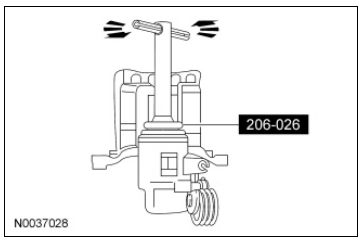


7. Remove the brake caliper bleeder screw cap and place a box-end wrench on the bleeder screw. Attach a rubber drain hose to the bleeder screw and submerge the free end of the hose in a container partially filled with clean, specified brake fluid.



8. Loosen the brake caliper bleeder screw.

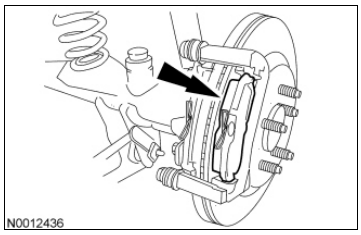
9. Using the Rear Caliper Piston Adjuster, fully retract the brake caliper piston and tighten the bleeder screw to specifications, refer to Specifications in this section.



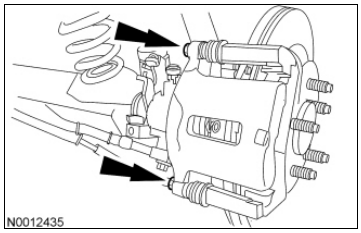
10. Repeat Steps 4 through 9 until clear, bubble free fluid comes out.
    - Refill the brake master cylinder reservoir as necessary.
    - Remove the rubber hose and install the bleeder screw cap.

11. Remove the 2 guide pin bolts and the shop towel.

12. Install the outer brake pad.



13. Position the brake caliper and install the 2 guide pin bolts.
    - Tighten to specifications, refer to Specifications in this section.



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

Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	590-790 ml (1.24-1.66 pt) [a]
High Temperature Nickel Anti-Seize Lubricant XL-2	-	-
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	-	-

[a] Actual brake fluid capacity will vary depending on vehicle options.

General Specifications

Item	Specification
Brake disc minimum thickness	23.0 mm (0.905 in)
Brake pad maximum taper wear (in any direction)	3.0 mm (0.118 in)
Brake pad minimum thickness	3.0 mm (0.118 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake caliper anchor plate bolts	90	66	-
Brake caliper flow bolt	25	18	-
Brake caliper guide pin bolts	27	20	-
Brake disc screws	20	-	177
Brake flexible hose bracket-to-body bolt	18	-	159
Brake flexible hose bracket-to-wheel knuckle bolt	23	17	-
Brake tube fitting	17	-	150

Front Disc Brake

The front brake disc system consists of the following components:

- Brake pads
- Brake caliper anchor plate
- Brake caliper
- Brake disc
- Brake disc shield
- Brake flexible hose

When mechanical force is applied by the driver to the brake pedal, the force is converted into hydraulic pressure by the master cylinder. The hydraulic force is directed to the disc brake calipers and transferred to the brake pads. The brake pads are then forced against the brake friction surfaces by the brake caliper pistons. The friction of the brake pads on the brake disc causes the slowing of wheel rotation and the vehicle.

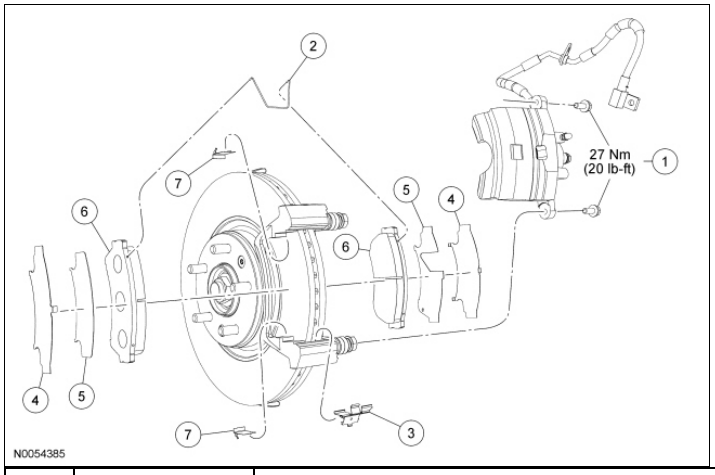
Front Disc Brake

Refer to Section 206-00 .

Brake Pads

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



Item	Part Number	Description
1	2L527	Brake caliper guide pin bolts (2 required) (part of kit)
2	-	Brake pad retraction spring (2 required) (part of 2001)
3	-	Brake pad slide (2 required) (part of 2001)
4	-	Stainless steel shims (2 required) (part of 2001)
5	-	Brake pad shims (2 required) (part of 2001)
6	2001	Brake pads (2 required)
7	-	Brake pad slide clips (4 required) (part of 2001)

Removal

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always install new brake shoes or pads at both ends of an axle to reduce the possibility of brakes pulling vehicle to one side. Failure to follow this instruction may result in uneven braking and serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

1. Check the brake fluid level in the brake master cylinder reservoir.
   - If required, remove the fluid until the brake master cylinder reservoir is half full.

2. Remove the wheel and tire. For additional information, refer to Section 204-04 .

3. ***NOTICE:*** **Do not pry in the caliper sight hole to retract the pistons as this can damage the pistons and boots.**

   NOTICE: **Do not allow the brake caliper to hang from the brake hose or damage to the hose can occur.**

   Remove the 2 brake caliper guide pin bolts and position the caliper aside.

   - Support the caliper using mechanic's wire.

4. Remove the 2 brake pad retraction springs.

5. Remove the brake pads, brake pad shims and stainless steel shims.
   - Inspect the brake pads and shims for wear or contamination.

6. Remove the brake pad slides.

7. Remove the 4 brake pad slide clips.

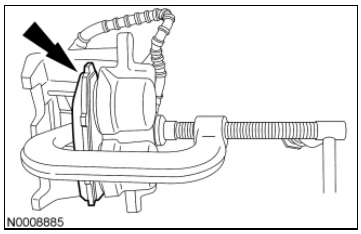
Installation

1. Install the 4 brake pad slide clips.

2. ***NOTICE:*** **Protect the piston and boots when pushing the caliper piston into the caliper piston bores or damage to components may occur.**

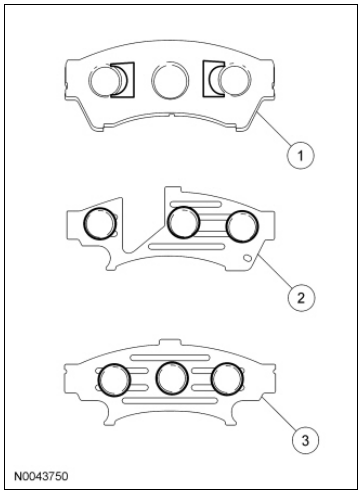
   NOTICE: **Make sure that the caliper guide pin boots are fully seated or damage to the caliper guide pin boots can occur.**

   If installing new brake pads, using a C-clamp and a worn brake, compress the disc brake caliper pistons into the caliper.

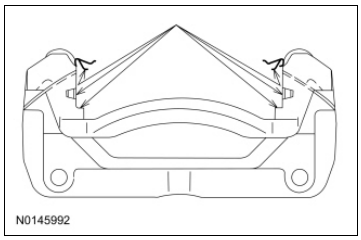


3. Install the brake pad slides.

4. Apply the black grease (6E1-2L064-AA) that is supplied to the pad backing plate and shims in the areas indicated.
   1. Apply grease to the back of the brake pad.
   2. Apply grease to the inner piston side stainless steel shim.
   3. Apply grease to the outer stainless steel shim.



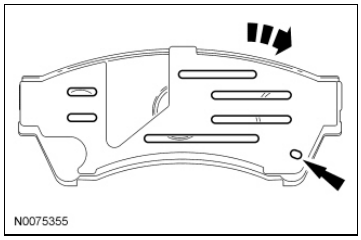
5. Apply the white grease (6E1-2L064-BA) that is supplied to the brake pad retainer clips as indicated.



6. **NOTE:** LH inboard shim shown.

   NOTE: The cut shim is directional and used on the inboard pad only. The cut is positioned toward the leading side. Correct installation can be verified if the shim hole is positioned on the bottom side.

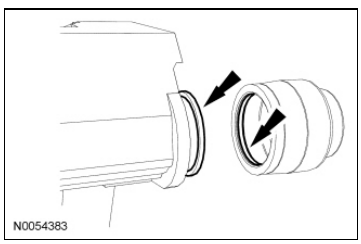
   Install the brake pad shims and the stainless steel shims to the brake pads.



7. Install the 2 brake pad retraction springs.

8. ***NOTICE:*** **The caliper guide pin boots must be seated correctly on the anchor plate or the guide pins may become contaminated.**

   Inspect the guide pin boots and make sure they are seated on the anchor plate correctly. The boot has a lip that fits under the edge of the anchor plate extension.



9. **NOTE:** Make sure that the brake caliper hose does not become twisted.

   Position the brake caliper and install the 2 guide pin bolts.

   - Tighten to 27 Nm (20 lb-ft).

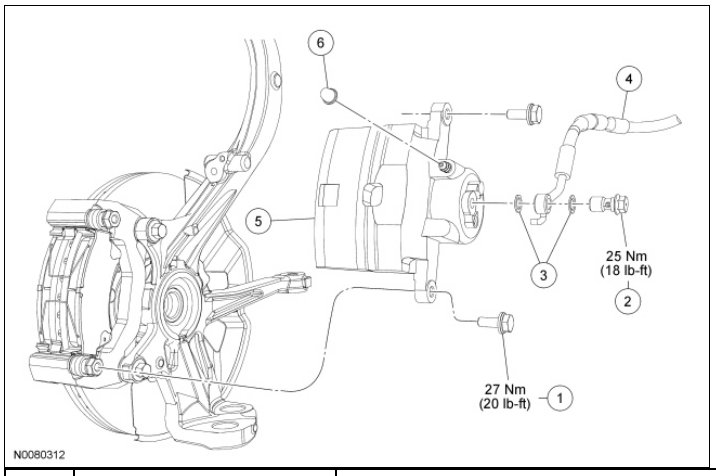
10. Fill the brake master cylinder reservoir with clean, specified brake fluid.

11. Install the wheel and tire. For additional information, refer to Section 204-04 .
    - Apply brakes several times to verify correct brake operation.

Brake Caliper

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



Item	Part Number	Description
1	2L527	Brake caliper guide pin bolt (2 required) (part of kit)
2	2M085	Brake caliper flow bolt
3	99562	Copper washers (2 required)
4	2078	Front brake hose
5	2B120 RH/ 2B121 LH	Brake caliper
6	2L126	Bleeder screw cap

Removal and Installation

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: The brake caliper and anchor plate are serviced together as a kit.

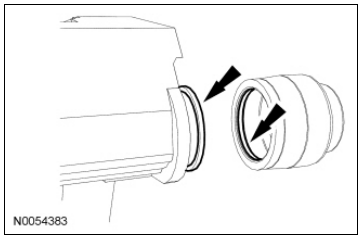
1. Remove the brake pads. For additional information, refer to Brake Pads in this section.

2. Remove the brake caliper flow bolt and position the hose aside.
   - Discard the 2 copper washers.
   - To install, tighten to 25 Nm (18 lb-ft).

3. Remove the 2 brake caliper anchor plate bolts.
   - To install, tighten to 90 Nm (66 lb-ft).

4. ***NOTICE:*** **The caliper guide pin boots must be seated correctly on the anchor plate or the guide pins may become contaminated.**

   Inspect the guide pin boots and make sure they are seated on the anchor plate correctly. The boot has a lip that fits under the edge of the anchor plate extension.



5. **NOTE:** During installation, make sure that the brake caliper hose does not become twisted.

   To install, reverse the removal procedure.

   - Install new copper washers.
   - Bleed the brake caliper. For additional information, refer to Component Bleeding in Section 206-00 .

Brake Caliper Anchor Plate

Removal and Installation

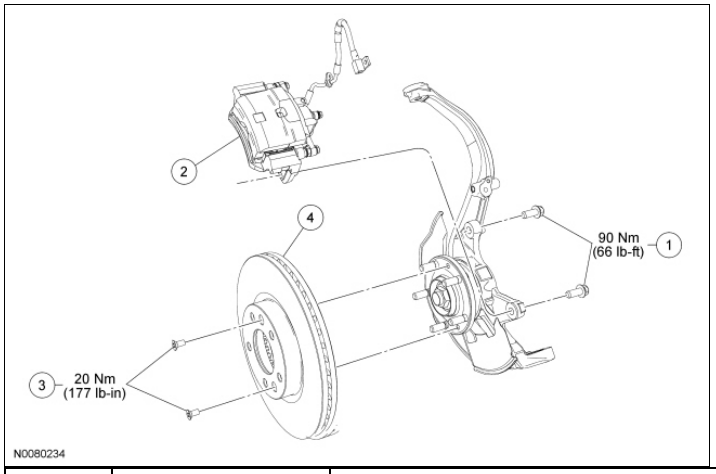
NOTE: The brake caliper and anchor plate are serviced together as a kit.

For additional information, refer to Brake Caliper in this section.

Brake Disc

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	-
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	-



Item	Part Number	Description
1	W711241	Brake caliper anchor plate bolts (2 required)
2	2B292	Brake caliper and anchor plate assembly
3	W505741	Brake disc screws (2 required)
4	1032	Brake disc

Removal and Installation

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

2. ***NOTICE:*** **Do not allow the brake caliper to hang from the brake hose or damage to the hose can occur.**

   Remove the brake caliper anchor plate bolts and position the brake caliper, pads and anchor plate aside as an assembly.

   - Support the caliper using mechanic's wire.
   - To install, tighten the bolts to 90 Nm (66 lb-ft).

3. Remove the 2 brake disc screws.
   - Tstall, tighten to 20 Nm (177 lb-in).

4. Remove the brake disc.

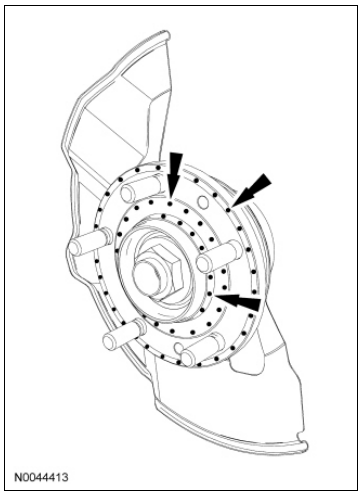
5. **NOTE:** During installation, make sure that the brake caliper hose does not become twisted.

   NOTE: Make sure the brake disc-to-hub mounting surface is free of rust and foreign material before applying anti-seize lubricant.

   NOTE: Do not allow anti-seize to make contact with the wheel studs.

   To install, reverse the removal procedure.

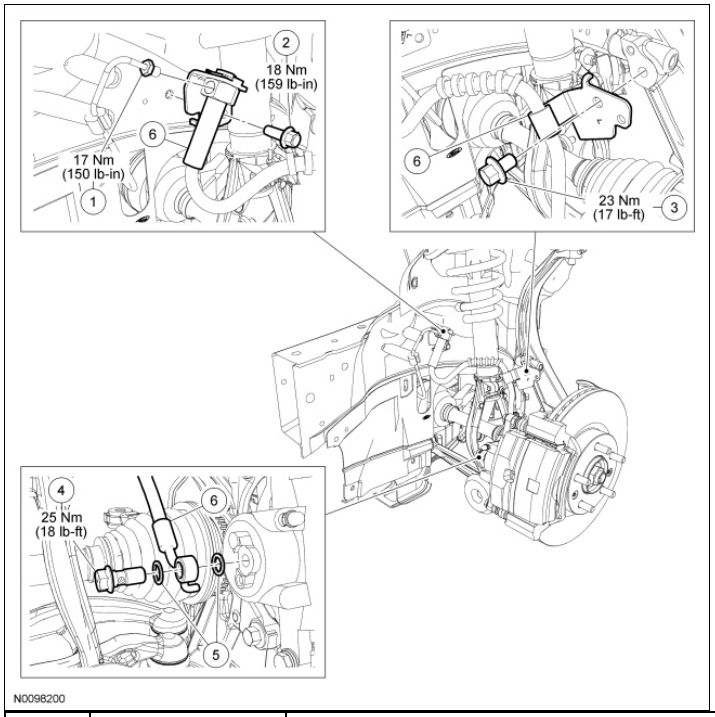
   - Using the specified brake cleaner, clean the mating surfaces.
   - Apply specified lubricant as shown.



Brake Flexible Hose

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



Item	Part Number	Description
1	-	Brake tube fitting (part of 2263 RH/ 2264 LH)
2	W505263	Brake flexible hose bracket-to-body bolt
3	W500020	Brake flexible hose bracket-to-wheel knuckle bolt
4	2L122	Brake caliper flow bolt
5	2149	Copper washers (2 required)
6	2078	Brake flexible hose

Removal and Installation

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call:

1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid ispilled onto a painted or plastic surface, immediately wash the surface with water.**

1. Remove the brake caliper flow bolt and discard the 2 copper washers.
    - To install, tighten to 25 Nm (18 lb-ft).

2. Disconnect the brake tube fitting from the brake flexible hose.
    - To install, tighten to 17 Nm (150 lb-in).

3. Remove the brake flexible hose bracket-to-wheel knuckle bolt.
    - To install, tighten to 23 Nm (17 lb-ft).

4. Remove the brake flexible hose bracket-to-body bolt and the brake flexible hose.
    - To install, tighten bolt to 18 Nm (159 lb-in).

5. To install, reverse the removal procedure.
    - Install new copper washers.
    - Bleed the brake caliper. For additional information, refer to Component Bleeding in Section 206-00 .

Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	590-790 ml (1.24-1.66 pt) [a]
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A	-
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	-	-

[a] Actual brake fluid capacity will vary depending on vehicle options.

General Specifications

Item	Specification
Brake Disc	
Brake disc minimum thickness	8.0 mm (0.314 in)
Brake Pad	
Brake pad maximum taper wear (in any direction)	3.0 mm (0.118 in)
Brake pad minimum thickness	3.0 mm (0.118 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Bleeder screw	8	-	71
Brake caliper anchor plate bolts	70	52	-
Brake caliper flow bolt	25	18	-
Brake caliper guide pin bolts	26	19	-
Brake disc screws	20	-	177
Brake disc shield bolts	23	17	-
Brake tube fitting	17	-	150

Rear Disc Brake

The rear disc brake system consists of the following components:

- Brake caliper anchor plate
- Brake caliper
- Brake disc
- Brake flexible hose
- Brake pads

When mechanical force is applied by the driver to the brake pedal, the force is converted into hydraulic pressure by the master cylinder. The hydraulic force is directed to the disc brake calipers and transferred to the brake pads. The brake pads are then forced against the brake friction surfaces by the brake caliper pistons. The friction of the brake pads on the brake disc causes the slowing or stopping of wheel rotation and the vehicle.

Rear Disc Brake

Refer to Section 206-00 .

Brake Pads

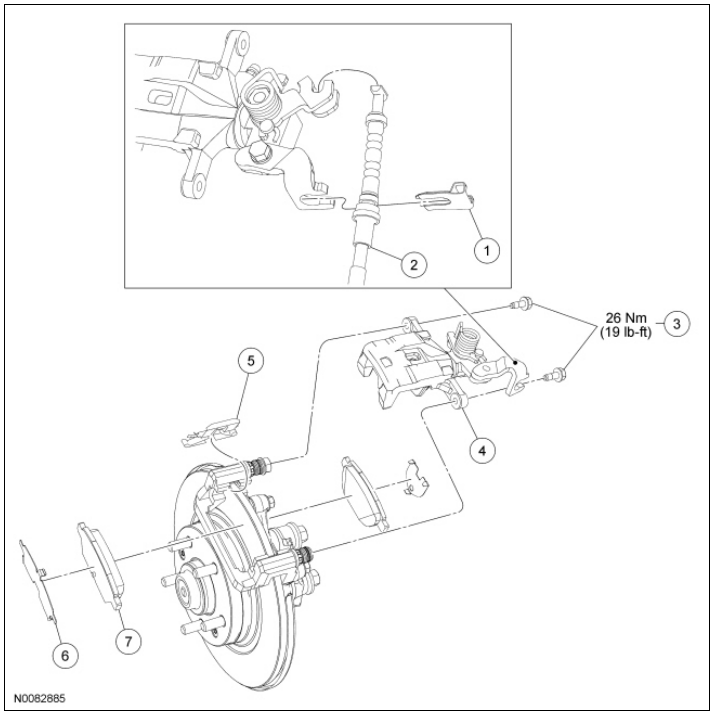
Special Tool(s)

 ST1112-A	Adapter, Rear Brake Caliper Piston Adjuster 206-026 (T87P-2588-A) or equivalent

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.



Item	Part Number	Description
1	2860	Parking brake cable conduit retaining clip
2	2A815	Parking brake cable
3	-	Brake caliper guide pin bolts (part of 2386)
4	2552 LH/ 2553 RH	Brake caliper

5	-	Brake pad slide clip (2 required) (part of 2200)
6	-	Brake pad shim (2 required) (part of 2200)
7	2200	Brake pad (2 required)

Removal

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always install new brake shoes or pads at both ends of an axle to reduce the possibility of brakes pulling vehicle to one side. Failure to follow this instruction may result in uneven braking and serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

1. Check the brake fluid level in the brake master cylinder reservoir.
   - If required, remove the fluid until the brake master cylinder reservoir is 1/2 full.

2. Remove the wheel and tire. For additional information, refer to Section 204-04 .

3. Disconnect the parking brake cable from the brake caliper.
   - Pull back the parking brake lever.
   - Disconnect the cable from the parking brake lever.
   - Remove the cable conduit retaining clip.
   - Disconnect the cable from the brake caliper.

4. ***NOTICE:*** **Do not pry in the caliper sight hole to retract the pistons, as this can damage the pistons and boots.**

   NOTICE: **Do not allow the brake caliper to hang from the brake hose or damage to the hose can occur.**

   Remove the 2 brake caliper guide pin bolts and position the caliper aside.

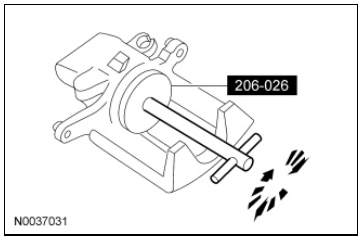
   - Support the caliper using mechanic's wire.

5. Remove the 2 brake pads, shims and retraction clips. Inspect the brake pads and shims for wear, damage or contamination.
   - Discard the slide clips.
   - Inspect the brake pads for wear and contamination.

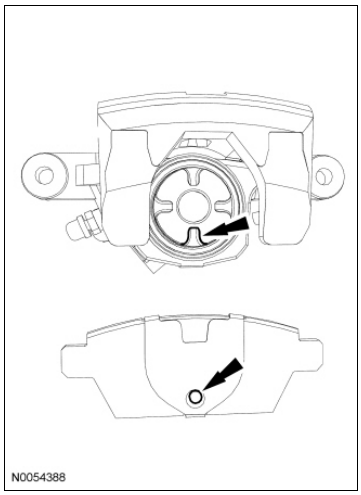
Installation

1. **NOTE:** Make sure the caliper piston boot is clean and free of foreign material.

   Using the Rear Brake Caliper Piston Adjuster Adapter, compress the brake caliper piston into the brake caliper bore.



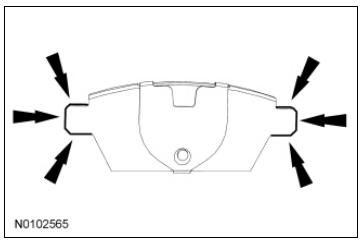
2. Position the notch in the caliper piston so that it will correctly align with the pin on the backside of the inboard brake pad.



3. **NOTE:** If installing new brake pads, install all new hardware as supplied with the brake pad kit.

   Install the shims and slide clips to the brake caliper anchor plate.

4. Apply equal amounts of lubricant (supplied with brake pad kit) to all brake pad-to-caliper anchor plate contact points and install brake pads.



5. **NOTE:** Make sure that the brake caliper hose is not twisted.

   Position the brake caliper on the anchor plate and install the 2 bolts.

   - Tighten to 26 Nm (19 lb-ft).

6. Install the parking brake cable to the brake caliper.
   - Pull back the parking brake lever.
   - Connect the cable to the parking brake lever.
   - Install the cable conduit retaining clip.

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

8. Fill the brake master cylinder reservoir with clean, specified brake fluid.

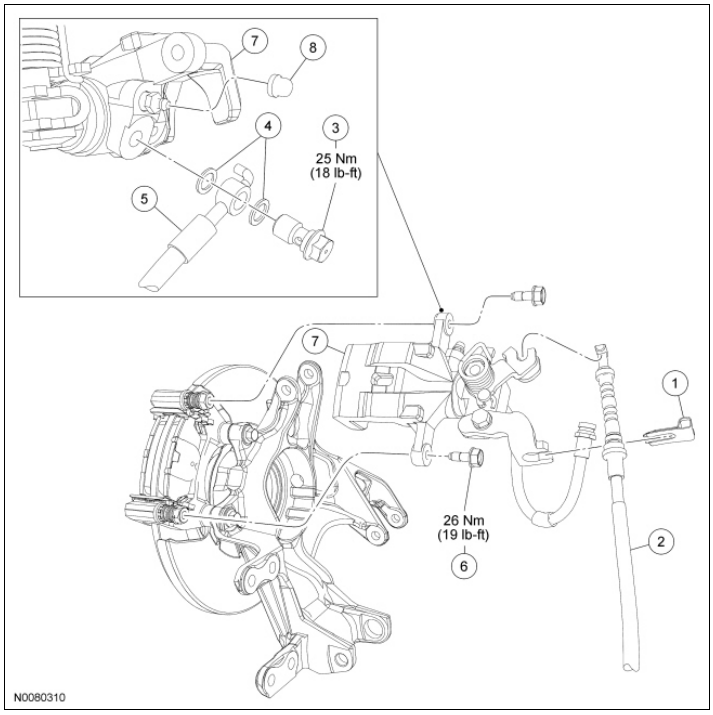
9. Cycle the park brake several times to verify normal operation. For additional information on parking brake adjustment, refer to Section 206-05 .
    - Apply brakes several times to verify correct brake operation.

Brake Caliper

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.



Item	Part Number	Description
1	2860	Parking brake cable conduit retaining clip
2	2A815	Parking brake cable
3	2M085	Brake caliper flow bolt
4	99562	Copper washers
5	2282	Brake hose
6	-	Brake caliper guide pin bolt (2 required) (part of 2386)
7	2552 LH/ 2553 RH	Brake caliper

8	2426	Brake caliper bleeder screw cap

Removal

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

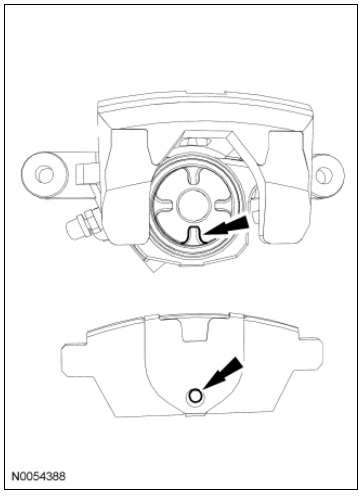
2. Disconnect the parking brake cable from the brake caliper.
   - Pull back the parking brake lever.
   - Disconnect the cable from the parking brake lever.
   - Remove the cable conduit retaining clip.
   - Disconnect the cable from the brake caliper.

3. Remove the brake caliper flow bolt and position the brake hose aside.
   - Discard the 2 copper washers.

4. Remove the 2 brake caliper guide pin bolts and the brake caliper.
   - If a leaking or damaged caliper piston boot is found, install a new disc brake caliper.

Installation

1. Position the notch in the caliper piston so that it will correctly align with the pin on the backside of the inboard brake pad.



2. **NOTE:** Make sure that the brake caliper hose is not twisted.

   Position the brake caliper onto the anchor plate.

3. Install the 2 brake caliper guide pin bolts.

- To install, tighten to 26 Nm (19 lb-ft).

4. Using 2 new copper washers, position the brake hose and install the brake caliper flow bolt.
   - Tighten to 25 Nm (18 lb-ft).

5. Install the parking brake cable to the brake caliper.
   - Pull back the parking brake lever.
   - Connect the cable to the parking brake lever.
   - Install the cable conduit retaining clip.

6. Bleed the brake caliper. For additional information, refer to Section 206-00 Component Bleeding.

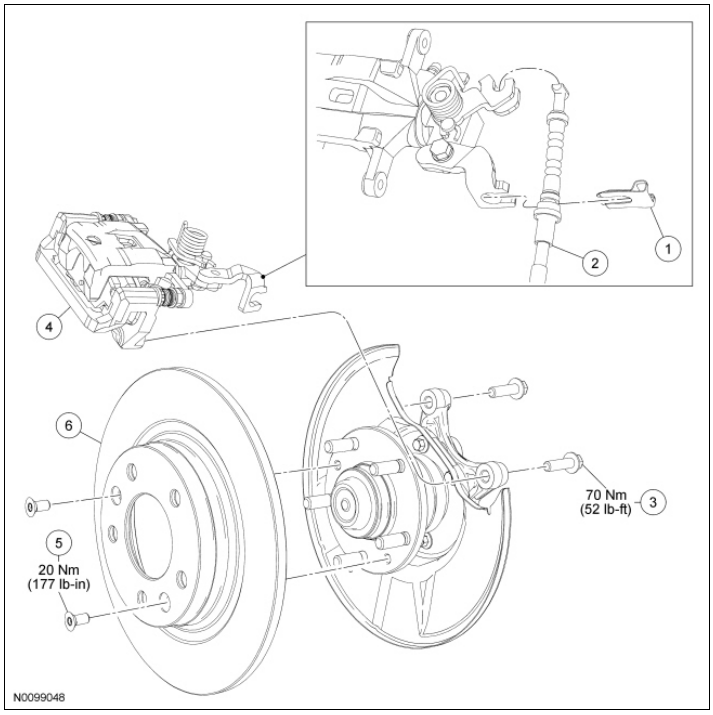
7. Cycle the park brake several times to verify normal operation.

Brake Disc

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	-

NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.



Item	Part Number	Description
1	2860	Parking brake cable conduit retaining clip
2	2A815	Parking brake cable
3	W711240	Brake caliper anchor plate bolt (2 required)
4	-	Brake caliper, brake pads and brake caliper anchor plate assembly
5	W505741	Brake disc screw (2 required)
6	2C026	Brake disc

Removal

1. Remove the wheel and tire. For additional information, refer to Section 204-04 .

2. Disconnect the parking brake cable from the brake caliper.
   - Pull back the parking brake lever.
   - Disconnect the cable from the parking brake lever.
   - Remove the cable conduit retaining clip.
   - Disconnect the cable from the brake caliper.

3. ***NOTICE:*** **Do not allow the brake caliper to hang from the brake hose or damage to the hose can occur.**

   Remove the 2 brake caliper anchor plate bolts and position the brake caliper, brake pads and brake caliper anchor plate aside as an assembly.

   - Support the brake caliper, brake pads and brake caliper anchor plate assembly using mechanic's wire.

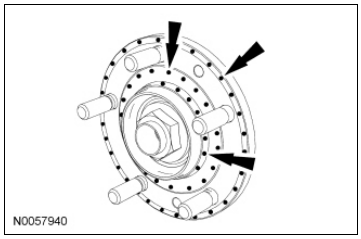
4. Remove the 2 brake disc screws and the brake disc.

Installation

1. **NOTE:** Make sure the brake disc-to-hub mounting surface is free of rust and foreign material before applying anti-seize lubricant.

   Install the brake disc and the 2 brake disc screws.

   - Using the specified brake cleaner, clean the mating surfaces.
   - Apply specified lubricant as shown.
   - Tighten the screws to 20 Nm (177 lb-in).



2. **NOTE:** Make sure that the brake caliper hose is not twisted.

   Position the brake caliper, brake pads and brake caliper anchor plate assembly and install the 2 brake caliper anchor plate bolts.

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

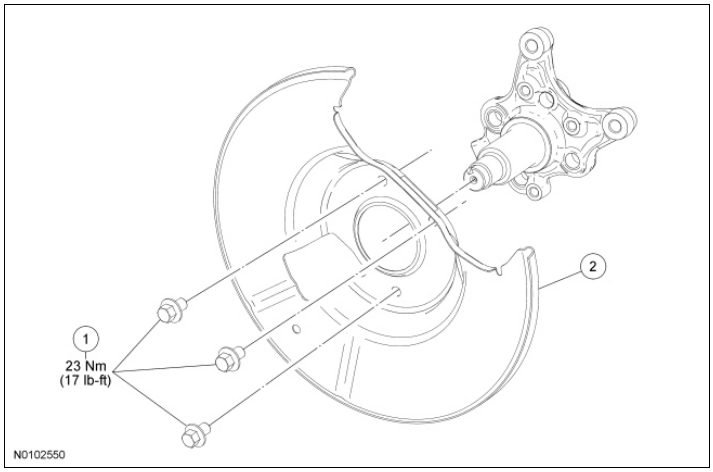
3. Install the parking brake cable to the brake caliper.
   - Pull back the parking brake lever.
   - Connect the cable to the parking brake lever.
   - Install the cable conduit retaining clip.

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

5. Cycle the park brake several times to verify normal operation.

- Apply brakes several times to verify correct brake operation.

Brake Disc Shield - Front Wheel Drive (FWD)



Item	Part Number	Description
1	N500020	Brake disc shield bolts (3 required)
2	2K045 RH/ 2K046 LH	Brake disc shield

Removal and Installation

1. Remove the wheel bearing and wheel hub. For additional information, refer to Section 204-02 .

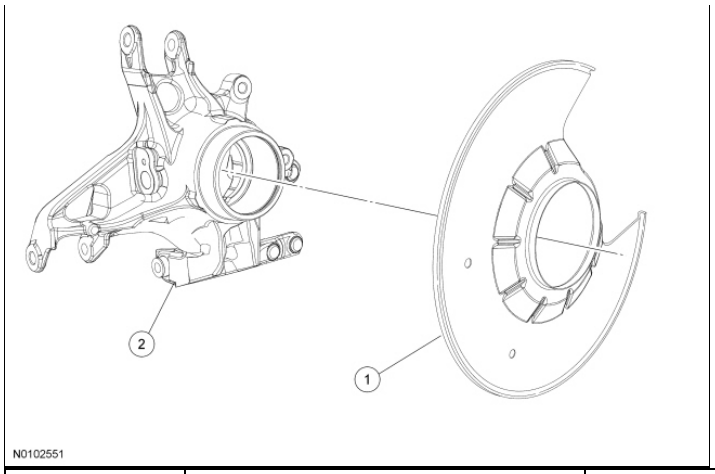
2. Remove the 3 brake disc shield bolts and the brake disc shield.
   - To install, tighten to 23 Nm (17 lb-ft).

3. To install, reverse the removal procedure.

Brake Disc Shield - All Wheel Drive (AWD)

Special Tool(s)

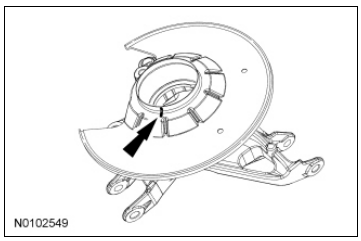
 ST1569-A	Remover/Installer, Front Subframe Bushing 204-362/2



Item	Part Number	Description
1	2K005 LH/ 2K004 RH	Brake disc shield
2	3K186 LH/ 3K185 RH	Wheel knuckle

Removal

1. Remove the wheel bearing and wheel hub. For additional information, refer to Section 204-02 .
2. Index-mark the brake disc shield to the wheel knuckle.

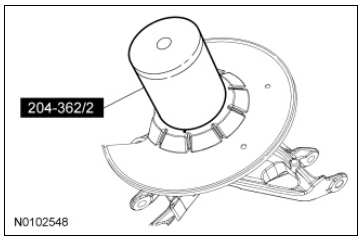


3. Cut the brake disc shield and remove it from the wheel knuckle.

Installation

1. Transfer the index mark from the removed brake disc shield to the new brake disc shield.
2. Position the brake disc shield onto the wheel knuckle.

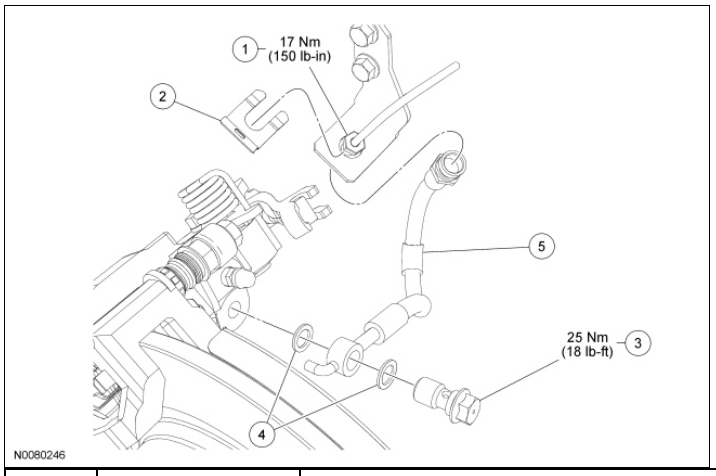
3. Align the index marks and install the brake disc shield onto the wheel knuckle using the Front Subframe Bushing Remover/Installer.



Brake Flexible Hose

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



Item	Part Number	Description
1	-	Brake tube fitting (part of 2268 RH/ 9J279 LH)
2	2L198	Brake flexible hose retaining clip (part of 2282)
3	2L122	Brake caliper flow bolt
4	2149	Copper washers
5	2282	Brake flexible hose

Removal and Installation

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

1. move the wheel and tire. For additional information, refer to Section 204-04 .

2. Remove the brake caliper flow bolt and discard the 2 copper washers.
    - To install, tighten to 25 Nm (18 lb-ft).

3. Disconnect the brake tube fitting from the brake flexible hose.
    - To install, tighten to 17 Nm (150 lb-in).

4. Remove the brake flexible hose retaining clip and the brake hose.

5. To install, reverse the removal procedure.
    - Bleed the brake caliper. For additional information, refer to Section 206-00 Component Bleeding.

Torque Specifications

Description	Nm	lb-ft	lb-in
Catalytic converter-to-exhaust flexible pipe nut	40	30	-
Parking brake cable routing bracket bolts	23	17	-
Parking brake cable routing bracket nuts	9	-	80
Parking brake control bolt	20	-	177
Parking brake control nuts	20	-	177

Parking Brake

The parking brake system consists of the following components:

- Parking brake control
- Parking brake warning indicator switch
- Rear parking brake cable assembly

The parking brake system is a mechanical system that activates a self-adjusting brake system within the rear brake caliper.

The parking brake system is cable-actuated and controlled by an independent, hand-operated parking brake control. The parking brake control applies tension to rear brake pads through the front parking brake cable and conduit and the LH and RH rear parking brake cables. The parking brake warning indicator is located in the instrument cluster. It illuminates to signal the driver that the parking brake is applied or to signal a low brake fluid condition. The warning indicator system is diagnosed in Section 413-01 .

Parking Brake

Principles of Operation

Parking Brake System

The parking brake system is cable-actuated and controlled by an independent, hand-operated parking brake control that is not self adjusting. The parking brake system is actuated when the parking brake control is pulled up. When the parking brake control is pulled, tension is applied to the front parking brake cable. This tension pulls on both rear parking brake cables, which are attached to the brake caliper parking brake actuators and apply the brake pads. When the parking brake release button is pressed and the brake control is released, the return springs on the brake calipers and the parking brake control return the system to the released position.

Inspection and Verification

NOTE: Prior to carrying out any diagnosis, make sure the red brake warning indicator is functional. Refer to Section 413-01 .

The first indication that something may be wrong in the brake system is a change in the feeling through the parking brake control. The parking brake not holding on an incline or dragging after being released are also indicators of system concerns.

Check the operation of the parking brake system with the vehicle on a hoist and the parking brake control fully released. Check for any damaged cables and install new components as necessary. Carry out the brake system diagnosis.

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• Front parking brake cable and conduit • Parking brake control • Parking brake equalizer • Rear brake calipers • Rear parking brake cables and conduits

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

4. If the cause is not visually evident, verify the symptom and GO to Symptom Chart .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The Parking Brake Will Not Apply

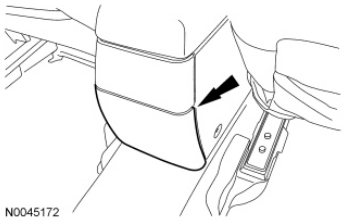
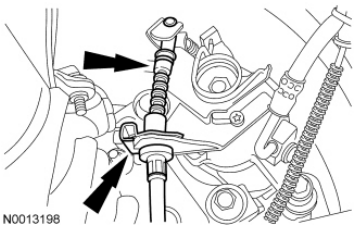
Normal Operation

The parking brake system is cable-actuated and controlled by an independent, hand-operated parking brake control that is not self adjusting. The parking brake system is actuated when the parking brake control is pulled up. When the parking brake control is pulled, tension is applied to the front parking brake cable. This tension pulls on both rear parking brake cables, which are attached to the brake caliper parking brake actuators and apply the brake pads.

This pinpoint test is intended to diagnose the following:
- Parking brake control
- Parking brake cables
- Rear brake calipers

PINPOINT TEST A: THE PARKING BRAKE WILL NOT APPLY

Test Step	Result / Action to Take
A1 CHECK THE PARKING BRAKE CONTROL	
• Apply the parking brake control. • **Does the parking brake control move?**	**Yes** GO to A2 . **No** GO to A3 .
A2 CHECK FOR BROKEN CABLES	
• **NOTE:** Have an assistant apply and release the parking brake control to help isolate disconnected cables or cables that do not move. • Inspect the following items for damage and correct connections: ♦ Parking brake control ♦ Front cable ♦ Equalizer ♦ LH rear cable ♦ RH rear cable	**Yes** CONNECT the component(s) or INSTALL a new parking brake component(s) as necessary. TEST the system for normal operation. **No** VERIFY that the rear pads are within thickness specifications. REFER to Specifications in Section 206-00 . If the rear pads are OK, INSTALL new rear brake

♦ Rear brake caliper actuators • **Is any damage found or are any components disconnected?**	calipers. REFER to Section 206-04 .
A3 ISOLATE THE PARKING BRAKE CONTROL AND FRONT PARKING BRAKE CABLE	
• Remove the floor console rear access panel.  N0045172 • Loosen the parking brake adjustment nut and disconnect the rear cables from the equalizer. • Apply the parking brake control. • **Does the parking brake control move?**	**Yes** GO to A4 . **No** INSTALL a new parking brake control. REFER to Parking Brake Control in this section. TEST the system for normal operation.
A4 ISOLATE THE REAR PARKING BRAKE CABLES	
• Disconnect the LH and RH parking brake cables from the brake calipers.  N0013198 • While holding the cable conduit, attempt to slide the cable inside the conduit. • **Does the cable slide freely inside the conduit?**	**Yes** INSTALL new rear brake calipers. REFER to Section 206-04 . ADJUST the parking brake cable. REFER to Parking Brake Cable Adjustment in this section. **No** INSTALL a new rear brake cable(s). REFER to Parking Brake Cable - Rear in this section. TEST the system for normal operation.

Pinpoint Test B: The Parking Brake Will Not Release

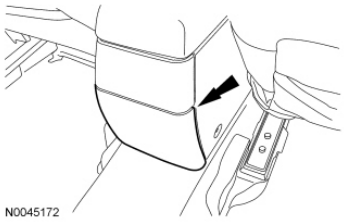
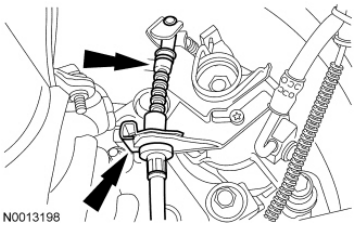
Normal Operation

When the parking brake release button is pressed and the brake control is released, the return springs on the brake calipers and the parking brake control return the system to the released position.

This pinpoint test is intended to diagnose the following:

- Parking brake cables
- Parking brake control
- Parking brake rear wheel components

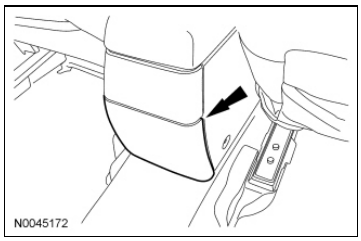
PINPOINT TEST B: THE PARKING BRAKE WILL NOT RELEASE

Test Step	Result / Action to Take
B1 CHECK THE PARKING BRAKE CONTROL	
• Press the release button on the parking brake control and release the handle. • **Does the parking brake control move?**	**Yes** GO to B2 . **No** INSTALL a new parking brake control. REFER to Parking Brake Control in this section. TEST the system for normal operation.
B2 CHECK THE REAR PARKING BRAKE CABLES	
• Remove the floor console rear access panel.  N0045172 • Loosen the parking brake adjustment nut and disconnect the rear cables from the equalizer. • Disconnect the LH and RH parking brake cables from the brake calipers.  N0013198 • While holding the rear cable conduit, attempt to slide the rear cable inside the conduit. • **Does the cable slide freely inside the conduit?**	**Yes** INSTALL new rear brake calipers. REFER to Section 206-04 . ADJUST the parking brake cable. REFER to Parking Brake Cable Adjustment in this section. **No** INSTALL new rear brake cable(s). REFER to Parking Brake Cable - Rear in this section. TEST the system for normal operation.

Parking Brake Cable Adjustment

1. **NOTE:** Do not pry at the floor console rear access panel with a screwdriver or damage to the panel may occur.

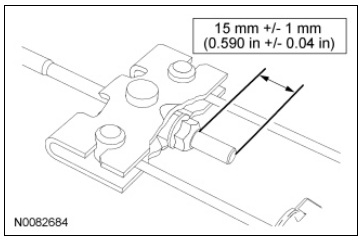
   Remove the floor console rear access panel.



2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

3. **NOTE:** The dimension will vary depending on the amount of cable stretch. New cables require cycling the parking brake control 5-10 times to remove the cable slack.

   Adjust the parking brake adjustment nut as shown.

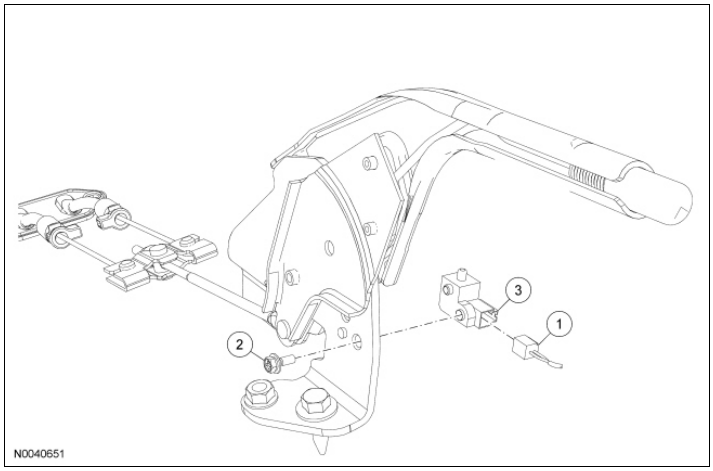


4. Verify correct operation of the parking brake system.
   - At 2 clicks of the parking brake control, slight drag at the rear wheels should be present.
   - At 5 clicks of the parking brake control, no movement at the rear wheels should be present.

5. Install the floor console rear access panel.

Parking Brake Warning Indicator Switch

NOTE: Parking brake control cover removed for clarity.

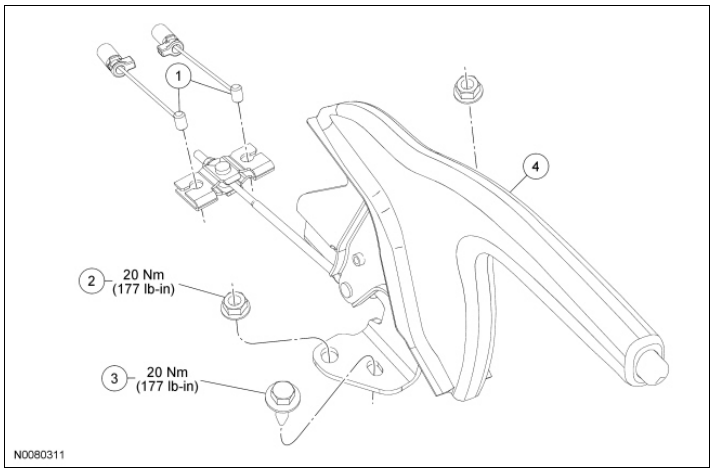


Item	Part Number	Description
1	-	Parking brake warning indicator switch electrical connector
2	-	Parking brake warning indicator switch screw
3	-	Parking brake warning indicator switch

Removal and Installation

1. Remove the floor console. For additional information, refer to Section 501-12 .
2. Disconnect the parking brake warning indicator switch electrical connector.
3. Remove the parking brake warning indicator switch screw.
4. Remove the parking brake warning indicator switch.
5. To install, reverse the removal procedure.

Parking Brake Control



Item	Part Number	Description
1	2A815	Rear parking brake cables
2	W520413	Parking brake control nut (2 required)
3	W706246	Parking brake control bolt
4	2780	Parking brake control

Removal and Installation

1. Remove the floor console. For additional information, refer to Section 501-12 .

2. Make sure the parking brake control is in the released position.

3. Disconnect the warning indicator switch electrical connector.

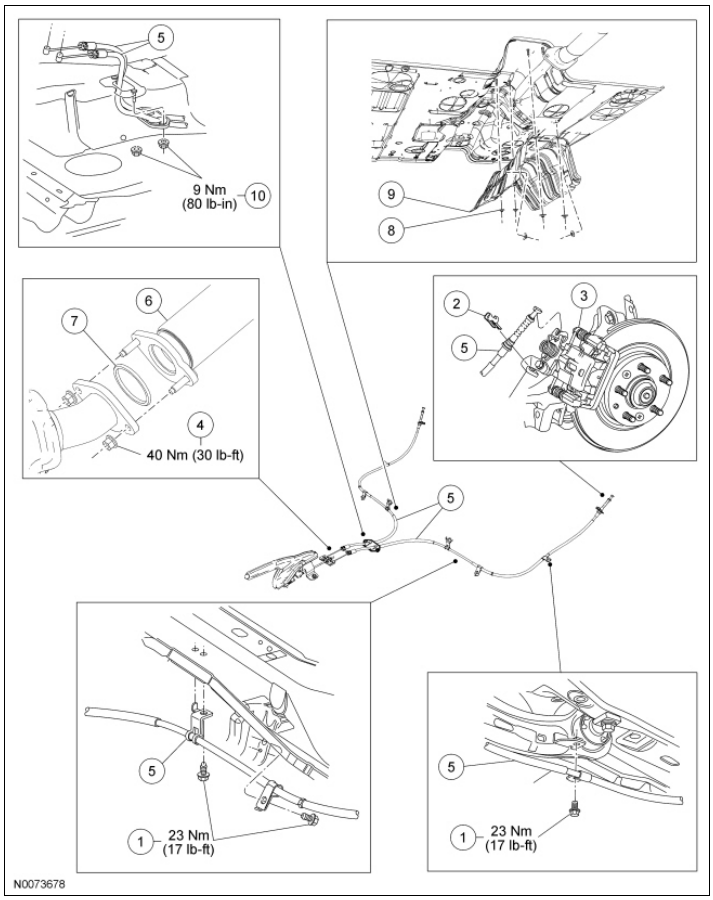
4. Loosen the parking brake control adjusting nut.

5. Remove the 2 parking brake control nuts.
   - To install, tighten to 20 Nm (177 lb-in).

6. Remove the parking brake control bolt and the parking brake control.
   - To install, tighten to 20 Nm (177 lb-in).

7. To install, reverse the removal procedure.
   - Adjust the parking brake cable. For additional information, refer to Parking Brake Cable Adjustment in this section.

Parking Brake Cable - Rear



Item	Part Number	Description
1	W505263	Parking brake cable routing bracket bolts (6 required)
2	2860	Parking brake cable routing clip (2 required)
3	2552 LH/ 2553 RH	Brake caliper
4	W705443	Catalytic converter-to-exhaust flexible pipe nut (2 required)
5	2A815	Rear parking brake cable assembly
6	5G203	Exhaust flexible pipe
7	9451	Gasket
8	W709729	Heat shield nut (6 required)
9	114B04	Heat shield
10	W707142	Parking brake cable routing bracket nuts (2 required)

Removal and Installation

NOTE: Do not use oil or grease-based lubricants on the isolators.

1. Remove the floor console. For additional information, refer to Section 501-12 .

2. Loosen the parking brake control adjusting nut.

3. Disconnect the rear parking brake cables from the equalizer.

4. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

5. Support the muffler and tailpipe with a suitable jackstand.

6. Separate the 2 muffler and tailpipe isolators from the vehicle.

7. Remove and discard the 2 catalytic converter-to-exhaust flexible pipe nuts and separate the exhaust flexible pipe and the catalytic converter.
    - Discard the gasket.
    - To install, position a new gasket and tighten the new nuts to 40 Nm (30 lb-ft).

8. Remove the heat shield.
    - Remove the 6 nuts, the 2 pin-type retainers and the heat shield.

9. Remove the 2 parking brake cable routing bracket nuts.
    - To install, tighten to 9 Nm (80 lb-in).

10. Remove the 6 parking brake cable routing bracket bolts.
    - To install, tighten to 23 Nm (17 lb-ft).

11. Remove the 2 parking brake cable routing clips.

12. Disconnect the rear parking brake cables from the calipers and remove the cables.

13. To install, reverse the removal procedure.
    - Adjust the parking brake cable. For additional information, refer to Parking Brake Cable Adjustment in this section.

Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	590-790 ml (1.24-1.66 pt) [a]

[a] Actual brake fluid capacity will vary depending on vehicle options.

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake booster nuts [a]	-	-	-
Brake fluid remote reservoir nuts	7	-	62
Brake fluid reservoir pin bolt	6	-	53
Brake master cylinder brake tube fittings (non-hybrid)	28	21	-
Brake master cylinder brake tube fittings (hybrid)	20	-	177
Brake master cylinder nuts	20	-	177
Brake pedal and bracket upper bolts	23	17	-
Brake pedal angle sensor screws	2	-	18
Brake pedal bracket bolts [a]	-	-	-
Brake pressure control valve bolts	11	-	97
Brake pressure control valve brake tube fittings 20	-	177	
Steering column opening trim panel reinforcement bolts	3	-	27

[a] Refer to the procedure in this section.

Hydraulic Brake Actuation

The hydraulic brake actuation system consists of the following components:

- Brake master cylinder
- Brake pedal and bracket assembly
- Brake tubes and hoses
- Hydraulic Control Unit (HCU)
- Pressure control valve (non-hybrid vehicles only)

The hydraulic brake system is diagonally split with the LH front and RH rear brakes on one circuit and the RH front and LH rear brakes on the other circuit.

Hydraulic Brake Actuation

The brake pedal is connected to the power brake booster, which is connected to the brake master cylinder. When the brake pedal is pressed, brake fluid is pushed from the master cylinder through the steel tubes, HCU , pressure control valve (non-hybrid vehicles only) and flexible hoses to the front brake calipers and rear wheel cylinders. When the brake pedal is released, brake fluid pressure is relieved, returning the front and rear brake components to the unapplied position.

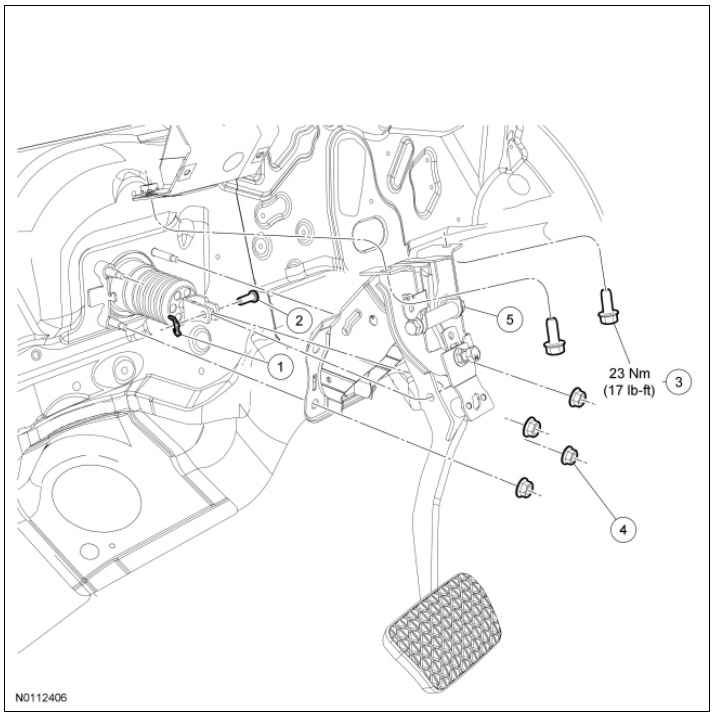
Brake Pedal Assembly - Hybrid

Hybrid vehicles are equipped with a brake pedal assembly that utilizes driver input and electronic components to apply the brakes. The brake booster push rod has an elongated slot that attaches to the brake pedal with a clevis pin. The elongated slot allows for a small amount of pedal travel (freeplay) to occur without the brake pedal applying pressure on the booster push rod. This freeplay allows regenerative braking to occur. To compensate for the freeplay, the pedal assembly is equipped with a hydraulic brake pedal feel simulator that provides the same feel and resistance as a conventional brake pedal. On light or normal brake applications, sensors attached to the brake pedal assembly measure brake pedal angle and the amount of pressure applied to the brake pedal. The sensors send signals to ABS module which activates a solenoid inside the brake booster. The solenoid draws the booster push rod into the booster, applying pressure to the master cylinder piston which then applies hydraulic pressure to the brake system. On hard brake applications, the brake pedal will travel to the end of the elongated slot, eliminating the freeplay and physically engaging the booster push rod, operating the brakes similar to a conventional brake actuation system.

Hydraulic Brake Actuation

Refer to Section 206-00 .

Brake Pedal and Bracket - Non-Hybrid



Item	Part Number	Description
1	7B096	Brake booster push rod pin clip
2	2N513	Brake booster push rod pin
3	W505263	Brake pedal bracket bolt (2 required)
4	W520212	Brake pedal bracket nut (4 required)
5	2455	Brake pedal and bracket

Removal and Installation

1. ***NOTICE:*** **Do not service the brake pedal or brake booster without first removing the stoplamp switch. This switch must be removed with the brake pedal in the at-rest position. The switch plunger must be compressed for the switch to rotate in the bracket. Attempting to remove the switch when the plunger is extended (during pedal apply) will result in damage to the switch.**

   Remove the stoplamp switch. For additional information, refer to Section 417-01 .

2. Remove the brake booster push rod pin clip.

3. Remove the brake booster push rod pin.

4. Remove the 2 brake pedal bracket bolts.
   - To install, tighten to 23 Nm (17 lb-ft).

5. ***NOTICE:*** **Use only hand tools to remove the fasteners or damage to the booster may occur.**

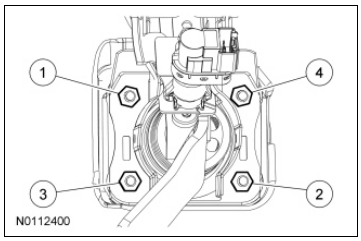
   Remove the 4 brake pedal bracket nuts and the brake pedal and bracket assembly.

6. ***NOTICE:*** **Do not press, pull or otherwise move the brake pedal while installing the stoplamp switch. This switch must be installed with the booster push rod attached to the brake pedal and with the brake pedal in the at-rest position. Installing this switch with the brake pedal in any other position will result in incorrect adjustment and may damage the switch.**

   To install, reverse the removal procedure.

7. ***NOTICE:*** **Use only hand tools to install the fasteners or damage to the booster may occur.**

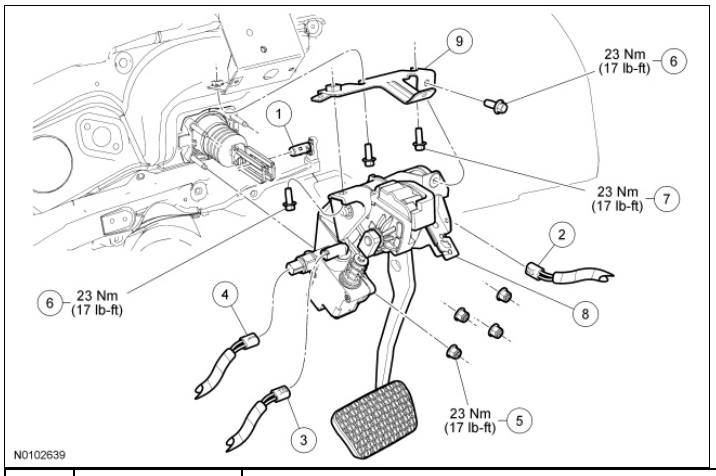
   Tighten the brake pedal bracket nuts to 23 Nm (17 lb-ft) in the sequence shown.



Brake Pedal and Bracket - Hybrid

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

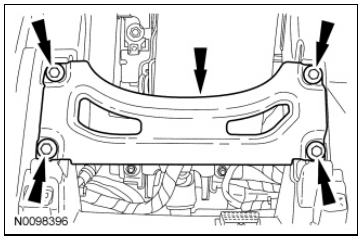


Item	Part Number	Description
1	2L523	Brake booster push rod clevis locking pin
2	-	Brake pedal angle sensor electrical connector (part of 14290)
3	-	Simulator cut off valve solenoid electrical connector (part of 14290)
4	-	Simulator fluid pressure sensor electrical connector (part of 14290)
5	W520112	Brake booster nut (4 required)
6	W505263	Brake pedal and bracket upper bolts (2 required)
7	W505263	Brake pedal bracket bolt (2 required)
8	2455	
9	2468	Brake pedal bracket

Removal and Installation

1. Remove the knee air bag module. For additional information, refer to Section 501-20B .

2. Remove the 4 steering column opening trim panel reinforcement bolts and the steering column opening trim panel reinforcement.
   - To install, tighten to 3 Nm (27 lb-in).



3. ***NOTICE:*** **Do not service the brake pedal without first removing the stoplamp switch. This switch must be removed with the brake pedal in the at-rest position. The switch plunger must be compressed for the switch to rotate in the bracket. Attempting to remove the switch when the plunger is extended (during pedal apply) will result in damage to the switch.**

   Remove the stoplamp switch. For additional information, refer to Section 417-01 .

4. Remove the 3 lower steering column shroud screws and separate the lower steering column shroud from the upper shroud.

5. Disconnect the 3 electrical connectors from the brake pedal and bracket assembly.

6. **NOTE:** The booster push rod clevis-locking pin is a one-time use only part. Any time the booster push rod clevis-locking pin is removed, a new booster push rod clevis-locking pin should be used.

   NOTE: Remove the clevis-locking pin by squeezing the locking tabs and pulling outward on the opposite end.

   Remove and discard the booster push rod clevis-locking pin.

7. Remove the 2 brake pedal and bracket upper bolts.
   - To install, tighten to 23 Nm (17 lb-ft).

8. ***NOTICE:*** **Use only hand tools to remove and install the fasteners or damage to the booster may occur.**

   Remove and discard the 4 brake booster nuts.

   - To install, tighten new nuts to 23 Nm (17 lb-ft) following a clockwise pattern starting with the lower left nut.

9. From the engine compartment, pull the brake booster toward the front of the vehicle until the brake booster studs are clear of the brake pedal bracket holes.

10. ***NOTICE:*** **Do not press, pull or otherwise move the brake pedal while installing the stoplamp switch. This switch must be installed with the booster push rod attached to the brake pedal and with the brake pedal in the at-rest position. Installing this switch with the brake pedal in any other position will result in incorrect adjustment and may damage the switch.**

    To install, reverse the removal procedure.

11. Carry out the Multi-Calibration Routine. Follow the scan tool directions.

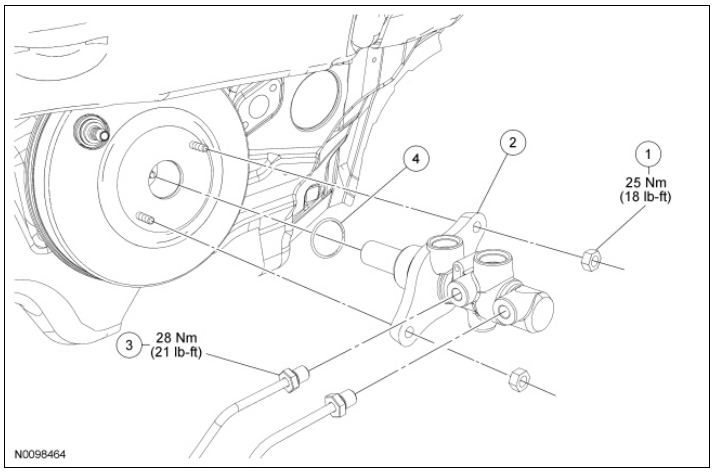
Brake Master Cylinder

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

NOTE: Automatic transmission shown, manual transmission similar.

NOTE: Non-hybrid vehicle shown, hybrid vehicle similar.



Item	Part Number	Description
1	2L364	Brake master cylinder nut (2 required)
2	2140	Brake master cylinder assembly
3	-	Brake master cylinder brake tube fitting (2 required) (part of 2C360)
4	2152	Brake master cylinder-to-brake booster seal

Removal and Installation

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

1. Remove the brake fluid reservoir. For additional information, refer to Brake Fluid Reservoir in this section.

2. If equipped with a manual transmission, disconnect the clutch master cylinder feed hose.
   - Plug the clutch master cylinder feed hose.

3. Disconnect the brake master cylinder brake tube fittings, plug the brake tubes and the brake master cylinder ports.
   - **Non-hybrid vehicles:** To install, tighten to 28 Nm (21 lb-ft).
   - **Hybrid vehicles:** To install, tighten to 20 Nm (177 lb-in).

4. ***NOTICE:*** **Use only hand tools to remove and install the fasteners or damage to the booster may occur.**

   Remove the 2 brake master cylinder nuts.

   - To install, tighten to 20 Nm (177 lb-in).

5. Remove the brake master cylinder.

6. ***NOTICE:*** **Do not allow the flexible portion of the brake tubes to twist during installation, or damage to the brake tubes may occur.**

   To install, reverse the removal procedure.

   - Bleed the master cylinder. For additional information, refer to Section 206-00 .
   - If equipped with a manual transmission, bleed the clutch master cylinder. For additional information, refer to Section 308-00 .

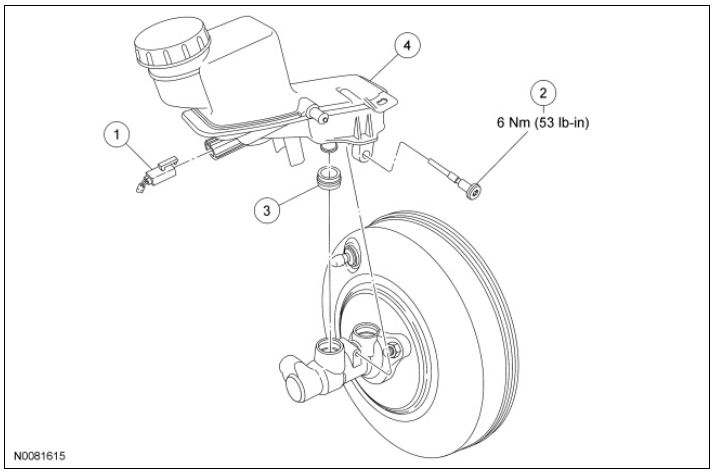
Brake Fluid Reservoir

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

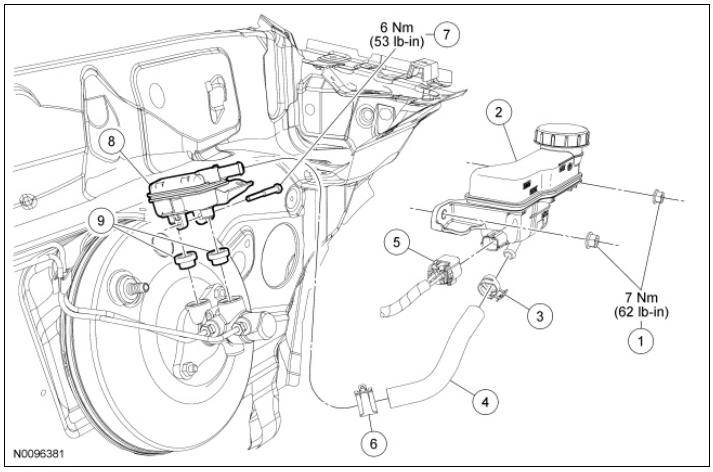
2.5L Non-Hybrid

NOTE: Automatic transmission shown, manual transmission similar.



Item	Part Number	Description
1	-	Brake fluid level warning switch electrical connector (part of 14290)
2	2B176	Brake fluid reservoir pin bolt
3	2L074	Brake fluid reservoir seal (2 required)
4	2C246	Brake fluid reservoir

2.5L Hybrid, 3.0L and 3.5L



Item	Part Number	Description
1	W520111	Brake fluid remote reservoir nuts (2 required)
2	2K478	Brake fluid remote reservoir
3	-	Spring clamp (part of 2K478)
4	-	Brake fluid reservoir hose (part of 2K478)
5	-	Brake fluid level warning switch electrical connector (part of 14290)
6	-	Spring clamp (part of 2K478)
7	2B176	Brake fluid reservoir pin bolt
8	2K478	Brake fluid reservoir
9	2L074	Brake fluid reservoir seals (2 required)

Removal and Installation

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

All vehicles

1. Using a suitable suction device, remove the brake fluid from the remote reservoir.

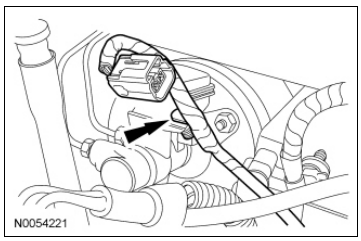
2. Disconnect the brake fluid level switch electrical connector.

2.5 Hybrid, 3.0L and 3.5L vehicles

3. Remove the lower cowl panel grille. For additional information, refer to Section 501-02 .

4. Disconnect the hose from the remote reservoir.

5. Disconnect the brake fluid level switch harness from the brake fluid reservoir.



All vehicles

6. Remove the brake fluid reservoir pin bolt and the brake fluid reservoir.
    - To install, tighten to 6 Nm (53 lb-in).

7. Remove and discard the 2 brake fluid reservoir seals.

8. **NOTE:** Install new brake fluid reservoir seals. Lubricate the seals with clean, specified brake fluid.

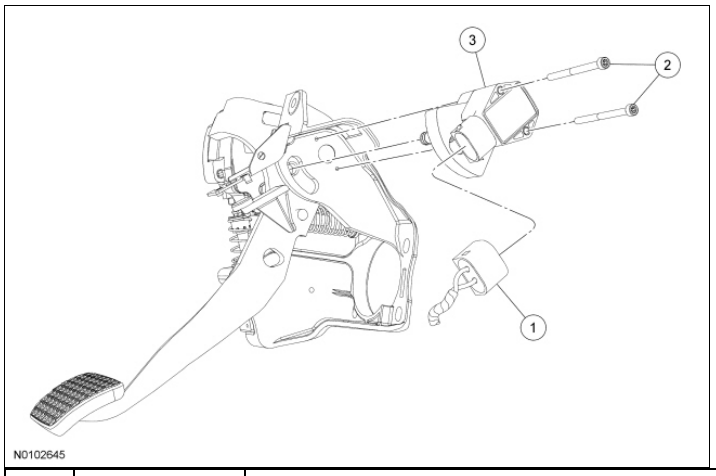
   To install, reverse the removal procedure.

    - Bleed the brake system. For additional information, refer to Section 206-00 .
    - If equipped with a manual transmission, bleed the clutch master cylinder. For additional information, refer to Section 308-00 .

Brake Pedal Angle Sensor

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool



Item	Part Number	Description
1	-	Brake pedal angle sensor electrical connector (part of 14290)
2	-	Brake pedal angle sensor screws (2 required) (part of 14F385A)
3	14F385A	Brake pedal angle sensor

Removal and Installation

1. Remove the brake pedal bracket. For additional information, refer to Brake Pedal and Bracket - Hybrid in this section.

2. Remove and discard the 2 brake pedal angle sensor screws.

3. Remove the brake pedal angle sensor.

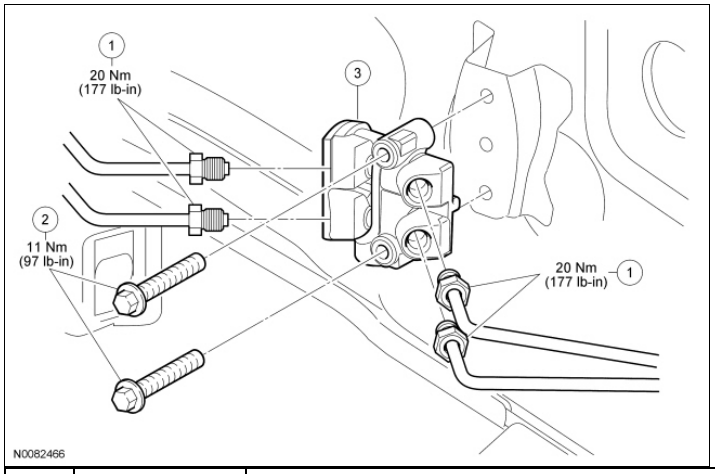
4. To install, reverse the removal procedure.
   - Install new brake pedal angle sensor screws.

5. Carry out the Multi-Calibration Routine. Follow the scan tool directions.

Brake Pressure Control Valve

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



Item	Part Number	Description
1	-	Brake pressure control valve brake tube fittings (part of 9J279)
2	W711239	Brake pressure control valve bolts (2 required)
3	43900	Brake pressure control valve

Removal and Installation

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

All vehicles

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

100-02 .

3.0L and 3.5L vehicles

2. Remove the RH fender splash shield. For additional information, refer to Section 501-02 .

All vehicles

3. Remove the nut and the brake tube heat shield.

4. Disconnect the brake pressure control valve brake tube fittings, plug the tubes and the ports on the brake pressure control valve.
    - To install, tighten to 20 Nm (177 lb-in).

5. Remove the 2 brake pressure control valve bolts and the brake pressure control valve.
    - To install, tighten to 11 Nm (97 lb-in).

6. To install, reverse the removal procedure.
    - Bleed the brake system. For additional information, refer to Section 206-00 .

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolts	25	18	-
A/C compressor bracket bolts	25	18	-
Auxiliary coolant pump bracket bolts	25	18	-
Brake booster nuts [a]	-	-	-
Ground cable bolt	12	-	106
Motor Electronics Cooling System (MECS) coolant pump bolts	20	-	177
MECS expansion tank nut and bolt	12	-	106
PCM bracket nuts	11	-	97
Push rod jam nut	17	-	150
Remote brake fluid reservoir nuts	7	-	62
Transmission fluid level indicator tube op" align="center">8	-	71	
Transmission selector lever cable bracket nuts	23	17	-
Vacuum pump bracket bolt	25	18	-
Vacuum pump bracket nut	25	18	-

[a] Refer to the procedure in this section.

Brake Booster

The power brake actuation system consists of the following components:

- Brake booster
- Brake booster check valve
- Brake booster vacuum supply hose
- Brake booster vacuum sensor
- Brake booster travel sensor (hybrid vehicles)
- Engine-mounted vacuum pump (hybrid vehicles)

Conventional brake booster

The brake booster uses engine vacuum from the intake manifold to create a partial vacuum inside the vacuum booster on both sides of the diaphragm. When the brake pedal is pressed, the booster rod opens a valve, allowing air to enter the booster on one side of the diaphragm while sealing off the opposite side. This increases pressure on that side of the diaphragm so that it helps push the rod, which in turn pushes the piston in the master cylinder. As the brake pedal is released, the valve seals off the outside air supply while opening the vacuum valve. This restores vacuum to both sides of the diaphragm, allowing everything to return to its original position. Vehicles with 3.0L All-Wheel Drive (AWD) and 3.5L engines are equipped with a vacuum sensor. The ABS module uses the signals produced by the vacuum pressure sensor to verify that vacuum maintained in the brake booster.

Active brake booster (hybrid vehicles)

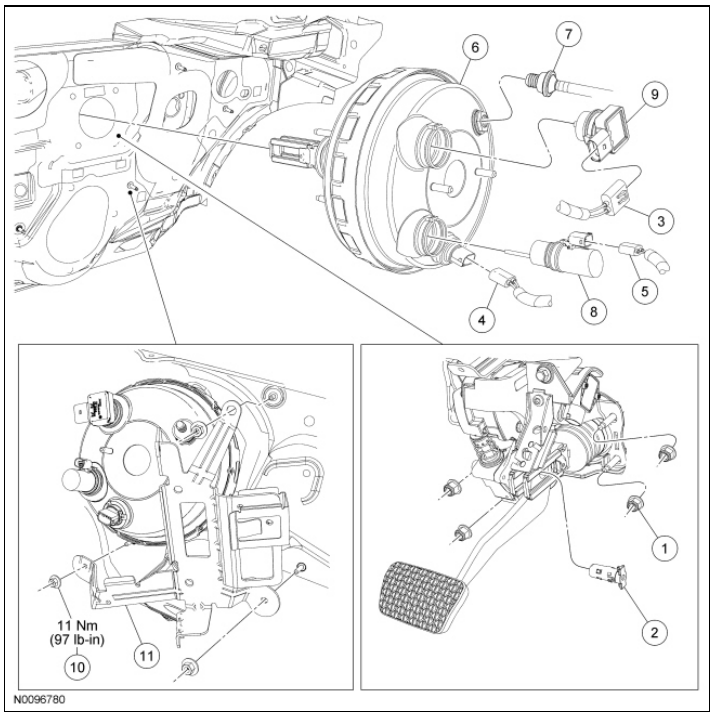
The active brake booster uses vacuum supplied by an electric vacuum pump mounted on the engine when engine vacuum is unavailable. The active brake booster is similar to a conventional brake booster but with the addition of a brake booster (vacuum) solenoid, a brake booster travel sensor and a vacuum sensor. If it is necessary to apply the friction brakes, the ABS module will send a Pulse Width Modulated (PWM) signal to the brake booster solenoid that is proportional to the amount of brake torque requested. The booster solenoid will open to allow vacuum to draw the booster diaphragm and push rod toward the master cylinder piston, building hydraulic pressure. The vacuum sensor is used by the ABS module to monitor vacuum maintained inside the brake booster. The brake booster travel sensor is used to monitor the performance of the brake booster.

Power Brake System

Refer to Section 206-00 .

Brake Booster - Exploded View

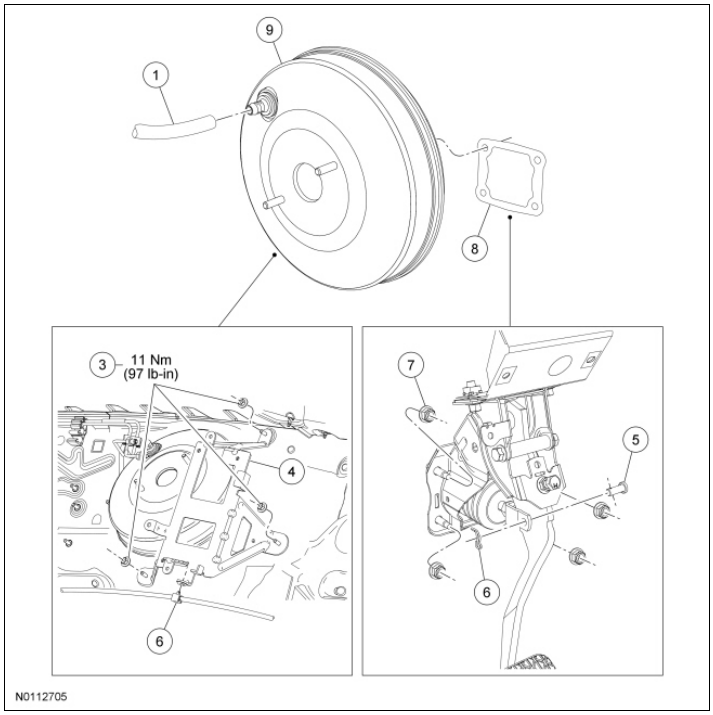
Brake Booster - Hybrid Vehicles



Item	Part Number	Description
1	W520413	Brake booster nut (4 required)
2	2L523	Booster rod clevis-locking pin
3	-	Vacuum sensor electrical connector (part of 14290)
4	-	Booster solenoid electrical connector (part of 14290)
5	-	Booster travel sensor electrical connector (part of 14290)
6	2005	Brake booster
7	9C482	Vacuum supply tube
8	2M113	Brake booster travel sensor
9	2365	Brake booster vacuum sensor
10	N804795	PCM bracket nut (3 required)
11	12A659	PCM bracket

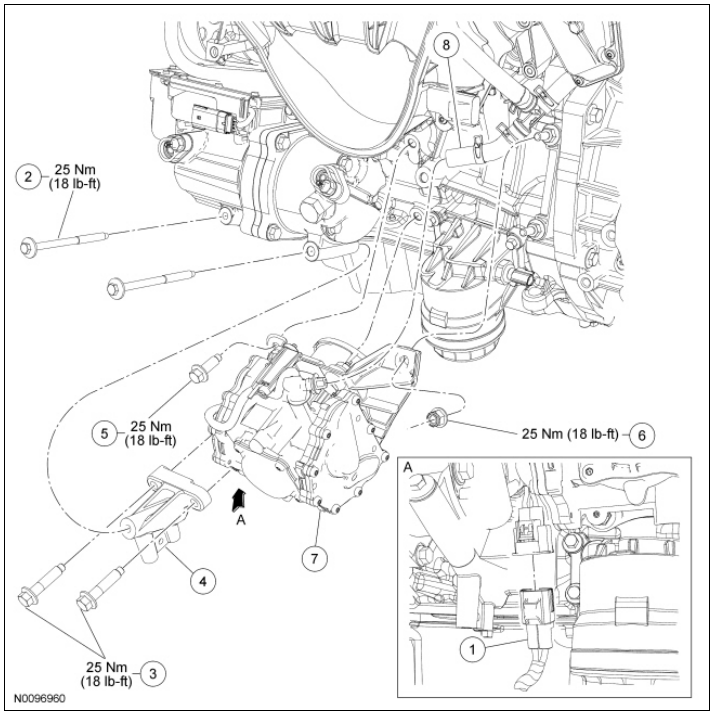
Brake Booster - Non-Hybrid Vehicles

NOTE: 3.0L Front Wheel Drive (FWD) shown, 3.0L All-Wheel Drive (AWD) and 3.5L similar.



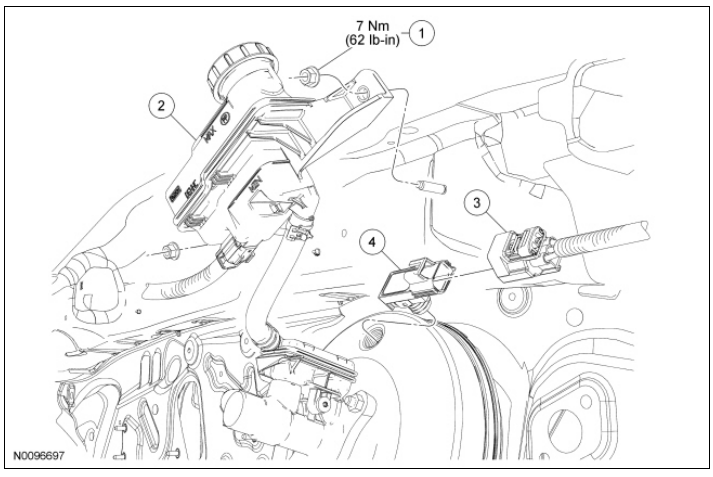
Item	Part Number	Description
1	9C840	Vacuum hose/aspirator assembly
2	-	Harness fastener (part of 14290)
3	N804795	PCM bracket nuts
4	12A659	PCM bracket
5	2N513	Brake booster push rod pin
6	7B096	Brake booster push rod clip
7	W520212	Brake booster nut (4 required)
8	2B022	Brake booster-to-cowl gasket
9	2B195	Brake booster with check valve

Vacuum Pump - Hybrid Vehicles



Item	Part Number	Description
1	-	Vacuum pump electrical connector (part of 14A411)
2	W701626	A/C compressor bolt (2 required)
3 W500320	A/C compressor bracket bolts	
4	19D624	A/C compressor bracket
5	W500233	Vacuum pump bracket bolt
6	W520212	Vacuum pump bracket nut
7	2A451	Vacuum pump assembly
8	9C482	Vacuum hose

Vacuum Sensor - 3.0L All-Wheel Drive (AWD) and 3.5L Vehicles



Item	Part Number	Description

1	W520111	Remote brake fluid reservoir nut (2 required)
2	2K478	Remote brake fluid reservoir
3	-	Vacuum sensor electrical connector (part of 14290)
4	2C444	Vacuum sensor

1. For additional information, refer to the procedures in this section.

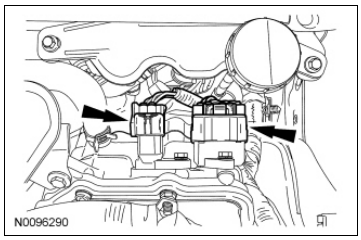
Brake Booster - Hybrid

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

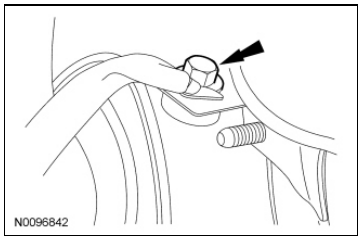
Removal and Installation

1. Disconnect the 2 low-voltage electrical connectors.


N0096290

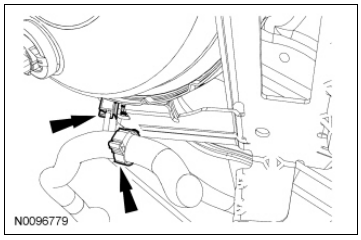
2. Remove the master cylinder. For additional information, refer to Section 206-06 .

3. Remove the bolt and position the ground cable aside.
   - To install, tighten the bolt to 12 Nm (106 lb-in).


N0096842

4. Remove the PCM. For additional information, refer to Section 303-14D .

5. Detach the wiring harness and brake tube routing retainers from the PCM bracket.


N0096779

6. Remove the 3 nuts and the PCM mounting bracket.
   - To install, tighten the nuts to 11 Nm (97 lb-in).

7. Disconnect the vacuum hose/check valve assembly from the brake booster.

8. Disconnect the vacuum sensor, booster solenoid and the booster travel sensor electrical connectors.

9. ***NOTICE:*** **Do not service the brake pedal or brake booster without first removing the stoplamp switch. This switch must be removed with the brake pedal in the at-rest position. The switch plunger must be compressed for the switch to rotate in the bracket. Attempting to remove the switch when the plunger is extended (during pedal apply) will result in damage to the switch.**

   Remove the stoplamp switch. For additional information, refer to Section 417-01 .

10. **NOTE:** The booster push rod clevis-locking pin is a one-time-use only part. Any time the booster push rod clevis-locking pin is removed, a new booster push rod clevis-locking pin must be used.

    NOTE: Remove the clevis-locking pin by squeezing the locking tabs and pulling outward on the opposite end.

    Remove and discard the booster push rod clevis-locking pin.

11. Remove and discard the 4 brake booster nuts and remove the brake booster.
    - To install, tighten the new nuts to 23 Nm (17 lb-ft) in a clockwise pattern, starting with the lower left nut.

12. ***NOTICE:*** **Do not press, pull or otherwise move the brake pedal while installing the stoplamp switch. This switch must be installed with the booster push rod attached to the brake pedal and with the brake pedal in the at-rest position. Installing this switch with the brake pedal in any other position will result in incorrect adjustment and may damage the switch.**

    To install, reverse the removal procedure.

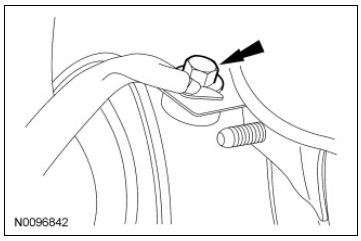
13. Following the scan tool instructions, carry out the Multi-Calibration Routine.

Brake Booster - Non-Hybrid

Removal and Installation

All vehicles

1. Remove the brake master cylinder. For additional information, refer to Section 206-06 .
2. Remove the PCM. For additional information, refer to Section 303-14A or Section 303-14B .
3. Remove the battery tray. For additional information, refer to Section 414-01 .
4. If equipped, remove the brake booster vacuum sensor. For additional information, refer to Brake Booster Vacuum Sensor - Non-Hybrid in this section.
5. Remove the bolt and position the ground cable aside.
    - To install, tighten the bolt to 12 Nm (106 lb-in).



6. Disconnect the harness fastener and remove the 3 nuts and the PCM bracket.
    - To install, tighten the nuts to 11 Nm (97 lb-in).
7. *NOTICE:* **Make sure that the aspirator tube is routed correctly and that the clamps are positioned so they do not make contact with surrounding components or damage to the tube may occur.**

   Disconnect the vacuum hose/check valve assembly from the brake booster.

Automatic transmission vehicles

8. **NOTE:** It is not necessary to remove the fluid level indicator tube from the transmission. The tube can be positioned aside with only the bolt removed.

   Remove the transmission fluid level indicator tube bolt and position the tube aside.

    - To install, tighten to 8 Nm (71 lb-in).

All vehicles

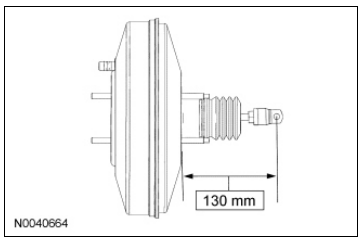
9. Remove the brake booster push rod pin and clip and disconnect the push rod from the brake pedal.
10. *NOTICE:* **Use only hand tools to remove the fasteners or damage to the booster may occur.**

    Remove the 4 nuts and the brake booster

11. ***NOTICE:*** **Prior to installation, make sure that the distance between the booster mating surface and the push rod center point is as shown or reduced brake assist may occur.**

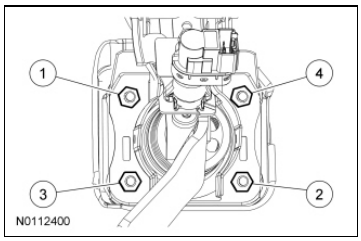
    To install, reverse the removal procedure.

    - Check for correct booster push rod distance and adjust as necessary.
        - ♦ Tighten the booster push rod jam nut to 17 Nm (150 lb-in).



12. ***NOTICE:*** **Use only hand tools to install the fasteners or damage to the booster may occur.**

    Tighten the brake booster nuts to 23 Nm (17 lb-ft) in the sequence shown.



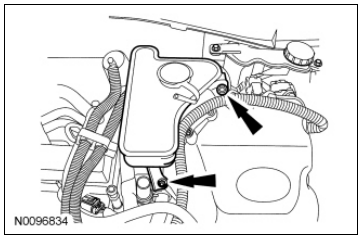
Brake Booster Travel Sensor - Hybrid

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

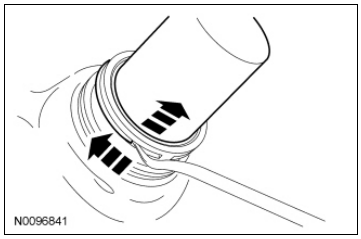
Removal and Installation

1. Remove the Motor Electronics Cooling System (MECS) expansion tank nut and bolt, position the tank aside.
    - To install, tighten the nut and bolt to 12 Nm (106 lb-in).



2. Disconnect the brake booster travel sensor electrical connector.

3. Release the brake booster travel sensor retainer ring and remove the travel sensor.



4. To install, reverse the removal procedure.

5. Following the scan tool instructions, carry oue Multi-Calibration Routine.

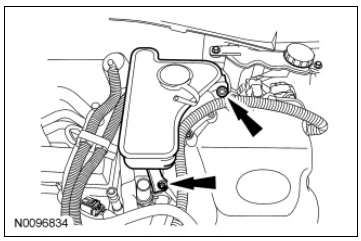
Brake Booster Vacuum Sensor - Hybrid

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

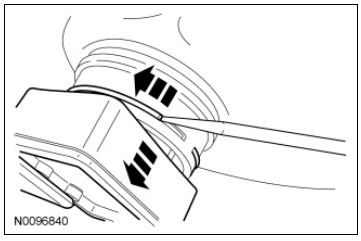
Removal and Installation

1. Remove the Motor Electronics Cooling System (MECS) expansion tank nut and bolt, position the tank aside.
    - To install, tighten the nut and bolt to 12 Nm (106 lb-in).



2. Disconnect the brake booster vacuum sensor electrical connector.

3. Release the brake booster vacuum sensor retainer ring and remove the vacuum sensor.



4. To install, reverse the removal procedure.

5. Following the scan tool instructions, carry oue Multi-Calibration Routine.

Brake Booster Vacuum Sensor - Non-Hybrid

1. Remove the battery. For additional information, refer to Section 414-01 .

2. Remove the 2 brake fluid remote reservoir nuts and position the reservoir aside.
   - To install, tighten the nuts to 7 Nm (62 lb-in).

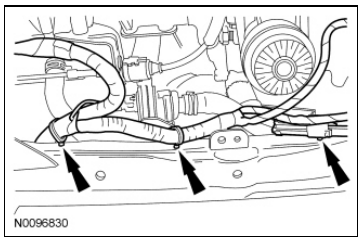
3. Disconnect the vacuum sensor electrical connector and remove the vacuum sensor.

4. To install, reverse the removal procedure.

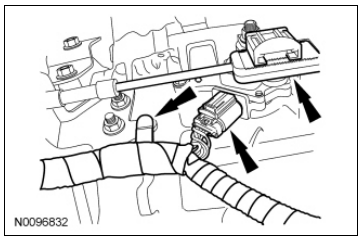
Brake Vacuum Pump

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

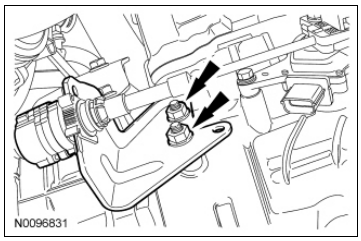
2. Detach the 3 wiring harness retainers from the subframe.



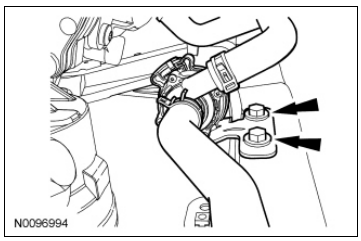
3. Disconnect the electrical connector and the selector lever cable.
   - Detach the harness retainer and position harness aside.



4. Remove the 2 transmission selector lever cable bracket nuts and position cable and bracket aside.
   - To install, tighten the nuts to 23 Nm (17 lb-ft).

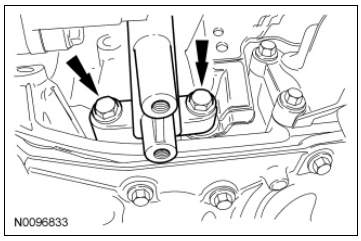


5. Remove the Motor Electronics Cooling System (MECS) coolant pump bolts and position the pump aside.
   - To install, tighten the bolts to 20 Nm (177 lb-in).

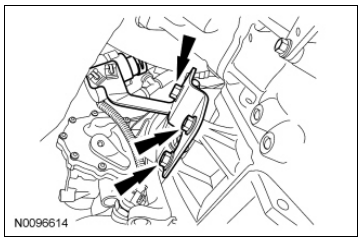


6. Remove the 2 lower A/C compressor bolts.
   - To install, tighten to 25 Nm (18 lb-ft).

7. Remove the 2 A/C compressor bracket bolts and the bracket.
    - To install, tighten the bolts to 25 Nm (18 lb-ft).



8. Remove the 3 auxiliary coolant pump bracket bolts and position the auxiliary coolant pump aside.
    - To install, tighten the bolts to 25 Nm (18 lb-ft).



9. Disconnect the vacuum pump electrical connector.

10. Remove the vacuum pump bracket nut.
    - To install, tighten to 25 Nm (18 lb-ft).

11. Remove the vacuum pump bracket bolt.
    - To install, tighten the bolts to 25 Nm (18 lb-ft).
    - Position the vacuum pump to release the clamp, detach the vacuum hose and remove the vacuum pump.

12. To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	590-790 ml (1.24-1.67 pt) [a]

[a] Actual brake fluid capacity will vary depending on vehicle options.

Torque Specifications

Description	Nm	lb-ft	lb-in
ABS module screws - Hybrid [a]	-	-	-
ABS module screws - Non-hybrid	2	-	18
Degas bottle hose nut	20	177	-
Front brake tube fittings - Hybrid	20	-	177
Front brake tube fittings - Non-hybrid	20	-	177
Front wheel speed sensor bolt	23	17	-
Front wheel speed sensor harness bracket-to-body bolt	7	-	62
Hydraulic Control Unit (HCU) bracket bolts	23	17	-
HCU bracket-to-frame bolt	23	17	-
HCU bracket-to-frame nut	23	17	-
HCU bracket-to-frame stud bolt	23	17	-
HCU bracket-to- HCU bolt	9	-	80
Master cylinder brake tube fittings - Hybrid	20	-	177
Master cylinder brake tube fittings - Non-hybrid	27	20	-
Rear brake tube fittings - Hybrid	20	-	177
Rear brake tube fittings - Non-hybrid	20	-	177
Rear wheel speed sensor bolt	23	17	
Rear wheel speed sensor harness bolt - All-Wheel Drive (AWD)	23	17	-
Rear wheel speed sensor harness nut - AWD	23	17	-
Windshield washer reservoir filler neck bolt	7	62	-

[a] Refer to the procedure for the specification.

Anti-Lock Control

ABS with AdvanceTrac® Stability Enhancement System

The ABS with AdvanceTrac® system coists of the following components:

- ABS module - attached to the Hydraulic Control Unit (HCU), but can be serviced separately from the HCU .
- Front wheel speed sensors - one sensor is located in each front wheel knuckle. The sensors are serviced separately from the knuckle.
- Front wheel speed sensor tone rings - one tone ring is located on the outer CV joint of each halfshaft and is serviced with the halfshaft.
- HCU - which contains several valves (inlet, outlet, isolation and dump) and the hydraulic pump motor. On hybrid vehicles, the HCU is mounted in the rear, RH side of the engine compartment near the RH shock tower. On all other vehicles, the HCU is mounted in the front, RH side of the engine compartment near the degas bottle.
- Rear wheel speed sensors - one sensor is located in each rear wheel knuckle, the sensors are serviced separately from the knuckle).
- Rear wheel speed sensor tone rings - on All-Wheel Drive (AWD) vehicles, one tone ring is located on the outer CV joint of each halfshaft and is serviced with the halfshaft. On Front Wheel Drive (FWD) vehicles, one tone ring is located on each rear wheel hub and is serviced with the wheel hub.
- Stability control sensors - located inside the Restraints Control Module (RCM) and consist of the following sensors: yaw rate, lateral accelerometer and longitudinal accelerometer. The sensors are integral to the RCM and cannot be serviced separately.
- Steering wheel rotation sensor - only on vehicles equipped with a 3.5L engine, the rotation sensor is located on the RH side of the clockspring and is serviced separately from the clockspring assembly. On all other vehicles, steering wheel rotation position information is sent from the Power Steering Control Module (PSCM) over the High Speed Controller Area Network (HS-CAN).
- Steering wheel rotation sensor ring - only on vehicles equipped with a 3.5L engine, the rotation sensor ring is located on the clockspring and is serviced with the clockspring assembly.
- Traction control switch - on Fusion and Milan vehicles, the switch is part of a 2 or 3 switch package (depending on vehicle options) located in the instrument panel center finish panel and is serviced separately from the finish panel. On MKZ vehicles, the switch is part of the Front Controls Interface Module (FCIM) and is serviced with the module.
- Vacuum sensor (3.0L AWD , 3.5L and hybrid) - located on the front of the brake booster in the 12 o'clock position on non-hybrid vehicles, and in the 10 o'clock position on hybrid vehicles. The sensor can be serviced separately from the booster, refer to Section 206-07 .

Anti-Lock Braking

The anti-lock braking system aids in the prevention of wheel lock-up during braking events which allows the driver to maintain control and stop in the shortest distance possible under most conditions. This is accomplished by the ABS module and HCU modulating brake fluid pressure to the affected brake caliper(s).

When the ABS activates, both of the following can occur:

- A rumble or grinding sound may be heard
- If the driver's foot is on the brake pedal, a vibration may be felt in the brake pedal

Electronic Brake Distribution (EBD)

The ABS module and HCU incorporate a strategy called Electronic Brake Distribution (EBD). The EBD strategy uses the HCU as an electronic proportioning valve to create a balanced braking condition between the front and rear wheels and minimize the chance of rear wheel lockup during hard braking.

AdvanceTrac® Stability Enhancement System

The AdvanceTrac® system is made up of 2 distinct vehicle systems: traction control and ESC .

Traction Control System

The traction control system aids in the prevention of excessive wheel spin which allows the vehicle to maintain traction during acceleration. This is accomplished by the ABS module and the HCU modulating brake fluid pressure to the affected brake caliper(s) and by the PCM modulating engine torque.

ESC System

The ESC system constantly monitors the vehicle's direction of travel relative to the driver's intended course, except when the vehicle is traveling in reverse, and aids in keeping the vehicle traveling along that course. This is accomplished by the ABS module and the HCU modulating brake fluid pressure to the affected brake caliper(s) and by the PCM modulating engine torque.

When the ABS, traction control or ESC system activates, any of the following can occur:

- A rumble or grinding sound may be heard, much like ABS
- If the driver's foot is on the brake pedal, a vibration may be felt in the brake pedal, much like ABS
- A small deceleration or a reduction in the acceleration of the vehicle
- The stability/traction control indicator (also known as the sliding car icon) flashes

Traction Control Switch

The traction control switch can be used by the driver to disable and enable the traction control portion of the AdvanceTrac® system. When the switch is pressed, the sliding car OFF icon in the Instrument Panel Cluster (IPC) illuminates The conventional ABS and the ESC system cannot be disabled through the use of the traction control switch. If a MyKeyTM restricted key is in use with AdvanceTrac® always-on feature configured to "on", the traction control system cannot be disabled. An admin key must be used in order to enable and disable the traction control system.

Stability/Traction Control Indicators

There are 2 separate sliding car icons; the sliding car OFF icon and the sliding car icon. The sliding car OFF icon is used to alert the driver that the traction control portion of the AdvanceTrac® system has been disabled by the driver. This icon only illuminates continuously and does not flash. The sliding car icon is used to alert the driver that a stability/traction event is taking place (flashes twice per second) and to alert the driver of potential concerns in the AdvanceTrac® system (illuminates solidly).

Optimized Hydraulic Braking (3.0L All-Wheel Drive (AWD) and 3.5L only)

Optimized hydraulic braking is a system built into the ABS module to aid in bringing the vehicle to a safe, controlled stop in the event of severe vacuum loss at the brake booster. The ABS module continually monitors the vacuum in the brake booster through the use of a sensor. If a loss of vacuum is detected, the ABS module activates the pump motor in the HCU to assist with vehicle braking.

Hybrid Braking System

The hybrid vehicle is equipped with a few additional components, including:

- Active brake booster - which includes the booster vacuum sensor, the active brake booster solenoid and the active brake booster travel sensor. The sensors are serviced separately from the active brake booster. The booster solenoid is not serviced separately from the active brake booster.
- Brake pedal angle sensor - located on the brake pedal bracket and can be serviced separately from the pedal bracket.
- Brake pedal feel cut-off solenoid - located on the brake pedal bracket and is serviced with the pedal bracket.
- Brake pedal feel simulator - located on the brake pedal bracket and is serviced with the pedal bracket.
- Electric vacuum pump - located in the front of the engine compartment below the intake manifold.
- Vacuum pump relays - vacuum pump operation is controlled by 1 solid state relay and 1 mechanical relay. Both relays are located in the auxiliary relay box.

Regenerative Braking

During a braking event (not an ABS or other stability control event), the regenerative braking system utilizes the electric motor portion of the Electronically Controlled Continuously Variable Transmission (eCVT) as a generator to create electrical current. This current is used to recharge the High Voltage Traction Battery (HVTB) and creates brake torque that is used in place of, or in combination with, the conventional friction brakes to slow the vehicle. The amount of brake torque provided by the electric motor is dependent upon the state-of-charge of the HVTB . When the HVTB is almost fully charged, the amount of brake torque provided is limited to avoid overcharging the HVTB and vehicle deceleration is produced by conventional friction braking alone.

Brake-By-Wire

Because much of the necessary brake torque required to stop the vehicle can be accomplished through regenerative braking, it is not always necessary to apply the conventional friction brakes. Under most normal brake applications, the ABS module applies the friction brakes as needed.

During a normal brake application, the brake pedal feel simulator allows the pressure applied to the brake pedal by the driver's foot to act against a spring instead of the brake booster push rod. The brake pedal angle sensor is mounted to the brake pedal assembly and provides the ABS module with an analog signal indicating the amount of deceleration the driver is demanding. If it is necessary for the conventional friction brakes to be applied, the ABS module applies a Pulse Width Modulated (PWM) voltage to a solenoid inside the active brake booster. The solenoid allows vacuum from either the combustion engine (if the engine is running) or the electric vacuum pump to move the booster push rod. This in turn pushes the piston in the master cylinder creating hydraulic brake pressure. If the brake pedal is applied quickly and forcefully enough, the driver can overcome the brake pedal feel simulator spring pressure, allowing a direct connection between the brake pedal, booster push rod and master cylinder.

Anti-Lock Control - Non-Hybrid

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3030-A	Rotunda Active Wheel Speed Sensor Tester 105-R0110 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operations

Anti-Lock Braking

The ABS module continuously monitors and compares the rotational speed of each wheel. This is accomplished through the use of 4 active wheel speed sensors, 1 for each wheel. The wheel speed sensors are connected to the ABS module by 2 circuits. One circuit provides voltage for sensor operation and the other circuit provides sensor input to the ABS module. As the wheels spin, the wheel speed sensor tone rings pass through the magnetic field generated by the active wheel speed sensor. This creates a square-wave signal that is sent to the ABS module to indicate individual wheel speed.

The ABS module uses a Hydraulic Control Unit (HCU) to prevent the wheels from locking up during a braking event. The HCU contains several solenoid-controlled valves, a pump motor, an accumulator and several sensors. The fluid flows through 4 normally open inlet valves inside the HCU , and through the outlet ports of the HCU to the brake calipers. If the ABS module senses that a wheel is about to lock up, based on wheel speed sensor data, the module closes the normally open inlet valve for that wheel. This prevents more fluid from getting to the brake caliper. The ABS module then reads the wheel speed sensor signal from the affected wheel again. If the wheel is still decelerating (locking up), the module opens the normally closed outlet valve. This allows a controlled amount of hydraulic pressure in the brake caliper to be relieved into the HCU accumulator. The ABS pump motor runs during an ABS braking event so that sufficient brake fluid pressure is consistently available to the HCU valves. This procedure of closing and opening valves is repeated several times per second until the speed of the affected wheel matches the speeds of the other wheels. Once this has been accomplished, the ABS module returns the solenoid valves to their normal position.

The ABS module is self-monitoring. When the ignition switch is turned to the RUN position, the ABS module carries out a preliminary electrical check of the wheel speed sensor circuitry by sending voltage through the sensor and checking for the voltage to return. At speeds above 15 km/h (9 mph), without the brake pedal being pressed, the pump motor is commanded ON for approximately one-half second to check pump motor

operation. Also, during all phases of operation while the vehicle is in motion, the ABS module checks for correct operation of the wheel speed sensors. In the event that the ABS module detects a concern, the module sets a DTC and sends a message to the Instrument Panel Cluster (IPC) over the High Speed Controller Area Network (HS-CAN) bus to illuminate the yellow ABS warning indicator, the stability/traction control indicator (also known as the sliding-car icon) and/or the red brake warning indicator. If the concern is severe enough, ABS may be disabled. Normal power-assisted braking, however, remains.

Electronic Brake Distribution (EBD)

The ABS module incorporates a strategy called Electronic Brake Distribution (EBD). The EBD strategy uses the HCU as an electronic proportioning valve. On initial application of the brake pedal, full pressure is applied to the rear brakes. The ABS module uses wheel speed input to calculate an estimated rate of deceleration. Once vehicle deceleration exceeds a certain threshold, the ABS module closes the appropriate solenoid valves in the HCU to hold the rear brake pressure constant while allowing the front brake pressure to build. This creates a balanced braking condition between the front and rear wheels and minimizes the chance of rear wheel lockup during hard braking. As the vehicle decelerates, the valves are opened to increase the rear brake pressure in proportion to the front brake pressure.

If there is a DTC in the ABS module specifically for the HCU or there are 2 or more wheel speed sensor DTCs, EBD is disabled. When EBD is disabled, the ABS warning indicator, the red brake warning indicator and the sliding-car icon illuminates.

Optimized Hydraulic Braking (3.0L All-Wheel Drive (AWD) and 3.5L only)

When the vacuum sensor in the booster indicates vacuum is below a predetermined level, a DTC is set in the ABS module. A low vacuum DTC is set after a pre-determined time, depending on driving conditions. It could take as long as 10 minutes to set the DTC with vehicle speed above 2 km/h and greater than 30% throttle. If the brake pedal is applied with low vacuum in the booster, the ABS module activates the pump motor in the HCU to assist with braking.

Refer to Section 206-07 for sensor removal and installation information.

AdvanceTrac® Stability Enhancement System

The AdvanceTrac® system provides the following stability enhancement features for certain driving situations:

- Traction Control System - helps to avoid excessive drive-wheel spin and loss of traction.
- Electronic Stability Control (ESC) System - helps to avoid skids and lateral slides.

Traction Control System

The traction control system uses the ABS and the PCM to limit wheel spin. When the ABS module detects a wheel spinning excessively, brake pressure to the appropriate brake caliper is modulated. This is accomplished by opening and closing the appropriate solenoid valves inside the HCU while the hydraulic pump motor is activated. At the same time, the ABS module sends a message over the bus that a traction control event is taking place. When the IPC receives this message, it flashes the sliding-car icon (twice per second). If the event is severe enough, the ABS module also sends a message to the PCM over the HS-CAN bus to assist with traction control. When the PCM receives this message, it adjusts engine timing and decrease fuel injector pulses. Once the affected wheel returns to normal speed, the ABS module returns the solenoid valves in the HCU to their normal position, deactivates the hydraulic pump motor and sends another message over the HS-CAN bus indicating that the traction event has ended. The PCM returns engine timing and fuel

injectors to normal operation and the IPC extinguishes the sliding-car icon.

Once vehicle speed reaches or exceeds 100 km/h (62 mph), traction control is accomplished only through PCM intervention.

Certain DTCs in the ABS module disables the traction control system. Depending on the DTCs present, the yellow ABS warning indicator and/or the sliding-car icon is illuminated.

Electronic Stability Control (ESC) System

The ESC system is controlled by the ABS module and uses the same wheel speed sensors and tone rings that are used for anti-lock braking. The ESC system also uses input from the steering wheel rotation sensor (3.5L) or Power Steering Control Module (PSCM) (2.5L, 3.0L and Hybrid), and the stability control sensors (yaw rate, longitudinal acceleration and lateral acceleration), which are internal to the Restraints Control Module (RCM). Additional information from other modules is sent over the HS-CAN bus to help maintain vehicle stability.

The ABS module uses the various sensors to continuously monitor vehicle direction of travel relative to the driver's intended course. If the ABS module determines from all these inputs that the vehicle is unable to travel in the intended direction, it modulates brake pressure to the appropriate brake caliper(s) by opening and closing the appropriate solenoid valves inside the HCU while the hydraulic pump motor is activated. At the same time, the ABS module sends a message over the HS-CAN bus that a stability event is taking place. When the IPC receives this message, it flashes the sliding-car icon. Under certain conditions during a stability event, the PCM may be requested to reduce engine torque as it does for traction control. Once the stability condition has been corrected, the ABS module sends another message over the HS-CAN bus indicating that the event has ended. The PCM returns engine timing and fuel injectors to normal operation and the IPC extinguishes the sliding-car icon.

Certain DTCs being present in the ABS module may disable the ESC system. Depending on the DTCs present, the yellow ABS warning indicator and/or the sliding-car icon is illuminated.

Traction Control Switch

Unlike conventional ABS, the traction control portion of the AdvanceTrac® can be deactivated by the driver through the use of the traction control switch. The switch is hardwired to the IPC . When pressed, the switch sends a ground signal to the IPC . The IPC then sends a message over the HS-CAN bus indicating that the driver has requested that the system be deactivated and illuminates the sliding-car OFF icon. One disabled, the system remains in that state until the driver presses the switch again or the ignition key is cycled.

Stability Control Sensors

The stability control sensors for the AdvanceTrac® system consist of the yaw rate sensor, lateral accelerometer and longitudinal accelerometer. The sensors are housed in the RCM which sends sensor information to the ABS module over the dedicated Controller Area Network (CAN) bus. If any of the sensors are defective, a new RCM must be installed. Refer to Section 501-20B for additional information on the RCM .

- The yaw rate sensor measures the relative vehicle motion about the vertical axis through the vehicle center of gravity.
- The longitudinal accelerometer measures the acceleration corresponding to the force involved when the vehicle moves forward and rearward in the horizontal plane, along the centerline of the vehicle's front and rear wheels.

- The lateral accelerometer measures the acceleration that corresponds to the force involved when the vehicle moves sideways.

Lateral acceleration has 2 forms. The first is the centrifugal acceleration that is generated when the vehicletravels around in a circle. The second is the acceleration due to gravity. On level ground there is no contribution from this acceleration. However, if the vehicle is parked sideways on a bank or incline, the sensor measures some lateral acceleration due to gravity, even though the vehicle is not moving.

Steering Wheel Position Information

On vehicles equipped with Electronic Power Assist Steering (EPAS) (2.5L, 3.0L and Hybrid vehicles), the steering wheel position information is sent to the ABS module from the PSCM along the HS-CAN bus. The PSCM calculates steering position based on motor position within the EPAS steer gear. For information on EPAS , refer to Section 211-00A .

On vehicles equipped with Hydraulic Power Assist Steering (HPAS) (3.5L vehicles only), the steering wheel rotation information is sent from the steering wheel rotation sensor. The steering wheel rotation sensor measures the rate of rotation of the steering wheel by monitoring the steering wheel rotation ring as it passes through the sensor gap. The rotation sensor uses 2 signal lines to transmit information to the ABS module about whether the steering wheel is being turned left or right and how far it is being turned. The rotation sensor does not indicate the position of the steering wheel relative to straight-ahead. The ESC system learns this position by comparing the steering wheel position with other signals and storing the position it has learned. The ESC system confirms this position and modifies it as necessary during every new driving cycle.

ABS Module Configuration

Module configuration is a scan tool process which configures specific vehicle settings in a new module. If installing a new ABS module and/or a new HCU , the ABS module must be configured. To configure the ABS module, refer to Programmable Module Installation (PMI) in Section 418-01 .

ABS Module Calibration

Non-hybrid vehicles do not require a module calibration. For module calibration information for hybrid vehicles, refer to ABS Module Calibration in Anti-Lock Control - Hybrid in this section.

Inspection and Verification

1. Verify the customer concern.
2. Verify the stoplamps operate correctly by pressing and releasing the brake pedal with the ignition switch in the ON position. If the stoplamps do not operate correctly, refer to Section 417-01 . If the stoplamps operate correctly, proceed to the next step.
3. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Base brake system • Hydraulic Control Unit (HCU) • Incorrectly inflated tires • Mismatched wheels or tires on vehicle • Steering wheel rotation sensor ring • Wheel speed sensor tone ring	• ABS module • Battery Junction Box (BJB) fuse(s): ♦ 8 (40A) ♦ 10 (30A) • Electronic Power Assist Steering (EPAS) gear (2.5L and 3.0L only) • Restraints Control Modu (RCM) • Smart Junction Box (SJB) fuse 42 (10A) • Stoplamp switch • Traction control switch • Steering wheel rotation sensor (3.5L only) • Vacuum sensor (2.5L and 3.0L only) • Wheel speed sensors • Wiring, terminals or connectors

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

7. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

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

9. Clear the CMDTCs and carry out the self-test diagnostics for the ABS module.

10. If the DTCs retrieved are related to the concern, go to the ABS Module DTC Chart. For all other DTCs, refer to Section 419-10 .

DTC Charts

NOTE: This DTC chart applies to non-hybrid vehicles **only** . For hybrid vehicle DTCs, refer to the ABS Module DTC Chart in Anti-Lock Control - Hybrid in this section.

ABS Module DTC Chart

DTCs	Description	Action
B1342	ECU is Faulted	CLEAR the DTCs. CYCLE the ignition switch. REPEAT the self-test. RETRIEVE the DTCs. If other DTCs are retrieved, ADDRESS those DTCs before addressing DTC B1342. If only DTC B1342 is returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section.
B83	Brake Pedal Input Open Circuit	GO to Pinpoint Test A .
B1676	Battery Pack Voltage Out of Range	GO to Pinpoint Test B .
B2477	Module Configuration Failure	CLEAR the DTCs. REPEAT the self-test. If DTC B2477 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. REPEAT the self-test.
B2900	VIN Mismatch	**NOTE:** This DTC is usually set when a new ABS module is installed. GO to Pinpoint Test H .
C1095	ABS Hydraulic Pump Motor Circuit Failure	GO to Pinpoint Test E .
C109D	Low Vacuum Condition	GO to Pinpoint Test K .
C109E	Vacuum Sensor Circuit Fault	GO to Pinpoint Test K .
C109F	Vacuum Sensor Signal Fault	GO to Pinpoint Test K .
C1145	Wheel Speed Sensor RF Input Circuit Failure	GO to Pinpoint Test C .
C1155	Wheel Speed Sensor LF Input Circuit Failure	GO to Pinpoint Test C .
C1165	Wheel Speed Sensor RR Input Circuit Failure	GO to Pinpoint Test C .
C1175	Wheel Speed Sensor LR Input Circuit Failure	GO to Pinpoint Test C .
C1233	Wheel Speed LF Signal Fault	GO to Pinpoint Test D .
C1234	Wheel Speed RF Signal Fault	GO to Pinpoint Test D .
C1235	Wheel Speed RR Signal Fault	GO to Pinpoint Test D .

C1236	Wheel Speed LR Signal Fault	GO to Pinpoint Test D .
C1277	Steering Wheel Angle 1 and 2 Circuit Failure	GO to Pinpoint Test F .
C1278	Steering Wheel Angle 1 and 2 Signal Faulted	GO to Pinpoint Test F .
C1280	Yaw Rate Sensor Signal Fault	**NOTE:** The yaw rate sensor is integral to the Restraints Control Module (RCM) and cannot be serviced separately. If a new yaw rate sensor is needed, a new RCM must be installed. REFER to Restraints Control Module (RCM) Removal and Installation in Section 501-20B . ADHERE to all safety warnings in the procedure. INSPECT the RCM for damage. VERIFY that all RCM fasteners are tightened to their correct specification. CLEAR the DTCs. TEST DRIVE the vehicle at speeds above 20 km/h (12 mph). REPEAT the self-test. If DTC C1280 returns, INSTALL a new RCM . REFER to Section 501-20B .
C1282	Lateral Accelerometer Signal Fault	**NOTE:** The lateral acceleration sensor is integral to the RCM and cannot be serviced separately. If a new lateral acceleration sensor is needed, a new RCM must be installed. REFER to Restraints Control Module (RCM) Removal and Installation in Section 501-20B . ADHERE to all safety warnings in the procedure. INSPECT the RCM for damage. VERIFY that all RCM fasteners are tightened to their correct specification. CLEAR the DTCs. TEST DRIVE the vehicle at speeds above 20 km/h (12 mph). REPEAT the self-test. If DTC C1282 returns, INSTALL a new RCM . REFER to Section 501-20B .
C1288	Pressure Sensor Main/Primary Input Circuit Failure	GO to Pinpoint Test I .
C1440	Pressure Sensor Main/Primary Signal Faulted	GO to Pinpoint Test I .
C1470	TCS Function Temporarily Disabled (Thermal Brake Protection) [a]	ALLOW the brake fluid time to cool. CLEAR the DTC. TEST DRIVE the vehicle and VERIFY traction control system operation.
C1805	Mismatched PCM and/or ABS-TC Module [b]	GO to Pinpoint Test H .
C1963	Stability Assist Inhibit Warning	**NOTE:** This DTC cannot clear until the vehicle has been driven above 48 km/h (30 mph) with input from the steering wheel rotation sensor. **NOTE:** REPAIR all other non-communication DTCs before repairing DTC C1963. GO to Pinpoint Test F .
C1991	Module Calibration Failure	CLEAR the DTCs. CYCLE the ignition switch. REPEAT the self-test.

		RETRIEVE the DTCs. If DTC C1991 is present, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section.
C1996	Active Yaw and/or Roll Control Disabled	GO to Pinpoint Test J .
C2770	Longitudinal Acceleration Sensor Signal Fault	**NOTE:** The longitudinal acceleration sensor is integral to the RCM and cannot be serviced separately. If a new longitudinal acceleration sensor is needed, a new RCM must be installed. REFER to Restraints Control Module (RCM) Removal and Installation in Section 501-20B . ADHERE to all safety warnings in the procedure. INSPECT the RCM for damage. VERIFY that all RCM fasteners are tightened to their correct specification. CLEAR the DTCs. TEST DRIVE the vehicle at speeds above 20 km/h (12 mph). REPEAT the self-test. If DTC C2770 returns, INSTALL a new RCM . REFER to Section 501-20B .
C2777	Sensor Cluster Bus Failure	GO to Pinpoint Test G .
U0001	HS-CAN Communication Bus	REFER to Section 418-00 to diagnose the HS-CAN bus.
U0100	Lost Communication With ECM /PCM	REPAIR all other DTCs first. If DTC U0100 is still present, REFER to Section 418-00 to diagnose the HS-CAN bus.
U0101	Lost Communication With TCM	REPAIR all other DTCs first. If DTC U0101 is still present, REFER to Section 418-00 to diagnose the HS-CAN bus.
U0114	Lost Communication With Four-Wheel Drive (4WD) Clutch Control Module	REPAIR all other DTCs first. If DTC U0114 is still present, REFER to Section 418-00 to diagnose the HS-CAN bus.
U0140	Lost Communication with Body Control Module	REPAIR all other DTCs first. If DTC U0140 is still present, REFER to Section 418-00 to diagnose the HS-CAN bus.
U0151	Lost Communication With Restraints Control Module (RCM)	GO to Pinpoint Test G .
U0155	Lost Communication With Instrument Panel Cluster (IPC) Control Module	REPAIR all other DTCs first. If DTC U0155 is still present, REFER to Section 418-00 to diagnose the HS-CAN bus.
U0401	Invalid Data Received From ECM /PCM	VERIFY the correct ABS module configuration. VERIFY that the correct Vehicle Identification Number (VIN) is programmed to the PCM. CARRY OUT the PCM self-test, RETRIEVE and RECORD any DTCs. REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .
U0402	Invalid Data Received From TCM	VERIFY the correct ABS module configuration. VERIFY that the correct VIN is programmed to the PCM. CARRY OUT the PCM self-test, RETRIEVE and RECORD any DTCs. REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .
U0414	Invalid Data Received From Four-Wheel Drive (4WD) Clutch Control Module	VERIFY the correct ABS module configuration. VERIFY that the correct VIN is programmed to the PCM. CARRY OUT the on-demand self test for the 4x4 Control Module, RETRIEVE and RECORD any DTCs. REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

U0452	Invalid Data Received From Restraints Control Module (RCM)	GO to Pinpoint Test G .
U1901	CAN Network #2 Communication Bus Fault	GO to Pinpoint Test G .
U2050	No Application Present	VERIFY that the ABS module installed is the correct module for the vehicle configuration. If the ABS module is OK, CLEAR the DTCs. CARRY OUT the self-test, RETRIEVE and RECORD any DTCs. If DTC U2050 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test.

[a] Traction Control System
[b] Traction Control

Instrument Panel Cluster (IPC) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Source	Action
C0089:11	TCS Disable Switch: Circuit Short to Ground [a]	Instrument Panel Cluster (IPC)	GO to Pinpoint Test M .
-	All Other IPC DTCs	IPC	REFER to the Master DTC Chart in Section 419-10 .

[a] Traction Control System

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: DTC B1483

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

When the brake pedal is pressed, the Brake Pedal Position (BPP) switch opens, this interrupts a voltage signal that is sent to the PCM. When the PCM detects this interruption, it sends a message over the High Speed Controller Area Network (HS-CAN) bus indicating that the brake pedal has been pressed. The PCM uses the BPP switch information for the speed control system. The ABS module receives the BPP switch information

from the PCM over the HS-CAN bus.

The BPP is also known as the stoplamp switch.

- DTC B1483 (Brake Pedal Input Open Circuit) - The ABS module compares the BPP message against other inputs (brake pressure and wheel speed) and if the message does not match the other inputs and there are no DTCs present for those inputs, DTC B1483 is set.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- BPP switch
- PCM
- ABS module

PINPOINT TEST A: DTC B1483

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK THE ABS MODULE DTCs	
• Review the DTCs recorded during Inspection and Verification. • **Were any wheel speed sensor DTCs retrieved?**	**Yes** For DTC C1145, C1155, C1165 or C1175, GO to Pinpoint Test C . For DTC C1233, C1234, C1235 or C1236, GO to Pinpoint Test D . **No** GO to A2 .
A2 CHECK FOR PCM DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: KOEO Self Test - PCM. • Retrieve and record any PCM DTCs. • **Are any DTCs present in the PCM?**	**Yes** REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 . **No** GO to A3 .
A3 CHECK THE ABS MODULE DTCs	
• Review the DTCs recorded during Inspection and Verification. • **Are DTCs U0100 and/or U0401 also present?**	**Yes** DIAGNOSE DTCs U0100 and/or U0401 before diagnosing B1483. REFER to the ABS Module DTC Chart. **No** If DTCs C1288 and/or C1440 are present, GO to Pinint Test I . If no other DTCs are present, GO to A4 .
A4 CHECK THE ABS MODULE BRAKE ON/OFF (BOO_ABS) PID	

• Enter the following diagnostic mode on the scan tool: DataLogger - ABS Module. • Monitor the BOO_ABS PID while pressing and releasing the brake pedal. • **Does the PID agree with the pedal position?**	**Yes** The system is operating correctly at this time. CLEAR the DTC. REPEAT the self-test. **No** GO to A5 .
A5 CHECK THE PCM BOO1 PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - PCM. • Monitor the BOO1 PID while pressing and releasing the brake pedal. • **Does the PID agree with the pedal position?**	**Yes** REFER to to diagnose the communication concern. **No** REFER to Section 419-03 and diagnose the speed control deactivation switch.

Pinpoint Test B: DTC B1676

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The operating voltage required to supply the ABS module, hydraulic pump and isolation valves is in a range between 10 and 16 volts.

Fused battery voltage is supplied to the ABS module from the Battery Junction Box (BJB). Fused ignition voltage is supplied to the ABS module from the Smart Junction Box (SJB).

- DTC B1676 (Battery Pack Voltage Out of Range) - If during normal operation, the vehicle battery voltage becomes less than 9.7 volts for more than 210 ms with vehicle speed greater than 20 km/h (12 mph), or the vehicle battery voltage becomes greater than 18 volts at any time, DTC B1676 is set. Also, if during the ABS module self-test the vehicle battery voltage becomes higher than 18 volts, DTC B1676 sets.

This pinpoint test is intended to diagnose the following:

- Fuse(s)
- Wiring, terminals or connectors
- Charging system
- ABS module

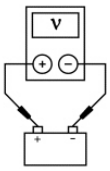
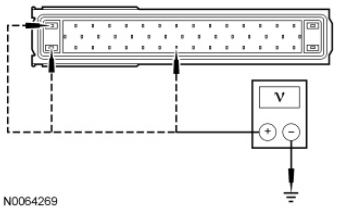
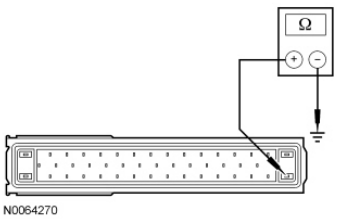
PINPOINT TEST B: DTC B1676

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: DTC B1676 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

Test Step	Result / Action to Take
B1 RETRIEVE ALL CMDTCs IN ALL MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - All CMDTCs . • **Is DTC B1317, B1318 or B1676 present in one or more modules AND DTC P0563, P0620, P0625, P0626 or P065B present in the PCM?**	**Yes** REFER to Section 414-00 for diagnosis of the battery and charging system. **No** GO to B2 .
B2 CHECK BATTERY CONDITION	
• Ignition OFF. • Refer to Section 414-01 and carry out the Battery - Condition Test. • **Does the battery pass the condition test?**	**Yes** If the battery passed the condition test, but required a recharge, REFER to Section 414-00 to diagnose the charging system. CLEAR the DTCs. REPEAT the self-test. If the battery passed the condition test and did not require a recharge, GO to B3 . **No** INSTALL a new battery. REFER to Section 413-01 . CLEAR the DTCs. REPEAT the self-test.
B3 CHECK CHARGING SYSTEM VOLTAGE	
NOTE: Do not allow the engine speed to increase above 2,000 rpm while performing this step or the generator may self excite and result in default charging system output voltage. If engine speed goes above 2,000 rpm, shut the vehicle OFF and restart the engine before performing this step. • Start the engine. • Measure the voltage of the battery with and without a load on the charging system as follows: ♦ Turn off all accessories and run the engine at 1,500 rpm for a minimum of 2 minutes while measuring battery voltage. ♦ Turn on headlights and HVAC fan on high and run engine at 1,500 rpm for a minimum of 2 minutes while measuring battery voltage.	**Yes** GO to B4 . **No** REFER to Section 414-00 to diagnose the charging system. CLEAR the DTCs. REPEAT the self-test.

 AJ0210-A • **Are the voltages between 13 and 15.2 volts?**	
B4 CHECK THE VOLTAGE TO THE ABS MODULE	
NOTE: The degas bottle may need to be positioned aside to access the ABS module connector. • Ignition OFF. • Disconnect: ABS Module C135. • Ignition ON. • Measure the voltage between ground and: ♦ ABS module C135-1, SBB08 (VT/RD), harness side. ♦ ABS module C135-8, CBP42 (GN), harness side. ♦ ABS module C135-32, SBB10 (YE/RD), harness side.  N0064269 • **Are the voltages greater than 10 volts?**	**Yes** GO to B5 . **No** VERIFY BJB fuse 8 (40A) is OK. If OK, REPAIR circuit SBB08 (VT/RD). VERIFY SJB fuse 42 (10A) is OK. If OK, REPAIR circuit CBP42 (GN). VERIFY BJB fuse 10 (30A) is OK. If OK, REPAIR circuit SBB10 (YE/RD). If any fuse is not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test.
B5 CHECK CIRCUIT GD123 (BK/GY) FOR AN OPEN	
• Ignition OFF. • Measure the resistance between ABS module C135-16, circuit GD123 (BK/GY), harness side and ground.  N0064270 • **Is the resistance less than 5 ohms?**	**Yes** CLEAR the DTCs. REPEAT the self-test. If DTC B1676 is retrieved again, GO to B6 . **No** REPAIR circuit GD123 (BK/GY). CLEAR the DTCs. REPEAT the self-test.
B6 CHECK FOR CORRECT ABS MODULE OPERATION	
• Check ABS module C135 for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals.	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs.

• Connect: ABS Module C135. • Make sure the connector seats correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test C: DTCs C1145, C1155, C1165 and C1175

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

Active wheel speed sensors generate a square wave signal that is sent to the ABS module. The wheel speed sensor circuitry connects to the ABS module through 2 wires and a connector at each wheel speed sensor. When the ignition switch is turned to the RUN position, the ABS module carries out a self-test by sending a reference voltage through the wheel speed sensors and their circuitry.

DTC Description	Fault Trigger Condition
• C1145 - RF Wheel Speed Sensor Input Circuit Failure • C1155 - LF Wheel Speed Sensor Input Circuit Failure • C1165 - RR Wheel Speed Sensor Input Circuit Failure • C1175 - LR Wheel Speed Sensor Input Circuit Failure	If, during the ABS module on-demand self test or during normal operation, the ABS module detects an open, short to ground or voltage or a defecti speed sensor input circuit, the appropriate DTC is set. These DTCs are usually set by a damaged sensor or a circuit fault.

This pinpoint test is intended to diagnose the following:

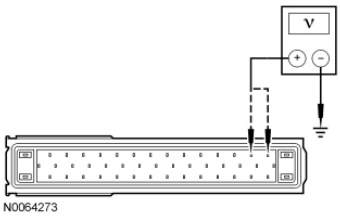
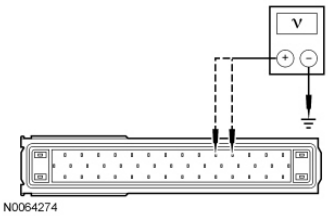
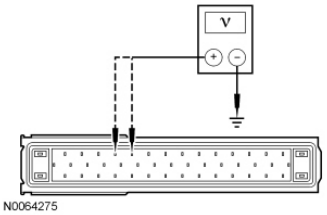
- Wiring, terminals or connectors
- Wheel speed sensor ring (part of the wheel bearing and hub assembly)
- Wheel speed sensors
- ABS module

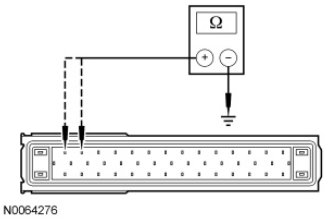
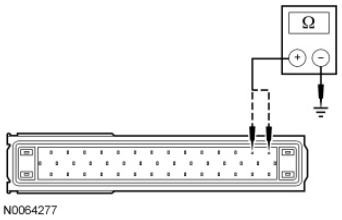
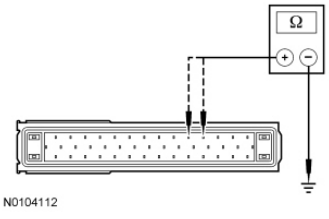
PINPOINT TEST C: DTCs C1145, C1155, C1165 AND C1175

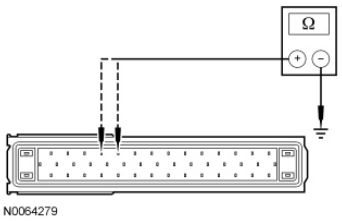
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 CHECK FOR FAULT REPEATABILITY	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear the ABS module DTCs. • Drive the vehicle at least 16 km/h (10 mph). • Retrieve and record the ABS module DTCs. • **Is DTC C1145, C1155, C1165 or C1175 retrieved?**	**Yes** For DTC C1145 or C1155, if the Rotunda Active Wheel Speed Sensor Tester is available, GO to C2 . For DTC C1165 or C1175, or if the Rotunda Active Wheel Speed Sensor Tester is not available, GO to C4 . **No** INSPECT the wheel speed sensors, wheel speed sensor wiring and wheel speed sensor tone rings. REPAIR or INSTALL new as necessary. If any other DTCs are retrieved, GO to the ABS Module DTC Chart.
C2 CHECK THE ABS MODULE OUTPUT USING THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER	
NOTE: The front wheel speed sensor electrical connectors are located behind the wheel well splash shields. The rear wheel speed sensor electrical connectors are located under the rear seat cushion. • Ignition OFF. • Disconnect: Suspect Wheel Speed Sensor. • Connect the Rotunda Active Wheel Speed Sensor Tester to the wheel speed sensor connectors. • Ignition ON. • Select the correct system polarity on the Rotunda Active Wheel Speed Sensor Tester and turn the power switch to the ON position. • **Is the module output LED illuminated?**	**Yes** GO to C3 . **No** GO to C6 .
C3 CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER	
• Raise the suspect wheel until it can spin freely. Refer to Section 100-02 . • While monitoring the Rotunda Active Wheel Speed Sensor Tester, slowly spin	**Yes** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

the suspect wheel. • **Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?**	**No** If the current level LED is not illuminated and the sensor output LEDs do not illuminate or if the current level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front or Wheel Speed Sensor - Rear, Front Wheel Drive (FWD) in this section. CLEAR the DTCs. REPEAT the self-test. If the current level LED is not illuminated and the sensor output LEDs illuminate green, but do not flash, INSPECT the wheel speed sensor tone ring and INSTALL new if necessary. If tone ring is OK, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front or Wheel Speed Sensor - Rear, Front Wheel Drive (FWD) in this section. CLEAR the DTCs. REPEAT the self-test.
C4 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
NOTICE: **No measurements should be taken with the wheel speed sensor connected. Damage to the wheel speed sensor results.** **NOTE:** Both circuits must be checked for each DTC. **NOTE:** The degas bottle may need to be positioned aside to access the ABS module connector. **NOTE:** The front wheel speed sensor electrical connectors are located behind the wheel well splash shields. The rear wheel speed sensor electrical connectors are located under the rear seat cushion. • Ignition OFF. • Disconnect: ABS Module C135. • Disconnect: Suspect Wheel Speed Sensor. • Ignition ON. • **For DTC C1145** , measure the voltage between ground and: ♦ ABS module C135-34, circuit VCA05 (GY/VT), harness side. ♦ ABS module C135-33, circuit RCA19 (VT), harness side.	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. **No** GO to C5 .

• **For DTC C1155** , measure the voltage between ground and: ♦ ABS module C135-45, circuit VCA03 (VT/WH), harness side. ♦ ABS module C135-46, circuit RCA17 (YE), harness side.  N0064273 • **For DTC C1165** , measure the voltage between ground and: ♦ ABS module C135-43, circuit VCA06 (WH/OG), harness side. ♦ ABS module C135-42, circuit RCA20 (BN), harness side.  N0064274 • **For DTC C1175** , measure the voltage between ground and: ♦ ABS module C135-36, circuit VCA04 (BU/OG), harness side. ♦ ABS module C135-37, circuit RCA18 (BN/GN), harness side.  N0064275 • **Is any voltage present?**	
C5 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO GROUND	

NOTE: Both circuits must be checked for each DTC. • Ignition OFF. • **For DTC C1145** , measure the resistance between ground and: ♦ ABS module C135-34, circuit VCA05 (GY/VT), harness side. ♦ ABS module C135-33, circuit RCA19 (VT), harness side.  N0064276 • **For DTC C1155** , measure the resistance between ground and: ♦ ABS module C135-45, circuit VCA03 (VT/WH), harness side. ♦ ABS module C135-46, circuit RCA17 (YE), harness side.  N0064277 • **For DTC C1165** , measure the resistance between ground and: ♦ ABS module C135-43, circuit VCA06 (WH/OG), harness side. ♦ ABS module C135-42, circuit RCA20 (BN), harness side.  N0104112 • **For DTC C1175** , measure the resistance between ground and: ♦ ABS module C135-36, circuit VCA04 (BU/OG), harness side. ♦ ABS module C135-37, circuit RCA18 (BN/GN), harness side.	**Yes** GO to C6 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.



- **Are the resistances greater than 10,000 ohms?**

C6 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR AN OPEN

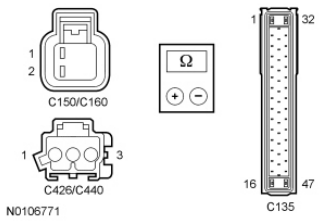
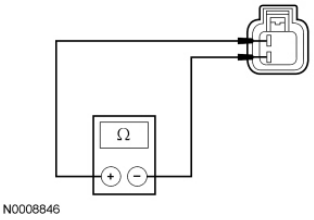
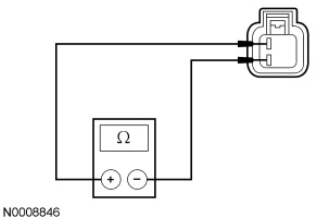
NOTE: Both circuits must be checked for each DTC.

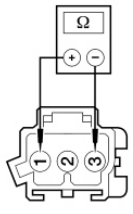
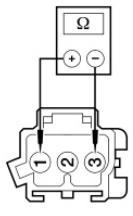
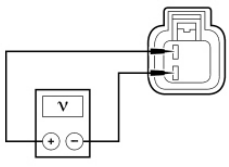
- Ignition OFF.
- Disconnect: ABS Module C135.
- Disconnect: Suspect Wheel Speed Sensor.
- Measure the resistance between ABS module C135, harness side and the suspect wheel speed sensor connector, harness side as indicated in the following chart:

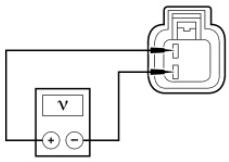
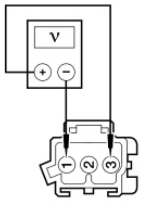
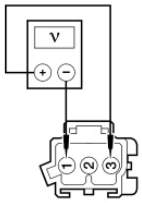
ABS Module	Circuit	Wheel Speed Sensor
DTC C1145		
C135-34	VCA05 (GY/VT)	C160-1
C135-33	RCA19 (VT)	C160-2
DTC C1155		
C135-45	VCA03 (VT/WH)	C150-1
C135-46	RCA17 (YE)	C150-2
DTC C1165		
C135-43	VCA06 (WH/OG)	C426-3
C135-42	RCA20 (BN)	C426-1
DTC C1175		
C135-36	VCA04 (BU/OG)	C440-3
C135-37	RCA18 (BN/GN)	C440-1

Yes
GO to C7 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the ABS self-test.

 • **Are the resistances less than 5 ohms?**	
C7 CHECK FOR SHORTED WHEEL SPEED SENSOR CIRCUITS	
• **For DTC C1145** , measure the resistance between: ♦ RF wheel speed sensor C160-1, circuit VCA05 (GY/VT), harness side and RF wheel speed sensor C160-2, circuit RCA19 (VT), harness side.  • **For DTC C1155** , measure the resistance between: ♦ LF wheel speed sensor C150-1, circuit VCA03 (VT/WH), harness side and LF wheel speed sensor C150-2, circuit RCA17 (YE), harness side.  • **For DTC C1165** , measure the resistance between: ♦ RR wheel speed sensor C426-3, circuit VCA06 (WH/OG), harness side and RR wheel speed sensor C426-1, circuit RCA20 (BN), harness side.	**Yes** GO to C8 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

 N0086936 • **For DTC C1175** , measure the resistance between: ♦ LR wheel speed sensor C440-3, circuit VCA04 (BU/OG), harness side and LR wheel speed sensor C440-1, circuit RCA18 (BN/GN), harness side.  N0086936 • **Are the resistances greater than 10,000 ohms?**	
C8 CHECK THE ABS MODULE OUTPUT	
• Connect: ABS Module C135. • Ignition ON. • **For DTC C1145** , measure the voltage between: ♦ RF wheel speed sensor C160-1, circuit VCA05 (GY/VT), harness side and RF wheel speed sensor C160-2, circuit RCA19 (VT), harness side.  N0086939 • **For DTC C1155** , measure the voltage between: ♦ LF wheel speed sensor C150-1, circuit VCA03 (VT/WH), harness side and LF wheel speed sensor C150-2, circuit RCA17 (YE), harness side.	**Yes** INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front , Wheel Speed Sensor - Rear, All Wheel Drive (AWD) or Wheel Speed Sensor - Rear, Front Wheel Drive (FWD) in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to C9 .

 N0086939 • **For DTC C1165** , measure the voltage between: ♦ RR wheel speed sensor C426-3, circuit VCA06 (WH/OG), harness side and RR wheel speed sensor C426-1, circuit RCA20 (BN), harness side.  N0106658 • **For DTC C1175** , measure the voltage between: ♦ LR wheel speed sensor C440-3, circuit VCA04 (BU/OG), harness side and LR wheel speed sensor C440-1, circuit RCA18 (BN/GN), harness side.  N0106658 • **Are the voltages greater than 10 volts?**	
C9 CHECK FOR CORRECT ABS MODULE OPERATION	
• Ignition OFF. • Disconnect: ABS Module C135. Check the connector for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: ABS Module C135. • Make sure the connector seats correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test D: DTCs C1233, C1234, C1235 and C1236

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The wheel speed sensor and sensor ring generate a square wave signal to the ABS module that is proportional to the wheel speed. The ABS module compares the wheel speed inputs from all the wheel speed sensors to determine an impending wheel lockup.

DTC Description	Fault Trigger Condition
• C1233 - LF Wheel Speed Sensor Signal Fault • C1234 - RF Wheel Speed Sensor Signal Fault • C1235 - RR Wheel Speed Sensor Signal Fault • C1236 - LR Wheel Speed Sensor Signal Fault	If the ABS module does not receive a signal from a wheel speed sensor when the vehicle speed is greater than 15 km/h (9 mph), the appropriate DTC is set. If the difference of 2 wheel speed values is greater than 25 km/h (16 mph), the appropriate DTC sets. These DTCs are usually set by a damaged wheel speed sensor or damaged sensor tone ring, they can also be set by wheels and/or tires of different sizes being installed on the vehicle or a difference in tire pressures.

This pinpoint test is intended to diagnose the following:

- Mismatched tire sizes
- Wheel speed sensor ring (part of the wheel bearing and hub assembly)
- Wheel speed sensor
- ABS module

PINPOINT TEST D: DTCs C1233, C1234, C1235 AND C1236

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 CHECK THE DTCs FROM THE SELF-TEST	
• Review the DTCs recorded during Inspection and Verification.	**Yes** GO to Pinpoint Test C . **No**

• **Are DTCs C1145, C1155, C1165 or C1175 present?**	GO to D2 .

D2 CHECK THE TIRES SIZE AND PRESSURE

• Verify that the tires are the correct size for the vehicle as indicated on the Vehicle Certification (VC) label. • Verify that the air pressure in all the tires is correct as indicated on the VC label. • **Are the wheels and tires OK?**	**Yes** GO to D3 . **No** INSTALL the correct tires or ADJUST tire pressure as necessary. CLEAR the DTCs. TEST the system for normal operation.

D3 INSPECT THE WHEEL SPEED SENSOR MOUNTING

• Ignition ON. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Inspect the suspect wheel speed sensor for looseness. • **Is the wheel speed sensor loose?**	**Yes** TIGHTEN the wheel speed sensor to specification. REFER to Specifications in this section. CLEAR the DTCs. GO to D4 . **No** GO to D5 .

D4 RECHECK THE WHEEL SPEED PIDs

• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - ABS Module. • Monitor the following PIDs while iving the vehicle at a constant speed: ♦ Left Front Wheel Speed Sensor (LF_WSPD) ♦ Right Front Wheel Speed Sensor (RF_WSPD) ♦ Left Rear Wheel Speed Sensor (LR_WSPD) ♦ Right Rear Wheel Speed Sensor (RR_WSPD) • **Are all the wheel speed sensor PID values similar?**	**Yes** The vehicle is OK. The concern may have been caused by a loose wheel speed sensor. **No** GO to D5 .

D5 INSPECT THE WHEEL SPEED SENSOR FOR DAMAGE

• **NOTE:** Examine the wheel speed sensor wire carefully with a good light source. Failure to verify damage in the wheel speed sensor wire can lead to unnecessary installation of a new component. • Inspect the suspect wheel speed sensor for general damage. • **Is the wheel speed sensor OK?**	**Yes** GO to D6 . **No** INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front , Wheel Speed Sensor - Rear, Front Wheel Drive (FWD) or Wheel Speed Sensor - Rear, All Wheel Drive (AWD) in this section. CLEAR the DTCs. REPEAT the self-test.

D6 INSPECT THE WHEEL SPEED SENSOR RING AND WHEEL BEARING FOR DAMAGE

• Inspect the wheel bearing for damage. • Inspect the suspect wheel speed sensor ring for damaged or missing teeth. Rotate the wheel to verify that no teeth are missing. • **Is the wheel speed sensor ring and wheel bearing OK?**	**Yes** If the Active Wheel Speed Sensor Tester is available, GO to D7 . If the Active Wheel Speed Sensor Tester is not available, GO to D9 . **No** INSTALL a new front or rear wheel hub and bearing. REFER to Section 204-01 for front wheel hubs or Section 204-02 for rear wheel hubs. CLEAR the DTCs. REPEAT the self-test.

D7 CHECK THE ABS MODULE OUTPUT USING THE ACTIVE WHEEL SPEED SENSOR TESTER

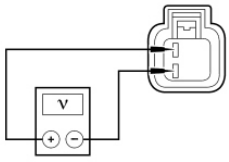
• Ignition OFF. • Disconnect: Suspect Wheel Speed Sensor. • Connect the Active Wheel Speed Sensor Tester to the wheel speed sensor connectors. • Select the correct system polarity on the tester and turn the tester power switch to the ON position. • Ignition ON. • **Is the module output LED illuminated?**	**Yes** GO to D8 . **No** GO to D10 .

D8 CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE ACTIVE WHEEL SPEED SENSOR TESTER

• Raise the suspect wheel until it can spin freely. Refer to Section 100-02 . • While monitoring the Active Wheel Speed Sensor Tester, slowly spin the suspect wheel. • **Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?**	**Yes** INSPECT the wheel speed sensor tone ring for damage and looseness. INSTALL new components as necessary. If the tone ring is OK, the concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. **No** If the current level LED is not illuminated and the sensor output LEDs do not illuminate or if the current level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front , Wheel Speed Sensor - Rear, Front Wheel Drive (FWD) or Wheel Speed Sensor - Rear, All Wheel Drive (AWD) in this section. CLEAR the DTCs. REPEAT the self-test. If the current level LED is not illuminated and the sensor output LEDs illuminate green, but do not flash, INSPECT the wheel hub and bearing (tone ring is part of the wheel bearing). INSTALL new as necessary. If the wheel hub and bearing are OK, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front , Wheel Speed Sensor - Rear, Front Wheel Drive (FWD) or Wheel Speed Sensor - Rear, All Wheel Drive (AWD) in this

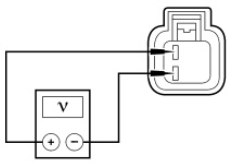
D9 ABS MODULE OUTPUT

- Ignition OFF.
- Disconnect: Suspect Wheel Speed Sensor.
- Ignition ON.
- **For DTC C1233** , measure the voltage between:
    - ♦ LF wheel speed sensor C150-1, circuit VCA03 (VT/WH), harness side and LF wheel speed sensor C150-2, circuit RCA17 (YE), harness side.



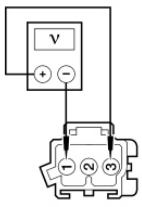
N0086939

- **For DTC C1234** , measure the voltage between:
    - ♦ RF wheel speed sensor C160-1, circuit VCA05 (GY/VT), harness side and RF wheel speed sensor C160-2, circuit RCA19 (VT), harness side.



N0086939

- **For DTC C1235** , measure the voltage between:
    - ♦ RR wheel speed sensor C426-3, circuit VCA06 (WH/OG), harness side and RR wheel speed sensor C426-1, circuit RCA20 (BN), harness side.



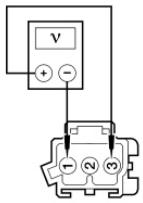
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section. CLEAR the DTCs. REPEAT the self-test.

Yes
INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front , Wheel Speed Sensor - Rear, Front Wheel Drive (FWD) or Wheel Speed Sensor - Rear, All Wheel Drive (AWD) in this section. CLEAR the DTCs. REPEAT the self-test.

No
GO to D10 <

- **For DTC C1236** , measure the voltage between:
  - ♦ LR wheel speed sensor C440-3, circuit VCA04 (BU/OG), harness side and LR wheel speed sensor C440-1, circuit RCA18 (BN/GN), harness side.



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- **Is the voltage greater than 10 volts?**

D10 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR AN OPEN

NOTE: Both circuits must be checked for each DTC.

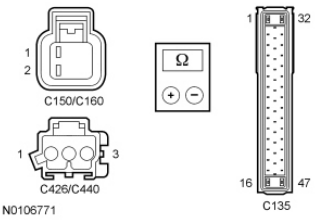
- Ignition OFF.
- Disconnect: Suspect Wheel Speed Sensor (if not previously disconnected).
- Disconnect: ABS Module C135.
- Measure the resistance between the ABS module connector, harness side and the suspect wheel speed sensor connector, harness side as indicated in the following chart:

Yes
GO to D11 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

Wheel Speed Sensor	Circuit	ABS Module
DTC C1233 - LF Wheel Speed Sensor Signal Fault		
C150-1	VCA03 (VT/WH)	C135-45
C150-2	RCA17 (YE)	C135-46
DTC C1234 - RF Wheel Speed Sensor Signal Fault		
C160-1	VCA05 (GY/VT)	C135-34
C160-2	RCA19 (VT)	C135-33
DTC C1235 - RR Wheel Speed Sensor Signal Fault		
C426-1	RCA20 (BN)	C135-42
C426-3		

	VCA06 (WH/OG)	**DTC C1236 - LR Wheel Speed Sensor Signal Fault**
C440-1	RCA18 (BN/GN)	C135-37
C440-3	VCA04 (BU/OG)	C135-36



- **Are the resistances less than 5 ohms?**

D11 CHECK FOR CORRECT ABS MODULE OPERATION

- Disconnect: ABS Module C135.
- Check for:
  - ♦ corrosion.
  - ♦ pushed-out pins.
  - ♦ spread terminals.
- Connect the ABS module connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test E: DTC C1095

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The operating voltage required to supply the hydraulic pump motor is in a range between 10 and 16 volts. Fused battery voltage for the hydraulic pump is supplied to the ABS module from Battery Junction Box (BJB). Ground for the hydraulic pump is provided through the ABS module.

- DTC C1095 (ABS Hydraulic Pump Motor Circuit Failure) - If the ABS module detects an open circuit, a short to voltage or ground or a defective internal power transistor during normal operation or the ABS module self-test, DTC C1095 sets. The ABS module commands the pump motor ON for 100 ms (±6 ms), then command the motor OFF and measure the voltage produced by the motor after 6 ms. If the voltage indicates that the motor is spinning at less than 500 rpm, there may be a locked motor. If this condition is detected 4 times, then DTC C1095 is set. The pump motor is also checked for an open circuit 2 seconds after the most recent successful pump motor off command. If the pump motor feedback remains greater than 0.75 volt for more than 50 ms (±6 ms) after these conditions have been

met, then DTC C1095 sets.

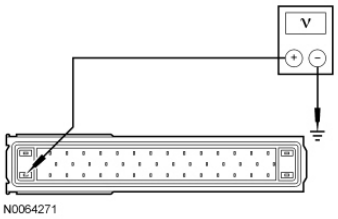
This pinpoint test is intended to diagnose the following:

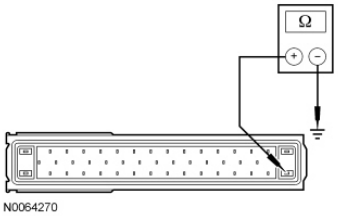
- Fuse
- Wiring, terminals or connectors
- Hydraulic Control Unit (HCU)
- ABS module

PINPOINT TEST E: DTC C1095

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 CHECK THE ABS PUMP MOTOR	
• Ignition OFF. • Ignition ON. • **Is the ABS pump motor running all the time?**	**Yes** GO to E2 . **No** GO to E3 .
E2 CHECK THE ABS MODULE CONNECTOR	
• Ignition OFF. • Disconnect: ABS Module C135. • Check the connector for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • **Is the connector undamaged and free of any corrosion?**	**Yes** INSTALL a new ABS module and HCU . REFER to Anti-Lock Brake System (ABS) Module and Hydraulic Control Unit (HCU) in this section. CLEAR the DTCs. REPEAT the self-test. **No** REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.
E3 CHECK THE PUMP MOTOR OUTPUT COMMAND (PMP_MOTOR)	
• Enter the following diagnostic mode on the scan tool: DataLogger - ABS. • Toggle the PMP_MOTOR output command ON. • **Does the ABS pump motor run for approximately 2 seconds?**	**Yes** TOGGLE the PMP_MOTOR output command OFF. GO to E4 . **No** TOGGLE the PMP_MOTOR output command OFF. CLEAR the DTCs. CYCLE the ignition switch. RETRIEVE and RECORD the ABS module DTCs. If DTC C1095 is retrieved, GO to E5 . For all other ABS module DTCs, GO to the ABS Module DTC Chart.
E4 CHECK FOR RETURNING ABS MODULE DTCs	

• Enter the following diagnostic mode on the scan tool: Self Test - ABS Module. • Retrieve and record the ABS module DTCs. • **Are any ABS module DTCs present?**	**Yes** If DTC C1095 is retrieved, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. CLEAR the DTCs. REPEAT the self-test. For all other ABS module DTCs, GO to the ABS Module DTC Chart. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CARRY OUT the self-test with the brake pedal not applied.
E5 CHECK THE VOLTAGE TO THE ABS MODULE	
NOTE: The degas bottle may need to be positioned aside to access the ABS module connector. • Ignition OFF. • Disconnect: ABS Module C135. • Ignition ON. • Measure the voltage between ABS module C135-1, circuit SBB08 (VT/RD), harness side and ground.  N0064271 • **Is the voltage greater than 10 volts?**	**Yes** GO to E6 . **No** VERIFY BJB fuse 8 (40A) is OK. If OK, REPAIR circuit SBB08 (VT/RD). CLEAR the DTCs. REPEAT the self-test. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
E6 CHECK CIRCUIT GD123 (BK/GY) FOR AN OPEN	
• Measure the resistance between ABS module C135-16, circuit GD123 (BK/GY), harness side and ground.	**Yes** GO to E7 . **No** REPAIR circuit GD123 (BK/GY). CLEAR the DTCs. REPEAT the self-test.

 • **Is the resistance less than 5 ohms?**	
E7 CHECK FOR CORRECT ABS MODULE OPERATION	
• Ignition OFF. • Disconnect: ABS Module C135. • Check the connector for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: ABS Module C135. • Make sure the connector seats correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module and HCU . REFER to Anti-Lock Brake System (ABS) Module and Hydraulic Control Unit (HCU) in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test F: DTCs C1277, C1278 and C1963

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

On vehicles equipped with Hydraulic Power Assist Steering (HPAS) (3.5L vehicles only), a slotted wheel is attached to the steering column inside the clockspring and the steering wheel rotation sensor is attached to the RH side of the multifunction switch just above the ignition lock cylinder. The steering wheel rotation senor has a LED and an opposing optical sensor. As the steering wheel is turned, the slotted wheel passes between the LED and the sensor, interrupting the signal and indicating how far and how fast the steering wheel is being turned. This information is sent to the ABS module and is used to help determine if the AdvanceTrac® system needs to be activated.

On vehicles equipped with Electronic Power Assist Steering (EPAS), the steering wheel rotation sensor is located inside the EPAS gear assembly. Rotation speed and angle are sent to the ABS module from the Power Steering Control Module (PSCM) along the High Speed Controller Area Network (HS-CAN) bus.

DTC Description	Fault Trigger Condition
• C1277 - Steering Wheel Angle 1 and 2 Circuit Failure (vehicles with HPAS)	If the ABS module detects an open circuit, short to voltage or short to ground during normal operation or an on-demand self test, DTC C1277 sets. An internal failure of the steering wheel rotation sensor may also cause DTC C1277 to set.

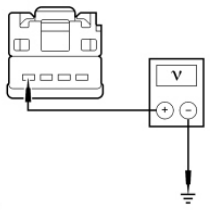
• C1277 - Steering Wheel Angle 1 and 2 Circuit Failure (vehicles with EPAS)	If the ABS module does not receive the steering wheel rotation/angle message from the PSCM for more than 5 seconds with vehicle speed above 3 km/h (2 mph), DTC C1277 sets. This could be due to a failure of the HS-CAN bus or a failure of the EPAS system, which causes other ABS module DTCs to set.
• C1278 - Steering Wheel Angle 1 and 2 Signal Faulted	If during normal operation or the ABS module on-demand self test, the ABS module does not receive the steering wheel rotation sensor input or if the input received does not agree with the input from other sensors, DTC C1278 sets.
• C1963 - Stability Assist Inhibit Warning	If conditions exist during normal operation that prevent the AdvanceTrac® system from operating, DTC C1963 sets. This DTC is usually set due to the steering wheel rotation sensor being damaged/installed incorrectly or due to invalid/missing data from the Restraints Control Module (RCM).

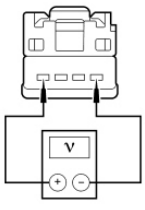
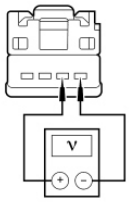
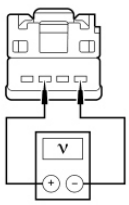
This pinpoint test is intended to diagnose the following:
- Wiriminals or connectors
- Steering wheel rotation sensor incorrectly installed
- Steering wheel rotation sensor
- ABS module

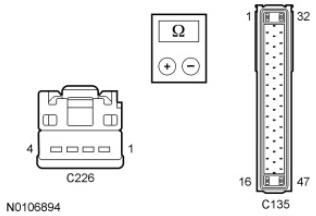
PINPOINT TEST F: DTCs C1277, C1278 AND C1963

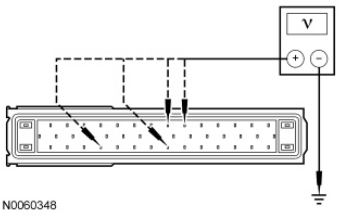
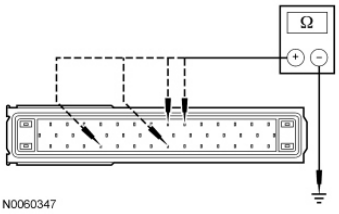
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

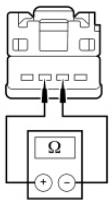
Test Step	Result / Action to Take
F1 VERIFY THE VEHICLE STEERING SYSTEM TYPE	
• **NOTE:** Steering system type can be identified by checking for the presence of a power steering pump. Vehicles equipped with EPAS do not have a power steering pump. • Verify the type of steering system the vehicle is equipped with, HPAS or EPAS . • **Is the vehicle equipped with HPAS ?**	**Yes** GO to F4 . **No** GO to F2 .
F2 CHECK THE ABS MODULE DTCs	
• Review the DTCs retrieved during Inspection and Verification. • **Are there any communication "U-code" DTCs present in the ABS module?**	**Yes** REFER to the ABS Module DTC Chart and DIAGNOSE the U-code DTCs before diagnosing DTC C1963. **No** GO to F3 .
F3 CHECK FOR PSCM DTCs	
• Connect the scan tool.	**Yes** REFER to Section 211-00A to diagnose the EPAS

• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - PSCM . • **Are there any DTCs present in the PSCM ?**	system concern. **No** GO to Pinpoint Test G .
F4 MONITOR THE STEERING ROTATION SENSOR POSITION (SWA POS) PID	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - ABS Module. • Monitor the SWA POS PID while rotating the steering wheel clockwise and counterclockwise very slowly, from lock to lock. • **Does the PID move in intervals of 1.5 degrees?**	**Yes** CLEAR the DTCs. DRIVE the vehicle above 48 km/h (30 mph) with input from the steering wheel rotation sensor. RETRIEVE the DTCs. If DTC C1277 or C1278 is still present, GO to F13 . If DTC C1963 is present, INSPECT the steering wheel rotation sensor for damage and correctnstallation. INSPECT for possible sources of light intrusion (cracked, missing or poor fitting steering shroud). REINSTALL or INSTALL new as necessary. If the sensor is OK, GO to F5 . **No** GO to F5 .
F5 CHECK THE VOLTAGE TO THE STEERING WHEEL ROTATION SENSOR	
NOTE: The steering wheel rotation sensor is located on the RH side of the multifunction switch. • Ignition OFF. • Disconnect: Steering Wheel Rotation Sensor C226. • Ignition ON. • Measure the voltage between steering wheel rotation sensor C226-4, circuit CCA40 (GY/BU), harness side and ground.  N0057967 • **Is the voltage greater than 9.5 volts?**	**Yes** GO to F6 . **No** REPAIR circuit CCA40 (GY/BU). CLEAR the DTCs. REPEAT the self-test.
F6 CHECK THE GROUND CIRCUIT FOR AN OPEN	

• Measure the voltage between steering wheel rotation sensor C226-4, circuit CCA40 (GY/BU), harness side and steering wheel rotation sensor C226-1, circuit RCA40 (BN/VT), harness side.  N0043016 • **Is the voltage greater than 9.5 volts?**	**Yes** GO to F7 . **No** REPAIR circuit RCA40 (BN/VT). CLEAR the DTCs. REPEAT the self-test.
F7 CHECK THE CHANNEL "A" CIRCUIT FOR AN OPEN OR A SHORT TO GROUND	
• Measure the voltage between steering wheel rotation sensor C226-2, circuit VCA41 (VT/GN), harness side and steering wheel rotation sensor C226-1, circuit RCA40 (BN/VT), harness side.  N0043017 • **Is the voltage between 4.75 volts and 5.25 volts?**	**Yes** GO to F8 . **No** REPAIR circuit VCA41 (VT/GN). CLEAR the DTCs. REPEAT the self-test.
F8 CHECK THE CHANNEL "B" CIRCUIT FOR AN OPEN OR A SHORT TO GROUND	
• Measure the voltage between steering wheel rotation sensor C226-3, circuit VCA42 (VT/OG), harness side and steering wheel rotation sensor C226-1, circuit RCA40 (BN/VT), harness side.  N0043018	**Yes** GO to F9 . **No** REPAIR circuit VCA42 (VT/OG). CLEAR the DTCs. REPEAT the self-test.

• **Is the voltage between 4.75 volts and 5.25 volts?**	
F9 CHECK THE STEERING POSITION SENSOR CIRCUITS FOR AN OPEN	
NOTE: The degas bottle may need to be positioned aside to access the ABS module connector. • Ignition OFF. • Disconnect: ABS Module C135. • Disconnect: Steering Wheel Rotation Sensor C226. • Measure the resistance between ABS module C135, harness side and steering wheel rotation sensor C226, harness side using the following table: **Steering Wheel Rotation Sensor** / **Circuit** / **ABS Module** C226-1 / RCA40 (BN/VT) / C135-40 C226-2 / VCA41 (VT/GN) / C135-41 C226-3 / VCA42 (VT/OG) / C135-9 C226-4 / CCA40 (GY/BU) / C135-5  • **Are the resistances less than 5 ohms?**	**Yes** GO to F10 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
F10 CHECK THE STEERING POSITION SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between: ♦ ABS module C135-5, circuit CCA40 (GY/BU), harness side and ground. ♦ ABS module C135-9, circuit VCA42 (VT/OG), harness side and	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. **No** GO to F11 .

ground. ♦ ABS module C135-40, circuit RCA40 (BN/VT), harness side and ground. ♦ ABS module C135-41, circuit VCA41 (VT/GN), harness side and ground.  N0060348 • **Is any voltage present?**	
F11 CHECK THE STEERING POSITION SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between: ♦ ABS module C135-5, circuit CCA40 (GY/BU), harness side and ground. ♦ ABS module C135-9, circuit VCA42 (VT/OG), harness side and ground. ♦ ABS module C135-40, circuit RCA40 (BN/VT), harness side and ground. ♦ ABS module C135-41, circuit VCA41 (VT/GN), harness side and ground.  N0060347 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to F12 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
F12 CHECK THE CHANNEL "A" AND "B" CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between steering wheel rotation sensor C226-2, circuit VCA41 (VT/GN), harness side and steering wheel rotation sensor C226-3, circuit VCA42 (VT/OG), harness side.	**Yes** If DTC C1963 is present, GO to Pinpoint Test G . INSTALL a new steering wheel rotation sensor. REFER to Steering Wheel Rotation Sensor in this section. CLEAR the DTCs. REPEAT the self-test.

 • **Are the resistances greater than 10,000 ohms?**	**No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
F13 CHECK FOR CORRECT ABS MODULE OPERATION	
• Ignition OFF. • Disconnect: ABS Module C135. • Check the connector for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: ABS Module C135. • Make sure the connector seats correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test G: DTCs C1963, C2777, U0151, U0452 and U1901

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The yaw rate sensor, lateral accelerometer and longitudinal accelerometer are contained in Restraints Control Module (RCM). The RCM measures vehicle yaw rate, lateral acceleration and longitudinal acceleration and then sends the information to the ABS module along the dedicated Controller Area Network (CAN) bus. This dedicated CAN bus is used only for communication between the RCM and the ABS module. The information sent to the ABS module is used to help determine if the AdvanceTrac® system needs to be activated.

DTC Description	Fault Trigger Conditions
• C2777 - Sensor Cluster Bus Failure • U0151 - Lost Communication With Restraints Control Module (RCM) • U1901 - CAN Network #2 Communication Bus	If, during normal operation or the ABS module on-demand self test the ABS module detects an open circuit, a short to voltage or a short to ground on one or both of the dedicated CAN bus circuits, or a failure of the RCM causes the appropriate DTC to set.

Fault	
• C1963 - Stability Control Inhibit Warning	If conditions exist during normal operation that prevent the AdvanceTrac® system from operating, DTC C1963 sets. This DTC is usually set due to the steering wheel rotation sensor or the RCM being damaged or installed incorrectly.
• U0452 - Invalid Data Received From RCM	This DTC indicates that one or more of the stability/traction control system sensors internal to the RCM have failed and the RCM is transmitting on "invalid data" message.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- RCM incorrectly mounted
- RCM
- ABS module

PINPOINT TEST G: DTCs C1963, C2777, U0151, U0452 AND U1901

⚠ WARNING: Never probe the electrical connectors on airbag, Safety Canopy® or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

⚠ WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

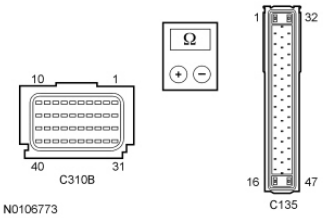
NOTE: Supplemental Restraint System (SRS) components should only be disconnected or reconnected when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS .

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
G1 CHECK FOR AN HS-CAN CONCERN WITH THE RCM	
• Connect the scan tool. • Ignition ON. • **NOTE:** The Network Test does not test the dedicated CAN communications between the ABS module and RCM . • Using the scan tool, carry out the Network Test. • **Does the RCM pass the Network Test?**	**Yes** GO to G2 . **No** REFER to Section 418-00 to diagnose the High Speed Controller Area Network (HS-CAN) concern.
G2 CHECK FOR CORRECT RCM	
• Ignition OFF.	**Yes** GO to G3 .

• **⚠ WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Gain access to the RCM and check the part number on the RCM against the part number listed in the master parts catalog. Refer to Section 501-20B . • **Does the part number on the RCM match the part number listed in the master parts catalog?**	**No** INSTALL the correct RCM . REFER to Section 501-20B . GO to G13 .
G3 CHECK FOR CORRECT ABS MODULE	
• Enter the following diagnostic mode on the scan tool: Log Viewer. • Retrieve and record the ABS module part number from Log Viewer and check the part number on the ABS module against the part number listed in the master parts catalog. • **Does the part number retrieved from the ABS module match the part number listed in the master parts catalog?**	**Yes** GO to G4 . **No** INSTALL the correct ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. GO to G13 .
G4 CHECK THE RCM CONDITION AND INSTALLATION	
• Depower the Supplemental Restraint System (SRS). Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Inspect the RCM for cracks in the case, broken anchor tabs, broken electrical connector and correct installation. Refer to Removal and Installation, Restraints Control Module (RCM) in Section 501-20B . • **Is the RCM installed correctly and undamaged?**	**Yes** GO to G5 . **No** REINSTALL or INSTALL new as necessary. GO to G13 .
G5 CHECK THE DEDICATED CAN CIRCUITS FOR AN OPEN	
• Disconnect: ABS Module C135. • Disconnect: RCM C310B. • Measure the resistance between the ABS module C135, harness side and the RCM C310B, harness side as indicated in the following chart: **ABS Module** | **Circuit** | **RCM**	**Yes** GO to G6 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. CYCLE the ignition key. REPEAT the self-test. GO to G13 .

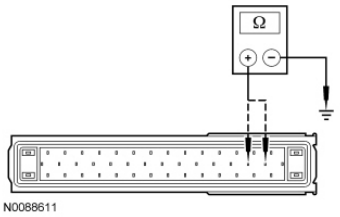
C135-18	VCA23 (BU/WH)	C310B-20
C135-19	VCA24 (GN/OG)	C310B-19



- **Are the resistances less than 5 ohms?**

G6 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TO GROUND

- Measure the resistance between ground and:
  - ABS module C135-19, circuit VCA24 (GN/OG), harness side.
  - ABS module C135-18, circuit VCA23 (BU/WH), harness side.



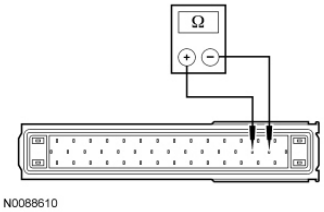
- **Are the resistances greater than 10,000 ohms?**

Yes
GO to G7 .

No
REPAIR the affected circuit(s). GO to G13 .

G7 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TOGETHER

- Measure the resistance between ABS module C135-19, circuit VCA24 (GN/OG), harness side and ABS module C135-18, circuit VCA23 (BU/WH), harness side.

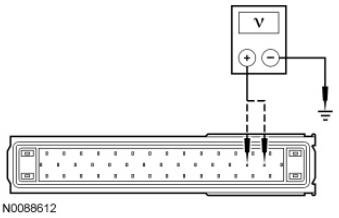
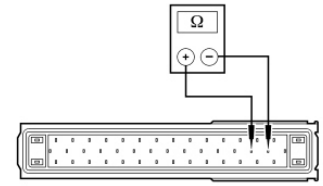


- **Are the resistances greater than 10,000 ohms?**

Yes
GO to G8 .

No
REPAIR the affected circuit(s). GO to G13 .

G8 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TO VOLTAGE

• Ignition ON. • Measure the voltage between ground and: ♦ ABS module C135-19, circuit VCA24 (GN/OG), harness side. ♦ ABS module C135-18, circuit VCA23 (BU/WH), harness side.  N0088612 • **Is any voltage present?**	**Yes** REPAIR the affected circuit(s). GO to G13 . **No** GO to G9 .
G9 CHECK RCM TERMINATING RESISTOR	
• Ignition OFF. • Connect: RCM C310B. • Measure the resistance between ABS module C135-18, circuit VCA23 (BU/WH), harness side and C135-19, circuit VCA24 (GN/OG), harness side.  N0088610 • **Is the resistance between 108 and 132 ohms?**	**Yes** GO to G10 . **No** GO to G11 .
G10 CHECK THE ABS MODULE FOR CORRECT OPERATION	
• Prior to reconnecting any previously disconnected SRS component: ♦ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ♦ inspect wire harness for any damage, pinched, cut or pierced wires. ♦ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to RCM in Section 501-20B .	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. GO to G13 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. GO to G13 .

♦ inspect ABS module C135 for dirt, corrosion, water intrusion, pushed out, loose or spread terminals and loose or frayed wire connections at terminals. ♦ repair any concerns found. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component(s)/Connector(s). • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Enter the following diagnostic mode on the scan tool: Self Test - ABS Module. • **Do any of the DTCs listed in Normal Operation return?**	
G11 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components, sensor electrical connectors and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs can be recorded. • If previously directed to repower the SRS , depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Prior to reconnecting any previously disconnected SRS component: ♦ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ♦ inspect wire harness for any damage, pinched, cut or pierced wires. ♦ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to RCM Removal and Installation in Section 501-20B . ♦ inspect ABS module C135 for dirt, corrosion, water intrusion, pushed out, loose or spread terminals and loose or frayed wire connections at terminals. ♦ repair any concerns found.	**Yes** INSTALL a new RCM . REFER to Section 501-20B . GO to G13 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition frequently. ACTIVATE other systems in the same wire harness. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test. b> GO to G12 .**

Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component(s)/Connector(s). • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Were DTCs U0028:08 and/or U0028:88 retrieved on-demand during self-test?**	
G12 CHECK FOR AN INTERMITTENT FAULT	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Disconnect RCM C310B and ABS module C135: ♦ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals. ♦ inspect wire harness for any damage, pinched, cut or pierced wires. ♦ repair any concerns found. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component(s)/Connector(s). • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • **Are any RCM DTCs retrieved on-demand during thself-test?**	**Yes** REFER to Diagnosis and Testing in Section 501-20B . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to G13 .
G13 CHECK FOR ADDITIONAL RCM AND ABS MODULE DTCs	
• Ignition OFF.	Do not clear any DTCs until all DTCs have been

• ⚠ **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - RCM . • Enter the following diagnostic mode on the scan tool: Self Test - ABS Module. • **Were any DTCs retrieved on-demand from the RCM or ABS module during self-test?**	resolved. GO to the appropriate DTC Chart in this section and/or Section 501-20B for pinpoint test direction. **No** CLEAR all Continuous Memory Diagnostic Trouble Codes (CMDTCs). PROVE OUT the SRS . REFER to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . Repair is complete. RETURN the vehicle to the customer.

Pinpoint Test H: DTCs B2900 and C1805

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

When the ignition is turned to the RUN position, the ABS module and the PCM share Vehicle Identification Number (VIN) information over the High Speed Controller Area Network (HS-CAN) bus.

- DTC B2900 (VIN Mismatched) - If the VIN information stored in the ABS module does not match the information transmitted by the PCM, DTC B2900 set.
- DTC C1805 (Mismatched PCM and/or ABS Module) - If the VIN information stored in the ABS module does not match the information transmitted by the PCM, DTC C1805 sets.

This pinpoint test is intended to diagnose the following:
- Module configuration (ABS and PCM)
- ABS module

PINPOINT TEST H: DTCs B2900 AND C1805

Test Step	Result / Action to Take
H1 VERIFY PCM VIN	&nbs
• Connect the scan tool. • Ignition ON. • Using the scan tool, carry out the Network Test.	**Yes** GO to H2 . **No** RECONFIGURE the PCM. FOLLOW the instructions on the scan tool. CLEAR the DTCs. CYCLE the ignition key. REPEAT the

• Enter the following diagnostic mode on the scan tool: Log Viewer. • Compare the VIN in Log Viewer to the vehicle VIN plate. • **Does VIN in Log Viewer match the vehicle VIN plate?**	self-test.
H2 VERIFY ABS MODULE PART NUMBER	
• Retrieve and record the ABS module part number from Log Viewer and verify that the vehicle has the correct ABS module installed. • **Is the correct ABS module installed in the vehicle?**	**Yes** CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available in Section 418-01 . CLEAR the DTC. CYCLE the ignition key. REPEAT the self-test. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTC. CYCLE the ignition key. REPEAT the self-test.

Pinpoint Test I: DTCs C1288 and C1440

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The ABS module monitors the pressure of the hydraulic brake system through the use of a brake pressure transducer. The brake pressure transducer is internal to the Hydraulic Control Unit (HCU). The brake pressure transducer cannot be serviced separately. If a new brake pressure transducer is needed, a new HCU must be installed.

- DTC C1288 (Pressure Transducer Main/Primary Input Circuit Failure) - If there is an improper connection between the ABS module and HCU , if the brake pressure transducer is faulted or if the ABS module is faulted internally, this DTC sets.
- DTC C1440 (Pressure Transducer Main/Primary Signal Faulted) - If there is an improper connection between the ABS module and the HCU , if there is air in the hydraulic brake system, if the brake pressure transducer is faulted or if the ABS module is faulted internally, this DTC sets.

This pinpoint test is intended to diagnose the following:

- HCU
- ABS module

PINPOINT TEST I: DTCs C1288 AND C1440

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step h>	Result / Action to Take

I1 MONITOR THE PCM BRAKE ON/OFF (BOO) PID	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - PCM. • Press and release the brake pedal while monitoring the BOO PID. • **Does the PID switch to ON with the brake pedal pressed and then to OFF with the brake pedal released?**	**Yes** GO to I2 . **No** RETRIEVE any PCM DTCs. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for non-communication DTCs and REFER to Section 418-00 for any communication DTCs.
I2 REVIEW THE ABS MODULE DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear All ABS Module DTCs. • Ignition OFF. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - ABS Module . • Retrieve and record any ABS module DTCs. • **Is DTC C1288 or C1440 present?**	**Yes** G I4 . **No** GO to I3 .
I3 CHECK FOR RETURNING DTCs	
• Enter the following diagnostic mode on the scan tool: Clear All ABS Module DTCs. • Drive the vehicle in a straight line at a speed greater than 40 km/h (25 mph) for at least 60 seconds. • Enter the following diagnostic mode on the scan tool: Self Test - ABS Module . • Retrieve and record any ABS module DTCs. • **Is DTC C1288 or C1440 present?**	**Yes** For DTC C1288, GO to I5 . For DTC C1440, GO to I4 . **No** The concern is not present at this time. For all other DTCs, REFER to the ABS Mule DTC Chart.
I4 CARRY OUT THE ABS SERVICE BLEED	
	Yes GO to I6 .

• Carry out the Brake System Service Bleed, refer to Section 206-00 . Clear the DTCs. Repeat the self-test. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear All ABS Module DTCs. • Drive the vehicle in a straight line at a speed greater than 40 km/h (25 mph) for at least 60 seconds. • Enter the following diagnostic mode on the scan tool: Self Test - ABS Module . • **Is DTC C1288 or C1440 present?**	**No** The system is operating correctly at this time. The concern may have been caused by air trapped in the hydraulic brake system. CLEAR the DTCs. REPEAT the self-test.
I5 CHECK THE ABS TO HCU CONNECTION	
• Ignition OFF. • Disconnect: ABS Module C135. • Remove the ABS module. Refer to Anti-Lock Brake System (ABS) Module in this section. • Inspect the ABS module-to-HCU mating surfaces for damage or contamination. ♦ Inspect the 4-pin pressure sensor connector in the ABS module and on the HCU side for damage, corrosion or contamination. • **Are the ABS-to- HCU mating surfaces undamaged and free of contamination or corrosion?**	**Yes** GO to I6 . **No** INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. If there is visible damage to the ABS module, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section.
I6 CHECK THE ABS MAIN BRAKE PRESSURE (MPRETDR) PID	
• If not already done, separate the ABS module from the HCU . Refer to Anti-Lock Brake System (ABS) Module in this section. • With the ABS module separated from the HCU , connect ABS module C135. • Ignition ON.	**Yes** INSTALL a new HCU . REFER Hydraulic Control Unit (HCU) in this section. CLEAR the DTCs. TEST the system for normal operation. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. TEST the system for normal operation.

• Enter the following diagnostic mode on the scan tool: DataLogger - ABS Module . • Monitor the MPRETDR PID. • **Is the PID value between 21.13K and 22.59K?**	

Pinpoint Test J: DTC C1996

Normal Operation

The ABS module uses information (wheel speed, steering wheel position, vehicles stability) received from various sensors and modules to determine if a vehicle instability event is about to occur. If an event is going to occur, the ABS module adjusts the brake torque at specific wheels and the PCM reduces engine torque to make the vehicle more stable. Once the ABS module has determined that the stability event has been corrected, it returns brake and engine torque to normal and continues to monitor the vehicle.

- DTC C1996 (Active Yaw and/or Roll Control Disabled) - The ABS module monitors the stability event and is programmed to set DTC C1996 and disable the stability control system if the stability event lasts longer than 15 seconds.

This pinpoint test is intended to diagnose the following:

- Steering wheel rotation sensor (3.5L only)
- Restraints Control Module (RCM)
- Wheel speed sensors
- ABS module
- High Speed Controller Area Network (HS-CAN)
- Power Steering Control Module (PSCM)

PINPOINT TEST J: DTC C1996

J1 CHECK FOR ABS MODULE DTCs	
• Review the DTCs recorded during Inspection and Verification. • **Are any DTCs other than C1996 present?**	**Yes** REPAIR all other DTCs before repairing C1996. GO to the ABS Module DTC Chart in this section. **No** GO to J2 .
J2 CHECK RETURNING DTCs	
• Connect the scan tool. • Ignition ON. • Using the scan tool, clear all ABS module DTCs. • Cycle the ignition switch from RUN to	**Yes** If **only** DTC C1996 is present, GO to J3 . If DTC C1996 is present along with other DTCs, REPAIR the other DTCs before repairing DTC C1996. GO to the ABS Module DTC Chart in this section. **No**

OFF and back to RUN. • Test drive the vehicle above 49 km/h (30 mph). • Enter the following diagnostic mode on the scan tool: Self Test - ABS Module. • **Are any ABS module DTCs present?**	The condition is not present at this time.
a>**J3 CHECK THE WHEEL SPEED SENSOR PIDs**	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - ABS Module . • While driving the vehicle, have an assistant monitor the following wheel speed sensor PIDs: ♦ Left Front Wheel Speed Sensor (LF_WSPD) ♦ Right Front Wheel Speed Sensor (RF_WSPD) ♦ Left Rear Wheel Speed Sensor (LR_WSPD) ♦ Right Rear Wheel Speed Sensor (RR_WSPD) • **Do all the PIDs match the vehicle speed and match each other?**	**Yes** GO to J8 . **No** GO to J4 .
J4 INSPECT THE WHEEL SPEED SENSOR MOUNTING	
• Ignition OFF. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .	**Yes** GO to J5 . **No** TIGHTEN the wheel speed sensor bolt to specification. REFER to Specifications in this section. CLEAR the DTCs.

• Verify the bolt of the suspect wheel speed sensor is tightened to specifications. • **Is the bolt tightened to specifications?**	
J5 INSPECT THE WHEEL SPEED SENSOR AND HARNESS FOR DAMAGE	
• **NOTE:** Examine the wheel speed sensor harness carefully with a good light source. Failure to verify damage in the sensor harness can lead to unnecessary installation of a new component. • Inspect the suspect wheel speed sensor and harness for cuts, broken tabs, broken casing and/or corrosion. • **Are the wheel speed sensor and harness OK?**	**Yes** GO to J6 . **No** INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front , href="SCS~us~en~file=SCS69011.HTM~gen~ref.HTM" >Wheel Speed Sensor - Rear, All Wheel Drive (AWD) or Wheel Speed Sensor - Rear, Front Wheel Drive (FWD) in this section. CLEAR the DTCs. REPEAT the self-test.
J6 INSPECT THE WHEEL SPEED SENSOR RING FOR DAMAGE	
• **NOTE:** Examine the wheel speed sensor ring carefully with a good light source. Failure to verify damage in the sensor ring can lead to unnecessary installation of a new component. • Inspect the suspect wheel speed sensor ring for cracks, chips or missing teeth. Rotate the wheel to verify that no teeth are missing. • **Is the wheel speed sensor ring OK?**	**Yes** GO to J7 . **No** INSTALL a new wheel hub and bearing assembly (wheel speed sensor rings are part of the wheel hub and bearing assembly). Refer to the appropriate section in Group 204 for the procedure. CLEAR the DTCs. REPEAT the self-test.
J7 INSPECT THE WHEEL BEARING FOR DAMAGE AND LOOSENESS	
• Verify that the wheel bearing has no end-play	**Yes** INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front , Wheel Speed Sensor - Rear, All Wheel Drive (AWD) or Wheel

and is undamaged. • **Is the wheel bearing OK?**	Speed Sensor - Rear, Front Wheel Drive (FWD) in this section. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new wheel hub and bearing assembly. Refer to the appropriate section in Group 204 for the procedure. CLEAR the DTCs. REPEAT the self-test.
J8 CHECK THE ABS MODULE YAW RATE (YAWRATE) PID	
• **NOTE:** The vehicle must be on level ground and at a complete standstill. Any vehicle movement results in false values for this test. • Monitor the YAWRATE PID. • **Is the YAWRATE PID value between -0.05 and 0.05?**	**Yes** GO to J9 . **No** GO to J11 .
J9 CHECK THE ABS MODULE LATERAL ACCELERATION (LAT_ACCL) PID	
• **NOTE:** The vehicle must be on level ground and at a complete standstill. Any vehicle movement results in false values for this test. • Monitor the LAT_ACCL PID. • **Is the LAT_ACCL PID value between -0.4 and 0.4?**	**Yes** If the vehicle is equipped with All-Wheel Drive (AWD), GO to J10 . For all other vehicles, GO to J12 . **No** GO to J11 .
J10 CHECK THE ABS MODULE LONGITUDINAL ACCELERATION (LONG_ACCL) PID	
• **NOTE:** The vehicle must be on level ground and at a complete standstill. Any vehicle movement results in false values for this test. • Monitor the LONG_ACCL PID. • **Is the LONG_ACCL PID value between**	**Yes** GO to J12 . **No** GO to J11 .

-0.4 and 0.4?	
J11 CHECK THE RCM INSTALLATION AND MOUNTING SURFACE	
• Ignition OFF. • ⚠ **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Gain access to the RCM and inspect the RCM installation. Make sure that the nuts are fully seated and tightened correctly. Refer to Section 501-20B . • Inspect the mounting surface for damage, corrosion or dirt. • **Is the RCM installed correctly and is the mounting surface clean and free from damage?**	**Yes** INSTALL a new RCM . REFER to Section 501-20B . TEST the system for normal operation. **No** REPAIR, REINSTALL or INSTALL new as necessary. CLEAR the DTC. REPEAT the self-test.
J12 CHECK THE STEERING WHEEL ANGLE SENSOR POSITION (SWA POS) PID	
NOTE: For all vehicles **except** those with a 3.5L engine, the steering wheel angle information is sent to the ABS module from the PSCM over the HS-CAN bus. • Monitor the SWA POS PID while rotating the steering wheel clockwise and counterclockwise very slowly, from lock to lock.	**Yes** GO to J13 . **No** For vehicles equipped with a 3.5L engine, INSTALL a new steering wheel rotation sensor. REFER to Steering Wheel Rotation Sensor in this section. CLEAR the DTCs. REPEAT the self-test. For all other vehicles, CARRY OUT a self-test of the PSCM . REFER to Section 211-00A .

• **Does the PID change in intervals of 1.5 degrees on vehicles with a 3.5L engine (intervals of 0.05-0.25 degrees on all other vehicles) and show a 360-degree increase for each complete revolution of the steering wheel?**	
J13 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect: ABS Module C155. • Check the connector for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: ABS Module C155. • Make sure the ABS module electrical connector is fully seated, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test K: DTCs C109D, C109E and C109F

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The vacuum sensor is used by the ABS module to determine if hydraulic pump intervention is necessary due to loss of vacuum. The ABS module sends a 5-volt reference voltage to the sensor, the sensor compares the pressure in the booster to the ambient air pressure in the engine compartment and sends a varying voltage back to the ABS module based on the difference between the pressures. Normally, the pressure in the booster is much lower than ambient air pressure, as the pressure in the booster gets higher (closer to matching ambient air pressure), the lower the voltage sent back to the ABS module becomes.

When the vacuum in the brake booster falls below a predetermined level, the ABS module commands the hydraulic pump motor to activate on the next (and any subsequent) brake pedal application to assist with vehicle braking. The ABS module continues to use the pump motor for braking assist as long as the low vacuum condition exists.

- DTC C109D (Low Vacuum Condition Detected) - This DTC is set when the optimized hydraulic brake system is activated and does not necessarily indicate a concern with the vacuum sensor, the related wiring or the ABS module. This DTC most likely indicates a vacuum concern in the brake booster, engine and any related vacuum hoses/tubes. High altitude locations with low ambient air temperatures can cause a low vacuum condition to exist in the booster until the engine compartment warms up.
- DTC C109E (Vacuum Sensor Circuit Fault) - If, during normal operation or the ABS module on-demand self test, the ABS module detects an open circuit, a short to voltage or a short to ground on the vacuum sensor circuits, DTC C109E sets. Also, a failure of the vacuum sensor causes DTC C109E to set.
- DTC C109F (Vacuum Sensor Signal Fault) - The vacuum sensor has 4 ambient air pressure inlet ports (2 on each side). If these ports become restricted or clogged, DTC C109F sets.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Vacuum sensor
- ABS module

PINPOINT TEST K: DTCs C109D, C109E AND C109F

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.Test StepResult / Action to Take K1 CHECK THE ABS MODULE DTCs**

- Review the DTCs recorded during Inspection and Verification.
- **Was DTC C109D the only recorded DTC?**

Yes
GO to K2 .

No
If DTC C109E and/or C109F was retrieved, GO to K6 .

For all other DTCs, REFER to the ABS Module DTC Chart in this section. **K2 CHECK DTC RETURNABILITY**

- Using the scan tool, clear the ABS module DTCs.
- Ignition OFF.
- Disconnect the scan tool.
- Start the engine.
- **NOTE:** It may take up to 3 minutes for DTC C109D to set.
- Allow the vehicle to idle for a minimum of 4 minutes.
- Ignition OFF.
- Connect the scan tool.
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: Self Test - ABS Module.
- **Is DTC C109D the only vacuum sensor DTC present?**

Yes
GO to K3 .

No
If DTC C109E and/or C109F was retrieved, GO to K6 .

For all other DTCs, REFER to the ABS Module DTC Chart in this section. **K3 CHECK THE ENGINE VACUUM**

- Carry out the Intake Manifold Vacuum Test, refer to Diagnosis and Testing in Section 303-00 .
- Record the vacuum reading.
- **Does the vacuum gauge indicate normal vacuum?**

Yes
GO to K4 .

No
FOLLOW the diagnostic direction as laid out in Section 303-00 . **K4 CHECK THE BRAKE BOOSTER**

- Carry out the Brake Booster Component Test, refer to Diagnosis and Testing in Section 206-00 .
- **Do the brake booster and check valve pass the component test?**

Yes
GO to K5 .

No
REPAIR or INSTALL new as necessary. CLEAR the DTC. REPEAT the self-test. **K5 CHECK THE BRAKE BOOSTER VACUUM LEVEL PID**

- Connect the scan tool.
- Start the engine.
- Enter the following diagnostic mode on the scan tool: DataLogger - ABS Module.
- Compare the recorded vacuum reading to the brake booster vacuum level PID.
- **Does the PID match the recorded vacuum reading?**

Yes
INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST The system for normal operation.

No
INSTALL a new brake booster vacuum sensor. REFER to Section 206-07 . CLEAR the DTCs. TEST the system for normal operation. **K6 CHECK THE BRAKE BOOSTER VACUUM SENSOR**

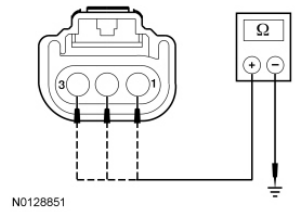
- Inspect the vacuum sensor ambient air pressure inlet ports.
- **Are all 4 ports free of contamination and/or foreign material?**

Yes
GO to K7 .

No
REPAIR or INSTALL a new vacuum sensor as necessary. REFER to Section 206-07 . CLEAR the DTCs. REPEAT the self-test. **K7 CHECK THE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR A SHORT TO GROUND**

- Ignition OFF.
- Disconnect: ABS Module C135.
- Disconnect: Brake Booster Vacuum Sensor C1603.
- Measure the resistance between ground and:
    - ♦ brake booster vacuum sensor C1603-1, circuit VCA38 (BN/VT), harness side.

- ♦ brake booster vacuum sensor C1603-2, circuit RCA37 (WH/BU), harness side.
- ♦ brake booster vacuum sensor C1603-3, circuit LCA37 (YE/OG), harness side.



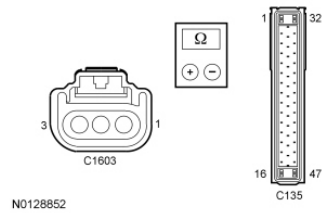
- **Are the resistances greater than 10,000 ohms?**

Yes
GO to K8 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. **K8 CHECK THE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR AN OPEN**

- Measure the resistance between the ABS module C135, harness side and the brake booster vacuum sensor C1603, harness side as indicated in the following chart:

ABS Module	Circuit	Vacuum Sensor
C135-30	VCA38 (BN/VT)	C1603-1
C135-27	RCA37 (WH/BU)	C1603-2
C135-26	LCA37 (YE/OG)	C1603-3



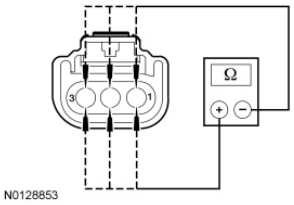
- **Are the resistances less than 5 ohms?**

Yes
GO to K9 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. **K9 CHECK THE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR A SHORT TOGETHER**

- Measure the resistance between:
  - ♦ brake booster vacuum sensor C1603-1, circuit VCA38 (BN/VT), harness side and brake booster vacuum sensor C1603-2, circuit RCA37 (WH/BU), harness side.
  - ♦ brake booster vacuum sensor C1603-1, circuit VCA38 (BN/VT), harness side and brake booster vacuum sensor C1603-3, circuit LCA37 (YE/OG), harness side.

- ♦ brake booster vacuum sensor C1603-2, circuit RCA37 (WH/BU), harness side, and brake booster vacuum sensor C1603-3, circuit LCA37 (YE/OG), harness side.

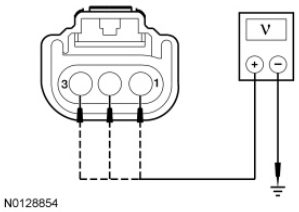


- **Are the resistances greater than 10,000 ohms?**

Yes
GO to K10 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. **K10 CHECK THE ACTIVE BRAKE BOOSTER CIRCUITS FOR A SHORT TO VOLTAGE**

- Ignition ON.
- Measure the voltage between ground and:
  - ♦ brake booster vacuum sensor C1603-1, circuit VCA38 (BN/VT), harness side.
  - ♦ brake booster vacuum sensor C1603-2, circuit RCA37 (WH/BU), harness side.
  - ♦ brake booster vacuum sensor C1603-3, circuit LCA37 (YE/OG), harness side.



- **Is any voltage present?**

Yes
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

No
GO to K11 . **K11 CHECK THE ABS MODULE CONNECTORS**

- Check ABS module C135 for:
  - ♦ corrosion.
  - ♦ pushed-out pins.
  - ♦ spread terminals.
- Connect: ABS Module C135.
- Make sure the connector seats correctly, then operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. TEST the system for normal operation.

No

The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test L: Poor Vehicle Tracking During Anti-Lock Function

Normal Operation

The operating voltage required to supply the ABS module, hydraulic pump and isolation valves is in a range between 10 and 16 volts. The ABS module uses input from several different sensors (wheel speed sensors, Brake Pedal Position (BPP) switch, sensor cluster, etc.) to determine if an ABS event is necessary. If an ABS event is necessary, the ABS module commands the hydraulic pump motor on and command the Hydraulic Control Unit (HCU) to actuate the appropriate solenoids. During an ABS event, the front and rear end of the vehicle should track true to the direction of travel along the vehicle centerline unless driver input dictates otherwise, there is an internal issue with the HCU or an issue with the base brake system (caliper, tubes, etc.) that allows one or more wheels to lock up.

Fused battery voltage is supplied to the ABS module from Battery Junction Box (BJB) fuse 10 (30A) along circuit SBB10 (YE/RD) and fuse 8 (40A) along circuit SBB08 (VT/RD). Fused ignition voltage is supplied to the ABS module from Smart Junction Box (SJB) fuse 42 (10A) along CBP42 (GN) and ground is provided to the module along circuit GD123 (BK/GY).

This pinpoint test is intended to diagnose the following:

- Base brake system
- HCU

PINPOINT TEST L: POOR VEHICLE TRACKING DURING ANTI-LOCK FUNCTION

Test Step	Result / Action to Take
L1 BLEED THE BRAKE SYSTEM	
• Bleed the brake system using the scan tool. Refer to Section 206-00 . • Test drive the vehicle. • **Does the vehicle track correctly?**	**Yes** The brake system is operating correctly. The concern may have been caused by air in the hydraulic system or a sticking valve in the HCU . **No** GO to L2 .
L2 VERIFY VEHICLE TRACKING DURING NON-ABS BRAKING	
• Test drive the vehicle and verify vehicle tracking during normal braking. • **Does the vehicle track correctly during normal braking?**	**Yes** GO to L3 . **No** The condition could be caused by a base brake component or vehicle alignment. REFER to Section 206-00 to verify base brake components and REFER to Section 204-00 to verify suspension components.
L3 CHECK THE ABS INLET VALVE (CLOSED POSITION)	
	Yes TOGGLE the LF_INLET output command OFF.

• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Rotate all the wheels to make sure they rotate freely (the transaxle must be in NEUTRAL). • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: ABS DataLogger. • Apply moderate brake pedal effort. • Toggle the left front inlet valve (LF_INLET) active command ON and at the same time, have an assistant attempt to rotate the LF wheel. • **Does the LF wheel rotate?**	GO to L4 . **No** TOGGLE the LF_INLET output command OFF. INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation.
L4 CHECK THE ABS INLET VALVE (OPEN POSITION)	
• Apply moderate brake pedal effort. • Have an assistant attempt to rotate the LF wheel. • **Does the LF wheel rotate?**	**Yes** INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation. **No** GO to L5 .
L5 CHECK THE ABS OUTPUT VALVE (OPEN POSITION)	
• Apply moderate brake pedal effort. • **NOTE:** Each activation of the output command runs the pump for 2 seconds. • Toggle the following active commands ON: ♦ LF_INLET ♦ Left front outlet valve (LF_OUTLET) ♦ Hydraulic pump motor (PMP_MOTOR) • At the same time, have an assistant attempt to rotate the LF wheel. • **Does the LF wheel rotate?**	**Yes** TOGGLE all output commands OFF. GO to L6 . **No** TOGGLE all output commands OFF. INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation.
L6 CHECK THE ABS INLET AND OUTLET VALVE (CLOSED POSITION)	
• Apply moderate brake pedal effort. • Have an assistant attempt to rotate the LF wheel. • **Does the LF wheel rotate?**	**Yes** INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation. **No** Beginning with Step L3, REPEAT this procedure for the RF, LR and RR wheels using the appropriate output commands. If no failure occurs, the system is operating normally.

Pinpoint Test M: The Stability/Traction Control System Cannot Be Disabled

Normal Operation

The traction control portion of the AdvanceTrac® can be disabled by pressing the traction control switch located on the instrument panel center finish panel. When the system is disabled, the sliding car OFF icon in the Instrument Panel Cluster (IPC) illuminates continuously. On MKZ vehicles, the traction control switch is part of the Front Controls Interface Module (FCIM). On Fusion and Milan vehicles, the traction control switch is part of the ambient lighting switch.

The IPC sends 5 volts to the traction control switch along circuit CCA15 (YE/GY). When the traction control switch is pressed, this voltage is sent through the switch and to ground along circuit GD116 (BK/VT). When the IPC detects this ground, it sends a message to the PCM and the ABS module along the High Speed Controller Area Network (HS-CAN) bus that the driver has disabled the system. An open circuit or a defective traction control switch prevents the system from being disabled, but does not set a DTC.

If a MyKeyTM restricted key is in use with Advance Trac® always-on feature configured to "on", the traction control system cannot be disabled. An admin key must be used irder to enable and disable the traction control system.

DTC C0089:11 (TCS Disable Switch: Circuit Short to Ground) - If the IPC detects the ground signal during the on-demand self test or if it is shorted to ground, DTC C0089:11 sets. Also, if the traction control switch is held or stuck closed for more than 2 minutes during normal operation, DTC C0089:11 sets.

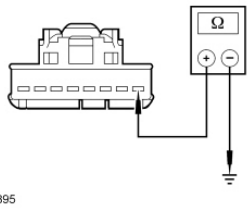
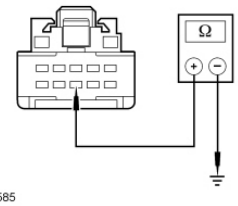
This pinpoint test is intended to diagnose the following:

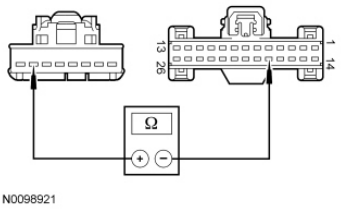
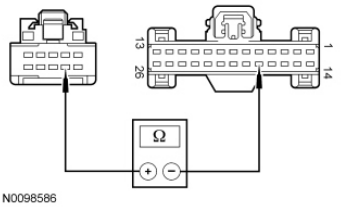
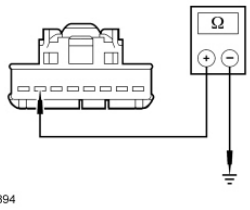
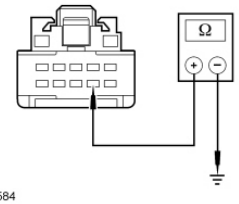
- Wiring, terminals or connectors
- Traction control switch
- IPC

PINPOINT TEST M: THE STABILITY/TRACTION CONTROL SYSTEM CANNOT BE DISABLED

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
M1 CHECK FOR ANY COMMUNICATION DTCs	
• Connect the scan tool. • Ignition ON. • Check the IPC , the PCM and the ABS module for any communication DTCs. • **Are any communication DTCs present?**	**Yes** For ABS communication DTCs, GO to the ABS Module DTC Chart. For IPC and PCM mmunication DTCs, REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 . **No** GO to M2 .
M2 ISOLATE THE TRACTION CONTROL SWITCH	
	Yes GO to M3 .

NOTE: If a MyKeyTM restricted key is in use with Advance Trac® always-on feature configured to "on", the traction control system cannot be disabled. An admin key must be used in order to enable and disable the traction control system. • Ignition OFF. • Disconnect: FCIM C2402 (MKZ). • Disconnect: Traction Control/Ambient Lighting Switch C2304 (Fusion/Milan). • **For Fusion or Milan** , measure the resistance between traction control/ambient lighting switch C2304 pin-7 and pin-1, component side, while pressing and releasing the traction control switch. • **For MKZ** , measure the resistance between FCIM C2402 pin-7 and pin-8, component side, while pressing and releasing the switch. • **Is the resisnce less than 5 ohms with the switch pressed and greater than 10,000 ohms with the switch released?**	**No** **For Fusion or Milan** , INSTALL a new traction control switch. REFER to Traction Control Switch in this section. **For MKZ** , INSTALL a new FCIM . REFER to Section 415-00 . TEST the system for normal operation.
M3 CHECK THE TRACTION CONTROL SWITCH GROUND CIRCUIT FOR AN OPEN	
• **For Fusion or Milan** , measure the resistance between traction control/ambient lighting switch C2304-1, circuit GD116 (BK/VT), harness side and ground.  N0098895 • **For MKZ** , measure the resistance between FCIM C2402-8, circuit GD116 (BK/VT), harness side and ground.  N0098585 • **Is the resistance less than 5 ohms?**	**Yes** GO to M4 . **No** REPAIR circuit GD116 (BK/VT). TEST the system for normal operation.
M4 CHECK THE TRACTION CONTROL SWITCH CONTROL CIRCUIT FOR AN OPEN	
• Disconnect: IPC C220. • **For Fusion or Milan** , measure the resistance between traction control/ambient lighting switch C2304-7, circuit CCA15 (YE/GY), harness side and IPC C220-18, circuit CCA15 (YE/GY), harness side.	**Yes** GO to M5 . **No** REPAIR circuit CCA15 (YE/GY). TEST the system for normal

 N0098921 • **For MKZ** , measure the resistance between FCIM C2402-7, circuit CCA15 (YE/GY), harness side and IPC C220-18, circuit CCA15 (YE/GY), harness side.  N0098586 • **Is the resistance less than 5 ohms?**	operation.
M5 CHECK THE TRACTION CONTROL SWITCH CONTROL CIRCUIT FOR A SHORT TO GROUND	
• **For Fusion or Milan** , measure the resistance between traction control/ambient lighting switch C2304-7, circuit CCA15 (YE/GY), harness side and ground.  N0098894 • **For MKZ** , measure the resistance between FCIM C2402-7, circuit CCA15 (YE/GY), harness side and ground.  N0098584 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to M6 . **No** REPAIR circuit CCA15 (YE/GY). TEST the system for normal operation.
M6 CHECK FOR CORRECT IPC OPERATION	
• Ignition OFF.	**Yes** INSTALL a new IPC .

• Check IPC C220 for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: IPC C220. • Make sure the connector is seated correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	REFER to Section 413-01. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Anti-Lock Control â Hybrid

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3030-A	Rotunda Active Wheel Speed Sensor Tester 105-R0110 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Regenerative Braking

The regenerative brake system utilizes the electric motor portion of the hybrid electric powertrain as a generator to create electrical current. This recharges the High Voltage Traction Battery (HVTB) and delivers brake torque to be used in place of or in combination with the conventional friction brakes to slow the vehicle. The amount of brake torque provided by the electric motor is dependent upon the state of charge of the HVTB . When the HVTB is almost fully charged, the amount of regenerative braking is limited to avoid overcharging, and the requested deceleration is produced by conventional friction braking alone.

Conventional Friction Braking

If the HVTB is almost fully charged, or the requested amount of braking cannot be achieved by regenerative braking alone, the ABS module applies the conventional friction brakes. The friction brakes utilize components similar to those found in a conventional vacuum assisted brake system with ABS. For a list of components, refer to Section 206-00 .

Brake-By-Wire

During a normal brake application, the brake pedal feel simulator allows the pressure applied to the brake pedal by the driver's foot to act against a spring instead of the brake booster push rod. The brake pedal angle sensor is mounted to the brake pedal assembly and provides the ABS module with an analog signal indicating the amount of deceleration the driver is demanding. If it is necessary for the conventional friction brakes to be applied, the ABS module applies a Pulse Width Modulated (PWM) voltage to a vacuum solenoid inside the active brake booster. The solenoid allows vacuum from either the combustion engine (if the engine is running)

or the electric vacuum pump to move the booster push rod which in turn pushes the piston in the master cylinder and create hydraulic brake pressure. If the brake pedal is applied quickly and forcefully enough, the driver can overcome the brake pedal feel simulator spring pressure, allowing a direct connection between the brake pedal, booster push rod and master cylinder.

Brake Pedal Feel Simulator and Cut-Off Device

When the ignition is turned on, the ABS module runs a series of checks to make sure the system is running properly. Once these checks are complete, the ABS module closes the valve in the simulator cut-off device which puts the brake system into brake-by-wire mode. Brake-by-wire mode is when the pedal feedback to the driver is provided by the pedal feel simulator and not the pressure in the base brake system. The simulator uses spring pressure to provide a familiar brake pedal sensation. When the driver presses the brake pedal, the ABS module interprets the pedal movement through the brake pedal angle sensor. Based on the pedal angle and the amount of brake torque that can be provided through regenerative braking, the ABS module determines how much brake torque is provided by the power train and how much is provided by the hydraulic brakes. The brake pedal is uncoupled from the brake booster push rod allowing the system to hold off hydraulic pressure when regenerative braking is providing the necessary brake torque. When hydraulic braking is required, the ABS module activates the booster solenoid, this allows the vacuum booster to push on the master cylinder creating pressure in the hydraulic system. In the event a fault occurs which inhibits the brake-by-wire mode, the ABS module opens the cut-off device valve. This puts the system into conventional mode with vacuum boosted hydraulic brakes and no regenerative braking. In this mode, the pedal feedback to the driver is provided by the booster. When the driver pushes the pedal, the uncoupling between the pedal and the booster push rod is overcome, and the pedal arm pushes on the booster push rod as in a conventional brake system.

Active Brake Booster

The active brake booster is similar to a conventional vacuum assisted brake booster with the addition of a brake booster solenoid, a brake booster travel sensor and a vacuum pressure sensor. If it is necessary to apply the friction brakes due to inadequate deceleration from regenerative braking, the ABS module sends a PWM voltage to the brake booster solenoid that is proportional to the amount of brake torque requested. The booster solenoid opens, which allows the vacuum booster push rod to push on the master cylinder creating pressure in the hydraulic system.

The ABS module uses the signals produced by the vacuum pressure sensor to verify that vacuum is being maintained in the brake booster. The ABS module uses the signals produced by the brake booster travel sensor to monitor brake booster performance.

Electric Vacuum Pump

When the combustion engine is not running, an electric vacuum pump is used to maintain vacuum inside the brake booster. The ABS module turns the electric vacuum pump on and off through the use of a mechanical relay and a solid state relay. If the ABS module detects a vacuum pump motor circuit concern, a vacuum system leak or a vacuum pump performance concern, a DTC sets in the ABS module and the combustion engine runs to provide vacuum for the brake booster.

Anti-Lock Braking

The ABS module continuously monitors and compares the rotational speed of each wheel. This is accomplished through the use of 4 active wheel speed sensors, one for each wheel. The wheel speed sensors

are connected to the ABS module by 2 circuits. One circuit provides voltage for sensor operation and the other circuit provides sensor input to the ABS module. As the wheels spin, the wheel speed sensor tone rings pass through the magnetic field generated by the active wheel speed sensor. This creates a square-wave signal that is sent to the ABS module to indicate individual wheel speed.

The ABS module uses a Hydraulic Control Unit (HCU) to prevent the wheels from locking up during a braking event. The HCU contains several solenoid-controlled valves, a pump motor, an accumulator and several sensors. The fluid flows through 4 normally open inlet valves inside the HCU and through the outlet ports of the HCU to the brake calipers. If the ABS module senses that a wheel is about to lock up, based on wheel speed sensor data, the module closes the normally open inlet valve for that wheel. This prevents more fluid from getting to the brake caliper. The ABS module then reads the wheel speed sensor signal from the affected wheel again. If the wheel is still decelerating (locking up), the module opens the normally closed outlet valve. This allows a controlled amount of hydraulic pressure in the brake caliper to be relieved into the HCU accumulator. The ABS pump motor runs during an ABS braking event so that sufficient brake fluid pressure is consistently available to the HCU valves. This procedure of closing and opening valves is repeated several times per second until the speed of the affected wheel matches the speeds of the other wheels. Once this has been accomplished, the ABS module returns the solenoid valves to their normal positions.

The ABS module is self-monitoring. When the ignition switch is turned to the RUN position, the ABS module carries out a preliminary electrical check of the wheel speed sensor circuitry by sending voltage through the sensor and checking for the voltage to return. At speeds above 20 km/h (12 mph), without the brake pedal being pressed, the pump motor is commanded ON for less than 2 seconds to check pump motor operation. Also, during all phases of operation while the vehicle is in motion, the ABS module checks for correct operation of the wheel speed sensors. In the event that the ABS module detects a concern, the module sets a DTC and send a message to the Instrument Panel Cluster (IPC) over the High Speed Controller Area Network (HS-CAN) bus to illuminate the yellow ABS warning indicator, the stability/traction control indicator (also known as the sliding-car icon) and/or the red brake warning indicator. If the concern is severe enough, ABS may be disabled. Normal power-assisted braking, however, remains.

Electronic Brake Distribution (EBD)

The ABS module incorporates a strategy called Electronic Brake Distribution (EBD). The EBD strategy uses the HCU as an electronic proportioning valve. On initial application of the brake pedal, full pressure is applied to the rear brakes. The ABS module uses wheel speed input to calculate an estimated rate of deceleration. Once vehicle deceleration exceeds a certain threshold, the ABS module closes the appropriate solenoid valves in the HCU to hold the rear brake pressure constant while allowing the front brake pressure to build. This creates a balanced braking condition between the front and rear wheels and minimizes the chance of rear wheel lockup during hard braking. As the vehicle decelerates, the valves are opened to increase the rear brake pressure in proportion to the front brake pressure.

Some drivers may feel a slight bump sensation in the brake pedal when EBD is active.

If there is a DTC in the ABS module specifically for the HCU or there are 2 or more wheel speed sensor DTCs, EBD is disabled. When EBD is disabled, the ABS warning indicator, the red brake warning indicator and the sliding-car icon is illuminated.

AdvanceTracÂ® Stability Enhancement System

The AdvanceTracÂ® system provides the following stability enhancement features for certain driving situations:

- Traction Control System â helps to avoid excessive drive-wheel spin and loss of traction.

- Electronic Stability Control (ESC) System â helps to avoid skids and lateral slides.

The traction control system uses the ABS and the PCM to limit wheel spin. When the ABS module detects a wheel spinning excessively, brake pressure to the appropriate brake caliper is modulated. This is accomplished by opening and closing the appropriate solenoid valves inside the HCU while the hydraulic pump motor is activated. At the same time, the ABS module sends a message over the HS-CAN bus that a traction control event is taking place. When the IPC receives this message, it flashes the sliding-car icon (twice per second). If the event is severe enough, the ABS module also sends a message to the PCM over the HS-CAN bus to assist with traction control. When the PCM receives this message, it adjusts engine timing and decreases fuel injector pulses. Once the affected wheel returns to normal speed, the ABS module returns the solenoid valves in the HCU to their normal position, deactivates the hydraulic pump motor and sends another message over the HS-CAN bus indicating that the traction event has ended. The PCM returns engine timing and fuel injectors to normal operation and the IPC extinguishes the sliding-car icon.

Once vehicle speed reaches or exceeds 100 km/h (62 mph), traction control is accomplished only through PCM intervention.

Certain DTCs in the ABS module disables the traction control system. Depending on the DTCs present, the yellow ABS warning indicator and/or the sliding-car icon are illuminated.

Electronic Stability Control (ESC) System

The ESC system is controlled by the ABS module and uses the same wheel speed sensors and tone rings that are used for anti-lock braking. The ESC system also uses input from the steering wheel rotation sensor and the stability control sensors (yaw rate, roll rate, longitudinal acceleration and lateral acceleration), which are internal to the Restraints Control Module (RCM). Additional information from other modules is sent over the HS-CAN bus to help maintain vehicle stability.

The ABS module uses the various sensors to continuously monitor vehicle direction of travel relative to the driver's intended course. If the ABS module determines from all these inputs that the vehicle is unable to travel in the intended direction, it modulates brake pressure to the appropriate brake caliper(s) by opening and closing the appropriate solenoid valves inside the HCU while the hydraulic pump motor is activated. At the same time, the ABS module sends a message over the HS-CAN bus that a stability event is taking place. When the IPC receives this message, it flashes the sliding-car icon. Under certain conditions during a stability event, the PCM may be requested to reduce engine torque as it does for traction control. Once the stability condition has been corrected, the ABS module sends another message over the HS-CAN bus indicating that the event has ended. The PCM returns engine timing and fuel injectors to normal operation and the IPC extinguishes the sliding-car icon.

Certain DTCs being present in the ABS module may disable the ESC system. Depending on the DTCs present, the yellow ABS warning indicator and/or the sliding-car icon is illuminated.

Traction Control Switch

Unlike conventional ABS, the traction control portion of the AdvanceTracÂ® can be deactivated by the driver through the use of the traction control switch. The switch is hardwired to the IPC . When pressed, the switch sends a ground signal to the IPC . The IPC then sends a message over the HS-CAN bus indicating that the driver has requested that the system be deactivated and illuminates the sliding-car OFF icon. Once disabled, the system remains in that state until the driver presses the switch again or the ignition is cycled.

Stability Control Sensors

The stability control sensors for the AdvanceTracÂ® system consist of the yaw rate sensor, lateral accelerometer and longitudinal accelerometer. The sensors are housed in the RCM which sends sensor information to the ABS module over the dedicated Controller Area Network (CAN) bus. If any of the sensors are defective, a new RCM must be installed. Refer to Section 501-20B for additional information on the RCM .

- The yaw rate sensor measures the relative vehicle motion about the vertical axis through the vehicle center of gravity.
- The longitudinal accelerometer measures the acceleration corresponding to the force involved when the vehicle moves forward and rearward in the horizontal plane, along the centerline of the vehicle's front and rear wheels.
- The lateral accelerometer measures the acceleration that corresponds to the force involved when the vehicle moves sideways.

Lateral acceleration has 2 forms. The first is the centrifugal acceleration that is generated when the vehicle travels around in a circle. The second is the acceleration due to gravity. On level ground there is no contribution from this acceleration. However, if the vehicle is parked sideways on a bank or incline, the sensor measures some lateral acceleration due to gravity, even though the vehicle is not moving.

Steering Wheel Position Information

The steering wheel position information is sent to the ABS module from the Power Steering Control Module (PSCM) along the HS-CAN bus. The PSCM calculates steering position based on motor position within the Electronic Power Assist Steering (EPAS) steering gear. For information on the PSCM and EPAS system, refer to Section 211-00A .

ABS Module Calibration (Multi-Calibration Routine)

When an ABS fault has been corrected or an ABS component has been replaced, it is necessary to calibrate the ABS module. The calibration procedure is required for the brake-by-wire sensors to learn the "zero-position" of the vehicle which means the vehicle must not be moving and that the brake pedal must not be applied.

To carry out the calibration procedure, connect the scan tool, proceed to the Multi-Calibration routine and follow the scan tool instructions.

ABS Module Configuration

When a new ABS module is installed, it must be configured. To configure the ABS module, refer to Programmable Module Installation (PMI) in Section 418-01 .

Inspection and Verification

NOTE: If a new ABS module is installed, it must be configured and the multi-calibration completed. Follow the scan tool directions.

1. Verify the customer concern.

2. Verify the stoplamps operate correctly by applying and releasing the brake pedal with the ignition switch in the OFF position. If the stoplamps do not operate correctly, refer to Section 417-01 . If the stoplamps operate correctly, proceed to the next step.

3. Verify the PRNDL operates correctly on the instrument cluster. If the PRNDL does not operate correctly, refer to Section 413-01 . If the PRNDL operates correctly, proceed to the next step.

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

Visual Inspection Chart

Mechanical	Electrical
• Active brake booster • Base brake system • Brake pedal assembly • Electric vacuum pump • Hydraulic Control Unit (HCU) • Incorrectly inflated tires • Mismatched wheels or tires on vehicle • Restraints Control Module (RCM) installation • Steering components and suspension components • Wheel speed sensor ring	• ABS module • Battery Junction Box (BJB) fuse(s): ♦ 3 (40A) ♦ 7 (40A) ♦ 8 (50A) ♦ 10 (30A) ♦ 37 (5A) ♦ 47 (10A) • Brake fluid level switch • Electric vacuum pump mechanical relay • Electric vacuum pump solid state relay • PCM relay • RCM • Stoplamp switch • Traction control switch • Wheel speed sensor • Wiring, terminals or connectors

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

8. If the scan tool does not communicate with the vehicle:
   - verify the ignition is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

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

10. **NOTE:** The vehicle must be at a complete standstill and on a level surface while carrying out the self-test. Any movement of the vehicle during the self-test may result in false DTCs being set.

    Carry out the self-test diagnostics for the ABS module.

11. If the DTCs retrieved are related to the concern, go to ABS Module DTC Chart in this section. For all other DTCs, refer to Section 419-10 .

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

DTC Charts

NOTE: This DTC chart applies to hybrid vehicles **only** . For non-hybrid vehicle DTCs, refer to the ABS Module DTC Chart in Anti-Lock Control â Non-Hybrid in this section.

ABS Module DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
C0001:49	TCS Control Channel A Valve 1: Internal Electric Failure [a]	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0001:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C0002:49	TCS [a] Control Channel A Valve 2: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0002:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C0003:49	TCS [a] Control Channel "B" Valve 1: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0003:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C0004:49	TCS [a] Control Channel "B" Valve 2: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0004:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.

C0010:49	Left Front Inlet Control: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0010:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C0011:49	Left Front Outlet Control: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0011:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C0014:49	Right Front Inlet Control: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0014:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C0015:49	Right Front Outlet Control: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0015:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C0018:49	Left Rear Inlet Control: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0018:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C0019:49	Left Rear Outlet Control: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0019:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C001C:49	Right Rear Inlet Control: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C001C:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C001D:49	Right Rear Outlet Control: Internal Electronic Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C001D:49 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C0020:11	ABS Pump Motor Control: Circuit Short To Ground	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0020:11 returns, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C0020:12	ABS Pump Motor Control: Circuit Short To Battery	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C0020:12 returns, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C0020:13	ABS Pump Motor Control: Circuit Open	GO to Pinpoint Test N .

C0020:71	ABS Pump Motor Control: Actuator Stuck	GO to Pinpoint Test N .
C0021:21	Brake Booster Performance: Signal Amplitude	GO to Pinpoint Test Q .
C0021:66	Brake Booster Performance: Signal Has Too Many Transitions/Events	GO to Pinpoint Test Q .
C0021:77	Brake Booster Performance: Commanded Position Not Reachable	GO to Pinpoint Test Q .
C0022:11	Brake Booster Solenoid: Circuit Short To Ground	GO to Pinpoint Test P .
C0022:12	Brake Booster Solenoid: Circuit Short To Battery	GO to Pinpoint Test P .
C0022:13	Brake Booster Solenoid: Circuit Open	GO to Pinpoint Test P .
C0022:14	Brake Booster Solenoid: Circuit Short To Ground or Open	GO to Pinpoint Test P .
C0022:1D	Brake Booster Solenoid: Circuit Current Out of Range	GO to Pinpoint Test P .
C0022:49	Brake Booster Solenoid: Internal Electronic Failure	GO to Pinpoint Test P .
C0030:07	Left Front Tone Wheel: Mechanical Failure	GO to Pinpoint Test S .
C0031:01	Left Front Wheel Speed Sensor: General Electrical Failure	GO to Pinpoint Test R .
C0031:29	Left Front Wheel Speed Sensor: Signal Invalid	GO to Pinpoint Test S .
C0031:2F	Left Front Wheel Speed Sensor: Signal Erratic	GO to Pinpoint Test S .
C0031:64	Left Front Wheel Speed Sensor: Signal Plausibility Failure	GO to Pinpoint Test S .
C0033:07	Right Front Tone Wheel: Mechanical Failure	GO to Pinpoint Test S .
C0034:01	Right Front Wheel Speed Sensor: General Electrical Failure	GO to Pinpoint Test R .
C0034:29	Right Front Wheel Speed Sensor: Signal Invalid	GO to Pinpoint Test S .
C0034:2F	Right Front Wheel Speed Sensor: Signal Erratic	GO to Pinpoint Test S .
C0034:64	Right Front Wheel Speed Sensor: Signal Plausibility Failure	GO to Pinpoint Test S .
C0036:07	Left Rear Tone Wheel: Mechanical Failure	GO to Pinpoint Test S .

C0037:01	Left Rear Wheel Speed Sensor: General Electrical Failure	GO to Pinpoint Test R .
C0037:29	Left Rear Wheel Speed Sensor: Signal Invalid	GO to Pinpoint Test S .
C0037:2F	Left Rear Wheel Speed Sensor: Signal Erratic	GO to Pinpoint Test S .
C0037:64	Left Rear Wheel Speed Sensor: Signal Plausibility Failure	GO to Pinpoint Test S .
C0039:07	Right Rear Tone Wheel: Mechanical Failure	GO to Pinpoint Test S .
C003A:01	Right Rear Wheel Speed Sensor: General Electrical Failure	GO to Pinpoint Test R .
C003A:29	Right Rear Wheel Speed Sensor: Signal Invalid	GO to Pinpoint Test S .
C003A:2F	Right Rear Wheel Speed Sensor: Signal Erratic	GO to Pinpoint Test S .
C003A:64	Right Rear Wheel Speed Sensor: Signal Plausibility Failure	GO to Pinpoint Test S .
C0044:28	Brake Pressure Sensor "A": Signal Bias Level Out of Range/Zero Adjustment Failure	This DTC is set if the brake pressure sensor signals do not match. This fault could set by either an internal ABS module failure or a pressure sensor failure. The pressure sensors are internal to the HCU and cannot be serviced separately. CLEAR the DTCs. REPEAT the self-test. If DTC C0044:28 returns, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test. If C0044:28 returns again, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C0044:49	Brake Pressure Sensor "A": Internal Electronic Failure	This DTC is set if the brake pressure sensor signals do not match. This fault could set by either an internal ABS module failure or a pressure sensor failure. The pressure sensors are internal to the HCU and cannot be serviced separately. CLEAR the DTCs. REPEAT the self-test. If DTC C0044:49 returns, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test.

		If C0044:49 returns again, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C0044:64	Brake Pressure Sensor "A": Signal Plausibility Failure	This DTC is set if the brake pressure sensor signals do not match. This fault could set by either an internal ABS module failure or a pressure sensor failure. The pressure sensors are internal to the HCU and cannot be serviced separately. CLEAR the DTCs. REPEAT the self-test. If DTC C0044:64 returns, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test. If C0044:64 returns again, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C0048:11	Brake Booster Travel Sensor: Circuit Short To Ground	GO to Pinpoint Test T .
C0048:12	Brake Booster Travel Sensor: Circuit Short To Battery	GO to Pinpoint Test T .
C0048:64	Brake Booster Travel Sensor: Signal Plausibility Failure	**NOTE:** This DTC can set as a result of a booster travel sensor circuit fault or a circuit fault with other brake system components. GO to Pinpoint Test T .
C0061:28	Lateral Acceleration Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	GO to Pinpoint Test Y .
C0061:64	Lateral Acceleration Sensor: Signal Plausibility Failure	GO to Pinpoint Test Y .
C0063:28	Yaw Rate Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	GO to Pinpoint Test Y .
C0063:64	Yaw Rate Sensor: Signal Plausibility Failure	GO to Pinpoint Test Y .
C100A:28	Brake Pedal Angle Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	This DTC indicates the brake pedal cannot return to the fully released position. INSTALL a new brake pedal and bracket. REFER to Brake Pedal and Bracket â Hybrid in Section 206-06 .
C100A:41	Brake Pedal Angle Sensor: General Checksum Failure	This DTC indicates that part of the ABS module has failed internally. CLEAR the DTCs. REPEAT the self-test. If DTC C100A:41 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C100A:62	Brake Pedal Angle Sensor: Signal Compare Failure	GO to Pinpoint Test U .
C100A:64	Brake Pedal Angle Sensor: Signal Plausibility Failure	This DTC can set due to a brake pedal angle sensor, brake pedal feel simulator cut-off pressure sensor or brake pedal feel simulator cut-off valve solenoid fault or a mechanical fault with the brake

		pedal assembly. CORRECT all other DTCs for the brake pedal angle sensor and brake pedal feel simulator first. If only DTC C100A:64 is present, INSTALL a new brake pedal assembly. REFER to Brake Pedal and Bracket â Hybrid in Section 206-06 .
C100D:21	Brake Pedal Angle Sensor Circuit 1: Signal Amplitude â © Minimum	GO to Pinpoint Test U .
C100D:22	Brake Pedal Angle Sensor Circuit 1: Signal Amplitude > Maximum	GO to Pinpoint Test U .
C100E:21	Brake Pedal Angle Sensor Circuit 2: Signal Amplitude â © Minimum	GO to Pinpoint Test U .
C100E:22	Brake Pedal Angle Sensor Circuit 2: Signal Amplitude > Maximum	GO to Pinpoint Test U .
C100F:11	Brake Pedal Angle Sensor Supply: Circuit Short To Ground	GO to Pinpoint Test U .
C100F:12	Brake Pedal Angle Sensor Supply: Circuit Short To Battery	GO to Pinpoint Test U .
C1011:1C	Brake Pedal Feel Simulator Cut-Off Pressure Sensor: Circuit Voltage Out of Range	GO to Pinpoint Test V .
C1011:1F	Brake Pedal Feel Simulator Cut-Off Pressure Sensor: Circuit Intermittent	GO to Pinpoint Test V .
C1011:67	Brake Pedal Feel Simulator Cut-Off Pressure Sensor: Signal Incorrect After Event	GO to Pinpoint Test V .
C1012:01	Brake Pedal Feel Simulator Cut-Off Valve Solenoid: General Electrical Failure	GO to Pinpoint Test V .
C1014:07	Brake System Total Volume Balance: Mechanical Failure	This DTC can set as a result of a brake booster travel sensor fault, a brake fluid pressure sensor fault or air trapped in the hydraulic brake system. CORRECT all DTCs that indicate a brake booster travel sensor fault or a hydraulic brake pressure sensor fault. If only DTC C1014:07 is present, CARRY OUT the Brake System Service Bleed, REFER to Brake System Bleeding in Section 206-00 . CLEAR the DTCs, REPEAT the self-test. If DTC C1014:07 returns, INSTALL a new brake booster. REFER to Brake Booster in Section 206-07 . CLEAR the DTCs. REPEAT the self-test. If DTC C1014:07 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. REPEAT the self-test.

		If DTC C1014:07 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1015:64	Vacuum Supply: Signal Plausibility Failure	This DTC sets if the ABS module detects a vacuum leak. If other DTCs are present for the vacuum pump, vacuum pressure sensor or booster travel sensor, DIAGNOSE them first. If only DTC C1015:64 is present, INSPECT the vacuum hoses, lines and fittings for vacuum leaks. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. If DTC C1015:64 returns, INSTALL a new vacuum pump. REFER to Brake Vacuum Pump in Section 206-07 .
C1015:7A	Vacuum Supply: Fluid Leak or Seal Failure	This DTC sets if the ABS module detects a vacuum leak. CARRY OUT the brake booster component test. REFER to Section 206-00 . INSTALL new as necessary. CLEAR the DTCs. REPEAT the self-test.
C1015:7B	Vacuum Supply: Low Fluid Level	This DTC sets if the ABS module detects a vacuum leak. If other DTCs are present for the vacuum pump, vacuum pressure sensor or booster travel sensor, DIAGNOSE them first. If only DTC C1015:7B is present, INSPECT the vacuum hoses, lines and fittings for vacuum leaks. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. If DTC C1015:7B returns, INSTALL a new vacuum pump. REFER to Brake Vacuum Pump in Section 206-07 .
C1018:00	Regenerative Braking: No Sub Type Information	This DTC can set as a result of missing network messages or invalid data from the PCM over the High Speed Controller Area Network (HS-CAN) bus. RETRIEVE the DTCs from the PCM. REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .
C1018:46	Regenerative Braking: Calibration/Parameter Memory Failure	Using the scan tool, CARRY OUT the Multi-Calibration routine. Follow the scan tool instructions. CLEAR the DTCs. REPEAT the self-test.
C1018:62	Regenerative Braking: Signal Compare Failure	This DTC indicates that the PCM cannot provide the amount of brake torque that the ABS module is requesting. RETRIEVE the DTCs from the PCM. REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .
C101A:1C	Vacuum Pressure Sensor: Circuit Voltage Out of Range	GO to Pinpoint Test W .
C101A:62	Vacuum Pressure Sensor: Signal Compare Failure	GO to Pinpoint Test W .
C101A:64	Vacuum Pressure Sensor: Signal Plausibility Failure	GO to Pinpoint Test W .
C101B:1C	Vacuum Pressure Sensor Circuit B: Circuit Voltage Out of Range	GO to Pinpoint Test W .
C101C:01	Brake Vacuum Pump: General Electrical Failure	GO to Pinpoint Test X .

C101C:71	Brake Vacuum Pump: Actuator Stuck	GO to Pinpoint Test X .
C1021:21	ABS Booster Control Pressure: Signal Amplitude â © Minimum	This DTC indicates that other DTCs are present for the brake pedal angle sensor, the vacuum pressure sensor or a brake (fluid) pressure sensor. If DTCs for one or more of these components is present, DIAGNOSE them first. CLEAR the DTCs. REPEAT the self-test. If only DTC C1021:21 is present, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR all DTCs. REPEAT the self-test. If DTC C1021:21 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1021:22	ABS Booster Control Pressure: Signal Amplitude > Maximum	This DTC indicates that other DTCs are present for the brake pedal angle sensor, the vacuum pressure sensor or a brake (fluid) pressure sensor. If other DTCs are present for the brake pedal angle sensor, the vacuum pressure sensor or a brake (fluid) pressure sensor, DIAGNOSE them first. CLEAR the DTCs. REPEAT the self-test. If only DTC C1021:22 is present, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
C1025:21	Brake Primary Circuit Overboost Pressure: Signal Amplitude â © Minimum	INSPECT the brake system for brake fluid leaks. REPAIR as necessary. If no leaks are found, CARRY OUT the Brake System Service Bleed, REFER to Brake System Bleeding in Section 206-00 . CLEAR the DTCs, REPEAT the self-test. If DTC C1025:21 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test. If C1025:21 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1025:22	Brake Primary Circuit Overboost Pressure: Signal Amplitude > Maximum	INSPECT the brake system for brake fluid leaks. REPAIR as necessary. If no leaks are found, CARRY OUT the Brake System Service Bleed, REFER to Brake System Bleeding in Section 206-00 . CLEAR the DTCs, REPEAT the self-test. If DTC C1025:22 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test. If C1025:22 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1026:21	ABS Secondary Circuit Overboost Pressure: Signal Amplitude â © Minimum	INSPECT the brake system for brake fluid leaks. REPAIR as necessary. If no leaks are found, CARRY OUT the Brake System Service Bleed, REFER to Brake System Bleeding in Section 206-00 . CLEAR the DTCs, REPEAT the self-test.

		If DTC C1026:21 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test. If C1026:21 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1026:22	ABS Secondary Circuit Overboost Pressure: Signal Amplitude > Maximum	INSPECT the brake system for brake fluid leaks. REPAIR as necessary. If no leaks are found, CARRY OUT the Brake System Service Bleed, REFER to Brake System Bleeding in Section 206-00 . CLEAR the DTCs, REPEAT the self-test. If DTC C1026:22 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test. If C1026:22 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1027:62	Master Cylinder (MC) to Primary Circuit Pressure: Signal Amplitude > Maximum	INSPECT the brake system for brake fluid leaks. REPAIR as necessary. If no leaks are found, CARRY OUT the Brake System Service Bleed, REFER to Brake System Bleeding in Section 206-00 . CLEAR the DTCs, REPEAT the self-test. If DTC C1027:62 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test. If C1027:62 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1028:62	ABS Primary Circuit Wheel Pressure: Signal Compare Failure	INSPECT the brake system for brake fluid leaks. REPAIR as necessary. If no leaks are found, CARRY OUT the Brake System Service Bleed, REFER to Brake System Bleeding in Section 206-00 . CLEAR the DTCs, REPEAT the self-test. If DTC C1028:62 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test. If C1028:62 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1029:00	ABS Primary Circuit Pressure Lower Than Secondary: No Sub Type Information	GO to Pinpoint Test AC
C102A:62	Brake Secondary Circuit Pressure Mismatch Between Wheels: Signal Compare Failure	INSPECT the brake system for brake fluid leaks. REPAIR as necessary. If no leaks are found, CARRY OUT the Brake System Service Bleed, REFER to Brake System Bleeding in Section 206-00 . CLEAR the DTCs, REPEAT the self-test. If DTC C102A:62 returns, INSTALL a new ABS module. REFER

		to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test. If C102A:62 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C102B:00	ABS Secondary Circuit Pressure Lower Than Primary: No Sub Type Information	GO to Pinpoint Test AC
C1108:11	Pedal Sensor(s) Supply Voltage: Circuit Short To Ground	GO to Pinpoint Test T .
C1108:12	Pedal Sensor(s) Supply Voltage: Circuit Short To Battery	GO to Pinpoint Test T .
C1108:1C	Pedal Sensor(s) Supply Voltage: Circuit Voltage Out of Range	GO to Pinpoint Test T .
C1133:28	Left Front Brake Pressure Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1133:28 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1133:49	Left Front Brake Pressure Sensor: Internal Electronic Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1133:49 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1133:64	Left Front Brake Pressure Sensor: Signal Plausibility Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1133:64 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1134:28	Right Front Brake Pressure Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1134:28 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1134:49	Right Front Brake Pressure Sensor: Internal Electronic Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1134:49 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications,

		INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1134:64	Right Front Brake Pressure Sensor: Signal Plausibility Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1134:64 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1135:28	Left Rear Brake Pressure Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1135:28 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1135:49	Left Rear Brake Pressure Sensor: Internal Electronic Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1135:49 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1135:64	Left Rear Brake Pressure Sensor: Signal Plausibility Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1135:64 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1136:28	Right Rear Brake Pressure Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1136:28 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1136:49	Right Rear Brake Pressure Sensor: Internal Electronic Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1136:49 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1136:64	Right Rear Brake Pressure Sensor: Signal Plausibility Failure	CLEAR the DTCs. REPEAT the self-test. If DTC C1136:64 is present, make sure all ABS module-to- HCU fasteners are tightened to their correct torque specifications. If all fasteners are tightened to their correct torque specifications, INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1A99:28		

	Pressure Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	This DTC is set if the brake pressure sensor signals do not match. This fault could set by either an internal ABS module failure or a pressure sensor failure. The pressure sensors are internal to the Hydraulic Control Unit (HCU) and cannot be serviced separately. If all fasteners are tightened to their correct torque specifications, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTCs. TEST DRIVE the vehicle. REPEAT the self-test. If C1A99:28 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section.
C1B00:28	Steering Angle Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	**NOTE:** The Electronic Power Assist Steering (EPAS) gear assembly contains the steering wheel angle sensor. The sensor is not serviceable separately from the assembly. The ABS module receives the steering wheel angle sensor information from the Power Steering Control Module (PSCM) over the HS-CAN bus. The cause of this DTC is indicated by a DTC in the PSCM . CARRY OUT a self-test of the PSCM . REFER to Diagnosis and Testing in Section 211-00A to diagnose the DTCs retrieved.
C1B00:29	Steering Angle Sensor: Signal Invalid	**NOTE:** The EPAS gear assembly contains the steering wheel angle sensor. The sensor is not serviceable separately from the assembly. The ABS module receives the steering wheel angle sensor information from the PSCM over the HS-CAN bus. The cause of this DTC is indicated by a DTC in the PSCM . CARRY OUT a self-test of the PSCM . REFER to Diagnosis and Testing in Section 211-00A to diagnose the DTCs retrieved.
C1B00:64	Steering Angle Sensor: Signal Plausibility Failure	**NOTE:** The EPAS gear assembly contains the steering wheel angle sensor. The sensor is not serviceable separately from the assembly. The ABS module receives the steering wheel angle sensor information from the PSCM over the HS-CAN bus. The cause of this DTC is indicated by a DTC in the PSCM . CARRY OUT a self-test of the PSCM . REFER to Diagnosis and Testing in Section 211-00A to diagnose the DTCs retrieved.
C1B00:86	Steering Angle Sensor: Signal Invalid	**NOTE:** The EPAS gear assembly contains the steering wheel angle sensor. The sensor is not serviceable separately from the assembly. The ABS module receives the steering wheel angle sensor information from the PSCM over the HS-CAN bus. The cause of this DTC is indicated by a DTC in the PSCM . CARRY OUT a self-test of the PSCM . REFER to Diagnosis and Testing in Section 211-00A to diagnose the DTCs retrieved.
P0561:1C		

	System Voltage Unstable: Circuit Voltage Out Of Range	The ABS module receives low voltage system information from the DC to DC Converter Control Module (DC/DC) over the HS-CAN bus. If the message the ABS module receives indicates that system voltage has dropped below 9 volts or has risen above 16 volts, DTC P0561:1C sets. CARRY OUT a self-test of the DC/DC converter. REFER to Diagnosis and Testing in Section 414-05 to diagnose the DTCs retrieved.
U0001:88	High Speed Controller Area Network (HS-CAN) Communication Bus: Bus Off	REFER to Section 418-00 to diagnose the network communication concern.
U0100:00	Lost Communication With ECM /PCM "A": No Sub Type Information	REFER to Section 418-00 to diagnose the network communication concern.
U0131:87	Lost Communication With Power Steering Control Module: Missing Message	This DTC can set due to a fault in the EPAS system or because the PSCM is unable to communicate over the HS-CAN bus. CARRY OUT a self-test of the PSCM . If the scan tool indicates that the PSCM is not responding, REFER to Section 418-00 to diagnose the network communication concern. If PSCM DTCs are present, REFER to Section 211-00A to diagnose the EPAS system fault.
U0151:87	Lost Communication With Restraints Control Module (RCM): Missing Message	GO to Pinpoint Test Y .
U0151:88	Lost Communication With RCM : Bus off	GO to Pinpoint Test Y .
U0155:87	Lost Communication With Instrument Panel Cluster (IPC) Control Module: Missing Message	This DTC can set due to an IPC fault or because the IPC is unable to communicate over the HS-CAN bus. CARRY OUT a self-test of the IPC . If the scan tool indicates that the IPC is not responding, REFER to Section 418-00 to diagnose the network communication concern. If IPC DTCs are present, REFER to Section 413-01 to diagnose the IPC fault.
U0298:87	Lost Communication With DC to DC Converter Control Module (DC/DC) "A": Missing Message	This DTC can set due to a DC/DC fault or because the DC/DC is unable to communicate over the HS-CAN bus. CARRY OUT a self-test of the DC/DC . If the scan tool indicates that the module is not responding, REFER to Section 418-00 to diagnose the network communication concern. If DTCs are present in the DC/DC , REFER to Section 414-05 to diagnose the module fault.
U0300:51	Internal Control Module Software Incompatibility: Not Programmed	CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) in Section 418-01 . REPEAT the self-test.

		If U0300:51 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
U0401:00	Invalid Data Received From ECM /PCM "A": No Sub Type Information	The PCM sends an "invalid data" message to the ABS module if there are DTCs in the PCM that prevent known good data from being sent. RETRIEVE the DTCs from the PCM. REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 to diagnose the powertrain fault.
U0420:87	Invalid Data Received From Power Steering Control Module: Missing Message	This DTC can set due to a fault in the EPAS system or because the PSCM is unable to communicate over the HS-CAN bus. CARRY OUT a self-test of the PSCM . If the scan tool indicates that the PSCM is not responding, REFER to Section 418-00 to diagnose the network communication concern. If PSCM DTCs are present, REFER to Section 211-00A to diagnose the EPAS system fault.
U0423:64	Invalid Data Received From Instrument Panel Control Module: Signal Plausibility Failure	This DTC indicates that the ABS module has not received network messages from the IPC . This DTC can set due to an IPC fault or because the IPC is unable to communicate over the HS-CAN bus. CARRY OUT a self-test of the IPC . If the scan tool indicates that the IPC is not responding, REFER to Section 418-00 to diagnose the network communication concern. If IPC DTCs are present, REFER to Section 413-01 to diagnose the IPC fault.
U0452:29	Invalid Data Received From Restraints Control Module (RCM): Signal Invalid	GO to Pinpoint Test Y .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) in Section 418-01 . REPEAT the self-test. If U2100:00 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
U2100:41	Initial Configuration Not Complete: General Checksum Failure	CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) in Section 418-01 . REPEAT the self-test. If U2100:41 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
U2100:56	Initial Configuration Not Complete: Invalid/Incompatible Configuration	CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) in Section 418-01 . REPEAT the self-test. If U2100:56 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
U3000:41	Control Module: General Checksum Failure	CORRECT all other DTCs prior to addressing DTC U3000:41. If only DTC U3000:41 was retrieved from the ABS module,

		INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
U3000:43	Control Module: Special Memory Failure	CLEAR the DTCs. REPEAT the self-test. If U3000:43 is returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
U3000:47	Control Module: Watchdog/Safety WC Failure	This DTC can set if the ABS module electrical connector is not fully seated and locked. DISCONNECT the ABS module C135. INSPECT the connector for bent or loose pins. REPAIR as necessary. If OK, RECONNECT C135. CLEAR the DTCs. REPEAT the self-test. If DTC U3000:47 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
U3000:49	Control Module: Internal Electronic Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:49 is present, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
U3000:4B	Control Module: Over Temperature	This DTC is set if the signal from the temperature sensor internal to the ABS module is out of range or is implausible when compared to the temperature sensors inside the HCU . CLEAR the DTCs. REPEAT the self-test. If DTC U3000:4B is present, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section.
U3002:62	Vehicle Identification Number: Signal Compare Failure	**NOTE:** This DTC can set as if the ABS module cannot communicate with the PCM. Correct any network communications DTCs prior to diagnosing DTC U3002:62. GO to Pinpoint Test Z .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test O .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test O .

[a] Traction Control System

Instrument Panel Cluster (IPC) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Source	Action
C0089:11	TCS Disable Switch: Circuit Short to Ground [a]	Instrument Panel Cluster (IPC)	GO to Pinpoint Test AA .
â	All Other IPC DTCs	IPC	REFER to the Master DTC Chart in Section 419-10 .

[a] Traction Control System

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test N: DTCs C0020:13 and 71

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The ABS module uses an internal solid state switch to operate the ABS pump motor. When the engine speed is above 700 rpm or the vehicle speed is at approximately 7 km/h (4 mph), the ABS module tests the ABS pump motor by activating it for 30 milliseconds. While the pump motor is being activated, the ABS module monitors the voltage drop across the ABS pump motor solid state switch and the amount of current the ABS pump motor draws through the solid state switch. If the voltage drop is too high or if the ABS pump motor is drawing too much current, the ABS module sets a DTC. After 30 milliseconds have passed, the ABS module stops applying voltage to the pump motor and observe the voltage that the spinning ABS pump motor is generating. The voltage generated by the motor indicates how fast the motor is spinning. A voltage that is too low indicates that the motor is not spinning freely and a DTC sets.

- DTC C0020:13 (ABS Pump Motor Control: Circuit Open) â If the voltage supplied to the ABS module is less than 10 volts, if there is an open or high resistance on the ABS pump motor circuit between the ABS module and the Hydraulic Control Unit (HCU), or if the ABS module is faulted internally, this DTC sets.
- DTC C0020:71 (ABS Pump Motor Control: Circuit Actuator Stuck) â If the ABS module detects that the ABS pump motor is not rotating, when it is commanded to run, this DTC sets.

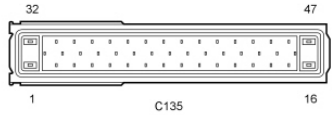
This pinpoint test is intended to diagnose the following:

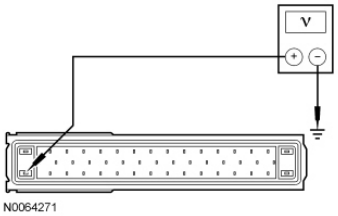
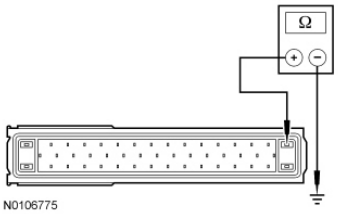
- Fuse(s)
- Wiring, terminals or connectors
- HCU
- ABS module

PINPOINT TEST N: DTCs C0020:13 AND 71

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
N1 VERIFY ALL WIRING CONNECTIONS	

• Disconnect: ABS Module C135 . • Using a good light source, inspect each connector terminal for any corrosion. • Inspect both connectors for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C135-1 ♦ C135-47  N0108946 • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	**Yes** GO to N2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.
N2 CHECK THE PUMP MOTOR (PMP_MTR) ACTIVE COMMAND	
• Connect: ABS Module C135 . • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger â ABS Module . • Toggle the PMP_MTR active command ON. • **Does the ABS pump motor run for approximately 4 seconds?**	**Yes** TOGGLE the PMP_MTR active command OFF. CLEAR the DTCs. DRIVE the vehicle at speeds greater than 20 km/h (12 mph). RETRIEVE the DTCs. If DTCs C0020:13 or 71 are retrieved, GO to N5 . For all other ABS module DTCs, GO to the ABS Module DTC Chart in this section. **No** TOGGLE the ABS module PMP_MTR active command OFF. GO to N3 .
N3 CHECK THE PUMP MOTOR VOLTAGE SUPPLY TO THE ABS MODULE	
• Ignition OFF. • Disconnect: ABS Module C135 . • Ignition ON. • Measure the voltage between ABS module C135-1, circuit SBB08 (VT/RD), harness side and ground.	**Yes** GO to N4 . **No** VERIFY that BJB fuse 8 (50A) is OK. If OK, REPAIR circuit SBB08 (VT/RD). If the fuse is not OK, REFER to the Wiring Diagrams manual to identify the cause of the circuit short.

 N0064271 • **Is the voltage greater than 10 volts?**	CLEAR the DTCs and REPEAT the self-test.
N4 CHECK THE ABS MODULE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between ABS module C135-47, circuit GD121 (BK/YE), harness side and ground.  N0106775 • **Is the resistance less than 5 ohms?**	**Yes** GO to N5 . **No** REPAIR circuit GD121 (BK/YE). CLEAR the DTCs. REPEAT the self-test.
N5 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect: ABS Module C135 . • Check for: ♦ corrosion ♦ pushed-out pins ♦ spread terminals • Connect: ABS Module C135 . • Make sure the connector is seated correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HCU and ABS module. REFER to Hydraulic Control Unit (HCU) â Hybrid in this section. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test O: DTCs U3003:16 and 17

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The voltage required for correct ABS operation is between 10 and 17.8 volts. Fused battery voltage is supplied to the ABS module from the Battery Junction Box (BJB), BJB). Fused ignition voltage is supplied to the ABS module from the BJB .

- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) â If the voltage is below 10 volts, this DTC sets.

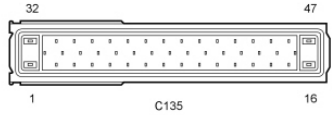
- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) â If the voltage is above 17 volts, this DTC sets.

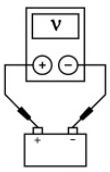
This pinpoint test is intended to diagnose the following:
- Fuses
- Wiring, terminals or connectors
- ABS module

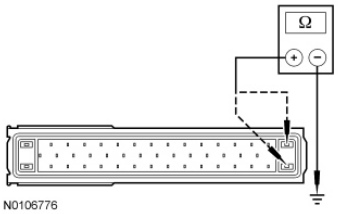
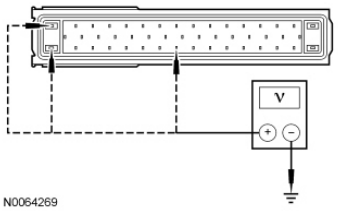
PINPOINT TEST O: DTCs U3003:16 AND 17

NOTE: DTCs U3003:16 and 17 can set if the vehicle has been recently jump started, the 12-volt battery has been recently charged or the 12-volt battery has been discharged. The 12-volt battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

Test Step	Result / Action to Take
O1 VERIFY ALL WIRING CONNECTIONS	
• Disconnect: ABS Module C135 . • Using a good light source, inspect each connector terminal for any corrosion. • Inspect both connectors for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C135-1 ♦ C135-8 ♦ C135-16 ♦ C135-32 ♦ C135-47  N0108946 • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	**Yes** GO to O2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.

O2 RETRIEVE ALL CMDTCs IN ALL MODULES	
• Connect: ABS Module C135 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test â All CMDTCs . • **Is DTC U3003:16 or 17, DTCs B1317, B1318 and/or B1676 present in one or more modules AND DTC P0563, P0620, P0625, P0626 or P065B present in the PCM?**	**Yes** REFER to Section 414-05 for diagnosis of the battery and charging system. **No** GO to O3 .
O3 CHECK BATTERY CONDITION	
• Ignition OFF. • Refer to Section 414-01 and carry out the Battery â Condition Test. • **Does the battery pass the condition test?**	**Yes** If the battery passed the condition test but required a recharge, REFER to Section 414-00 to diagnose the charging system. CLEAR all Continuous Memory Diagnostic Trouble Codes (CMDTCs). TEST the system for normal operation. If the battery passed the condition test and did not require a recharge, GO to O4 . **No** INSTALL a new battery. CLEAR all CMDTCs . TEST the system for normal operation.
O4 CHECK CHARGING SYSTEM VOLTAGE	
• Start the vehicle, verify that the ready indicator is illuminated. • Measure the voltage of the battery with and without a load on the charging system as follows: ♦ Turn off all accessories and measure battery voltage. ♦ Turn on headlights and HVAC fan on high and measure battery voltage.  AJ0210-A • **Are the voltages between 13 and 15.2 volts?**	**Yes** GO to O5 . **No** REFER to Section 414-05 to diagnose the charging system. CLEAR all CMDTCs . TEST the system for normal operation.
O5 CHECK THE ABS MODULE GROUND CIRCUIT FOR AN OPEN	

• Ignition OFF. • Disconnect: ABS Module C135 . • Measure the resistance between ground and: ♦ ABS module C135-16, circuit GD121 (BK/YE), harness side. ♦ ABS module C135-47, circuit GD121 (BK/YE), harness side. ♦ Repeat this measurement while wiggling the harness.  N0106776 • **Is the resistance less than 5 ohms?**	**Yes** GO to O6 . **No** REPAIR circuit GD121 (BK/YE). CLEAR all CMDTCs . REPEAT the self-test.
O6 CHECK FOR VOLTAGE AT THE ABS MODULE	
• Ignition ON. • Measure the voltage between ground and: ♦ ABS module C135-1, SBB08 (VT/RD), harness side. ♦ ABS module C135-8, CBK03 (GY), harness side. ♦ ABS module C135-32, SBB10 (YE/RD), harness side.  N0064269 • **Are the voltages greater than 10 volts?**	**Yes** GO to O7 . **No** VERIFY that BJB fuses 8 (50A), 10 (30A) and 47 (10A) are OK. If OK, REPAIR the affected circuit(s). If the fuses are not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs and REPEAT the self-test.
O7 CHECK FOR CORRECT ABS MODULE OPERATION	
• Ignition OFF. • Disconnect: ABS Module C135 . • Check for: ♦ corrosion ♦ pushed-out pins ♦ spread terminals • Connect: ABS Module C135 . • Make sure the connector seats correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test P: DTCs C0022:11, 12, 13, 14, 1D and 49

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The brake booster solenoid is internal to the brake booster. During normal braking, the ABS module applies a Pulse Width Modulated (PWM) voltage to the brake booster solenoid. The ABS module provides ground to the solenoid along circuit VCA22 (GN/BN). The ABS module constantly checks the integrity of the booster solenoid and circuits. If a booster solenoid fault is detected, the brake system transitions from brake-by-wire mode to conventional friction braking. Other DTCs for brake booster performance may set as a result of a brake booster solenoid circuit fault. The brake booster solenoid cannot be serviced separately from the brake booster. If a new brake booster solenoid is needed, a new brake booster must be installed.

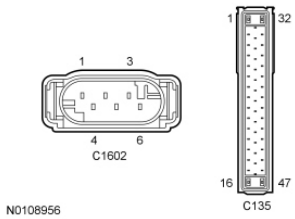
DTC Description	Fault Trigger Conditions
• C0022:11 â Brake Booster Solenoid: Circuit Short to Ground	If the ABS module detects a short to ground on either circuit, this DTC sets.
• C0022:12 â Brake Booster Solenoid: Circuit Short to Battery	If the ABS module detects a short to voltage on either circuit, this DTC sets.
• C0022:13 â Brake Booster Solenoid: Circuit Open	If the ABS module detects an open or high resistance on either circuit, this DTC sets.
• C0022:14 â Brake Booster Solenoid: Circuit Short to Ground or Open	If the ABS module detects a short to ground, open or high resistance on either circuit or the solenoid, this DTC sets.
• C0022:1D â Brake Booster Solenoid: Circuit Current Out of Range	If the ABS module detects a short to ground, open or high resistance on either circuit , the solenoid or if the ABS module is faulted internally, this DTC sets.
• C0022:49 â Brake Booster Solenoid: Internal Electronic Failure	If the ABS module detects a short to ground on either circuit, the solenoid or if the ABS module is faulted internally, this DTC sets.

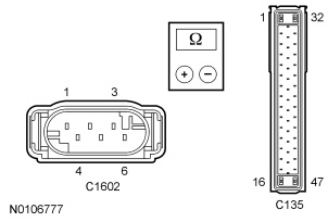
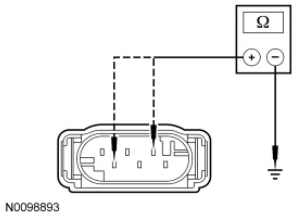
This pinpoint test is intended to diagnose the following:

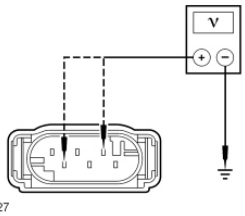
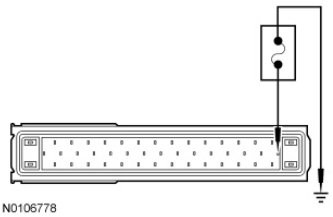
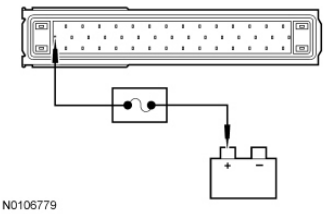
- Wiring, terminals or connectors
- Brake booster
- ABS module

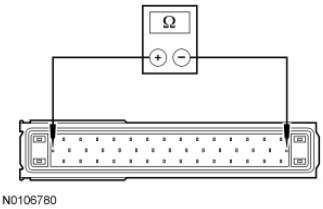
PINPOINT TEST P: DTCs C0022:11, 12, 13, 14, 1D and 49

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
P1 VERIFY ALL WIRING CONNECTIONS	
• Disconnect: ABS Module C135 . • Disconnect: Brake Booster C1602 . • Using a good light source, inspect each connector terminal for any corrosion. • Inspect both connectors for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C135-17 ♦ C135-31 ♦ C1602-3 ♦ C1602-4  • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	**Yes** GO to P2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.
P2 REVIEW THE DTCs FROM THE ABS MODULE SELF-TEST	
• Review the DTCs retrieved and recorded during Inspection and Verification. • **Is DTC C0022:13, C0022:14 or C0022:1D present?**	**Yes** GO to P3 . **No** If DTC C0022:11 or C0022:49 were retrieved from the self-test, GO to P4 . If DTC C0022:12 was retrieved from the self-test, GO to P5 .
P3 CHECK THE BRAKE BOOSTER SOLENOID CIRCUITS FOR AN OPEN	

• Ignition OFF. • Measure the resistance between ABS module C135 harness side, and brake booster solenoid C1602 harness side as indicated in the following chart: | ABS Module	Circuit	Brake Booster Solenoid | |---|---|---| | C135-17 | CCA22 (GY/YE) | C1602-3 | | C135-31 | VCA22 (GN/BN) | C1602-4 |  • **Are the resistances less than 5 ohms?**	**Yes** If DTC C0022:14 or C0022:1D was retrieved from the self-test, GO to P4 . If DTC C0022:13 was retrieved from the self-test, GO to P6 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
P4 CHECK THE BRAKE BOOSTER SOLENOID CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between ground and: ♦ brake booster solenoid C1602-3, circuit CCA22 (GY/YE), harness side. ♦ brake booster solenoid C1602-4, circuit VCA22 (GN/BN), harness side.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to P6 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
P5 CHECK THE BRAKE BOOSTER SOLENOID CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between ground and: ♦ brake booster solenoid C1602-3, circuit CCA22 (GY/YE), harness side. ♦ brake booster solenoid C1602-4, circuit VCA22 (GN/BN), harness side.	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. **No** GO to P6 .

 N0098927 • **Is any voltage present?**	
P6 CHECK THE BRAKE BOOSTER SOLENOID FOR CORRECT OPERATION	
• Ignition OFF. • Connect: Brake Booster C1602 . • Connect: ABS Module C135 . • Ignition ON. • Start then engine. • Apply and release the brake pedal. • Allow the engine to run for 10 to 15 seconds in order to build vacuum in the brake booster. • Ignition OFF. • Disconnect: ABS Module C135 . • Connect a fused jumper wire between ABS module C135-31, circuit VCA22 (GN/BN), harness side and ground.  N0106778 • While observing the clevis on the brake booster push rod for movement, **momentarily** connect a fused jumper wire between ABS module C135-17, circuit CCA22 (GY/YE), harness side and the battery positive post.  N0106779 • **Does the brake pedal move?**	**Yes** GO to P8 . **No** GO to P7 .
P7 CHECK THE BRAKE BOOSTER SOLENOID	

• Disconnect: All fused jumper wires . • Measure the resistance between ABS module C135-17, circuit CCA22 (GY/YE), harness side and ABS module C135-31, circuit VCA22 (GN/BN), harness side.  N0106780 • **Is the resistance between 1 and 3 ohms?**	**Yes** GO to P8 . **No** INSTALL a new brake booster. REFER to Brake Booster in Section 206-07 . CLEAR the DTCs. REPEAT the self-test.
P8 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect: All Fused Jumper Wires (if not previously disconnected) . • Check for: ♦ corrosion ♦ pushed-out pins ♦ spread terminals • Connect: ABS Module C135 . • Make sure the connector seats correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test Q: DTCs C0021:21, 66 and 77

Normal Operation

The ABS module measures the amount of hydraulic brake pressure generated every time the brakes are applied. The ABS module tests the brake booster every key cycle by operating the brake booster independently of brake pedal input and measuring the hydraulic brake pressure generated. The ABS module utilizes input from the brake pedal angle sensor, brake booster travel sensor, the brake pressure sensors internal to the Hydraulic Control Unit (HCU) and the vacuum pressure sensor to determine if the required amount of hydraulic brake pressure is being generated. If the ABS module detects that the brake booster is not able to build adequate hydraulic brake pressure in the master cylinder, the brake system transitions from brake-by-wire mode into low temperature conventional mode. While in low temperature conventional mode, the ABS module continues to test the brake booster. If the brake booster begins to generate the expected amount of pressure in hydraulic system, the brake system recovers into brake-by-wire mode. If the brake system has to transition from brake-by-wire mode to low temperature conventional mode 3 times in the same ignition cycle because of a brake booster performance fault, the brake system downgrades to conventional brake pedal operation for the rest of the ignition cycle.

- DTC C0021:21 (Brake Booster Performance: Signal Amplitude â © Minimum) â This DTC is for information only and does not cause any indicators to illuminate. However, other DTCs that cause DTC C0021:21 to set may cause indicators to illuminate. If the red brake warning indicator is illuminated, diagnose all other DTCs before diagnosing DTC C0021:21. Otherwise, disregard DTC C0021:21.

- ♦ If the brake booster is not able to build adequate hydraulic brake pressure when the brakes are applied either through input from the driver or when the ABS module checks the brake booster, DTC C0021:21 sets. In most cases DTC C0021:21 sets if the vehicle was started in low ambient temperatures or as a result of low ambient temperatures causing slow booster reaction time. This DTC set as a result of other brake booster, brake pedal angle sensor, hydraulic brake pressure sensors or vacuum pressure sensor DTCs being set.

- DTC C0021:66 (Brake Booster Performance: Signal Has Too Many Transitions) â This DTC indicates that the regenerative brake system has switched from brake-by-wire mode to low temperature conventional mode 3 times due to the cause of DTC C0021:21. When this DTC is present, the regenerative brake system downgrades to conventional mode until the cause of DTC C0021:21 has been corrected. The red brake warning indicator illuminates when this DTC is set. If only DTCs C0021:21 and 66 are present, there is likely to be mechanical damage to the brake booster, brake pedal and bracket, master cylinder, a hydraulic brake fluid leak, air trapped in the hydraulic system or a vacuum leak may be present.
- DTC C0021:77 (Brake Booster Performance: Commanded Position is Not Reachable) â This DTC is for information only and does not indicate a fault with the brake system. If the hydraulic brake pressure does not change when the ABS module checks the brake booster, this DTC sets. This DTC does not cause any indicators to illuminate and may set as a result of low ambient temperatures causing slow booster reaction time. If the red brake warning indicator is not illuminated, this DTC should be disregarded. Diagnose all other DTCs retrieved along with this DTC.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Wheel speed sensor
- ABS module

PINPOINT TEST Q: DTCs C0021:21, 66 AND 77

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
Q1 CHECK THE DTCs FROM THE SELF-TEST	
• Review the DTCs retrieved and recorded in Inspection and Verification. • **Are other DTCs present along with DTC C0021:21, 66 or 77?**	**Yes** The other ABS module DTCs indicates the cause of DTCs C0021:21, 66 and/or 77. DIAGNOSE all other ABS module DTCs before diagnosing DTC C0021:21, 66 or 77. REFER to the ABS Module DTC Chart in this section. **No** GO to Q2 .
Q2 CHECK THE BRAKE PEDAL AND BRACKET	
• Inspect the brake pedal and bracket and the clevis end of the booster push rod for misalignment or damage. Verify that all brake pedal and bracket fasteners are tightened to the specified torque. Apply	**Yes** GO to Q3 . **No** REPAIR or INSTALL new components

and release the brake pedal. Verify that the brake pedal moves freely and returns to the full released position. • **Is the brake pedal and bracket OK?**	as necessary. REFER to Section 206-06 .
Q3 CHECK THE BRAKE BOOSTER AND BRAKE MASTER CYLINDER	
• Inspect the brake booster and brake master cylinder for misalignment or damage. Verify that all brake booster and master cylinder fasteners are tightened to the specified torque. • **Is the brake booster and the brake master cylinder OK?**	**Yes** GO to Q4 . **No** REPAIR or INSTALL new components as necessary. REFER to Section 206-07 for the brake booster. REFER to Section 206-06 for the brake master cylinder.
Q4 CHECK FOR VACUUM LEAKS	
• Inspect the vacuum pump and brake booster vacuum hoses, lines and fittings for vacuum leaks. • **Are the vacuum pump and brake booster vacuum hoses, lines and fittings OK?**	**Yes** GO to Q5 . **No** REPAIR or INSTALL new components as necessary. REFER to Section 206-07 .
Q5 CHECK THE BRAKE SYSTEM FOR BRAKE FLUID LEAKS	
• Inspect the brake system for brake fluid leaks. • **Are any brake fluid leaks found?**	**Yes** REPAIR as necessary. FILL the brake master cylinder reservoir using the specified brake fluid. BLEED the brake system, REFER to Brake System Bleeding in Section 206-00 . **No** GO to Q6 .
Q6 CHECK FOR AIR IN THE BRAKE SYSTEM	
• Bleed the brake system, refer to Brake System Bleeding in Section 206-00 . • Ignition ON. • Using the scan tool, clear all Continuous Memory Diagnostic Trouble Codes (CMDTCs). • Disconnect the scan tool. • Test drive the vehicle at speeds greater than 32 km/h (20 mph). • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test â ABS Module . • Carry out the ABS module self-test. • **Are DTCs C0021:21, 66 and 77 present?**	**Yes** GO to Q7 . **No** The system is operating correctly at this time. The concern may have been caused by air trapped in the hydraulic brake system. CLEAR the DTCs. REPEAT the self-test.
Q7 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect: ABS Module C135 .	**Yes** INSTALL a ABS module. REFER to

• Using a good light source, carefully inspect ABS module connector C135 for corroded terminals. • Inspect for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each pin location. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Connect: ABS Module C135 . • Make sure the connector seats correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation. CLEAR the DTCs. DRIVE the vehicle. REPEAT the self-test. If the DTCs identified in the normal operation of this pinpoint test are retrieved, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) â Hybrid in this section. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test R: DTC C0031:01; C0034:01; C0037:01 or C003A:01

Normal Operation

Active wheel speed sensors generate a square wave signal that is sent to the ABS module. The wheel speed sensor circuitry connects to the ABS module through 2 wires and a connector at each wheel speed sensor. When the ignition switch is turned to the RUN position, the ABS module carries out a self-test by sending a reference voltage through the wheel speed sensors and their circuitry.

Both voltage and ground are supplied to the active wheel speed sensors from the ABS module.

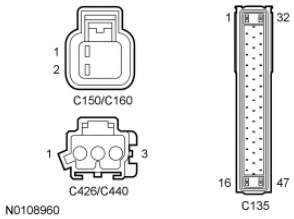
DTC Description	Fault Trigger Conditions
• C0031:01 â Left Front Wheel Speed Sensor: General Electrical Failure	If the left front wheel speed sensor signal current is below 45 mA or above 20 mA for longer than 140 milliseconds, this DTC sets.
• C0034:01 â Right Front Wheel Speed Sensor: General Electrical Failure	If the right front wheel speed sensor signal current is below 45 mA or above 20 mA for longer than 140 milliseconds, this DTC sets.
• C0037:01 â Left Rear Wheel Speed Sensor: General Electrical Failure	If the left rear wheel speed sensor signal current is below 45 mA or above 20 mA for longer than 140 milliseconds, this DTC sets.
• C003A:01 â Right Rear Wheel Speed Sensor: General Electrical Failure	If the right rear wheel speed sensor signal current is below 45 mA or above 20 mA for longer than 140 milliseconds, this DTC sets.

This pinpoint test is intended to diagnose the following:

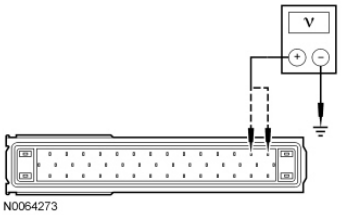
- Wiring, terminals or connectors
- Wheel speed sensor
- ABS module

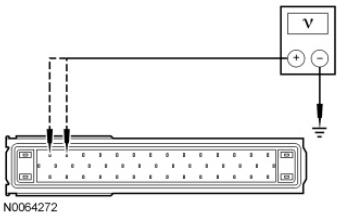
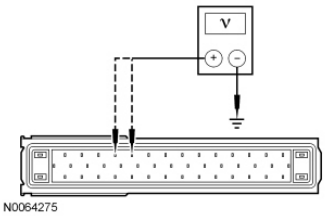
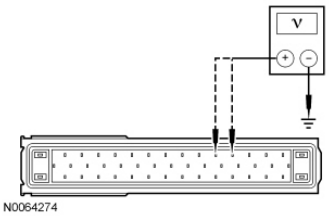
PINPOINT TEST R: DTC C0031:01; C0034:01; C0037:01 OR C003A:01

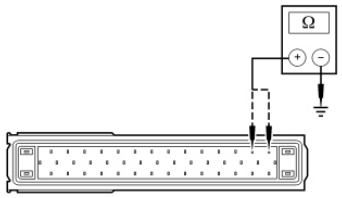
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
R1 VERIFY ALL WIRING CONNECTIONS	
• Disconnect: ABS Module C135 . • Disconnect: Suspect Wheel Speed Sensor . • Using a good light source, inspect each connector terminal for any corrosion. • Inspect both connectors for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C135-33 ♦ C135-34 ♦ C135-36 ♦ C135-37 ♦ C135-42 ♦ C135-43 ♦ C135-45 ♦ C135-46 ♦ Suspect wheel speed sensor, pin-1 ♦ Suspect wheel speed sensor, pin-2 (front sensor) or pin-3 (rear sensor)  • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	**Yes** GO to R2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.

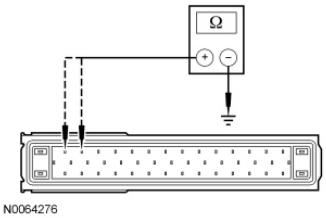
R2 CHECK FOR FAULT REPEATABILITY	
• Connect: ABS Module C155 . • Connect: Suspect Wheel Speed Sensor . • Connect the scan tool. • Ignition ON. • Using the scan tool, clear the ABS module DTCs. • Drive the vehicle at least 20 km/h (12 mph). • Enter the following diagnostic mode on the scan tool: Self Test â ABS Module . • Retrieve and record the ABS module DTCs. • **Are DTCs C0031:01, C0034:01, C0037:01 and/or C003A:01 retrieved?**	**Yes** For DTCs C0031:01 and C0034:01, if the Rotunda Active Wheel Speed Sensor Tester is available, GO to R3 . If the Rotunda Active Wheel Speed Sensor Tester is not available, GO to R5 . For DTCs C0037:01 and C003A:01, GO to R5 . **No** INSPECT the wheel speed sensors, wheel speed sensor wiring and wheel speed sensor tone rings. REPAIR or INSTALL new as necessary. If any other DTCs are retrieved, GO to the ABS Module DTC Chart in this section.
R3 CHECK THE ABS MODULE OUTPUT USING THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER	
NOTE: The front wheel speed sensor electrical connectors are located behind the wheel well splash shields. The rear wheel speed sensor electrical connectors are located under the rear seat cushion. • Ignition OFF. • Disconnect: Suspect Wheel Speed Sensor . • Connect the Rotunda Active Wheel Speed Sensor Tester to the wheel speed sensor connectors. • Ignition ON. • Select the correct system polarity on the Rotunda Active Wheel Speed Sensor Tester and turn the power switch to the ON position. • **Is the module output LED illuminated?**	**Yes** GO to R4 . **No** GO to R7 .
R4 CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER	
• Raise the suspect wheel until it can spin freely. Refer to Section 100-02 . • While monitoring the Rotunda Active Wheel Speed Sensor Tester, slowly spin the suspect wheel. • **Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?**	**Yes** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. **No** If the current level LED is not illuminated and the sensor output LEDs do not illuminate or if the current level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor â Front or Wheel Speed Sensor â Rear, Front Wheel Drive (FWD) in this section. CLEAR the DTCs. REPEAT the

	self-test. If the current level LED is not illuminated and the sensor output LEDs illuminate green, but do not flash, INSPECT the wheel speed sensor tone ring and INSTALL new if necessary. If the tone ring is OK, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor â Front or Wheel Speed Sensor â Rear, Front Wheel Drive (FWD) in this section. CLEAR the DTCs. REPEAT the self-test.
R5 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO POWER	
NOTICE: **No measurements should be taken with the wheel speed sensor connected. Damage to the wheel speed sensor results.** **NOTE:** The front wheel speed sensor electrical connectors are located behind the wheel well splash shields. The rear wheel speed sensor electrical connectors are located under the rear seat cushion. • Ignition OFF. • Disconnect: ABS Module C135 . • Disconnect: Suspect Wheel Speed Sensor . • Ignition ON. • **For DTC C0031:01 (LF)** , measure the voltage between ground and: ♦ ABS module C135-45, circuit VCA03 (VT/WH), harness side. ♦ ABS module C135-46, circuit RCA17 (YE), harness side.  • **For DTC C0034:01 (RF)** , measure the voltage between ground and: ♦ ABS module C135-33, circuit RCA19 (VT), harness side. ♦ ABS module C135-34, circuit VCA05 (GY/VT), harness side.	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. **No** GO to R6 .

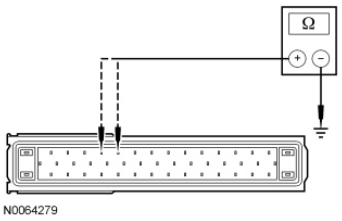
 N0064272 • **For DTC C0037:01 (LR)** , measure the voltage between ground and: ♦ ABS module C135-36, circuit VCA04 (BU/OG), harness side. ♦ ABS module C135-37, circuit RCA18 (BN/GN), harness side.  N0064275 • **For DTC C003A:01 (RR)** , measure the voltage between ground and: ♦ ABS module C135-42, circuit RCA20 (BN), harness side. ♦ ABS module C135-43, circuit VCA06 (WH/OG), harness side.  N0064274 • **Is any voltage present?**	
R6 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO GROUND	
NOTE: Both circuits must be checked for each DTC. • Ignition OFF. • **For DTC C0031:01 (LF)** , measure the resistance between ground and: ♦ ABS module C135-45, circuit VCA03 (VT/WH), harness side. ♦ ABS module C135-46, circuit RCA17 (YE), harness side.	**Yes** GO to R7 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.



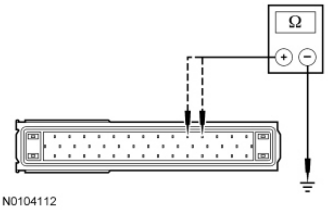
- **For DTC C0034:01 (RF)** , measure the resistance between ground and:
  - ♦ ABS module C135-34, circuit VCA05 (GY/VT), harness side.
  - ♦ ABS module C135-33, circuit RCA19 (VT), harness side.



- **For DTC C0037:01 (LR)** , measure the resistance between ground and:
  - ♦ ABS module C135-36, circuit VCA04 (BU/OG), harness side.
  - ♦ ABS module C135-37, circuit RCA18 (BN/GN), harness side.



- **For DTC C003A:01 (RR)** , measure the resistance between ground and:
  - ♦ ABS module C135-43, circuit VCA06 (WH/OG), harness side.
  - ♦ ABS module C135-42, circuit RCA20 (BN), harness side.



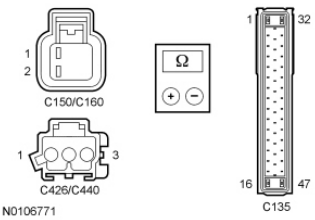
- **Are the resistances greater than 10,000 ohms?**

R7 CHECK THE WHEEL SPEED CIRCUITS FOR AN OPEN	

NOTE: The front wheel speed sensor electrical connectors are located behind the wheel well splash shields. The rear wheel speed sensor electrical connectors are located under the rear seat cushion.

- Ignition OFF.
- Disconnect: ABS Module C135 .
- Disconnect: Suspect Wheel Speed Sensor .
- Measure the resistance between ABS module connector C135, harness side and the suspect wheel speed sensor connector, harness side as indicated in the following chart:

ABS Module	Circuit	Wheel Speed Sensor
DTC C0031:01 (LF)		
C135-45	VCA03 (VT/WH)	C150-1
C135-46	RCA17 (YE)	C150-2
DTC C0034:01 (RF)		
C135-34	VCA05 (GY/VT)	C160-1
C135-33	RCA19 (VT)	C160-2
DTC C0037:01 (LR)		
C135-36	VCA04 (BU/OG)	C440-3
C135-37	RCA18 (BN/GN)	C440-1
DTC C003A:01 (RR)		
C135-43	VCA06 (WH/OG)	C426-3
C135-42	RCA20 (BN)	C426-1



- **Are the resistances less than 5 ohms?**

Yes
GO to R8 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

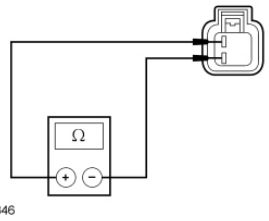
R8 CHECK FOR SHORTED WHEEL SPEED SENSOR CIRCUITS

- **For DTC C0031:01 (LF)** , measure the resistance between:
  - ♦ LF wheel speed sensor C150-1, circuit VCA03 (VT/WH), harness side and LF wheel speed sensor C150-2, circuit

Yes
GO to R9 .

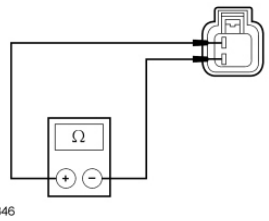
No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

RCA17 (YE), harness side.



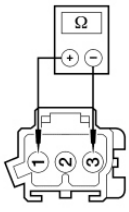
N0008846

- **For DTC C0034:01 (RF)** , measure the resistance between:
  - ♦ RF wheel speed sensor C160-1, circuit VCA05 (GY/VT), harness side and RF wheel speed sensor C160-2, circuit RCA19 (VT), harness side.



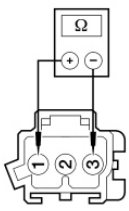
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- **For DTC C0037:01 (LR)** , measure the resistance between:
  - ♦ LR wheel speed sensor C440-3, circuit VCA04 (BU/OG), harness side and LR wheel speed sensor C440-1, circuit RCA18 (BN/GN), harness side.



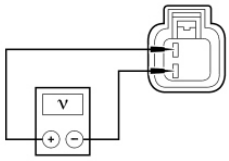
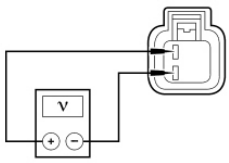
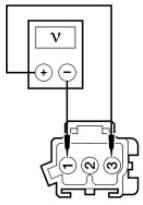
N0086936

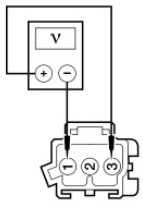
- **For DTC C003A:01 (RR)** , measure the resistance between:
  - ♦ RR wheel speed sensor C426-3, circuit VCA06 (WH/OG), harness side and RR wheel speed sensor C426-1, circuit RCA20 (BN), harness side.



N0086936

- **Is the resistance greater 10,000 ohms?**

R9 CHECK FOR CORRECT ABS MODULE OUTPUT	
• Connect: ABS Module C135 . • Ignition ON. • **For DTC C0031:01 (LF)** , measure the voltage between: ♦ LF wheel speed sensor C150-1, circuit VCA03 (VT/WH), harness side and LF wheel speed sensor C150-2, circuit RCA17 (YE), harness side.  N0086939 • **For DTC C0034:01 (RF)** , measure the voltage between: ♦ RF wheel speed sensor C160-1, circuit VCA05 (GY/VT), harness side and RF wheel speed sensor C160-2, circuit RCA19 (VT), harness side.  N0086939 • **For DTC C0037:01 (LR)** , measure the voltage between: ♦ LR wheel speed sensor C440-3, circuit VCA04 (BU/OG), harness side and LR wheel speed sensor C440-1, circuit RCA18 (BN/GN), harness side.  N0106658 • **For DTC C003A:01 (RR)** , measure the voltage between: ♦ RR wheel speed sensor C426-3, circuit VCA06 (WH/OG), harness side and RR wheel speed sensor C426-1, circuit RCA20 (BN), harness side.	**Yes** INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor â Front , Wheel Speed Sensor â Rear, Front Wheel Drive (FWD) or Wheel Speed Sensor â Rear, All Wheel Drive (AWD) in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to R10 .

 • **Is the voltage greater than 10 volts?**	
R10 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect: ABS Module C135 . • Check for: ♦ corrosion ♦ pushed-out pins ♦ spread terminals • Connect: ABS Module C135 . • Make sure the connector is seated correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test S: DTC C0030:07; C0031:29, 2F, 64; C0033:07; C0034:29, 2F, 64; C0036:07: C0037:29, 2F, 64; C0039:07; C003A:29, 2F or 64

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The wheel speed sensor and sensor ring generate a square wave signal to the ABS module that is proportional to wheel speed. The ABS module compares wheel speed inputs from all wheel speed sensors to determine an impending wheel lockup.

DTC Description	Fault Trigger Conditions
• C0030:07 â Left Front Wheel Speed Sensor: Mechanical Failure	Damage to the wheel speed sensor ring or damage to the wheel bearing causes this DTC to set.
• C0031:29 â Left Front Wheel Speed Sensor: Signal Invalid	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor, a wheel speed sensor that is not mounted properly or mismatched tire sizes.
• C0031:2F â Left Front Wheel Speed Sensor: Signal Erratic	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor or a wheel speed sensor that is not mounted properly.
	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor, a wheel speed sensor

• C0031:64 â Left Front Wheel Speed Sensor: Signal Plausibility Failure	that is not mounted properly or mismatched tire sizes.
• C0033:07 â Right Front Wheel Speed Sensor: Mechanical Failure	Damage to the wheel speed sensor ring or damage to the wheel bearing causes this DTC to set.
• C0034:29 â Right Front Wheel Speed Sensor: Signal Invalid	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor, a wheel speed sensor that is not mounted properly or mismatched tire sizes.
• C0034:2F â Right Front Wheel Speed Sensor: Signal Erratic	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor or a wheel speed sensor that is not mounted properly.
• C0034:64 â Right Front Wheel Speed Sensor: Signal Plausibility Failure	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor, a wheel speed sensor that is not mounted properly or mismatched tire sizes.
• C0036:07 â Left Rear Wheel Speed Sensor: Mechanical Failure	Damage to the wheel speed sensor ring or damage to the wheel bearing causes this DTC to set.
• C0037:29 â Left Rear Wheel Speed Sensor: Signal Invalid	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor, a wheel speed sensor that is not mounted properly or mismatched tire sizes.
• C0037:2F â Left Rear Wheel Speed Sensor: Signal Erratic	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor or a wheel speed sensor that is not mounted properly.
• C0037:64 â Left Rear Wheel Speed Sensor: Signal Plausibility Failure	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor, a wheel speed sensor that is not mounted properly or mismatched tire sizes.
• C0039:07 â Right Rear Wheel Speed Sensor: Mechanical Failure	Damage to the wheel speed sensor ring or damage to the wheel bearing causes this DTC to set.
• C003A:29 â Right Rear Wheel Speed Sensor: Signal Invalid	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor, a wheel speed sensor that is not mounted properly or mismatched tire sizes.
• C003A:2F â Right Rear Wheel Speed Sensor: Signal Erratic	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor or a wheel speed sensor that is not mounted properly.
• C003A:64 â Right Rear Wheel Speed Sensor: Signal Plausibility Failure	This DTC can set by a damaged wheel speed sensor ring, a damaged or defective wheel speed sensor, a wheel speed sensor that is not mounted properly or mismatched tire sizes.

This pinpoint test is intended to diagnose the following:

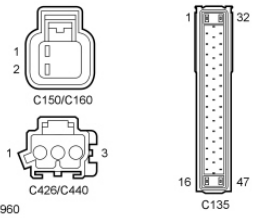
- Wiring, terminals or connectors
- Tire size
- Tire pressure

- Wheel speed sensor
- Wheel speed sensor ring
- Wheel bearing
- ABS module

PINPOINT TEST S: DTC C0030:07; C0031:29, 2F, 64; C0033:07; C0034:29, 2F, 64; C0036:07: C0037:29, 2F, 64; C0039:07; C003A:29, 2F or 64

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

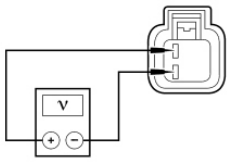
Test Step	Result / Action to Take
S1 VERIFY ALL WIRING CONNECTIONS	
• Disconnect: ABS Module C135 . • Disconnect: Suspect Wheel Speed Sensor . • Using a good light source, inspect each connector terminal for any corrosion. • Inspect both connectors for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C135-33 ♦ C135-34 ♦ C135-36 ♦ C135-37 ♦ C135-42 ♦ C135-43 ♦ C135-45 ♦ C135-46 ♦ Suspect wheel speed sensor, pin-1 ♦ Suspect wheel speed sensor, pin-2 (front sensor) or pin-3 (rear sensor)	**Yes** GO to S2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.

 • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	
S2 CHECK THE DTCs FROM THE SELF-TEST	
• Review the DTCs retrieved and recorded during Inspection and Verification. • **Are DTCs C0031:01; C0034:01; C0037:01 and/or C003A:01 present?**	**Yes** GO to Pinpoint Test P . **No** If DTC C0030:07; C0033:07; C0036:07; or C0039:07 is present, GO to S5 . If DTCs C0031:2F; C0034:2F; C0037:2F; and/or C003A:2F are present, GO to S4 . If DTCs C0031:29, 64; C0034:29, 64; C0037:29, 64; C003A:29 and/or 64 are present, GO to S3 . For all other DTCs, REFER to the ABS Module DTC Chart in this section.
S3 CHECK THE TIRES SIZE AND PRESSURE	
• Verify that all tires and wheels are the same size and that the inflation pressures are correct as indicated on the Vehicle Certification (VC) label. • **Are the wheels and tires OK?**	**Yes** GO to S4 . **No** INSTALL the correct size tire or ADJUST tire pressure as necessary.
S4 MONITOR THE WHEEL SPEED SENSOR PIDs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger â ABS Module . • Drive the vehicle at a speed greater than 20 km/h (12 mph) while monitoring the following PIDs: ♦ Left front wheel speed sensor (LF_WSPD) ♦ Right front wheel speed sensor (RF_WSPD) ♦ Left rear wheel speed sensor (LR_WSPD)	**Yes** CLEAR the DTCs. DRIVE the vehicle. RETRIEVE the DTCs. If DTCs C0031:29, 2F, 64; C0034:29, 2F, 64; C0037:29, 2F, 64; C003A:29, 2F; and/or C003A:64 are present, GO to S14 . **No** GO to S5 .

♦ Right rear wheel speed sensor (RR_WSPD) • **Are the wheel speed PIDs consistent with each other, within 5 km/h (3 mph) and the vehicle speed as indicated on the speedometer?**	
S5 INSPECT THE WHEEL SPEED SENSOR MOUNTING	
• Ignition OFF. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Inspect the wheel speed sensor and fastener for looseness. • **Are the wheel speed sensor and fastener tight?**	**Yes** GO to S7 . **No** TIGHTEN the wheel speed sensor to specification. REFER to Specifications in this section. CLEAR the DTCs. GO to S6 .
S6 RECHECK THE WHEEL SPEED PIDs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger â ABS Module . • Drive the vehicle at a speed greater than 20 km/h (12 mph) while monitoring the following PIDs: ♦ LF_WSPD ♦ RF_WSPD ♦ LR_WSPD ♦ RR_WSPD • **Are the wheel speed PIDs consistent with each other, within 5 km/h (3 mph) and the vehicle speed as indicated on the speedometer?**	**Yes** The system is operating correctly at this time. The concern may have been caused by a loose wheel speed sensor. **No** GO to S7 .
S7 CHECK THE WHEEL SPEED SENSOR FOR DAMAGE	
• Ignition OFF. • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • **NOTE:** Examine the wheel speed sensor wire carefully with a good light source. Failure to verify damage in the wheel speed sensor wire can lead to unnecessary installation of a new component. • Inspect the wheel speed sensor and harness for abrasion, broken connector tabs or water intrusion. • **Is the wheel speed sensor and harness OK?**	**Yes** GO to S8 . **No** INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor â Front , Wheel Speed Sensor â Rear, Front Wheel Drive (FWD) or Wheel Speed Sensor â Rear, All Wheel Drive (AWD) in this section. CLEAR the DTCs. REPEAT the self-test.

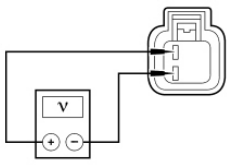
S8 CHECK FOR WHEEL SPEED SENSOR RING DAMAGE	
• Inspect the wheel speed sensor ring for damaged or missing teeth. Rotate the wheel to verify that no teeth are missing. • **Is the wheel speed sensor ring OK?**	**Yes** GO to S9 . **No** INSTALL a new halfshaft. For front halfshafts, REFER to Section 205-04 . For rear halfshafts, REFER to Section 205-05 . CLEAR the DTCs. REPEAT the self-test.
S9 CHECK FOR WHEEL BEARING DAMAGE	
• Inspect the wheel bearings for damage. • **Are the wheel bearings OK?**	**Yes** For front wheel speed sensor concerns, if the Rotunda Active Wheel Speed Sensor Tester is available, GO to S10 . If the Rotunda Active Wheel Speed Sensor Tester is not available, GO to S12 . For rear wheel speed sensor concerns, GO to S12 . **No** INSTALL new wheel bearings as necessary. REFER to Section 204-01 for front wheel bearings or Section 204-02 for rear wheel bearings. CLEAR the DTCs. REPEAT the self-test.
S10 CHECK THE ABS MODULE OUTPUT USING THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER	
NOTE: The front wheel speed sensor electrical connectors are located behind the wheel well splash shields. The rear wheel speed sensor electrical connectors are located under the rear seat cushion. • Ignition OFF. • Disconnect: Suspect Wheel Speed Sensor . • Connect the Rotunda Active Wheel Speed Sensor Tester to the wheel speed sensor connectors. • Ignition ON. • Select the correct system polarity on the Rotunda Active Wheel Speed Sensor Tester and turn the power switch to the ON position. • **Is the module output LED illuminated?**	**Yes** GO to S11 . **No** GO to S14 .

S11 CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER	
• Raise the suspect wheel until it can spin freely. Refer to Section 100-02 . • While monitoring the Rotunda Active Wheel Speed Sensor Tester, slowly spin the suspect wheel. • **Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?**	**Yes** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. **No** If the current level LED is not illuminated and the sensor output LEDs do not illuminate or if the current level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor â Front or Wheel Speed Sensor â Rear, Front Wheel Drive (FWD) in this section. CLEAR the DTCs. REPEAT the self-test. If the current level LED is not illuminated and the sensor output LEDs illuminate green, but do not flash, INSPECT the wheel speed sensor tone ring and INSTALL new if necessary. If the tone ring is OK, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor â Front or Wheel Speed Sensor â Rear, Front Wheel Drive (FWD) in this section. CLEAR the DTCs. REPEAT the self-test.
S12 CHECK FOR CORRECT ABS MODULE OUTPUT	
NOTE: The front wheel speed sensor electrical connectors are located behind the wheel well splash shields. The rear wheel speed sensor electrical connectors are located under the rear seat cushion. • Ignition OFF. • Disconnect: Suspect Wheel Speed Sensor . • Ignition ON. • **For LF wheel speed sensor DTCs** , measure the voltage between: ♦ LF wheel speed sensor C150-1, circuit VCA03 (VT/WH), harness side and LF wheel speed sensor C150-2, circuit RCA17 (YE), harness side.	**Yes** GO to S13 . **No** GO to S14 .



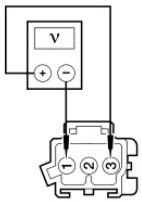
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- **For RF wheel speed sensor DTCs** , measure the voltage between:
  - ♦ RF wheel speed sensor C160-1, circuit VCA05 (GY/VT), harness side and RF wheel speed sensor C160-2, circuit RCA19 (VT), harness side.



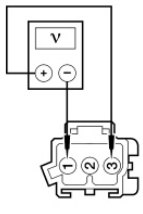
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- **For LR wheel speed sensor DTCs** , measure the voltage between:
  - ♦ LR wheel speed sensor C440-3, circuit VCA04 (BU/OG), harness side and LR wheel speed sensor C440-1, circuit RCA18 (BN/GN), harness side.



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- **For RR wheel speed sensor DTCs** , measure the voltage between:
  - ♦ RR wheel speed sensor C426-3, circuit VCA06 (WH/OG), harness side and RR wheel speed sensor C426-1, circuit RCA20 (BN), harness side.

 N0106658 • **Is the voltage greater than 10 volts?**	
S13 CHECK THE WHEEL SPEED SENSOR OUTPUT	
NOTE: The front wheel speed sensor electrical connectors are located behind the wheel well splash shields. The rear wheel speed sensor electrical connectors are located under the rear seat cushion. • Disconnect: Suspect Wheel Speed Sensor . • **For LF wheel speed sensor DTCs** : ♦ connect the meter between LF wheel speed sensor C150-1, circuit RCA17 (YE), harness side and LF wheel speed sensor pin-1, component side. ♦ connect a fused jumper wire between LF wheel speed sensor C150-2, circuit VCA03 (VT/WH), harness side and LF wheel speed sensor pin-2, component side. • **For RF wheel speed sensor DTCs** : ♦ connect the meter between RF wheel speed sensor C160-1, circuit RCA19 (VT), harness side and RF wheel speed sensor pin-1, component side. ♦ connect a fused jumper wire between RF wheel speed sensor C160-2, circuit VCA05 (GY/VT), harness side and RF wheel speed sensor pin-2, component side. • **For LR wheel speed sensor DTCs** : ♦ connect the meter between LR wheel speed sensor C440-1, circuit RCA18 (BN/GN), harness side and LR wheel speed sensor pin-1, component side. ♦ connect a fused jumper wire between LR wheel speed sensor C440-3, circuit VCA04	**Yes** GO to S14 . **No** INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor â Front , Wheel Speed Sensor â Rear, Front Wheel Drive (FWD) or Wheel Speed Sensor â Rear, All Wheel Drive (AWD) in this section. CLEAR the DTCs. REPEAT the self-test.

(BU/OG), harness side and LR wheel speed sensor pin-3, component side. • **For RR wheel speed sensor DTCs** : ♦ connect the meter between RR wheel speed sensor C426-1, circuit RCA20 (BN), harness side and RR wheel speed sensor pin-1, component side. ♦ connect a fused jumper wire between RR wheel speed sensor C426-3, circuit VAC06 (WH/OG), harness side and RR wheel speed sensor pin-3, component side. • Ignition ON. • Measure the current while slightly rotating the wheel, using incremental turns. • **Does the automotive meter switch between the low state (5 to 8 mA) and the high state (12 to 16 mA)?**	
S14 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect: ABS Module C135 . • Check for: ♦ corrosion ♦ pushed-out pins ♦ spread terminals • Connect: ABS Module C135 . • Make sure the connector is seated correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test T: DTCs C0048:11, 12, 64; C1108:11, 12 and 1C

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The booster travel sensor provides the ABS module with an analog signal indicating the position of the diaphragm inside the brake booster. The ABS module supplies a 5-volt reference voltage to the sensor and ground. The ABS module receives a varying voltage proportional to the position of the diaphragm inside the brake booster. The ABS module monitors the brake booster travel sensor circuits for circuit faults. The ABS module compares the brake booster travel sensor signal with other brake system inputs to verify that the brake booster travel sensor signal is accurate. If a brake booster travel sensor circuit or signal fault is detected, the red brake warning indicator illuminates.

DTC Description	Fault Trigger Conditions
• C0048:11 â Brake Booster Travel Sensor: Circuit Short To Ground	If circuit VCB34 (WH/BU) is open or shorted to ground or if the ABS module is faulted internally, this DTC sets.
• C0048:12 â Brake Booster Travel Sensor: Circuit Short to Battery	If the circuit is open, or if the ABS module is faulted internally, this DTC sets.
• C0048:64 â Brake Booster Travel Sensor: Signal Plausibility Failure	This DTC can set if the booster travel sensor is improperly mounted, if the booster travel sensor is faulted internally or if the ABS module is faulted internally. This DTC can also set as a result of other brake booster travel sensor faults. All other brake booster travel sensor DTCs should be diagnosed prior to diagnosing DTC C0048:64.
• C1108:11 â Pedal Sensor(s) (Booster Travel Sensor) Supply Voltage: Circuit Short to Ground	This DTC is set if the brake booster travel sensor supply circuit is shorted ground, if the booster travel sensor is shorted internally or if the ABS module is faulted internally.
• C1108:12 â Pedal Sensor(s) (Booster Travel Sensor) Supply Voltage: Circuit Short to Battery	This DTC is set if the brake booster travel sensor supply circuit is shorted voltage, if the booster travel sensor is shorted internally or if the ABS module is faulted internally.
• C1108:1C â Pedal Sensor(s) (Booster Travel Sensor) Supply Voltage: Circuit Voltage Out of Range	This DTC can set as a result of other brake booster travel sensor circuit faults or if the ABS module is faulted internally. All other booster travel sensor DTCs should be diagnosed prior to diagnosing DTC C1108:1C.

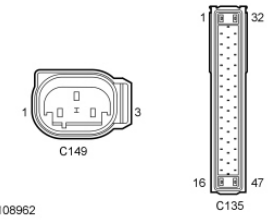
This pinpoint test is intended to diagnose the following:

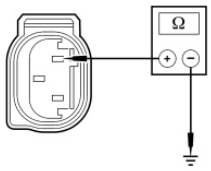
- Wiring, terminals or connectors
- Booster travel sensor
- ABS module

PINPOINT TEST T: DTCs C0048:11, 12, 64; C1108:11, 12 and 1C

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

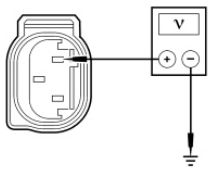
Test Step	Result / Action to Take
T1 VERIFY ALL WIRING CONNECTIONS	

• Disconnect: ABS Module C135 . • Disconnect: Brake Booster Travel Sensor C149 . • Using a good light source, inspect each connector terminal for any corrosion. • Inspect both connectors for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C135-26 ♦ C135-27 ♦ C135-38 ♦ C149-1 ♦ C149-2 ♦ C149-3  • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	**Yes** GO to T2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.
T2 CHECK THE DTCs FROM THE SELF-TEST	
• Review the DTCs retrieved and recorded during Inspection and Verification. • **Is DTC C0048:11, 12 or 64 present?**	**Yes** If DTC C0048:11 is present, GO to T3 . If DTC C0048:12 is present, GO to T4 . If only DTC C0048:64 is present, GO to T5 . **No** If DTC C1108:11 is present, GO to T8 . If DTC C1108:12 is present, GO to T7 . If only DTC C1108:1C is present, GO to T10 . For all other DTCs, REFER to the ABS Module DTC Chart in this section.
T3 CHECK THE SENSOR SIGNAL RETURN CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Booster Travel Sensor C149 . • Disconnect: ABS Module C135 . • Measure the resistance between brake booster travel sensor C149-3, circuit VCB34 (WH/BU), harness side and ground.	**Yes** GO to T5 . **No** REPAIR circuit VCB34 (WH/BU). CLEAR the DTCs. REPEAT the self-test.



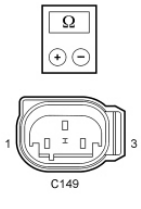
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- **Is the resistance greater than 10,000 ohms?**

T4 CHECK THE SENSOR SIGNAL RETURN CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Booster Travel Sensor C149 . • Disconnect: ABS Module C135 . • Ignition ON. • Measure the voltage between brake booster travel sensor C149-3, circuit VCB34 (WH/BU), harness side and ground.  N0088578 • **Is any voltage present?**	**Yes** REPAIR circuit VCB34 (WH/BU). CLEAR the DTCs. REPEAT the self-test. **No** GO to T5 .
T5 CHECK ALL SENSOR CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Disconnect: Booster Travel Sensor C149 . • Disconnect: ABS Module C135 . • Measure the resistance between brake booster travel sensor C149 pins, harness side, as indicated in the following chart:	**Yes** GO to T6 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

Brake Booster Travel Sensor	Circuit	Brake Booster Travel Sensor
C149-1	CCB33 (GY/OG)/ RCB33 (VT/GY)	C149-2
C149-1	CCB33 (GY/OG)/	C149-3

	VCB34 (WH/BU)	
C149-2	VCB34 (WH/BU)/ RCB33 (VT/GY)	C149-3

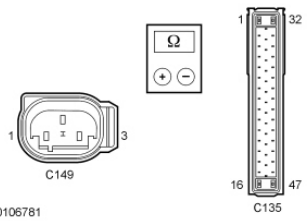


- **Are the resistances greater than 10,000 ohms?**

T6 CHECK ALL SENSOR CIRCUITS FOR AN OPEN

- Measure the resistance between ABS module C135, harness side and brake booster travel sensor C149, harness side as indicated in the following chart:

ABS Module	Circuit	Brake Booster Travel Sensor
C135-26	CCB33 (GY/OG)	C149-1
C135-27	RCB33 (VT/GY)	C149-2
C135-38	VCB34 (WH/BU)	C149-3



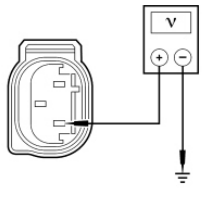
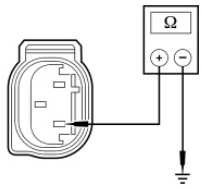
- **Are the resistances less than 5 ohms?**

Yes
If only DTC C0048:64 was retrieved from the self-test, INSPECT the installation of the sensor. CORRECT the installation as necessary.

If the sensor is correctly installed, INSTALL a new brake booster travel sensor. REFER to Booster Travel Sensor in Section 206-07 . For DTCs C0048:11 and C0048:12, GO to T9 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

T7 CHECK THE SENSOR VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO VOLTAGE

• Ignition OFF. • Disconnect: Booster Travel Sensor C149 . • Disconnect: ABS Module C135 . • Ignition ON. • Measure the voltage between the brake booster travel sensor C149-1, circuit CCB33 (GY/OG), harness side and ground.  N0088580 • **Is any voltage present?**	**Yes** REPAIR circuit CCB33 (GY/OG). CLEAR the DTCs. REPEAT the self-test. **No** GO to T9 .
T8 CHECK THE SENSOR VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Booster Travel Sensor C149 . • Disconnect: ABS Module C135 . • Measure the resistance between the brake booster travel sensor C149-1, circuit CCB33 (GY/OG), harness side and ground.  N0088581 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to T9 . **No** REPAIR circuit CCB33 (GY/OG). CLEAR the DTCs. REPEAT the self-test.
T9 CHECK THE BOOSTER TRAVEL SENSOR INSTALLATION	
• Inspect the installation of the booster travel sensor to the brake booster. Verify the booster travel is securely attached to the booster and that the booster and booster travel sensor are free of damage. • **Is the booster travel sensor installed correctly and are the sensor and booster free of any damage?**	**Yes** GO to T10 . **No** INSTALL a new brake booster travel sensor and/or brake booster as necessary. REFER to Booster Travel Sensor and/or Brake Booster in Section 206-07 .
T10 CHECK THE BOOSTER TRAVEL SENSOR (BRKBST_MEMB) PID	
• Connect: Booster Travel Sensor C149 . • Connect: ABS Module C135 .	**Yes** CLEAR the DTCs. DRIVE the vehicle. REPEAT the self-test. If any of the DTCs

• Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger â ABS Module . • Monitor the BRKBST_MEMB PID while applying and releasing the brake pedal. • **Does the PID value increase when the brake pedal is pressed and decrease when the brake pedal is released?**	identified in the normal operation of this pinpoint test return, GO to T11 . **No** INSTALL a new brake booster travel sensor. REFER to Booster Travel Sensor in Section 206-07 .
T11 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect: ABS Module C135 . • Check for: ♦ corrosion ♦ pushed-out pins ♦ spread terminals • Connect: ABS Module C135 . • Make sure the connector is seated correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test U: DTCs C100A:62; C100D:21, 22; C100E:21, 22 and C100F:11, 12

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The ABS module uses input from the brake pedal angle sensor to determine the amount of deceleration the driver is requesting. The brake pedal angle sensor utilizes 2 Hall-effect sensors that provide redundant signals indicating the position of the brake pedal. The ABS module provides a 5-volt reverence voltage used by both of the sensors. The ABS module provides a signal return common to both sensors.

DTC Description	Fault Trigger Conditions
• C100A:62 â Brake Pedal Angle Sensor: Signal Compare Failure	This DTC sets if 1 of the 2 sensors inside the brake pedal angle sensor is inconsistent with the other or if the ABS module is faulted internally. This DTC can set as a result of other DTCs indicating a brake pedal angle sensor circuit fault. If DTCs C100D:21, 22 or C100E:21, 22 are present along with this DTC, diagnose them first.
• C100D:21 â Brake Pedal Angle Sensor Circuit 1: Signal Amplitude â © Minimum	If the voltage is less than 300 millivolts or if the ABS module is faulted internally, this DTC can set. This DTC can set as a result of a brake pedal sensor supply or signal return circuit fault (such as an open circuit). Diagnose DTC C100F:11 or 12 first if it is retrieved along with this DTC.
• C100D:22 â Brake Pedal Angle	If the voltage is greater than 4.72 volts, this DTC can set. This DTC can set as a result of a brake pedal angle sensor supply or signal return circuit fault (such as an open circuit), an internal brake pedal angle sensor fault or an internal ABS

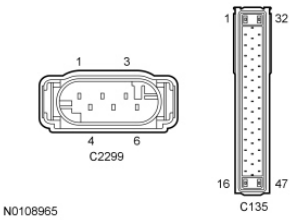
Sensor Circuit 1: Signal Amplitude > Maximum	module fault. Diagnose DTC C100F:11 or 12 first if it is retrieved along with this DTC.
• C100E:21 â Brake Pedal Angle Sensor Circuit 2: Signal Amplitude â © Minimum	If the voltage is less than 300 millivolts, this DTC can set. This DTC can set as a result of a brake pedal angle sensor supply or signal return circuit fault (such as an open circuit), an internal brake pedal angle sensor fault or an internal ABS module fault. Diagnose DTC C100F:11 or 12 first if it is retrieved along with this DTC.
• C100E:22 â Brake Pedal Angle Sensor Circuit 2: Signal Amplitude > Maximum	If the voltage is greater than 4.72 volts, this DTC can set. This DTC can set as a result of a brake pedal angle sensor supply or signal return circuit fault (such as an open circuit), an internal brake pedal angle sensor fault or an internal ABS module fault. Diagnose DTC C100F:11 or 12 first if it is retrieved along with this DTC.
• C100F:11 â Brake Pedal Angle Sensor Supply: Circuit Short To Ground	If the circuit is shorted to ground, this DTC sets. The ABS module supplies power to both of the sensors inside the brake pedal angle sensor. Correct this DTC before diagnosing DTCs C100D:21, 22 or C100E:21, 22.
• C100F:12 â Brake Pedal Angle Sensor Supply: Circuit Short To Battery	If the circuit is shorted to voltage, this DTC sets. Correct this DTC before diagnosing DTCs C100D:21, 22 or C100E:21, 22.

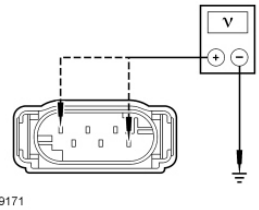
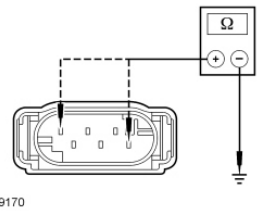
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Brake pedal angle sensor
- ABS module

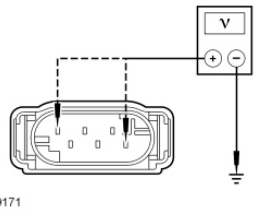
PINPOINT TEST U: DTCs C100A:62; C100D:21, 22; C100E:21, 22 AND C100F:11, 12

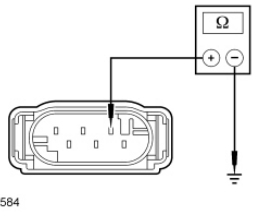
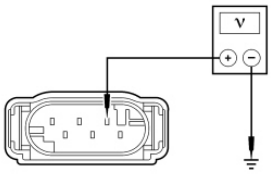
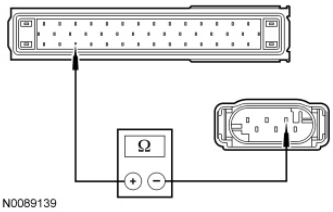
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

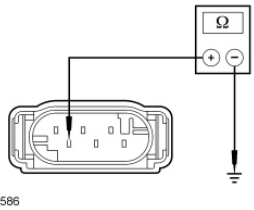
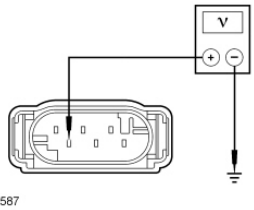
Test Step	Result / Action to Take
U1 VERIFY ALL WIRING CONNECTIONS	
• Disconnect: Brake Pedal Angle Sensor C2299 . • Disconnect: ABS Module C135 . • Using a good light source, inspect each connector terminal for any corrosion. • Inspect both connectors for any pushed-out pins.	**Yes** GO to U2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.

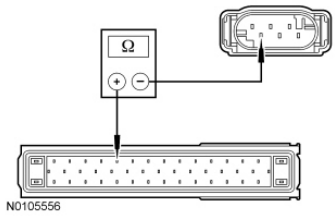
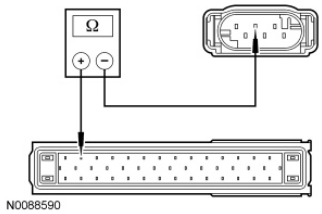
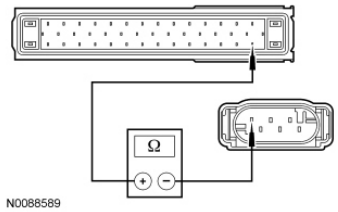
Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C135-2 ♦ C135-11 ♦ C135-14 ♦ C135-44 ♦ C2299-1 ♦ C2299-2 ♦ C2299-3 ♦ C2299-4 ♦ C2299-5 ♦ C2299-6 • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information.  • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	
U2 CHECK THE DTCs FROM THE ABS MODULE	
• Review the DTCs retrieved and recorded during Inspection and Verification. • **Is DTC C100F:11 or 12 present?**	**Yes** If DTC C100F:11 or 12 is present, GO to U3 . **No** If DTC C100D:21 is present, GO to U10 . If DTC C100D:22 is present, GO to U11 . If DTC C100E:21 is present, GO to U7 . If DTC C100E:22 is present, GO to U8 . If only DTC C100A:62 is present, GO to U6 . If DTCs C100D:22 **and** C100E:22 are present, GO to U13 . For all other ABS module DTCs, REFER to the ABS Module DTC Chart in this section.
U3 CHECK THE VOLTAGE SUPPLY TO THE PEDAL ANGLE SENSOR	

• Connect: ABS Module C135 . • Ignition ON. • Measure the voltage between ground and: ♦ brake pedal angle sensor C2299-1, circuit LCA27 (BN/WH), harness side. ♦ brake pedal angle sensor C2299-6, circuit LCA27 (BN/WH), harness side.  N0099171 • **Are the voltages approximately 5 volts?**	**Yes** INSTALL a new brake pedal angle sensor. REFER to Brake Pedal Angle Sensor in Section 206-06 . **No** If the voltage is less than 5 volts, GO to U4 . If the voltage is greater than 5 volts, GO to U5 .
U4 CHECK THE SENSOR VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: ABS Module C135 . • Measure the resistance between ground and: ♦ brake pedal angle sensor C2299-1, circuit LCA27 (BN/WH), harness side. ♦ brake pedal angle sensor C2299-6, circuit LCA27 (BN/WH), harness side.  N0099170 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation. **No** REPAIR circuit LCA27 (BN/WH). CLEAR the DTCs. REPEAT the self-test.
U5 CHECK THE SENSOR VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO VOLTAGE	

• Ignition OFF. • Disconnect: ABS Module C135 . • Ignition ON. • Measure the voltage between ground and: ♦ brake pedal angle sensor C2299-1, circuit LCA27 (BN/WH), harness side. ♦ brake pedal angle sensor C2299-6, circuit LCA27 (BN/WH), harness side.  N0099171 • **Is any voltage present?**	**Yes** REPAIR circuit LCA27 (BN/WH). CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation.
U6 CHECK THE BRAKE PEDAL ANGLE SENSOR PIDs	
• Connect: ABS Module C135 . • Connect: Brake Pedal Angle Sensor C2299 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger â ABS Module . • Monitor the following PIDs while applying and releasing the brake pedal: ♦ Brake Pedal Angle Sensor Circuit 1 (BRK_PDL) ♦ Brake Pedal Angle Sensor Circuit 2 (BRK_PDL_B) • **Do the PID values reflect the movement of the brake pedal?**	**Yes** CLEAR the DTCs. REPEAT the self-test. If DTC C100A:62 returns, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation. **No** If the BRK_PDL PID does not reflect the movement of the brake pedal, GO to U10 . If the BRK_PDL_B PID does not reflect the movement of the brake pedal, GO to U7 .
U7 CHECK THE SENSOR SIGNAL 1 RETURN CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Brake Pedal Angle Sensor C2299 (if not previously disconnected) . • Disconnect: ABS Module C135 (if not previously disconnected) . • Measure the resistance between brake pedal angle sensor C2229-3, circuit VCA30 (YE/VT), harness side and ground.	**Yes** GO to U9 . **No** REPAIR circuit VCA30 (YE/VT). CLEAR the DTCs. REPEAT the self-test.

 N0088584 • **Is the resistance greater than 10,000 ohms?**	
U8 CHECK THE SENSOR SIGNAL 1 RETURN CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Brake Pedal Angle Sensor C2299 . • Disconnect: ABS Module C135 . • Ignition ON. • Measure the voltage between brake pedal angle sensor C2299-3, circuit VCA30 (YE/VT), harness side and ground.  N0080073 • **Is any voltage present?**	**Yes** REPAIR circuit VCA30 (YE/VT). CLEAR the DTCs. REPEAT the self-test. **No** GO to U13 .
U9 CHECK THE SENSOR SIGNAL 1 RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between brake pedal angle sensor C2299-3, circuit VCA30 (YE/VT), harness side and ABS module C135-44, circuit VCA30 (YE/VT), harness side.  N0089139 • **Is the resistance less than 5 ohms?**	**Yes** GO to U14 . **No** REPAIR circuit VCA30 (YE/VT). CLEAR the DTCs. REPEAT the self-test.

U10 CHECK THE SENSOR SIGNAL 2 RETURN CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Brake Pedal Angle Sensor C2299 (if not previously disconnected) . • Disconnect: ABS Module C135 (if not previously disconnected) . • Measure the resistance between brake pedal angle sensor C2299-4, circuit VCA43 (WH/GN), harness side and ground.  N0088586 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to U12 . **No** REPAIR circuit VCA43 (WH/GN). CLEAR the DTCs. REPEAT the self-test.
U11 CHECK THE SENSOR SIGNAL 2 RETURN CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between brake pedal angle sensor C2299-4, circuit VCA43 (WH/GN), harness side and ground.  N0088587 • **Is any voltage present?**	**Yes** REPAIR circuit VCA43 (WH/GN). CLEAR the DTCs. REPEAT the self-test. **No** GO to U13 .
U12 CHECK THE SENSOR SIGNAL 2 RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between brake pedal angle sensor C2299-4, circuit VCA43 (WH/GN), harness side and ABS module C135-11, circuit VCA43 (WH/GN), harness side.	**Yes** GO to U14 . **No** REPAIR circuit VCA43 (WH/GN). CLEAR the DTCs. REPEAT the self-test.

 N0105556 • **Is the resistance less than 5 ohms?**	
U13 CHECK THE SENSOR GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between brake pedal angle sensor C2299-2, circuit RCA27 (WH), harness side and ABS module C135-14, circuit RCA27 (WH), harness side.  N0088590 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new brake pedal angle sensor. REFER to Brake Pedal Angle Sensor in Section 206-06 . **No** REPAIR circuit RCA27 (WH). CLEAR the DTCs. REPEAT the self-test.
U14 CHECK THE SENSOR VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Measure the resistance between brake pedal angle sensor C2299-1, circuit LCA27 (BN/WH), harness side and ABS module C135-2, circuit LCA27 (BN/WH), harness side.  N0088589 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new brake pedal angle sensor. REFER to Brake Pedal Angle Sensor in Section 206-06 . **No** REPAIR circuit LCA27 (BN/WH). CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test V: DTCs C1011:1C, 1F, 67 and C1012:01

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The brake pedal feel simulator cut-off solenoid valve and brake pedal feel simulator cut-off pressure sensor are located within the brake pedal feel simulator, which is attached to the brake pedal assembly. The ABS module applies a Pulse Width Modulated (PWM) ground signal to the brake pedal feel simulator cut-off solenoid valve to increase the resistance felt when the driver applies the brake pedal. The ABS module uses input from the brake pedal feel simulator cut-off valve pressure sensor to verify that the brake pedal feel simulator cut-off solenoid valve is functioning properly. If the ABS module detects a fault with a brake system component that would adversely affect brake-by-wire operation, the module removes power from the brake pedal feel simulator cut-off valve solenoid, relieving simulator fluid pressure.

The ABS module provides power to the brake pedal feel simulator cut-off valve solenoid.

The ABS module provides the brake pedal feel simulator cut-off pressure sensor a 5-volt reference voltage. The brake pedal feel simulator provides a signal voltage proportional to the fluid pressure in the brake pedal feel simulator cut-off device to the ABS module. The ABS module provides a signal return for brake pedal feel simulator cut-off pressure sensor.

Both the brake pedal feel simulator cut-off solenoid valve and brake pedal feel simulator cut-off pressure sensor are internal to the brake pedal feel simulator and cannot be serviced separately. If a new brake pedal feel simulator is needed, a new brake pedal assembly must be installed.

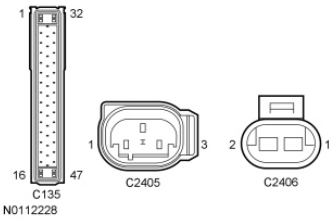
DTC Description	Fault Trigger Conditions
• C1011:1C â Brake Pedal Feel Simulator Cut-Off Pressure Sensor: Circuit Voltage Out of Range	If the brake pedal feel simulator cut-off pressure sensor circuits are intermittently shorted to ground, shorted to voltage or have high resistance, this DTC sets.
• C1011:1F â Brake Pedal Feel Simulator Cut-Off Pressure Sensor: Circuit Intermittent	If the brake pedal feel simulator cut-off pressure sensor circuits are shorted to ground, shorted to voltage or have high resistance, this DTC sets.
• C1011:67 â Brake Pedal Feel Simulator Cut-Off Pressure Sensor: Signal Incorrect After Event	If the test signal produced by the brake pedal feel simulator cut-off pressure sensor is incorrect, this DTC sets.
• C1012:01 â Brake Pedal Feel Simulator Cut-Off Valve Solenoid: General Electrical Failure	If the brake pedal feel simulator cut-off valve solenoid circuits are shorted to ground, shorted to power or have high resistance or if the brake pedal feel simulator cut-off valve solenoid is shorted internally, this DTC sets.

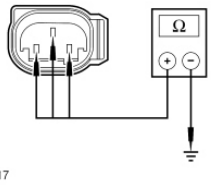
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Brake pedal feel simulator cut-off pressure sensor
- Brake pedal feel simulator valve solenoid
- ABS module

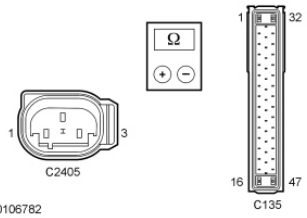
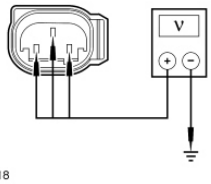
PINPOINT TEST V: DTCs C1011:1C, 1F, 67 AND C1012:01

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
V1 VERIFY ALL WIRING CONNECTIONS	
• Disconnect: ABS Module C135 . • Disconnect: Brake Pedal Feel Simulator Cut-Off Pressure Sensor C2405 . • Disconnect: Brake Pedal Feel Simulator Cut-Off Valve Solenoid C2406 . • Using a good light source, inspect each connector terminal for any corrosion. • Inspect both connectors for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C135-5 ♦ C135-40 ♦ C135-41 ♦ C2405-1 ♦ C2405-2 ♦ C2405-3 ♦ C2406-1 ♦ C2406-2  • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	**Yes** GO to V2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.
V2 CHECK THE DTCs FROM THE ABS MODULE SELF-TEST	
• Review the DTCs retrieved and recorded during Inspection and Verification. • **Is DTC C1011:1C, 1F, 67 or C1012:01 present?**	**Yes** If DTC C1011:1C, 1F, or 67 is present, GO to V3 . If DTC C1012:01 is present, GO to V8 .

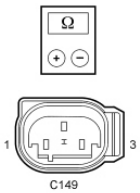
	No For all other ABS module DTCs, REFER to the ABS Module DTC Chart in this section.
V3 CHECK THE BRAKE PEDAL FEEL SIMULATOR CUT-OFF PRESSURE SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between ground and: ♦ brake pedal feel simulator cut-off pressure sensor C2405-1, circuit RCA16 (BU/BN), harness side. ♦ brake pedal feel simulator cut-off pressure sensor C2405-2, circuit VCA13 (YE/BU), harness side. ♦ brake pedal feel simulator cut-off pressure sensor C2405-3, circuit LCA16 (GN), harness side.  N0093117 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to V4 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
V4 CHECK THE BRAKE FLUID PRESSURE SENSOR CIRCUITS FOR AN OPEN	
• Measure the resistance between ABS module C135, harness side and brake pedal feel simulator cut-off pressure sensor C2405, harness side as indicated in the following chart:	**Yes** GO to V5 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

ABS Module	Circuit	Brake Pedal Feel Simulator Cut-Off Pressure Sensor
C135-5	LCA16 (GN)	C2405-3
C135-41	VCA13 (YE/BU)	C2405-2
C135-40	RCA16 (BU/BN)	C2405-1

 • **Are the resistances less than 5 ohms?**	
V5 CHECK THE BRAKE PEDAL FEEL SIMULATOR CUT-OFF PRESSURE SENSOR CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between ground and: ♦ brake pedal feel simulator cut-off pressure sensor C2405-1, circuit RCA16 (BU/BN), harness side. ♦ brake pedal feel simulator cut-off pressure sensor C2405-2, circuit VCA13 (YE/BU), harness side. ♦ brake pedal feel simulator cut-off pressure sensor C2405-3, circuit LCA16 (GN), harness side.  • **Is any voltage present?**	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. **No** GO to V6 .
V6 CHECK THE BRAKE PEDAL FEEL SIMULATOR CUT-OFF PRESSURE SENSOR CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between brake pedal feel simulator cut-off pressure sensor C2405 pins, harness side, as indicated in the following chart:	**Yes** GO to V7 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

Brake Pedal Feel Simulator Cut-off Pressure Sensor	Circuit	Brake Pedal Feel Simulator Cut-off Pressure Sensor
C2405-1	RCA16 (BU/BN)/ VCA13 (YE/BU)	C2405-2
C2405-1	RCA16 (BU/BN)/	C2405-3

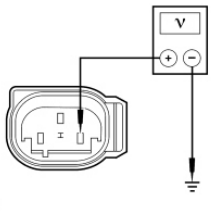
	LCA16 (GN)	
C2405-2	VCA13 (YE/BU)/ LCA16 (GN)	C2405-3



- **Are the resistances greater than 10,000 ohms?**

V7 CHECK THE ABS MODULE OUTPUT

- Ignition OFF.
- Connect: ABS Module C135 .
- Ignition ON.
- Measure the voltage between brake pedal feel simulator cut-off pressure sensor C2405-3, circuit LCA16 (GN), harness side and ground.



- **Is the voltage approximately 5 volts?**

Yes
INSTALL a new brake pedal and bracket assembly. REFER to Brake Pedal and Bracket â Hybrid in Section 206-06 . CLEAR the DTCs. REPEAT the self-test.

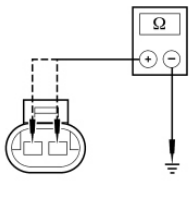
No
GO to V12 .

V8 CHECK THE BRAKE PEDAL FEEL SIMULATOR CUT-OFF VALVE SOLENOID CIRCUITS FOR A SHORT TO GROUND

- Ignition OFF.
- Disconnect: Brake Pedal Feel Simulator Cut-Off Valve Solenoid C2406 .
- Disconnect: ABS Module C135 .
- Measure the resistance between ground and:
  - ♦ brake pedal feel simulator cut-off valve solenoid C2406-1, circuit CCB31 (BU/OG), harness side.
  - ♦ brake pedal feel simulator cut-off valve solenoid C2406-2, circuit CCB32 (GN/VT), harness side.

Yes
GO to V9 .

No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

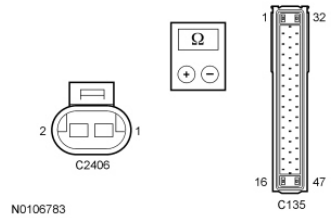


- **Is the resistance greater than 10,000 ohms?**

V9 CHECK THE BRAKE PEDAL FEEL SIMULATOR CUT-OFF VALVE SOLENOID CIRCUITS FOR AN OPEN

- Measure the resistance between ABS module C135, harness side and brake pedal feel simulator cut-off valve solenoid C2406, harness side as indicated in the following chart:

ABS Module	Circuit	Brake Pedal Feel Simulator Cut-Off Valve Solenoid
C135-4	CCB31 (BU/OG)	C2406-1
C135-3	CCB32 (GN/VT)	C2406-2



- **Are the resistances less than 5 ohms?**

Yes
GO to V10 .

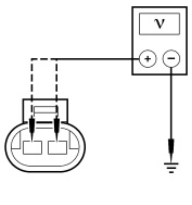
No
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

V10 CHECK THE BRAKE PEDAL FEEL SIMULATOR CUT-OFF VALVE SOLENOID CIRCUITS FOR A SHORT TO VOLTAGE

- Ignition ON.
- Measure the voltage between ground and:
  - ♦ brake pedal feel simulator cut-off valve solenoid C2406-1, circuit CCB31 (BU/OG), harness side.
  - ♦ brake pedal feel simulator cut-off valve solenoid C2406-2, circuit CCB32 (GN/VT), harness side.

Yes
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

No
GO to V11 .

 • **Is any voltage present?**	
V11 ISOLATE THE BRAKE PEDAL FEEL SIMULATOR CUT-OFF VALVE SOLENOID	
• Measure the resistance between brake pedal feel simulator cut-off valve solenoid C2406 pin-1 and pin-2, component side. • **Is the resistance between 18 and 20 ohms?**	**Yes** GO to V12 . **No** INSTALL a new brake pedal assembly. REFER to Brake Pedal and Bracket in Section 206-06 .
V12 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect: ABS Module C135 . • Check the connector for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: ABS Module C135 . • Make sure the connector is seated correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test W: DTC C101A:1C, 62, 64 or C101B:1C

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The vacuum pressure sensor produces 2 signals used by the ABS module to check the integrity of the vacuum lines, hoses and fittings, and to measure the performance of the brake vacuum pump and brake booster. The ABS module provides a 5-volt reference voltage to the vacuum pressure sensor. The ABS module provides a signal return to the vacuum pressure sensor along circuit.

DTC Description	Fault Trigger Conditions
• C101A:1C â Vacuum Pressure Sensor: Circuit Voltage Out of Range	If vacuum pressure sensor circuit is shorted to ground, shorted to voltage or has high resistance, this DTC sets. A short to ground or a short to voltage, or an open on or short to voltage on circuit could cause both DTCs C101A:1C and C101B:1C to set.

• C101A:62 â Vacuum Pressure Sensor: Signal Compare Failure	If the 2 vacuum pressure signals produced by the vacuum pressure sensor do not match, this DTC sets. If vacuum sensor circuit has high resistance (open circuit), this DTC sets. This DTC can set as a result of DTCs C101A:1C, 64 and C101B:1C.
• C101A:64 â Vacuum Pressure Sensor: Signal Plausibility Failure	If the vacuum pressure sensor signal A, circuit is shorted to vacuum pressure sensor signal B, circuit, this DTC sets.
• C101B:1C â Vacuum Pressure Sensor Circuit B: Circuit Voltage Out of Range	If vacuum pressure sensor circuit is shorted to ground, shorted to voltage or has high resistance, this DTC sets. A short to ground or a short to voltage on circuit, or an open on or short to voltage on circuit could cause both DTCs C101A:1C and C101B:1C to set.

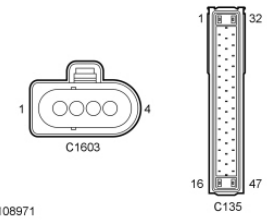
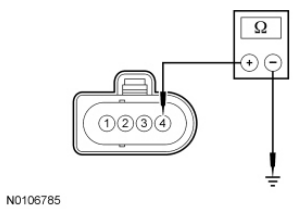
This pinpoint test is intended to diagnose the following:

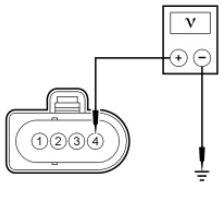
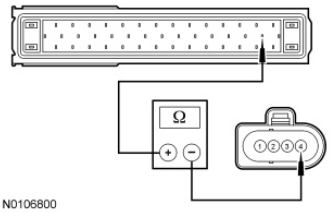
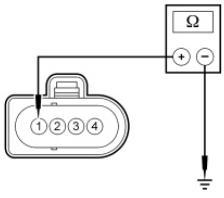
- Wiring, terminals or connectors
- Vacuum pressure sensor
- ABS module

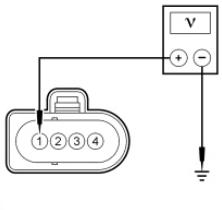
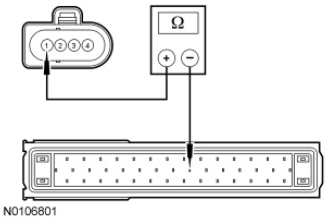
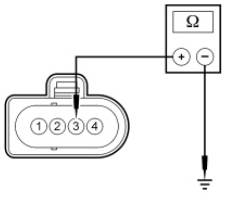
PINPOINT TEST W: C101A:1C, 62, 64 or C101B:1C

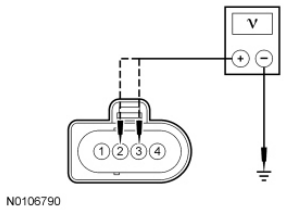
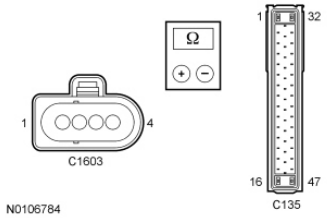
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
W1 VERIFY ALL WIRING CONNECTIONS	
• Ignition OFF. • Disconnect: Vacuum Sensor C1603 . • Disconnect: ABS Module C135 . • Using a good light source, inspect each connector terminal for any corrosion. • Inspect both connectors for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C135-6 ♦ C135-25 ♦ C135-28 ♦ C135-30 ♦ C1603-1 ♦ C1603-2 ♦ C1603-3	**Yes** GO to W2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.

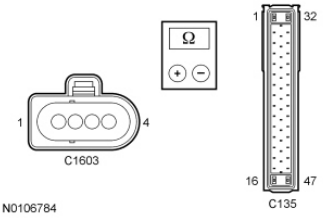
♦ C1603-4 • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information.  • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	
W2 CHECK THE DTCs FROM THE ABS MODULE SELF-TEST	
• Review the DTCs recorded during Inspection and Verification. • **Are both DTCs C101A:1C and C101B:1C present?**	**Yes** GO to W9 . **No** If DTC C101A:1C is present without DTC C101B:1C, GO to W3 . If DTC C101B:1C is present without DTC C101A:1C, GO to W6 . If DTC C101A:64 is present, GO to W13 . If only DTC C101A:62 is present, GO to W11 . For all other DTCs, GO to the ABS Module DTC Chart in this section.
W3 CHECK THE SENSOR SIGNAL 1 RETURN CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between vacuum sensor C1603-4, circuit VCA38 (BN/VT), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to W4 . **No** REPAIR circuit VCA38 (BN/VT). CLEAR the DTCs. REPEAT the self-test.

W4 CHECK THE SENSOR SIGNAL 1 RETURN CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between vacuum sensor C1603-4, circuit VCA38 (BN/VT), harness side and ground.  N0106786 • **Is any voltage present?**	**Yes** REPAIR circuit VCA38 (BN/VT). CLEAR the DTCs. REPEAT the self-test. **No** GO to W5 .
W5 CHECK THE SENSOR SIGNAL 1 RETURN CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between vacuum sensor C1603-4, circuit VCA38 (BN/VT), harness side and ABS module C135-30, circuit VCA38 (BN/VT), harness side.  N0106800 • **Is the resistance less than 5 ohms?**	**Yes** GO to W9 . **No** REPAIR circuit VCA38 (BN/VT). CLEAR the DTCs. REPEAT the self-test.
W6 CHECK THE SENSOR SIGNAL 2 RETURN CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between vacuum sensor C1603-1, circuit VCA39 (BU/GN), harness side and ground.  N0106787 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to W7 . **No** REPAIR circuit VCA39 (BU/GN). CLEAR the DTCs. REPEAT the self-test.

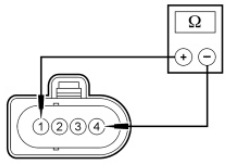
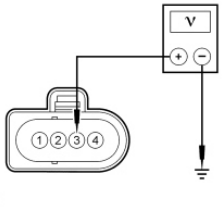
W7 CHECK THE SENSOR SIGNAL 2 RETURN CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between vacuum sensor C1603-1, circuit VCA39 (BU/GN), harness side and ground.  N0106788 • **Is any voltage present?**	**Yes** REPAIR circuit VCA39 (BU/GN). CLEAR the DTCs. REPEAT the self-test. **No** GO to W8 .
W8 CHECK THE SENSOR SIGNAL 2 RETURN CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between vacuum sensor C1603-1, circuit VCA39 (BU/GN), harness side and ABS module C135-25, circuit VCA39 (BU/GN), harness side.  N0106801 • **Is the resistance less than 5 ohms?**	**Yes** GO to W9 . **No** REPAIR circuit VCA39 (BU/GN). CLEAR the DTCs. REPEAT the self-test.
W9 CHECK THE SENSOR VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between vacuum sensor C1603-3, circuit LCA37 (YE/OG), harness side and ground.  N0106789 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to W10 . **No** REPAIR circuit LCA37 (YE/OG). CLEAR the DTCs. REPEAT the self-test.

W10 CHECK THE SENSOR VOLTAGE SUPPLY AND GROUND CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between ground and: ♦ C1603-3, circuit LCA37 (YE/OG), harness side. ♦ C1603-2, circuit RCA37 (WH/BU), harness side.  N0106790 • **Is any voltage present?**	**Yes** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. **No** GO to W11 .
W11 CHECK THE SENSOR VOLTAGE SUPPLY AND GROUND CIRCUITS FOR AN OPEN	
• Ignition OFF. • Measure the resistance between ABS module C135, harness side and vacuum sensor C1603, harness side as indicated in the following chart: **ABS Module / Circuit / Vacuum Sensor** C135-6 / LCA37 (YE/OG) / C1603-3 C135-28 / RCA37 (WH/BU) / C1603-2  N0106784 • **Are the resistances less than 5 ohms?**	**Yes** If only DTC C101A:62 is present, GO to W12 . For all other DTCs, GO to W13 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
W12 CHECK BOTH SENSOR SIGNAL RETURN CIRCUITS FOR AN OPEN	
• Measure the resistance between ABS module C135, harness side and vacuum sensor C1603, harness side as indicated in the following chart:	**Yes** GO to W13 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

ABS Module	Circuit	Vacuum Sensor
C135-30	VCA38 (BN/VT)	C1603-4
C135-25	VCA39 (BU/GN)	C1603-1



- **Are the resistances less than 5 ohms?**

W13 CHECK BOTH SENSOR SIGNAL RETURN CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between vacuum sensor C1603-1, circuit VCA39 (BU/GN), harness side and ABS module C1603-4, circuit VCA38 (BN/VT), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to W14 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
W14 CHECK ABS MODULE OUTPUT	
• Connect: ABS Module C135 . • Ignition ON. • Measure the voltage between vacuum sensor C1603-3, circuit LCA37 (YE/OG) and ground.  • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** INSTALL a new vacuum sensor. REFER to Section 206-07 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. REPEAT the self-test.

Pinpoint Test X: DTCs C101C:01 and 71

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

When the combustion engine is not running, the electric vacuum pump is utilized to maintain a vacuum inside the brake booster. The ABS module controls the electric vacuum pump through the use of a mechanical relay located in the Battery Junction Box (BJB) and a solid state relay located in the auxiliary relay box. The mechanical relay provides power to the solid state relay. The solid state relay provides power to the electric vacuum pump motor. When the ignition is in the RUN position, the ABS module closes the mechanical relay. After the vehicle is started (the ready indicator is illuminated), the ABS module activates the solid state relay as necessary to maintain a vacuum inside the brake booster.

Fused battery voltage is provided to the mechanical relay from the BJB . When the ignition switch is turned to the RUN position, the ABS module grounds the output side of the mechanical relay solenoid. This closes the mechanical relay and send voltage to the solid state relay. When it is necessary to build vacuum in the brake booster, the ABS module grounds the solid state relay along circuit. The solid state relay then sends voltage to the vacuum pump and BJB fuse 37. The voltage passes through BJB fuse 37 (5A) and is delivered to the ABS module along circuit. The ABS module uses this voltage input to monitor the vacuum pump.

The logic internal to the solid state relay provides circuit protection for the vacuum pump circuit. If a short to ground on circuit is detected, the relay stops applying power until the short has been repaired.

If a vacuum pump DTC is set, the red brake warning indicator illuminates and the combustion engine runs to supply vacuum to the brake booster.

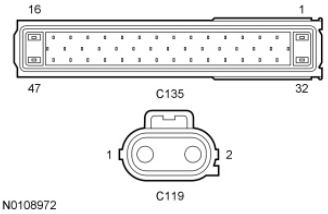
- DTC C101C:01 (Brake Vacuum Pump: General Electrical Failure) â If the ABS module detects a short to ground, an open or high resistance on circuits CBB37 (WH), CCB29 (WH/VT) and CCB30 (GY/VT), or an open or high resistance , this DTC sets.
- DTC C101C:71 (Brake Vacuum Pump: Actuator Stuck) â If the ABS module detects that vacuum in the brake booster is increasing when the vacuum pump is commanded off and the combustion engine is not running, this DTC sets.

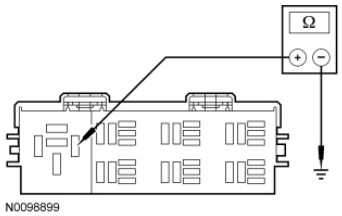
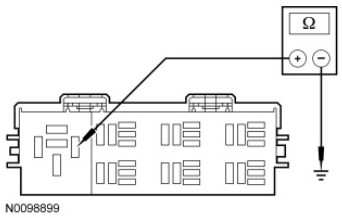
This pinpoint test is intended to diagnose the following:

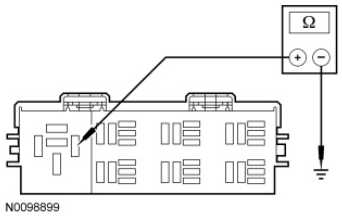
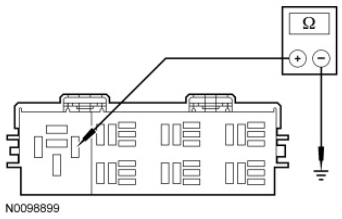
- Fuses
- Wiring, terminals or connectors
- Electric vacuum pump solid state relay
- Electric vacuum pump solid mechanical relay
- Electric vacuum pump
- ABS module

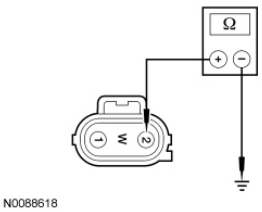
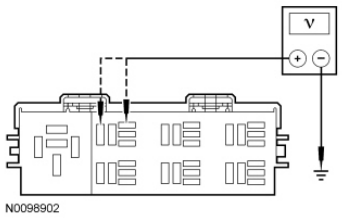
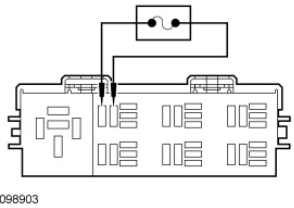
PINPOINT TEST X: DTCs C101C:01 AND 71

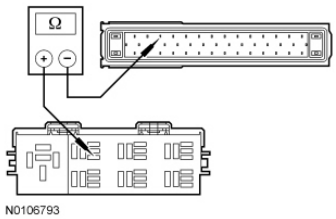
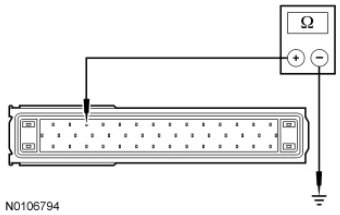
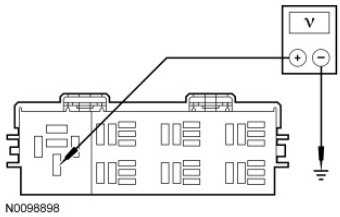
Test Step	Result / Action to Take
X1 VERIFY ALL WIRING CONNECTIONS	
• Disconnect: Vacuum Pump Motor C1119 . • Disconnect: ABS Module C135 . • Disconnect: Vacuum Pump Solid State Relay . • Disconnect: Vacuum Pump Mechanical Relay . • Using a good light source, inspect each connector terminal for any corrosion.	**Yes** GO to X2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.

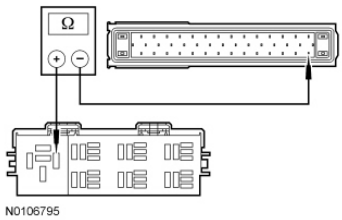
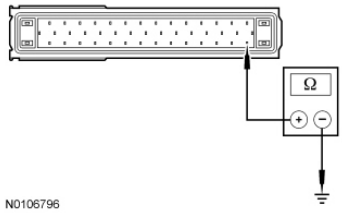
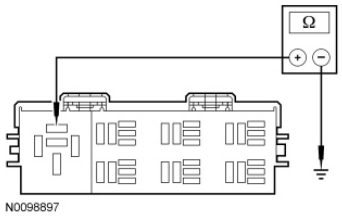
• Inspect both connectors for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C135-15 ♦ C135-20 ♦ C135-35 ♦ C1119-1 ♦ C1119-2 ♦ Vacuum pump solid state relay cavities ♦ Vacuum pump mechanical relay cavities • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information.  • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	
X2 CHECK THE DTCs FROM THE ABS MODULE SELF-TEST	
• Connect: Vacuum Pump Motor C1119 . • Connect: ABS Module C135 . • Connect: Vacuum Pump Solid State Relay . • Connect: Vacuum Pump Mechanical Relay . • Review the DTCs retrieved and recorded during Inspection and Verification. • **Is DTC C101C:01 or C101C:71 present?**	**Yes** If DTC C101C:01 is present, GO to X5 . If DTC C101C:71 is present, GO to X3 . **No** For all other ABS module DTCs, GO to the ABS Module DTC Chart in this section.
X3 CHECK THE SOLID STATE RELAY CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Vacuum Pump Solid State Relay . • Measure the resistance between the vacuum pump solid state relay socket 86, circuit CCB30 (GY/VT) and ground.	**Yes** INSTALL a new vacuum pump solid state relay. **No** GO to X4 .

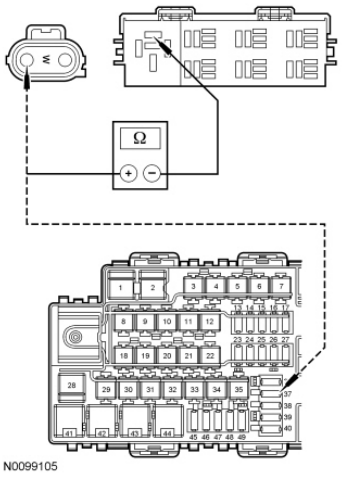
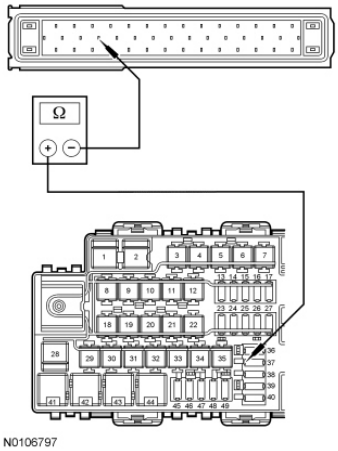
 • **Is the resistance greater than 10,000 ohms?**	
X4 ISOLATE THE SOLID STATE RELAY CONTROL CIRCUIT	
• Ignition OFF. • Disconnect: ABS Module C135 . • Measure the resistance between the vacuum pump solid state relay socket 86, circuit CCB30 (GY/VT) and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to X24 . **No** REPAIR circuit CCB30 (GY/VT). CLEAR the DTCs. REPEAT the self-test.
X5 CHECK THE VACUUM PUMP MOTOR	
• Ignition ON. • **Is the vacuum pump running all the time?**	**Yes** GO to X6 . **No** GO to X11 .
X6 ISOLATE THE SOLID STATE RELAY	
• Disconnect: Vacuum Pump Solid State Relay . • **Is the vacuum pump running all the time?**	**Yes** GO to X9 . **No** GO to X7 .
X7 CHECK THE SOLID STATE RELAY CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the vacuum pump solid state relay cavity 86, circuit CCB30 (GY/VT) and ground.	**Yes** INSTALL a new solid state relay. CLEAR the DTCs. REPEAT the self-test. **No** GO to X8 .

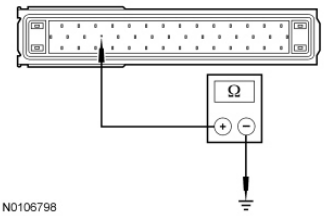
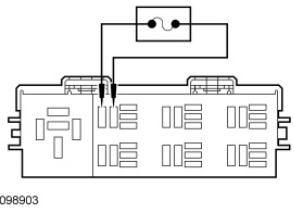
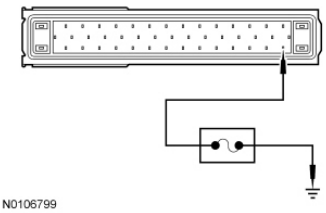
 • **Is the resistance greater than 10,000 ohms?**	
X8 ISOLATE THE ABS MODULE	
• Disconnect: ABS Module C135 . • Measure the resistance between the vacuum pump solid state relay cavity 86, circuit CCB30 (GY/VT) and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to X24 . **No** REPAIR circuit CCB30 (GY/VT). CLEAR the DTCs. REPEAT the self-test.
X9 ISOLATE THE VACUUM PUMP MOTOR CONTROL CIRCUIT	
• Disconnect: BJB Fuse 37 (5A) . • **Is the pump running all the time?**	**Yes** REPAIR circuit CCB29 (WH/VT). CLEAR the DTCs. REPEAT the self-test. **No** GO to X10 .
X10 CHECK THE ABS MODULE PUMP MOTOR MONITOR CIRCUIT	
• Connect: BJB Fuse 37 (5A) . • Ignition OFF. • Disconnect: ABS Module C135 . • Ignition ON. • **Is the pump running all the time?**	**Yes** REPAIR circuit CBB37 (WH). CLEAR the DTCs. REPEAT the self-test. **No** GO to X24 .
X11 CHECK THE VACUUM PUMP GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Vacuum Pump Motor C1119 . • Measure the resistance between vacuum pump motor C1119-2, circuit GD121 (BK/YE), harness side and ground.	**Yes** GO to X12 . **No** REPAIR circuit GD121 (BK/YE). CLEAR the DTCs. REPEAT the self-test.

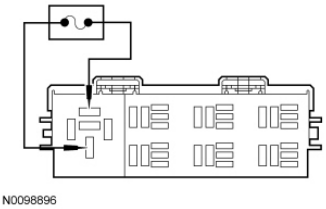
 N0088618 • **Is the resistance less than 5 ohms?**	
X12 CHECK THE VACUUM PUMP MECHANICAL RELAY INPUT CIRCUIT FOR VOLTAGE	
• Connect: Vacuum Pump Motor C1119 . • Measure the voltage between ground and: ♦ vacuum pump mechanical relay cavity 3, circuit SBB07 (WH/RD). ♦ vacuum pump mechanical relay cavity 2, circuit SBB07 (WH/RD).  N0098902 • **Are the voltages greater than 10 volts?**	**Yes** GO to X13 . **No** VERIFY BJB fuse 7 (40A) is OK. If OK, REPAIR circuit SBB07 (WH/RD). If not OK, REFER to the Wiring Diagrams manual to identify the cause of the circuit short. CLEAR the DTCs. REPEAT the self-test.
X13 ISOLATE THE VACUUM PUMP MECHANICAL RELAY	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger â ABS Module . • Install a fused jumper wire between vacuum pump mechanical relay cavity 3, circuit SBB07 (WH/RD) and cavity 5, circuit CBB07 (GN/BU).  N0098903 • Using the scan tool, toggle the vacuum pump (VAC_PMP) active command on. • **Does the pump motor run?**	**Yes** REMOVE the fused jumper wire. GO to X14 . **No** GO to X16 .
X14 CHECK THE MECHANICAL RELAY CONTROL CIRCUIT FOR AN OPEN	

• Ignition OFF. • Disconnect: ABS Module C135 . • Measure the resistance between ABS module C135-35, circuit CBB30 (GY/BK), harness side and vacuum pump mechanical relay socket 1, circuit CBB30 (GY/BK).  N0106793 • **Is the resistance less than 5 ohms?**	**Yes** GO to X15 . **No** REPAIR circuit CBB30 (GY/BK). CLEAR the DTCs. REPEAT the self-test.
X15 CHECK THE MECHANICAL RELAY CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between ABS module C135-35, circuit CBB30 (GY/BK), harness side and ground.  N0106794 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new vacuum pump mechanical relay. CLEAR the DTCs. REPEAT the self-test. **No** REPAIR circuit CBB30 (GY/BK). CLEAR the DTCs and REPEAT the self-test.
X16 CHECK THE SOLID STATE RELAY INPUT CIRCUIT FOR VOLTAGE	
• Disconnect: Vacuum Pump Solid State Relay . • Measure the voltage between vacuum pump solid state relay cavity 30, circuit CBB07 (GN/BU) and ground.  N0098898 • **Is the voltage greater than 10 volts?**	**Yes** REMOVE the fused jumper wire. GO to X17 . **No** REPAIR circuit CBB07 (GN/BU). CLEAR the DTCs and REPEAT the self-test.
X17 CHECK THE SOLID STATE RELAY CONTROL CIRCUIT FOR AN OPEN CIRCUIT	

• Disconnect: ABS Module C135 . • Measure the resistance between the vacuum pump solid state relay cavity 86, circuit CCB30 (GY/VT), and ABS module C135-15, circuit CCB30 (GY/VT), harness side.  N0106795 • **Is the resistance less than 5 ohms?**	**Yes** GO to X18 . **No** REPAIR circuit CCB30 (GY/VT). CLEAR the DTCs. REPEAT the self-test.
X18 CHECK THE SOLID STATE RELAY CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between ABS module C135-15, circuit CCB30 (GY/VT), harness side and ground.  N0106796 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to X19 . **No** REPAIR circuit CCB30 (GY/VT). CLEAR the DTCs and REPEAT the self-test.
X19 CHECK THE VACUUM PUMP SOLID STATE RELAY OUTPUT CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: Vacuum Pump Motor C1119 . • Disconnect: BJB Fuse 37 (5A) . • Measure the resistance between the vacuum pump solid state relay cavity 87, circuit CBB29 (WH/VT), harness side and ground.  N0098897 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to X20 . **No** REPAIR circuit CBB29 (WH/VT). CLEAR the DTCs and REPEAT the self-test.
X20 CHECK THE VACUUM PUMP SOLID STATE RELAY OUTPUT CIRCUIT FOR AN OPEN CIRCUIT	

• Measure the resistance between the vacuum pump solid state relay cavity 87, circuit CBB29 (WH/VT) and: ♦ vacuum pump motor C1119-1, circuit CBB29 (WH/VT), harness side. ♦ BJB fuse 37 (5A), circuit CBB29 (WH/VT), input side.  N0099105 • **Is the resistance less than 5 ohms?**	**Yes** GO to X21 . **No** REPAIR circuit CBB29 (WH/VT). CLEAR the DTCs and REPEAT the self-test.
X21 CHECK THE VACUUM PUMP MONITOR CIRCUIT FOR AN OPEN CIRCUIT	
• Measure the resistance between BJB fuse 37 (5A), circuit CBB37 (WH), input side and ABS module C135-20, circuit CBB37 (WH), harness side.  N0106797 • **Is the resistance less than 5 ohms?**	**Yes** GO to X22 . **No** REPAIR circuit CBB37 (WH). CLEAR the DTCs and REPEAT the self-test.
X22 CHECK THE VACUUM PUMP MONITOR CIRCUIT FOR A SHORT TO GROUND	

• Measure the resistance between ABS module C135-20, circuit CBB37 (WH), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to X23 . **No** REPAIR circuit CBB37 (WH). CLEAR the DTCs and REPEAT the self-test.
X23 CHECK THE VACUUM PUMP OPERATION	
• Connect: Vacuum Pump Motor C1119 . • Connect: Vacuum Pump Motor Solid State Relay . • Install a fused jumper wire between vacuum pump mechanical relay cavity 3, circuit SBB07 (WH/RD) and cavity 5, circuit CBB07 (GN/BU).  • **Momentarily** connect a fused jumper wire between ABS module C135-15, circuit CBB30 (GY/BK), harness side and ground.  • **Does the pump run when the jumper wire is connected to ground?**	**Yes** REMOVE both fused jumper wires. GO to X24 . **No** REMOVE the fused jumper wire from the ABS module connector. GO to X25 .
X24 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect: ABS Module C135 . • Check the connector for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: ABS Module C135 .	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. TEST the system for normal operation. **No**

• Make sure the connector is seated correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
X25 ISOLATE THE VACUUM PUMP MOTOR	
• Disconnect: Vacuum Pump Motor Solid State Relay . • **NOTE:** The fused jumper wire on the mechanical relay should still be installed from the previous step. • **Momentarily** connect a fused jumper wire between vacuum pump solid state relay cavity 30, circuit CCB29 (WH/VT) and cavity 87, circuit CBB07 (GN/BU).  N0098896 • **Does the pump run when the jumper wire is connected?**	**Yes** INSTALL a new solid state relay. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new vacuum pump. REFER to Brake Vacuum Pump in Section 206-07 . CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test Y: DTCs C0061:28, 64; C0063:28, 64; U0151:87, 88 and U0452:29

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The yaw rate sensor, lateral accelerometer and longitudinal accelerometer are contained in the Restraints Control Module (RCM). The RCM measures vehicle yaw rate and lateral acceleration and then sends the information to the ABS module along the dedicated Controller Area Network (CAN) bus. This CAN bus is used only for communication between the RCM and the ABS module. The information sent to the ABS module is used to help determine if the AdvanceTracÂ® system needs to be activated.

DTC Description	Fault Trigger Conditions
• C0061:28 â Lateral Acceleration Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	This DTC is set if the lateral acceleration sensor measures acceleration when the vehicle is not moving.
	This DTC indicates that the lateral acceleration sensor is inconsistent with other acceleration sensor, steering wheel angle sensor and wheel

• C0061:64 â Lateral Acceleration Sensor: Signal Plausibility Failure	speed sensor signals.
• C0063:28 â Yaw Rate Sensor: Signal Bias Level Out of Range/Zero Adjustment Failure	This DTC indicates that the yaw rate sensor is measuring rotation when the vehicle is not moving.
• C0063:64 â Yaw Rate Sensor: Signal Plausibility Failure	This DTC indicates that the yaw rate sensor is inconsistent with other acceleration sensor, steering wheel angle sensor and wheel speed sensor signals.
• U0151:87 â Lost Communication With Restraints Control Module: Missing Message	This DTC sets as a result of a loss of communication with the RCM over either the High Speed Controller Area Network (HS-CAN) bus or the dedicated CAN bus.
• U0151:88 â Lost Communication With Restraints Control Module: Bus Off	This DTC can set if either the dedicated CAN circuits are open, shorted to ground or shorted to each other. Other DTCs indicating missing messages or invalid signal from the RCM sensors can set as a result of a dedicated CAN bus fault.
• U0452:29 â Invalid Data Received From Restraints Control Module: Signal Invalid	This DTC indicates that one or more of the stability/traction control system sensors internal to the RCM have failed and the RCM is transmitting an "invalid data" message.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- RCM incorrectly mounted
- RCM
- ABS module

PINPOINT TEST Y: DTCs C0061:28, 64; C0063:28, 64; U0151:87, 88 AND U0452:29

⚠ WARNING: Never probe the electrical connectors on airbag, Safety CanopyÂ® or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

⚠ WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Supplemental Restraint System (SRS) components should only be disconnected or reconnected when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in

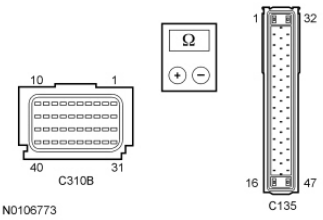
incorrect diagnosis of the SRS .

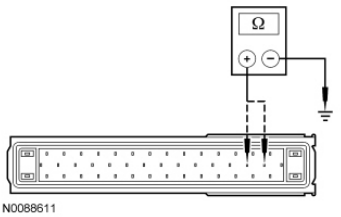
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

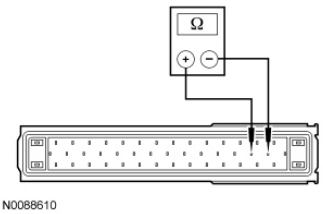
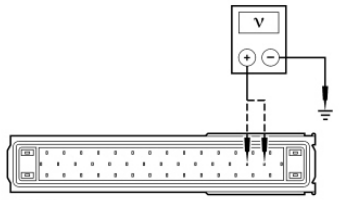
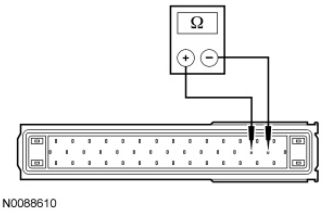
Test Step	Result / Action to Take
Y1 CHECK FOR AN HS-CAN CONCERN WITH THE RCM	
• Connect the scan tool. • Ignition ON. • **NOTE:** The Network Test does not test the dedicated CAN communications between the ABS module and RCM . • Using the scan tool, carry out the Network Test. • **Does the RCM pass the Network Test?**	**Yes** GO to Y2 . **No** REFER to Section 418-00 to diagnose the HS-CAN concern.
Y2 CHECK FOR CORRECT RCM	
• Ignition OFF. • ⚠ **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Gain access to the RCM and check the part number on the RCM against the part number listed in the master parts catalog. Refer to Section 501-20B . • **Does the part number on the RCM match the part number listed in the master parts catalog?**	**Yes** GO to Y3 . **No** INSTALL the correct RCM . REFER to Section 501-20B . GO to Y13 .
Y3 CHECK FOR CORRECT ABS MODULE	
• Enter the following diagnostic mode on the scan tool: Log Viewer . • Retrieve and record the ABS module part number from Log Viewer and check the part number on the ABS module against the part number listed in the master parts catalog. • **Does the part number retrieved from the ABS module match the part number listed in the master parts catalog?**	**Yes** GO to Y4 . **No** INSTALL the correct ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. GO to Y13 .
Y4 CHECK THE RCM CONDITION AND INSTALLATION	
• Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Inspect the RCM for cracks in the case, broken anchor tabs, broken electrical connector and correct installation. Refer to	**Yes** GO to Y5 . **No** REINSTALL or INSTALL new as necessary. GO to Y13 .

Removal and Installation, Restraints Control Module (RCM) in Section 501-20B . • **Is the RCM installed correctly and undamaged?**	
Y5 CHECK THE DEDICATED CAN CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: ABS Module C135 . • Disconnect: RCM C310B . • Measure the resistance between the ABS module C135, harness side and the RCM C310B, harness side as indicated in the following chart: • **Are the resistances less than 5 ohms?**	**Yes** GO to Y6 . **No** REPAIR the affected circuit(s). CLEAR the DTCs. CYCLE the ignition key. REPEAT the self-test. GO to Y13 .
Y6 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between ground and: ♦ ABS module C135-19, circuit VCA24 (GN/OG), harness side. ♦ ABS module C135-18, circuit VCA23 (BU/WH), harness side. • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to Y7 . **No** REPAIR the affected circuit(s). GO to Y13 .
Y7 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TOGETHER	

ABS Module	Circuit	RCM
C135-18	VCA23 (BU/WH)	C310B-20
C135-19	VCA24 (GN/OG)	C310B-19





• Measure the resistance between ABS module C135-19, circuit VCA24 (GN/OG), harness side and ABS module C135-18, circuit VCA23 (BU/WH), harness side.  N0088610 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to Y8 . **No** REPAIR the affected circuit(s). GO to Y13 .
Y8 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between ground and: ♦ ABS module C135-19, circuit VCA24 (GN/OG), harness side. ♦ ABS module C135-18, circuit VCA23 (BU/WH), harness side.  N0088612 • **Is any voltage present?**	**Yes** REPAIR the affected circuit(s). GO to Y13 . **No** GO to Y9 .
Y9 CHECK RCM TERMINATING RESISTOR	
• Ignition OFF. • Connect: RCM C310B . • Measure the resistance between ABS module C135-18, circuit VCA23 (BU/WH), harness side and C135-19, circuit VCA24 (GN/OG), harness side.  N0088610 • **Is the resistance between 108 and 132 ohms?**	**Yes** GO to Y10 . **No** GO to Y11 .

Y10 CHECK THE ABS MODULE FOR CORRECT OPERATION	
• Prior to reconnecting any previously disconnected SRS component: ♦ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ♦ inspect wire harness for any damage, pinched, cut or pierced wires. ♦ inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to Restraints Control Module (RCM) in Section 501-20B . ♦ inspect ABS module C135 for dirt, corrosion, water intrusion, pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ♦ repair any concerns found. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component(s)/Connector(s) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Enter the following diagnostic mode on the scan tool: Self Test â ABS Module . • **Do any of the DTCs listed in Normal Operation return?**	**Yes** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. GO to Y13 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. GO to Y13 .
Y11 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system components, sensor electrical connectors and the RCM electrical connectors are connected before carrying out the self-test. If not, DTCs can be set. • If previously directed to repower the SRS , depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Prior to reconnecting any previously disconnected SRS component:	**Yes** INSTALL a new RCM . REFER to Section 501-20B . GO to Y13 . **No** In the process of diagnosing the fault, the fault condition has become intermittent. CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition frequently. ACTIVATE other systems in the same wire harness. **Do not install any new SRS**

♦ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ♦ inspect wire harness for any damage, pinched, cut or pierced wires. ♦ inspect RCM C310A and C310B CPA lever/lock for correct operation. Refer to Restraints Control Module (RCM) Removal and Installation in Section 501-20B . ♦ inspect ABS module C135 for dirt, corrosion, water intrusion, pushed-out, loose or spread terminals and loose or frayed wire connections at terminals. ♦ repair any concerns found. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component(s)/Connector(s) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Enter the following diagnostic mode on the scan tool: Self Test â RCM . • **Were DTCs U0028:08 and/or U0028:88 retrieved on-demand during self-test?**	**components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to Y12 .
Y12 CHECK FOR AN INTERMITTENT FAULT	
• Ignition OFF. • Depower the SRS . Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Disconnect RCM C310B and ABS module C135: ♦ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals. ♦ inspect wire harness for any damage, pinched, cut or pierced wires. ♦ repair any concerns found. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ	**Yes** REFER to Diagnosis and Testing in Section 501-20B . **No** The fault is not present and cannot be recreated at this time. **Do not install any new SRS components at this time. SRS components should only be installed when directed to do so in the pinpoint test.** GO to Y13 .

Hybrid), Connector Repair Procedures for schematic and connector information. • Connect: All Previously Disconnected Component(s)/Connector(s) . • Repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test â RCM . • **Are any RCM DTCs retrieved on-demand during the self-test?**	
Y13 CHECK FOR ADDITIONAL RCM AND ABS MODULE DTCs	
• Ignition OFF. • ⚠ **WARNING: Turn the ignition OFF and wait one minute to deplete the backup power supply. Failure to follow this instruction may result in serious personal injury or death in the event of an accidental deployment.** • Reconnect all SRS components (if previously disconnected). • If previously directed to depower the SRS , repower the SRS . **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test â RCM . • Enter the following diagnostic mode on the scan tool: Self Test â ABS Module . • **Were any DTCs retrieved on-demand from the RCM or ABS module during self-test?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the appropriate DTC Chart in this section and/or Section 501-20B for pinpoint test direction. **No** CLEAR all Continuous Memory Diagnostic Trouble Codes (CMDTCs). PROVE OUT the SRS . REFER to Supplemental Restraint System (SRS) Depowering and Repowering in Section 501-20B . Repair is complete. RETURN the vehicle to the customer.

Pinpoint Test Z: DTC U3002:62

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

When the ignition is turned to the RUN position, the ABS module and the PCM share Vehicle Identification Number (VIN) information over the High Speed Controller Area Network (HS-CAN) bus.

- DTC U3002:62 (Vehicle Identification Number: Signal Compare Failure) â This DTC indicates that the VIN message sent by the PCM over the HS-CAN bus does not match the VIN stored in the ABS module.

This pinpoint test is intended to diagnose the following:

- Module configuration (ABS and PCM)
- ABS module

PINPOINT TEST Z: DTC U3002:62

Test Step	Result / Action to Take
Z1 VERIFY PCM VIN	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Log Viewer . • Compare the VIN in Log Viewer to the vehicle VIN plate. • **Does VIN in Log Viewer match the vehicle VIN plate?**	**Yes** GO to Z2 . **No** RECONFIGURE the PCM. FOLLOW the instructions on the scan tool. CLEAR the DTCs. CYCLE the ignition key. REPEAT the self-test.
Z2 VERIFY ABS MODULE PART NUMBER	
• Retrieve and record the ABS module part number from Log Viewer and verify that the vehicle has the correct ABS module installed. • **Is the correct ABS module installed in the vehicle?**	**Yes** CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available in Section 418-01 . CLEAR the DTC. CYCLE the ignition key. REPEAT the self-test. **No** INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module â Hybrid in this section. CLEAR the DTC. CYCLE the ignition key. REPEAT the self-test.

Pinpoint Test AA: The Stability/Traction Control System Cannot Be Disabled

Normal Operation

The traction control portion of the AdvanceTracÂ® can be disabled by pressing the traction control switch located on the instrument panel. When the system is disabled, the sliding car OFF icon in the Instrument Panel Cluster (IPC) illuminates continuously. The traction control switch is part of the ambient lighting switch.

The IPC sends 5 volts to the traction control switch. When the traction control switch is pressed, this voltage is sent through the switch and to ground. When the IPC detects this ground, it sends a message to the PCM and the ABS module along the High Speed Controller Area Network (HS-CAN) bus that the driver has disabled the system. An open circuit or a defective traction control switch prevents the system from being disabled, and does not set a DTC.

If a MyKeyâ ¢ restricted key is in use with Advance TracÂ® always-on feature configured to "on", the traction control system cannot be disabled. An admin key must be used in order to enable and disable the traction control system.

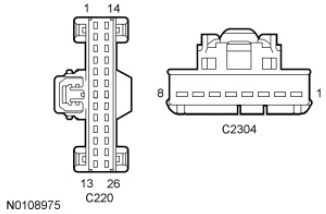
DTC C0089:11 (TCS Disable Switch: Circuit Short to Ground) â If the IPC detects the ground signal during the on-demand self test or if circuit CCA15 (YE/GY) is shorted to ground, DTC C0089:11 is set. Also, if the traction control switch is held or stuck closed for more than 2 minutes during normal operation, DTC C0089:11 is set. If a MyKeyâ ¢ restricted key is in use with Advance TracÂ® always-on feature configured to "on", an admin key must be used in order to enable and disable the traction control system.

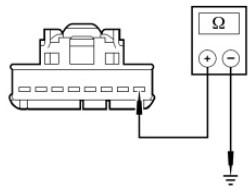
This pinpoint test is intended to diagnose the following:

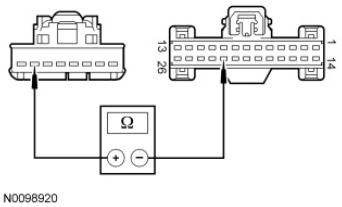
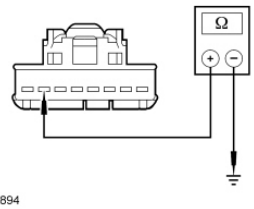
- Wiring, terminals or connectors
- Traction control switch
- IPC

PINPOINT TEST AA: THE STABILITY/TRACTION CONTROL SYSTEM CANNOT BE DISABLED

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AA1 VERIFY ALL WIRING CONNECTIONS	
• Disconnect: Instrument Panel Cluster (IPC) C220 . • Disconnect: Traction Control/Ambient Lighting Switch C2304 . • Using a good light source, inspect each connector terminal for any corrosion. • Inspect both connectors for any pushed-out pins. Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • Using a suitable mating terminal, check each female terminal for deformed or enlarged contacts by comparing the mating terminal's fit between each of the following pins: ♦ C220-22 ♦ C2304-1 ♦ C2304-7  • Refer to Wiring Diagrams Cell 5 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information. • **Is each terminal free of corrosion, pushed-out pins or spread terminals?**	**Yes** GO to AA2 . **No** REPAIR the affected terminal(s). CLEAR the DTCs. REPEAT the self-test.
AA2 CHECK FOR ANY COMMUNICATION DTCs	
• Connect: Traction Control/Ambient Lighting Switch C2304 . • Connect: IPC C220 . • Connect the scan tool. • Ignition ON.	**Yes** For ABS communication DTCs, GO to the ABS Module DTC Chart.

• Check the IPC , the PCM and the ABS module for any communication DTCs. • **Are any communication DTCs present?**	For IPC and PCM communication DTCs, REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 . **No** GO to AA3 .
AA3 ISOLATE THE TRACTION CONTROL SWITCH	
NOTE: If a MyKeyâ ¢ restricted key is in use with Advance TracÂ® always-on feature configured to "on", the traction control system cannot be disabled. An admin key must be used in order to enable and disable the traction control system. • Ignition OFF. • Disconnect: Traction Control/Ambient Lighting Switch C2304 . • Measure the resistance between traction control/ambient lighting switch C2304 pin-7 and pin-1, component side, while pressing and releasing the traction control switch. • **Is the resistance less than 5 ohms with the switch pressed and greater than 10,000 ohms with the switch released?**	**Yes** GO to AA4 . **No** INSTALL a new traction control switch. REFER to Traction Control Switch in this section. TEST the system for normal operation.
AA4 CHECK THE TRACTION CONTROL SWITCH GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between traction control/ambient lighting switch C2304-1, circuit GD116 (BK/VT), harness side and ground.  N0098895 • **Is the resistance less than 5 ohms?**	**Yes** GO to AA5 . **No** REPAIR circuit GD116 (BK/VT). TEST the system for normal operation.
AA5 CHECK THE TRACTION CONTROL SWITCH CONTROL CIRCUIT FOR AN OPEN	
• Disconnect: IPC C220 . • Measure the resistance between traction control/ambient lighting switch C2304-7, circuit CCA15 (YE/GY), harness side and IPC C220-22, circuit CCA15 (YE/GY), harness side.	**Yes** GO to AA6 . **No** REPAIR circuit CCA15 (YE/GY). TEST the system for normal operation.

 • **Is the resistance less than 5 ohms?**	
AA6 CHECK THE TRACTION CONTROL SWITCH CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between traction control/ambient lighting switch C2304-7, circuit CCA15 (YE/GY), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AA7 . **No** REPAIR circuit CCA15 (YE/GY). TEST the system for normal operation.
AA7 CHECK FOR CORRECT IPC OPERATION	
• Ignition OFF. • Disconnect: IPC C220 . • Check for: ♦ corrosion ♦ pushed-out pins ♦ spread terminals • Connect: IPC C220 . • Make sure the connector is seated correctly, then operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AB: Soft or Excessive Brake Pedal Travel

Normal Operation

The brake pedal should be firm at all times when applied.

This pinpoint test is intended to diagnose the following:

- Leak in the hydraulic system
- Air in brake system
- Brake master cylinder
- Hydraulic Control Unit (HCU)

PINPOINT TEST AB: SOFT OR EXCESSIVE BRAKE PEDAL TRAVEL

Test Step	Result / Action to Take
AB1 RETRIEVE THE RECORDED DTCs FROM THE ABS SELF-TEST	
• Check for recorded ABS DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to DTC charts in this section. **No** GO to AB2 .
AB2 CHECK THE BRAKE SYSTEM COMPONENTS FOR CORRECT INSTALLATION OR DAMAGE	
• Inspect the brake system for the following concerns: ♦ Check the brake pedal and bracket, brake master cylinder, brake calipers and fluid lines/hoses for correct installation. ♦ Check the brake pedal and bracket, brake master cylinder, brake calipers and fluid lines/hoses for damage or leaks. ♦ Check the flexible brake hoses for bulging with the brake pedal is pressed. ♦ For brake pedal and master cylinder, refer to Section 206-06 . ♦ For brake booster, refer to Section 206-07 . • **Are the brake system components correctly installed and free from leaks or damage?**	**Yes** GO to AB3 . **No** REPAIR the identified concern. TEST the system for normal operation.
AB3 BLEED THE BRAKE SYSTEM	
• Bleed the brake system including the Hydraulic Control Unit (HCU) bleeding procedure. Refer to Section 206-00 . • **Is the concern still present?**	**Yes** GO to AB4 . **No** The system is operating correctly at this time. The concern may have been caused by air in the brake system.
AB4 CHECK BRAKE MASTER CYLINDER	
• Carry out the Brake Master Cylinder â Bypass Condition Test in Section 206-00 , Component Tests. • **Did the master cylinder pass the component test?**	**Yes** INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation. **No** INSTALL a new master cylinder. REFER to Section 206-06 . TEST the system for normal operation.

Pinpoint Test AC: DTCs C1029:00, C102B:00

Normal Operation

The primary channel consists of the RF and LR hydraulic circuits, and the secondary brake channel consists of the LF and RR hydraulic circuits. Pressure imbalances between the primary or secondary hydraulic pressure could be caused by air in the lines or fluid leaks in the brake fluid system.

- C1029:00 (ABS Primary Circuit Pressure Lower Than Secondary: No Sub type Information) â this DTC sets if the ABS module detects that the pressure in the primary circuit is less than in the secondary circuit.
- C102B:00 (ABS Secondary Circuit Pressure Lower Than Primary: No Sub Type Information) â this DTC sets if the ABS module detects that the pressure in the secondary circuit is less than in the primary circuit .

This pinpoint test is intended to diagnose the following:

- Air in brake fluid system
- Master Cylinder
- Hydraulic Control Unit.

PINPOINT TEST AC: DTC C1029:00, C102B:00

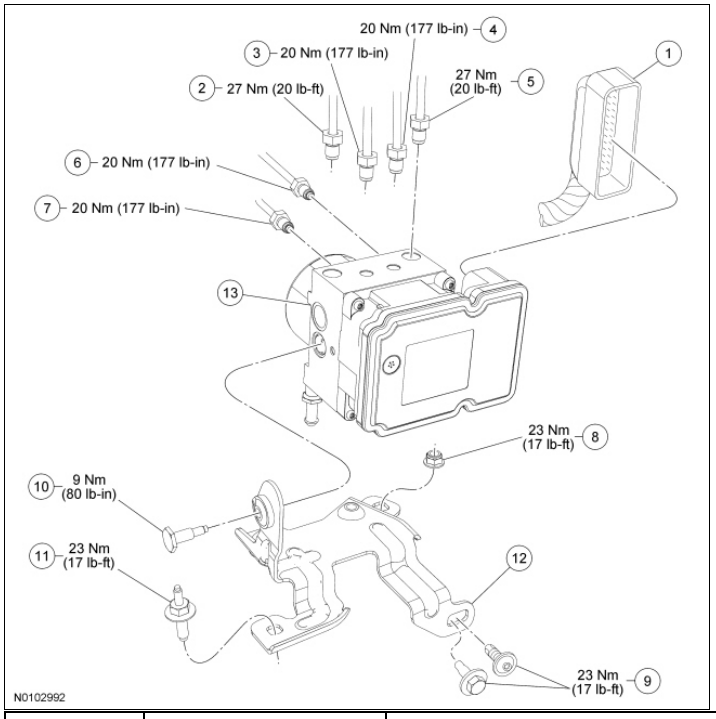
Test Step	Result / Action to Take
AC1 BLEED THE BRAKES	
• Bleed the brakes. Refer to Section 206-00 . ♦ Clear the DTCs. ♦ Road test the vehicle. • **Is the concern still present?**	**Yes** GO to AC2 **No** The system is operating correctly at this time. The concern may have been caused by air in the brake system.
AC2 MONITOR THE ABS PRIMARY AND SECONDARY CHANNEL PRESSURES	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: ABS Module DataLogger. • Select the following PIDs to monitor the primary and secondary channels. ♦ Left front brake pressure (LF_BRK_PRS) ♦ Right rear brake pressure (RR_BRK_PRS) ♦ Right front brake pressure (RF_BRK_PRS) ♦ Left rear brake pressure (LR_BRK_PRS) • Depress the brake pedal firmly and note the brake pressures displayed by each PID.	**Yes** CLEAR the DTCs, REPEAT the self-test. If C1029:00 or C102B:00 returns, INSTALL a new HCU . REFER to Hydraulic Control Unit (HCU) in this section. **No** CLEAR the DTCs, REPEAT the self-test. If C1029:00 or C102B:00 returns, INSTALL a new brake master cylinder. REFER to Section 206-06 .

• Add the pressures for the left front brake pressure and the right rear brake pressure together (secondary channel). • Add the pressures for the right front brake pressure and the left rear brake pressure together (primary channel). • **Are the primary and secondary channel pressures within 10% of each other?**	

Hydraulic Control Unit (HCU)

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



Item	Part Number	Description
1	-	ABS module electrical connector (part of 14290)
2	-	Master cylinder secondary brake tube fitting (part of 2C360)
3	-	RH front brake tube fitting (part of 2263)
4	-	Rear back pressure valve brake tube fitting (part of 2C360)
5	-	Master cylinder primary brake tube fitting (part of 2C360)
6	-	Rear back pressure valve brake tube fitting (part of 2C360)
7	-	LH front brake tube fitting (part of 2C360)
8	W520102	Hydraulic Control Unit (HCU) bracket-to-frame nut

9	W712710	HCU bracket-to-frame bolt (Torx head) (3.5L only)
9	W505433	HCU bracket-to-frame bolt (hex head) all other engines
10	2C398	HCU bracket-to- HCU bolt
11	W704925	HCU bracket-to-frame stud bolt
12 4	HCU bracket	
13	2C346	HCU

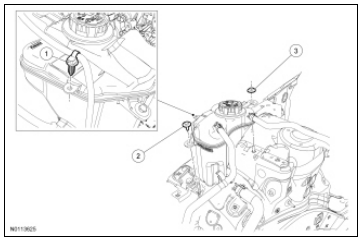
Removal and Installation

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

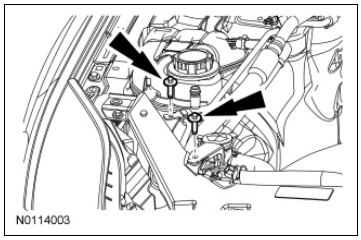
NOTICE: **Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.**

1. Position the engine coolant degas bottle aside.
    1. If equipped, detach the wiring harness retainer from the degas bottle.
    2. Remove the bolt.
        - ♦ To install, tighten to 9 Nm (80 lb-in).
    3. Remove the nut.
        - ♦ To install, tighten to 9 Nm (80 lb-in).

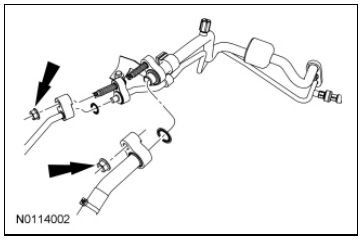


2. Recover the refrigerant. For additional information, refer to Section 412-00A .

3. Remove the condenser-to-evaporator line and compressor manifold and tube bracket bolts.
    - To install, tighten to 6 Nm (53 lb-in).



4. Remove the condenser-to-evaporator line and compressor manifold and tube fitting nuts. Disconnect the fittings.
    - Discard the gasket seals.
    - To install, tighten to 15 Nm (133 lb-in).



5. Disconnect the ABS module electrical connector.

6. Disconnect the brake tube fittings.
   - To install:
     - ♦ tighten the front and rear brake tube fittings to 20 Nm (177 lb-in).
     - ♦ tighten the master cylinder brake tube fittings to 27 Nm (20 lb-ft).

7. Remove the HCU bracket-to- HCU bolt.
   - To install, tighten to 9 Nm (80 lb-in).

8. Remove the HCU .

9. **NOTE:** Make sure the HCU and ABS module are clean and free of any brake fluid or foreign material before separating the components.

   To install, reverse the removal procedure.

   - Install new O-ring seals and new gasket seals.
   - Add the correct amount of clean PAG oil. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A
   - Bleed the brake system. For additional information, refer to Section 206-00 .

10. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A

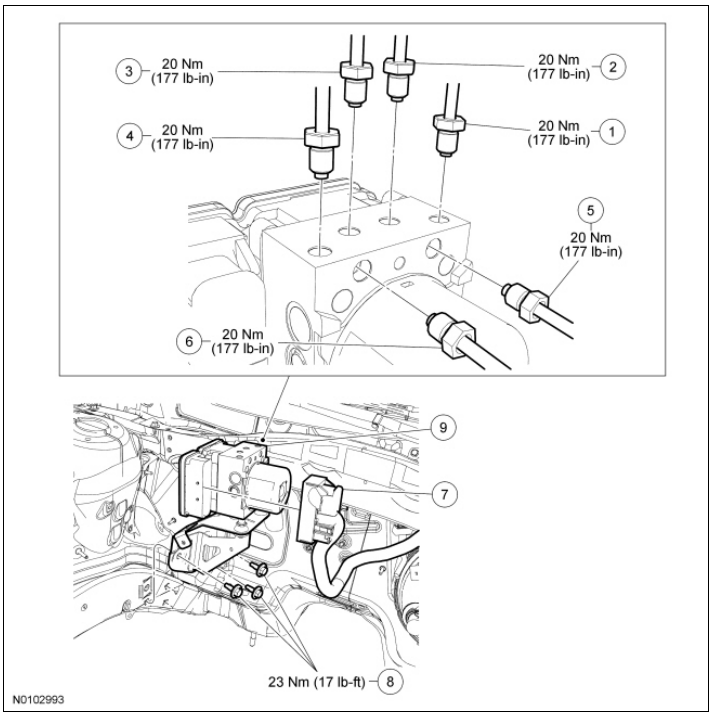
Hydraulic Control Unit (HCU) - Hybrid

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



Item	Part Number	Description
1	-	Master cylinder primary brake tube fitting (part of 2C360)
2	-	RH front brake tube fitting (part of 2263)
3	-	LH front brake tube fitting (part of 2C360)
4	-	Master cylinder secondary brake tube fitting (part of 2C360)
5	-	
6	-	LH rear brake tube fitting (part of 9J279)

7	-	ABS module electrical connector (part of 14290)
8	W505433	Hydraulic Control Unit (HCU) bracket-to-frame bolts
9	2C065	HCU

Removal and Installation

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

⚠ WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

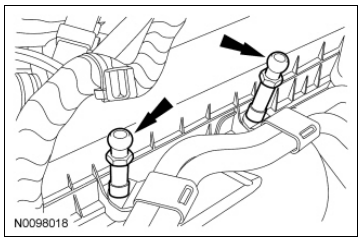
NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the sue may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

1. **NOTE:** This step is necessary only if a new ABS module is being installed.

   Connect the scan tool and upload the module configuration information from the ABS module. For additional information, refer to Section 418-01 .

2. Remove the Thermostatic Expansion Valve (TXV) manifold and tube assembly. For additional information, refer to Section 412-01 .

3. Remove the 2 engine cover studs from the valve cover stud bolts.



4. Disconnect the ABS module electrical connector.

5. Detach the wire harness push-type fastener from the Hydraulic Control Unit (HCU) bracket and position the harness aside.

6. Disconnect the brake tube fittings.
   - To install, tighten to 20 Nm (177 lb-in).

7. With the vehicle in NEUTRAL, position it on a hoist. For additional information refer to Section 100-02 .

8. Remove the HCU bracket-to-frame bolts.
   - To install, tighten to 23 Nm (17 lb-ft).

9. Remove the HCU and bracket assembly.

10. **NOTE:** Make sure the HCU and ABS module are clean and free of any brake fluid or foreign material before separating the components.

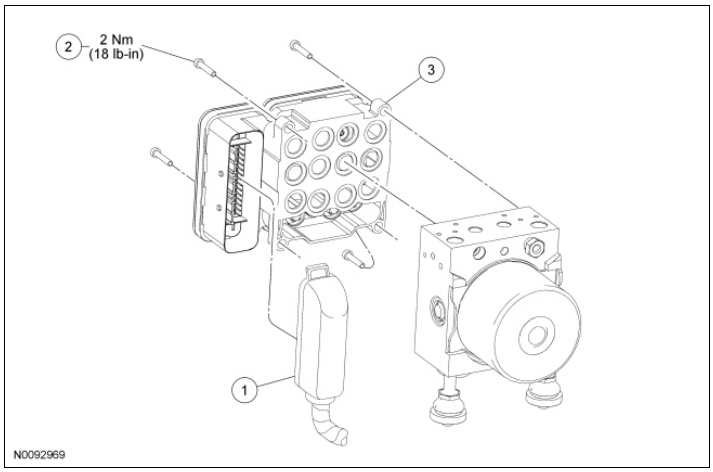
    To install, reverse the removal procedure.

    - Bleed the brake system. For additional information, refer to Section 206-00 .

11. If a new ABS module was installed, download the module configuration information from the scan tool. For additional information, refer to Section 418-01 .

12. If a new ABS module and/or a new HCU was installed, carry out the Multi-Calibration routine, follow the scan tool directions.

Anti-Lock Brake System (ABS) Module



Item	Part Number	Description
1	-	ABS module electrical connector (part of 14290)
2	2M101	ABS module screw (4 required)
3	2C219	ABS module

Removal and Installation

NOTICE: **Electronic modules are sensitive to electrical charges. The ABS module can be damaged if exposed to these charges.**

NOTICE: **Do not allow any brake fluid or foreign material to enter the mating side of the ABS module or damage to the solenoids can occur.**

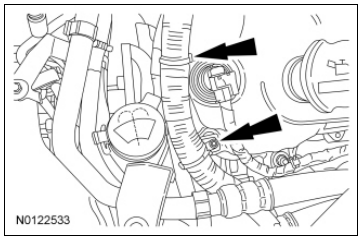
All vehicles

1. If a new ABS module is being installed, connect the scan tool and upload the module configuration from the ABS module. For additional information, refer to Section 418-01 .

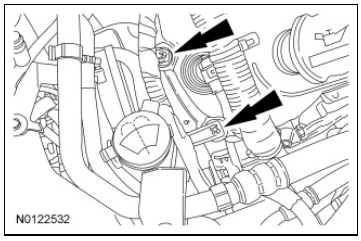
2. Remove the degas bottle. For additional information, refer to Section 303-03A .

Vehicles equipped with a 3.5L engine

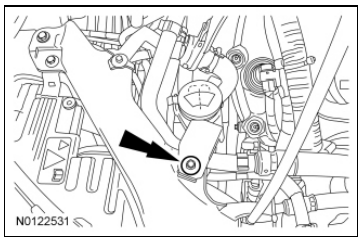
3. Detach the body harness from the 2 valve cover studs and position the harness aside.



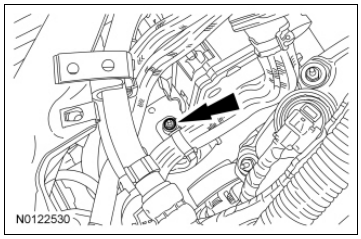
4. Detach the wire harness from the 2 valve cover studs and position the harness aside.



5. Remove the bolt and position the windshield washer reservoir filler neck aside.
    - To install, tighten to 7 Nm (62 lb-in).



6. Remove the nut and position the degas bottle hose aside.
    - To install, tighten to 20 Nm (177 lb-in).



All vehicles

7. Disconnect the ABS module electrical connector.

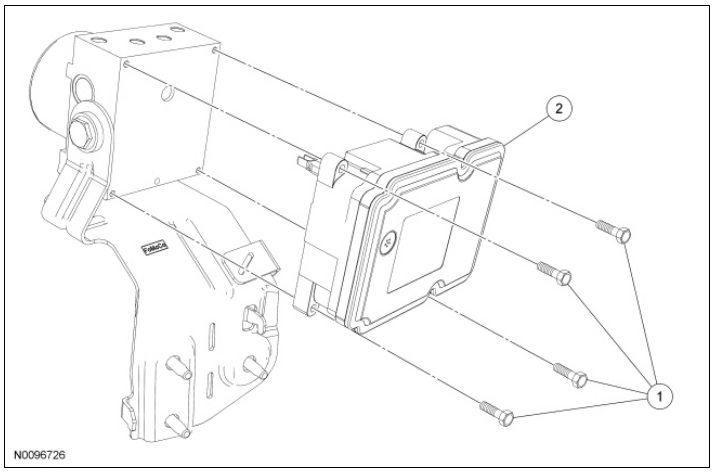
8. Remove the 4 ABS module screws and the ABS module.
    - To install, tighten to 2 Nm (18 lb-in).

9. **NOTE:** Visually inspect the ABS module terminals for damage before installation.

    To install, reverse the removal procedure.

10. If a new ABS module was installed, download the module configuration information from the scan tool. For additional information, refer to Section 418-01 .

Anti-Lock Brake System (ABS) Module - Hybrid



Item	Part Number	Description
1	2M101	ABS module screws (4 required)
2	2C219	ABS module

Removal and Installation

NOTICE: **Electronic modules are sensitive to electrical charges. The Anti-lock Brake System (ABS) module can be damaged if exposed to these charges.**

NOTICE: **Do not allow any brake fluid or foreign material to enter the mating side of the Anti-lock Brake System (ABS) module or damage to the solenoids can occur.**

1. Remove the Hydraulic Control Unit (HCU). For additional information, refer to Hydraulic Control Unit (HCU) - Hybrid in this section.

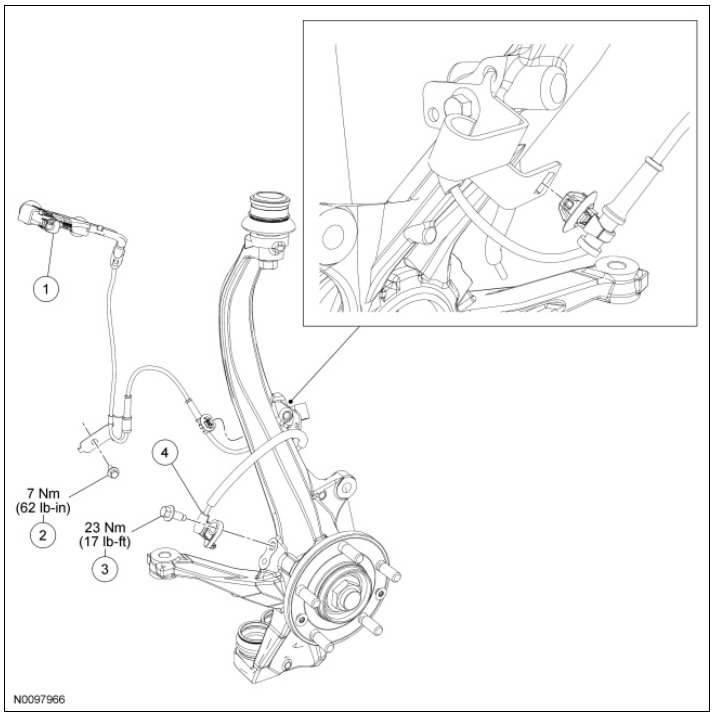
2. **NOTE:** Make sure the HCU and ABS module are clean and free of any brake fluid or foreign material before separating the components.

   Remove the 4 ABS module screws and the ABS module.

3. **NOTE:** Visually inspect the ABS module terminals for damage before installation.

   To install, reverse the removal procedure.

Wheel Speed Sensor - Front



Item	Part Number	Description
1	-	Wheel speed sensor electrical connector (part of 14290)
2	W500020	Wheel speed sensor harness bracket-to-body bolt
3	W500222	Wheel speed sensor bolt
4	2C204 RH/ 2C205 LH	Wheel speed sensor

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

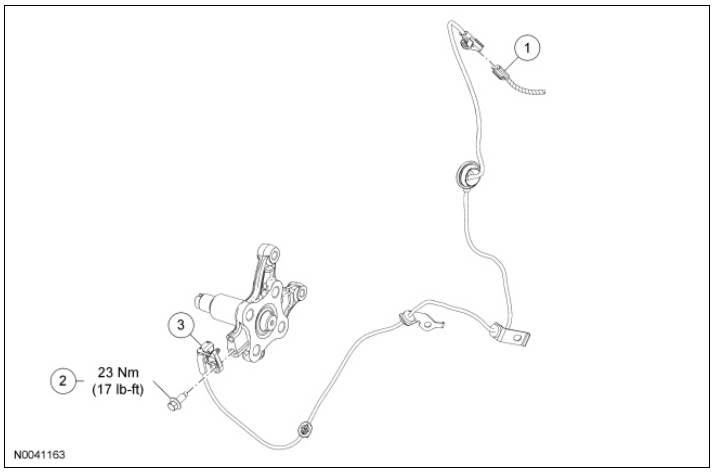
2. Remove the fender splash shield. For additional information, refer to Section 501-02 .

3. Disconnect the wheel speed sensor electrical connector.

<

4. Remove the wheel speed sensor harness bracket-to-body bolt.
   - To install, tighten to 7 Nm (62 lb-in).
5. Detach the wheel speed sensor harness from the wheel knuckle bracket.
6. Remove the wheel speed sensor bolt and the wheel speed sensor.
   - To install, tighten to 23 Nm (17 lb-ft).
7. To install, reverse the removal procedure.

Wheel Speed Sensor - Rear, Front Wheel Drive (FWD)



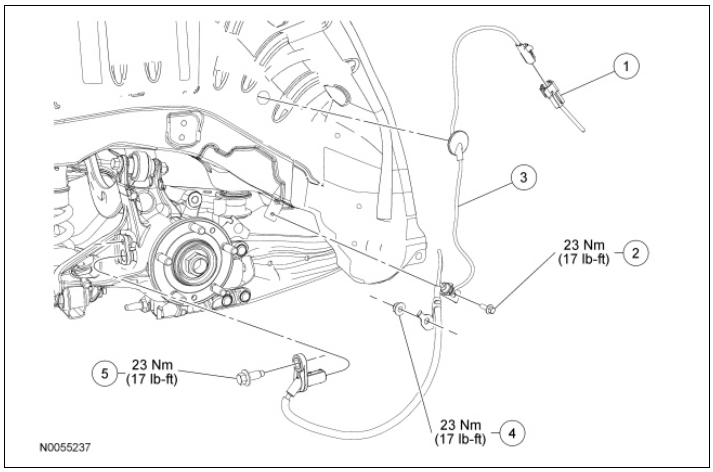
Item	Part Number	Description
1	-	Wheel speed sensor electrical connector (part of 14A227)
2	W500222	Wheel speed sensor bolt
3	2C186 RH/ 2C187 LH	Wheel speed sensor

Removal and Installation

1. Remove the rear seat bolster. For additional information, refer to Section 501-10 .
2. Disconnect the wheel speed sensor electrical connector.
3. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
4. Using a suitable tool, disconnect theet from the body.
5. **NOTE:** It is not necessary to remove the harness routing brackets.

   Disconnect the wheel speed sensor harness from the brackets.
6. Remove the wheel speed sensor wire bolt and the wheel speed sensor.
   - To install, tighten to 23 Nm (17 lb-ft).
7. To install, reverse the removal procedure.

Wheel Speed Sensor - Rear, All Wheel Drive (AWD)



Item	Part Number	Description
1	-	Wheel speed sensor electrical connector (part of 14A227)
2	W505253	Wheel speed sensor harness bolt
3	2C186 RH/ 2C187 LH	Wheel speed sensor
4	W520102	Wheel speed sensor harness nut
5	W500222	Wheel speed sensor bolt

Removal and Installation

1. Remove the rear seat bolster. For additional information, refer to Section 501-10 .

2. Disconnect the wheel speed sensor electrical connector.

3. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

4. Using a suitable tool, disconnect the grommet from the body.

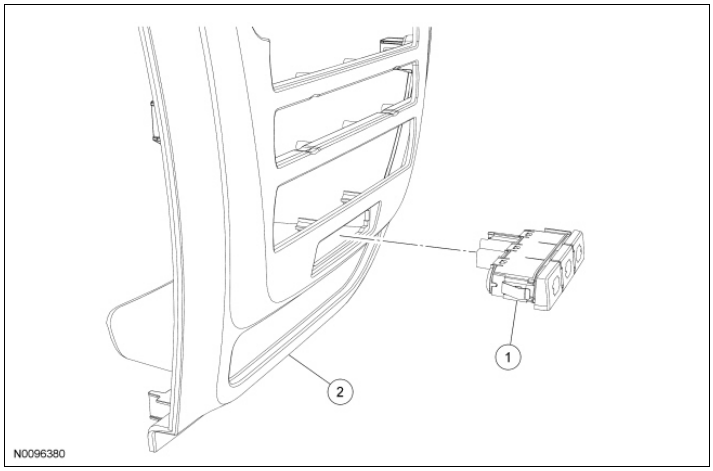
5. Remove the wheel speed sensor harness nut and bolt.
   - To install, tighten to 23 Nm (17 lb-ft).

6. Remove the wheel speed sensor bolt and the wheel speed sensor.
   - To install, tighten to 23 Nm (17 lb-ft).

7. To install, reverse the removal procedure.

Traction Control Switch

NOTE: Fusion shown, MKZ similar.



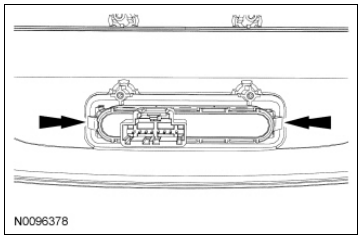
Item	Part Number	Description
1	432A38	Traction control switch
2	04302	Instrument panel center finish panel

Removal and Installation

NOTE: For MKZ when equipped with a navigation system, the traction control switch is serviced with the Front Controls Interface Module (FCIM). For additional information, refer to Section 415-00 .

1. Remove the instrument panel center finish panel. For additional information, refer to Section 501-12 .

2. Press the retaining tabs and remove the traction control switch.

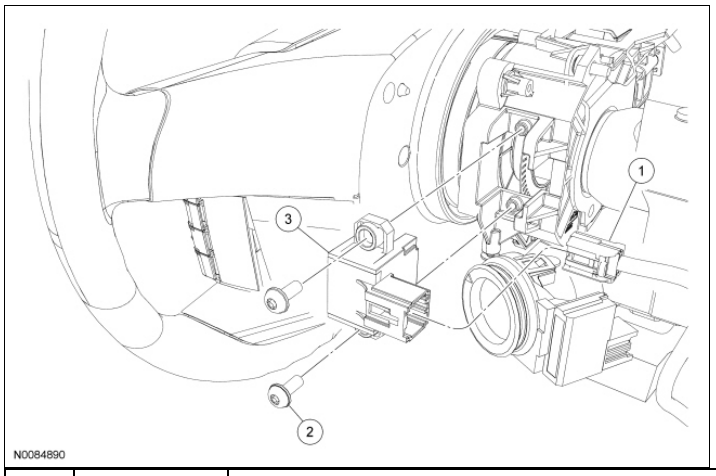


3. To install, reverse the removal procedure.

Steering Wheel Rotation Sensor

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool



Item	Part Number	Description
1	-	Steering wheel rotation sensor electrical connector (3.5L Fusion part of 2C011, MKZ part of 14401)
2	W506942	Steering wheel rotation sensor bolt (2 required)
3	3F818	Steering wheel rotation sensor

Removal and Installation

1. Remove the steering column shroud. For additional information, refer to Section 211-04 .
2. Disconnect the steering wheel rotation sensor electrical connector.
3. Remove the 2 bolts and the steering wheel rotation sensor.
4. To install, reverse the removal procedure.
   - Using the scan tool, calibrate the new steering wheel rotation sensor to the ABS module. Follow the scan tool instructions for Interactive Vehicle Dynamics (IVD) Initialization.

Material

Item	Specification	Fill Capacity
Dye-Lite® ATF/Power Steering Fluid Leak Detection Dye 164-R3701 (Rotunda)	-	-
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A	7.0L (7.4 qt)
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B	-
Threadlock and Sealer TA-25	WSK-M2G351-A5	-
Ultra Silicone Sealant TA-29	-	-

General Specifications

Item	Specification
Fluid	
NOTICE: The use of any transmission fluid other than what is recommended for this transaxle will cause transaxle damage. Refer to the Owner's Literature to determine the correct service interval for the specific vehicle.	
NOTICE: Do not use water-based cleaners to clean or flush the transmission fluid cooler tubes or transaxle damage will occur. Use only clean	

transmission fluid designated for this transaxle.

General Specifications

Item	Specification
Torque Converter End Play	
New or rebuilt	0.355-1.04 mm (0.013-0.04 in)
Used	0.355-1.87 mm (0.013-0.073 in)
Transmission Fluid Filter	
Internal to the transmission	-

Gear and Solenoid Operation Chart

Gear	SSC	SSD	SSE	SSF	SSA	SSB
1st	OFF	ON	ON	ON	OFF	ON
1st Engine Braking	OFF	ON	ON	ON	ON	ON
2nd	OFF	ON	ON	OFF	OFF	OFF
3rd	OFF	ON	OFF	ON	OFF	OFF
4th	OFF	OFF	ON	ON	OFF	OFF
5th	ON	OFF	OFF	ON	OFF	OFF
6th	ON	OFF	ON	OFF	OFF	OFF

Gear Ratio

Gear	Ratio
1st	4.148 to 1
2nd	2.370 to 1
3rd	1.556 to 1
4th	1.155 to 1
5th	0.859 to 1
6th	0.686 to 1
Reverse	3.394 to 1
Final Drive	3.329 to 1

Shift Speed

Manual D	km/h	mph
1-2 upshift	14-21	9-13
2-3 upshift	21-29	13-18
3-4 upshift	33-40	20-25
4-5 upshift	49-55	30-35
5-6 upshift	65-70	40-44
3-1 downshift	7-17	4-11
4-3 downshift	26-36	16-24
5-4 downshift	38-46	24-29
6-5 downshift	56-63	35-39

Stall Speed

Engine	rpm
3.5L	1,878-2,678

Solenoid Resistance Reading

Component	Readings (ohm) @ 20°C (68°F)
Shift Solenoid A (SSA) and Shift Solenoid B (SSB)	11-15 ohms
Shift Solenoid C (SSC), Shift Solenoid D (SSD), Shift Solenoid E (SSE), Shift Solenoid F (SSF), Line Pressure Control (LPC) and Torque Converter Clutch (TCC)	5.0-5.6 ohms

Clutch and Brake Pressure Chart

Clutch/Band	Range	Pressure
C1 (Drive Clutch)	Drive (1st-4th)	196-1,372 kPa (28-199 psi)
C2 (Drive Clutch)	196-1,372 kPa (28-199 psi)	
C3 (Drive Clutch)	Drive (3rd-5th)	196-1,372 kPa (28-199 psi)
C3 (Drive Clutch)	Reverse	392-1,863 kPa (57-270 psi)
B1	Drive	196-1,372 kPa (28-199 psi)

(Brake Clutch)	(2nd and 6th)	
B2 (Brake Band)	Low, manual 1st	588-1,372 kPa (85-199 psi)
B2 (Brake Band)	Reverse	392-1,863 kPa (57-270 psi)

Torque Specifications

Description	Nm	lb-ft	lb-in
Ground strap bolts	12	-	106
Main control valve body bolts [a]	-	-	-
Power steering return line bolts	9	-	80
trol lever nut	12	-	106
Roll restrictor bracket bolts	90	66	-
Selector lever cable bracket bolts	12	-	106
Selector lever cable bracket nut	12	-	106
Stabilizer bar link nuts	40	30	-
Steering gear mounting bolts	107	79	-
Subframe bracket-to-body bolts	103	76	-
Subframe nuts	150	111	-
Tie rod end nuts	48	35	-
Torque converter nuts	36	27	-
Transaxle insulator-to-frame bolts [b]	62	46	-
Transaxle support insulator bracket bolt	80	59	-
Transaxle support insulator bracket nuts	90	66	-
Transaxle support insulator bracket through bolt	150	111	-
Transaxle-to-engine bolts	48	35	-
Transmission Control Module (TCM)	24	18	-
Transmission fluid cooler tubes	10	-	89
Transmission fluid drain plug	47	35	-
Transmission fluid fill plug	39	29	-
Transmission fluid pan bolts	13	-	115
Transmission Fluid Temperature (TFT) sensor	10	89	
Turbine Shaft Speed (TSS) sensor	12	-	106

[a] Refer to the procedure in this section.

[b] When reinstalling fasteners originally coated with threadlock, clean the fasteners with a wire brush prior to applying new threadlock. Apply threadlock and sealer to threads of the bolt.

Transaxle Description

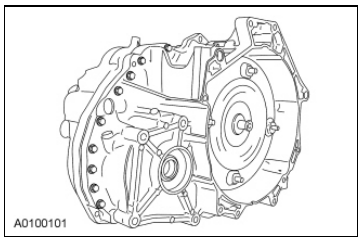
This transaxle is a compact, lightweight, next generation electronically controlled, 6-speed automatic transaxle that employs Ravigeneaux-type and one single planetary gear set.

This transaxle contains a high-precision clutch hydraulic control system for a smooth, highly responsive gear shift feel.

All hydraulic functions are directed by electronic solenoids to control:

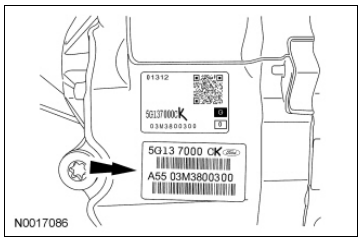
- engagement feel.
- shift feel.
- shift scheduling.
- modulated Torque Converter Clutch (TCC) applications.
- engine braking, utilizing the coast clutch.

Automatic Transmission



Identification Tags

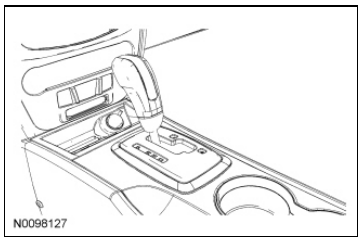
When servicing the automatic transaxle, use the bar code identification label located on side of the transaxle case.



Range Selection

Range Selection

This transaxle has 5 fixed range positions: P, R, N, D, M and 2 spring-loaded manual positions (-) and (+).



Park

In the P position:

- the transmission is locked and prevents the wheels from turning.
- there is no powerflow through the transaxle.
- the parking pawl locks the final drive.
- the engine may be started.
- the ignition key may be removed.

Reverse

In the R position:

- the vehicle may be operated in a backward direction, at a reduced gear ratio. i>
- engine braking will occur.

Neutral

In the N position:

- the vehicle is able to roll.
- there is no powerflow through the transaxle.
- the output shaft is not held and is free to turn.
- the engine may be started.

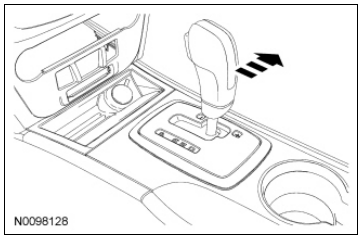
Drive

D is the normal position for most forward driving.

D provides:

- automatic shifts - 1st through 6th gears, which includes Overdrive (O/D).
- apply and release of the Torque Converter Clutch (TCC).
- maximum fuel economy during normal operation.

Manual



The transaxle is in MANUAL when the selector lever is moved to the right (M) position without commanding a gear by pushing the selector lever backward (+) or forward (-).

In the M position:

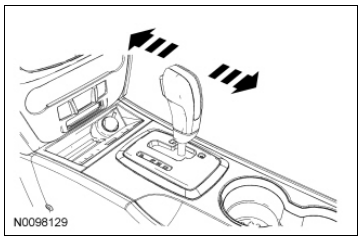
- O/D is cancelled.
- the transmission operates in gears 1st through 4th.
- grade assist is activated.
- some engine braking may occur.

Grade Assist

- Improves vehicle handling in hilly terrain or mountainous areas by providing additional engine braking and extends lower gear operation on uphill climbs.
- Additional engine braking is provided through the automatic transaxle shift strategy which reacts to vehicle inputs including vehicle acceleration, accelerator pedal, brake pal and vehicle speed.
- The transaxle will select gears that will provide the engine braking desired, based on the vehicle inputs, this will increase engine rpm during engine braking.

It is recommended to return to DRIVE mode on flat terrain to provide the best fuel economy and transaxle function. The transaxle returns to O/D when the selector lever is moved back into the D position.

Select Shift Transmission Selector Lever



The select shift transmission selector lever gives the driver the ability to change gears up or down manually as desired.

The transaxle is in the select shift whenever the selector lever is moved backward to the (+) position or forward to the (-) position from the (M) position.

In the - M + position:

- Gears 1 through 6 available.
- Moving the selector lever to the forward (-) or backward (+) position will allow the transmission to utilize the Manual Mode for select shifting.
- Moving the spring-loaded selector lever forward into (-) in the gate and releasing the selector lever, the selector lever will return to the M position and the transmission will downshift.
- Moving the spring-loaded selector lever backward into (+) in the gate and releasing the selector lever, the selector lever will return to the M position and the transmission will upshift.

When selecting the appropriate gear in select shift transmission mode, the instrument cluster will display the current selected gear.

The select shift transmission will make some shifts automatically, primarily to protect the engine from stalling.

The transmission will not upshift if the redline is approached and must be shifted manually by moving the selector lever back into (+) and releasing.

Gear Availability

MANUAL LEVER POSITION	TRANSAXLE GEAR OPERATION	DESCRIPTION
P	Park	Forward or reverse gears not available. Final drive is held to the transaxle case.
R	Reverse	Transaxle allows reverse only.
N	Neutral	Forward or reverse gears not available. Final drive moves freely.
D	1 ⇆ 2 ⇆ 3 ⇆ 4 ⇆ 5 ⇆ 6	6 forward gears are available. Gears are dependent on vehicle speed and throttle position with coast braking.
M	1 ⇆ 2 ⇆ 3 ⇆ 4 ⟝ 5 ⟝ 6	1st through 4th gears are available. Transaxle shifts to 4th gear if the selector lever is moved to the M position when the transaxle is in 6th or 5th gear. Transaxle provides engine braking.
(-) (+)	1 ⇆ 2 ⇆ 3 ⇆ 4 ⇆ 5 ⇆ 6	1st through 6th gears are available upon deceleration. The transaxle will make downshifts to first gear if a stop from 4th, 5th or 6th gear occurs. The transaxle also makes downshifts if the accelerator pedal is depressed past 90%. Upshifts are done manually with the selector lever. Transaxle can start in 1st, 2nd or 3rd gear.

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Shift Patterns

Based on signals from the sensors, the system controls gear shift lockup.

Downshifts

Under certain conditions the transaxle will downshift automatically to a lower gear range (without moving the selector lever). There are 3 categories of automatic downshifts:

- Coastdown
- Torque demand
- Forced or kickdown shifts

Coastdown

The coastdown downshift occurs when the vehicle is coasting down to a stop.

Torque Demand

The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide hat gear ratio. If applied, the transaxle will disengage the Torque Converter Clutch (TCC) to provide added acceleration.

Kickdown

For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size, engine and transmission calibration requirements.

Transaxle Operational Strategies

Automatic Gearshift Control

In automatic gearshift control, based on each gearshift pattern, Shift Solenoid A (SSA) and Shift Solenoid B (SSB) turn ON or OFF and Shift Solenoid C (SSC), Shift Solenoid D (SSD), Shift Solenoid E (SSE) and Shift Solenoid F (SSF) are operated linearly according to information that includes vehicle speed, the degree to which the accelerator is open and brake signal.

Driver Adaptive Shift Control

This automatic transaxle does not have a driving mode selection switch that allows drivers to select a mode themselves. The vehicle is ordinarily in adaptive mode. However, when specific conditions are met, the Transmissiontrol Module (TCM) selects a shifting pattern appropriate to driving conditions from all of the shifting patterns and switches automatically.

- GREEN - Mode 1 - Switched from mode 2 to warm up the transmission fluid. This mode acts to protect the transaxle before the adaptive mode.
- GREEN - Mode 2 - After engine start-up, warm-up speed is increased for a certain period when transmission fluid temperature is low and the vehicle speed is 0.
- HIGH TEMP - When transmission fluid temperature becomes too high, this mode activates lock-up at an earlier timing to stop the temperature rise and lower the temperature.

- DOWN SLOPE - When driving down a slope, the TCM detects a down slope based on the engine control unit signal and output rpm. TCM switches to down slope mode to alleviate the load to the brake by downshifting.

Gear Shift Control

When the selector lever is moved from N to D or from N to R, after the engine is started, shift control solenoid assembly SSC , SSD or SSE is used for the fluid pressure required by C1 clutch or C3 clutch and appropriately regulated fluid pressure is supplied to the clutch, engaging smoothly without shov>

Reverse Converter Control

If the selector lever is moved from N to R while the vehicle is moving forward and the transaxle shifts into REVERSE, the wheels will be locked, which is extremely dangerous. In order to avoid this, the TCM inhibits the transaxle from shifting into REVERSE while moving forward.

Torque Converter Clutch (TCC)

Based on output rpm signals, signals from the engine control unit (engine rpm and throttle opening) and vehicle speed, a smooth engagement is carried out through linear control of the Torque Converter Clutch (TCC) solenoid. Also, the slip rate is detected by adding input rpm signals and slip control is carried out.

- Engagement Control - control is carried out using a TCC solenoid. The TCC solenoid is linearly turned ON and OFF. The clutch inside the torque converter is operated and the pump impeller and turbine runner are connected. Through this, the engine and the transaxle are coupled and engine output is connected directly to the transaxle, eliminating transaxle loss and enhancing fuel economy
- Slip Control - control is carried out using a TCC solenoid. The TCC soleno is linearly turned ON and OFF and the clutch within the torque converter is operated outside of the engagement range. The clutch slides without being in a completely coupled condition, increasing transaxle efficiency and enhancing fuel economy.

Torque Converter

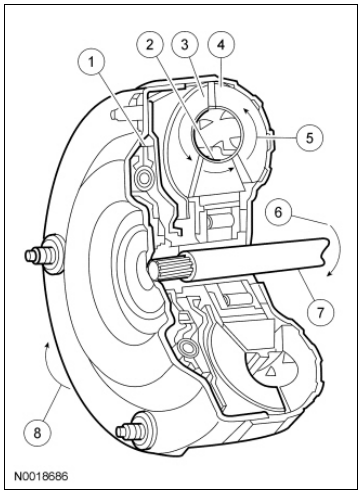
The torque converter transmits and multiplies torque by means of transmission fluid inside the torque converter. The torque converter is composed of the following:

- Converter case
- Pump impeller assembly
- Turbine assembly
- Stator assembly/One-Way Clutch (OWC)
- Lock-up clutch

In addition, the use of the lock-up clutch is intended to improve fuel economy as a direct coupling between the engine and the transaxle.

The standard torque converter components operate as follows:

- Rotation of the converter housing and impeller sets the transmission fluid in motion.
- The turbine reacts to the transmission fluid motion from the impeller, transferring rotation to the geartrain through the input shaft.
- The tor redirects transmission fluid going back into the impeller, providing for torque multiplication.
- The clutch and damper assembly dampens powertrain torsional vibration and provides a direct mechanical connection for improved efficiency.
- Power is transmitted from the torque converter to the planetary gearsets and other components through the input shaft.



Item	Description
1	Converter clutch and damper (part of 7902)
2	Reactor (part of 7902)
3	Turbine (part of 7902)
4	Impeller (part of 7902)
5	Transmission fluid motion
6	Transmission input rotation

7	Input shaft
8	Engine rotation

Geartrain

The geartrain consists of the planetary gearsets, apply components, final drive gearset and differential.

Gear Ratio

Gear	Ratio
1st	4.148 to 1
2nd	2.370 to 1
3rd	1.556 to 1
4th	1.155 to 1
5th	0.859 to 1
6th	0.686 to 1
Reverse	3.394 to 1
Final drive	3.to 1

Differential

The differential allows the halfshafts and wheels to rotate at different speeds during cornering.

The differential assembly consists of the following components:

- Differential case (part of the final drive carrier)
- Two pinion gears supported by a pinion shaft
- Two side gears supported by the differential case and halfshafts

When driving in a straight line, both front wheels rotate at relatively the same speed. This means both side gears are rotating at the same speed, as well, while both pinion gears revolve (but do not rotate) with the side gears. During cornering, the wheel on the outside of the turn is forced to rotate faster than the wheel on the inside of the turn. Since the side gears must now rotate at different speeds, the pinion gears rotate on the pinion shaft allowing the drive axles to rotate at different speeds while still transferring output torque.

Apply Components

C1 Drive Clutch

The C1 clutch connects the front planetary carrier to the rear sun gear of the rear planetary set. The C1 clutch is applied in 1st (typical operation during engine braking), 2nd, 3rd and 4th gears.

C2 Drive Clutch

The C2 clutch connects the intermediate shaft to the rear planetary carrier. The C2 clutch is applied in 4th, 5th and 6th gears.

C3 Drive Clutch

The C3 clutch connects the front planetary carrier to the middle sun gear of the rear planetary set. The C3 clutch is applied in 3rd and 5th gears, and also in REVERSE when the vehicle speed is 7 km/h (4 mph) or less.

B1 Brake Clutch

The B1 brake locks the middle sun gear of the rear planetary gear set. The B1 brake is applied in 2nd and 6th gears.

B2 Brake Band

The B2 brake locks the rear planetary carrier in REVERSE gear when the vehicle speed is 7 km/h (4 mph) or less.

F1 One-Way Clutch

The F1 one-way clutch locks the counterclockwise rotation of the rear planetary carrier during 1st gear operation (during both normal operation and engine braking).

Hydraulic Systems

Valve Body

The valve body supplies transmission fluid by switching the transmission fluid circuit for the hydraulic pressure that is generated by the transmission fluid pump. Based on the hydraulic pressure generated by the transmission fluid pump the Transmission Control Module (TCM) sends control signals to the solenoid valves in accordance with vehicle conditions. When the solenoid valve is activated, the control hydraulic pressure to the clutch and brakes is determined (according to the equilibrium with the obtained hydraulic pressure) and gear shift and lockup are accomplished. In addition, an appropriate amount of transmission fluid is supplied to

the torque converter, planetary gears and lubricating parts.

Transaxle Electronic Control System

Transmission Control Module (TCM) Control Function

The Transmission Control Module (TCM) and its input/output network controls the following operations:

- Shift timing
- Line pressure (shift feel)
- Torque Converter Clutch (TCC)

The transaxle control is separate from the engine control strategy in the PCM, although some of the input signals are shared between the TCM and PCM. When determining the best operating strategy for transaxle operation, the TCM uses input information from certain engine-related and driver-demand related sensors and switches supplied by the PCM.

In addition, the TCM receives input signals from certain transaxle-related sensors and switches. The TCM also uses these signals when determining transaxle operating strategy.

Using all of these input signals, the TCM can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the best line pressure needed to optimize shift feel. To accomplish this the TCM uses output solenoids to control transaxle operation.

The following provides a brief description of each of the sensors and actuators used to control transaxle operation.

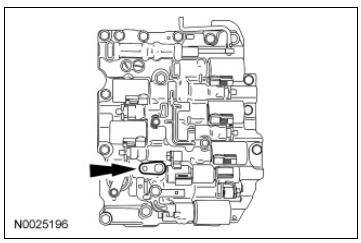
Transmission Range (TR) Sensor

The Transmission Range (TR) sensor is built in the TCM , it detects the automatic transmission range information via the Hall-effect sensor and outputs the information to the TCM . The TCM reads the voltage and adjusts the automatic transmission range.

Brake Pedal Position (BPP)

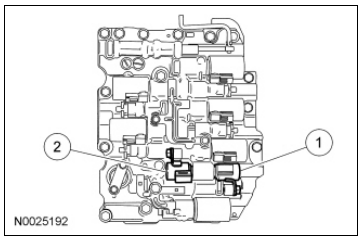
The Brake Pedal Position (BPP) switch tells the PCM when the brakes are applied. The TCC disengages when the brakes are applied and the BPP switch closes when the brakes are applied and opens when they are released.

Transmission Fluid Temperature (TFT) Sensor



The Transmission Fluid Temperature (TFT) sensor, which is integrated within the transmission wiring, is installed on the front of the valve body. It directs the transmission fluid temperature within the hydraulic pressure control circuit and transmits a signal based on that temperature to the TCM . Through this it controls gear shift, lockup and slip in response to changes in transmission fluid temperature for smooth shifting across wide fluid temperature zones.

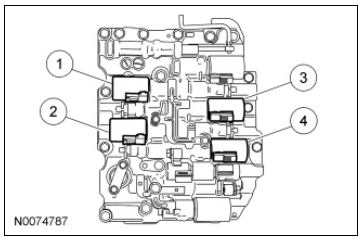
Transaxle Shift Solenoids SSA , SSB



Item	Description
1	Shift Solenoid A (SSA)
2	Shift Solenoid B (SSB)

The transaxle Shift Solenoid A (SSA) is installed on the middle valve body. The transaxle solenoid assembly Shift Solenoid B (SSB) is installed on the front valve body. The solenoids turn ON and OFF in response to signals output from the TCM . According to the ON or OFF status of SSA or SSB , the 1st gear engine brake operates or the gear shifts into REVERSE. As a fail-safe function, if any transaxle solenoid assembly abnormality occurs, the TCM will disable the current to the solenoids.

Shift Control Solenoids (SSC , SSD , SSE , SSF)

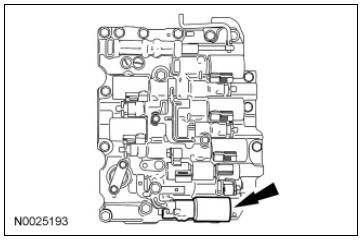


Item	Description
1	Shift Solenoid C (SSC)
2	Shift Solenoid D (SSD)
3	Shift Solenoid E (SSE)
4	Shift Solenoid F (SSF)

The shift control solenoid assembly (Shift Solenoid C (SSC), Shift Solenoid D (SSD), Shift Solenoid E (SSE), Shift Solenoid F (SSF)) is installed on the front valve body. The solenoids linearly control hydraulic pressure in response to signals, output from the TCM . Through this, it controls hydraulic pressure to the clutch (C1, C2, C3) and brakes (B1) for smooth shifting. According to the combination of ON or OFF status of the shift control solenoid assembly, the transaxle shifts from 1st gear into 6th gear and vice versa. As a fail-safe

function, if any shift control solenoid assembly abnormality occurs, the TCM will disable the current to the shift control solenoids.

Line Pressure Control (LPC)



The Line Pressure Control (LPC) is installed on the front valve body. Based on a signal indicating the degree to which the throttle is opened, engine torque, and according to a duty ratio predetermined in the TCM , the solenoids control line hydraulic pressure by linearly changing the comparable throttle hydraulic pressure. Through this, it controls operating hydraulic pressure to the clutch and brakes for smooth shifting. As a fail-safe function, if any shift control solenoid assembly abnormality occurs, the TCM will disable the current to the shift control solenoids. The line pressure is maximized, if the shift control solenoid assembly current is disabled when any abnormality other than locking occurs.

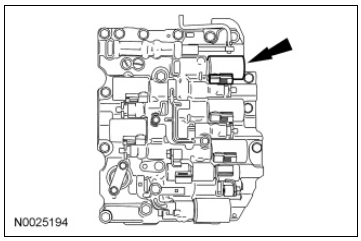
Speed Sensor

The 2 speed sensors are installed in the transaxle case. One speed sensor detects revolutions of the intermediate shaft's C2 drum as input shaft revolutions. The other speed sensor detects the counterdrive gear as output shaft revolutions. These signals are transmitted to the TCM . Based on these signals, the TCM controls engine torque, shift timing and lockup.

Adaptive Shift Control

The TCM has an adaptive learning strategy to electronically control the transaxle which will automatically adjust the shift feel. The first few hundred miles of operation of the transaxle may have abrupt shifting. This is a normal operation. If the battery has been disconnected for any reason it will need to be kept disconnected for approximately 20 minutes to reset the adaptive shift pressure strategy or use the scan tool to carry out the keep alive memory reset.

Torque Converter Clutch (TCC) Solenoid



The TCC solenoid is used in the transaxle control system to control the application, modulation and release of the torque converter clutch.

The TCC control solenoid is installed on the front valve body. Based on engine rpm, throttle opening degree signals and speed sensor signals, it linearly controls clutch hydraulic pressure. Through this, engagement and

slip are controlled. As a fail-safe function, if any control solenoid assembly abnormality occurs, the TCM will disable the current to the TCC solenoid.

Diagnostic Strategy

Troubleshooting an electronically controlled automatic transaxle is simplified by using the proven method of diagnosis. One of the most important things to remember is there's a definite procedure to follow.

NOTE: Do not take short cuts or assume that critical checks or adjustments have already been made.

Follow the procedures as written to avoid missing critical components or steps.

To correctly diagnose a concern, have the following publications available:

- Powertrain Control/Emissions Diagnosis (PC/ED) manual
- TSBs
- Wiring Diagrams manual

These publications provide the information required when diagnosing transaxle concerns.

Use the Diagnostic Flow Chart as a guide and follow the steps as indicated.

Preliminary Inspection

- Know and understand the customer's concern.
- Verify the concern by operating the vehicle.
- Check the transmission fluid level and condition.
- Check for nontory-installed items and verify correct installation.
- Check selector lever linkage for correct adjustment.
- Check TSBs regarding the concern.
- Retrieve and record all DTCs.

Diagnostics

- Retrieve and record all DTCs.
- Repair all non-transaxle codes first.
- Repair all transaxle codes second.
- Erase all continuous codes and attempt to repeat them with the drive cycle test. Refer to Transaxle Drive Cycle Test in this section.
- Repair all continuous memory codes.
- If only pass codes are obtained, proceed to the Diagnosis By Symptom in this section for further information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

Diagnostic Flow Chart

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Prior to carrying out the flow test, the following items should be checked:

- Know and understand the customer concerns
- Verify the concern by operating the vehicle
- Check the transmission fluid level and condition
- Check for non-factory-installed items and verify correct installation
- Check the selector lever linkage for correct adjustment
- Check TSBs regarding the concern
- Retrieve and recorl DTCs

Diagnostic Flow Chart

Test	Result	Action
1) Are any DTCs recorded?	Yes	• REPAIR all hard DTCs. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first, then this workshop manual, GO to Step 2.
	No	• REFER to Diagnosis By Symptom in this section, GO to Step 5.
2) Are any continuous test memory codes present?	Yes	• CLEAR codes and CARRY OUT the drive cycle test. If code returns, GO to Step 3.
	No	• GO to Step 4.
3) Did the continuous test memory codes reappear?	Yes	• REPAIR all continuous test memory codes. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, then the Transmission Reference manual, then this workshop manual, GO to Step 2.
	No	• GO to Step 4.
4) Is the concern repaired?	Yes	• VERIFY no DTCs are present. CLEAR memory codes.
	No	

		• REFER to Diagnosis By Symptom in this section.
5) Was the transmission concern corrected when the scan tool was installed?	Yes	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, intermittent fault diagnosis section and use the scan tool to diagnose cause of concern in the processor, vehicle harness or external inputs (sensors or switches).
	No	• REFER to the hydraulic and mechanical routine to diagnose the concern, GO to Step 6.
6) Is the concern repaired?	Yes	• CARRY OUT the drive cycle test and VERIFY no DTCs are present. CLEAR memory codes.
	No	• Concern should have been repaired. GO back through the Diagnostic Flow Chart and REVIEW other components that may have contributed to the concern. CHECK and DIAGNOSE those components. GET assistance from other sources.

Preliminary Inspection

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

The following items must be checked prior to beginning the diagnostic procedures.

Know and Understand the Concern

In order to correctly diagnose a concern, first understand the customer complaint or condition. Customer contact may be required in order to begin to verify the concern. Understand the conditions as to when the concern occurs. For example:

- Hot or cold vehicle temperature
- Hot or cold ambient temperatures
- Vehicle driving conditions
- Vehicle loaded/unloaded

After understanding when and how the concern occurs, proceed to verifying the concern.

Verification of Condition

This section provides information which must be used in both determining the actual cause of customer concerns and carrying out the appropriate procedures.

The following procedures must be used when verifying customer concerns for the transmission.

Determine Customer Concern

NOTE: Some transaxle conditions may cause engine concerns. An Electronic Pressure Control (EPC) short circuit can cause engine misfiring. The Torque Converter Clutch (TCC) not disengaging will stall the engine.

Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- Hot or cold vehicle operating temperature
- Hot or cold ambient temperatures
- Type of terrain
- Vehicle loaded/unloaded
- City/highway driving
- Upshift
- Downshift
- Coasting
- Engagement (harsh or soft)
- Noise/vibration - check for engine rpm, vehicle speed, shift, gear, range or temperature dependencies

Check Transmission Fluid Level and Condition p>

NOTICE: **The vehicle should not be driven if the transmission fluid level indicator shows the transmission fluid below the DO NOT DRIVE mark or internal failure could result.**

If the vehicle is operated for an extended period of time at highway speeds, city traffic, hot weather or while pulling a trailer, the transmission fluid needs to cool down to obtain an accurate reading.

The transmission fluid level reading on the transmission fluid level indicator will differ depending on operating and ambient temperatures. The correct reading should be within the normal operating temperature range.

Transmission Fluid Level Check

NOTE: Transmission fluid should be checked at normal operating temperature 60°C-70°C (140°F-158°F) on a level surface. Normal operating temperature is reached after approximately 32 km (20 mi) of driving and can be checked using the scan tool.

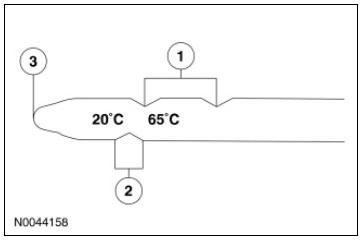
Check the transmission fluid level during normal maintenance. If the transaxle starts to slip, shifts slowly or shows signs of transmission fluid leaking, the transmission fluid level should be checked.

1. With the selector lever in PARK, engine at idle, brake pedal applied, move the selector lever through each gear range and allow engagement of each gear. Place the selector lever in the PARK position.

2. Wipe the transmission fluid level indicator cap and remove the transmission fluid level indicator.

3. Wipe the transmission fluid level indicator with a clean cloth.

4. Install the transmission fluid level indicator back in the transmission fluid filler tube until it is fully seated, then remove the indicator. The transmission fluid level should be within the normal operating range.



Item	Description

1	Transmission fluid level at operating temperature 60°C-70°C (140°F-158°F)
2	Transmission fluid level cold 15°C-25°C (59°F-77°F)
3	Do not drive mark

High Transmission Fluid Level

Transmission fluid level that is too high may cause the transmission fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of transmission fluid from the vent tube and possible transaxle malfunction and/or damage. If an overfill reading is indicated, refer to Transmission Fluid Exchange in this section.

Low Transmission Fluid Level

Low transmission fluid level could result in poor transaxle engagement, slipping, malfunction and/or damage. This could also indicate a leak in one of the transaxle seals or gaskets.

Adding Transmission Fluid

NOTICE: **The use of any type of transmission fluid other than specified could result in transaxle malfunction and/or damage.**

If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pt) increments through the transmission fluid filler tube. Do not the transmission fluid. For transmission fluid type, refer to the specification chart in this section.

Transmission Fluid Condition Check

1. Check the transmission fluid level.
2. Hold the transmission fluid level indicator over a white facial tissue and allow the transmission fluid to drip onto the facial tissue and examine the stain.
3. Observe the color and the odor. The color under normal circumstances should be dark red, not brown or black or have a burnt odor.
4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.
5. If the stain is a foamy pink color this may indicate coolant in the transaxle. The engine cooling system should also be inspected at this time.
6. If transmission fluid contamination or transaxle failure is confirmed by the sediment in the bottom of the transmission fluid pan, install a new transaxle. If installing a new transaxle the transmission fluid cooler bypass valve, transmission fluid coolers and transmission cooler tubes should be cleaned.
7. Carry out diagnostic checks and adjustments. Refer to Diagnosis By Symptom in this section.

Water in Transmission Fluid

To correctly repair an automatic transaxle that had water or coolant introduced into the system, only install a new transaxle for the units that cannot be disassembled and cleaned. Prior to installing the transaxle, the transmission fluid cooler(s), transmission fluid cooler tubes and transmission fluid cooler hoses need to be

flushed and cleaned.

Road Testing Vehicle

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

The Shift Point Road Test and Torque Converter Operation Tests provide diagnostic information on shift controls and torque converter operation.

Shift Point Road Test

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: Shift speed ranges are approximate for all applications.

This test verifies that the shift control system is operating correctly.

1. Bring engine and transaxle up to normal operating temperature.
2. Operate vehicle with selector lever in D range.
3. Using the shift speed charts, apply minimum throttle and observe the speeds at which the transaxle upshifts. The transaxle willhift 1st through 6th gears.
4. Press the accelerator pedal to the floor, Wide Open Throttle (WOT). The transaxle should downshift to the next lower gear depending on the vehicle speed. The Torque Converter Clutch (TCC) should release.

Shift Speed

Manual D	km/h	mph
1-2 upshift	14-21	9-13
2-3 upshift	21-29	13-18
3-4 upshift	33-40	20-25
4-5 upshift	49-55	30-35
5-6 upshift	65-70	40-44
3-1 downshift	7-17	4-11
4-3 downshift	26-36	16-24
5-4 downshift	38-46	24-29
6-5 downshift	56-63	35-39

5. If the transaxle fails to upshift/downshift or the TCC does not apply and release, refer to Diagnosis By Symptom in this section for possible causes.

Torque Converter Diagnosis

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Prior to torque converter installation, all diagnostic procedures must be followed. This is to prevent the unnecessary installation of new or remanufactured torque converters. Only after a complete diagnostic evaluation can the decision be made to installew or remanufactured torque converter.

Begin with the normal diagnostic procedures as follows:

1. Preliminary Inspection

2. Know and Understand the Customer Concern

3. Verify the Concern - carry out the torque converter operation test

4. Carry out Diagnostic Procedures:
   - Retrieve and record all DTCs. Refer to Diagnostics in this section.
     - Repair all non-transaxle related DTCs first.
     - Repair all transaxle DTCs.
     - Carry out Pressure Test. Refer to Special Testing Procedures in this section.
     - Carry out Stall Speed Test. Refer to Special Testing Procedures in this section.
     - Carry out diagnostic routines. Refer to Diagnosis By Symptom in this section.
     - Use the index to locate the appropriate routine that best describes the symptom(s). The routine will list all possible components that may cause or contribute to the symptom. Check each component listed, diagnose and repair as required, before repairing the torque converter.

Torque Converter Operation Test

NOTE: The Torque Converter Clutch (TCC) will not engage if the Transmission Fluid Temperature (TFT) is below 0°C (32°F).

1. Using the scan tool, make sure the TFT is within specification 43°C-47°C (109°F-117°F).

2. Accelerate the vehicle to 35-60 km/h (22-37 mph) and maintain a consistent speed.

3. Release the accelerator pedal to close the throttle then press the accelerator to partially open the throttle while monitoring the scan tool engine speed and TCCAMP_MES. The PID will read 0 when the TCC is released, and 1 when the TCC is applied. The engine speed will increase when the TCC is released and decrease when the TCC is appl

4. If these actions do not occur, see Torque Converter Operations Concerns, refer to Diagnosis By Symptom in this section.

Visual Inspection

This inspection will identify modifications or additions to the vehicle operating system that may affect diagnosis. Inspect the vehicle for non-Ford factory add-on devices such as:

- Electronic add-on items:
  - A/C
  - Generator (alternator)
  - Engine turbo
  - Cellular telephone
  - Cruise control
  - CB radio
  - Linear amplifiers
  - Backup alarm signal
  - Computer
- Vehicle modification:
  - These items, if not installed correctly, will affect the PCM or transmission function. Pay particular attention to add-on wiring splices in the PCM harness or transmission wiring harness, abnormal tire size or axle ratio changes.
  - Leaks. Refer to Leakage Inspectiona> in this section.
  - Correct selector lever linkage adjustments. Refer to Section 307-05A .

Selector Lever Linkage Check

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the selector lever linkage is not correctly adjusted. Refer to Section 307-05A for selector lever linkage adjustment.

Check TSBs

Refer to all TSBs which pertain to the concern and follow the procedure.

Diagnostics

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Self DiagnoFunction

The Transmission Control Module (TCM) monitors the communication status of each sensor, electronic component and the PCM. If any malfunctions occur, the TCM function warns the driver and stores the malfunction as a diagnosis code.

Fail-Safe

With the fail-safe function, if any malfunction should occur in the transaxle system, the TCM will output a control signal, and control will be carried out to make traveling a minimum distance possible. If all shift solenoids malfunction, the TCM will cancel the output of control signals to the solenoids. If this happens, the automatic transmission gear shifting will be controlled by transmission fluid pressure circuits only and the gears will shift as shown in the following table.

Selector Lever Position	Gear Position
R	Reverse
D	3rd or 5th gear

On-Board Diagnostic (OBD) With Scan Tool

NOTE: For detailed instruction and other diagnostic methods using the scan tool or equivalent, refer to the Scan Tool Tester manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

These Self Tests should be used to diagnose the PCM and should be carried out in order.

- Self Test - Key ON Engine OFF (KOEO)
- Self Test - Continuous Memory Codes
- Self Test - Key ON Engine Running (KOER)
- Special Test Modes
    - Wiggle Test Mode
    - Output Test Mode

- PCM Reset Mode
- Clearing DTCs P1000
- On-Board Diagnostic (OBD) II Drive Cycle
- Other scan tool features

Diagnostic Parameters Identification (PID) Chart

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

PID Name	Description	Units
DTCTCM	Continuous codes	Number of DTCs
Gear	Gear commanded by module	Gear (1-6)
GEAR_OSC	Gear commanded by output state control	• 0 = commanded gear is not controlled by OSC • 2 = 1st gear is commanded by OSC • 4 = 2nd gear is commanded by OSC • 12 = 6th gear is commanded by OSC
LPC	Line Pressure Control (LPC)	Pressure (psi)
LPC_AMP	LPC	Current (amps)
LPC_F	LPC	INT
OSS	Output Shaft Speed (OSS)	rpm
OSS_SRC	OSS	rpm
LPCAMP_MES	Measured current for LPC	Current (amps)
RPMTCM	Engine revolutions per minute	rpm
SHFTCTRL	Shift control	• 00 Economy mode • 01 Sport mode • 02 Up slope 1 mode • 03 Up slope 2 mode • 04 Down slope mode • 05 Hot 1 (over temperature 1) mode • 06 Hot 2 (over temperature 2) mode • 07 Cruise mode • 08 Traction mode • 09 l Position mode • 0A Tiptronic mode • 0B Coast shift

		• Flexible Fuel (FF) Invalid data
SSA_F	Shift solenoid 1 status	• 00 is not fault detected • 01 is short to ground • 02 is open circuit load • 04 is short circuit to battery power • 80 is general (non-specific) fault
SSB_F	Shift solenoid 2 status	• 00 is not fault detected • 01 is short to ground • 02 is open circuit load • 04 is short circuit to battery power • 40 is stack failure • 80 is general (non-specific) fault
SSC_AMP	Shift Solenoid Pressure Control C (SSPCC) current	Current (amps)
SSCAMP_MES	Measured current Shift Solenoid C (SSC)	Current (amps)
SSDAMP_MES	Measured current Shift Solenoid D (SSD)	Current (amps)
SSD_AMP	SSD	Current (amps)
SSEAMP_MES	Measured current Shift Solenoid E (SSE)	Current (amps)
SSE_AMP	Shift Solenoid Pressure Control E (SSPCE)	Current (amps)
SSFAMP_CMD	Commanded current Shift Solenoid F (SSF)	Current (amps)
SSFAMP_MES	Measured current SSF	Current (amps)
SSPCC	SSPCC	Pressure (psi)
SSPCC_F	SSPCC status	• 00 is not fault detected • 01 is short to ground • 02 is open circuit load • 04 is short circuit to battery power • 80 is general (non-specific) fault
SSPCD	Shift Solenoid Pressure Control D (SSPCD)	Pressure (psi)
SSPCD_F	SSPCD status	• 00 is not fault detected • 01 is short circuit to ground • 02 is open circuit load • 04 is short to battery power • 80 is general (non specific) fault
SSPCE	SSPCE	Pressure (psi)
SSPCE_F	SSPCE status	• 00 is not fault detected

		• 01 is short circuit to ground • 02 is open circuit load • 04 is short circuit to battery power • 80 is general (non-specific) fault
SSPCF_CMD	Commanded pressure Shift Solenoid Pressure Control F (SSPCF)	Pressure (psi)
SSPCF_F	SSPCF status	• 00 is not fault detected • 01 is short to ground • 02 is open circuit load • 04 is short circuit to battery power • 80 is general (non-specific) fault
TC_SLIPACT	Torque converter slip actual TCCMACT	rpm
TCC_AMP	Torque Converter Clutch (TCC) pressure control	Current (amps)
TCCAMP_MES	Measured current for the TCC pressure control	Current (amps)
TCCPC	Converter pressure control	Pressure (psi)
TCCSLPDSD	TCC slip desired	rpm
TCC_F	TCC fault	• 00 is not fault detected • 01 is short to ground • 02 is open circuit load • 04 is short circuit to battery power • 80 is general (non-specific) fault
TCC_OSC	Output state control of torque converter	• 00 TCC not controlled by OSC • 01 TCC is disengaged by OSC • 02 TCC is engaged by OSC
TCC_RAT	Transmission slip ratio	Ratio
TFT	Transmission Fluid Temperature (TFT)	Temperature (°C, °F)
TFT	TFT	Voltage
TORQUE	Net engine torque	Torque (lb-ft)
TP_REL	Relative Throttle Position (TP)	Percentage
TR	Transmission Range (TR)	• P = 7 • R = 6 • N = 5 • D = 4 • L = 1

TRAN_RAT	Transmission gear ratio	Ratio		
TSS_SRC	Turbine Shaft Speed (TSS)	TSS	TSS	rpm
TR_V	TR	Voltage		
VPWRTCM	Module supply voltage VBAT	Voltage		
VSS	Vehicle Speed Sensor (VSS)	Speed (mph)		

Transaxle Drive Cycle Test

NOTICE: **Prior to carrying out the Transaxle Drive Cycle Test, make sure that the transaxle is full of transmission fluid or damage to the transaxle may occur.**

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

Use the Transaxle Drive Cycle Test for checking continuous codes.

NOTE: The Transaxle Drive Cycle Test must be followed exactly. Malfunctions must occur multiple times consecutively for shift error or Torque Converter Clutch (TCC) codes to set.

NOTE: When carrying out the Transaxle Drive Cycle Test, see the Solenoid Operation Chart for correct solenoid operation. Refer to Specifications in this section.

1. Record and then erase all DTCs.

- Warm engine to normal operating temperature.

3. Make sure transmission fluid level is correct.

4. With the selector lever in DRIVE, moderately accelerate from stop to 80 km/h (50 mph). This allows the transaxle to shift into 6th gear. Hold speed and throttle steady for minimum of 15 seconds. Brake to a stop and remain stopped for minimum of 20 seconds.

5. Repeat Step 4 at least 5 times.

6. Retrieve and record any DTCs.

- If DTCs are present, refer to Diagnostic Trouble Code (DTC) Charts in this section. Service all non-transaxle DTCs first as they can directly affect the operation of the transaxle. Repeat the Road Test to verify the correction. Erase DTCs, carry out the Transaxle Drive Cycle Test, and road test after completing service on the DTCs.
- If the continuous test passes (system pass) and a concern is still present, refer to Diagnosis By Symptom in this section and check TSBs for diagnostic concern.

After On-Board Diagnostic (OBD)

NOTE: The vehicle wiring harness, PCM and non-transaxle sensors may affect transaxle operations. Service these concerns first.

After the On-Board Diagnostic (OBD) procedures are completed, service all DTCs.

Begin with non-transaxle related DTCs, then service any transaxle related DTCs. Refer to the Diagnostic Trouble Code (DTC) Charts in this section for information on Condition and Symptoms. This chart will be helpful in referring to the correct manual(s) and to aid in diagnosing internal transaxle concerns and external non-transaxle inputs. The pinpoint tests are used in diagnosing electrical concerns of the transaxle. Make sure that the vehicle wiring harness and the PCM are diagnosed as well. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosing non-transaxle electronic components. The diagnostic routine

hydraulic/mechanical charts will help in diagnosing internal transaxle concerns and external non-transaxle inputs.

Before Pinpoint Tests

NOTE: Prior to entering pinpoint tests, check the PCM wiring harness for correct connections, bent or broken pins, corrosion, loose wires, correct routing, correct seals and their condition. Check the PCM, sensors and actuators for damage. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

NOTE: If a concern still exists after electrical diagnosis has been carried out, refer to Diagnosis By Symptom in this section.

If DTCs appear while carrying out the on-board diagnostics, refer to the Diagnostic Trouble Code (DTC) Charts in this section for the appropriate repair procedure. Prior to entering pinpoint tests, refer to TSBs for transaxle concerns.

Diagnostic Trouble Code (DTC) Charts

DTC Chart

NOTICE: **This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as open or shorted to ground circuits. Continuous Memory Diagnostic Trouble Code (CMDTC) has an additional 2-character DTC status code suffix to assist in determining DTC history.**

DTC	Component	Description	Condition	Symptom	Action
P0562:00	Battery	System vol low.	PCM detected a voltage level below 9 volts.	No engagements, no adaptive or self-learning strategy.	CHECK charging system, REFER to Section 414-01 .
P0563:00	Battery	System voltage high.	PCM detected a voltage level above 18 volts.	No adaptive or self-learning strategy.	CHECK charging system, REFER to Section 414-01 .
P0601:00	Transmission Control Module (TCM)	TCM Read-Only Memory (ROM) error.	TCM detected an internal software concern with ROM .	No engagements, no adaptive or self-learning strategy.	INSTALL a new TCM .
P0603:00	TCM	TCM Keep Alive Memory (KAM) error.	TCM detected an internal software concern with KAM .	No engagements, no adaptive or self-learning strategy.	INSTALL a new TCM .
P0604:00	TCM	TCM Random Access Memory (RAM) error.	TCM detected an internal software concern with RAM .	No engagements, no adaptive or self-learning strategy.	INSTALL a new TCM .
P0706:00	Transmission Range (TR)	TR sensor range or performance error.	TR sensor signal is out of normal range.	TR sensor indicates a stuck position (D-3rd gear), no adaptive or self-learning strategy.	INSTALL a new TCM .
P0707:00	TR Sensor	TR sensor circuit low input.	TR sensor signal is below threshold of 0.127 volt, sensor/circuit electrical malfunction.	TR sensor indicates a stuck position (D-3rd gear), no adaptive or self-learning strategy.	INSTALL a new TCM .
P0708:00	TR Sensor				INSTALL a new TCM .

		TR sensor circuit high input.	TR sensor signal is above threshold of 4.87 volts, sensor/circuit electrical malfunction.	TR sensor indicates a stuck position (D-3rd gear), no adaptive or self-learning strategy.	
P0711:00	Transmission Fluid Temperature (TFT) Sensor	No change in TFT during operation.	PCM has detected no TFT change during operation. TFT value stuck at some normal reading.	TFT indicates 80°C (176°F) at all times, no self-learning strategy, no Torque Converter Clutch (TCC) engagement.	GO to Pinpoint Test B .
P0712:00	TFT Sensor	200°C (329°F) indicated, TFT sensor circuit grounded.	Voltage drop across TFT sensor exceeds scale set for temperature -43°C (-45°F).	TFT indicates 80°C (176°F) at all times, no self-learning strategy, no TCC engagement.	GO to Pinpoint Test B .
P0713:00	TFT Sensor	-43°C (-45°F) indicated, TFT sensor circuit grounded.	Voltage drop across TFT sensor exceeds scale set for temperature -43°C (-45°F).	TFT indicates 80°C (176°F) at all times, no self-learning strategy, no TCC engagement.	GO to Pinpoint Test B .
P0716:00	Turbine Shaft Speed (TSS) Sensor	TSS range out of performance, insufficient input from TSS .	PCM has detected a loss or noisy TSS signal during operation.	No TCC engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test D .
P0717:00	TSS Sensor	No TSS signal.	PCM has not detected a TSS signal. No TSS signal when Output Shaft Speed (OSS) signal present.	No TCC engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test D .
P0721:00	OSS Sensor	OSS range out of performance, insufficient input from OSS .	PCM has detected a loss or noisy OSS signal during operation.	No adaptive or self-learning strategy.	GO to Pinpoint Test C .
P0722:00	OSS Sensor	No OSS signal.	PCM has detected no OSS signal.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test C .
P0729:00	Transaxle	6th gear ratio.	No 6th gear ratio detected by TCM .	No 6th gear, no TCC	GO to Pinpoint Test A .

				engagements, no adaptive or self-learning strategy.	
P0730:00	Clutch Control Solenoids or Internal Parts	Gear ratio error.	PCM has detected a gear ratio error.	No self-learning strategy.	GO to Pinpoint Test A .
P0731:00	Solenoid or Internal Parts	1st gear ratio.	No 1st gear ratio detected by TCM .	No 1st gear, no TCC engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0732:00	Solenoid or Internal Parts	2nd gear ratio.	No 2nd gear ratio detected by TCM .	No 2nd gear, no TCC engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0733:00	Solenoid or Internal Parts	3rd gear ratio.	No 3rd gear ratio detected by TCM .	No 3rd gear, no TCC engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0734:00	Solenoid or Internal Parts	4th gear ratio.	No 4th gear ratio detected by TCM .	No 4th gear, no TCC engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0735:00	Solenoid or Internal Parts	5th gear ratio.	No 5th gear ratio detected by TCM .	No 5th gear, no TCC engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0736:00	Transaxle	Reverse gear ratio.	No reverse gear ratio detected by TCM .	No reverse gear, no self-learning strategy.	GO to Pinpoint Test A .
P0780:00	Solenoid or Valve Internal to Transaxle	Universal shifting (stuck valve).	Valve stuck.	Increase rpm during shifts. Slipping or erratic shifting.	GO to Main Control Valve Body in this section.
P0813:00	Reverse Output Circuit	Reverse lamp circuit.	Reverse lamp circuit short to ground, power or open.	Reverse lamps inoperative.	GO to Section 417-01 .
P0817:00	TCM /PCM Starter Circuit	Starter disable circuit open or shorted to	TCM detected a failure in the starter lock circuit, failed	DTC is set. Warning lamp is illuminated.	GO to Pinpoint Test E .

		power/ground.	ON or OFF. Ignition switch is ON, TCM and PCM communication is normal. No voltage is detected on the start lock circuit for more than 0.1 second or a continuous 12-volt output is detected for more than 0.1 second. Conditions present 2 times to set DTC.		
P0819:00	SelectShiftTM Transmission Control Circuit	Up And Down Shift Swich To Transmission Range (TR) Correlation	The associated circuitry connected to the SelectShiftTM switch or fuse, or the SelectShiftTM switch itself may have an issue causing a SelectShiftTM malfunction.	No manual up or down shift available.	GO to Section 307-05A .
P0961:00	Line Pressure Control (LPC)	LPC circuit or solenoid failure.	LPC circuit or solenoid failed during operation. Incorrect commanded current detected by TCM .	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0962:00	LPC	LPC solenoid signal or grounded circuits either short or open, solenoid circuit failure.	Voltage through LPC is checked. An error will be noted if tolerance is exceeded.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0963:00	LPC	LPC solenoid short to power circuit failure.	Voltage through LPC is checked. An error will be noted if tolerance is exceeded.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0973:00	Shift Solenoid A (SSA)	SSA solenoid or circuit shorted to ground.	Voltage through SSA (S1) circuit is checked. An error will be noted if tolerance is exceeded. Short to ground failure detected.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0974:00	SSA				GO to Pinpoint Test A .

		SSA or circuit shorted to power or open.	Voltage through SSA (S1) circuit is checked. An error will be noted if tolerance is exceeded. Short to power failure or open circuit detected.	No engagements, no adaptive or self-learning strategy.	
P0976:00	Shift Solenoid B (SSB)	SSB solenoid or circuit shorted to ground.	Voltage through SSB (S2) circuit is checked. An error will be noted if tolerance is exceeded. Short to ground failure detected.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0977:00	SSB	SSB solenoid or circuit shorted to power or open.	Voltage through SSB solenoid (S2) circuit is checked. An error will be noted if tolerance is exceeded. Short to power failure or open circuit detected.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0978:00	Shift Solenoid C (SSC)	SSC circuit or solenoid failure.	SSC circuit or solenoid failed during operation. Incorrect commanded current detected by TCM .	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0979:00	SSC	SSC solenoid signal or grounded circuits either shorted or open, solenoid circuit failure.	Voltage through SSC circuit is checked. An error will be noted if tolerance is exceeded. Short to power failure or open circuit detected.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0980:00	SSC	SSC solenoid or circuit shorted to power.	Voltage through SSC circuit is checked. An error will be noted if tolerance is exceeded. Short to power failure or open circuit detected.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0981:00	Shift Solenoid D (SSD)	SSD circuit or solenoid failure.	SSD circuit or solenoid failed during operation.	No engagements, no adaptive or	GO to Pinpoint Test A .

			Incorrect commanded current detected by TCM .	self-learning strategy.	
P0982:00	SSD	SSD signal or grounded circuits either shorted or open, solenoid circuit failure.	Voltage through SSD circuit is checked. An error will be noted if tolerance is exceeded. Short to power failure or open circuit detected.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0983:00	SSD	SSD or circuit shorted to power.	Voltage through SSD circuit is checked. An error will be noted if tolerance is exceeded. Short to power failure or open circuit detected.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0984:00	Shift Solenoid E (SSE)	SSE circuit or solenoid failure.	SSE circuit or solenoid failed during operation. Incorrect commanded current detected by TCM .	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0985:00	SSE	SSE signal or grounded circuits either shorted or open, solenoid circuit failure.	Voltage through SSE circuit is checked. An error will be noted if tolerance is exceeded. Short to power failure or open circuit detected.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0986:00	SSE	SSE or circuit shorted to power.	Voltage through SSE circuit is checked. An error will be noted if tolerance is exceeded. Short to power failure or open circuit detected.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0997:00	Shift Solenoid F (SSF)	SSF circuit or solenoid failure.	SSF circuit or solenoid failed during operation. Incorrect commanded current detected by TCM .	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P0998:00	SSF	SSF signal or grounded circuits	Voltage through SSF circuit is	No engagements,	GO to Pinpoint Test A .

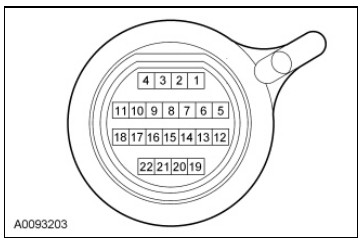
		either shorted or open, solenoid circuit failure.	checked. An error will be noted if tolerance is exceeded. Short to power failure or open circuit detected.	no adaptive or self-learning strategy.	
P0999:00	SSF	SSF or circuit shorted to power.	Voltage through SSF circuit is checked. An error will be noted if tolerance is exceeded. Short to power failure or open circuit detected.	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P1573:00	Accelerator Pedal Position (APP) Sensor	APP sensor input error.	PCM has detected an input error from the APP sensor.	No adaptive or self-learning strategy.	**NOTE:** If this DTC is displayed, a malfunction occurred in the vehicle not the TCM . Do not install a new TCM . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1576:00	Throttle Position (TP) Sensor	TP sensor input error.	TP not available.	Limited function.	**NOTE:** If this DTC is displayed, a malfunction occurred in the vehicle not the TCM . Do not install a new TCM . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1657:00	TCM	TCM communication link error.	Controller Area Network (CAN) link error detected by PCM.	No engagements, no adaptive or self-learning strategy. Limited fuel and spark.	INSTALL a new TCM .
P1700:00	Transaxle	Drive engagement error.	TCM detected neutral in the DRIVE position.	No engagements, no adaptive or self-learning strategy.	REFER to Diagnosis By Symptom in this section.
P1701:00	Transaxle	Reverse engagement error.	TCM detected neutral in the REVERSE position.	No self-learning strategy.	REFER to Diagnosis By Symptom in this section.
P1719:00	PCM	Engine torque signal.	Torque engine accuracy from PCM	Firm shifts and no adaptive	PERFORM self-test of PCM. REFER to the

			inaccurate.	learning.	Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnose any DTCs present. If no DTCs, IDENTIFY the driveability symptom present and REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for further diagnosis.
P1919:00	Engine Coolant Temperature (ECT)	Sensor signal error.	PCM/ TCM have detected an error in the CAN ECT information.	No TCC engagements, ECT set to 80°C (176°F).	**NOTE:** If this DTC is displayed, a malfunction occurred in the vehicle not, the TCM . Do notnstall a new TCM . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P2757:00	TCC Solenoid	TCC solenoid circuit failure, stuck OFF.	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open, shorted or PCM driver failure during On-Board Diagnostic (OBD).	No TCC engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P2758:00	TCC Solenoid	TCC solenoid circuit failure, stuck ON.	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open, shorted or PCM driver failure during OBD .	No TCC engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P2762:00	TCC Solenoid	TCC circuit or solenoid failure.	TCC circuit or solenoid failed during operation. Incorrect commanded current detected by TCM .	No engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P2763:00	TCC Solenoid	TCC circuit shorted to power.	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit shorted to power.	No TCC engagements, no adaptive or self-learning strategy.	GO to Pinpoint Test A .
P2764:00	TCC Solenoid				GO to Pinpoint Test A .

		TCC solenoid signal or grounded circuits either short or open solenoid circuit failure.	TCC solenoid circuit fails to provide voltage drop across solenoid.	No TCC engagements, no adaptive or self-learning strategy.	
U0073:00	TCM CAN	TCM communication link error.	CAN link error detected by PCM.	No engagements, no adaptive or self-learning strategy.	REFER to Section 418-00 .
U0100:00	TCM CAN	TCM communication link error.	CAN link error detected by PCM.	No engagements, no adaptive or self-learning strategy.	**NOTE:** If this DTC is displayed, a malfunction occurred in the vehicle not the TCM . Do not install a new TCM . A module cannot communicate with other modules on the communication network while being reprogrammed. CLEAR any network communication DTCs which may have been set in other modules during reprogramming. CHECK CAN harness between TCM and other modules. For diagnostic information, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and REFER to Section 418-00 .

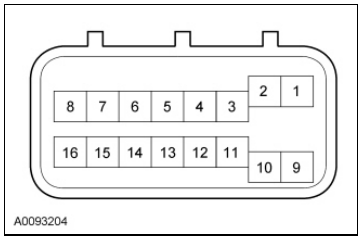
Transaxle Connector Layouts

Transaxle Bulkhead Electrical Connector



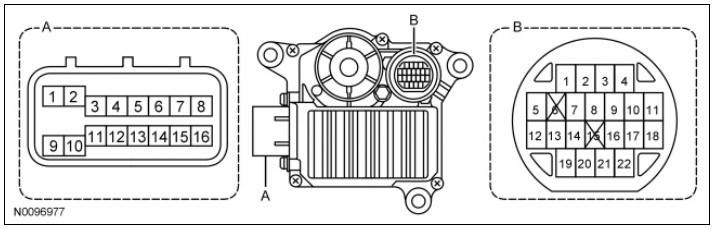
Pin Number	Circuit Function
1	Line Pressure Control (LPC) ground
2	Shift Solenoid B (SSB)
3	LPC signal
4	Torque Converter Clutch (TCC) ground
5	Shift Solenoid A (SSA)
6	NOT USED
7	Transmission Fluid Temperature (TFT) ground
8	TFT
9	TCC signal
10	Shift Solenoid C (SSC) ground
11	SSC signal
12	Turbine Shaft Speed (TSS) sensor signal
13	TSS sensor signal ground
14	Shift Solenoid E (SSE) signal
15	NOT USED
16	Shift Solenoid F (SSF) ground
17	Shift Solenoid D (SSD) signal
18	SSD ground
19	Output Shaft Speed (OSS) sensor signal
20	OSS sensor signal ground
21	SSF signal
22	SSE ground

Transmission Range (TR) Transmission Control Module (TCM) C1533 (A) Vehicle Harness



Pin Number	Circuit Function
1	Battery feed
2	NOT USED
3	Manual upshift command
4	Manual downshift command
5	Start lock signal out
6	Controller Area Network (CAN) -
7	NOT USED
8	NOT USED
9	Transmission Control Module (TCM) ground
10	NOT USED
11	Ignition switch signal input
12	NOT USED
13	Reverse lamp signal out
14	CAN +
15	NOT USED
16	NOT USED

Transaxle Control Module Terminal Testing



NOTE: For testing, place the positive lead on the terminal with the + sign and place the negative lead on the terminal with the - sign.

Pin Number	Pin Acronym	Description	Input / Output to Trans-mission Control Module (TCM)	Measure pins	Condition For Testing	Reference Value

A1	B+	Battery voltage	-	+A1 to ground	Hot at all times	10-14 volts
A3	SST(+)	Select shift upshift signal	Input	+A3 to -A9	Voltage high when upshift commanded by select shift	10-14 volts
A4	SST(-)	Select shift downshift signal	Input	+A4 to -A9	Voltage high when downshift commanded by select shift	10-14 volts
A5	STLK	Start lock signal output	Output	+A5 to -A9	Ignition ON in PARK Ignition ON in other than PARK	0-0.8 volt 9-14 volts
A6	CAN L	Controller Area Network (CAN) communi-cation low	Input/output	+A6 to -A9	Engine idling	-
A8	K	Diagnostic signal	Input/output	+A8 to -A9	-	-
A9	GRND	Transmission Control Module (TCM) ground	-	+ground to chassis ground	-	-
A11	IG	Ignition switch signal input	Input	+A11 to -A9	Ignition ON	10-14 volts
A12	Reverse Lamp	Reverse lamp is indicated in reverse	Output	+A12 to -A9	Voltage high when not in REVERSE Voltage low when in REVERSE	0-14 volts
A14	CAN H	communi-cation high	Input/output	+A14 to -A9	Engine idling	-
B1	LPC ground	Line Pressure Control (LPC) ground (SLTG)	-	-	-	-
B2	SSB	Shift Solenoid B (SSB) (S2)	Output	+B2 to ground	Vehicle in PARK, engine idling	0-1.5 volts
B3	LPC	LPC	Output	+B3 to -B1	Vehicle in PARK, engine idling	-
B4	TCC solenoid ground	Torque Converter Clutch (TCC) solenoid ground (SLUG)	-	-	-	-
B5	SSA		Output	+B5 to ground		0-1.5 volts

		Shift Solenoid A (SSA) (S1)			Vehicle in PARK, engine idling	
B7	TFT ground	Transmission Fluid Temperature (TFT) sensor ground (OTG)	-	-	-	-
B8	TFT	TFT sensor (OT)	Input	+B8 to -B7	TFT at 10°C to 110°C (50°F to 230°F)	4.0 to 0.0 volts
B9	TCC	TCC solenoid (SLU)	Output	+B9 to -B4	Vehicle in PARK, engine idling	-
B10	SSC ground	Shift Solenoid C (SSC) ground (SLC1G)	-	-	-	-
B11	SSC (SLC1)	Output	+B11 to -B10	Vehicle in PARK, engine idling	-	
B12	ISS	Input shaft speed sensor signal (NIN)	Input	+B12 to -B13	Vehicle in PARK, engine idling	-
B13	ISS ground	Input shaft speed sensor signal (NIN)	-	-	-	-
B14	SSE	Shift Solenoid E (SSE)	Output	+B14 to -B22	Vehicle in PARK, engine idling	-
B16	SSF ground	Shift Solenoid F (SSF) ground (SLB1G)	-	-	-	-
B17	SSD	Shift Solenoid D (SSD) (SLC2)	Output	+B17 to="top" align="left">Vehicle in PARK, engine idling	-	
B18	SSD ground	SSD ground (SLC2G)	-	-	-	-
B19	OSS	Output Shaft Speed (OSS) sensor signal (SP+)	Input	+B19 to -B20	Vehicle speed approximately 20 km/h (12 mph)	-
B20	OSS ground	OSS sensor ground (SP-)	-	-	-	-
B21	SSF	SSF (SLB1G)	Output	+B21 to -B16	Vehicle in PARK, engine idling	-
B22	SSE ground	SSE ground (SLC3G)	-	-	-	-

Pinpoint Tests - OSC Equipped Vehicle

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Anyelectrical connector or solenoid body is disconnected, inspect the connector for pin condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or install a new connector as required.

Prior to carrying out the pinpoint tests, check the following:

- Transmission fluid level
- Transmission fluid condition (burned, metal particles or discolored)
- Engine cooling system
- Other non-related transmission DTCs

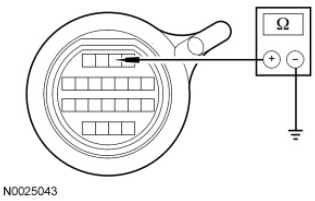
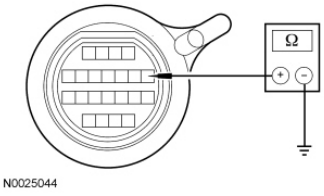
Pinpoint Tests

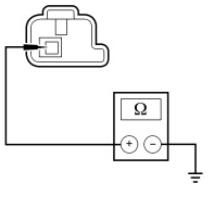
Refer to Wiring Diagrams Cell 29 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information.

PINPOINT TEST A: SHIFT SOLENOIDS

NOTE: Refer to the Transaxle Vehicle Harness Connector illustrations within the Transaxle Connector Layouts procedure in this section.

Test Step	Result / Action to Take
A1 ELECTRONIC DIAGNOSTICS	
• Check to make sure the transaxle harness connector is fully seated, pins are fully engaged in the connector and in good condition before proceeding. • Ignition OFF. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Retrieve DTCs.	**Yes** For Shift Solenoid A (SSA) and Shift Solenoid B (SSB), GO to A2 . For the Line Pressure Control (LPC), Shift Solenoid C (SSC), Shift Solenoid D (SSD), Shift Solenoid E (SSE), Shift Solenoid F (SSF) and Torque Converter Clutch (TCC), GO to A4 . **No** CLEAR all DTCs. ROAD TEST to verify if concern is still present. Concern could be intermittent. If concern is

• **Are there any transmission DTC faults present?**	still present or reappears, GO to the appropriate pinpoint test steps: For shift solenoids SSA and SSB , GO to A2 . For shift solenoids LPC , SSC , SSD , SSE , SSF and TCC , GO to A4 .
A2 CHECK RESISTANCE OF THE ON/OFF SOLENOID CIRCUIT	
• Ignition OFF. • Remove the Transmission Control Module (TCM). • Measure the resistance at the transaxle bulkhead electrical connector between pin 2 and ground for SSB .  N0025043 • Measure the resistance at the transaxle bulkhead electrical connector between pin 5 and ground for SSA .  N0025044 • **Is the resistance between 11-15 ohms?**	**Yes** INSTALL a new Transmission Control Module (TCM) and REFLASH to the latest level calibration. CLEAR all DTCs. ROAD TEST to verify concern is not present. Concern could be intermittent. If concern is still present or reappears, GO to A3 . **No** GO to A3 .
A3 CHECK RESISTANCE OF THE ON/OFF SOLENOIDS	
• Remove the transaxle side cover. • Remove the wiring connector from the affected solenoid (SSA or SSB). • Measure the resistance between solenoid pin 1 and ground of the affected solenoid.	**Yes** INSTALL a new internal wire harness or REPAIR affected circuit. **No** INSTALL a new main control.



- **Is the solenoid resistance between 11-15 ohms?**

A4 CHECK LINEAR SOLENOID SHORT TO GROUND

- Ignition OFF.
- Remove the TCM .
- Measure the resistance between the transaxle bulkhead electrical connector pin and ground using the following chart:

Transaxle Bulkhead Electrical Connector

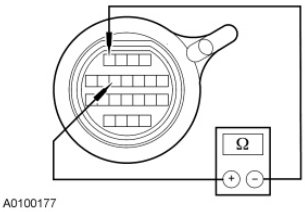
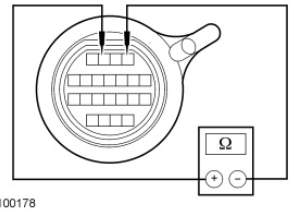
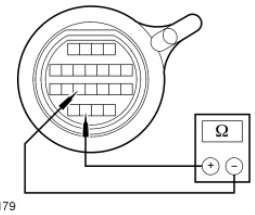
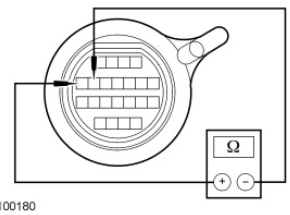
Pin Number	Circuit Function
1	Line Pressure Control (LPC) ground
3	LPC signal
4	Torque Converter Clutch (TCC) ground
9	TCC signal
10	Shift Solenoid C (SSC) ground
11	SSC signal
14	Shift Solenoid E (SSE) signal
16	Shift Solenoid F (SSF) ground
17	Shift Solenoid D (SSD) signal
18	SSD ground
21	SSF signal
22	SSE ground

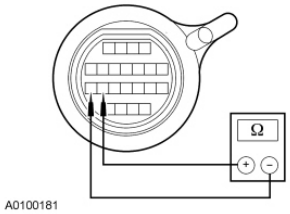
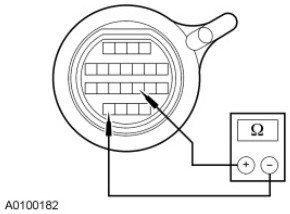
- **Is each resistance greater than 10,000 ohms?**

Yes
GO to A5 .

No
GO to A6 .

A5 CHECK RESISTANCE OF THE LINEAR SOLENOID(S)

• Inspect both sides of the TCM for damaged or pushed-out pins, corrosion or damaged seals. • For the TCC solenoid, measure the resistance between pin 4 and pin 9 at the transaxle.  A0100177 • For the LPC solenoid, measure the resistance between pin 3 and pin 1 at the transaxle.  A0100178 • For the SSF solenoid, measure the resistance between pin 21 and pin 16 at the transaxle.  A0100179 • For the SSC solenoid, measure the resistance between pin 11 and pin 10 at the transaxle.  A0100180	**Yes** INSTALL a new TCM and REFLASH to the latest level calibration. CLEAR all DTCs. ROAD TEST to verify concern is not present. Concern could be intermittent. If concern is still present or reappears, GO to A6 . **No** GO to A6 .

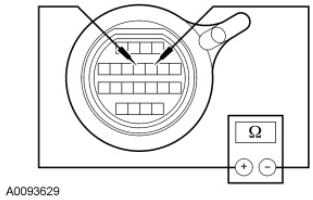
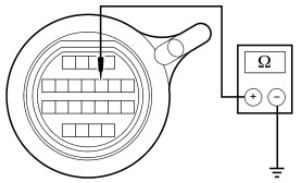
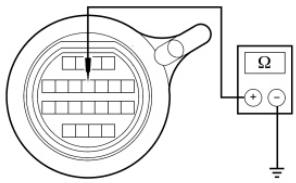
• For the SSD solenoid, measure the resistance between pin 17 and pin 18 at the transaxle.  A0100181 • For the SSE solenoid, measure the resistance between pin 14 and pin 22 at the transaxle.  A0100182 • **Is the resistance between 5.0 - 5.6 ohms?**	
A6 CHECK CONTINUITY OF THE INTERNAL HARNESS	
• Remove the transaxle side cover. • Remove the wiring connector from the affected solenoid(s) (LPC , SSC , SSD , SSE , SSF and TCC). • Measure the resistance between the bulkhead connector and the affected solenoid electrical connector. • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new main control. **No** INSTALL a new internal wire harness or repair affected circuit.

PINPOINT TEST B: TFT SENSOR

NOTE: Refer to the Transaxle Vehicle Harness Connector illustrations within the Transaxle Connector Layouts procedure in this section.

Test Step	Result / Action to Take
B1 ELECTRONIC DIAGNOSTICS	
• Connect the scan tool. • Check to make sure the transaxle harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. • Ignition ON.	**Yes** GO to B2 . **No** REPEAT procedure to enter DataLogger. If vehicle did not enter DataLogger,

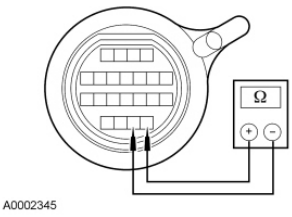
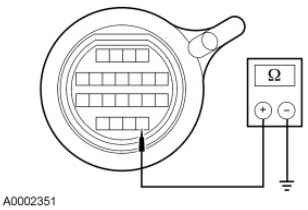
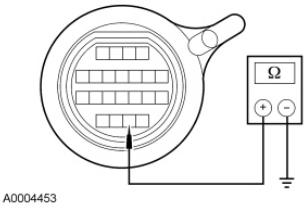
• Select DataLogger. • Select PID/TFT. • **Does the vehicle enter DataLogger?**	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2 TEMPERATURE SIGNAL CHECK	
• Ignition ON. • Select DataLogger. • Select TFT PID. • Monitor the TFT PID. The temperature value should be within -55°C to 175°C (-67°F to 347°F). • **Is the Transmission Fluid Temperature (TFT) within specified range?**	**Yes** GO to B3 . **No** GO to B4 .
B3 WARM-UP/COOL-DOWN CYCLE	
• While monitoring the TFT PIDs, carry out the following test: If transmission is cold, run transmission to warm it up. If transmission is warm, allow transmission to cool down. • **Do the TFT PIDs increase as the transmission is warmed up, decrease as the transmission is cooled and does the TFT stay within the specified range?**	**Yes** INSTALL a new Transmission Control Module (TCM) and REFLASH to the latest level calibration. CLEAR all DTCs. ROAD TEST to verify concern is not present. Concern could be intermittent. If concern is still present or reappears, GO to B4 . **No** GO to B4 .
B4 SIGNAL RESISTANCE	
• Remove the TCM . • Inspect both sides of the TCM for damaged or pushed-out pins, corrosion or damaged seals. • Measure the resistance between pins 7 and 8 at the transaxle bulkhead electrical connector. Refer to the following table. **TRANSMISSION FLUID TEMPERATURE (TFT) Sensor Resistance** **°C** / **°F** / **Resistance (Ohms)** 10 / 50 / 6.445 25 / 77 / 3.5 110 / 230 / 0.247	**Yes** GO to B5 . **No** INSTALL a new internal harness and TFT assembly.

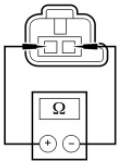
 A0093629 • Record the resistance. • **Is the resistance within range?**	
B5 SHORT TO GROUND	
• Measure the resistance between pin 7 and ground at the transaxle bulkhead electrical connector.  A0093630 • Measure the resistance between pin 8 and ground at the transaxle bulkhead electrical connector.  A0093631 • Record the resistances. • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new TCM and REFLASH to the latest level calibration. **No** INSTALL a new internal harness and TFT assembly.

PINPOINT TEST C: OSS SENSORS

NOTE: Refer to the Transaxle Vehicle Harness Connector illustrations within the Transaxle Connector Layouts procedure in this section.

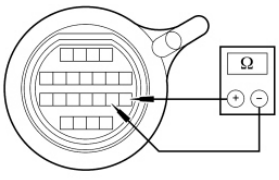
Test Step	Result / Action to Take
C1 ELECTRONIC DIAGNOSTICS	
• Check to make sure the Transmission Control Module (TCM) connector is fully seated, pins are fully engaged in the connector and in good condition before proceeding. • Connect the scan tool. • Ignition ON. • Monitor the PID for the Output Shaft Speed (OSS) sensor.	**Yes** CLEAR all DTCs. ROAD TEST to verify concern is not present. Concern could be intermittent. If concern is still present or reappears, GO to C2 . **No** GO to C2 .

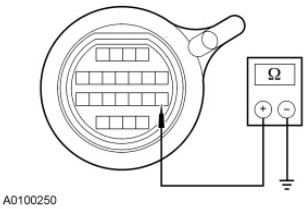
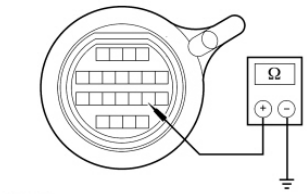
• Monitor and record speed. • **Does the OSS match the vehicle speed?**	
C2 CHECK OSS SENSOR RESISTANCE	
• Remove the TCM . • Measure the resistance at the transaxle bulkhead electrical connector between pin 19 and 20.  A0002345 • **Is the resistance less than 5 ohms?**	**Yes** CLEAR all DTCs. ROAD TEST to verify concern is not present. Concern could be intermittent. If concern is still present or reappears, GO to C3 . **No** GO to C4 .
C3 CHECK OSS SENSOR FOR SHORT TO GROUND	
• Remove the TCM . • Measure the resistance at the transaxle bulkhead electrical connector between pin 19 and ground.  A0002351 • Measure the resistance at the transaxle bulkhead electrical connector between pin 20 and ground.  A0004453 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new TCM and REFLASH to the latest level calibration. CLEAR all DTCs. ROAD TEST to verify concern is not present. Concern could be intermittent. If concern is still present or reappears, GO to C4 . **No** GO to C4 .
C4 CHECK OSS SENSOR RESISTANCE	

• Remove the transaxle side cover. • Measure the resistance at the speed sensor electrical connector between pin 1 and 2.  A0100200 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new internal harness. **No** INSTALL a new transaxle assembly.

PINPOINT TEST D: TSS SENSOR

NOTE: Refer to the Transaxle Vehicle Harness Connector illustrations within the Transaxle Connector Layouts procedure in this section.

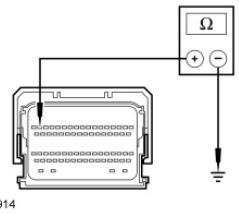
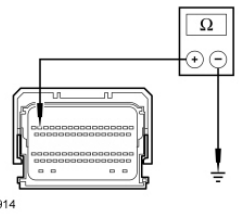
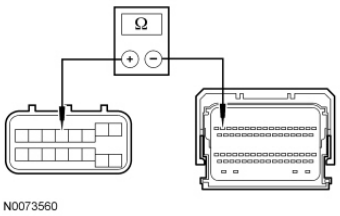
Test Step	Result / Action to Take
D1 ELECTRONIC DIAGNOSTICS	
• Check to make sure the Transmission Control Module (TCM) connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. • Connect the scan tool. • Ignition ON. • Monitor the PID for the Turbine Shaft Speed (TSS) sensor. • Monitor and record speed. • **Does the TSS match the engine rpm?**	**Yes** CLEAR all DTCs. ROAD TEST to verify concern is not present. Concern could be intermittent. If concern is still present or reappears, GO to D2 . **No** GO to D2 .
D2 CHECK TSS SENSOR RESISTANCE	
• Remove the TCM . • Measure the resistance at the transaxle bulkhead electrical connector between pin 12 and 13.  A0100249 • **Is the resistance less than 5 ohms?**	**Yes** CLEAR all DTCs. ROAD TEST to verify concern is not present. Concern could be intermittent. If concern is still present or reappears, GO to D3 . **No** GO to D4 .
D3 CHECK TSS SENSOR CIRCUIT FOR SHORT TO GROUND	

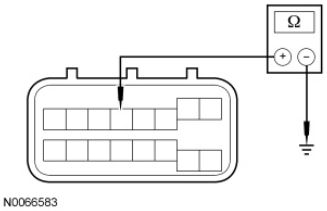
• Remove the TCM . • Measure the resistance at the transaxle bulkhead electrical connector between pin 12 and ground.  A0100250 • Measure the resistance at the transaxle bulkhead electrical connector between pin 13 and ground.  A0100251 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new TCM and REFLASH to the latest level calibration. CLEAR all DTCs. ROAD TEST to verify concern is not present. Concern could be intermittent. If concern is still present or reappears, GO to D4 . **No** GO to D4 .
D4 ELECTRONIC DIAGNOSTICS	
• Remove the transaxle side cover. • Measure the resistance at the TSS sensor electrical connector between pin 1 and 2. • **Is the resistance less than 5 ohms?**	**Yes** CLEAR all DTCs. ROAD TEST to verify concern is not present. Concern could be intermittent. If concern is still present or reappears, INSTALL a new internal harness. **No** The sensor is defective, INSTALL a new TSS sensor.

PINPOINT TEST E: PARK NEUTRAL SIGNAL

NOTE: Refer to the Transaxle Vehicle Harness Connector illustrations within the Transaxle Connector Layouts procedure in this section.

Test Step	Result / Action to Take
E1 CHECK RESISTANCE ON CIRCUIT CET40 (GN/OG)	
• Disconnect: PCM C175B. • Selector lever in PARK or NEUTRAL. • Measure the resistance between C175B-16, circuit CET40 (GN/OG) and chassis ground.	**Yes** GO to E2 . **No** GO to E3 .

 N0110914 • **Is the resistance between 13 to 40 ohms?**	
E2 CHECK RESISTANCE ON CIRCUIT CET40 (GN/OG)	
• Selector lever in REVERSE, DRIVE or M. • Measure the resistance between C175B-16, circuit CET40 (GN/OG) and chassis ground.  N0110914 • **Is the resistance greater than 1000 ohms?**	**Yes** INSTALL a new TCM . After installing the new TCM , VERIFY that the starting system is operating correctly. If not, REFER to Section 303-03A to check starting system. **No** GO to E3 .
E3 CHECK VEHICLE HARNESS CIRCUIT CET40 (GN/OG) FOR AN OPEN	
• Disconnect: Transmission Control Module (TCM) C1533. • Measure the resistance between C1533-5, circuit CET40 (GN/OG) and C175B-16.  N0073560 • **Is the resistance less than 5 ohms?**	**Yes** GO to E4 . **No** REPAIR circuit CET40 (GN/OG) for an open.
E4 CHECK VEHICLE HARNESS CIRCUIT CET40 (GN/OG) FOR A SHORT TO GROUND	

• Measure the resistance between C1533-5, circuit CET40 (GN/OG) and chassis ground.  N0066583 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new PCM. After installing the new PCM, VERIFY that the starting system is operating correctly. If not, REFER to Section 303-03A to check starting system. **No** REPAIR circuit CET40 (GN/OG) for a short to ground.

Special Testing Procedures

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST1565-A	Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)
 ST2834-A	Vehicle Communication Module and Integrated Diagnostic System software with appropriate hardware, or equivalent scan tool

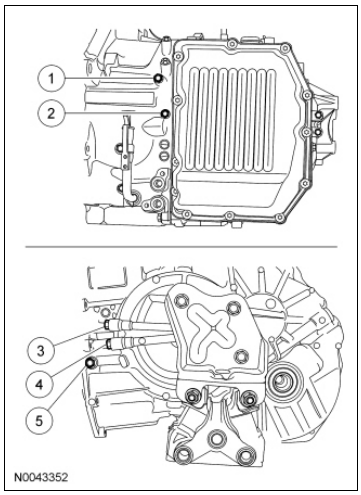
The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portions of the transaxle.

Engine Idle Speed Check

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the engine idle speed.

Pressure Test

Pressure Tap Location



Item	Description
1	Clutch C1 drive
2	Clutch C2 drive

3	Clutch C3 drive
4	Lube circuit
5	Clutch B2

NOTICE: **If the pressure is low at stall, do not continue with the test or further transaxle damage will occur. Do not maintain Wide Open Throttle (WOT) in any transaxle range for more than 5 seconds.**

This test verifies that the pressure is within specification.

1. Connect the Transmission Fluid Pressure Gauge to the appropriate pressure tap.
2. Start the engine and check the pressures, see the pressure charts to determine if the pressures are within specification.

Clutch and Brake Pressure Chart

Clutch/Band	Range	Pressure
C1 (Drive Clutch)	Drive (1st-4th)	196-1,372 kPa (28-199 psi)
C2 (Drive Clutch)	Drive (4th-6th)	196-1,372 kPa (28-199 psi)
C3 (Drive Clutch)	Drive (3rd-5th)	196-1,372 kPa (28-199 psi)
C3 (Drive Clutch)	Reverse	392-1,863 kPa (57-270 psi)
B1 (Brake Clutch)	Drive (2nd and 6th)	196-1,372 kPa (28-199 psi)
B2 (Brake Band)	Low manual (1st)	588-1,372 kPa (85-199 psi)
B2 (Brake Band)	Reverse	392-1,863 kPa (57-270 psi)

Pressure Diagnostic Chart

Test Results	Possible Source
Values of both DRIVE and REVERSE ranges are lower than the standards	• Line Pressure Control (LPC)

	• Primary regulator valve failure • Transmission oil pump failure • Leak from hydraulic circuit of DRIVE or REVERSE range
Only the value of DRIVE range is lower than the standards	• DRIVE range hydraulic circuit failure • C1 clutch failure
Only the value of REVERSE range is lower than the standards	• REVERSE range hydraulic circuit failure • C3 clutch failure • B2 brake failure

3. If the pressure is not within specification, install a new main control valve body.

4. If the pressures are OK, clear all DTCs. Test drive vehicle, code could be intermittent. If DTC returns, install a new valve body.

Stall Speed Test

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

The Stall Speed Test checks:

- Torque Converter Clutch (TCC) operation and installation.
- holding ability of the forward clutch.
- reverse clutch (the low-reverse bands).
- planetary One-Way Clutch (OWC).
- engine driveability concerns.

Conduct this test with the engine coolant and transmission fluid at correct levels and at normal operating temperature.

Apply the park brake firmly for each Stall Speed Test.

1. Find the specified stall rpm for the vehicle, see the Stall Speed Chart. Use a grease pencil to mark the rpm on the dial of a tachometer.

Stall Speed

Engine	rpm
3.5L	1,878-2,678

2. Connect a scan tool.

3. **NOTE:** If the rpm recorded by the scan tool exceeds the maximum limits, release the accelerator pedal immediately because clutch or band slippage is indicated.

   In each of the following range REVERSE, DRIVE and LOW, press the accelerator pedal to the floor and hold it just long enough to let the engine get to Wide Open Throttle (WOT). Do not hold the throttle open for more than 5 seconds at a time.

4. Note the results in each range.

5. After each range, move the selector lever to NEUTRAL and run the engine at 1,000 rpm for about 15 seconds to cool the torque converter before the next test.

6. Use the stall speed diagnosis chart for corrective actions.

7. **NOTE:** The stall speed in REVERSE will be lower.

   If stall speeds were too high, see the Stall Speed Chart. If stall speeds were too low, first check engine idle speed and tune up. If engine is OK, remove torque converter and check TCC for slippage.

Pressure Diagnostic Chart

Test Results	Possible Source
Values of both DRIVE and REVERSE ranges are lower than the standards	• Insufficient engine power • Torque converter stator One-Way Clutch (OWC) slipping
Only the value of DRIVE range is higher than the standards	• Low line pressure. Shift control solenoid assembly failure, primary regulator valve failure • Valve body failure (hydraulic pressure system) • C1 clutch slipping • OWC F1 failure
Only the value of REVERSE range is higher than the standards	• Low line pressure. Shift control solenoid assembly failure, primary regulator valve failure • Valve body failure (hydraulic pressure system) • C3 clutch failure • B2 brake failure
Values of both DRIVE and REVERSE ranges are higher than the standards	• Low line pressure. Shift control solenoid assembly failure, primary regulator valve failure • Primary regulator valve failure • Oil pump failure • Oil strainer clogging

Leakage Inspection

Material

Item	Specification
Dye-Lite® ATF/Power Steering Fluid Leak Detection Dye 164-R3701 (Rotunda)	-
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

NOTICE: **Do not try to stop the fluid leak by increasing the torque beyond specifications. This may cause damage to the case threads.**

Use the following chart to inspect and correct any external transmission fluid leaks.

External Transmission Fluid Leaks

Description	Action
Leaks at the transmission fluid pan to case	Tighten to specification or i new transmission fluid gasket.
Transmission fluid filler plug leaks	Install a new transmission fluid filler plug.
Transmission fluid cooler or fittings leaking	Tighten to specification or install new transmission fluid cooler tubes. Refer to Section 307-02A .
Transmission fluid cooler nut to case fitting leaking	Inspect for damage or missing O-ring seals. Tighten to specification, install new transmission fluid cooler tubes or install new O-rings. Refer to Section 307-02A .
Leaks at the transmission fluid cooler	Inspect the transmission fluid cooler for damage, if damaged, install a new transmission fluid cooler. Refer to Section 307-02A .
Leaks at the manual control lever seal	Install a new manual control lever seal.
Leaks at the solenoid body harness connector	Install a new solenoid body harness connector O-ring seal, either on the harness end or the solenoid body.

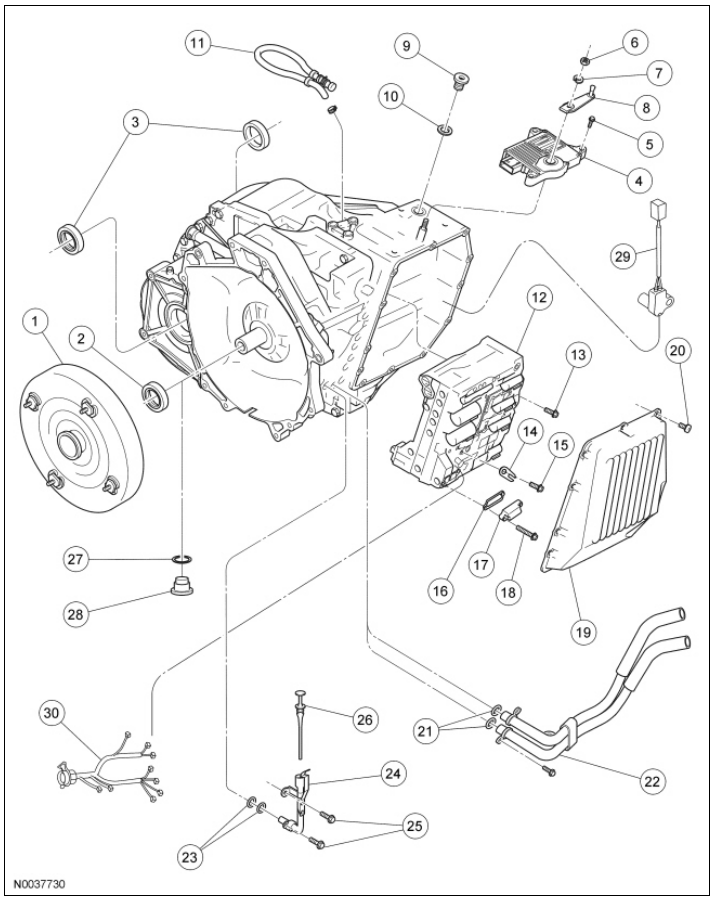
External Sealing

The transaxle has the following parts to prevent external transmission fluid leakage:

- Gaskets

- Lip type seals
- O-ring seals
- Seal rings
- Seal grommets
- Thread sealant

External Sealing

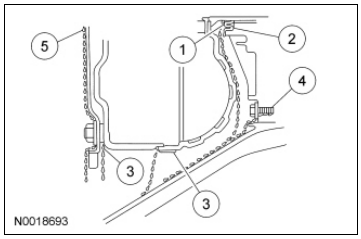


Item	Part Number	Description
1	7902	Torque converter
2	-	Torque converter hub seal
3	1177	Axle shaft seals
4	-	Transmission Control Module (TCM)
5	-	TCM bolt
6	7045	Manual control lever shaft nut
7	7C208	Manual control lever shaft nut washer
8	7A256	Manual control lever
td>	7A010	Transmission fluid fill plug
10	7E050	Transmission fluid fill plug O-ring
11	-	Breather hose
12	-	Main control valve body assembly
13	-	Main control valve body bolt
14	-	Lock plate

15	-	Lock plate bolt
16	-	Suction cover gasket
17	-	Suction cover
18	-	Suction cover bolt
19	-	Main control valve body side cover
20	-	Main control valve body side cover bolt
21	7J227	Transmission fluid cooler O-rings
22	7R081	Transmission fluid cooler tube
23	7E050	Transmission fluid level indicator tube O-rings
24	7A228	Transmission fluid level indicator tube
25	7A443	Transmission fluid level indicator tube bolts
26	7A228	Transmission fluid level indicator tube
27	7L101	Transmission fluid drain plug gasket
28	7A010	Transmission fluid drain plug
29	7M101	Turbine Shaft Speed (TSS) sensor
30	7G276	Internal wire harness and Transmission Fluid Temperature (TFT) sensor

Transmission Fluid Leakage in Torque Converter Area

Leakage at the front of transmission, as evidenced by transmission fluid around the torque converter housing part of the case, may have several sources. By careful observation it is possible, in many instances, to pinpoint the source of a leak before removing the transmission from the vehicle. The paths which the transmission fluid takes to reach the bottom of the torque converter housing are shown in the illustration. The 5 numbers in the illustration correspond with the 5 flow path steps.



Leak Path	Symptom	Possible Source
1, 2 and 4	Leak at front of transmission	Torque converter hub seal
1, 2 and 4	Leak at front of transmission	Vent
1, 2 and 4	Leak at front of transmission	Converter hub weld
1, 2 and 4	Leak at front of transmission	External pump seal (large)
1, 2 and 4	Leak at front of transmission	Pump to case screws
1, 2 and 4	Leak at front of transmission	Pump gasket
3	Leak at front of transmission	Torque converter seal weld
3	Leak at front of transmission	Torque converter stud
5	Leak at front of transmission	Engine oil leak; rear main seal
5	Leak at front of transmission	Engine valve cover
5	Leak at front of transmission	Oil galley
5	Leak at front of transmission	Pump lip seal
5	Leak at front of transmission	Engine Oil Pressure (EOP) sensor

Leak Check Test With Ultraviolet Lamp

Use Dye-Lite® ATF /Power Steering Fluid Leak Detection Dye to detect a transmission fluid leak.

1. Add dye to the transmission fluid. Use 30.0 ml (1 oz) of dye solution for every 3.8L (4 qt) of transmission fluid.

2. Start and run the engine until the transaxle reaches its normal operating temperature. Using an ultraviolt light, observe the back of the cylinder block and top of the torque converter housing for evidence of fluid leakage. Raise the vehicle on a hoist and run the engine at fast idle, then at engine idle, occasionally shifting to the DRIVE and REVERSE ranges to increase pressure within the transaxle. Observe the front of the flexplate, back of the cylinder block (in as far as possible), and inside the torque converter housing and front of the case. Continue running the engine until fluid leakage is evident and the probable source of leakage can be determined.

Diagnosis By Symptom

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

The Diagnosis by Symptom charts give the techni diagnostic information, direction and suggest possible components, using a symptom as a starting point.

The Diagnosis by Symptom charts are divided into 2 categories: Electrical Routines, indicated by 200 series numbers, and Hydraulic/Mechanical Routines, indicated by 300 series numbers. The Electrical Routines list the possible electrical components that could cause or contribute to the symptom described. The Hydraulic/Mechanical Routines list the possible hydraulic or mechanical components that could cause or contribute to the symptom described.

Diagnosis by Symptom Chart Directions

1. Using the Diagnosis by Symptom Index, select the concern/symptom that best describes the condition.

2. See the routine indicated in the Diagnosis by Symptom Index.

3. Always begin diagnosis of a symptom with:
    1. Preliminary inspections.
    2. Verifications of condition.
    3. Checking the fluid levels.
    4. Carry out other test procedures as directed.

4. **NOTE:** Not all concerns and conditions with electrical components will set a DTC. Be aware that the components listed may still be the cause. Verify correct function of these components prior to proceeding to the routine listed.

   Begin with the routine indicated. Follow the reference or action required statements. Always carry out the On-Board Diagnostic (OBD) tests as required. Never skip steps. Repair as required. These components are listed in the removal sequence and by the most probable cause. All components listed must be inspected to make sure of correct repair.

Diagnosis by Symptom Index

Title	Routines
Engagement Concerns	
No forward and/or No reverse	207
Harsh	208
Soft	209
Torque Converter Clutch Operation Concerns	
Does not apply	240
Cycling/shudder/chatters	242
NVH	
Noise/vibration - forward or reverse	254
Other Concerns	
Transmission fluid level	286
Transmission fluid condition	287
Transmission control module software	288

Diagnostic Routines

Engagement Concerns: No Forward and/or No Reverse

Possible Component	Reference/Action
207 - ROUTINE	
No Forward, No Reverse, No Forward or Reverse	
• Selector lever linkage damaged or out of position	• Using a scan tool, CHECK selector lever position. REFER to Section 307-05A .
• Incorrect neutral switch position	• CARRY OUT neutral position learning. REFER to Neutral Position Learning in this section.
	• DISCONNECT the Transmission Control Module (TCM) electrical connector. If concern still exists, this indicates an internal mechanical problem. CONNECT the TCM and CARRY OUT pressure checks.
	• If concern is resolved by disconnecting the TCM , this indicates an electrical concern. INSTALL a new TCM . REFER to Transmission Control Module (TCM) in this section. CHECK wiring harness (external and internal) valve body connections.
• Halfshafts broken	• INSPECT for damaged or broken halfshafts. REFER to Section 205-04 .

Engagement Concerns: Harsh

Possible Component	Reference/Action
208 - ROUTINE	
Harsh Engagements	
• Initial learn values wrong	• CARRY OUT Transmission Control Module (TCM) initial learning procedure. REFER to Transmission Control Module (TCM) Initial Learning in this section.
• Damaged internal transaxle components causing high or low pressures	• CARRY OUT pressure test. Refer to Special Testing Procedures in this section.
• Damaged or malfunctioning solenoids	• CARRY OUT pinpoint test. REFER to Pinpoint Tests - OSC Equipped Vehicle in this section.

Engagement Concerns: Soft

Possible Component	Reference/Action		
209 - ROUTINE			
Soft Engagements			
• Initial learn values wrong	• CARRY OUT Transmission Control Module (TCM) initial learning procedure. REFER to	• Damaged internal transaxle components causing high or low pressures	• CARRY OUT pressure test. REFER to Special Testing Procedures in this section.
• Damaged or malfunctioning solenoids	• CARRY OUT pinpoint test. REFER to Pinpoint Tests - OSC Equipped Vehicle in this section.		

Torque Converter Clutch Operations Concerns: Does Not Apply

Possible Component	Reference/Action
240 - ROUTINE	
Torque Converter Does Not Apply	

	• Damaged or malfunctioning solenoid	• CARRY OUT pinpoint test. REFER to Pinpoint Tests - OSC Equipped Vehicle in this section. INSTALL a new main control valve body. REFER to Main Control Valve Body in this section.
	• Damaged or disconnected wire harness	• INSPECT wire harness. CHECK connections to the Torque Converter Clutch (TCC) solenoid.
	• Damaged or malfunctioning torque converter	• INSTALnew torque converter. REFER to Torque Converter in this section.

Torque Converter Clutch Operations Concerns: Cycling/Shutter/Chatters

Possible Component	Reference/Action
242 - ROUTINE	
Torque Converter Cycling/Shudder/Chatters	
• Damaged or malfunctioning Torque Converter Clutch (TCC) solenoid	• INSTALL a new main control valve body. REFER to Main Control Valve Body in this section.
• Damaged or disconnected wire harness	• INSPECT wire harness. CHECK connections to the TCC solenoid.
• Damaged or malfunctioning torque converter	• INSTALL a new torque converter. REFER to Torque Converter in this section.

Other Concerns: Noise/Vibration - Forward or Reverse

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

Possible Component	Reference/Action
254 - ROUTINE	
Powertrain Control System	
• Transmission Control Module (TCM), vehicle wiring harnesses, Shift Solenoid A (SSA) and Shift Solenoid B (SSB)	• CARRY OUT On-Board Diagnostic (OBD) tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the TCM . GO to Pinpoint Test A . REPAIR as required. CLEAR the DTCs, road

		test and retrieve any DTCs.
Incorrect Transmission Fluid Level		
	• Transmission flu level low/overfilled	• CHECK the transmission fluid level. ADJUST the transmission fluid level as necessary. REFER to Preliminary Inspection in this section.
Torque Converter		
	• Worn or damaged torque converter	• REFER to Torque Converter Diagnosis in this section.
Transaxle Support Insulator		
	• Worn or damaged transaxle support insulator	• INSPECT the transaxle support insulator for damage. INSTALL new as necessary. REFER to Transaxle Support Insulator in this section.

Other Concerns: Transmission Fluid Level

Possible Component	Reference/Action
286 - ROUTINE	
Low Transmission Fluid Level	
• Axle shaft seal leaking	• INSTALL new axle shaft seals. REFER to Differential Seals - LH , Differential Seals - RH, Front Wheel Drive (FWD) and Differential Seals - RH, All Wheel Drive (AWD) in this section.
• Transmission fluid pan leaking	• RESEAL the transmission fluid pan.
• Torque converter hub seal leaking	• INSTALL a new torque converter hub seal. REFER to Torque Converter Hub Seal in this section.
• Transmission fluid cooler tubes leaking	• INSTALL new transmission fluid cooler tube O-rings.
• Manual control lever seal leaking	• INSTALL a new manual control lever seal. REFER to Manual Control Lever Shaft and Seal in this section.
• Transmission fluid drain plug leaking	• INSTALL a new transmission fluid drain plug seal.

Other Concerns: Transmission Fluid Condition

Possible Component	Reference/Action
287 - ROUTINE	
Transmission Fluid Burnt or Contaminated	
• Internal components damaged (clutch plate material)	• INSTALL a new transaxle. REFER to Transaxle in this section.

Other Concerns: Transmission Control Module (TCM) Software

Possible Component	Reference/Action	
288 - ROUTINE		
Shifting and Driveability Concerns		
	• Transmission Control Module (TCM) not at current software level	• REPROGRAM the TCM to current software level.

Transmission Fluid Cooler - Backflushing and Cleaning

Special Tool(s)

 ST2971-A	Transmission Heated Cooler Line Flusher 222-00007, 222-00004 or equivalent

Material

Item	Specification
Motorcraft® Premium Autansmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

NOTE: Transmission fluid cooler backflushing and cleaning will be performed using the Transmission Heated Cooler Line Flusher or equivalent. Follow the manufacturer's instructions included with the machine. Test the equipment to make sure that a vigorous fluid flow is present before proceeding.

NOTE: If the vehicle is equipped with an in-line transmission fluid thermal by-pass valve, the in-line transmission fluid thermal by-pass valve must be removed prior to flushing out the transmission fluid cooler and transmission fluid cooler lines.

1. Check and top off fluid level of the cooler line flusher tank with transmission fluid.
2. Allow the fluid in the cooler line flusher 15-30 minutes to heat up to 60°C (140°F) before using.
3. Install the line adapters into the transmission cooler lines.
4. Attach the cooler line flusher red line to the transmission fluid cooler pressure line quick disconnect fitting.
5. Attach the cooler line flusher blue line to the transmission fluid cooler return line quick disconnect fitting.
6. Follow the equipment instructions to purge the cooler lines and cooler prior to starting the flushing procedure.
7. Allow the cooling system to backflush for 10-15 minutes, then flush the cooler in a normal flow direction for an additional 10-15 minutes.
8. Clean the transaxle mounted cooler tubes by hand.

Transmission Fluid Drain and Refill

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

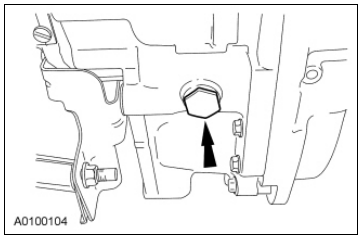
Item	Specification
Moraft Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

NOTICE: **The use of any fluid other than what is recommended for this transmission will cause transmission damage.**

Draining

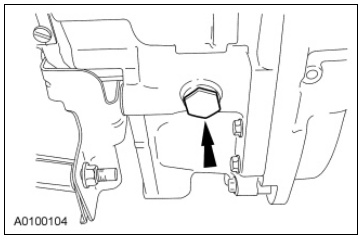
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the transmission fluid drain plug and allow the transmission fluid to drain.

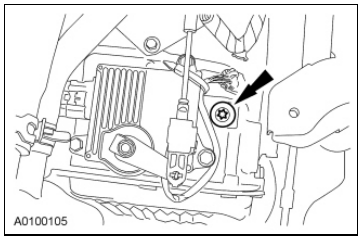


Refill

3. Install the transmission fluid drain plug.
   - Tighten to 47 Nm (35 lb-ft).

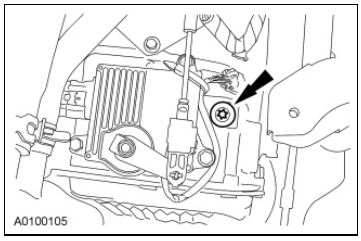


4. Remove the transmission fluid fill plug.



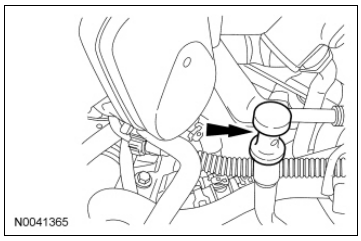
5. Fill the transaxle with approximately 3.7L (4 qt) of clean transmission fluid.

6. Install the transmission fluid fill plug.
   - Tighten to 39 Nm (29 lb-ft).



7. With the transaxle in (P) PARK, the vehicle should be on a level surface, the engine at idle (680-780 rpm), foot pressed on the brake, move the selector lever through each gear and allow engagement of each gear. Place the selector lever back in the PARK position.

8. Wipe the transmission fluid level indicator cap and remove the fluid level indicator.



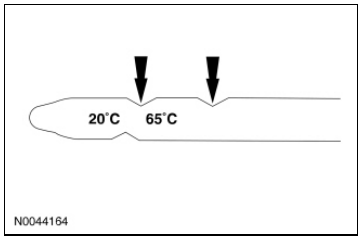
9. Wipe the transmission fluid level indicator with a clean cloth.

10. **NOTE:** In order to get an accurate transmission fluid level reading, the vehicle should be on a level surface, the engine at idle (680-780 rpm) for 5 minutes and the transmission fluid temperature should be at least 60°C-70°C (140°F-158°F) using the scan tool.

    If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pint) increments through the transmission fluid fill plug located on top of the transaxle near the transmission fluid level indicator. Do not overfill the transmission fluid. Install the transmission fluid level indicator back in the transmission fluid filler tube until it is fully seated, then remove the indicator. The transmission fluid level should be at the upper-most mark on the transmission fluid level indicator. Only fill to the upper-most mark on the transmission fluid indicator. Do not overfill. Damage to the transaxle will occur.

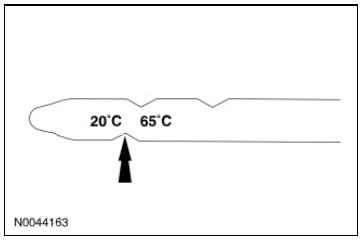
11. **NOTE:** The correct transmission fluid level at normal operating temperature of 60°C-70°C (140°F-158°F) is between the top 2 marks on the transmission fluid level indicator.

    Fill the transaxle to the correct transmission fluid level.



12. **NOTE:** The correct transmission fluid level at cool operating temperature of 15°C-25°C (59°F-77°F), is at the bottom mark on the transmission fluid level indicator.

    If the Transmission Fluid Temperature (TFT) is low, fill the transaxle with transmission fluid to the cold range on the transmission fluid level indicator. Recheck the transmission fluid level when the transaxle has reached the normal operating temperature.



Torque Converter Contamination Inspection

Material

Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

1. A new or remanufactured torque converter must be installed if one or more of the following statements is true:
    - A torque converter malfunction has been determined based on complete diagnostic procedures.
    - The torque converter stud or studs, impeller hub or bushing are damaged.
    - The torque converter exhibits external discoloration (due to overheating).
        - There is evidence of transmission assembly or fluid contamination due to the following transmission or converter failure modes.
            - Major metallic failure
            - Multiple clutch plates or band failures
            - Sufficient component wear which results in metallic contamination
            - Water or antifreeze contamination

2. If none of the above conditions are present, continue with the following fluid inspection.

3. Pour a small amount of transmission fluid from the torque converter onto an absorbent white tissue or through a paper filter.

4. Examine the fluid for contaminants, color and smell. The fluid must be free of contaminants, red in color and not have a burnt smell.

5. ***NOTICE:*** **Do not use water-based cleaners or mineral spirits to clean or flush the torque converter or transmission damage will occur.**

   If the fluid passed inspection:

    - drain the remaining fluid from the torque converter.
    - using only the recommended transmission fluid, add 1.9L (2 qt) of clean fluid into the converter and agitate by hand.
    - thoroughly drain the fluid.

Transmission Fluid Exchange

Special Tool(s)

 ST3088-A	ATF Fluid Exchanger W/Power Steering Fluid Exchanger 199-00059 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

NOTICE: **Use transmission fluid specific for this transmission. Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products can cause internal transmission components to fail, which will affect the operation of the transmission.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Use the ATF Fluid Exchanger W/Power Steering Fluid Exchanger to change the fluid.
3. Connect the ATF Fluid Exchanger W/Power Steering Fluid Exchanger to the transmission fluid coler tube after the transmission fluid cooler on the return tube. This will help remove any foreign material trapped in the transmission fluid coolers.
4. Perform the transmission fluid exchange using the ATF Fluid Exchanger W/Power Steering Fluid Exchanger. Follow the manufacturer's instructions included with the machine.
5. Once the transmission fluid exchange is completed, disconnect the ATF Fluid Exchanger W/Power Steering Fluid Exchanger. Reconnect any disconnected transmission fluid cooler tubes.
6. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 66-77°C (150-170°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

Neutral Position Learning

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: When installing a new Transmission Control Module (TCM), the initialized learned values will need to be carried out.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Install the scan tool.

3. Turn the ignition ON.

4. The scan tool should indicate NEUTRAL.
   - If the scan tool does not indicate NEUTRAL, carry out TCM adjustment. For additional information, refer to Transmission Control Module (TCM) in this section.

5. If NEUTRAL is indicated on the scan tool, move the selector lever to PARK and turn the ignition OFF.

6. Turn the ignition ON and move the selector lever from PARK to DRIVE.
   - The scan tool should indicate each PRNDL position.

7. If the diagnostic display indicates each PRNDL position, check for any DTCs.

8. If the diagnostic display does not indicate each PRNDL position, carry out Transmission Control Module (TCM) Initial Learning in this section.

Transmission Control Module (TCM) Initial Learning

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTICE: **Do not raise the Transmission Fluid Temperature (TFT) by stalling the engine, internal transaxle damage will occur.**

NOTE: Clear all DTCs first.

NOTE: When insing a new transmission, Transmission Control Module (TCM) or reflashing the TCM , the initialized learned values will need to be carried out.

NOTE: This procedure cannot be carried out if the transmission fluid is not within the correct temperature specification.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Install the scan tool.
3. Monitor and note the engagement and shift harshness.
4. With the engine idling, monitor the Transmission Fluid Temperature (TFT). The TFT should be between 66°C-110°C (151°F-230°F).
5. With a foot on the brake, move the selector lever to NEUTRAL and hold for 3 seconds. Then move the selector lever to DRIVE and hold for 3 seconds. Carry this out 5 times. Then move the selector lever to PARK.
6. With a foot on the brake, move the selector lever to NEUTRAL and hold for 3 seconds. Then move the selector lever to REVERSE and hold for 3 seconds. Carry this out 5 times. Then move the selector lever to PARK.
7. Drive the vehicle and monitor the scan tool.
8. Drive the vehicle with the throttle opening between 20-25%. Drive until the vehiceaches 6th gear, not to exceed 80 km/h (50 mph). Then release the accelerator and coast to a stop within 60 seconds. Carry this out 10 times.
9. If engagements and/or shifts are harsh, repeat Steps 4 through 8 one more time.

Main Control Valve Body

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

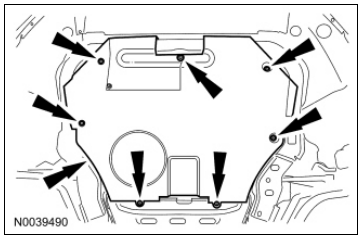
Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A
Ultra Silicone Sealant TA-29	-

Removal

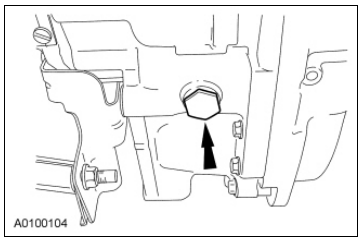
NOTICE: **The use of any transmission fluid other than what is recommended for this transaxle will cause transaxle damage.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

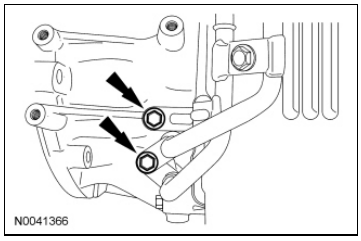
2. Remove the screws and the underbody cover.



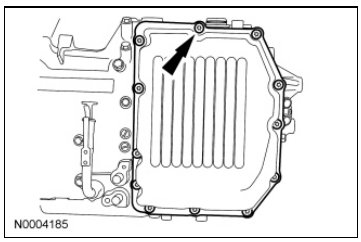
3. Remove the transmission fluid drain plug and allow the transmission fluid to drain.



4. Disconnect the transmission fluid cooler tubes at the transaxle and position the tubes aside.

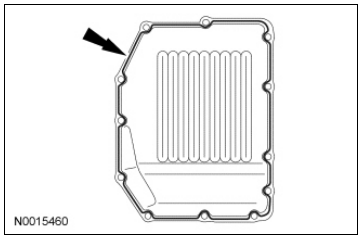


5. Remove and discard the transmission fluid pan bolts and remove the pan.

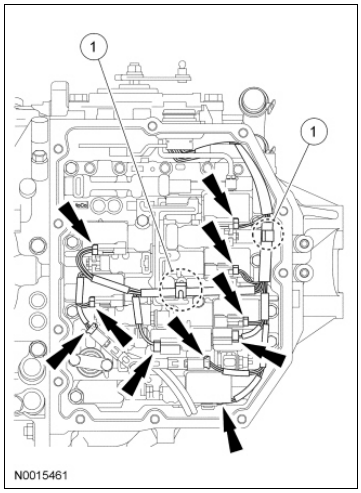


6. ***NOTICE:*** **When removing the sealer, use care not to damage the sealing surfaces.**

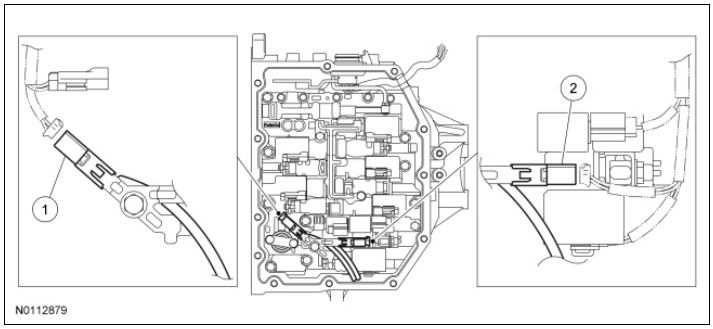
   Remove the sealer off the fluid pan.



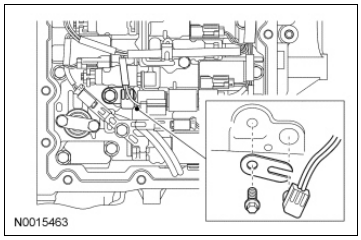
7. Disconnect the wire harness from the solenoids.
   1. Remove the wire harness from the clamps.
   - Disconnect the 8 solenoid connectors and the 2 speed sensor connectors.



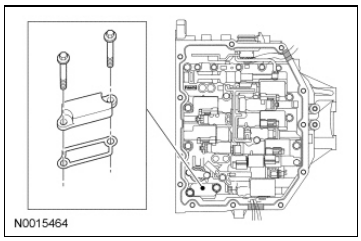
8. Remove the 2 speed sensor wire connectors from the solenoid clamp.
   1. Remove the Output Shaft Speed (OSS) sensor wire connector from the solenoid clamp.
   2. Remove the Turbine Shaft Speed (TSS) sensor wire connector from the solenoid clamp.



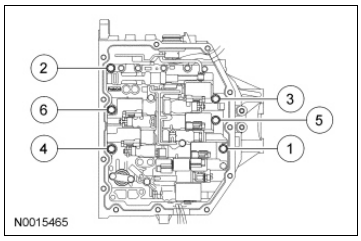
9. Remove the bolt and the lock plate and pull out the Transmission Fluid Temperature (TFT) sensor.



10. Remove the 2 bolts, suction cover and gasket.

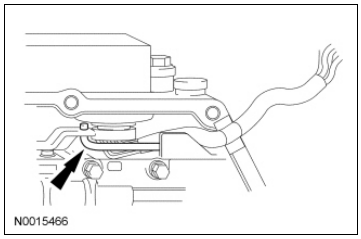


11. Remove the 6 main control valve body bolts in the sequence shown.



12. **NOTE:** Be careful when removing the main control valve body, the manual control lever will fall out of its bore. Also, once all the bolts are removed, the main control valve body will fall out of the transaxle.

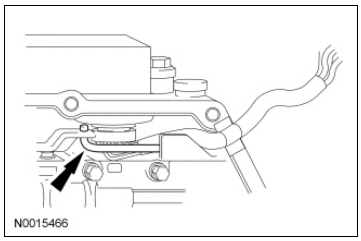
    Remove the main control valve body.



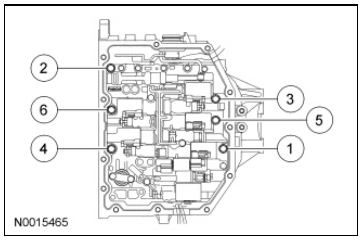
Installation

1. ***NOTICE:*** **When installing the main control valve body, place the wire harness in the open space of the separate plate, being careful not to pinch the harness. Damage to the harness will occur.**

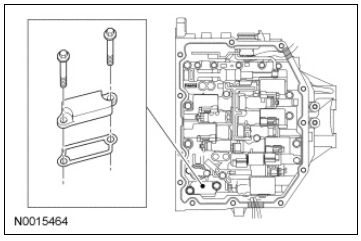
   Connect the manual valve link and position the main control valve body in place.



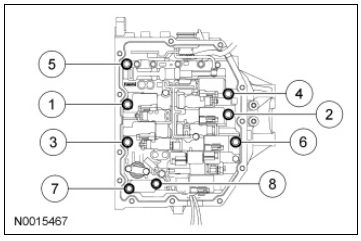
2. Loosely install the 6 main control valve body bolts in the sequence shown.



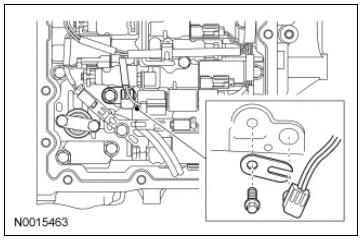
3. Install the suction cover gasket, cover and loosely install the 2 bolts.



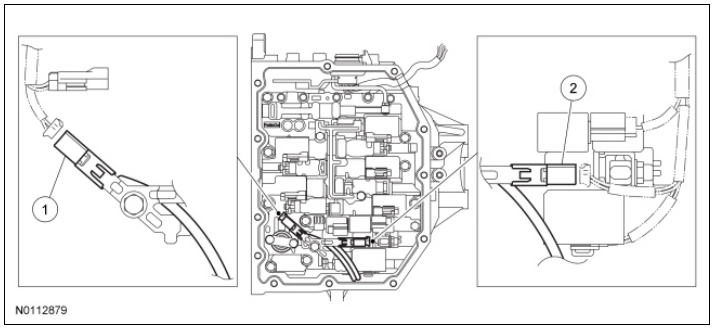
4. Tighten the 8 bolts to 10 Nm (89 lb-in) in the sequence shown.



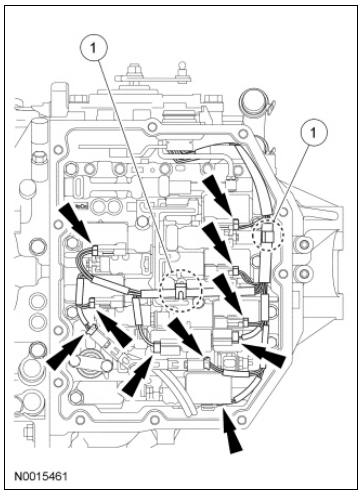
5. Lubricate the O-ring with clean automatic transmission fluid and install the TFT sensor.
   - Tighten to 10 Nm (89 lb-in).



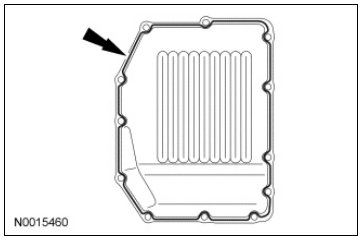
6. Install the 2 speed sensor wire connectors on the solenoid clamp.
   1. Install the Output Shaft Speed (OSS) sensor wire connector on the solenoid clamp.
   2. Install the Turbine Shaft Speed (TSS) sensor wire connector on the solenoid clamp.



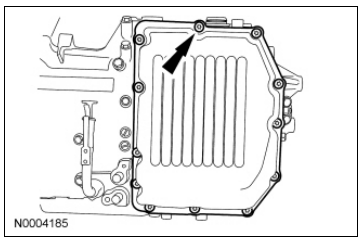
7. Connect the wire harness to the solenoids.
    1. Install the wire harness into the clamps.
    - Connect the 8 solenoid connectors and the 2 speed sensor connectors.



8. Install a bead of sealer to the fluid pan.



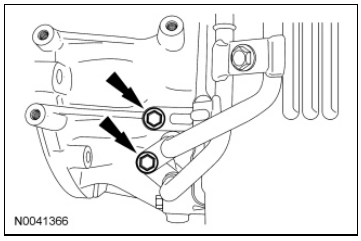
9. Using new pan bolts, install the fluid pan.
    - Tighten to 13 Nm (115 lb-in).



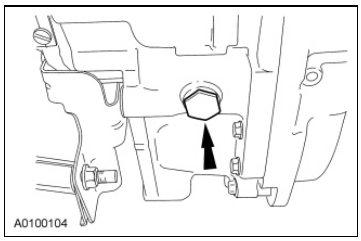
10. **NOTE:** Lubricate the new O-rings with clean automatic transmission fluid and install them onto the transmission fluid cooler tubes.

    Connect the transmission fluid cooler tubes to the transaxle.

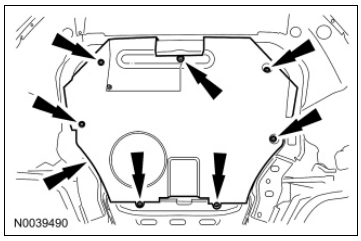
    - Tighten to 10 Nm (89 lb-in).



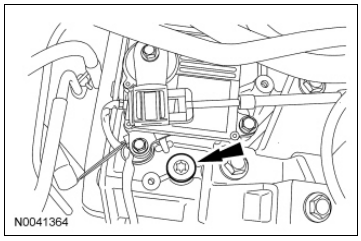
11. Install the transmission fluid drain plug.
    - Tighten to 47 Nm (35 lb-ft).



12. Install the underbody cover and the screws.

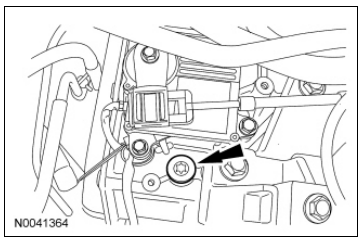


13. Remove the transmission fluid fill plug.



14. Fill the transaxle with approximately 4.7L (5 qt) of clean transmission fluid.

15. Install the transmission fluid fill plug.
    - Tighten to 39 Nm (29 lb-ft).



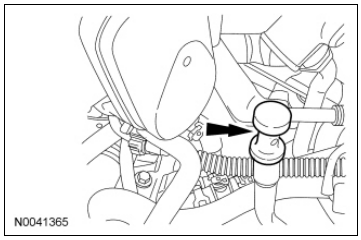
16. With the transaxle in PARK, the vehicle on a level surface, the engine at idle (680-780 rpm) and foot pressed on the brake, move the selector lever through each gear and allow engagement of each gear. Place the selector lever back in the PARK position.

17. Wipe the transmission fluid level indicator cap and remove the transmission fluid level indicator.

18. Wipe the transmission fluid level indicator with a clean cloth.

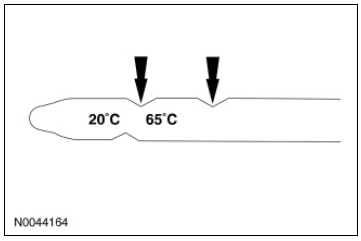
19. **NOTE:** In order to get an accurate transmission fluid level reading, the vehicle should be on a level surface. Idle the engine to reach the normal operating temperature. Using the scan tool, verify that the transaxle is at normal operating temperature 60°C-70°C (140°F-158°F), prior to adjusting the transmission fluid level.

    If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pt) increments through the transmission fluid fill plug located on the top of the transaxle near the transmission fluid level indicator. Do not overfill the transmission fluid. Install the transmission fluid level indicator back in the transmission fluid filler tube until it is fully seated, then remove the transmission fluid level indicator. The transmission fluid level should be at the upper most mark on the transmission fluid level indicator. Only fill to the upper most mark on the transmission fluid level indicator. Do not overfill. Damage to the transaxle will occur.



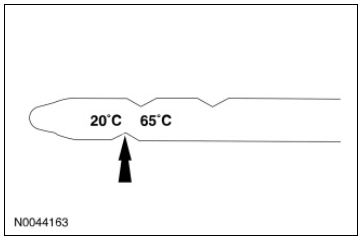
20. **NOTE:** The correct transmission fluid level at normal operating temperature of 60°C-70°C (140°F-158°F) is between the top 2 marks on the transmission fluid level indicator.

    Fill the transaxle to the correct transmission fluid level.



21. **NOTE:** The correct transmission fluid level at cool operating temperature of 15°C-25°C (59°F-77°F), is at the bottom mark on the transmission fluid level indicator.

    If the TFT is low, fill the transaxle with transmission fluid to the cold range on the transmission fluid level indicator. Recheck the transmission fluid level when the transaxle has reached the normal operating temperature.

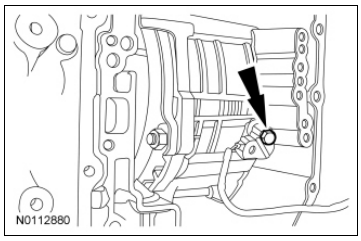


Turbine Shaft Speed (TSS) Sensor

Removal

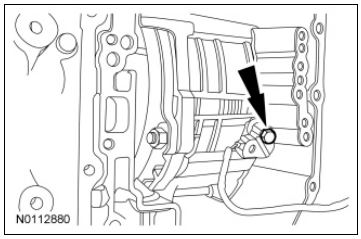
1. Remove the main control valve body. For additional information, refer to Main Control Valve Body in this section.

2. Remove the bolt and the Turbine Shaft Speed (TSS) sensor.



Installation

1. Lubricate the O-ring with clean automatic transmission fluid and install the TSS sensor.
   - Tighten to 12 Nm (106 lb-in).



2. Install the main control valve body. For additional information, refer to Main Control Valve Body in this section.

Differential Seals - LH

Special Tool(s)

 ST2959-A	Installer, Output Shaft Seal 307-567
 ST2834-A	Vehicle Communicaule (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

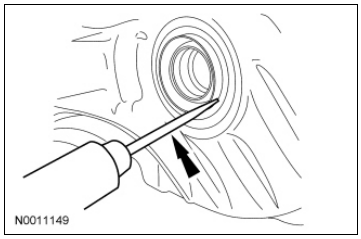
Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

Removal

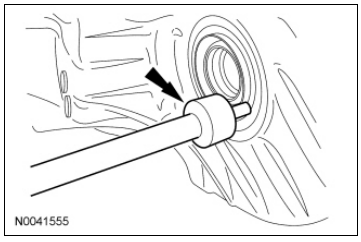
NOTICE: **The use of any transmission fluid other than what is recommended for this transaxle will cause transaxle damage.**

1. Remove the LH halfshaft. For additional information, refer to Section 205-04 .
2. ***NOTICE:*** **Be careful not to damage the case while removing the seal.**

   Using a suitable awl, poke a small hole in the seal.

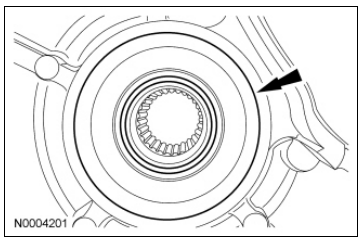


3. Using a suitable dent puller, remove the LH differential fluid seal.

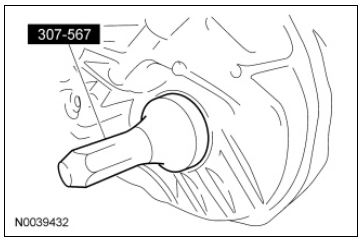


Installation

1. Position the new differential fluid seal in place.



2. Using the Output Shaft Seal Installer, install the outer differential fluid seal.



3. Install the LH halfshaft. For additional information, refer to Section 205-04 .

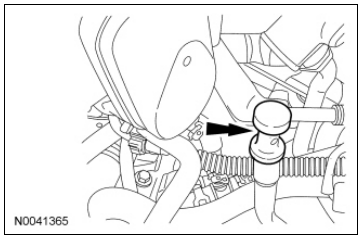
4. With the transaxle in PARK, the vehicle on a level surface, the engine at idle (680-780 rpm) and foot pressed on the brake, move the selector lever through each gear and allow engagement of each gear. Place the selector lever back in the PARK position.

5. Wipe the transmission fluid level indicator cap and remove the transmission fluid level indicator.

6. Wipe the transmission fluid level indicator with a clean cloth.

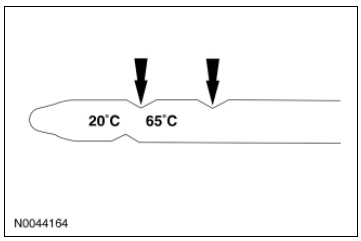
7. **NOTE:** In order to get an accurate transmission fluid level reading, the vehicle should be on a level surface. Idle the engine to reach the normal operating temperature. Using the scan tool, verify that the transaxle is at normal operating temperature 60°C-70°C (140°F-158°F), prior to adjusting the transmission fluid level.

   If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pt) increments through the transmission fluid fill plug located on the top of the transaxle near the transmission fluid level indicator. Do not overfill the transmission fluid. Install the transmission fluid level indicator back in the transmission fluid filler tube until it is fully seated, then remove the transmission fluid level indicator. The transmission fluid level should be at the uppermost mark on the transmission fluid level indicator. Only fill to the uppermost mark on the transmission fluid level indicator. Do not overfill. Damage to the transaxle will occur.



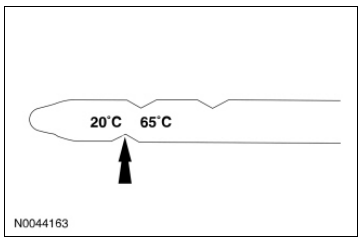
8. **NOTE:** The correct transmission fluid level at normal operating temperature of 60°C-70°C (140°F-158°F) is between the top 2 marks on the transmission fluid level indicator.

Fill the transaxle to the correct transmission fluid level.

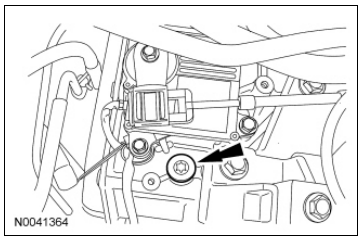


9. **NOTE:** The correct transmission fluid level at cold operating temperature of 15°C-25°C (59°F-77°F) is at the bottom mark on the transmission fluid level

   If the Transmission Fluid Temperature (TFT) is low, fill the transaxle with transmission fluid to the cold range on the transmission fluid level indicator. Recheck the transmission fluid level when the transaxle has reached the normal operating temperature.

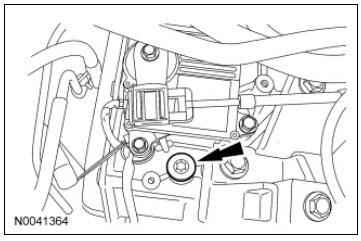


10. Remove the transmission fluid fill plug.



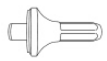
11. Fill the transaxle with clean transmission fluid.

12. Install the transmission fluid fill plug.
    - Tighten to 39 Nm (29 lb-ft).



Differential Seals - RH, Front Wheel Drive (FWD)

Special Tool(s)

 ST2960-A	Installer, Output Shaft Seal 307-568
	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

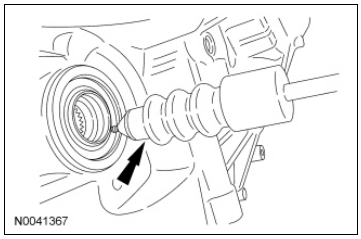
Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

Removal

NOTICE: **The use of any transmission fluid other than what is recommended for this transaxle will cause transaxle damage.**

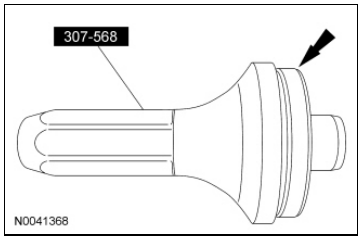
1. Remove the RH halfshaft. For additional information, refer to Section 205-04 .
2. ***NOTICE:*** **Be careful not to damage the case while removing the seal.**

   Using a suitable dent puller, remove the differential fluid seal.

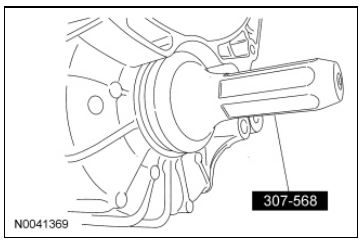


Installation

1. Position the new differential fluid seal on the Output Shaft Seal Installer.



2. Using the Output Shaft Seal Installer, install the outer differential fluid seal.



3. Install the RH halfshaft. For additional information, refer to Section 205-04 .

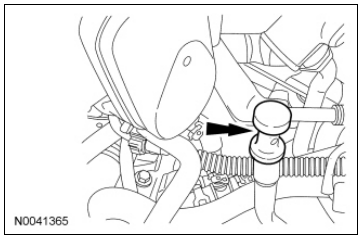
4. With the transaxle in PARK, the vehicle on a level surface, the engine at idle (680-780 rpm) and foot pressed on the brake, move the selector lever through each gear and allow engagement of each gear. Place the selector lever back in the PARK position.

5. Wipe the transmission fluid level indicator cap and remove the transmission fluid level indicator.

6. Wipe the transmission fluid level indicator with a clean cloth.

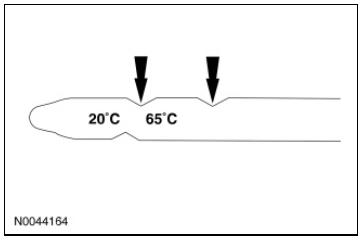
7. **NOTE:** In order to get an accurate transmission fluid level reading, the vehicle should be on a level surface. Idle the engine to reach the normal operating temperature. Using the scan tool, verify that the transaxle is at normal operating temperature 60°C-70°C (140°F-158°F), prior to adjusting the transmission fluid level.

   If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pt) increments through the transmission fluid fill plug located on the topthe transaxle near the transmission fluid level indicator. Do not overfill the transmission fluid. Install the transmission fluid level indicator back in the transmission fluid filler tube until it is fully seated, then remove the transmission fluid lever indicator. The transmission fluid level should be at the uppermost mark on the transmission fluid level indicator. Only fill to the uppermost mark on the transmission fluid level indicator. Do not overfill. Damage to the transaxle will occur.



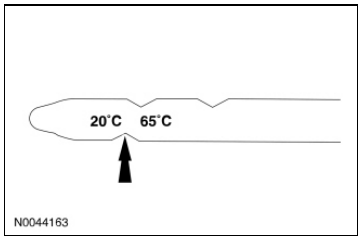
8. **NOTE:** The correct transmission fluid level at normal operating temperature of 60°C-70°C (140°F-158°F) is between the top 2 marks on the transmission fluid level indicator.

   Fill the transaxle to the correct transmission fluid level.

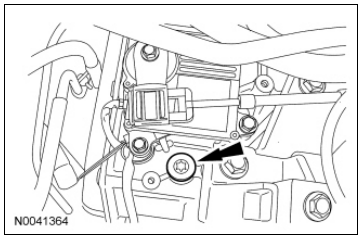


9. **NOTE:** The correct transmission fluid level at cold operating temperature of 15°C-25°C (59°F-77°F) is at the bottom mark on the transmission fluid level indicator.

   If the Transmission Fluid Temperature (TFT) is low, fill the transaxle with transmission fluid to the cold range on the transmission fluid level indicator. Recheck the transmission fluid level when the transaxle has reached the normal operating temperature.

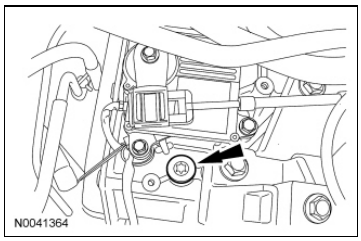


10. Remove the transmission fluid fill plug.



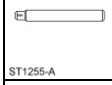
11. Fill the transaxle with clean transmission fluid.

12. Install the transmission fluid fill plug.
    - Tighten to 39 Nm (29 lb-ft).



Differential Seals - RH, All Wheel Drive (AWD)

Special Tool(s)

 ST2978A	Axle Seal Installer 307-593
 ST1255-A	Handle 205-153 (T80T-4000-W)
 ST2924-A	Remover, Input Shaft Oil Seal 308-375
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

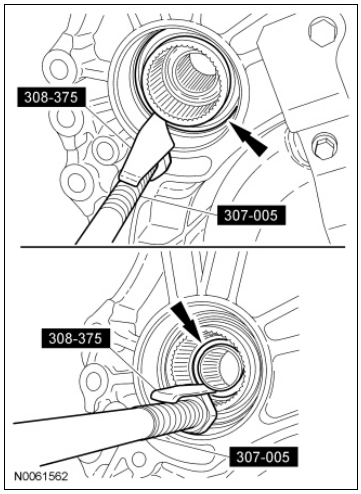
Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

Removal

NOTICE: **The use of any transmission fluid other than what is recommended for this transaxle will cause transaxle damage.**

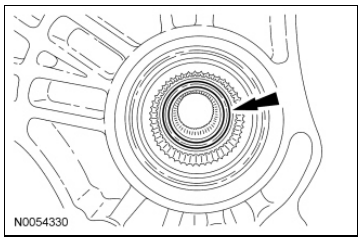
1. Remove the Power Transfer Unit (PTU). For additional information, refer to Section 308-07B .
2. **NOTE:** Transaxle removed for clarity.

   Using the Input Shaft Oil Seal Remover and Slide Hammer, remove the differential fluid seals.

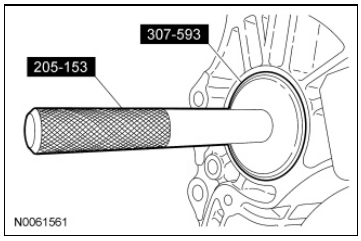


Installation

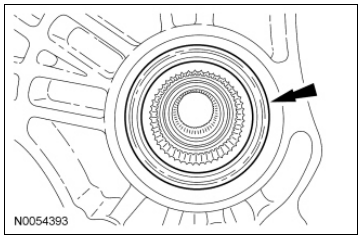
1. Position the new inner differential fluid seal in place.



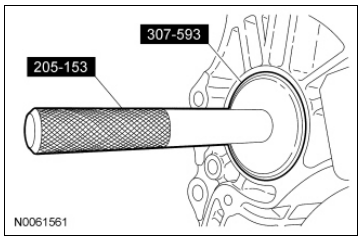
2. Using the Axle Seal Installer and Handle, install the inner differential fluid seal.



3. Position the new outer differential fluid seal in place.



4. Using the Axle Seal Installer and Handle, install the outer differential fluid seal.



5. Install the PTU . For additional information, refer to Section 308-07B .

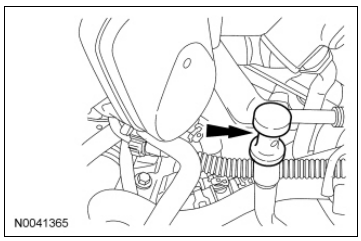
6. With the transaxle in PARK, the vehicle on a level surface, the engine at idle (680-780 rpm) and foot pressed on the brake, move the selector lever through each gear and allow engagement of each gear. Place the selector lever back in the PARK position.

7. Wipe the transmission fluid level indicator cap and remove the transmission fluid level indicator.

8. Wipe the transmission fluid level indicator with a clean cloth.

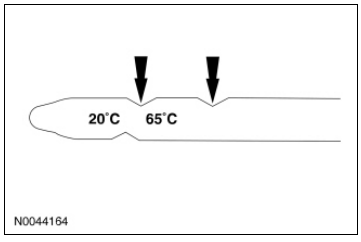
9. **NOTE:** In order to get an accurate transmission fluid level reading, the vehicle should be on a level surface. Idle the engine to reach the normal operating temperature. Using the scan tool, verify that the transaxle is at normal operating temperature 60°C-70°C (140°F-158°F), prior tousting the transmission fluid level.

   If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pt) increments through the transmission fluid fill plug located on the top of the transaxle near the transmission fluid level indicator. Do not overfill the transmission fluid. Install the transmission fluid level indicator back in the transmission fluid filler tube until it is fully seated, then remove the transmission fluid level indicator. The transmission fluid level should be at the uppermost mark on the transmission fluid level indicator. Only fill to the uppermost mark on the transmission fluid level indicator. Do not overfill. Damage to the transaxle will occur.



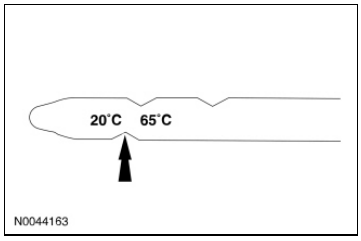
10. **NOTE:** The correct transmission fluid level at normal operating temperature of 60°C-70°C (140°F-158°F) is between the top 2 marks on the transmission fluid level indicator.

    Fill the transaxle to the correct transmission fluid level.

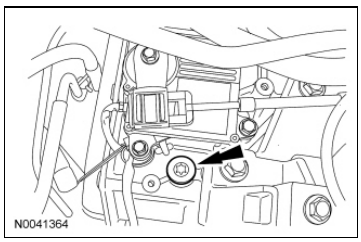


11. **NOTE:** The correct transmission fluid level at cold operating temperature of 15°C-25°C (59°F-77°F) is at the bottom mark on the transmission fluid level indicator.

    If the Transmission Fluid Temperature (TFT) is low, fill the transaxle with transmission fluid to the cold range on the transmission fluid level i. Recheck the transmission fluid level when the transaxle has reached the normal operating temperature.

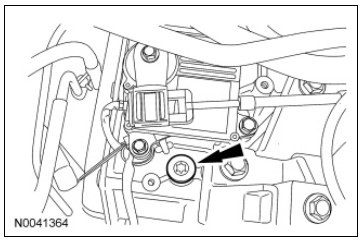


12. Remove the transmission fluid fill plug.



13. Fill the transaxle with clean transmission fluid.

14. Install the transmission fluid fill plug.
    - Tighten to 39 Nm (29 lb-ft).



Intermediate Servo

Special Tool(s)

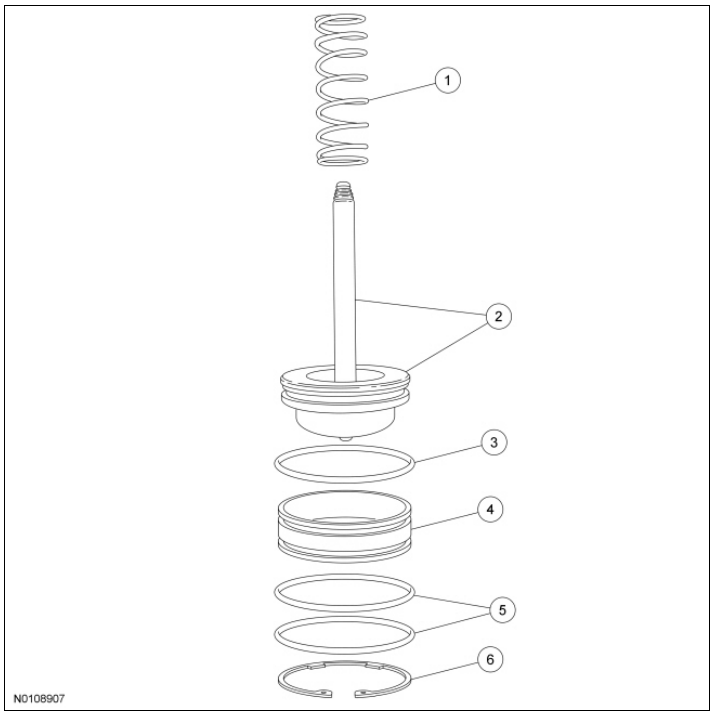
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

Servo Kit - 3.5L Engine

NOTE: Kit assembly part number is 7D027.



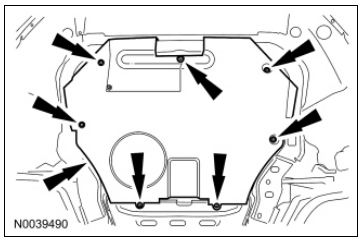
Item	Part Number	Description
1	-	Servo spring
2	-	Servo piston
3	7D024	Servo piston O-ring

4	7D027	Servo cover
5	7D024	Servo cover O-rings (2 required)
6	7H074	Servo retainer

Removal

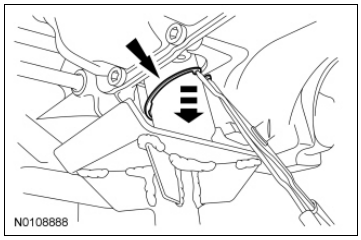
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the screws and the underbody cover.



3. ***NOTICE:*** **The servo cover is under pressure from the servo spring. Failure to use a jackstand can result in damage to the snap ring, servo piston, servo cover or the transaxle case.b>**

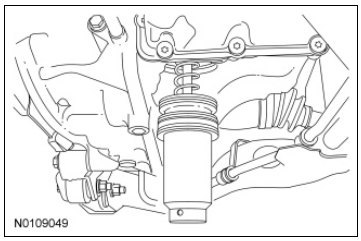
   Using an adjustable jackstand and a suitable tool, support the load of the servo spring and remove the servo snap ring.



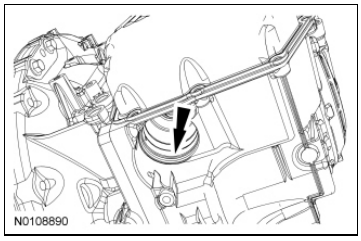
4. **NOTE:** Transmission fluid will drain from the transaxle when removing the servo cover.

   NOTE: If the servo cover is stuck in the bore, lightly tap on the servo cover to dislodge it from the bore.

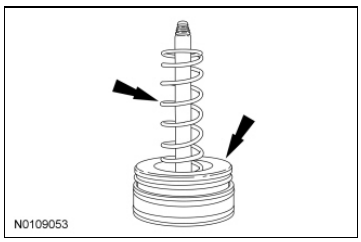
   Position a drain pan under the transaxle and slowly lower the jackstand to allow the servo spring to push the servo cover out of the bore. Remove the servo cover, servo piston and the servo spring from the transaxle case.



5. Using a pick, gently scrape the snap ring groove to clean the groove of any loose corrosion or debris.

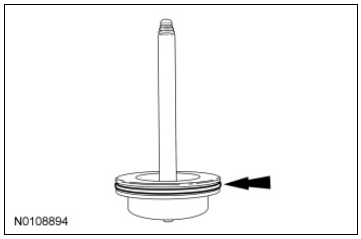


6. Remove the servo spring and the servo piston from the servo cover.



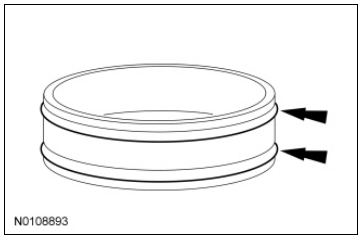
7. Discard the servo cover.

8. Remove the O-ring from the piston.

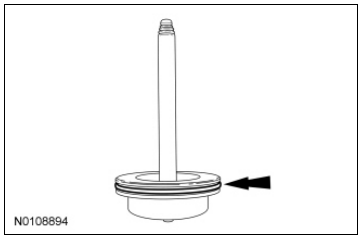


Installation

1. Install 2 new O-rings on the new servo cover and lubricate them with clean transmission fluid.

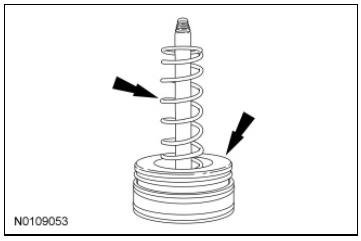


2. Install a new O-ring on the servo piston and lubricate it with clean automatic transmission fluid.

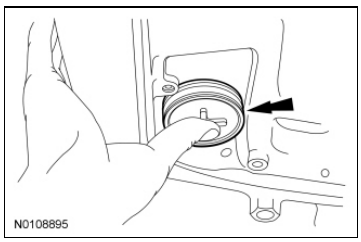


3. **NOTE:** The piston will rest on top of the servo.

   Position the servo spring on the piston and install the servo piston in the servo cover.



4. Position the servo in place in the servo bore.

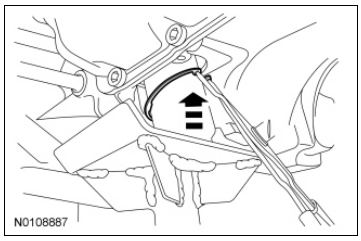


5. ***NOTICE:*** **Shake the servo cover when installing the servo to help align it in the bore or damage to the O-ring can result causing a leak.**

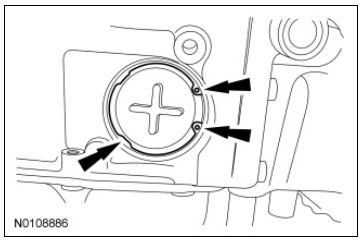
   NOTICE: **Install the snap ring with the bevel facing down or the snap ring can come loose causing damage to the transaxle.**

   NOTE: Position the snap ring under the servo cover before positioning the tool used to push the servo in the transaxle case.

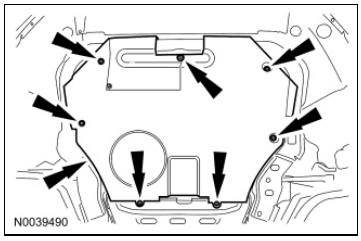
   Using a suitable tool and an adjustable jackstand, compress the servo spring. Install the servo and the snap ring into the transaxle case with the snap ring gap facing the right (engine side) of the transaxle.



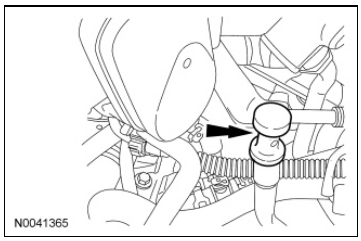
6. Inspect the snap ring to be sure it is fully seated in the snap ring groove. Be sure that the snap ring gap is facing right.



7. Install the underbody cover and the screws.



8. Slowly fill the transaxle through the transmission fluid level indicator tube with approximately 1.9L (2 qt) of clean transmission fluid.

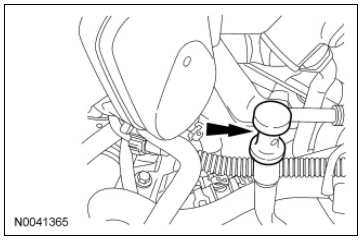


9. With the transaxle in PARK, the vehicle on a level surface, the engine at idle (680-780 rpm) and foot pressed on the brake, move the selector lever through each gear and allow engagement of each gear. Place the selector lever back in the PARK position.

10. Wipe the transmission fluid level indicator with a clean cloth.

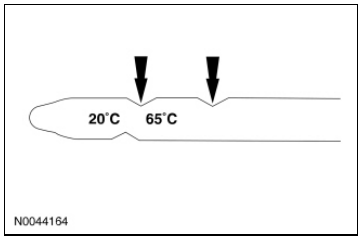
11. **NOTE:** In order to get an accurate transmission fluid level reading, the vehicle should be on a level surface. Idle the engine to reach the normal operating temperature. Using the scan tool, verify that the transaxle is at normal operating temperature 60°C-70°C (140°F-158°F), prior to adjusting the transmission fluid level.

    If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pt) increments through the transmission fluid level indicator tube. Do not overfill the transmission fluid. Install the transmission fluid level indicator back in the transmission fluid filler tube unit is fully seated, then remove the transmission fluid level indicator. The transmission fluid level should be at the upper most mark on the transmission fluid level indicator. Only fill to the upper most mark on the transmission fluid level indicator. Do not overfill. Damage to the transaxle will occur.



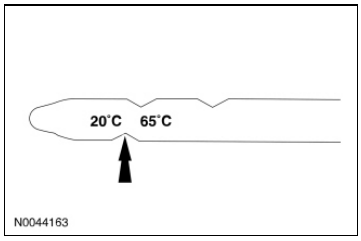
12. **NOTE:** The correct transmission fluid level at normal operating temperature of 60°C-70°C (140°F-158°F) is between the top 2 marks on the transmission fluid level indicator.

    Fill the transaxle to the correct transmission fluid level.



13. **NOTE:** The correct transmission fluid level at cool operating temperature of 15°C-25°C (59°F-77°F), is at the bottom mark on the transmission fluid level indicator.

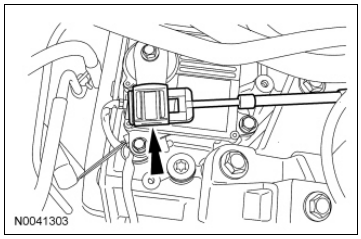
    If the Transmission Fluid Temperature (TFT) is low, fill the transaxle with transmission fluid to the cold range on the transmission fluid level indicator. Recheck the transmission fluid level when the transaxle has reached the normal operating temperature.



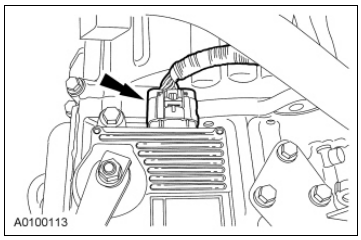
Transmission Control Module (TCM)

Removal

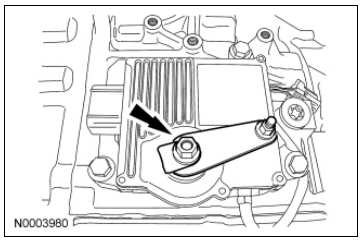
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12C .
4. Disconnect the selector lever cable end.



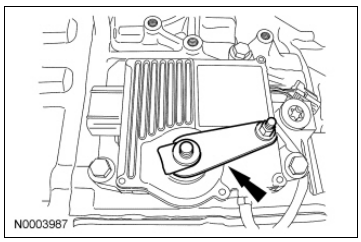
5. Disconnect the Transmission Control Module (TCM) electrical connector.



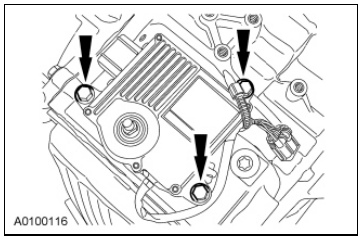
6. Remove the manual control lever nut.



7. Remove the manual control lever.

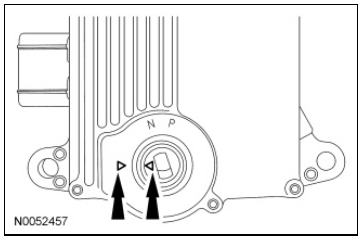


8. Remove the bolts and remove the TCM .

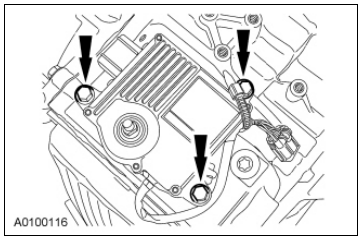


Installation

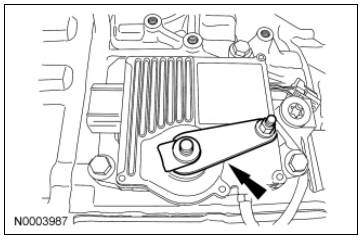
1. Verify that the manual lever position markings are aligned. Markings should indicate that the manual lever is in the OVERDRIVE position.



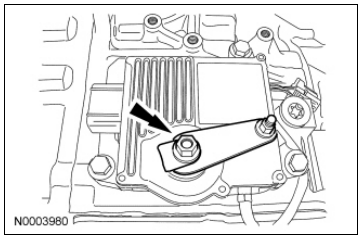
2. Install the TCM .
    - Tighten to 24 Nm (18 lb-ft).



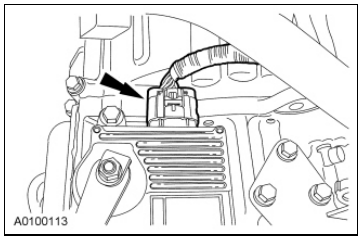
3. Install the manual control lever.



4. Install the manual control lever nut.
    - Tighten to 12 Nm (106 lb-in).

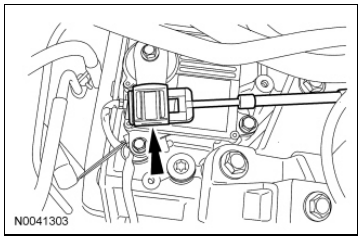


5. Connect the TCM electrical connector.



6. ***NOTICE:*** **Support the underside of the manual control lever when installing the selector lever cable or damage to the manual control lever or shaft may occur.**

   Connect the selector lever cable end.



7. Install the ACL assembly. For additional information, refer to Section 303-12C .
8. Connect the battery ground cable. For additional information, refer to Section 414-01 .
9. Carry out the TCM initial learning procedure. For additional information, refer to Transmission Control Module (TCM) Initial Learning in this section.
10. Check for correct vehicle operation.

Transaxle Support Insulator

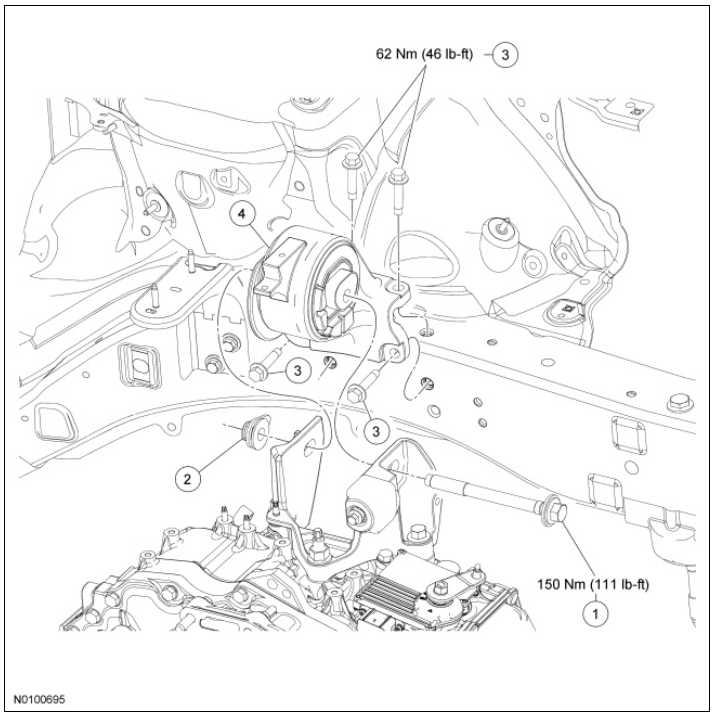
Special Tool(s)

 ST3034-A	Oil Pan Holding Fixture 303-1295

Material

Item	Specification
Threadlock and Sealer TA-25	WSK-M2G351-A5

Transaxle Support Insulator



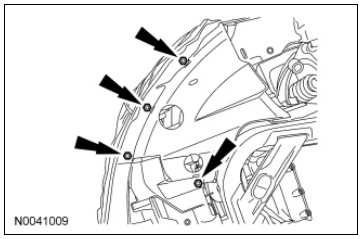
Item	Part Number	Description
1	W711873	Transaxle insulator through bolt
2	W711872	Transaxle insulator through bolt flagnut
3	W709234	Transaxle insulator-to-frame bolts
4	6F020	Transaxle insulator

Removal

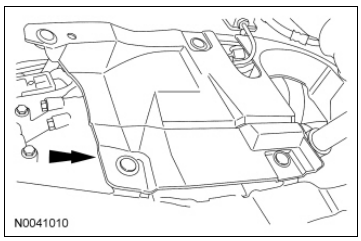
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the battery and battery tray. For additional information, refer to Section 414-01 .

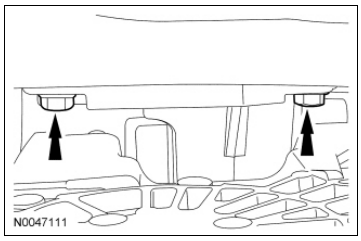
3. Remove the 4 screws and position the LH fender splash shield aside.



4. Remove the 6 pin-type retainers and the LH front structure-to-subframe splash shield.



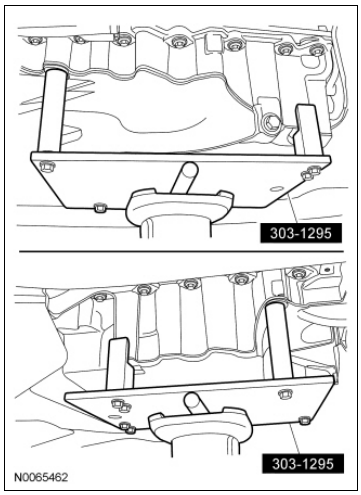
5. Remove the lower 2 transaxle insulator-to-frame bolts.



6. Remove the exhaust Y-pipe. For additional information, refer to Section 309-00 .

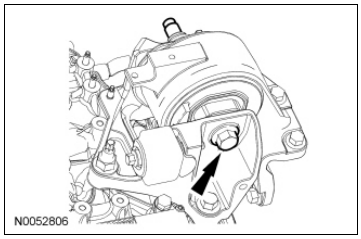
7. ***NOTICE:*** **The Oil Pan Holding Fixture must be carefully aligned to the mounting bosses on the oil pan. Failure to follow these instructions may result in damage to the oil pan.**

   Position a floor jack and the Oil Pan Holding Fixture under the oil pan.

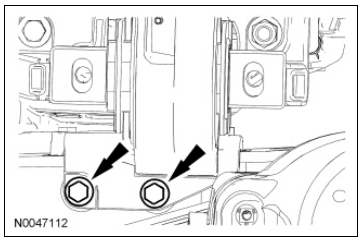


8. Remove the Air Cleaner (ACL). For additional information, refer to Section 303-01C .

9. Remove the transaxle support insulator through bolt.



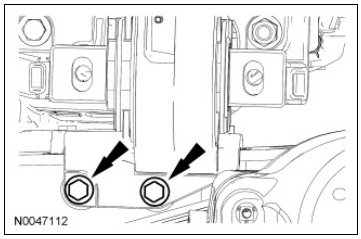
10. Remove the upper 2 transaxle insulator-to-frame bolts and remove the transaxle insulator.



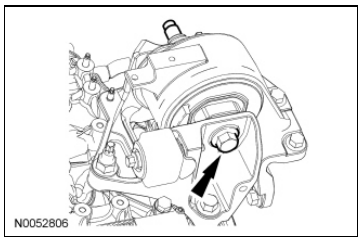
Installation

1. Clean the rear transaxle support insulator bolts using a wire brush and apply new threadlock to the threads.

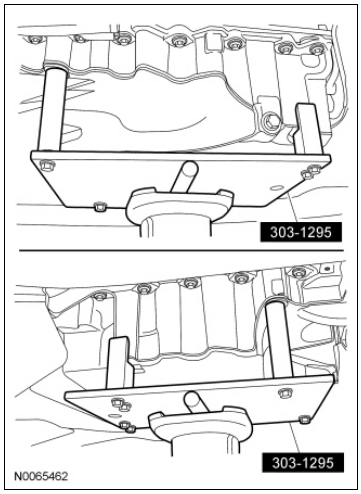
2. Position the transaxle support insulator in place and install the upper 2 transaxle insulator-to-frame bolts.
   - Tighten to 62 Nm (46 lb-ft).



3. Install the transaxle insulator through bolt and flagnut.
   - Tighten to 150 Nm (111 lb-ft).



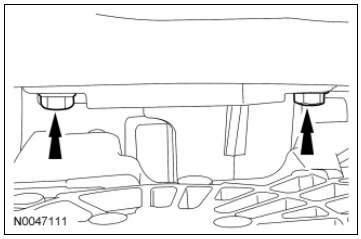
4. Remove the floor jack and the Oil Pan Holding Fixture.



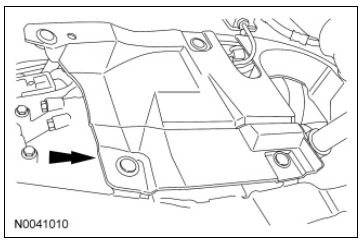
5. Install the ACL . For additional information, refer to Section 303-01C .

6. Install the exhaust Y-pipe. For additional information, refer to Section 309-00 .

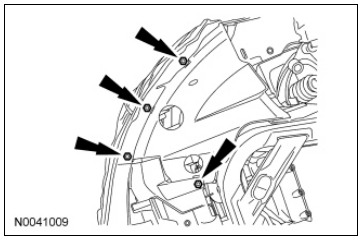
7. Position the transansaxle support insulator in place and install the lower 2 transaxle insulator-to-frame bolts.
    - Tighten to 62 Nm (46 lb-ft).



8. Position the LH front structure-to-subframe splash shield in place and install the 6 pin-type retainers.



9. Position the LH splash shield in place and install the 4 screws.



10. Install the battery and battery tray. For additional information, refer to Section 414-01 .

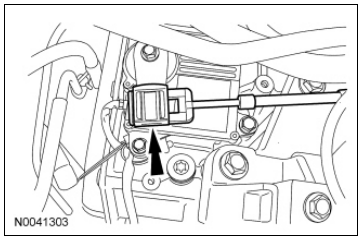
Manual Control Lever Shaft and Seal

Special Tool(s)

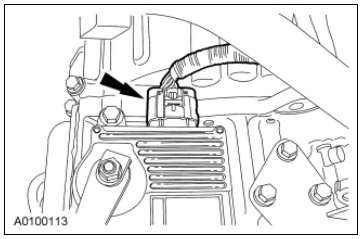
 ST2474-A	Installer, Shift Shaft Fluid Seal 307-549

Removal

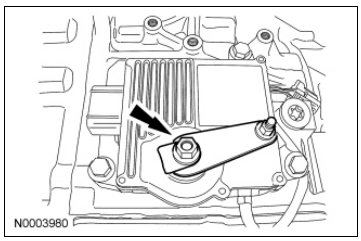
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Disconnect the battery ground cabler additional information, refer to Section 414-01 .
3. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12C .
4. Disconnect the selector lever cable end.


N0041303

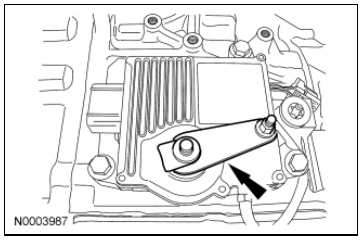
5. Disconnect the Transmission Control Module (TCM) electrical connector.


A0100113

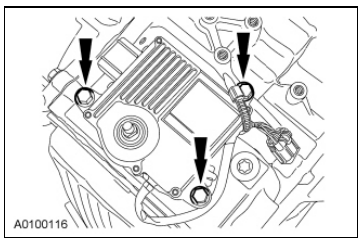
6. Remove the manual control lever nut.


N0003980

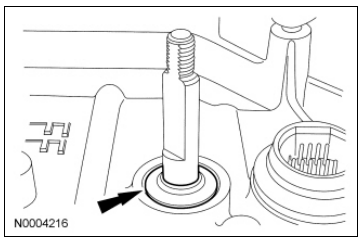
7. Remove the manual control lever.



8. Remove the bolts and remove the TCM .

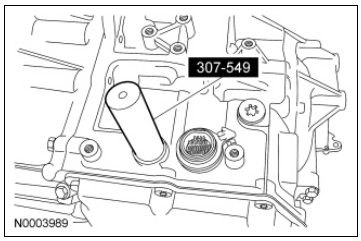


9. Using a suitable pick, remove the manual control lever seal.

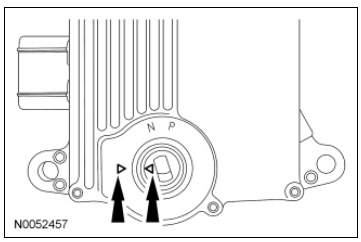


Installation

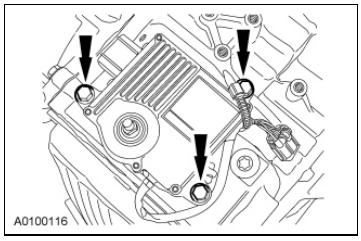
1. Using the Shift Shaft Fluid Seal Installer, install the manual control lever seal.



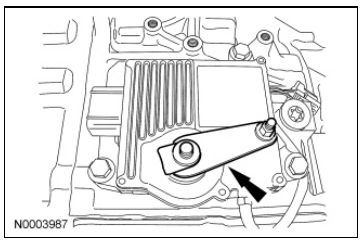
2. Verify that the manual lever position markings are aligned. Markings should indicate that the manual lever is in the OVERDRIVE position.



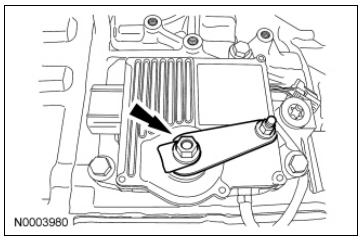
3. Install the TCM .
   - Tighten to 24 Nm (18 lb-ft).



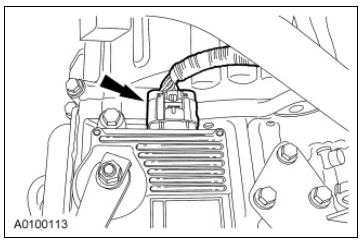
4. Install the manual control lever.



5. Install the manual control lever nut.
   - Tighten to 12 Nm (106 lb-in).

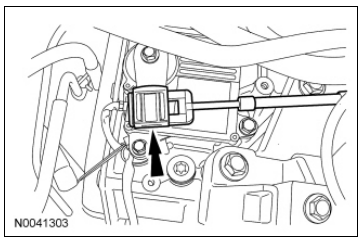


6. Connect the TCM electrical connector.



7. ***NOTICE:*** **Support the underside of the manual control lever when installing the selector lever cable or damage to the manual control lever or shaft may occur.**

   Connect the selector lever cable end.



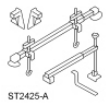
8. Install the ACL assembly. For additional information, refer to Section 303-12C .

9. Connect the battery ground cable. For additional information, refer to Section 414-01 .

10. Check for correct vehicle operation.

Transaxle

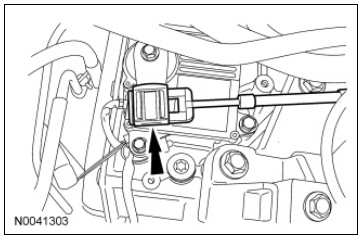
Special Tool(s)

 ST2976A	Eye, Engine Lift 303-1245
 ST2977-A	Bar, Engine Spreader 303-1246
	Powertrain Lift With Tilting Plate 300-OTC-1585AE
 ST1408-A	Remover, Tie-Rod End 211-105
 ST2425-A	Support Bar, Engine 303-F072

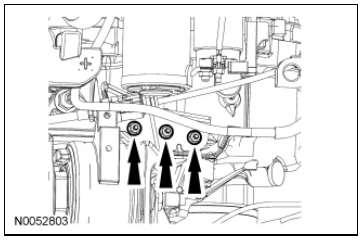
NOTE: Refer to the Transmission Cooler Flushing Job Aid on the FMCDealer website.

All vehicles

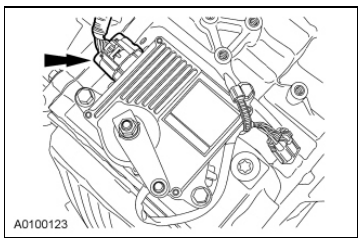
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the Air Cleaner (ACL) and the outlet pipe. For additional information, refer to Section 303-12C .
3. Remove the starter motor. For additional information, refer to Section 303-06 .
4. Remove the upper intake manifold. For additional information, refer to Section 303-01C .
5. Disconnect the selector lever cable end.



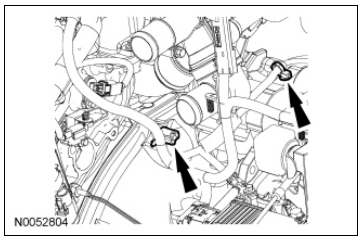
6. Remove the 2 bolts and the nut for the selector lever cable bracket and position the cable and bracket aside.



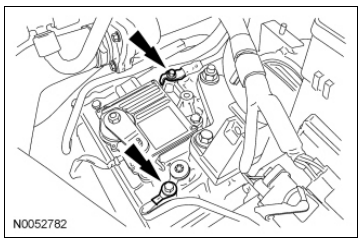
7. Disconnect the wire harness from the Transmission Control Module (TCM).



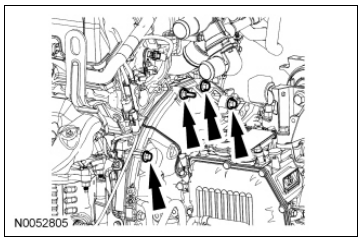
8. Disconnect the wiring harness fasteners from the torque converter housing stud bolt and the starter motor.



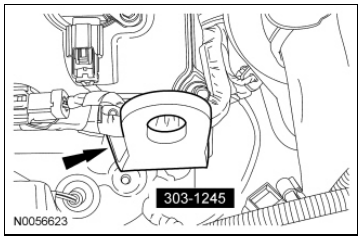
9. Remove the 2 ground strap bolts and position aside the ground straps.



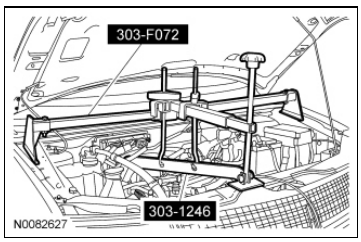
10. Remove the 4 upper torque converter housing bolts.



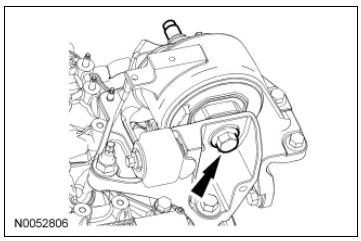
11. Install the Engine Lift Eye on the LH cylinder head.



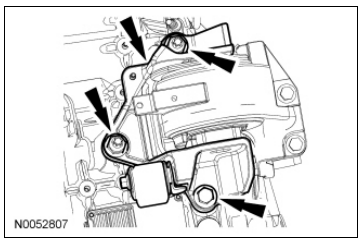
12. Install the Engine Support Bar and Engine Spreader Bar to support the engine.



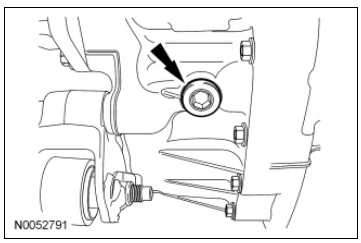
13. Remove the transaxle support insulator through bolt.



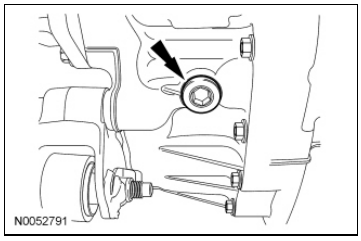
14. Using the Engine Support Bar, lower the transaxle and remove the 2 transaxle support insulator bracket nuts, the bolt and the bracket.



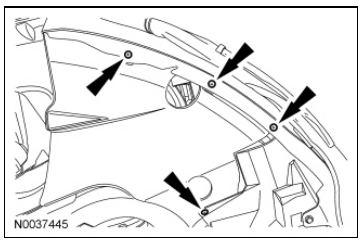
15. If a transaxle exchange or overhaul is required, the transmission fluid must be drained.
    - Remove the transmission drain plug and allow the transmission fluid to drain.



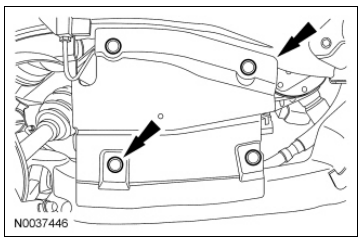
16. If removed, install the transmission fluid drain plug.
    - Tighten to 47 Nm (35 lb-ft).



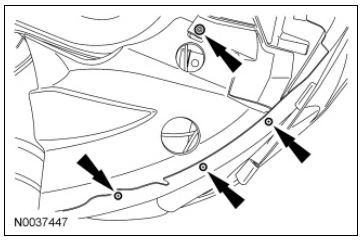
17. Remove the 4 screws and position the RH fender splash shield aside.



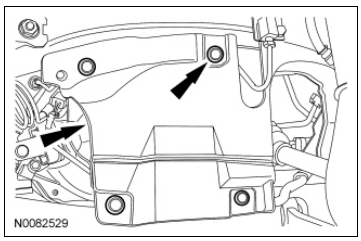
18. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



19. Remove the 4 screws and position the LH fender splash shield aside.



20. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.



21. Remove the LH halfshaft. For additional information, refer to Section 205-04 .

Front Wheel Drive (FWD)

22. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .

23. Remove the RH intermediate shaft. For additional information, refer to Section 205-04 .

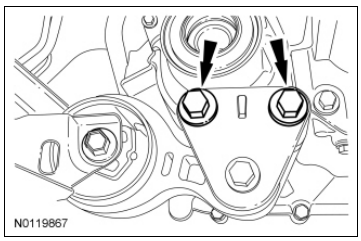
All-Wheel Drive (AWD) vehicles

24. Remove the PTU . For additional information, refer to Section 308-07B .

All vehicles

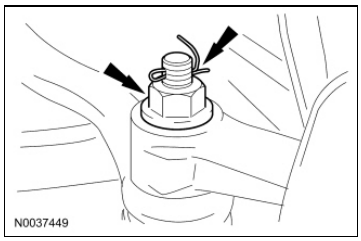
25. **NOTE:** Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.

    Remove the 2 roll restrictor bracket bolts.



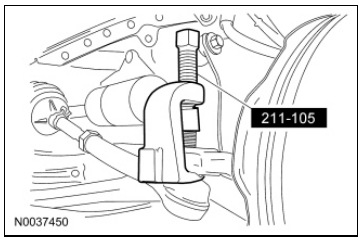
26. **NOTE:** LH shown, RH similar.

    Remove the cotter pins and nuts from the tie-rod ends.



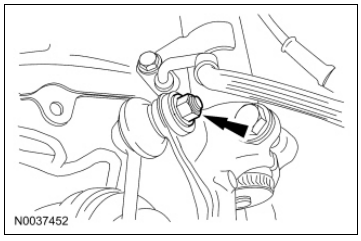
27. **NOTE:** LH shown, RH similar.

    Using the Tie-Rod End Remover, separate the tie-rod ends from the steering knuckles.

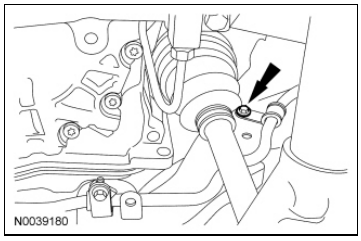


28. **NOTE:** LH shown, RH similar.

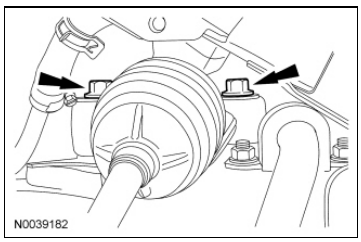
    Remove the nuts and separate the stabilizer bar links from the struts.



29. Remove the 3 power steering return line bolts.



30. Remove the 3 steering gear mounting bolts.

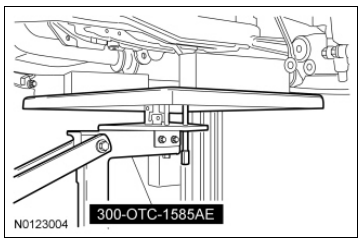


31. ***NOTICE:*** **Use care when handling the steering gear to avoid unseating the steering gear/dash seal. If the steering gear/dash seal becomes unseated, water and foreign material may enter the passenger compartment and damage to the vehicle interior can occur.**

    NOTE: The steering gear is not removed with the front subframe and must be positioned aside.

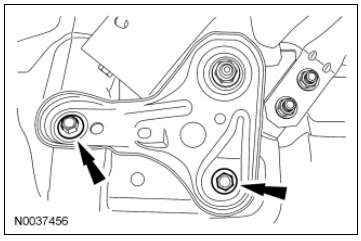
    Position the steering gear aside using mechanic's wire.

32. Position the Powertrain Lift With Tilting Plate under the subframe assembly.



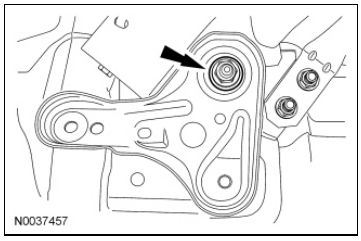
33. **NOTE:** LH shown, RH similar.

    Remove the 4 subframe bracket-to-body bolts.



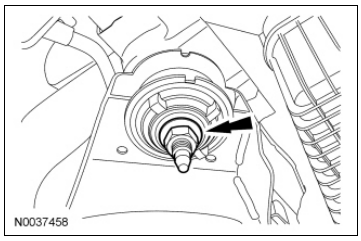
34. **NOTE:** LH shown, RH similar.

    Remove the 2 rear subframe nuts and the 2 subframe brackets.



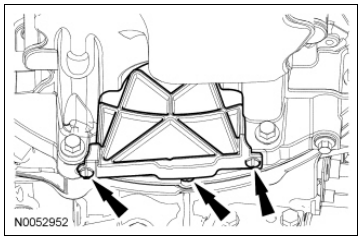
35. **NOTE:** LH shown, RH similar.

    Remove the 2 front subframe nuts.

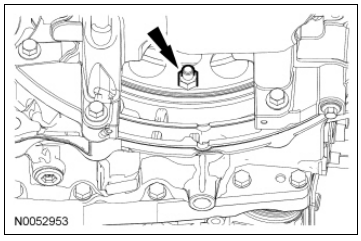


36. Lower the subframe assembly from the vehicle.

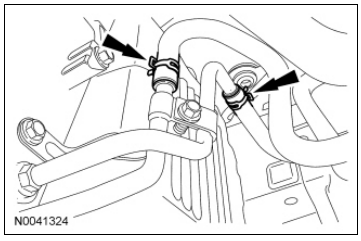
37. Remove the 2 fasteners and the inspection cover.



38. Remove and discard the 4 torque converter nuts.

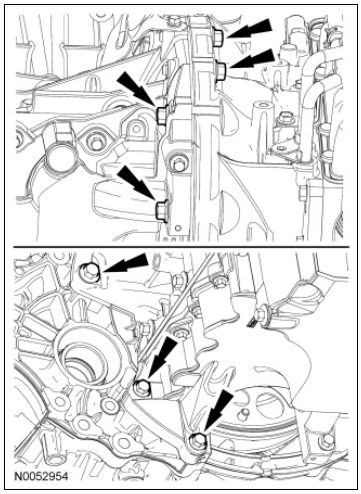


39. Disconnect the transmission fluid cooler hoses from the transmission fluid cooler tubes.



40. Support the transaxle with a suitable transmission jack. Secure the transaxle to the transmission jack with a safety strap.

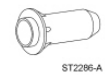
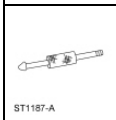
41. Remove the 7 torque converter housing bolts and remove the transaxle.



42. If installing a new transaxle, the transmission fluid cooler will need to be backflushed and cleaned. Carry out transmission fluid cooler tube backflushing and cleaning. For additional information, refer to Transmission Fluid Cooler - Backflushing and Cleaning in this section.

Torque Converter Hub Seal

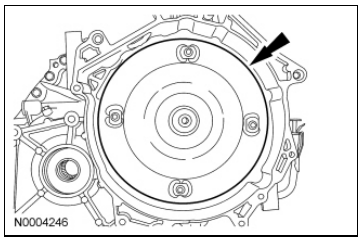
Special Tool(s)

 ST2286-A	Installer, Fluid Pump Seal 307-548
 ST2924-A	Remover, Input Shaft Oil Seal 308-375
 ST1187-A	Slide Hammer 307-005 (T59L100-B)

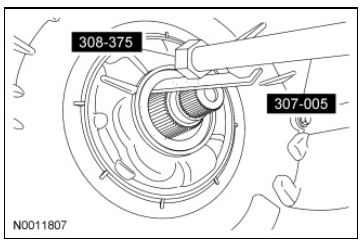
Disassembly

1. Remove the transaxle. For additional information, refer to Transaxle in this section.

2. Remove the torque converter.

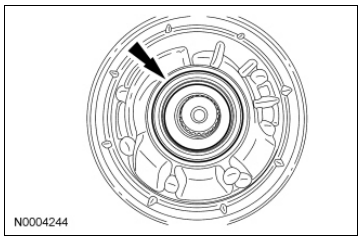


3. Using the Input Shaft Oil Seal Remover and Slide Hammer, remove the torque converter hub seal.

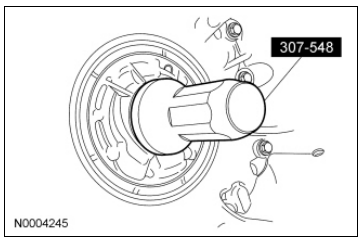


Assembly

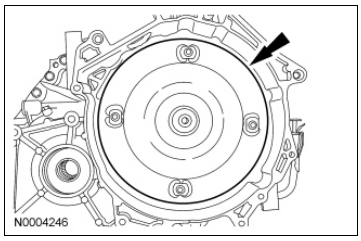
1. Position the torque converter hub seal in place.



2. Using the Fluid Pump Seal Installer, install the torque converter hub seal.



3. Install the torque converter.



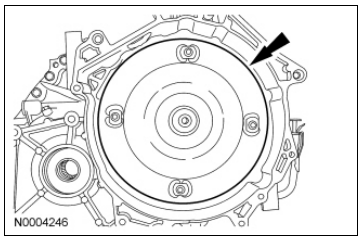
4. Install the transaxle. For additional information, refer to Transaxle in this section.

Torque Converter

Disassembly

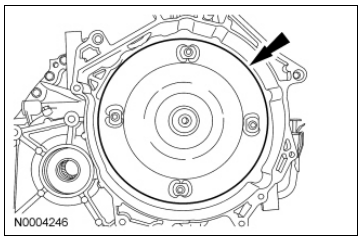
1. Remove the transaxle. For additional information, refer to Transaxle in this section.

2. Remove the torque converter.



Assembly

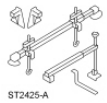
1. Install the torque converter.



2. Install the transaxle. For additional information, refer to Transaxle in this section.

Transaxle

Special Tool(s)

 ST2976A	Eye, Engine Lift 303-1245
 ST2977-A	Bar, Engine Spreader 303-1246
 ST1293-A	Powertrain Lift With Tilting Plate 300-OTC-1585AE
 ST2425-A	Support Bar, Engine 303-F072
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B
Threadlock and Sealer TA-25	WSK-M2G351-A5

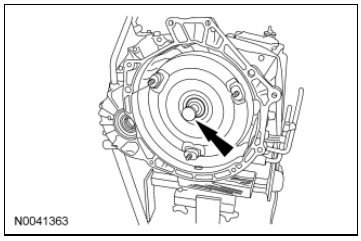
NOTICE: **The use of any transmission fluid other than what is recommended for this transaxle will cause transaxle damage.**

NOTE: If the transaxle was overhauled, or if installing a new transaxle and the transmission fluid cooler has not been flushed, flush the transmission fluid cooler at this time. For additional information, refer to Transmission Fluid Cooler - Backflushing and Cleaning in this section.

All vehicles

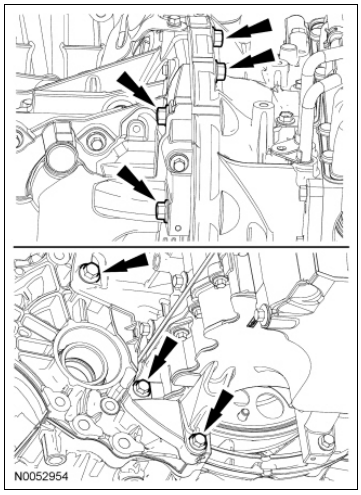
1. Secure the transaxle to a suitable transmission jack with a safety strap.

2. Prior to installing the transaxle, apply multi-purpose grease to the torque converter pilot hub.

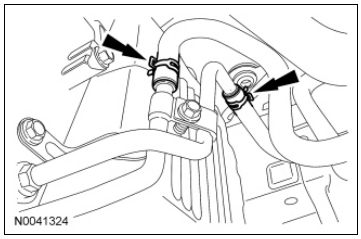


3. Position the transaxle to the back of the engine.

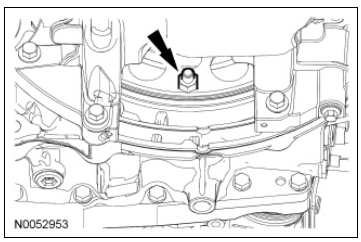
4. Install the 7 transaxle-to-engine bolts.
   - Tighten to 48 Nm (35 lb-ft).



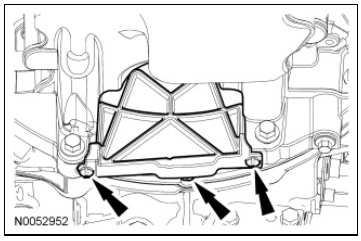
5. Connect the transmission fluid cooler hoses to the transmission cooler tubes.



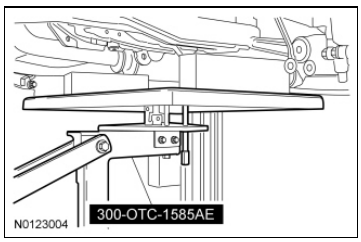
6. Install 4ew torque converter nuts.
   - Tighten to 36 Nm (27 lb-ft).



7. Position the inspection cover in place and install the 2 fasteners.



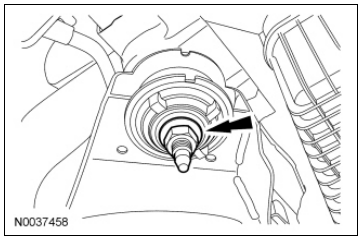
8. Using the Powertrain Lift With Tilting Plate, raise the subframe into the installed position.



9. **NOTE:** LH shown, RH similar.

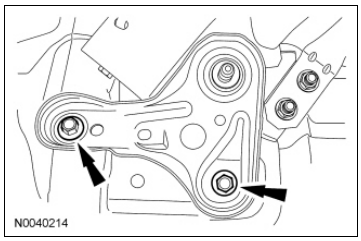
   Install the 2 front subframe nuts.

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



10. **NOTE:** LH shown, RH similar.

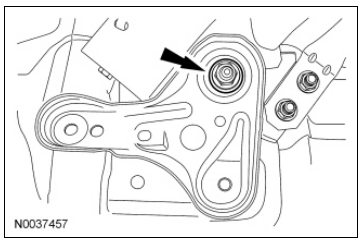
    Position the subframe brackets and install the 4 bolts finger-tight.



11. **NOTE:** LH shown, RH similar.

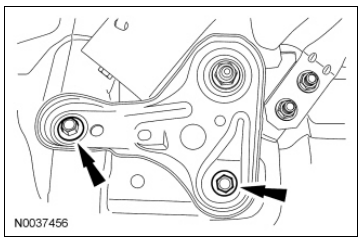
    Install the 2 rear subframe nuts.

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



12. **NOTE:** LH shown, RH similar.

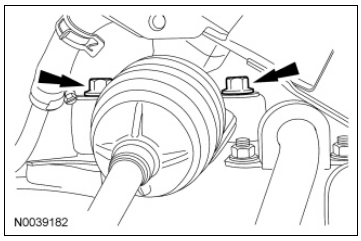
    Tighten the 4 subframe bracket-to-body bolts to 103 Nm (76 lb-ft).



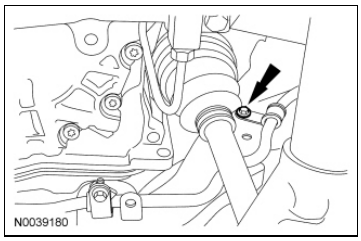
13. ***NOTICE:*** **Use care when handling the steering gear to avoid unseating the steering gear/dash seal. If the steering gear/dash seal becomes unseated, water and foreign material may enter the passenger compartment and damage to the vehicle interior can occur.**

    Position the steering gear.

    1. Install the 3 steering gear mounting bolts.
    2. Tighten to 107 Nm (79 lb-ft).



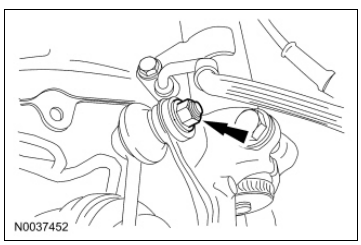
14. Install the 3 power steering return line bolts.
    - Tighten to 9 Nm (80 lb-in).



15. **NOTE:** LH shown, RH similar.

    Install the stabilizer bar links and nuts to the struts.

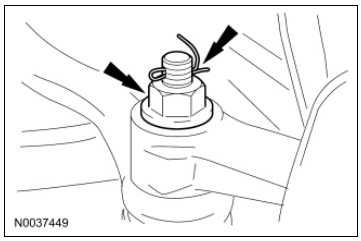
    - Tighten to 40 Nm (30 lb-ft).



16. **NOTE:** LH shown, RH similar.

Install the tie-rod ends and nuts.

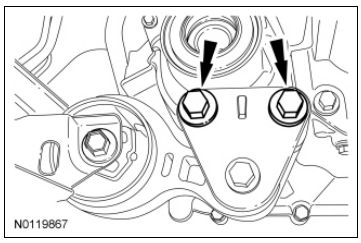
- Tighten to 48 Nm (35 lb-ft).
- Install new cotter pins.



17. **NOTE:** Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.

    Install the 2 roll restrictor bracket bolts.

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



All-Wheel Drive (AWD) vehicles

18. Install the Power Transfer Unit (PTU). For additional information, refer to Section 308-07B .

Front Wheel Drive (FWD)

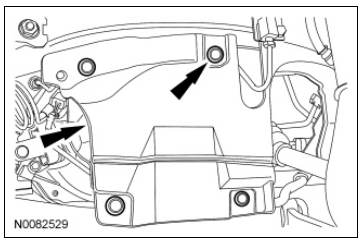
19. Install the exhaust flexible pipe. For additional information, refer to Section 309-00 .

20. Install the RH intermediate shaft. For additional information, refer to Section 205-04 .

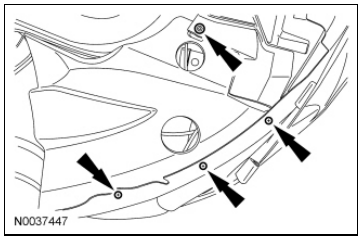
All vehicles

21. Install the LH halfshaft. For additional information, refer to Section 205-04 .

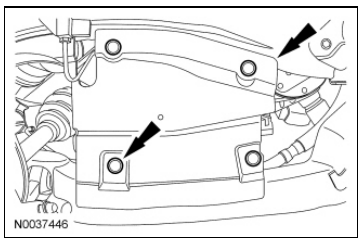
22. Install the LH splash shield and the 6 pin-type retainers (4 shown).



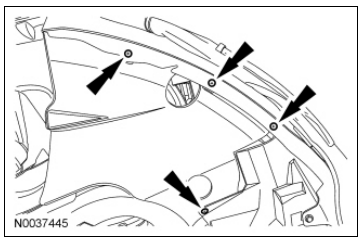
23. Position the LH fender splash shield and install the 4 screws.



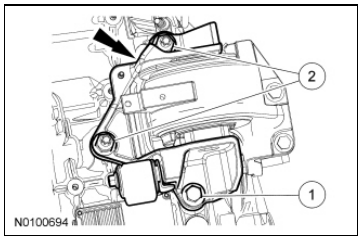
24. Install the RH splash shield and the 6 pin-type retainers (4 shown).



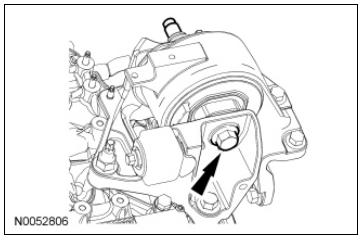
25. Position the RH fender splash shield and install the 4 screws.



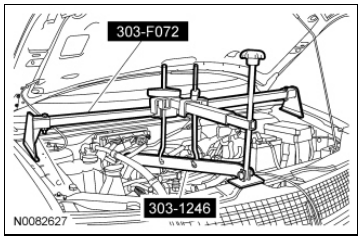
26. Apply threadlock and sealer to the threads and install the transaxle support insulator bracket, the 2 nuts and the bolt.
    1. Tighten the bolt to 80 Nm (59 lb-ft).
    2. Tighten the nuts to 90 Nm (66 lb-ft).



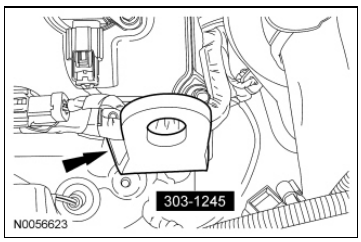
27. Using the Engine Support Bar, raise the transaxle. Apply threadlock and sealant to the threads and install the transaxle support insulator through bolt.
    - Tighten to 150 Nm (111 lb-ft).



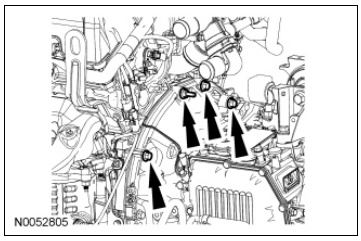
28. Remove the Engine Support Bar and Engine Spreader Bar.



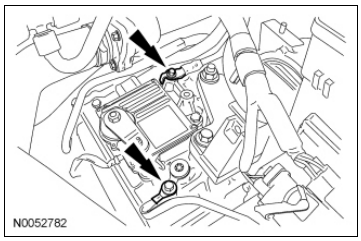
29. Remove the Engine Lift Eye from the LH cylinder head.



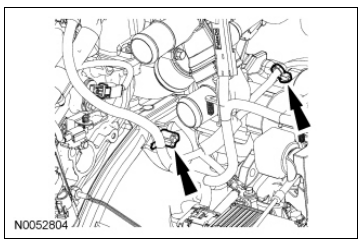
30. Install the 4 upper transaxle-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).



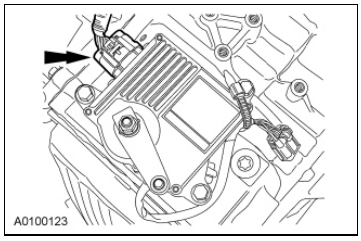
31. Position the 2 ground straps in place and install the 2 ground strap bolts.
    - Tighten to 12 Nm (106 lb-in).



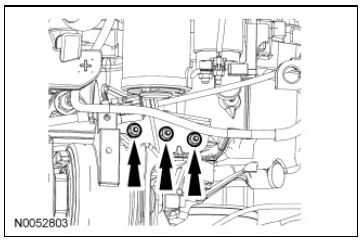
32. Connect the wiring harness fasteners on the torque converter housing stud bolt and the starter motor.



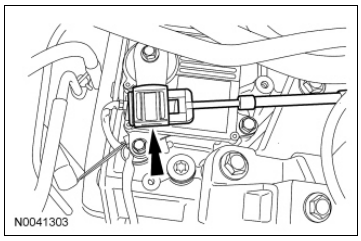
33. Connect the Transmission Control Module (TCM) electrical connector.



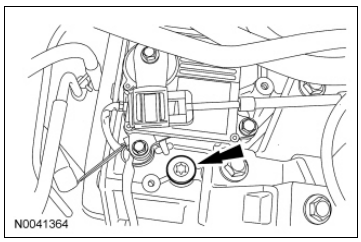
34. Position the selector lever cable bracket in place and install the 2 bolts and the nut.
    - Tighten to 12 Nm (106 lb-in).



35. Connect the selector lever cable end.

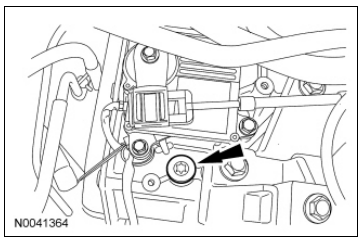


36. Remove the transmission fluid fill plug.



37. Fill the transaxle with clean transmission fluid.

38. Install the transmission fluid fill plug.
    - Tighten to 39 Nm (29 lb-ft).



39. Install the upper intake manifold. For additional information, refer to Section 303-01C .

40. Install the starter. For additional information, refer to Section 303-06 .

41. Install the Air Cleaner (ACL) and outlet tube. For additional information, refer to Section 303-12C .

42. Remove the transmission fluid level indicator and make sure that the transaxle has transmission fluid in it.

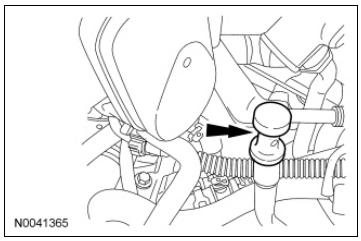
43. With the transaxle in PARK, the vehicle on a level surface, the engine at idle (680-780 rpm) and foot pressed on the brake, move the selector lever through each gear and allow engagement of each gear. Place the selector lever back in the PARK position.

44. Wipe the transmission fluid level indicator cap and remove the transmission fluid level indicator.

45. Wipe the transmission fluid level indicator with a clean cloth.

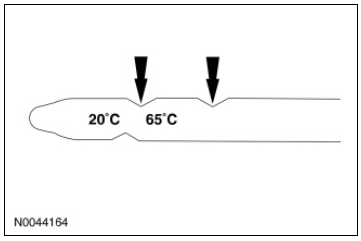
46. **NOTE:** In order to get an accurate transmission fluid level reading the vehicle should be on a level surface. Idle the engine to reach the normal operating temperature. Using the scan tool, verify that the transaxle is at normal operating temperature 60°C-70°C (140°F-158°F), prior to adjusting the transmission fluid level.

    If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pt) increments through the transmission fluid fill plug located on the top of the transaxle near the transmission fluid level indicator. Do not overfill the transmission fluid. Install the transmission fluid level indicator back in the transmission fluid filler tube until it is fully seated, then remove the indicator. The transmission fluid level should be at the upper most mark on the transmission fluid level indicator. Only fill to the upper most mark on the transmission fluid level indicator. Do not overfill. Damage to the transaxle will occur.



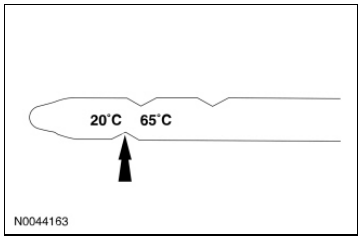
47. **NOTE:** The correct transmission fluid level at normal operating temperature of 60°C-70°C (140°F-158°F) is between the top 2 marks on the transmission fluid level indicator.

    Fill the transaxle to the correct transmission fluid level.



48. **NOTE:** The correct transmission fluid level at cold operating temperature of 15°C-25°C (59°F-77°F) is at the bottom mark on the transmission fluid level indicator.

    If the Transmission Fluid Temperature (TFT) is low, fill the transaxle with transmission flold range on the transmission fluid level indicator. Recheck the transmission fluid level when the transaxle has reached the normal operating temperature.



49. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

Material

Item	Specification	Fill Capacity
Dye-Lite® ATF/Power Steering Fluid Leak Detection Dye 164-R3701 (Rotunda)	-	-
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV	8.5L (9 qt)
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B	-
Threadlock and Sealer TA-25	WSK-M2G351-A5	-
Ultra Silicone Sealant TA-29	-	-

General Specifications

Item	Specification
Transaxle Weight	86 kg (189 lb)

Solenoid Operation Chart

Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (CB 1,2,3,4)	SSB (VFS) NH (3,5,R)	SSC (VFS) NL (CB 2,6)	SSD (VFS) NH (CB L,R/C 4,5,6)	SSE (On/Off) NC	
P	P	Off	On	Off	Off	On	Off
R	R	Off	Off	Off	Off	On	Off
N	N	Off	On	Off	Off	On	Off
D	1	On	On	Off	Off [a]	On [b]	Off
	2	On	On	On	On	Off	Off
	3	On	Off	Off	On	Off	Off
	4	On	On	Off	Off	Off	On/Off
	5	Off	Off	Off	Off	Off	On/Off
	6	Off	On	On	Off	Off	On/Off
L	1	On	On	Off	Off	On	Off

[a] Turns on above 8 km/h (5 mph).
[b] Turns off above 8 km/h (5 mph).

CB = Clutch brake

NC = Normally closed

NH = Normally high

NL = Normally low

Clutch Application Chart

Gear	Direct (C 3,5,R)	Overdrive (C 4,5,6)	Forward (CB 1,2,3,4)	Low/ Reverse (CB L,R)	Inter- mediate (CB 2,6)	One-Way
1st			X	X [a]		X
2nd			X		X	O/R
3rd	X		X			O/R
4th		X	X			O/R
5th	X	X				O/R
6th		X			X	O/R
Reverse	X			X		

[a] Turns off above 8 km/h (5 mph).

CB = Clutch brake

O/R = Overrunning

Line Pressure Chart

Gear	Line
Pressures at Idle [a]	
P	338-379 kPa (49-55 psi)
R	621-689 kPa (90-100 psi)
N	338-379 kPa (49-55 psi)
D	338-379 kPa (75-85 psi)
L	338-379 kPa (75-85 psi)
Pressure at Wide Open Throttle (WOT) Stall [a]	
P	338-379 kPa (49-55 psi)
R	1,868-2,068 kPa (271-300 psi)
N	338-379 kPa (49-55 psi)
D	1,868-2,068 kPa (271-300 psi)

L	1,868-2,068 kPa (271-300 psi)

[a] All pressures are approximate.

Stall Speed Chart

Selector Lever	Engine	rpm
Drive	2.5	2,200-2,300
Drive	3.0	2,400-2,500

Gear Ratio Chart

Gear	Ratio
1st/low	4.584:1
2nd	2.964:1
3rd	1.912:1
4th	1.446:1
5th	1:1
6th	0.746:1
Reverse	2.94:1

Shift Speeds 2.5L

Throttle Position	Range	Shift	KM/H	MPH
Light	D	1-2	11-16	7-10
Throttle [a]	D	2-3	21-27	13-17
	D	3-4	29-37	18-23
	D	4-5	45-56	28-35
	D	5-6	72-90	45-56
Medium	D	1-2	27-43	17-23
Throttle [a]	D	2-3	42-55	26-34
	D	3-4	58-77	36-48
	D	4-5	77-106	48-66
	D	5-6	135-177	84-110
Heavy	D	1-2	51-66	32-41
Throttle [a]	D	2-3	79-100	49-62
	D	3-4	113-143	70-89
	D	4-5	150-190	93-118
	D	5-6	201-245	125-152

[a] Do not exceed the speed limit.

Shift Speeds 3.0L

Throttle Position	Range	Shift	KM/H	MPH
Light	D	1-2	13-18	8-11
Throttle [a]	D	2-3	19-26	12-16
	D	3-4	29-37	18-23
	D	4-5	45-56	28-35
	D	5-6	72-90	45-56
Medium	D	1-2	32-42	20-26
Throttle [a]	D	2-3	48-61	30-38
	D	3-4	63-82	39-51
	D	4-5	80-108	50-67
	D	5-6	117-159	73-99
Heavy	D	1-2	58-72	36-45
Throttle [a]	D	2-3	85-106	53-66
	D	3-4	126-156	78-97
	D	4-5	151-192	94-119
	D	5-6	217-261	135-162

[a] Do not exceed the speed limit.

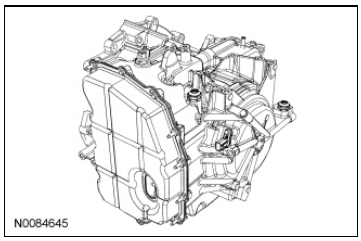
Torque Specifications

Description	Nm	lb-ft	lb-in
Battery Junction Box (BJB) support bracket	10	-	89
Clutch support tower bolts	12	-	106
EGR valve bracket bolts	10	-	89
Electronic Power Assist Steering (EPAS) ground bolt	12	-	106
Line pressure tap plug	12	-	106
Lube funnel hold-down bracket bolts	12	-	106
Main control cover bolts/stud bolts	12	-	106
Manual control lever nut	24	18	-
Main control stud nut [a]	-	-	-
Main control-to-case stud	10	-	89
Main control valve body bolts [a]	-	-	
Output Shaft Speed (OSS) sensor bolt	10	-	89
Pump assembly-to-torque converter housing bolts	35	26	-
RH exhaust manifold heat shield bolts	11	-	97
Roll restrictor bolts	90	66	-
Roll restrictor bracket bolts	90	66	-
Selector lever cable bracket nuts	12	-	106

Separator plate bolts	10	-	89
Solenoid body bolts	10	-	89
Solenoid body-to-valve body bolts	10	-	89
Stabilizer bar link nuts	40	30	-
20	-	177	
Subframe nuts	150	111	-
Subframe bracket-to-body bolts	103	76	-
Torque converter housing bolts	48	35	-
Torque converter nuts	40	30	-
Transaxle case-to-torque converter housing bolts	24	18	-
Transaxle support insulator bolts	62	46	-
Transaxle support insulator bracket bolt	63	46	-
Transaxle support insulator bracket nuts	63	46	-
Transaxle support insulator through bolt	150	111	-
Transmissio	12	-	106
Transmission fluid cooler tube bracket nuts	9	-	80
Transmission fluid drain plug	12	-	106
Transmission fluid filler tube nut	11	-	97
Transmission Range (TR) sensor detent spring bolt	13	-	115
Turbine Shaft Speed (TSS) sensor bolt	10	-	89

[a] Refer to the procedure for the specification.

Transaxle Description



This automatic transaxle is a 6-speed transaxle with electronic shift control. It is designed for operation in a transverse powertrain for Front Wheel Drive (FWD) and All-Wheel Drive (AWD) vehicles.

This transaxle has a 4-element torque converter design, which includes a Torque Converter Clutch (TCC) and a geartrain with 3 planetary gearsets.

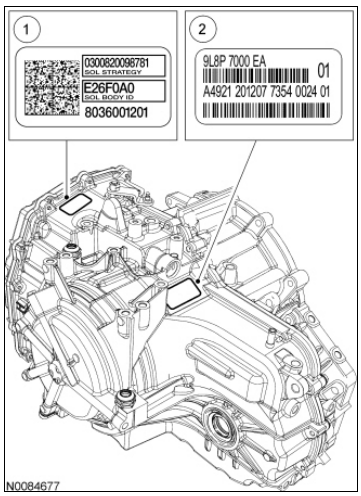
The hydraulic control system of this transaxle uses 7 electronically controlled solenoids for:

- Shift feel (through line pressure control and shift pressure control)
- Shift scheduling and timing
- TCC operation

p;

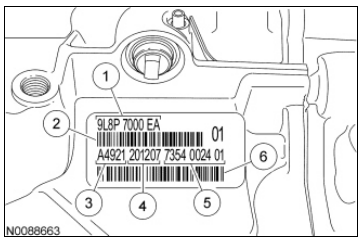
Identification Tags

Identification Tag Location



Item	Part Number	Description
1	7G342	Solenoid body identification tag
2	7B148	Transaxle identification tag

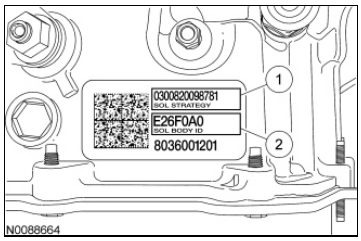
Transaxle Identification Tag



Description	
1	Transaxle part number
2	Bar code 1
3	Assembly plant line shift
4	Transaxle build date (DDMMYY)
5	Transaxle serial number
6	Bar code 2

When servicing the transaxle, use the transaxle identification tag located on top of the transaxle case.

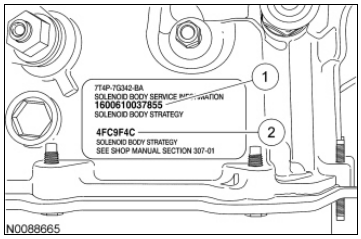
Original Solenoid Body Tag



Item	Description
1	Thirteen-digit solenoid body strategy
2	Seven-digit solenoid body identification

The solenoid body strategy is a file that is programmed into the PCM to control the shift, Line Pressure Control (LPC) and Torque Converter Clutch (TCC) solenoids to prevent harsh shifts. The solenoid body tag on the transaxle case contains the 13-digit solenoid body strategy and the 7-digit solenoid body identification.

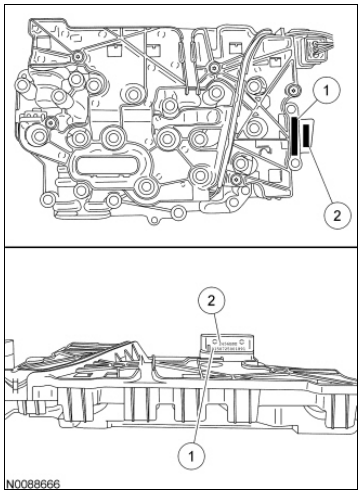
Replacement Solenoid Body Tag



Item	Description
1	Thirteen-digit solenoid body strategy
2	Seven-digit solenoid body identification

Any time a new solenoid body is installed, a new solenoid body strategy file is downloaded into the PCM using the scan tool. A replacement solenoid body tag is supplied with the new solenoid body which contains the 13-digit solenoid body strategy and the 7-digit solenoid body identification. The new tag is placed over the original solenoid body tag.

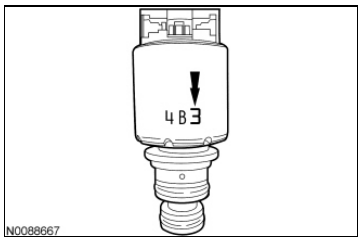
Solenoid Body Identification and Strategy



Item	Description
1	Thirteen-digit solenoid body strategy
2	Seven-digit solenoid body identification

If the solenoid body strategy printed on the solenoid body connector does not match the solenoid body tag, a new solenoid body must be installed and the solenoid body strategy must be downloaded into the PCM or harsh shifts will result.

Solenoid Band Number



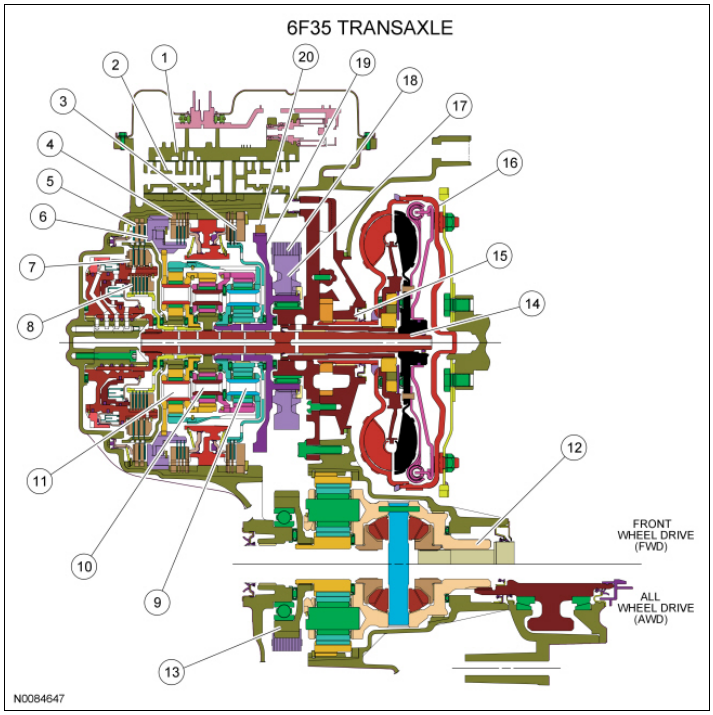
The solenoids are calibrated from the factory and are not all the same. The solenoids can be replaced separately, but only with a replacement solenoid with a band that matches the solenoid being replaced. When solenoid(s) are replaced, the new solenoid band number must match the old solenoid band number. The band number is the last digit of the number stamped on the side of the solenoid and will be a 1, 2, 3, 4 or 5.

Major Components

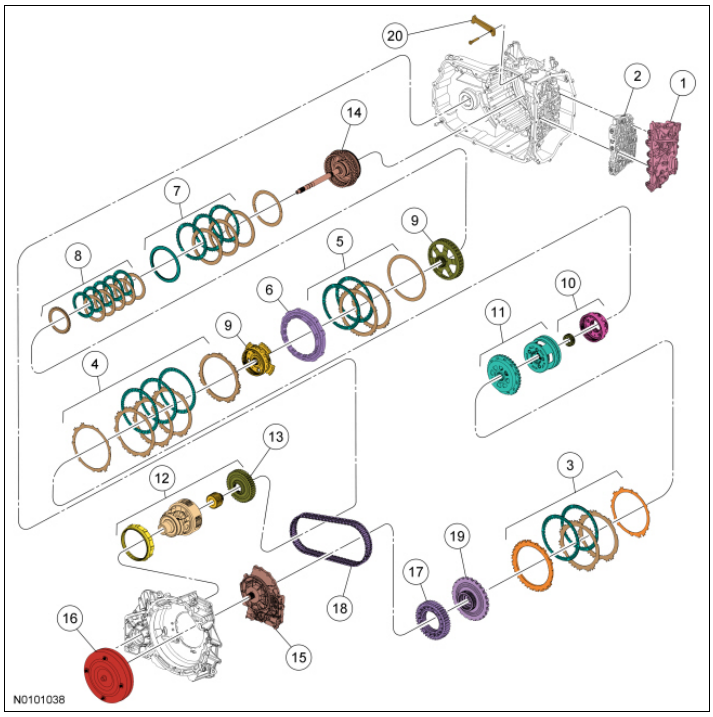
This transaxle has the following major components:

- Case with torque converter housing
- Two drive clutches:
  - Direct clutch
  - Overdrive (O/D) clutch
- Four brake clutches:
  - Forward clutch
  - Low one-way clutch
  - Low/reverse clutch
  - Intermediate clutch
- Three planetary gearsets:
  - Front
  - Center
  - Rear
- Drive chain and sprockets
- Final drive planetary gearset and differential assembly
- Pump and filter assembly
- Main control:
  - Valve body assembly
  - Solenoid body assembly

Major Component Cutaway View



Major Component Exploded View



Item	Part Number	Description
1	7G391	Solenoid body
2	7A100	Valve body
3	7B164	Forward clutch (clutch brake 1, 2, 3, 4)
4	7B164	Low/reverse clutch (clutch brake low/reverse)
5	7B164	Intermediate clutch (clutch brake 2, 6)
6	7A089	Low One-Way Clutch (OWC)
7	7B164	Direct clutch (drive clutch 3, 5, R)
8	7B164	Overdrive (O/D) clutch (drive clutch 4, 5, 6)
9	7D491	Rear planetary assembly
10	7D491	Center planetary assembly
11	7D491	Front planetary assembly
12	7F465	Final drive carrier and differential assembly
13	7G132	Drive chain driven sprocket
14	7G384	Input shaft assembly and direct/overdrive clutch hub
15	7A103	Pump assembly
16	7975	Torque converter
17	7G132	Drive chain drive sprocket
18	7G249	Drive chain
19	7060	Park gear
20	7A441	Park pawl

Gear Ratios

This transaxle has 6 forward speeds and reverse.

Gear Ratio Chart

Gear	Ratio
1st/low	4.584:1
2nd	2.964:1
3rd	1.912:1
4th	1.446:1
5th	1:1
6th	0.746:1
Reverse	2.94:1

Torque Converter

The torque converter transmits and multiplies torque. The torque converter is a 4-element device:

- Impeller and cover assembly
- Turbine
- Reactor
- Clutch and damper assembly

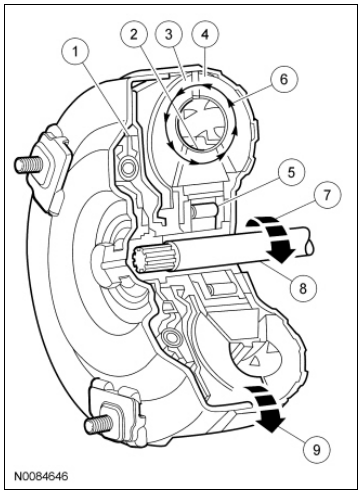
Rotation of the torque converter housing and impeller set the transmission fluid in motion by driving the impeller blades and pump.

The turbine is driven by the transmission fluid from the impeller and transmits power to the input shaft.

The reactor redirects transmission fluid flow returned from the turbine to the impeller so that it rotates in the same direction as the impeller. This action assists in torque multiplication.

The reactor has a One-Way Clutch (OWC) to hold it stationary during torque multiplication and allows it to rotate at higher vehicle speeds.

Torque Converter Operation



Item	Description
1	Torque Converter Clutch (TCC)
2	Reactor
3	Turbine
4	Impeller and cover assembly
5	One-Way Clutch (OWC)
6	Fluid motion
7	Input shaft rotation
8	Input shaft
9	Engine rotation

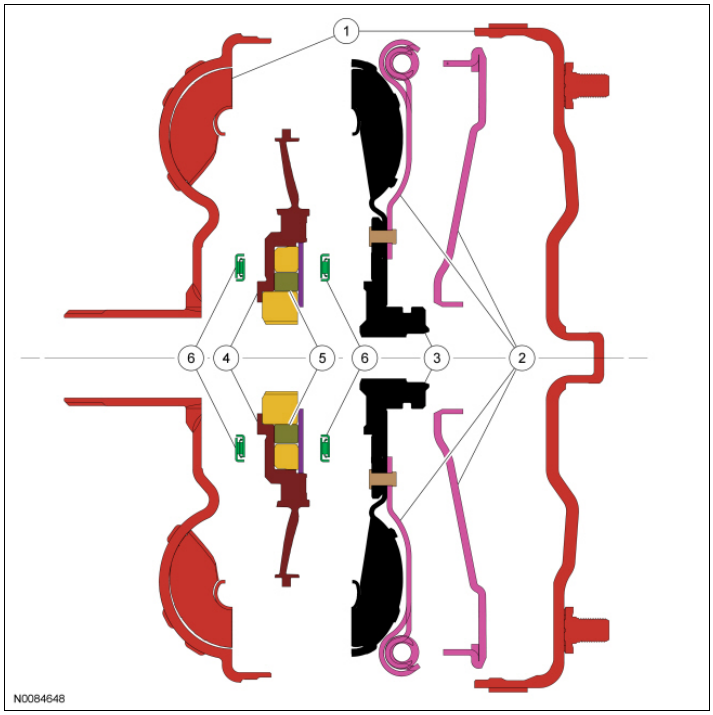
The Torque Converter Clutch (TCC) connects the torque converter housing to the damper when the TCC is applied.

During TCC release, the direction that the transmission fluid flows through the torque converter allows the TCC to release. During TCC apply, the transmission fluid flows in the opposite direction to apply the TCC .

The PCM controls TCC operation using the TCC solenoid in the solenoid body. TCC solenoid operation provides the modulation of hydraulic pressure to change the position of the TCC control valve and TCC regulator apply valve which changes the pressure and transmission fluid direction in the torque converter.

The TCC can be applied in 3rd, 4th, 5th and 6th gears.

Torque Converter Internal Component Exploded View



Item	Description
1	Impeller and cover assembly
2	Torque Converter Clutch (TCC) and damper assembly
3	Turbine
4	Reactor
5	One-Way Clutch (OWC)
6	Thrust bearings

Shift Patterns

Upshifts

Upshifting is controlled by the PCM. The PCM receives inputs from various engine or vehicle sensors and driver demands to control shift scheduling, shift feel and Torque Converter Clutch (TCC) operation.

The PCM has an adaptive learn strategy to electronically control the transaxle which will automatically adjust the shift feel through the life of the vehicle. The first few hundred miles of operation of the transaxle may have abrupt shifting. This is a normal operation. To reset the adaptive shift pressure strategy, use the scan tool to clear the transmission keep alive memory tables.

Downshifts

Under certain conditions, the transaxle will downshift automatically to a lower gear range (without moving the selector lever). There are 3 categories of automatic downshifts: coastdown, torque demand and forced or kickdown shifts.

Coastdown

The coastdown downshift occurs when the vehicle is ting down to a stop.

Torque Demand

The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide at that gear ratio. If applied, the transmission will disengage the TCC to provide added acceleration.

Kickdown

For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size, engine and transaxle calibration requirements.

Mechanical Components and Functions

Planetary Gearset

This transaxle has 3 planetary gearsets to provide operation in reverse and 6 forward speeds.

The gearsets are comprised of the following components:

- Front planetary sun gear (part of the front sun gear and shell assembly)
- Front planetary carrier
- Front planetary ring gear
- Center planetary sun gear
- Center planetary carrier
- Center planetary ring gear
- Rear planetary ring gear
- Rear planetary carrier
- Rear planetary sun gear and shell assembly

The front planetary sun gear is splined to the forward (1, 2, 3, 4) clutch and is held stationary in 1st, 2nd, 3rd and 4th gears.

The front planetary carrier is splined to the rear planetary ring gear and transfers power from the rear planetary gearset to the front planetary gearset in 2nd, 3rd, 5th and 6th gears and reverse. The front planetary carrier is splined to the drive chain drive sprocket. The front planetarrrier is the output component for the planetary gearset.

The front planetary ring gear is splined to the center planetary carrier and transfers power from the center planetary gearset to the front planetary gearset in 1st, 2nd, 3rd and 4th gears.

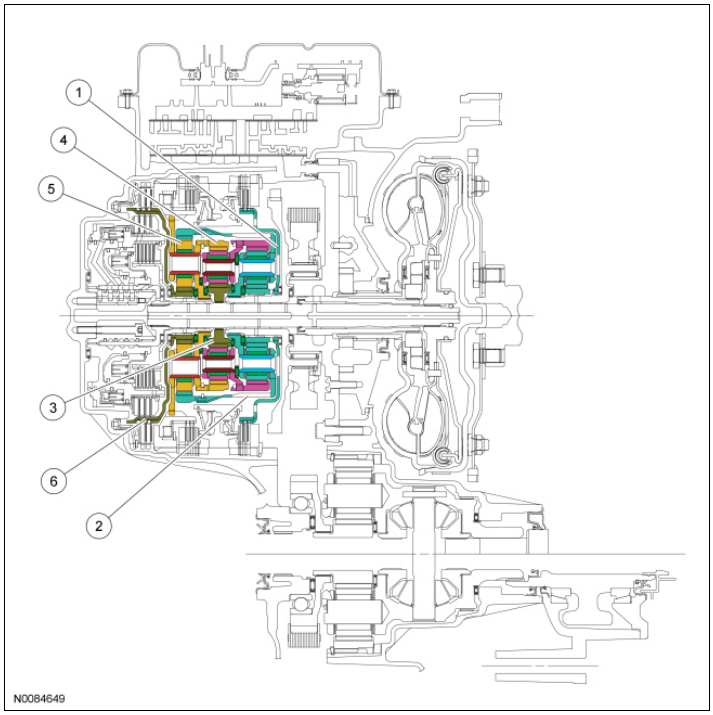
The center planetary sun gear is splined to the input shaft and is used as input to the planetary gearsets in 1st, 2nd, 3rd and 4th gear.

The center planetary ring gear is splined to the rear planetary carrier and transfers power from the center planetary gearset to the rear planetary gearset in 3rd gear, from the rear planetary gearset to the center planetary gearset in 4th gear and is held stationary by the low One-Way Clutch (OWC) and low/reverse clutch in 1st gear and reverse.

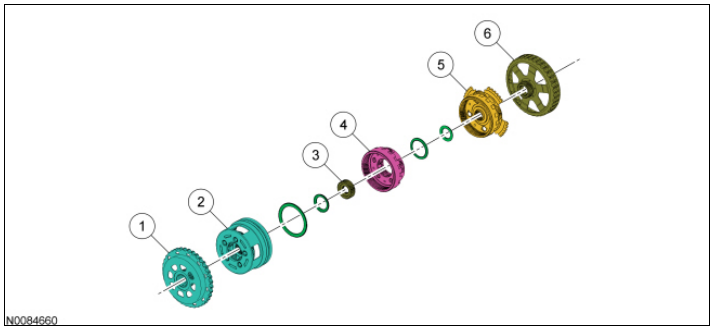
The rear planetary carrier is splined to the Overdrive (O/D) (4, 5, 6) clutch hub and transfers power from the input shaft to the rear planetary carrier in 4th, 5th and 6th gears.

The rear planetary sun gear and shell assembly is splined to both the intermediate (2, 6) clutch and the direct (3, 5, R) clutch. The rear planetary sun gear and shell assembly is held stationary by the intermediate (2, 6) clutch in 2nd and 6th gear and is driven by the direct (3, 5, R) clutch in 3rd and 5th gears and reverse.

Planetary Gearset Cutaway View



Planetary Gearset Exploded View

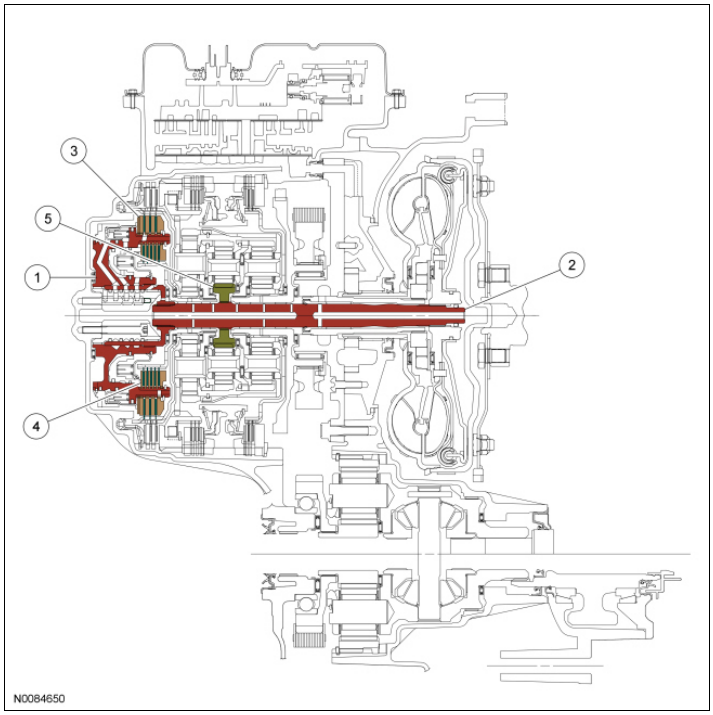


Item	Part Number	Description
1	7A019	Front planetary sun gear and shell assembly
2	7D491	Front planetary carrier/rear planetary ring gear assembly
3	7D063	Gear - center planetary sun
4	7D491	Center planetary carrier/front ring gear assembly
5	7D491	Rear planetary carrier/center ring gear assembly
6	7A019	Rear planetary sun gear and shell assembly

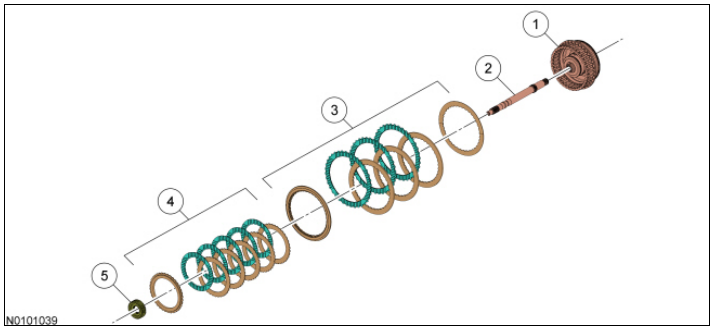
Input Shaft

The input shaft is part of the direct/ O/D clutch assembly and is splined to the torque converter turbine and the center planetary sun gear. The input shaft transfers power from the torque converter to the rear planetary gearset through the center planetary sun gear and the direct (3, 5, R) and O/D (4, 5, 6) clutches.

Input Shaft Cutaway View



Input Shaft Exploded View

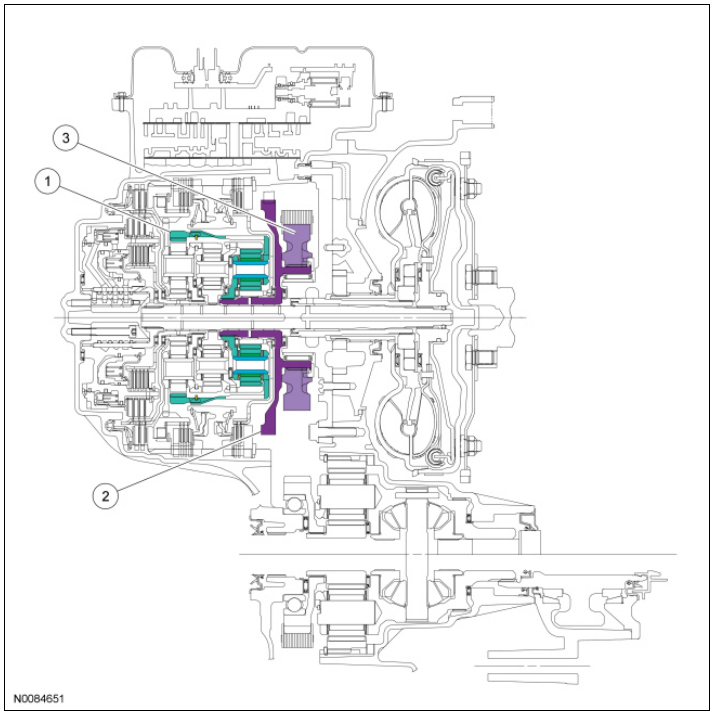


Item	Part Number	Description
1	7G384	Direct (3, 5, R)/ Overdrive (O/D) (4, 5, 6) clutch hub
2	7F213	Input shaft
3	7B164	Direct (3, 5, R) clutch
4	7B164	O/D (4, 5, 6) clutch
5	7D491	Center planetary sun gear

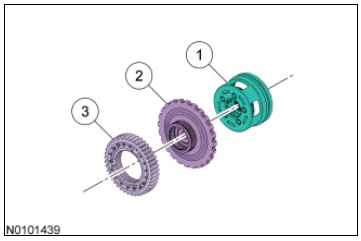
Front Planetary Carrier Hub (Output Hub)

The front planetary carrier hub/park gear is splined to the front planetary carrier and the drive chain drive sprocket. This allows torque to be transferred from the planetary gearset to the final drive gearset.

Front Planetary Carrier Hub Cutaway View



Front Planetary Carrier Hub Exploded View



Item	Part Number	Description
1	7D491	Front planetary carrier
2	7060	Front planetary carrier hub/park gear
3	7G132	Drive chain drive sprocket

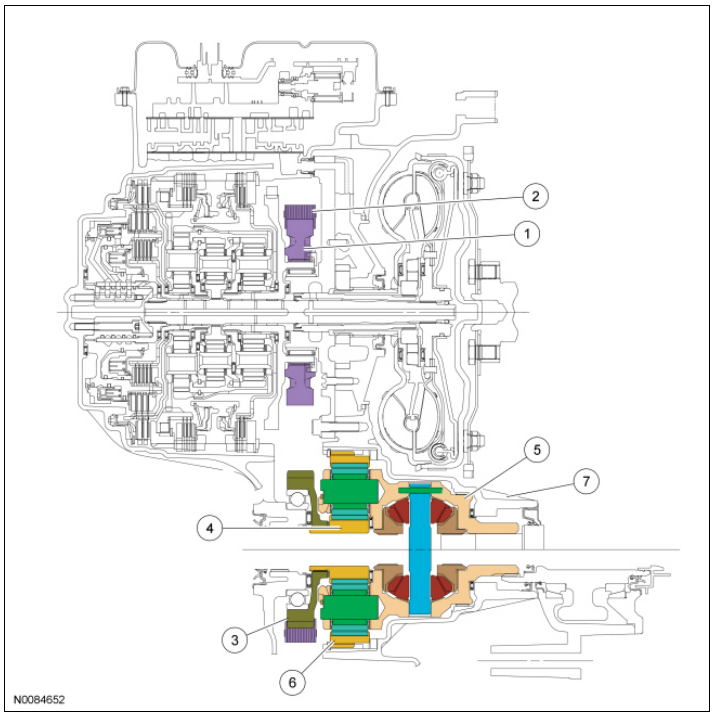
Final Drive Chain, Sprockets and Planetary Gearset

The final drive consists of a drive chain and sprockets and a planetary gearset and differential assembly. The drive chain and sprockets transfer torque from the front planetary carrier hub to the differential assembly that has a planetary gearset integrated into it for final drive torque multiplication.

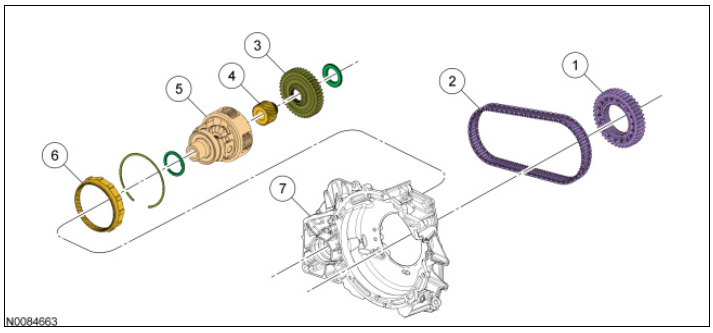
The final drive consists of the following components:

- Drive sprocket
- Drive chain
- Driven sprocket
- Final drive sun gear
- Final drive ring gear
- Final drive planetary carrier and differential assembly

Final Drive Component Cutaway View



Final Drive Component Exploded View



Item	Part Number	Description
1	7G132	Drive chain drive sprocket
2	7G249	Drive chain
3	7G132	Drive chain driven sprocket
4	7F342	Final drive planetary sun gear
5	7F465	Differential assembly
6	7F343	Final drive planetary ring gear
7	7975	Torque converter housing

Differential

The differential allows the halfshafts and wheels to rotate at different speeds during cornering and transfers power to the Power Transfer Unit (PTU) for All-Wheel Drive (AWD) vehicles.

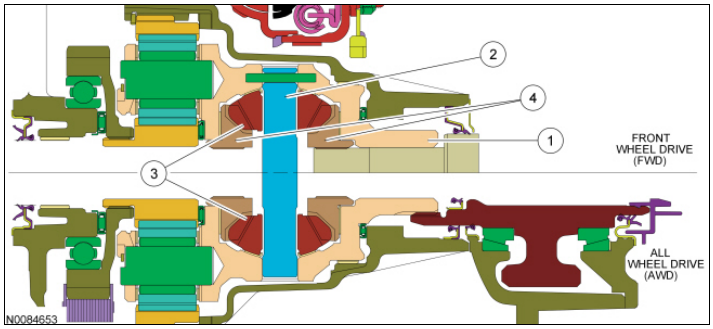
The differential assembly consists of the following components:

- Differential case (part of the final drive carrier)

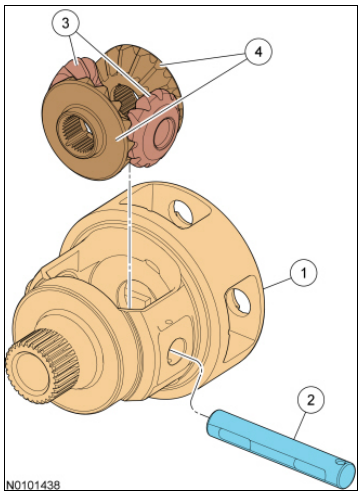
- Two pinion gears supported by a pinion shaft
- Two side gears supported by the differential case and halfshafts

When driving in a straight line, both front wheels rotate at relatively the same speed. This means both side gears are rotating at the same speed, as well, while both pinion gears revolve (but do not rotate) with the side gears. During cornering, the wheel on the outside of the turn is forced to rotate faster than the wheel on the inside of the turn. Since the side gears must now rotate at different speeds, the pinion gears rotate on the pinion shaft allowing the drive axles to rotate at different speeds while still transferring output torque.

Differential Cutaway View



Differential Exploded View



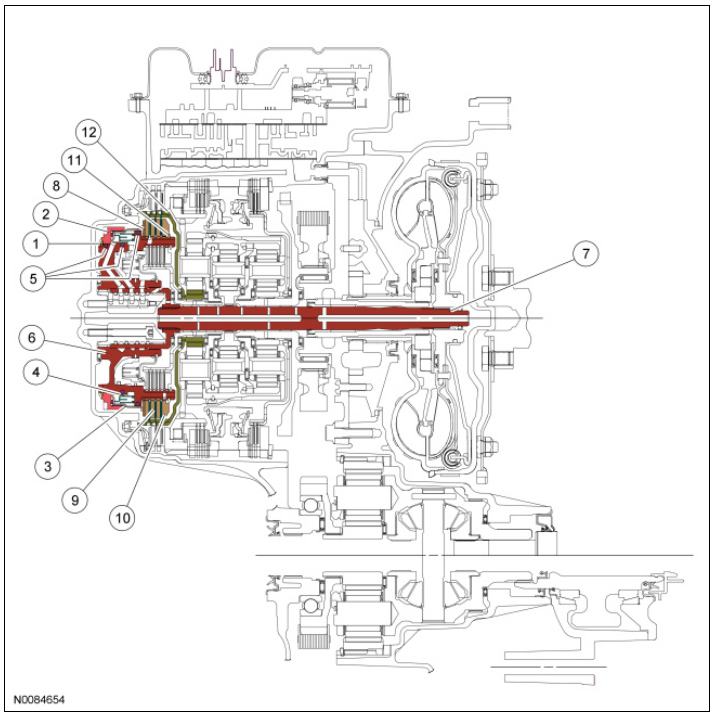
Item	Part Number	Description
1	7F465	Differential housing
2	-	Pinion shaft
3	-	Pinion gears
4	-	Side gears

Direct (3, 5, R) Clutch

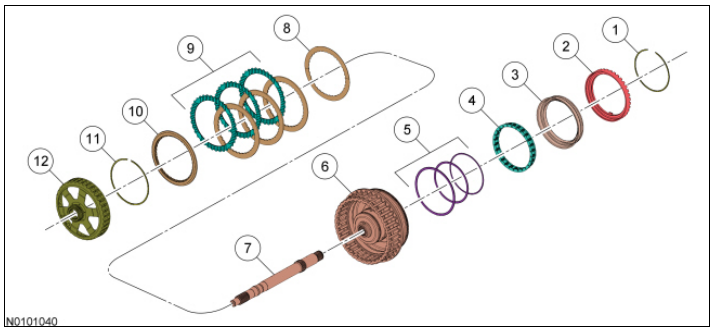
The direct clutch is a drive clutch that transfers power from the direct/ O/D clutch hub assembly to the rear planetary sun gear and shell assembly. The direct clutch is applied in 3rd and 5th gears and reverse.

Hydraulic pressure from the regulator valve in the valve body pushes the direct clutch piston against the direct clutch pack to apply the clutch. The input shaft and direct/ O/D clutch hub assembly transfers torque to the rear planetary sun gear and shell assembly as a result of the clutch being applied.

Direct (3, 5, R) Clutch Cutaway View



Direct (3, 5, R) Clutch Exploded View



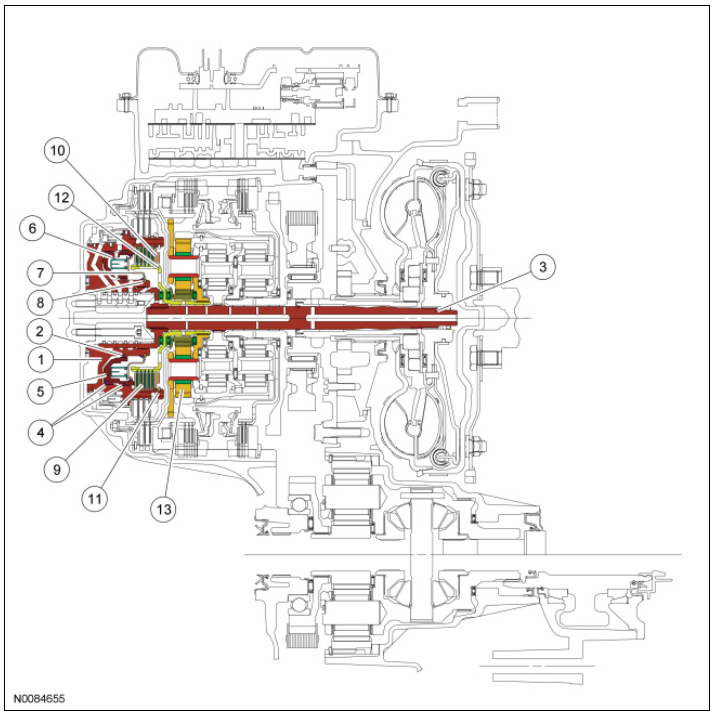
Item	Part Number	Description
1	7C122	Direct clutch cylinder snap ring
2	7F283	Direct clutch cylinder
3	7A262	Direct clutch piston
4	7F235	Direct clutch piston return spring
5	7C099	Direct clutch piston seals
6	7G384	Direct/Overdrive (O/D) clutch hub
7	7F213	Input shaft
8	7B070	Direct clutch wave spring
9	7B164	Direct (3, 5, R) clutch assembly
10	7B066	Direct clutch pressure plate
11	7D483	Direct clutch snap ring
12	7A019	Rear planetary sun gear and shell assembly

Overdrive (O/D) (4, 5, 6) Clutch

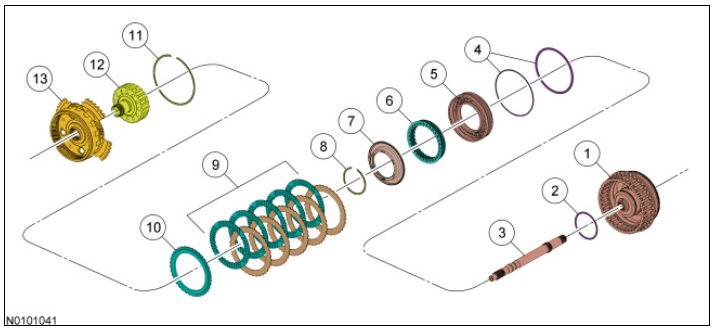
The O/D clutch is a drive clutch that transfers power from the direct/ O/D clutch hub assembly to the rear planetary carrier. The O/D clutch is applied in 4th, 5th and 6th gears.

Hydraulic pressure from the regulator valve in the valve body pushes the O/D clutch piston against the O/D clutch pack to apply the clutch. The input shaft and direct/ O/D clutch hub assembly transfers torque to the rear planetary carrier as a result of the clutch being applied.

Overdrive (O/D) (4, 5, 6) Clutch Cutaway View



Overdrive (O/D) (4, 5, 6) Clutch Exploded View



Item	Part Number	Description
1	7G384	Direct/Overdrive (O/D) clutch hub assembly
2	7A548	O/D clutch piston inner seal
3	7F213	Input shaft
4	7A548	O/D clutch piston outer seals
5	7A262	O/D clutch piston
6	7F222	O/D clutch piston return spring
7	7H360	O/D clutch balance piston
8	7C122	O/D clutch balance piston snap ring

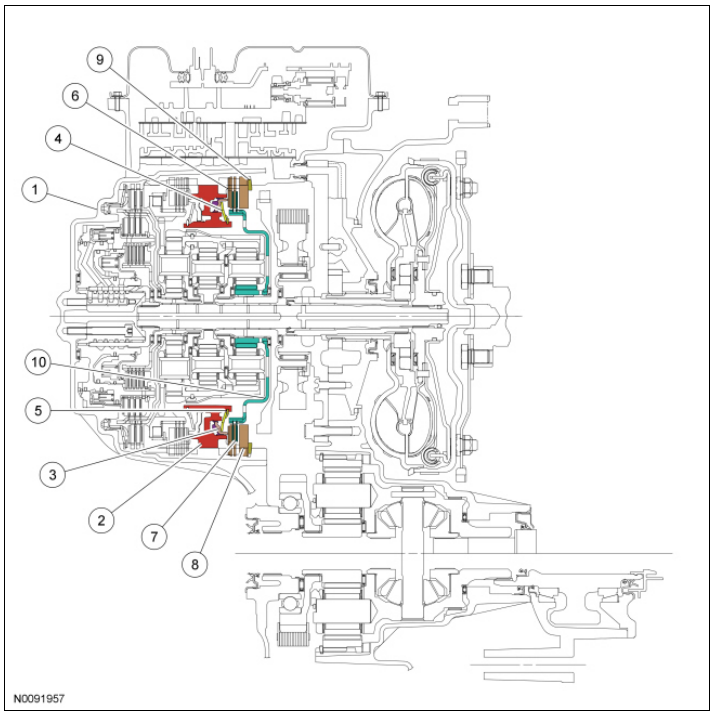
9	7B164	O/D (4, 5, 6) clutch assembly
10	7B066	O/D clutch pressure plate
11	7D483	O/D clutch snap ring
12	7H351	O/D clutch hub
13	7D491	Rear planetary carrier

Forward (1, 2, 3, 4) Clutch

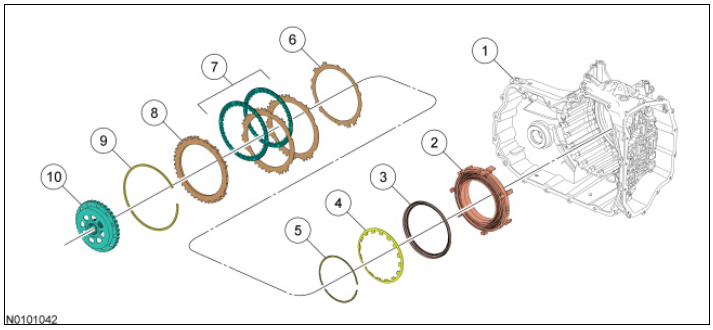
The forward clutch is a brake clutch that holds the front sun gear and shell assembly. The forward clutch is applied in 1st, 2nd, 3rd and 4th gears.

Hydraulic pressure from the regulator valve in the valve body pushes the forward clutch piston against the forward clutch pack to apply the clutch. The front sun gear and shell assembly is held stationary to the transaxle case as a result of the clutch being applied.

Forward (1, 2, 3, 4) Clutch Cutaway View



Forward (1, 2, 3, 4) Clutch Exploded View



Item	Part Number	Description
1	7005	Transaxle case

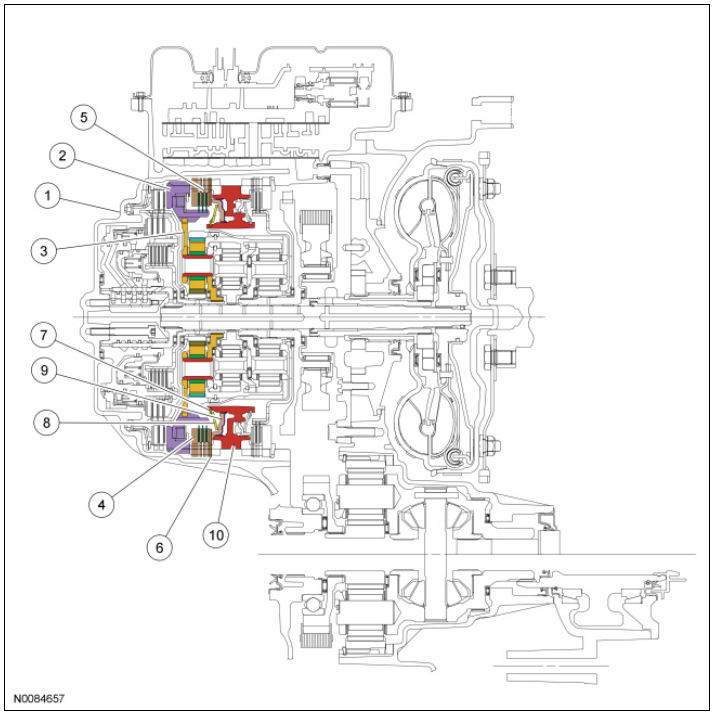
2	7L328	Center support
3	7A262	Forward clutch piston
4	7B070	Forward clutch piston return spring
5	7H365	Forward clutch piston return spring snap ring
6	7B070	Forward clutch wave spring
7	7B164	Forward (1, 2, 3, 4) clutch
8	7B066	Forward clutch pressure plate
9	7D483	Forward clutch snap ring
10	7A019	Front sun gear and shell assembly

Low/Reverse Clutch

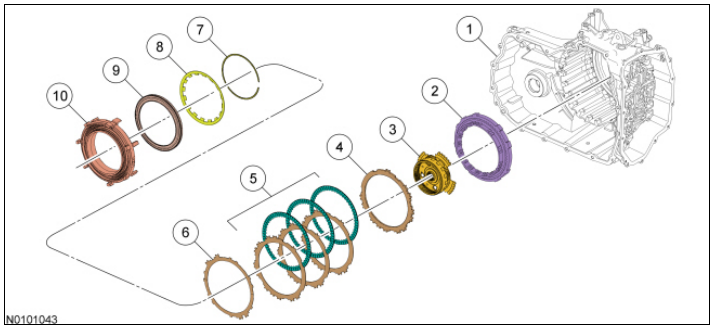
The low/reverse clutch is a brake clutch that holds the low OWC which is splined to the rear planetary carrier. The low/reverse clutch is applied in manual LOW, REVERSE and 1st gear up to 8 km/h (5 mph).

Hydraulic pressure from the regulator valve in the valve body pushes the low/reverse clutch piston against the low/reverse clutch pack to apply the clutch. The rear planetary carrier is held stationary to the transaxle case as a result of the clutch being applied.

Low/Reverse Clutch Cutaway View



Low/Reverse Clutch Exploded View



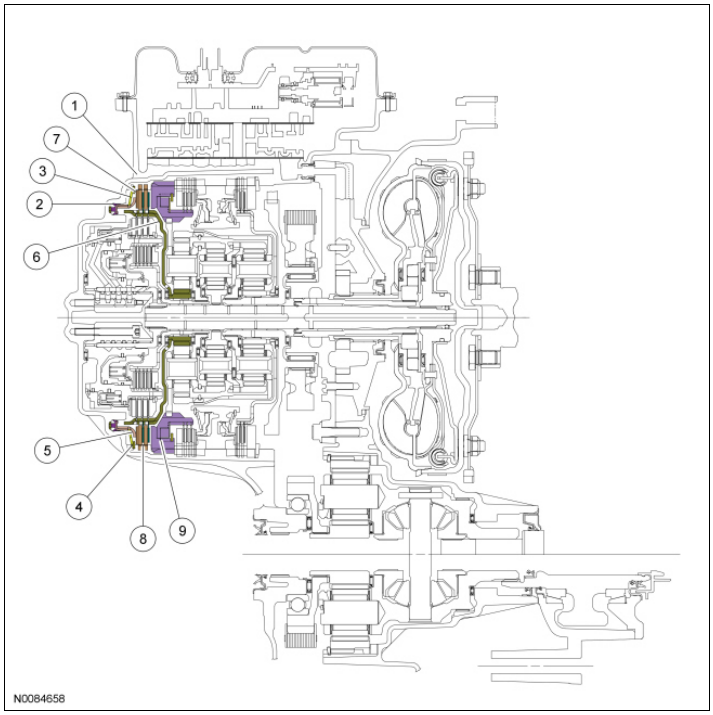
Item	Part Number	Description
1	7005	Transaxle case
2	7A089	Low One-Way Clutch (OWC)
3	7D491	Rear planetary carrier
4	7B066	Low/reverse clutch pressure plate
5	7B164	Low/reverse clutch
6	7E085	Low/reverse clutch wave spring
7	7C122	Low/reverse clutch piston return spring snap ring
8	7B070	Low/reverse clutch piston return spring
9	7D402	Low/reverse clutch piston
10	7L328	Center support

Intermediate (2, 6) Clutch

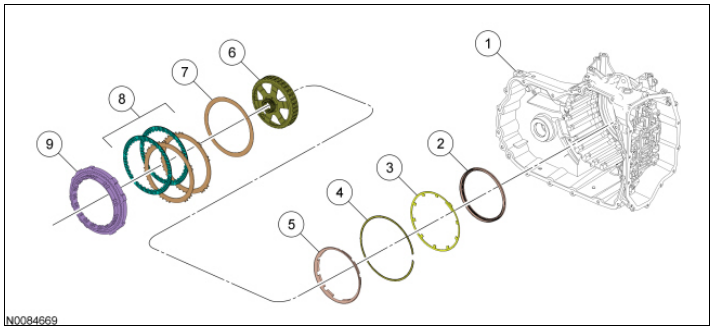
The intermediate clutch is a brake clutch that holds the rear planetary sun gear and shell assembly. The intermediate clutch is applied in 2nd and 6th gears.

Hydraulic pressure from the regulator valve in the valve body pushes the intermediate clutch piston against the intermediate clutch pack to apply the clutch. The low OWC works as a pressure plate for the intermediate (2, 6) clutch. The rear planetary sun gear and shell assembly is held stationary to the transaxle case as a result of the clutch being applied.

Intermediate (2, 6) Clutch Cutaway View



Intermediate (2, 6) Clutch Exploded View

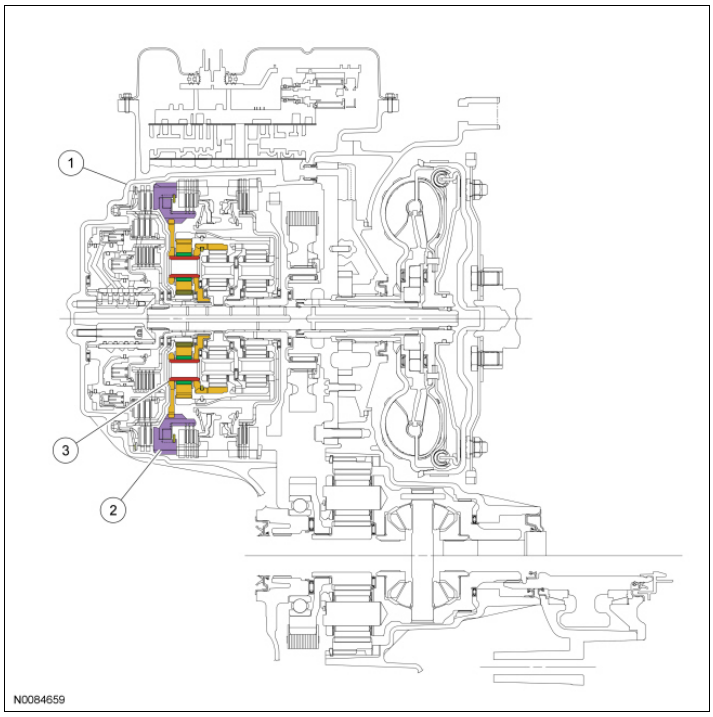


Item	Part Number	Description
1	7005	Transaxle case
2	7E005	Intermediate clutch piston
3	7B070	Intermediate clutch piston return spring
4	7D483	Intermediate clutch piston return spring snap ring
5	7E005	Intermediate clutch apply ring
6	7A019	Rear planetary sun gear and shell assembly
7	7E085	Intermediate clutch wave spring
8	7B164	Intermediate clutch assembly
9	7A089	Low/One-Way Clutch (OWC)

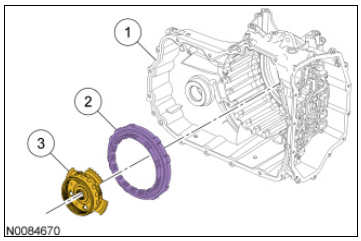
Low One-Way Clutch (OWC)

The low OWC is a brake clutch that holds the rear planetary carrier in one direction and allows it to freewheel in the opposite direction which eliminates engine braking in 1st gear when the transaxle is in DRIVE. The low OWC is also the pressure plate for the intermediate (2, 6) clutch.

Low One-Way Clutch (OWC) Cutaway View



Low One-Way Clutch (OWC) Exploded View



Item	Part Number	Description
1	7005	Transaxle case
2	7A089	Low One-Way Clutch (OWC)
3	7D491	Rear planetary carrier

External Sealing

The torque converter housing has a lip-type seal that seals the torque converter hub. The pump assembly seals to the torque converter housing with a rubber seal. The manual shaft and halfshafts also use lip-type seals. All-Wheel Drive (AWD) vehicles do not use a RH halfshaft seal, the transaxle is sealed by the Power Transfer Unit (PTU) on the RH side.

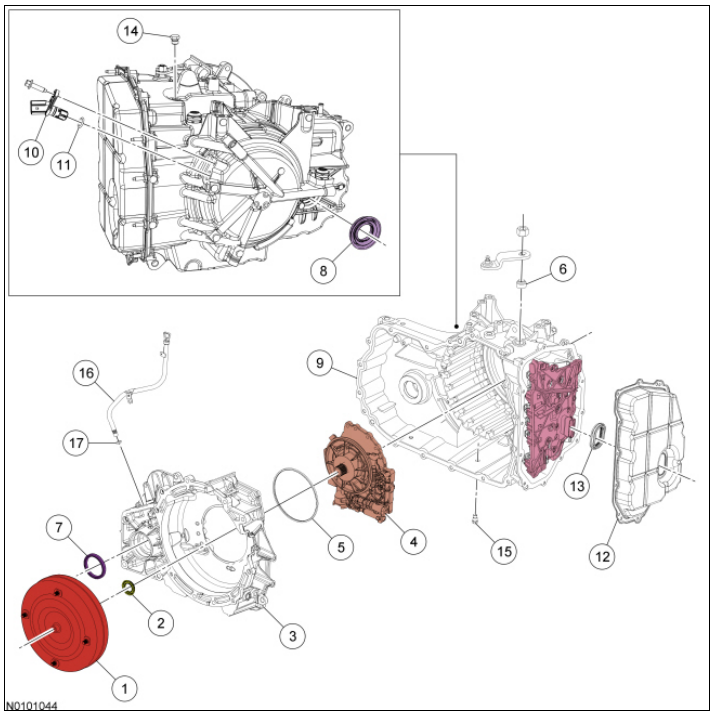
The torque converter housing is sealed to the transaxle case with silicone sealant.

The main control cover is sealed to the transaxle case with silicone sealant and seals to the solenoid body with a reusable rubber gasket. The Turbine Shaft Speed (TSS) sensor is sealed to the transaxle case with an O-ring seal.

The line pressure tap plug and transmission fluid drain plug have pipe threads and seal when tightened to specification.

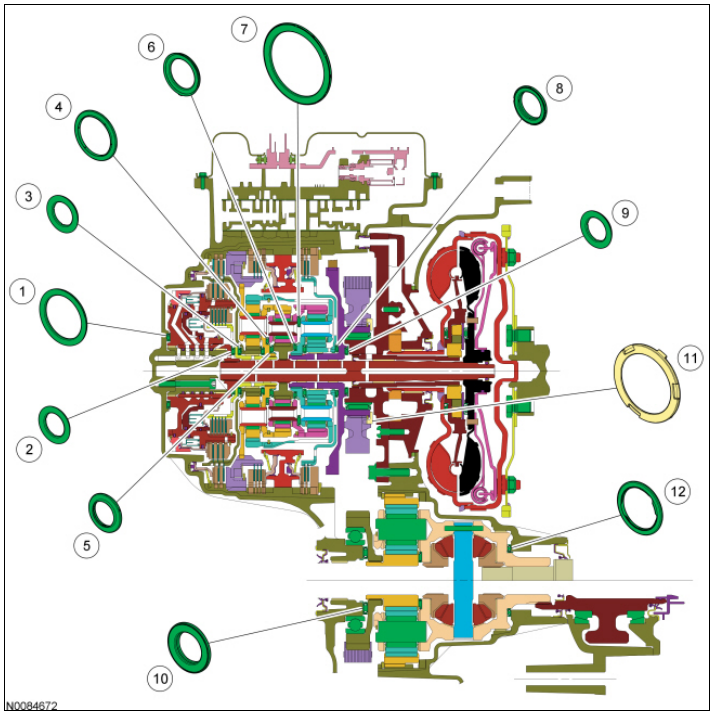
The transmission fluid filler tube is sealed to the torque converter housing with an O-ring seal.

External Sealing Exploded View



Item	Part Number	Description
1	7902	Torque converter
2	7A248	Torque converter hub seal
3	7975	Torque converter housing
4	7A103	Pump assembly
5	7A248	Pump assembly-to-torque converter housing O-ring seal
6	7F337	Manual control shaft seal
7	1177	RH halfshaft seal
8	1177	LH halfshaft seal
9	7005	Transaxle case
10	7M101	Turbine Shaft Speed (TSS) sensor
11	-	TSS sensor O-ring seal
12	7G004	Main control cover
13	7B329	Main control-to-cover seal
14	7H398	Line pressure tap plug
15	7010	Drain plug
16	7A228	Transmission fluid filler tube
17	391308	Transmission fluid filler tube O-ring seal

Bearing and Thrust Washer Locations



Item	Part Number	Description
1	7F242	No. 1 thrust bearing
2	7D234	No. 2 thrust bearing
3	7D234	No. 3 thrust bearing
4	7G177	No. 5 thrust bearing
5	7C096	No. 6 thrust bearing
6	7C096	No. 7 thrust bearing
7	7C096	. 8 thrust bearing
8	7D234	No. 10 thrust bearing
9	7D234	No. 11 thrust bearing
10	7G355	No. 12 thrust bearing
11	7G099	No. 13 thrust washer
12	7G112	No. 15 thrust bearing

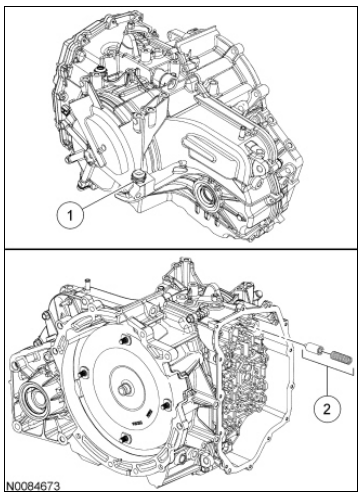
The No. 4 thrust bearing is part of the rear planetary carrier assembly. The No. 9 thrust bearing is part of the front planetary carrier assembly. The No. 14 thrust bearing is part of the differential assembly.

Lubrication

Transmission fluid enters the lubrication circuits after flowing through the transmission fluid cooler. The transmission fluid cooler is mounted at the front of the vehicle. When the transmission fluid is not up to operating temperature, an internal thermal bypass valve allows the transmission fluid to bypass the transmission fluid cooler. When the transmission fluid circulates through the transmission fluid cooler, the transmission fluid returns to the transaxle from the transmission fluid cooler tubes through the back transmission fluid cooler tube.

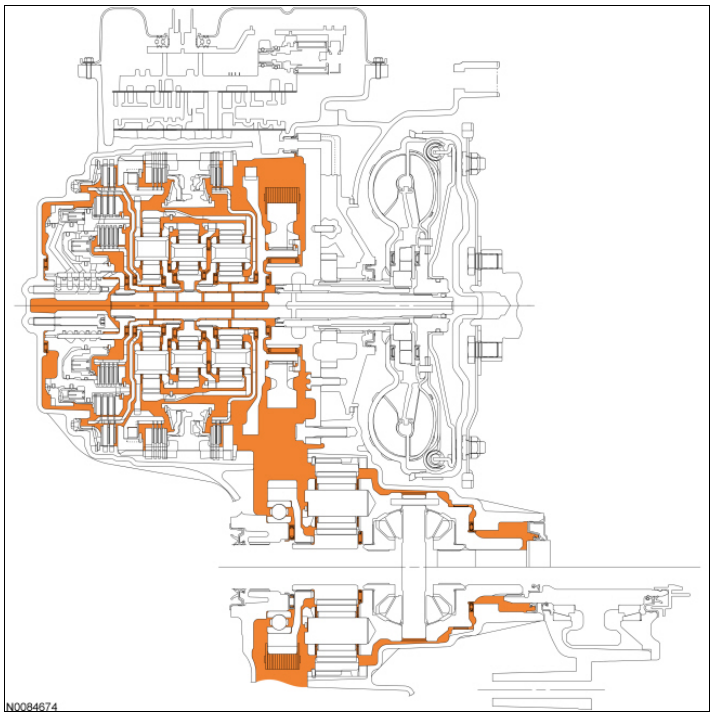
The transmission fluid enters main lubrication circuit through the transaxle case and flows through passages in the input shaft to lubricate the transaxle.

The transmission fluid in the input shaft circuit flows from the back of the input shaft toward the front of the input shaft and passes through ports in the input shaft to lubricate the planetary gearset, clutches, final drive assembly and other components of the transaxle.



Item	Part Number	Description
1	7D273	Transmission fluid cooler return tube fitting
2	7H322	Thermal bypass valve assembly

Lubrication Passages



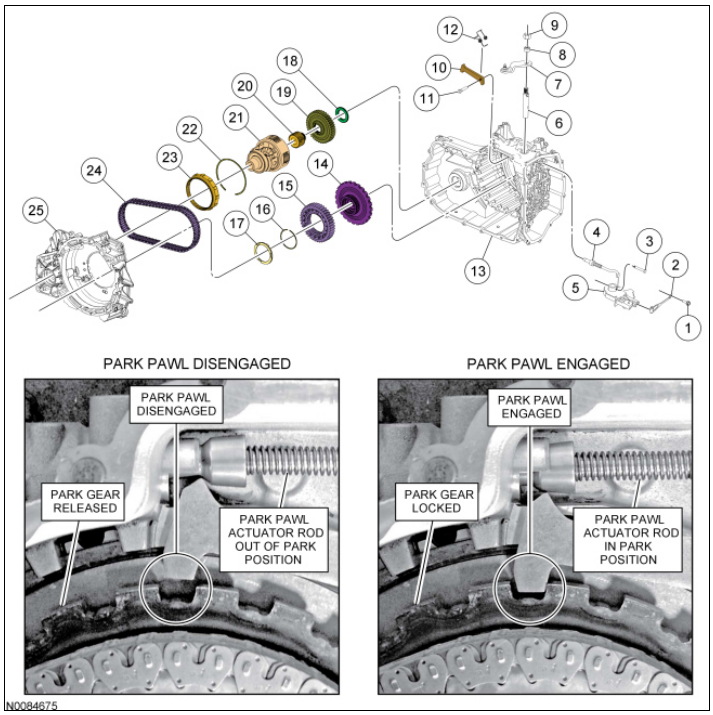
Park

The park gear is splined to the front planetary carrier and the drive chain drive sprocket. There are lugs around the outer diameter of the park gear to allow the park pawl to hold the park gear stationary to the transaxle case which holds the final drive assembly in place and keeps the vehicle from moving.

When the manual control lever is rotated to the PARK position, the park lock works as follows:

- The Transmission Range (TR) sensor rotates the range detent plate which pushes the park pawl actuator rod towards the park pawl.
- The actuator rod pivots the park pawl into the lugs on the park gear, locking the gear stationary to the transaxle case.

Park Component Exploded View



Item	Part Number	Description
1	W714437	Transmission Range (TR) sensor detent spring bolt
2	7E332	TR sensor detent spring
3	7G100	Manual shaft-to- TR sensor pin
4	7A232	Park pawl actuator rod
5	7H557	TR sensor
6	7C493	Manual shaft
7	7A256	Manual lever
8	7F337	Manual shaft seal
9	W302864	Manual lever nut
10	7A441	Park pawl
11	7D071	Park pawl pin
12	7D070	Park pawl spring
13	7005	Transaxle case
14	7090	Park gear
15	7G132	Drive chain drive sprocket
16	7C122	Drive sprocket snap ring
17	7G099	No. 13 thrust washer
18	7G355	No. 12 thrust bearing
19	7G132	Drive chain driven sprocket

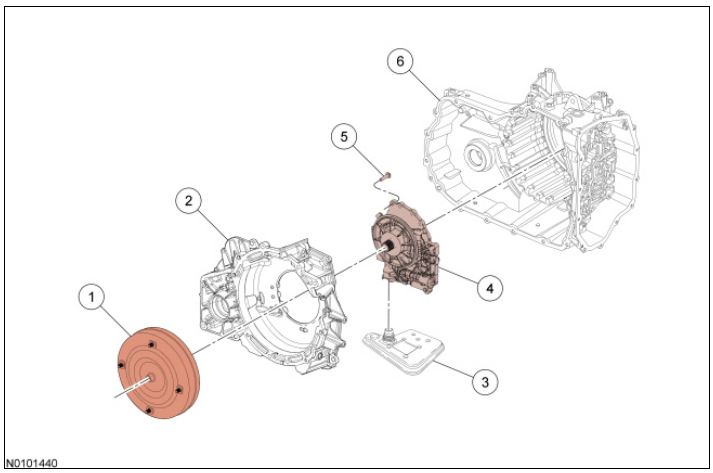
20	7F342	Final drive planetary gearset sun gear
21	7F465	Final drive planetary carrier/differential assembly
22	7C122	Final drive planetary ring gear snap ring
23	7F343	Final drive planetary ring gear
24	7G249	Drive chain
25	7975	Torque converter housing

Hydraulic System

Transmission Fluid Filter

The transmission fluid in the sump area at the bottom of the transaxle case flows through a transmission fluid filter to the pump assembly. The pump is bolted to the torque converter housing and is driven by the torque converter hub.

Fluid Pump and Transmission Fluid Filter Components



Item	Part Number	Description
1	7902	Torque converter
2	7975	Torque converter housing
3	7A098	Transmission fluid filter
4		
5	W302860	Pump-to-torque converter housing bolt
6	7005	Transaxle case

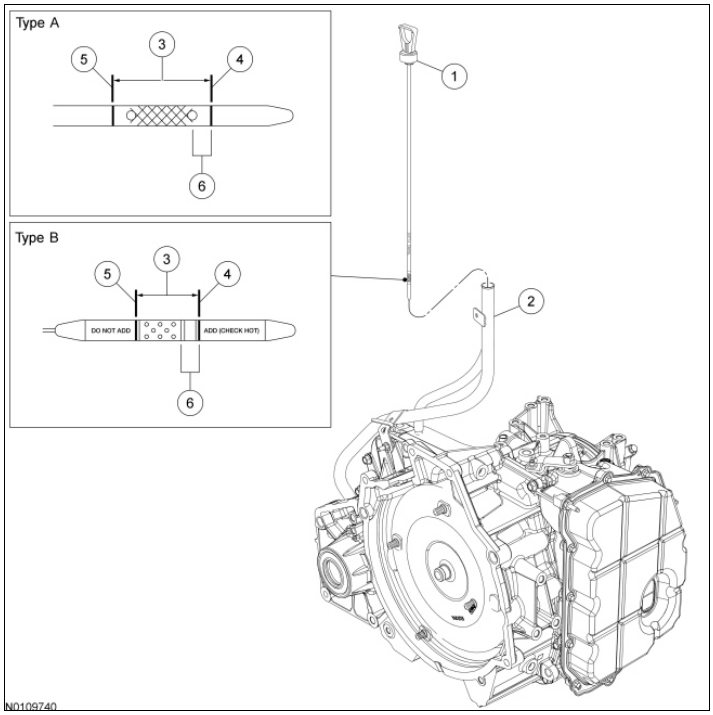
Transmission Fluid Level

The transmission fluid level is checked with the transaxle at normal operating temperature between 85°C and 93°C (185°F and 200°F).

The transmission fluid level indicator is part of the transmission fluid filler tube located at the back of the torque converter housing.

The correct transmission fluid level is between the minimum and maximum marks on the transmission fluid level indicator.

Transmission Fluid Level Indicator



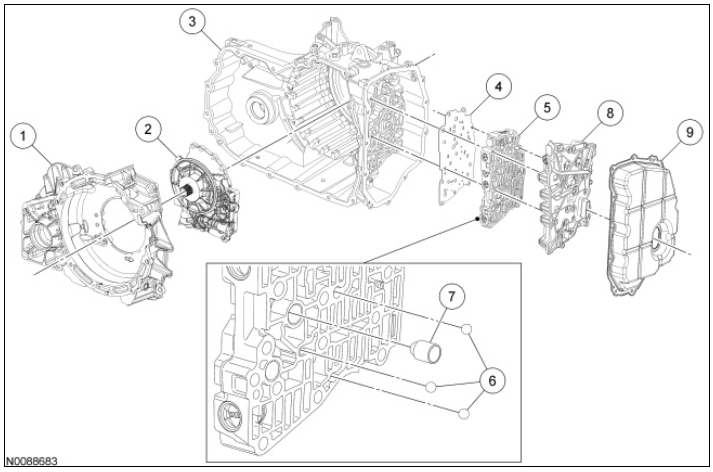
Item	Part Number	Description
1	7A020	Transmission fluid level indicator
2	7A228	Transaxle filler tube
3	-	Correct transmission fluid level at normal operating temperature 85°C-93°C (185°F-200°F)
4	-	Minimum transmission fluid level mark
5	-	Maximum transmission fluid level mark
6	-	Flat tow transmission fluid level

Main Control

The hydraulic system has a main contromain control assembly consists of a valve body and a solenoid body. Both the valve body and the solenoid body contain hydraulic shift valves. The solenoid body contains the shift solenoids that control the hydraulic valves. The solenoid body can be serviced as an assembly with the solenoids or the solenoids can be serviced individually. The solenoid body is controlled by the PCM. The PCM has software stored in it specific to the solenoid body currently in the transaxle, called the solenoid body strategy. A new solenoid body strategy must be downloaded into the PCM anytime a new solenoid body is installed.

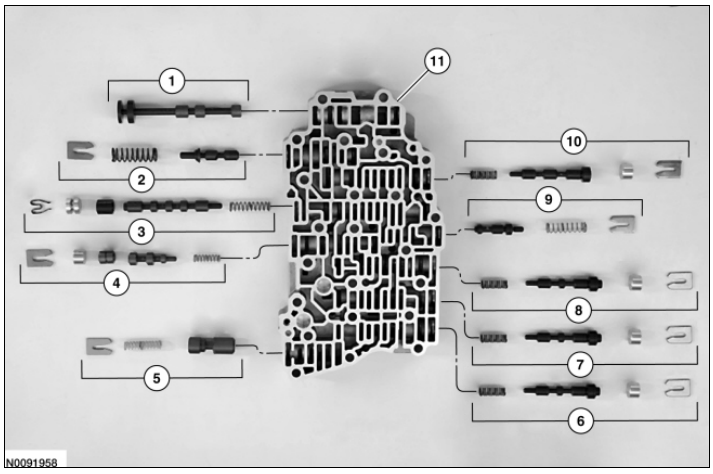
The pump assembly contains the main pressure regulator valve assembly and the Torque Converter Clutch (TCC) control valve assembly.

Main Control Components



Item	Part Number	Description
1	7975	Torque converter housing
2	7A103	Pump assembly
3	7005	Transaxle case
4	7Z490	Main control-to-transaxle case separator plate
5	7A100	Valve body
6	7E195	Check balls
7	7J191	Solenoid damper (Shift Solenoid A (SSA))
8	7G391	Solenoid body assembly
9	7G004	Main control cover

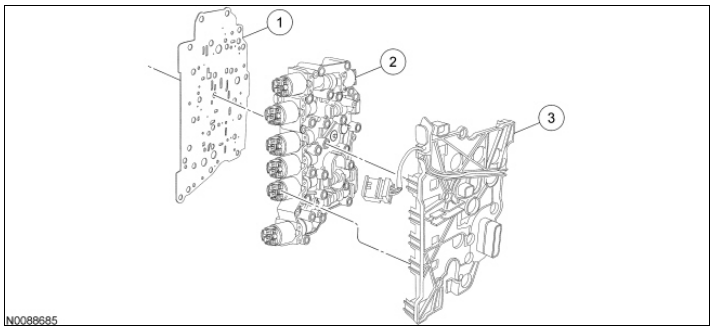
Main Control Valve Body

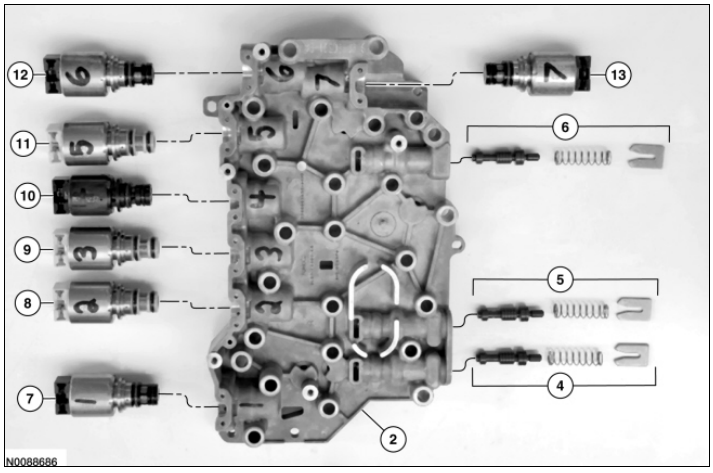


Item	Part Number	Description
1	7C389	Manual valve
2	7G473	Solenoid pressure regulator valve assembly
3	7G179	Clutch bypass valve
4	7G307	Torque Converter Clutch (TCC) regulator valve
5	7B200	Control pressure regulator
6	7D102	Direct (3, 5, R) clutch regulator valve

7	7D102	Intermediate (2, 6) clutch regulator valve
8	7D102	Forward (1, 2, 3, 4) clutch regulator valve
9	7J187	Forward (1, 2, 3, 4) clutch latch valve
10	7D102	Low reverse/overdrive (4, 5, 6) clutch regulator valve
11	7A100	Valve body

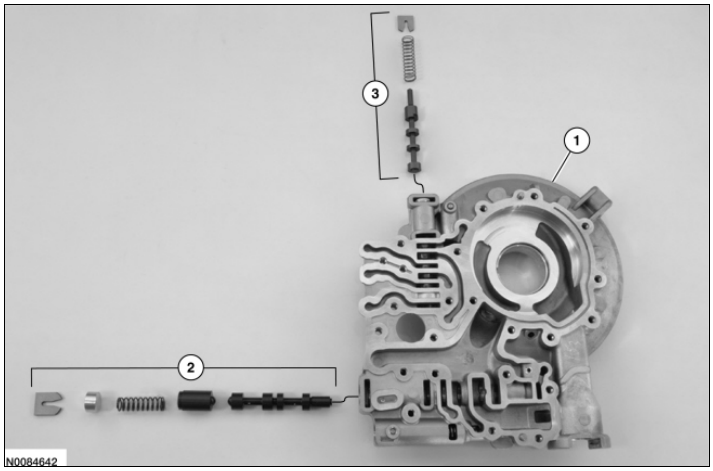
Solenoid Body





Item	Part Number	Description
1	7Z490	Main control valve body-to-solenoid body separator plate
2	7G391	Solenoid body
3	7G276	Solenoid body leadframe
4	7J187	Direct (3, 5, R) clutch latch valve
5	7J187	Intermediate (2, 6) clutch latch valve
6	7J187	Low reverse/overdrive (4, 5, 6) clutch latch valve
7	7G383	Line Pressure Control (LPC) solenoid
8	7G136	Shift Solenoid C (SSC)
9	7G136	Torque Converter Clutch (TCC)
10	7G484	ON/OFF solenoid
11	7G136	Shift Solenoid A (SSA)
12	7G383	Shift Solenoid B (SSB)
13	7G383	Shift Solenoid D (SSD)

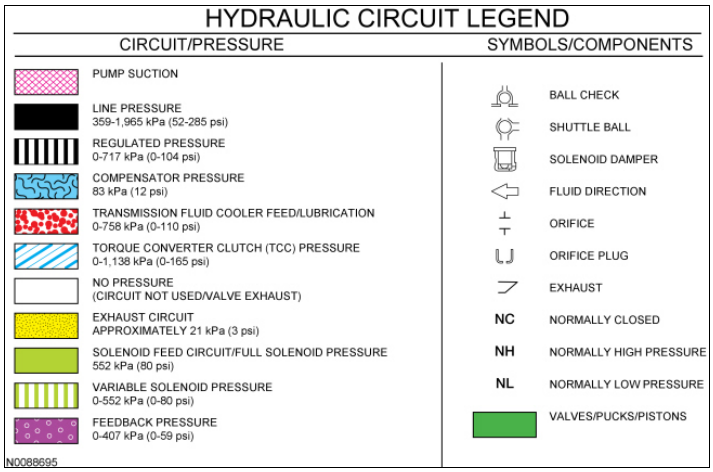
Pump Assembly



Item	Part Number	Description
1	7A103	Pump assembly
2	-	Main pressure regulator valve assembly
3	-	Torque Converter Clutch (TCC) control valve assembly

Hydraulic Circuits

Hydraulic Circuit Identification and Function

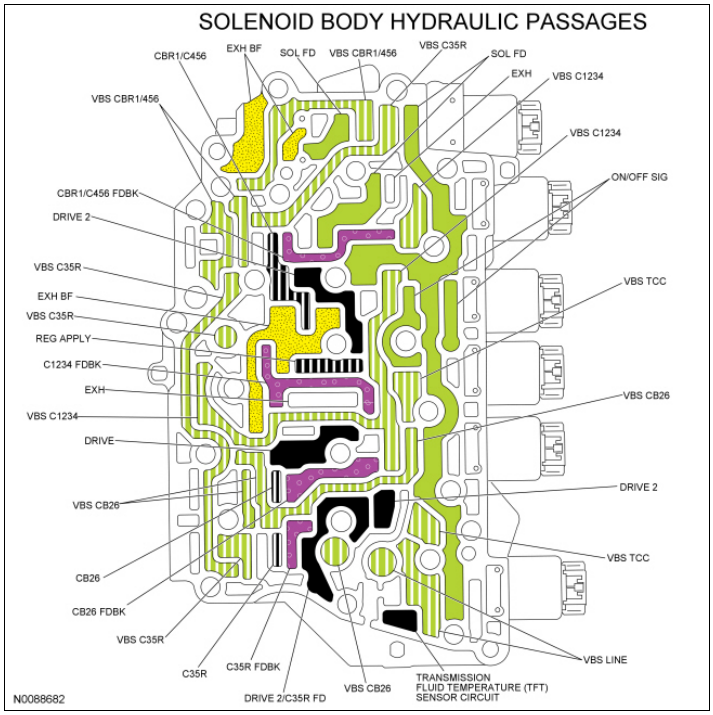


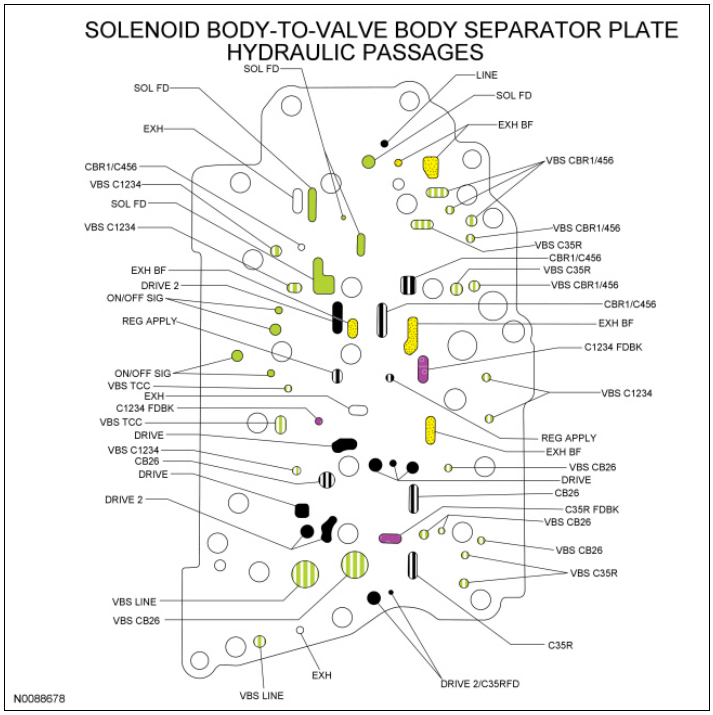
Hydraulic Circuit Identification Chart

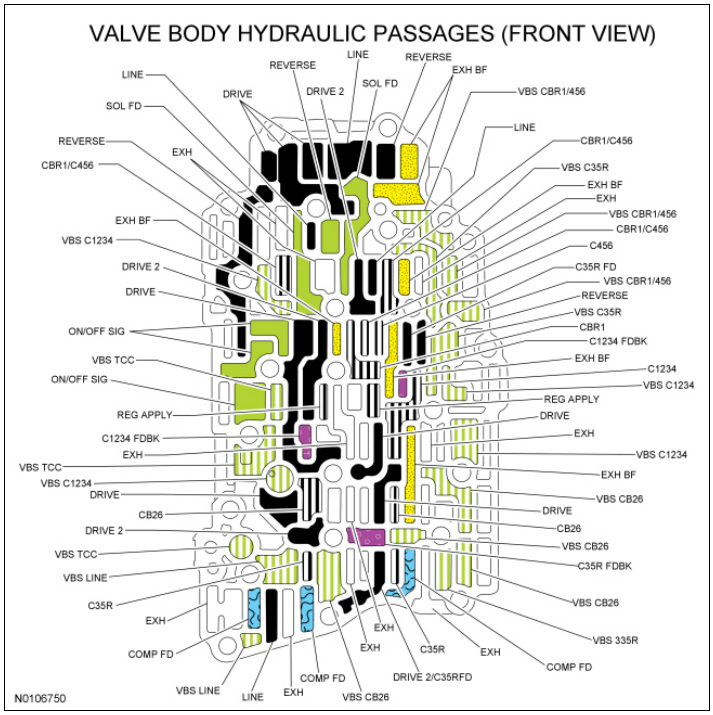
Circuit Name	Description
BYPASS	Pressure from the main pressure regulator valve to the pump assembly suction circuit for line pressure control.
C1234	Regulated line pressure from the 1234 regulator valve supplied to the forward (1, 2, 3, 4) clutch to apply the clutch.
C1234 FDBK	C1234 pressure from the 1234 latch valve supplied to the 1234 regulator valve to oppose movement of the valve from VBS C1234 pressure during forward (1, 2, 3, 4) clutch application.
C35R	Regulated line pressure from the 35R regulator valve supplied to the direct (3, 5, R) clutch to apply the clutch.
C35R FD	Line pressure from the REVERSE circuit supplied to the DRIVE 2/C35R FD shuttle valve by the clutch control bypass valve to supply the 35R regulator valve with line pressure in reverse.
C35R FDBK	C35R pressure from the 35R latch valve supplied to the 35R regulator valve to oppose movement of the valve from VBS C35R pressure during direct (3, 5, R) clutch application.
C456	Regulated line pressure from the low reverse/456 regulator valve directed to the Overdrive (O/D) (4, 5, 6) clutch by the clutch control bypass valve. C456 also provides latch pressure for the clutch control bypass valve.
CB26	Regulated line pressure from the 26 regulator valve to the intermediate (2, 6) clutch to apply the clutch in 2nd and 6th gears.
CB26 FDBK	CB26 pressure from the 26 latch valve supplied to the 26 regulator valve to oppose movement of the valve from VBS C26 pressure during intermediate (2, 6) clutch application.
CBR1	Regulated line pressure from the low reverse/456 regulator valve directed to the low/reverse clutch by the clutch control bypass valve.
CBR1/C456	

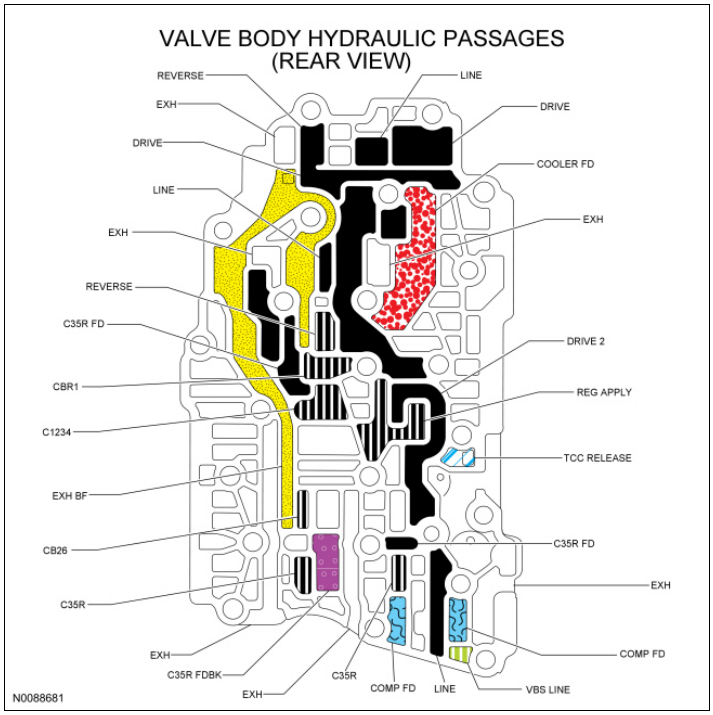
	Regulated line pressure from the low reverse/456 regulator valve to the clutch control bypass valve.
CBR1/C456 FDBK	CBR1/C456 pressure from the low reverse/456 latch valve supplied to the low reverse/456 regulator valve to oppose movement of the valve from VBS CBR1/456 pressure during low/reverse or O/D (4, 5, 6) clutch application.
COMP FD	Pressure supplied to the opposite side of the O/D (4, 5, 6) and direct (3, 5, R) clutch apply pistons to oppose centrifugal application of the clutches.
CONV FD	Line pressure from the main pressure regulator valve supplied to the Torque Converter Clutch (TCC) control valve for TCC release.
COOLER FD	Return pressure from the torque converter during TCC release that is directed to the transmission fluid cooler by the TCC control valve.
DRIVE	Line pressure directed to the clutch control bypass valve, 1234 regulator valve and the 26 regulator valve by the manual valve in the DRIVE position.
DRIVE 2	DRIVE pressure directed to the TCC regulator valve and the DRIVE 2/C35R FD shuttle valve by the clutch control bypass valve to supply the 35R regulator valve with line pressure in 3rd and 5th gears.
DRIVE 2/C35R FD	DRIVE 2 or C35R FD pressure supplied to the 35R regulator valve from the DRIVE 2/C35R FD shuttle valve during direct (3, 5, R) clutch application.
EXH	Fluid exhausted from the valves that drains to the sump area.
EXH BF	Unpressurized fluid from the manual valve that fills the unused hydraulic circuits.
LINE	Pressure from the pump to the control pressure regulator, solenoid regulator valve, manual valve and low reverse/456 regulator valve. Line pressure is regulated by the main pressure regulator valve.
LUBE	Transaxle lubrication circuit (through the input shaft)
ON/OFF SIG	Full solenoid output pressure from Shift Solenoid E (SSE) to the clutch control bypass valve and the TCC regulator valve. ON/OFF SIG pressure positions the clutch control bypass valve to apply either the low/reverse clutch or the O/D (4, 5, 6) clutch.
REG APPLY	Regulated DRIVE 2 pressure supplied to the TCC control valve by the control pressure regulator for TCC application.
REVERSE	Line pressure directed to the clutch control bypass valve by the manual valve in the REVERSE position.
SOL FD	Regulated line pressure supplied to the shift, TCC and Line Pressure Control (LPC) solenoids.
TCC APPLY	Pressure supplied to the torque converter by the TCC control valve to apply the clutch. TCC APPLY is also the return circuit for the TCC RELEASE circuit.
TCC RELEASE	Pressure supplied to the torque converter by the TCC control valve to release the clutch. TCC RELEASE is also the return circuit for the TCC APPLY circuit.
VBS C1234	Variable SOL FD pressure supplied to the 1234 regulator valve and 1234 latch valve by Shift Solenoid A (SSA) to position the valves to apply the forward (1, 2, 3, 4) clutch.
VBS C35R	Variable SOL FD pressure supplied to the 35R regulator valve and 35R latch valve by Shift Solenoid B (SSB) to position the valves to apply the direct (3, 5, R) clutch.
VBS CB26	Variable SOL FD pressure supplied to the 26 regulator valve and 26 latch valve by Shift Solenoid C (SSC) to position the valves to apply the intermediate (2, 6) clutch.
VBS CBR1/456	Variable SOL FD pressure supplied to the low reverse/456 regulator valve and low reverse/456 latch valve by Shift Solenoid D (SSD) to position the valves to apply the low/reverse clutch or O/D (4, 5, 6) clutch.
VBS LINE	Variable SOL FD pressure supplied to the main pressure regulator valve by the LPC solenoid to control line pressure.
VBS TCC	

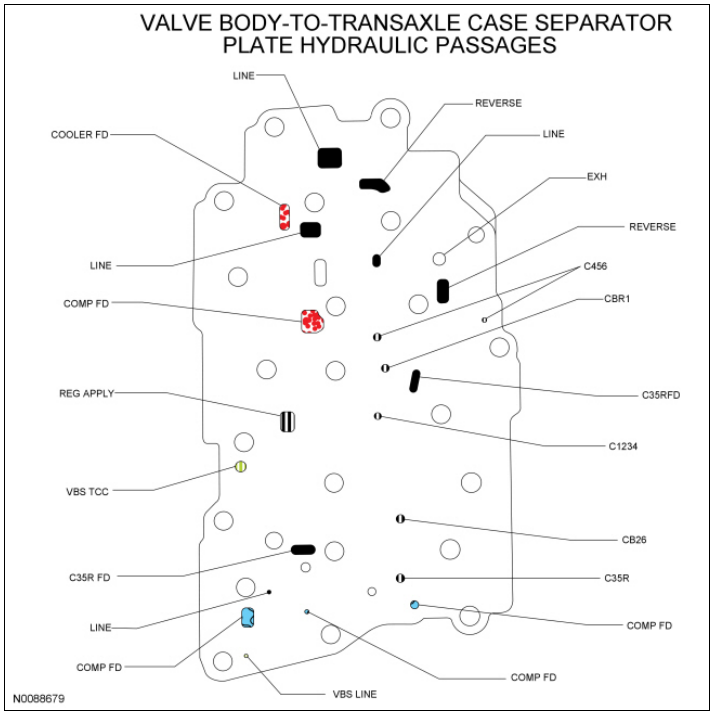
	Variable SOL FD pressure supplied to the TCC regulator valve and TCC control valve to position the valves by the TCC solenoid to apply the TCC .

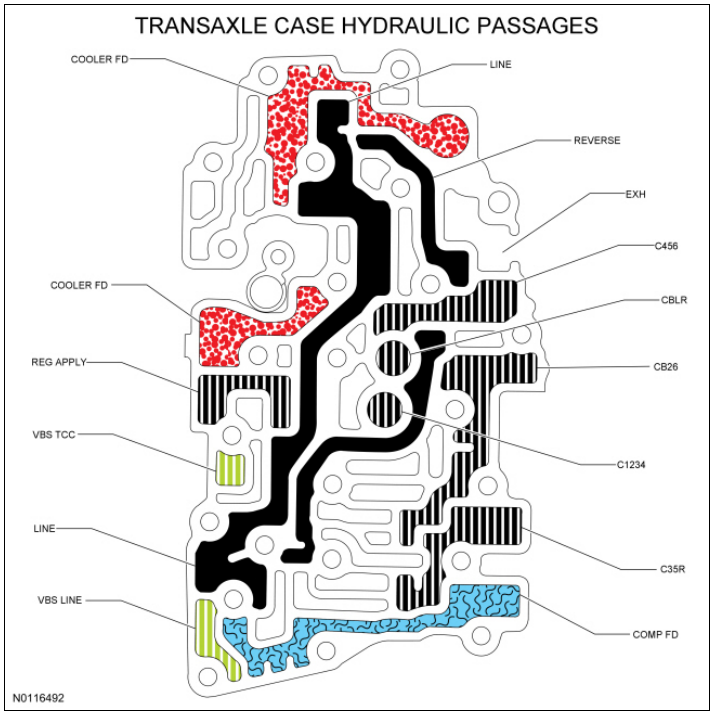





VALVE BODY HYDRAULIC PASSAGES (FRONT VIEW)
LINE
REVERSE
LINE
REVERSE
EXH BF
DRIVE
DRIVE 2
SOL FD
SOL FD
VBS CBR1/456
REVERSE
EXH
CBR1/C456
LINE
CBR1/C456
VBS C35R
EXH BF
EXH
VBS CBR1/456
CBR1/C456
C456
C35R FD
VBS CBR1/456
REVERSE
VBS C35R
CBR1
C1234 FDBK
EXH BF
C1234
VBS C1234
REG APPLY
DRIVE
EXH
VBS C1234
EXH BF
VBS CB26
DRIVE
CB26
VBS CB26
C35R FDBK
VBS CB26
VBS 335R
COMP FD
DRIVE 2/C35RFD
VBS CB26
LINE
EXH
COMP FD
VBS LINE
EXH
C35R
EXH
COMP FD
VBS LINE
VBS TCC
ON/OFF SIG
VBS TCC
ON/OFF SIG
REG APPLY
C1234 FDBK
EXH
VBS TCC
VBS C1234
DRIVE
CB26
DRIVE 2
VBS TCC
VBS LINE
C35R
EXH
COMP FD
EXH
EXH
C35R
EXH
N0106750


VALVE BODY HYDRAULIC PASSAGES
(REAR VIEW)
REVERSE
LINE
EXH
DRIVE
DRIVE
COOLER FD
LINE
EXH
EXH
REVERSE
C35R FD
DRIVE 2
CBR1
REG APPLY
C1234
TCC RELEASE
EXH BF
CB26
C35R FD
EXH
C35R
EXH
COMP FD
C35R FDBK
C35R
EXH
COMP FD
LINE
VBS LINE
N0088681





Line Pressure Hydraulic Circuits

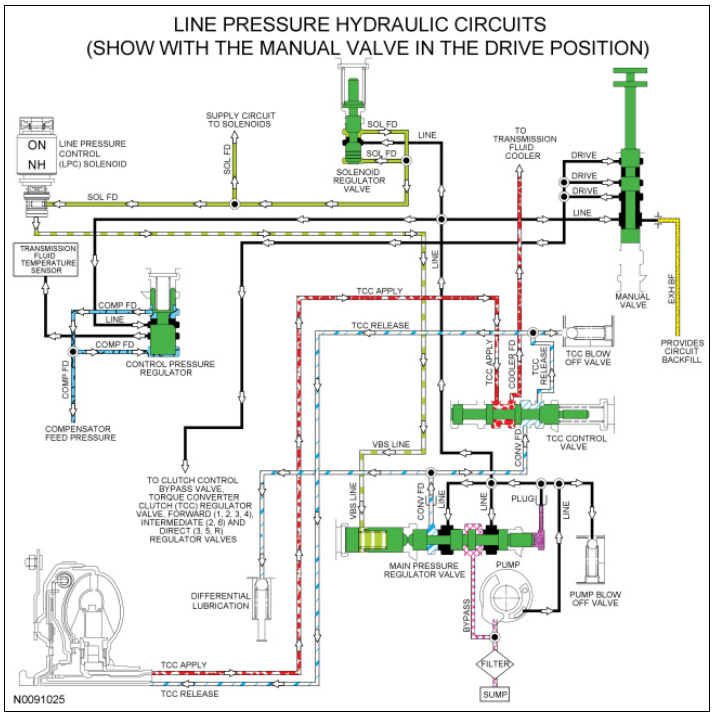
Line pressure is controlled by the Line Pressure Control (LPC) solenoid, which is controlled by the PCM. This effects shift feel and apply component operation.

When the engine is running, the pump supplies pressure to the main pressure regulator valve, which is controlled by the LPC solenoid. The main pressure regulator valve controls the line pressure to the LINE circuit which supplies the manual valve solenoid regulator valve and the control pressure regulator valve.

When the manual valve is in the reverse position, it supplies the clutch control bypass valve with line pressure to position it to supply line pressure to the direct (3, 5, R) regulator valve and regulated line pressure to the low/reverse clutch to apply the clutch.

When the manual valve is in the DRIVE or LOW positions, it directs line pressure from the LINE circuit to the DRIVE circuit to supply line pressure to the:

- Clutch control bypass valve
- Forward (1, 2, 3, 4) regulator valve
- Intermediate (2, 6) regulator valve
- Torque Converter Clutch (TCC) regulator valve
- Direct (3, 5, R) clutch regulator valve



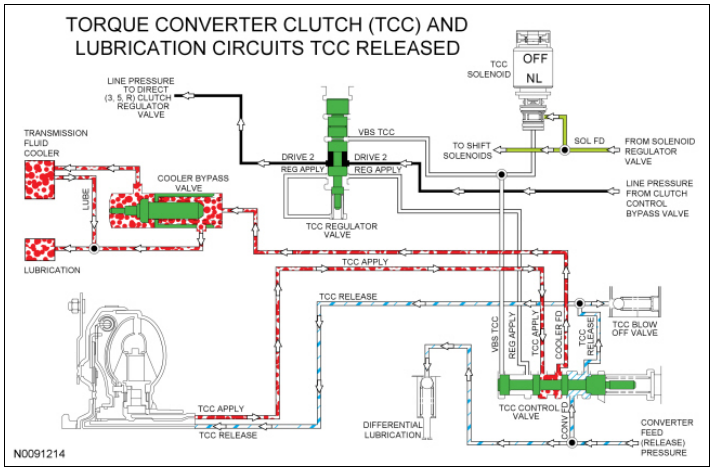
Torque Converter Clutch (TCC) And Lubrication Hydraulic Circuits

Pressure for TCC release is supplied by the main pressure regulator valve to the TCC control valve through the CONV FD circuit. The CONV FD circuit also supplies lubrication for the differential. When the TCC is released, the TCC control valve is positioned by the TCC solenoid to direct CONV FD pressure to the TCC RELEASE circuit to release the TCC . TCC RELEASE pressure returns to the TCC control valve through the TCC APPLY circuit. The position of the TCC control valve opens the TCC APPLY circuit to the COOLER FD circuit which allows the transmission fluid returned from the torque converter to cycle through the thermal bypass valve circuit when the Transmission Fluid Temperature (TFT) is below 80°C-93°C (176°F-200°F) or the transmission fluid cooler when the temperature is above 80°C-93°C (176°F-200°F).

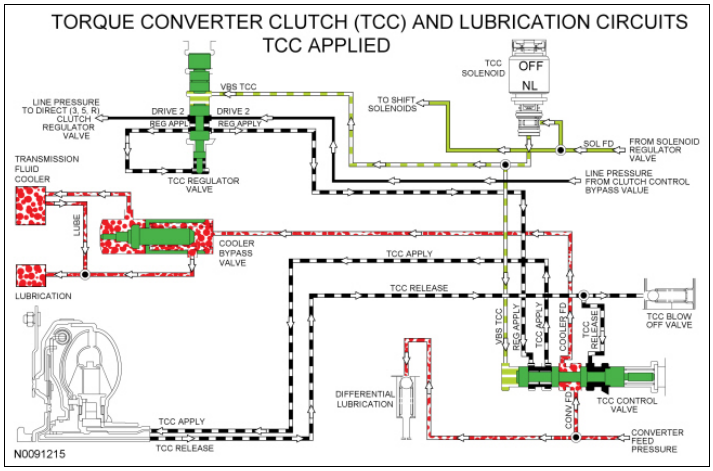
Return transmission fluid from tal bypass valve or the transmission fluid cooler supplies transaxle lubrication through the LUBE circuit which runs through the input shaft.

For lubrication passage location and description, refer to Mechanical Components and Functions in this section.

The position of the TCC control valve is controlled by pressure from the TCC solenoid through the VBS TCC circuit. The TCC solenoid is controlled by the PCM.



When the TCC clutch is applied, the TCC solenoid applies pressure to the TCC control and regulator valves to position the valves to apply the TCC clutch. Regulated line pressure is supplied to the TCC control valve through the REG APPLY circuit by the TCC regulator valve. The TCC control valve directs the regulated line pressure from the REG APPLY circuit to the TCC APPLY circuit to apply the TCC . The TCC control valve blocks the TCC RELEASE circuit to maintain pressure in the TCC APPLY circuit. The TCC control valve directs the CONV FD circuit to the COOLER FD circuit to allow the transmission fluid to flow through the thermal bypass valve or the transmission fluid cooler to the LUBE circuit to lubricate the transaxle.

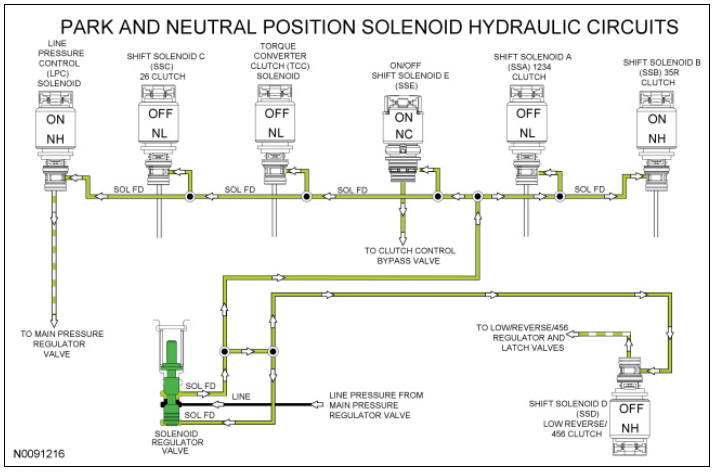


Solenoid Hydraulic Circuits

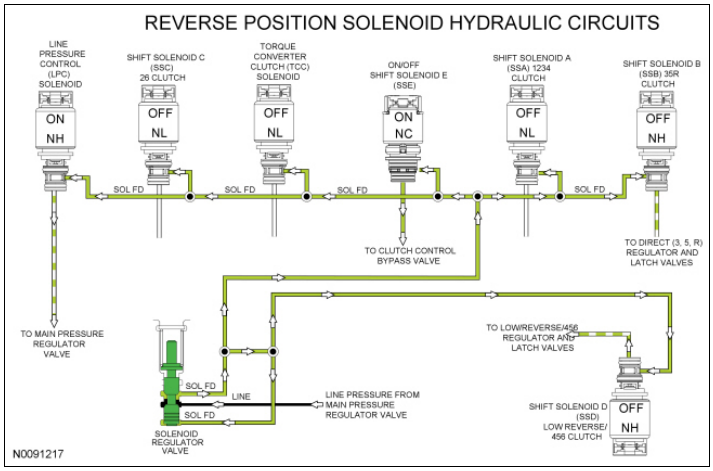
Line pressure from the main pressure regulator valve is directed to the individual shift, TCC and LPC solenoids by the solenoid regulator valve through the SOL FD circuit. The solenoids, controlled by the PCM, direct the fluid to the valves that they control.

The LPC solenoid applies varying pressure to the main pressure regulator valve to control line pressure.

In the PARK and NEUTRAL positions, Shift Solenoid D (SSD) applies varying pressure to the low reverse/456 regulator and latch valves through the VBS CBR1/456 hydraulic circuit to position the valves to apply the low/reverse clutch. ON/OFF Shift Solenoid E (SSE) directs pressure to the clutch control bypass valve to position the valve to direct regulated line pressure from the low reverse/456 regulator valve to the low/reverse clutch.

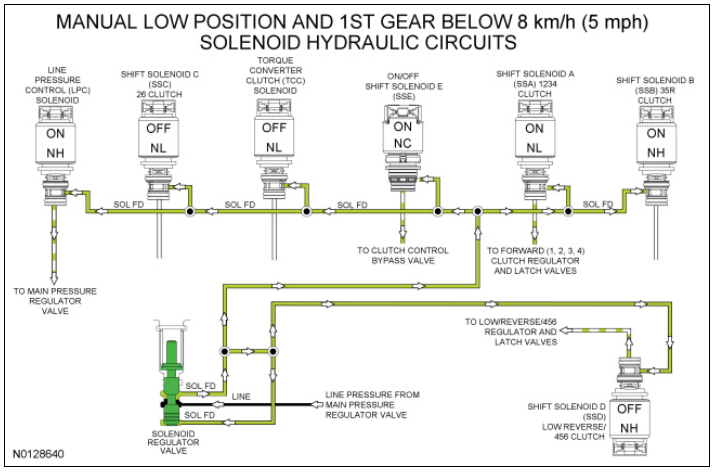


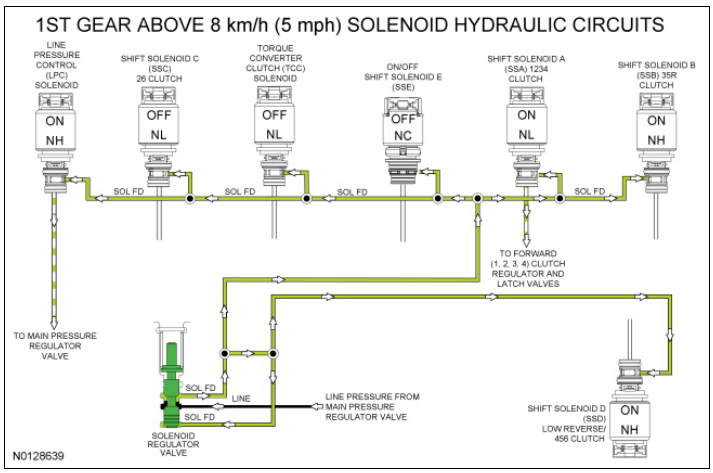
In the REVERSE position, SSD applies varying pressure to the low reverse/456 regulator and latch valves through the VBS CBR1/456 hydraulic circuit to position the valves to apply the low/reverse clutch. ON/OFF SSE directs pressure to the clutch control bypass valve to position the valve to direct regulated line pressure from the low reverse/456 regulator valve to the low/reverse clutch. The clutch control bypass valve also directs line pressure from the REVERSE circuit to the 35R regulator valve through the C35R FD and DRIVE 2/C35R FD circuits. Shift Solenoid B (SSB) directs varying pressure to the 35R regulator and latch valves through the VBS C35R hydraulic circuit to apply the direct (3, 5, R) clutch.



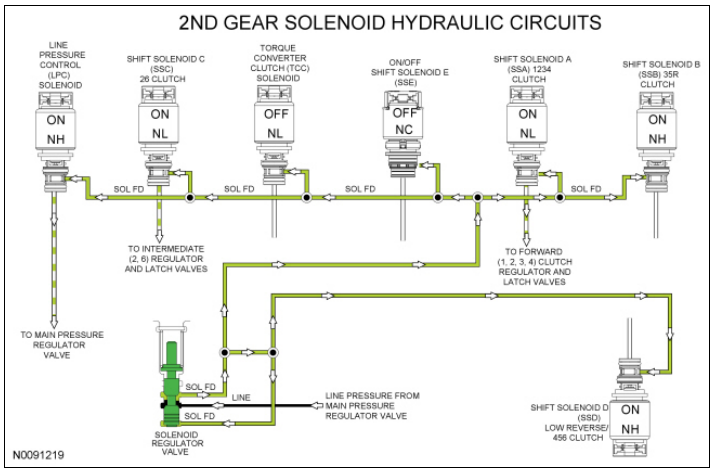
In 1st gear, Shift Solenoid A (SSA) applies varying pressure to the 1234 clutch regulator and latch valves through the VBS C1234 hydraulic circuit to apply the forward (1, 2, 3, 4) clutch.

When vehicle speed is below 8 km/h (5 mph), or the selector lever is in the manual low position, SSD applies varying pressure to the low reverse/456 regulator and latch valves through the VBS CBR1/456 hydraulic circuit to position the valves to apply the low/reverse clutch. ON/OFF SSE directs pressure to the clutch control bypass valve to position the valve to direct regulated line pressure from the low reverse/456 regulator valve to the low/reverse clutch. As vehicle speed increases above 8 km/h (5 mph) in 1st gear, SSD removes pressure from the low reverse/456 regulator and latch valves and SSE removes pressure from the clutch control bypass valve to release the low/reverse clutch.

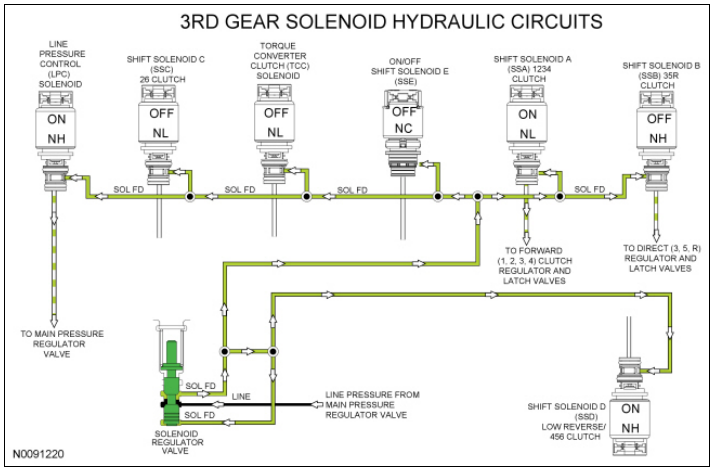




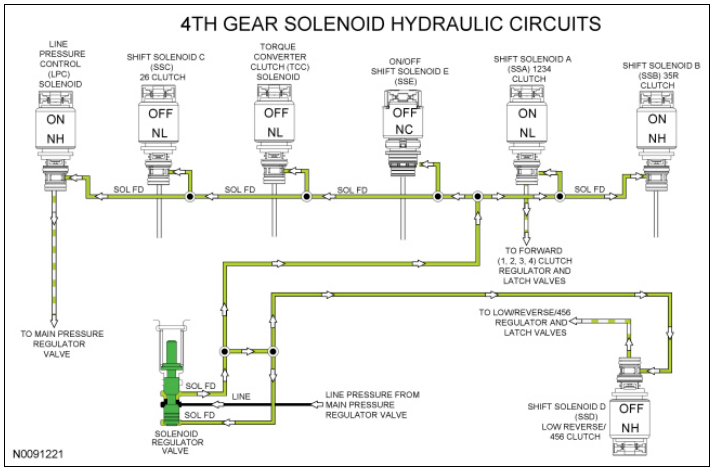
In 2nd gear, the forward (1, 2, 3, 4) clutch remains applied. SSC applies varying pressure to the 26 regulator and latch valves through the VBS CB26 hydraulic circuit to apply the intermediate (2, 6) clutch.



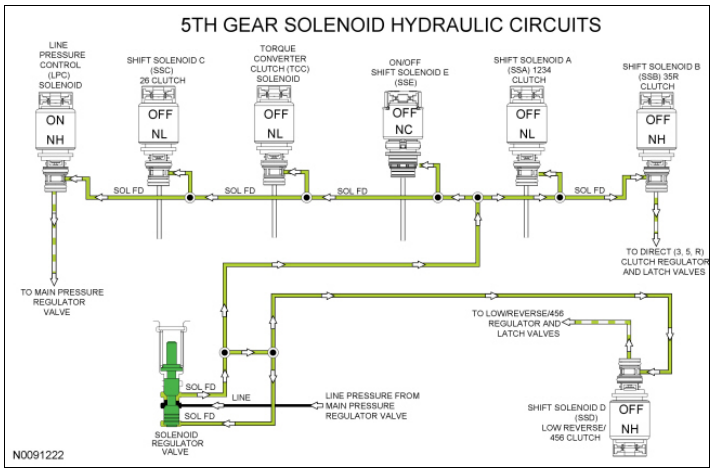
In 3rd gear, the forward (1, 2, 3, 4) clutch remains applied. SSC releases pressure to the 26 regulator and latch valves to release the intermediate (2, 6) clutch. SSB directs pressure to the 35R regulator and latch valves through the VBS CB26 hydraulic circuit to apply the direct (3, 5, R) clutch.



In 4th gear, the forward (1, 2, 3, 4) clutch remains applied. SSB releases pressure to the 35R regulator and latch valves. SSD directs pressure to the low reverse/456 regulator and latch valves through the VBS CBR1/456 hydraulic circuit. With SSE released, the clutch control bypass valve directs the regulated line pressure from the low reverse/456 regulator valve to the Overdrive (O/D) (4, 5, 6) clutch to apply the clutch.

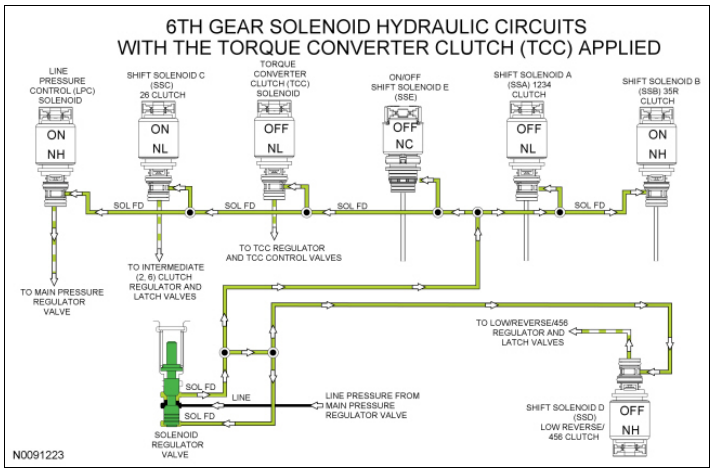


In 5th gear, the O/D (4, 5, 6) clutch remains applied. SSA releases pressure to the 1234 regulator and latch valves to release the forward (1, 2, 3, 4) clutch. SSB directs pressure to the 35R regulator and latch valves through the VBS C35R hydraulic circuit to apply the direct (3, 5, R) clutch.



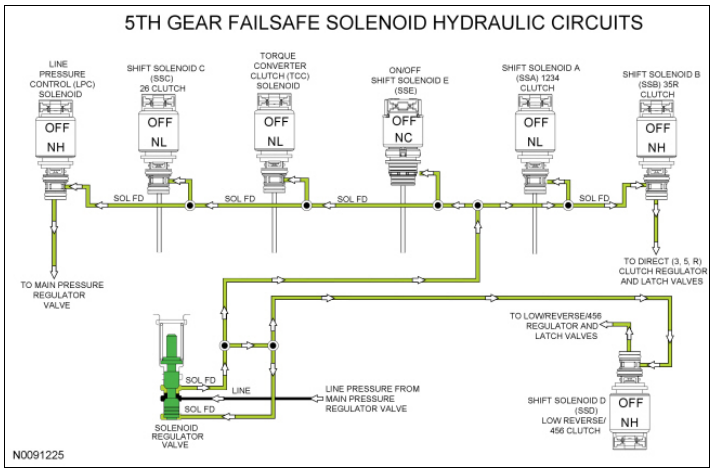
In 6th gear, the O/D (4, 5, 6) clutch remains applied. SSB releases pressure to the 35R regulator and latch valves. SSC applies varying pressure to the 26 clutch regulator and latch valves through the VBS CB26 hydraulic circuit to apply the intermediate (2, 6) clutch.

The TCC can be applied in 4th, 5th or 6th gear. To apply the TCC , the TCC solenoid applies pressure to the TCC regulator valve and the TCC control valve to position the valves to apply the clutch.



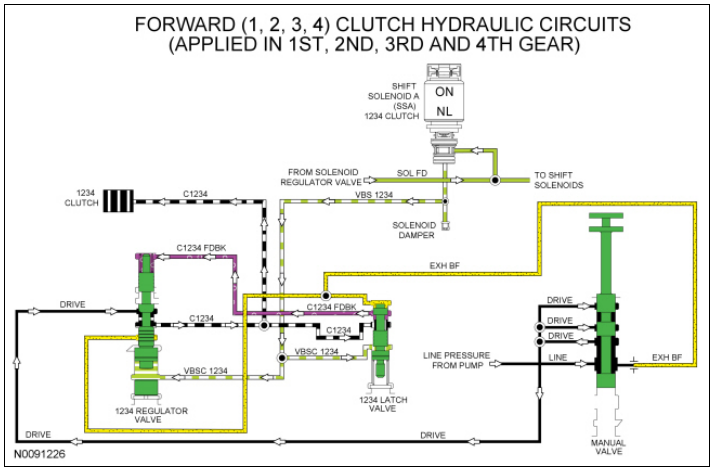
During a mechanical, hydraulic or electrical failure with the manual lever in the DRIVE position, the transaxle defaults to 5th gear. When the transaxle is in 5th gear failsafe, the PCM does not control the shift solenoids and they default to their normal state (maximum pressure, minimum pressure, on or off). The LPC solenoid defaults to maximum pressure, SSA defaults to minimum pressure, SSB defaults to maximum pressure, SSC defaults to minimum pressure, SSD defaults to maximum pressure and the TCC solenoid defaults to minimum pressure.

With SSB applying maximum pressure to the direct (3, 5, R) regulator and latch valves, the direct (3, 5, R) clutch is applied. With SSD applying maximum pressure to the low reverse/456 regulator and latch valves with SSE in the OFF position, the O/D (4, 5, 6) clutch is applied, providing 5th gear.



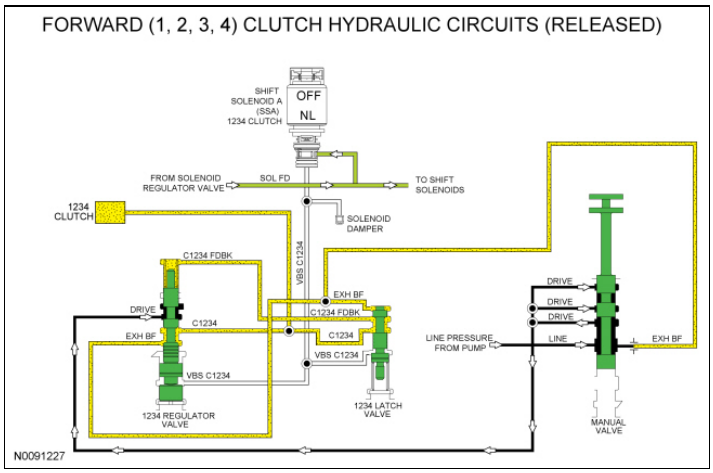
Forward (1, 2, 3, 4) Clutch Hydraulic Circuits

Line pressure is supplied to the 1234 regulator valve by the manual valve in the DRIVE and LOW position. To apply the forward (1, 2, 3, 4) clutch, SSA supplies varying solenoid pressure to the 1234 regulator and latch valves. As the regulator valve moves, it supplies the forward (1, 2, 3, 4) clutch and 1234 latch valve with regulated line pressure through the C1234 circuit. The 1234 latch valve directs the regulated line pressure to the opposite side of the 1234 regulator valve through the C1234 FDBK circuit for gradual forward (1, 2, 3, 4) clutch engagement. The forward (1, 2, 3, 4) clutch is applied in 1st, 2nd, 3rd and 4th gears and manual LOW position.



When the forward (1, 2, 3, 4) clutch is released in 5th and 6th gears, solenoid pressure from SSA is removed from the 1234 regulator and latch valves which positions the valves to block line pressure and release the forward (1, 2, 3, 4) clutch. When the forward (1, 2, 3, 4) clutch is released in the PARK, REVERSE or NEUTRAL position, line pressure is not supplied to the forward (1, 2, 3, 4) regulator valve.

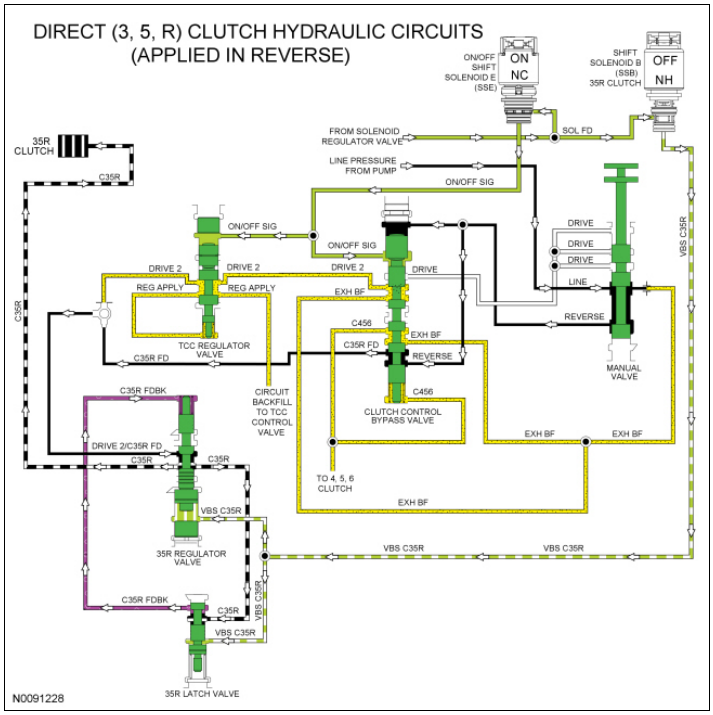
In the released position, exhaust backfill supplied to the 1234 regulator and latch valves by the manual valve through the EXH BF circuit is directed to the forward (1, 2, 3, 4) clutch to fill the unused circuits with unpressurized transmission fluid.



Direct (3, 5, R) Clutch Hydraulic Circuits

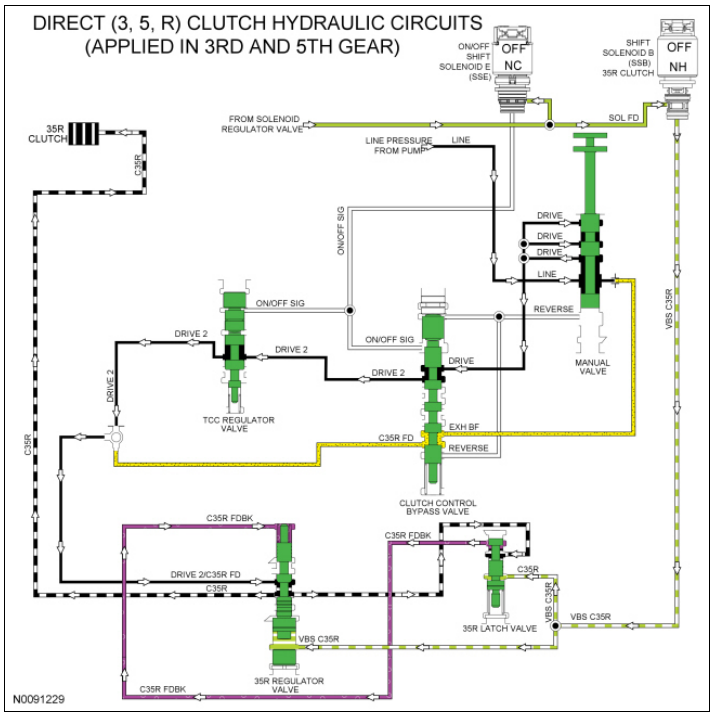
When the direct (3, 5, R) clutch is applied in the REVERSE position, line pressure from the manual valve is directed to the clutch control bypass valve through the REVERSE circuit. Line pressure in the REVERSE circuit positions the clutch control bypass valve and supplies line pressure to apply the direct (3, 5, R) clutch. Line pressure from the clutch control bypass valve is supplied to the 35R regulator valve through the C35R FD circuit, DRIVE 2/C35R FD shuttle ball and DRIVE 2/C35R FD circuit.

To apply the direct (3, 5, R) clutch, SSB applies varying solenoid pressure to the 35R regulator and latch valves. As the regulator valve moves, it supplies the direct (3, 5, R) clutch and 35R latch valve with regulated line pressure through the C35R circuit. The 35R latch valve directs the regulated line pressure to the opposite side of the 35R regulator valve through the C35R FDBK circuit for gradual direct (3, 5, R) clutch engagement.



When the direct (3, 5, R) clutch is applied in 3rd and 5th gear, line pressure from the pump is directed to the clutch control bypass valve by the manual valve through the DRIVE hydraulic circuit. The clutch control bypass valve directs the pressure to the 35R regulator valve through the TCC regulator valve, DRIVE 2 circuit, DRIVE 2/C35R FD shuttle ball and DRIVE 2/C35R FD circuit.

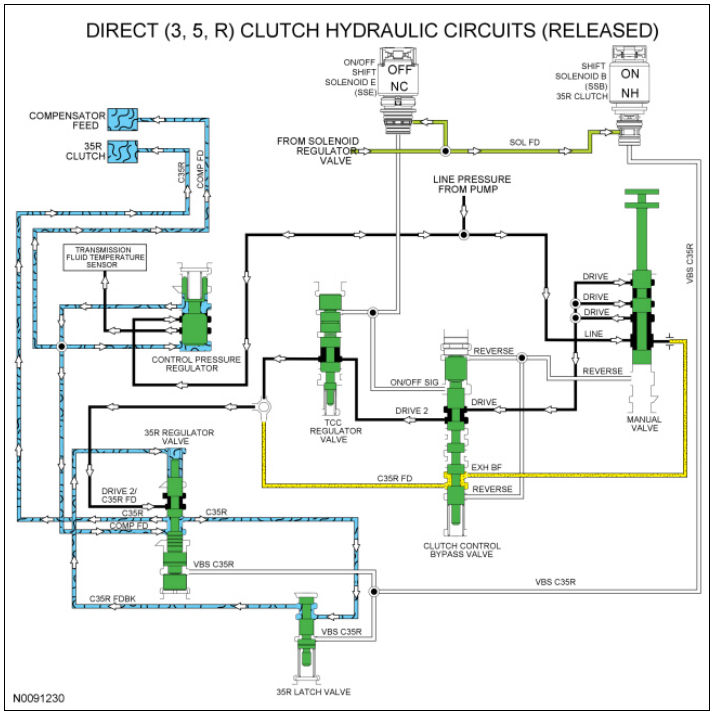
To apply the direct (3, 5, R) clutch, SSB applies varying solenoid pressure to the 35R regulator and latch valves. As the 35R regulator valve moves, it supplies the direct (3, 5, R) clutch and 35R latch valve with regulated line pressure through the C35R circuit. The 35R latch valve directs the regulated line pressure to the opposite side of the regulator valve through the C35R FDBK circuit for gradual direct (3, 5, R) clutch engagement.



When the direct (3, 5, R) clutch is released, solenoid pressure from SSB is removed from the 35R regulator

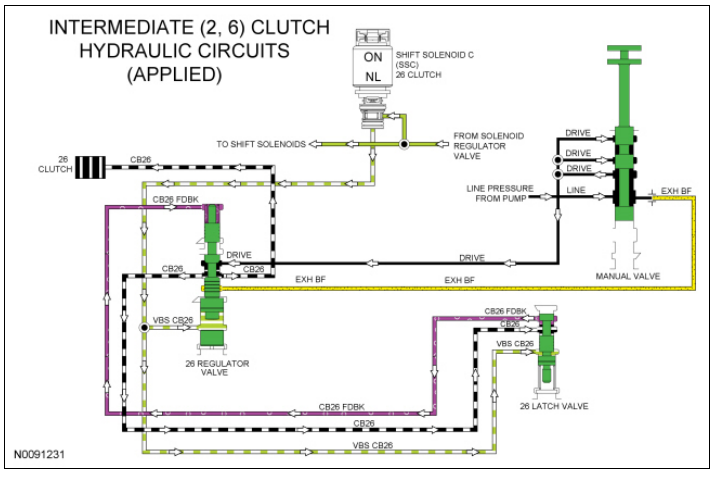
and latch valves which positions the valves to block line pressure and release the direct (3, 5, R) clutch. When the direct (3, 5, R) clutch is released in the PARK or NEUTRAL position, line pressure is not supplied to the 35R regulator valve.

Compensator feed pressure is supplied to the 35R regulator valve from the control pressure regulator through the COMP FD circuit and is supplied to the opposite side of the direct (3, 5, R) and O/D (4, 5, 6) clutch pistons to keep the clutches from centrifugally applying. COMP FD pressure is only about 83 kPa (12 psi) and is applied through all gears. When the direct (3, 5, R) clutch is released, COMP FD is applied by the 35R regulator valve to the direct (3, 5, R) clutch to fill the unused circuits.



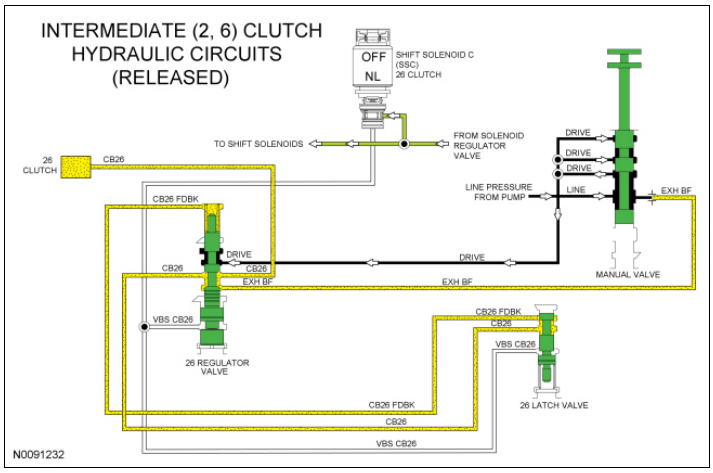
Intermediate (2, 6) Clutch Hydraulic Circuits

Line pressure is supplied to the 26 regulator valve by the manual valve in the DRIVE and LOW positions. To apply the intermediate (2, 6) clutch, SSC supplies varying solenoid pressure to the 26 regulator and latch valves. As the 26 regulator valve moves, it supplies the intermediate (2, 6) clutch and 26 latch valve with regulated line pressure through the CB26 circuit. The 26 latch valve directs the regulated line pressure to the opposite side of the 26 regulator valve through the CB26 FDBK circuit for gradual intermediate (2, 6) clutch engagement. The intermediate (2, 6) clutch is applied in 2nd and 6th gears.



When the intermediate (2, 6) clutch is released in 1st, 3rd, 4th and 5th gears and manual LOW position, solenoid pressure from SSC is removed from the 26 regulator and latch valves which positions the valves to block line pressure and release the intermediate (2, 6) clutch. When the intermediate (2, 6) clutch is released in the PARK, REVERSE or NEUTRAL position, line pressure is not supplied to the 26 regulator valve.

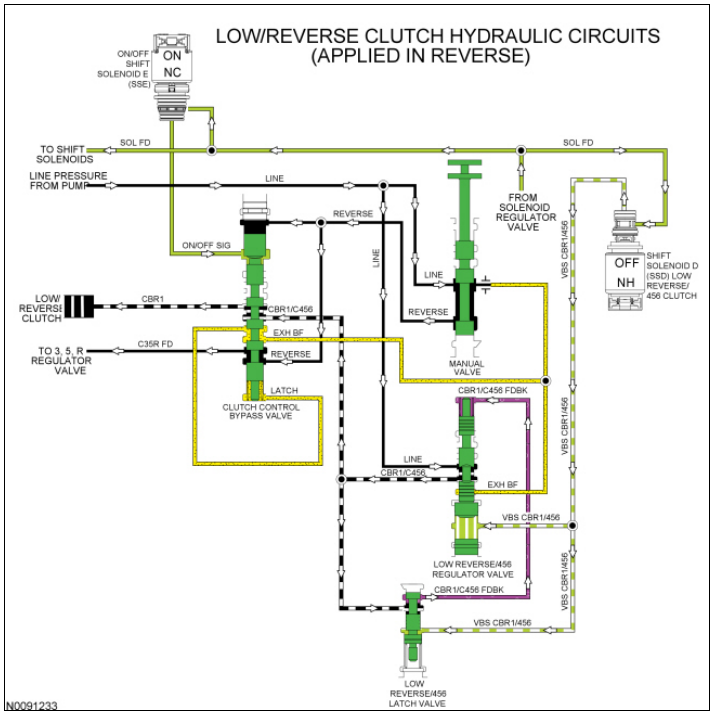
In the released position, exhaust backfill supplied to the 26 clutch regulator valve by the manual valve through the EXH BF circuit is directed to the intermediate (2, 6) clutch and 26 latch valve to fill the unused circuits with unpressurized transmission fluid.



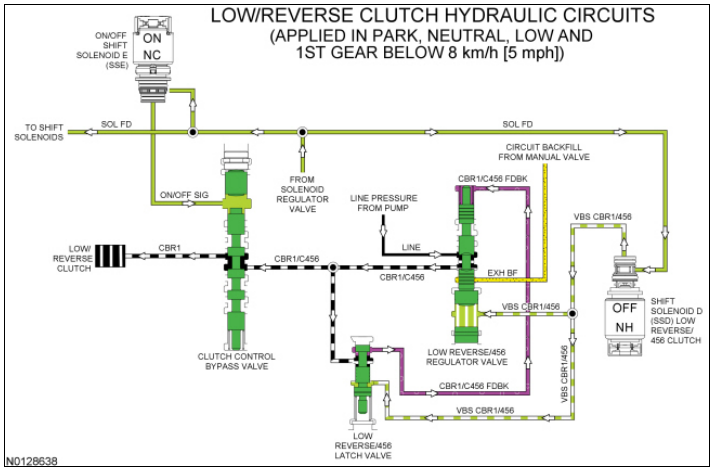
Low/Reverse Clutch Hydraulic Circuits

Line pressure is supplied to the low reverse/456 regulator valve by the pump in every gear and manual lever position. To apply the low/reverse clutch, SSD supplies varying solenoid pressure to the low reverse/456 regulator and latch valves. As the low reverse/456 regulator valve moves, it supplies the clutch control bypass valve and low reverse/456 latch valve with regulated line pressure through the CBR1/C456 circuit. The low reverse/456 latch valve directs the regulated line pressure to the opposite side of the 456 regulator valve through the CBR1/C456 FDBK circuit for gradual low reverse/456 clutch engagement. The low/reverse clutch is applied in PARK, REVERSE, NEUTRAL, 1st gear below 8 km/h (5 mph) and manual LOW position.

In REVERSE, both solenoid pressure from ON/OFF SSE and line pressure from the manual valve in the REVERSE circuit apply pressure to the clutch control bypass valve to position it for low/reverse clutch application. Regulated line pressure from the CBR1/C456 circuit is directed to the low/reverse clutch by the clutch control bypass valve through the CBR1 circuit to apply the low/reverse clutch.



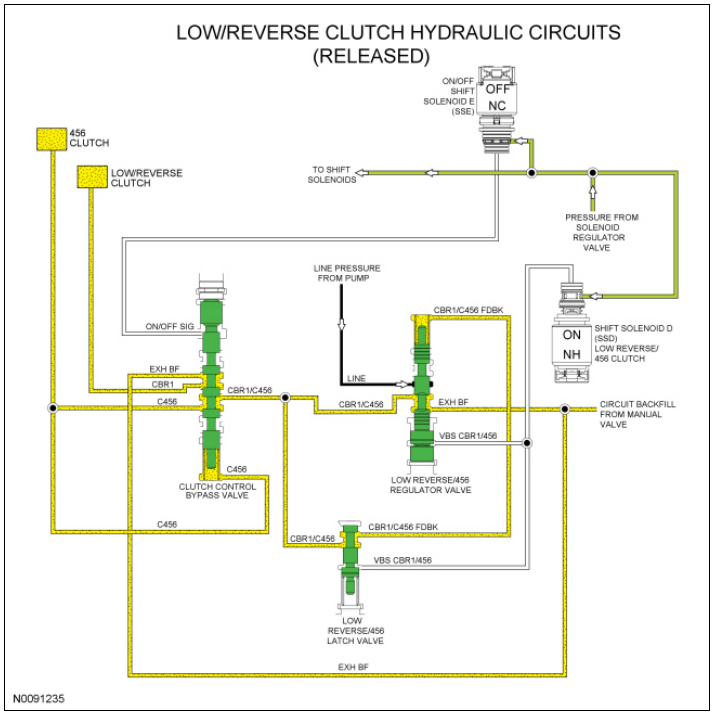
When the low/reverse clutch is applied in PARK, NEUTRAL, LOW or 1st gear below 8 km/h (5 mph), only pressure from ON/OFF SSE , positions the clutch control bypass valve. Line pressure from the REVERSE circuit is not supplied by the manual valve.



When the low/reverse clutch is released in 1st gear above 8 km/h (5 mph), 2nd and 3rd gears, solenoid pressure from SSD is removed from the low reverse/456 regulator and latch valves which positions the valves to block line pressure and release the low/reverse clutch. Solenoid pressure from SSE is removed from the clutch control bypass valve to position it to apply the O/D (4, 5, 6) clutch.

When the low/reverse clutch is released in 1st gear above 8 km/h (5 mph), 2nd and 3rd gears, exhaust backfill supplied to the low reverse/456 clutch regulator valve and the clutch control bypass valve by the manual valve through the EXH BF circuit is directed to the low reverse/456 latch valve, low/reverse clutch and O/D (4, 5, 6) clutch to fill the unused circuits with unpressurized transmission fluid.

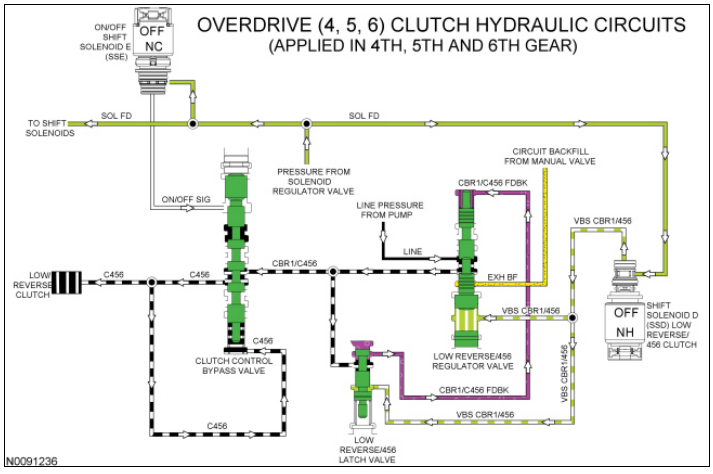
When the low/reverse clutch is released in 4th, 5th and 6th gears, the low reverse/456 regulator valve supplies regulated pressure to the clutch control bypass valve through the CBR1/C456 circuit. With ON/OFF SSE in the OFF position, the regulated pressure is directed to the O/D (4, 5, 6) clutch.



Overdrive (4, 5, 6) Clutch Hydraulic Circuits

Line pressure is supplied to the low reverse/456 regulator valve by the pump in every gear and manual lever position. To apply the low/reverse clutch, SSD supplies varying solenoid pressure to the low reverse/456 regulator and latch valves. As the regulator valve moves, it supplies the clutch control bypass valve and low reverse/456 latch valve with regulated line pressure through the CBR1/C456 circuit. The low reverse/456 latch valve directs the regulated line pressure to the opposite side of the low reverse/456 regulator valve through the CBR1/C456 FDBK circuit for gradual O/D (4, 5, 6) clutch engagement.

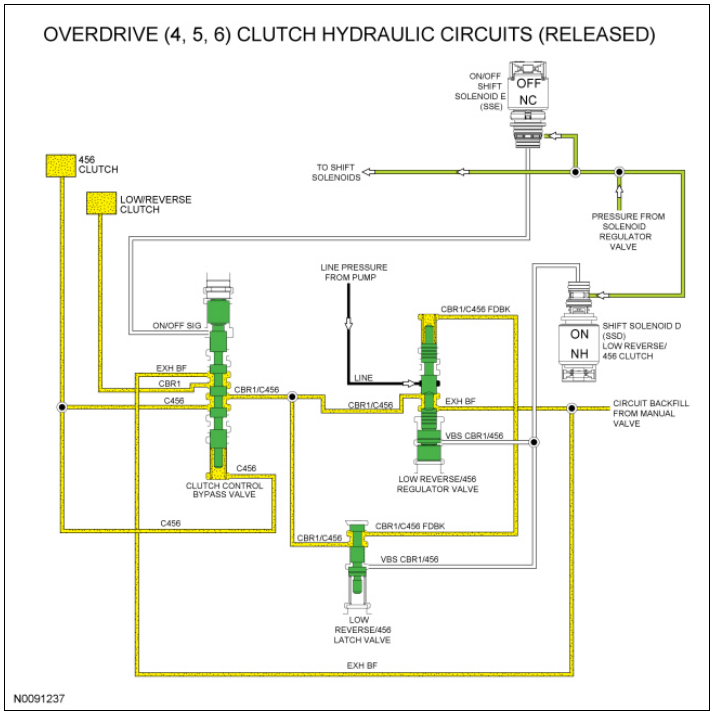
To apply the O/D (4, 5, 6) clutch, the position of the clutch control bypass valve allows the regulated line pressure in the CBR1/C456 circuit to supply the C456 circuit, applying the O/D (4, 5, 6) clutch. Clutch control bypass valve latch pressure is supplied by the C456 circuit. The O/D (4, 5, 6) clutch is applied in 4th, 5th and 6th gears.



When the O/D (4, 5, 6) clutch is released in 1st gear above 8 km/h (5 mph), 2nd and 3rd gears, solenoid pressure from SSD is removed from the low reverse/456 regulator and latch valves which positions the valves to block line pressure and release the O/D (4, 5, 6) clutch.

When the O/D (4, 5, 6) clutch is released in 1st gear above 8 km/h (5 mph), 2nd and 3rd gears, exhaust backfill supplied to the low reverse/456 clutch regulator valve and the clutch control bypass valve by the manual valve through the EXH BF circuit is directed to the low reverses latch valve, low/reverse clutch and O/D (4, 5, 6) clutch to fill the unused circuits with unpressurized transmission fluid.

When the O/D (4, 5, 6) clutch is released in PARK, REVERSE, NEUTRAL and 1st gear below 8 km/h (5 mph), the low reverse/456 regulator valve supplies regulated pressure to the clutch control bypass valve through the CBR1/C456 circuit. With ON/OFF SSE in the ON position, the regulated pressure is directed to the low/reverse clutch.



Transaxle Electronic Control System

Electronic System Description

The PCM and its input/output network control the following operations:

- Shift timing
- Line pressure (shift feel)
- Torque Converter Clutch (TCC)

The transaxle control is separate from the engine control strategy in the PCM, although some of the input signals are shared. When determining the best operating strategy for transaxle operation, the PCM uses input information from certain engine-related and driver-demand related sensors and switches.

In addition, the PCM receives input signals from certain transaxle-related sensors and switches. The PCM also uses these signals when determining transaxle operating strategy.

Using all of these input signals, the PCM can determine when the time and conditions are right for a shift, or when to apply or release the TCC . It will also determine the best line pressure needed to optimihift engagement feel. To accomplish this, the PCM uses output solenoids to control transaxle operation.

The following provides a brief description of each of the sensors and actuators used to control transaxle operation.

Electronic Ignition (EI)

The Electronic Ignition (EI) system consists of the PCM, a Crankshaft Position (CKP) sensor and ignition coils. The CKP sensor sends a crankshaft position signal to the PCM. The PCM then sends the appropriate ignition signal to the ignition coils. The PCM also uses this signal as well as Wide Open Throttle (WOT) shift control, TCC control and electronic pressure control.

Accelerator Pedal Position (APP)

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal. The APP detects the position of the accelerator pedal and inputs this information as a voltage to the PCM. The PCM uses APP sensor information to aid in determining line pressure, shift scheduling and TCC operation. Failure of this sensor will cause the transmission to operate at higher line pressure to avoid damage to the transmission. This higher line pressure causes harsh upshifts and harsh engagements.

Throttle Position (TP) Sensor

The Throttle Position (TP) sensor is a potentiometer mounted on the Throttle Body (TB). The TP sensor detects the position of the throttle plate and sends this information to the processor assembly as varying voltage signal.

The PCM uses the monitored voltage level of the TP sensor for control of Line Pressure Control (LPC), TCC operation and shift scheduling.

If a malfunction occurs in the TP sensor circuit, the processor will recognize that the TP sensor signal is out of specification. The processor will then operate the transaxle in a high capacity mode to prevent transaxle damage.

PCM

The PCM controls operation of the transaxle. Many input sensors provide information to the PCM. The PCM then controls the actuators which affect transaxle operation.

Transmission Range (TR) Sensor Assembly

The Transmission Range (TR) sensor assembly is an internally mounted sensor that includes the detent bracket and is located above the main control assembly. The components of the TR sensor are factory adjusted and is installed as a calibrated assembly. The TR sensor contains electronic circuitry that provides the PCM a fixed frequency duty cycle for each of the various positions of the manual lever (PARK, REVERSE, NEUTRAL, DRIVE and LOW to the PCM). The PCM uses the TR sensor signal for engine start, reverse lamps, LPC , shift scheduling and TCC operation.

Brake Pedal Position (BPP) Switch

The Brake Pedal Position (BPP) switch tells the PCM when the brakes are applied. The BPP switch closes when the brakes are applied and opens when they are released. The BPP signal is used for the brake shift interlock actuation.

Turbine Shaft Speed (TSS) Sensor

This Turbine Shaft Speed (TSS) sensor is a Hall-effect pickup that sends a signal to the PCM that indicates transaxle turbine shaft input speed. The TSS sensor provides converter turbine speed information for TCC strategy. Also used in determining static LPC pressure settings.

Output Shaft Speed (OSS) Sensor

The Output Shaft Speed (OSS) sensor is a Hall-effect pickup, located on the transfer shaft drive gear, that sends a signal to the PCM to indicate transmission output speed. The OSS is used for TCC control and shift scheduling.

Solenoid Body

NOTICE: **If the solenoid body identification and strategy does not match the solenoid body information in the Powertrain Control Module (PCM), transaxle damage or driveability concerns can occur.**

The solenoid body contains 7 solenoids, 5 shift solenoids (Shift Solenoid A (SSA), Shift Solenoid B (SSB), Shift Solenoid C (SSC), Shift Solenoid D (SSD) and Shift Solenoid E (SSE)), TCC solenoid and LPC solenoid. The Transmission Fluid Temperature (TFT) is also located in the solenoid body. The solenoid body is serviced as an assembly.

The solenoid body has a unique strategy data file that must be downloaded to the PCM. There is a 7-digit solenoid body identification and a 13-digit solenoid body strategy for each solenoid body. Any time a new solenoid body is installed or a new transaxle is installed, the scan tool must be used to get the solenoid body strategy data file and download it into the PCM.

If the PCM is replaced, the solenoid body identification and solenoid body strategy must be downloaded into the PCM.

Line Pressure Control (LPC) Solenoid

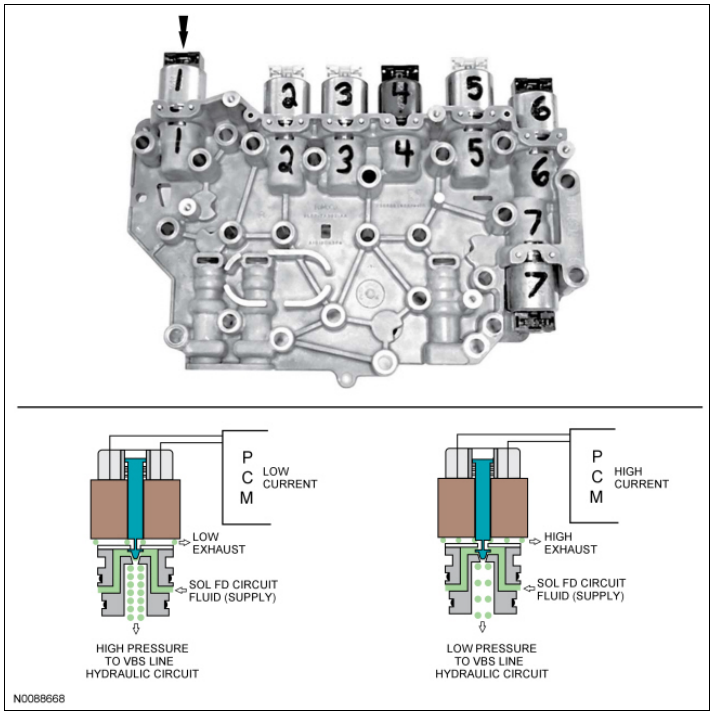
The LPC solenoid is a Variable Force Solenoid (VFS) that varies hydraulic pressure by actuating a hydraulic valve.

The PCM applies variable current to the LPC solenoid which varies pressure in the VBS LINE hydraulic circuit to the main pressure regulator valve. Refer to Hydraulic Circuits for additional information.

The LPC solenoid uses inversely proportional operation. As the current from the PCM decreases, the pressure from the solenoid increases. As the current from the PCM increases, the pressure from the solenoid decreases. The LPC solenoid is supplied hydraulic pressure from the SOL FD circuit.

With zero current, the LPC solenoid fully opens the hydraulic valve which applies the maximum amount of hydraulic pressure to the Main Pressure Regulator Valve through the VBS LINE hydraulic circuit and applies maximum line pressure in the LINE hydraulic circuit. With maximum current to the solenoid, the hydraulic valve fully closes the outlet port for minimum pressure to the VBS LINE hydraulic circuit to lower the line pressure in the LINE hydraulic circuit.

Line Pressure Control (LPC) Inversely Proportional Variable Force Solenoid (VFS)



Torque Converter Clutch (TCC) Solenoid

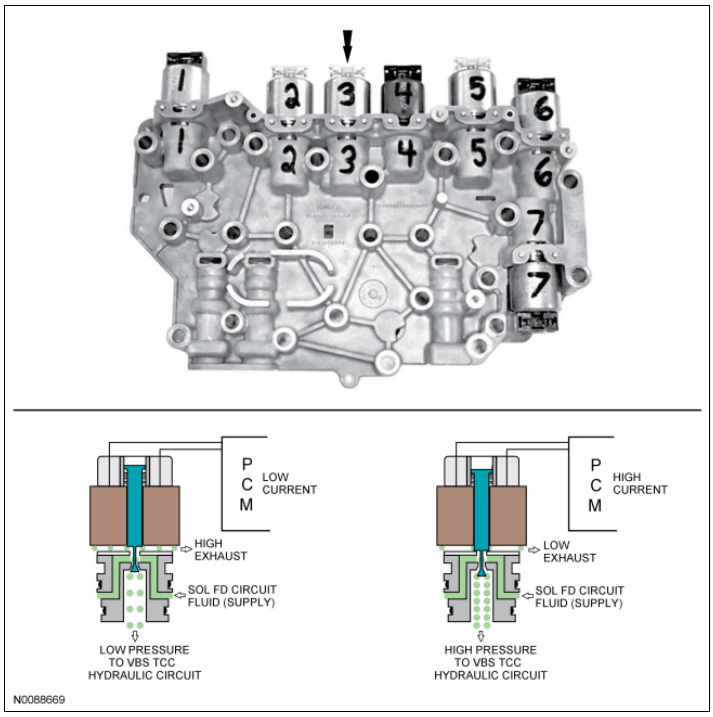
The TCC solenoid is a VFS that varies hydraulic pressure by actuating a hydraulic valve.

The PCM applies variable current to the TCC solenoid which varies pressure in the VBS TCC hydraulic circuit to the TCC regulator valve and the TCC control valve. Refer to Hydraulic Circuits for additional information.

The TCC solenoid uses proportional operation. As the current from the PCM decreases, the pressure from the solenoid decreases. As the current from the PCM increases, the pressure from the solenoid increases. The TCC solenoid is supplied hydraulic pressure from the SOL FD circuit.

With zero current, the TCC solenoid fully closes the hydraulic valve which applies the minimum amount of hydraulic pressure to the TCC regulator valve through the VBS TCC hydraulic circuit and releases the TCC . With maximum current to the solenoid, the hydraulic valve fully opens the outlet port for maximum pressure to the VBS TCC hydraulic circuit to apply the TCC .

Torque Converter Clutch (TCC) Proportional Variable Force Solenoid (VFS)



Shift Solenoid A (SSA), Shift Solenoid B (SSB), Shift Solenoid C (SSC) and Shift Solenoid D (SSD)

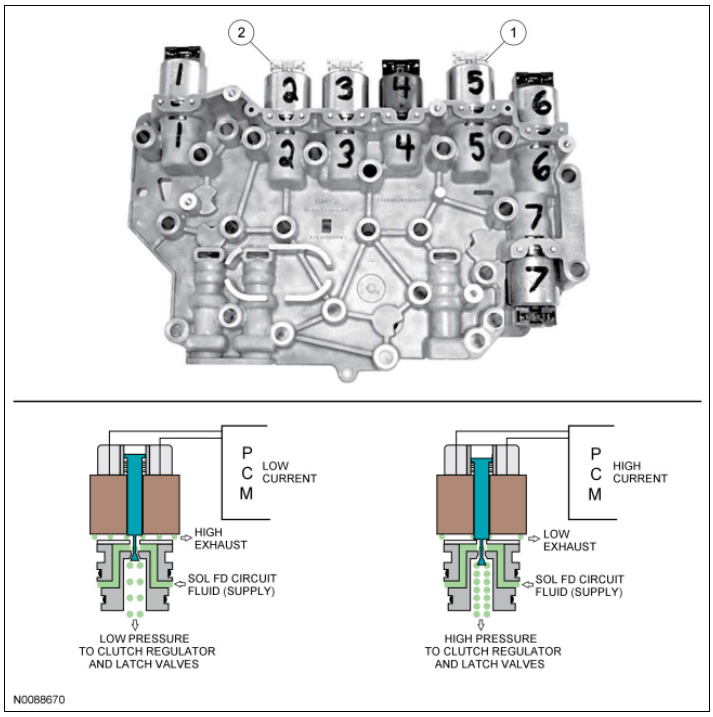
Shift solenoids A-D are variable force type solenoids that vary hydraulic pressure by actuating a hydraulic valve.

The PCM applies variable current to the shift solenoids which varies pressure in the hydraulic circuit to the regulator and latch valves of the clutch that it controls. Refer to Hydraulic Circuits for additional information.

SSA and SSC use proportional operation. As the current from the PCM decreases, the pressure from the solenoid decreases. As the current from the PCM increases, the pressure from the solenoid increases. SSA and SSC are supplied hydraulic pressure from the SOL FD circuit.

With zero current, SSA and SSC fully close the hydraulic valves which applies zero amount of hydraulic pressure to the clutch regulator and latch valves of the clutch that it controls and releases the clutch. With maximum current to the solenoids, the hydraulic valves are fully open for maximum pressure to the clutch regulator and latch valves to apply the clutch.

Shift Solenoid A (SSA) and Shift Solenoid C (SSC) Proportional Variable Force Type Solenoids

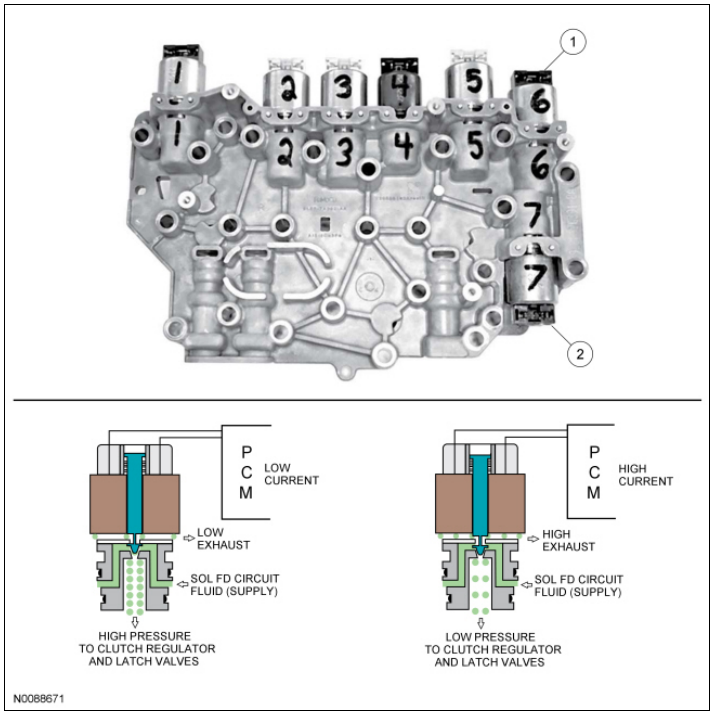


Item	Part Number	Description
1	7G136	Shift Solenoid A (SSA) Variable Force Solenoid (VFS)
2	7G136	Shift Solenoid C (SSC) VFS

SSB and SSD use inversely proportional operation. As the current from the PCM decreases, the pressure from the solenoid increases. As the current from the PCM increases, the pressure from the solenoid decreases. SSB and SSD are supplied hydraulic pressure from the SOL FD circuit.

With zero current, SSB and SSD fully open the hydraulic valves which applies maximum hydraulic pressure to the clutch regulator and latch valves to apply the clutch that it controls. With maximum current to the solenoids, the hydraulic valve is fully closed to apply zero amount of hydraulic pressure to the clutch regulator and latch valves of the clutch that it controls and releases the clutch.

Shift Solenoid B (SSB) and Shift Solenoid D (SSD) Inverse Proportional Variable Force Type Solenoids



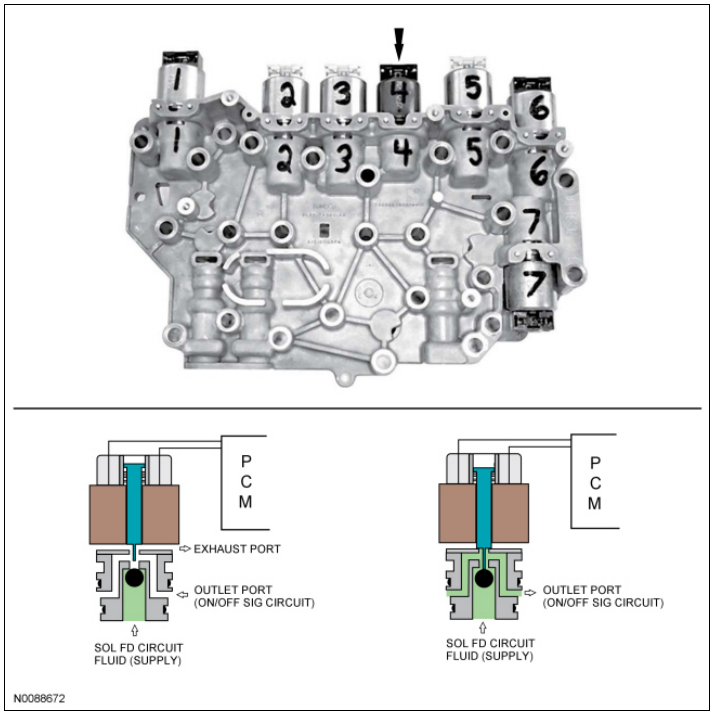
Item	Part Number	Description
1	7G383	Shift Solenoid B (SSB) Variable Force Solenoid (VFS)
2	7G383	Shift Solenoid D (SSD) VFS

Shift Solenoid E (SSE)

SSE is an ON/OFF solenoid. When SSE is in the ON position, SSD controls the clutch regulator and latch valves to apply the low/reverse clutch. When SSE is in the OFF position, SSD controls the clutch regulator and latch valves to apply the overdrive (4, 5, 6) clutch. Refer to Hydraulic Circuits for additional information.

SSE is supplied hydraulic pressure from the SOL FD circuit. When SSE is OFF, the solenoid supply is blocked and the outlet port (ON/OFF SIG circuit) is connected to the exhaust port. When SSE is ON, the exhaust port is blocked and the solenoid supply is connected to the outlet port (ON/OFF SIG circuit), supplying pressure to the clutch control bypass valve.

Shift Solenoid E (SSE) ON/OFF Solenoid


1
2
3
4
5
6
7
P
C
M
EXHAUST PORT
OUTLET PORT
(ON/OFF SIG CIRCUIT)
SOL FD CIRCUIT
FLUID (SUPPLY)
P
C
M
OUTLET PORT
(ON/OFF SIG CIRCUIT)
SOL FD CIRCUIT
FLUID (SUPPLY)
N0088672

Transaxle Operation

Transaxle Operation Overview

Torque Converter

This transaxle uses a torque converter with the following elements:

- Impeller
- Turbine
- Reactor
- Torque Converter Clutch (TCC)

For component information, refer to Torque Converter in this section.

Planetary Gearsets

Operation of this transaxle involves the use of the following planetary gearsets:

- Front
- Center
- Rear

Apply Clutches

This transaxle uses the following clutches to operate the 3 planetary gearsets:

- Forward (1, 2, 3, 4) clutch
- Low/reverse clutch
- Low One-Way ClutOWC)
- Direct (3, 5, R) clutch
- Intermediate (2, 6) clutch
- Overdrive (O/D) (4, 5, 6) clutch

For additional information about planetary gearsets or the apply clutches, refer to Mechanical Components and Functions in this section.

Hydraulic System

The hydraulic system of this transaxle consists of the following components:

- Transmission fluid pump with filter
- Transmission fluid filler tube with transmission fluid level indicator
- Main control assembly (valve body and solenoid body)

For component information, refer to Hydraulic System in this section.

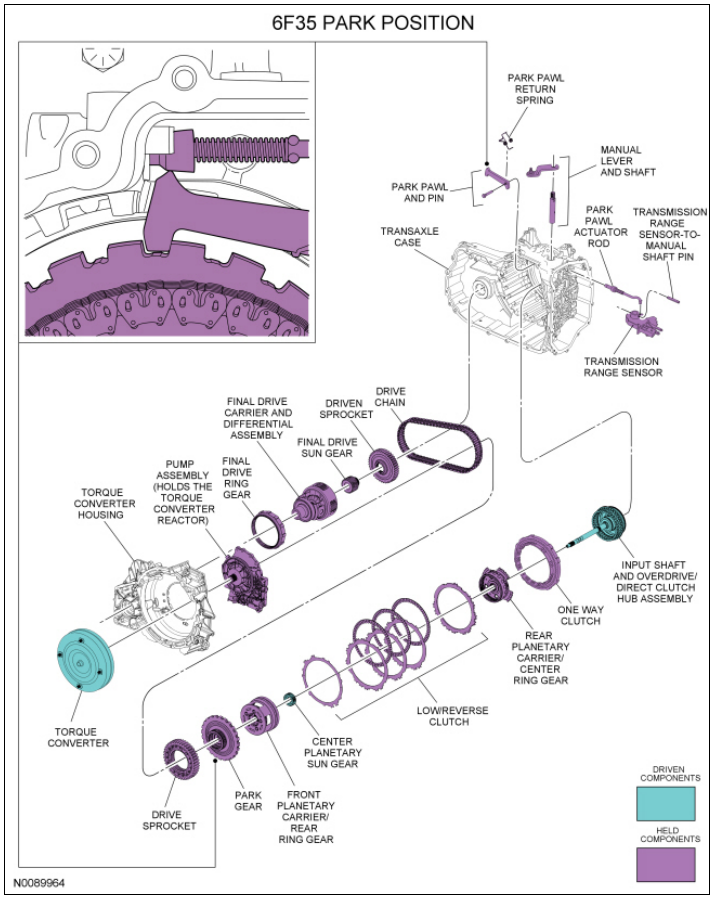
Electronic Operation

The PCM controls the operation of the transaxle with the following solenoids:

- Line Pressure Control (LPC) solenoid
- Shift Solenoid A (SSA)
- Shift Solenoid B (SSB)
- Shift Solenoid C (SSC)
- Shift Solenoid D (SSD)
- Shift Solenoid E (SSE)
- TCC solenoid

For solenoid information, refer to Transaxle Electronic Control System in this section.

Park Position



Mechanical Operation

Apply components:

- Park pawl engaged, holding the final drive assembly stationary
- Low/reverse clutch applied

Planetary Gearset Operation

Front planetary gearset driven components:

- None

Center planetary gearset driven components:

- Sun gear

Rear planetary gearset driven components:

- None

Front planetary gearset held components:

- Planetary carrier assembly (splined to final drive assembly, held stationary by park pawl)

Center planetary gearset held components:

- Center ring gear (splined to rear planetary carrier)

Rear planetary gearset held components:

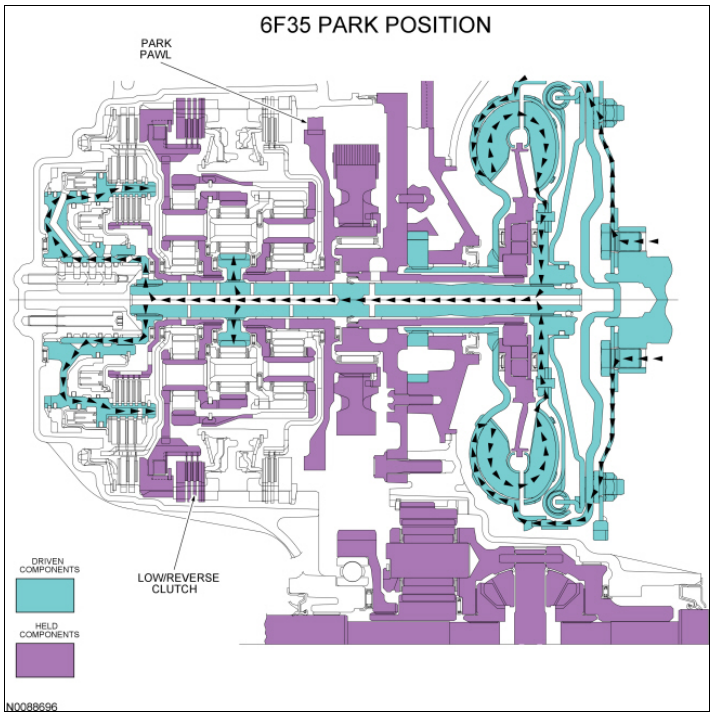
- Planetary carrier
- Rear ring gear (splined to front carrier)

Park Position Clutch Application Chart

Gear/Manual Lever Position	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	One-Way
PARK				X		

For component information, refer to Mechanical Components and Functions in this section.

Park Position Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit.

Torque converter circuits:

- Regulated line pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit.
- When the TCC is released, CONV FD pressure is directed to the TCC RELEASE circuit by the TCC control valve. Pressure from the TCC RELEASE circuit releases the TCC .
- Fluid from the TCC RELEASE returns to the TCC control valve through the TCC APPLY circuit.

Cooler and lubrication hydraulic circuits:

- The TCC control valve directs fluid from the TCC APPLY circuit (return circuit from the torque converter when the TCC is released) to the COOLER FD circuit.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies varying pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main pressure regulator valve.
- SSD applies pressure to the low reverse/456 regulator and latch valves to apply the low/reverse clutch.
- SSE applies pressure to the clutch control bypass valve to position the valve to direct regulated line pressure in the CBR1/C456 circuit to the low/reverse clutch.

Clutch hydraulic circuits:

- Line pressure from the pump is supplied to the low reverse/456 regulator valve. To apply the low/reverse clutch, SSD supplies varying solenoid pressure to the low reverse/456 regulator and latch valves. As the low reverse/456 regulator valve moves, it supplies the clutch control bypass valve and low reverse/456 latch valve with regulated line pressure through the CBR1/C456 circuit. The latch valve directs the regulated line pressure to the opposite side of the regulator valve through the CBR1/C456 FDBK circuit for gradual low/reverse clutch engagement.
- Regulated line pressure at the clutch control bypass valve in the CBR1/C456 circuit is directed to the low/reverse clutch through the CBR1 circuit to apply the clutch.

For additional hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

Park Position Solenoid Operation Chart

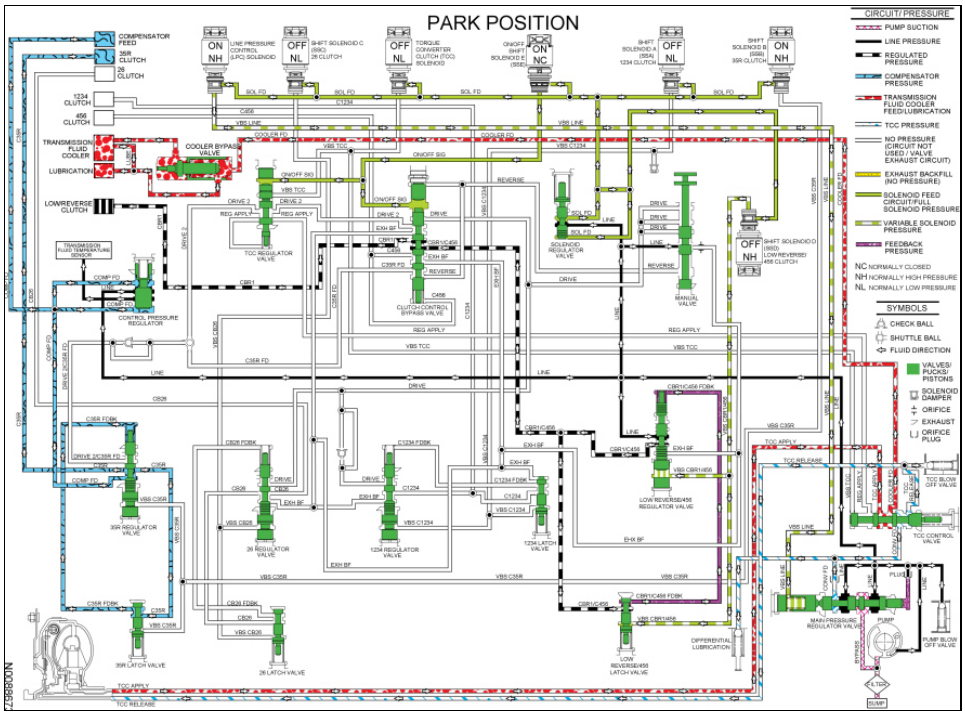
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC	
P	P	Off	On	Off	Off	On	Off

NC = Normally closed

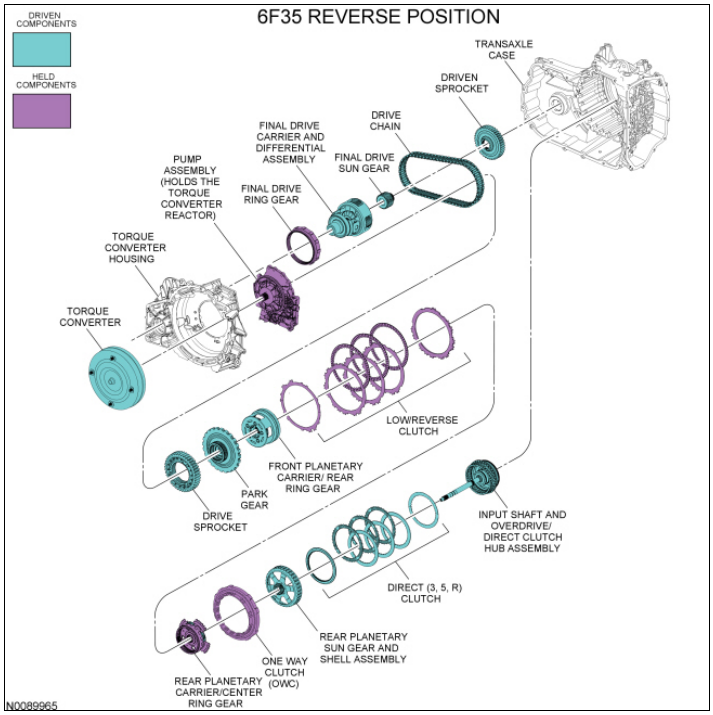
NH = Normally high

NL = Normally low

Printable / zoomable view of this graphic



Reverse Position



Mechanical Operation

Apply components:

- Low/reverse clutch applied
- Direct (3, 5, R) clutch applied

Planetary Gearset Operation

Front planetary gearset driven components:

- Planetary carrier

Center planetary gearset driven components:

- Sun gear (does not contribute to power flow)

Rear planetary gearset driven components:

- Sun gear

Front planetary gearset held components:

- None

Center planetary gearset held components:

- Center ring (does not contribute to power flow)

Rear planetary gearset held components:

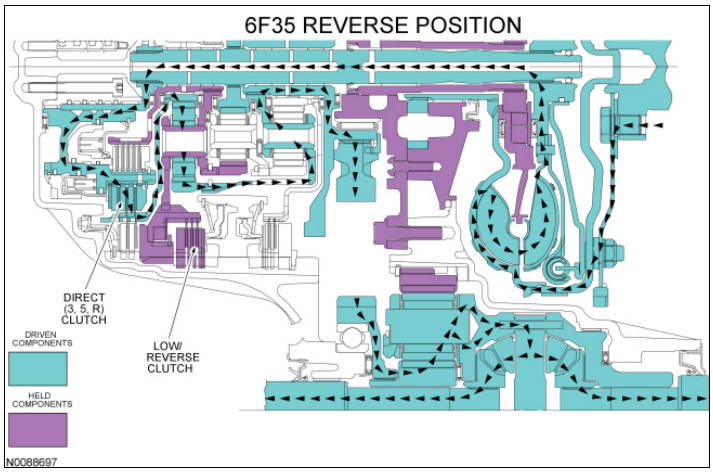
- Planetary carrier

Reverse Position Clutch Application Chart

Gear/Manual Lever Position	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	One-Way
REVERSE	X			X		

For component information, refer to Mechanical Components and Functions in this section.

Reverse Position Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit.

Torque converter circuits:

- Regulated line pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit.
- When the TCC is released, CONV FD pressure is directed to the TCC RELEASE circuit by the TCC control valve. Pressure from the TCC RELEASE circuit releases the TCC .
- Fluid from the TCC RELEASE returns to the TCC control valve through the TCC APPLY circuit.

Cooler and lubrication hydraulic circuits:

- The TCC control valve directs fluid from the TCC APPLY circuit (return circuit from the torque converter when the TCC is released) to the COOLER FD circuit.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies varying pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main pressure regulator valve.
- SSB applies pressure to the 35R regulator and latch valves to apply the direct (3, 5, R) clutch.
- SSD applies pressure to the low reverse/456 regulator valve to apply the low/reverse clutch.
- SSE applies pressure to the clutch control bypass valve to position the valve to direct regulated line pressure in the CBR1/C456 circuit to the CBR1 circuit to apply the low/reverse clutch.

Clutch hydraulic circuits:

- Line pressure supplied to the manual valve is directed to the clutch control bypass valve through the REVERSE circuit.
- The clutch control bypass valve directs the REVERSE circuit to the 35R regulator valve through the C35R FD circuit, DRIVE 2/C35R FD shuttle ball and DRIVE 2/C35R FD circuit. To apply the direct (3, 5, R) clutch, SSB applies varying solenoid pressure to the 35R regulator and latch valves. As the 35R regulator valve moves, it supplies the direct (3, 5, R) clutch and 35R latch valve with regulated line pressure through the C35R circuit. The 35R latch valve directs the regulated line pressure to the opposite side of the 35R regulator valve through the C35R FDBK circuit for gradual direct (3, 5, R) clutch engagement.
- Line pressure from the pump is supplied to the low reverse/456 regulator valve. To apply the low/reverse clutch, SSD supplies varying solenoid pressure to the low reverse/456 regulator and latch valves. As the regulator valve moves, it supplies the clutch control bypass valve and low reverse/456 latch valve with regulated line pressure through the CBR1/C456 circuit. The low reverse/456 latch valve directs the regulated line pressure to the opposite side of the regulator valve through the CBR1/C456 FDBK circuit for gradual low/reverse clutch engagement.
- Regulated line pressure at the clutch control bypass valve in the CBR1/C456 circuit is directed to the low/reverse clutch through the CBR1 circuit to apply the clutch.

For additional hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

Reverse Position Solenoid Operation Chart

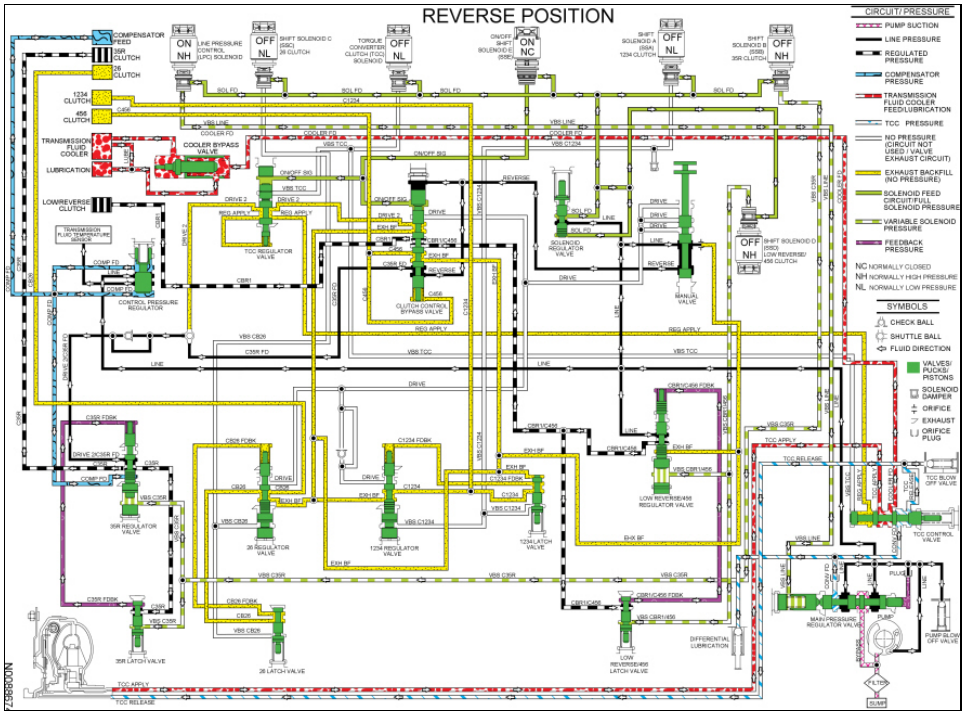
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC	
R	R	Off	Off	Off	Off	On	Off

NC = Normally closed

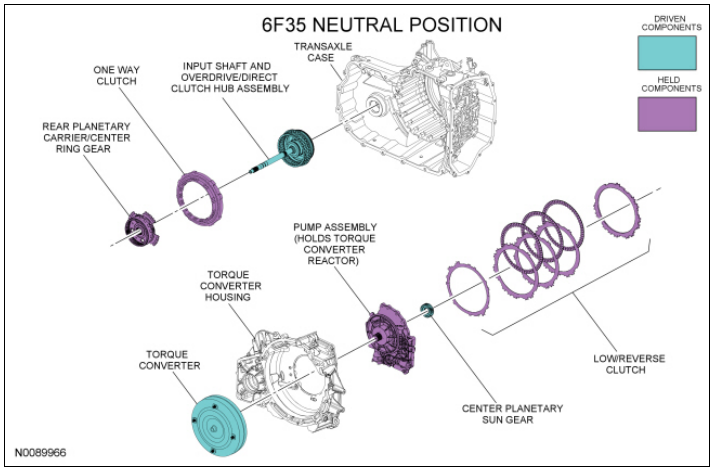
NH = Normally high

NL = Normally low

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Neutral Position



Mechanical Operation

Apply components:

- Low/reverse clutch applied

Planetary Gearset Operation

Front planetary gearset driven components:

- None

Center planetary gearset driven components:

- Sun gear

Rear planetary gearset driven components:

- None

Front planetary gearset held components:

- None

Center planetary gearset held components:

- Ring gear

Rear planetary gearset held components:

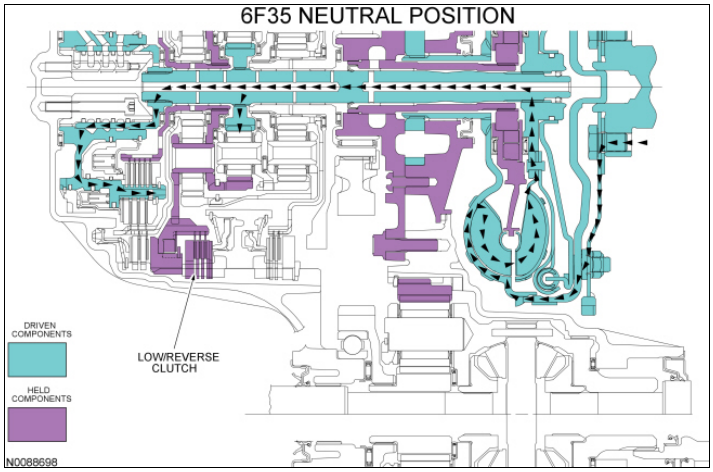
- Planetary carrier

Neutral Position Clutch Application Chart

Gear/Manual Lever Position	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	One-Way
NEUTRAL				X		

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit.

Torque converter circuits:

- Regulated line pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit.
- When the TCC is released, CONV FD pressure is directed to the TCC RELEASE circuit by the TCC control valve. Pressure from the TCC RELEASE circuit releases the TCC .
- Fluid from the TCC RELEASE returns to the TCC control valve through the TCC APPLY circuit.

Cooler and lubrication hydraulic circuits:

- The TCC control valve directs fluid from the TCC APPLY circuit (return circuit from the torque converter when the TCC is released) to the COOLER FD circuit.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies varying pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main pressure regulator valve.
- SSD applies pressure to the low reverse/456 regulator and latch valves to apply the low/reverse clutch.
- SSE applies pressure to the clutch control bypass valve to position the valve to direct regulated line pressure in the CBR1/C456 circuit to the low/reverse clutch.

Clutch hydraulic circuits:

- Line pressure from the pump is supplied to the low reverse/456 regulator valve. To apply the low/reverse clutch, SSD supplies varying solenoid pressure to the low reverse/456 regulator and latch valves. As the regulator valve moves, it supplies the clutch control bypass valve and low reverse/456 latch valve with regulated line pressure through the CBR1/C456 circuit. The low reverse/456 latch valve directs the regulated line pressure to the opposite side of the regulator valve through the CBR1/C456 FDBK circuit for gradual low/reverse clutch engagement.
- Regulated line pressure at the clutch control bypass valve in the CBR1/C456 circuit is directed to the low/reverse clutch through the CBR1 circuit to apply the clutch.

For additional hydraulic circuit information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

Neutral Position Solenoid Operation Chart

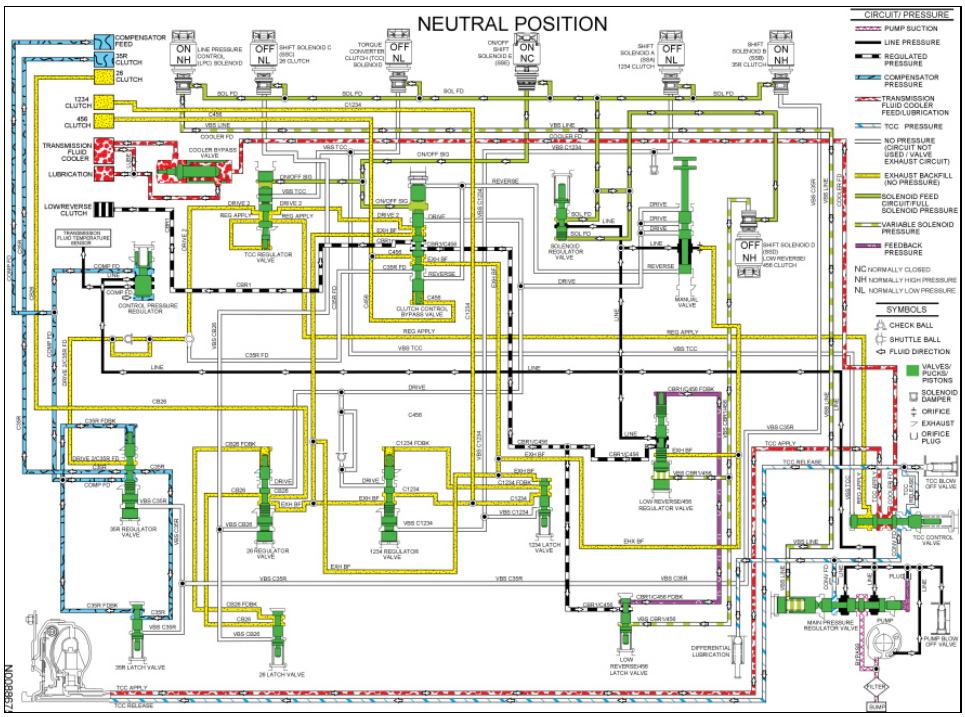
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC	
N	N	Off	On	Off	Off	On	Off

NC = Normally closed

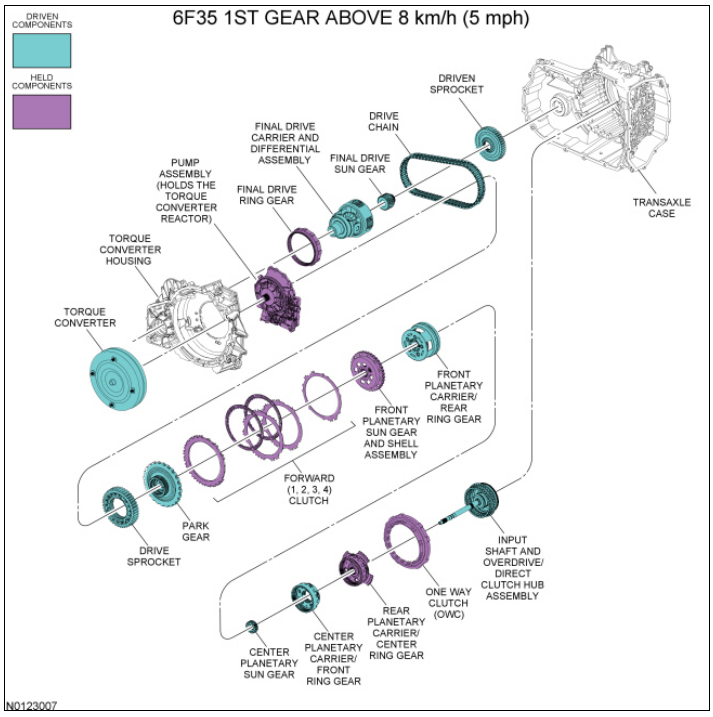
NH = Normally high

NL = Normally low

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1st Gear Above 8 km/h (5 mph)



NOTE: The transaxle operates differently in 1st gear above and below 8 km/h (5 mph). For transaxle operation below 8 km/h (5 mph), refer to Manual LOW Position and 1st Gear Below 8 km/h (5 mph) in this section.

Mechanical Operation

Apply components:

- Forward (1, 2, 3, 4) clutch
- OWC

Planetary Gearset Operation

Front planetary gearset driven components:

- Ring gear
- Planetary carrier

Center planetary gearset driven components:

- Sun gear
- Planetary carrier

Rear planetary gearset driven components:

- Ring gear

Front planetary gearset held components:

- Sun gear

Center planetary gearset held components:

- Ring gear

Rear planetary gearset held components:

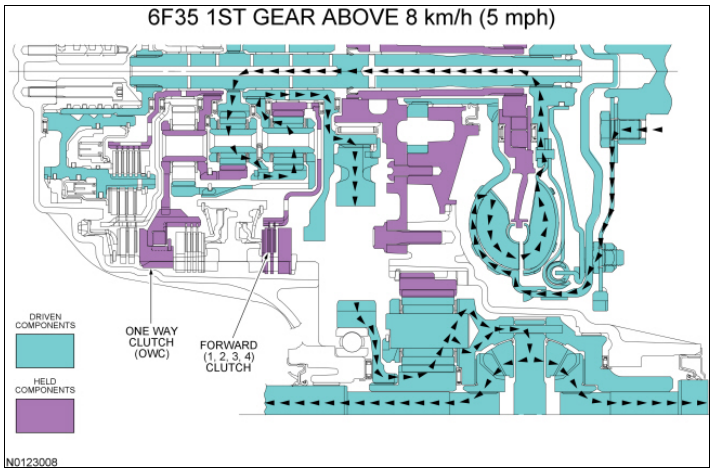
- Rear planetary carrier (does not contribute to power flow)

1st Gear Above 8 km/h (5 mph) Clutch Application Chart

Gear	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	One-Way
1st gear			X			X

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit.

Torque converter circuits:

- Regulated line pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit.
- When the TCC is released, CONV FD pressure is directed to the TCC RELEASE circuit by the TCC control valve. Pressure from the TCC RELEASE circuit releases the TCC .
- Fluid from the TCC RELEASE returns to the TCC control valve through the TCC APPLY circuit.

Cooler and lubrication hydraulic circuits:

- The TCC control valve directs fluid from the TCC APPLY circuit (return circuit from the torque converter when the TCC is released) to the COOLER FD circuit.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies varying pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main pressure regulator valve.
- SSA applies pressure to the 1234 regulator and latch valves to apply the forward (1, 2, 3, 4) clutch.
- SSD releases pressure to the low reverse/456 regulator and latch valves to release the low/reverse clutch.
- SSE releases pressure to the clutch control bypass valve to position it so that regulated line pressure supplied in the CBR1/C456 circuit for 4th, 5th and 6th gear will apply the O/D (4, 5, 6) clutch.

Clutch hydraulic circuits:

- SSD removes pressure from the low reverse/456 regulator and latch valves which positions the valves to block line pressure and release the low/reverse clutch. Solenoid pressure from SSE is removed from the clutch control bypass valve to position it to apply the O/D (4, 5, 6) clutch.
- Line pressure is supplied to the 1234 regulator valve by the manual valve in the DRIVE and LOW position. To apply the forward (1, 2, 3, 4) clutch, SSA supplies varying solenoid pressure to the 1234 regulator and latch valves. As the 1234 regulator valve moves, it supplies the forward (1, 2, 3, 4) clutch and 1234 latch valve with regulated line pressure through the C1234 circuit. The 1234 latch valve directs the regulated line pressure to the opposite side of the regulator valve through the C1234 FDBK circuit for gradual forward (1, 2, 3, 4) clutch engagement.

Electrical Operation

Solenoid operation:

1st Gear Above 8 km/h (5 mph) Solenoid Operation Chart

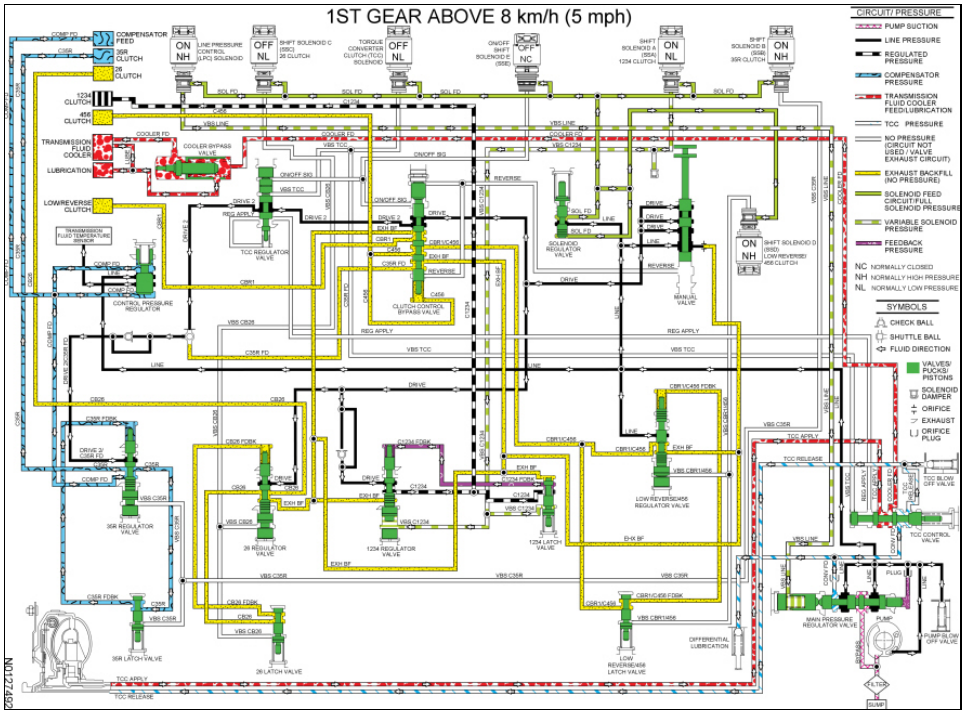
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC	
D	1	On	On	Off	On	Off	Off

NC = Normally closed

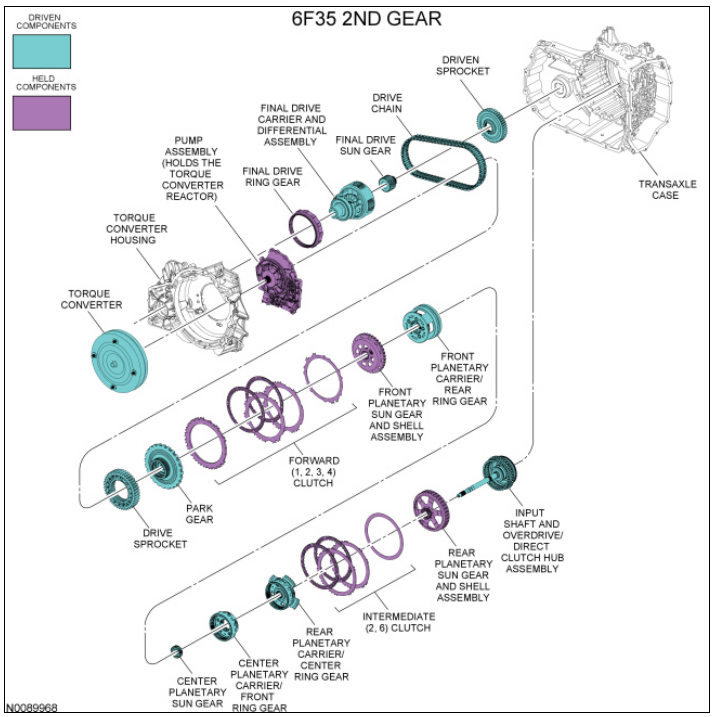
NH = Normally high

NL = Normally low

Printable / zoomable view of this graphic



2nd Gear



Mechanical Operation

Apply components:

- Forward (1, 2, 3, 4) clutch
- Intermediate (2, 6) clutch

Planetary Gearset Operation

Front planetary gearset driven components:

- Planetary carrier
- Ring gear

Center planetary gearset driven components:

- Sun gear
- Planetary carrier
- Ring gear

Rear planetary gearset driven components:

- Planetary carrier
- Ring gear

Front planetary gearset held components:

- Sun gear

Center planetary gearset held components:

- None

Rear planetary gearset held components:

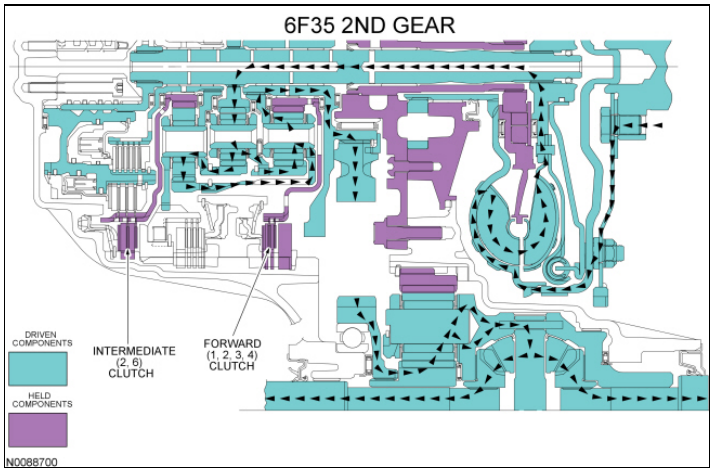
- Sun gear

2nd Gear Clutch Application Chart

Gear	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	One-Way
2nd gear			X		X	

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit.

Torque converter circuits:

- Regulated line pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit.
- When the TCC is released, CONV FD pressure is directed to the TCC RELEASE circuit by the TCC control valve. Pressure from the TCC RELEASE circuit releases the TCC .
- Fluid from the TCC RELEASE returns to the TCC control valve through the TCC APPLY circuit.

Cooler and lubrication hydraulic circuits:

- The TCC control valve directs fluid from the TCC APPLY circuit (return circuit from the torque converter when the TCC is released) to the COOLER FD circuit.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies varying pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main pressure regulator valve.
- SSA applies pressure to the 1234 regulator and latch valves to apply the forward (1, 2, 3, 4) clutch.
- SSC applies pressure to the 26 regulator and latch valves to apply the intermediate (2, 6) clutch.

Clutch hydraulic circuits:

- Line pressure is supplied to the 1234 regulator valve by the manual valve in the DRIVE and LOW position. To apply the forward (1, 2, 3, 4) clutch, SSA supplies varying solenoid pressure to the 1234 regulator and latch valves. As the regulator valve moves, it supplies the forward (1, 2, 3, 4) clutch and 1234 latch valve with regulated line pressure through the C1234 circuit. The 1234 latch valve directs the regulated line pressure to the opposite side of the regulator valve through the C1234 FDBK circuit for gradual forward (1, 2, 3, 4) clutch engagement.
- Line pressure is supplied to the 26 regulator valve by the manual valve in the DRIVE and LOW positions. To apply the intermediate (2, 6) clutch, SSC supplies varying solenoid pressure to the 26 regulator and latch valves. As the 26 regulator valve moves, it supplies the intermediate (2, 6) clutch and 26 latch valve with regulated line pressure through the CB26 circuit. The 26 latch valve directs the regulated line pressure to the opposite side of the 26 regulator valve through the CB26 FDBK circuit for gradual intermediate (2, 6) clutch engagement.

For additional hydraulic circuit and information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

2nd Gear Solenoid Operation Chart

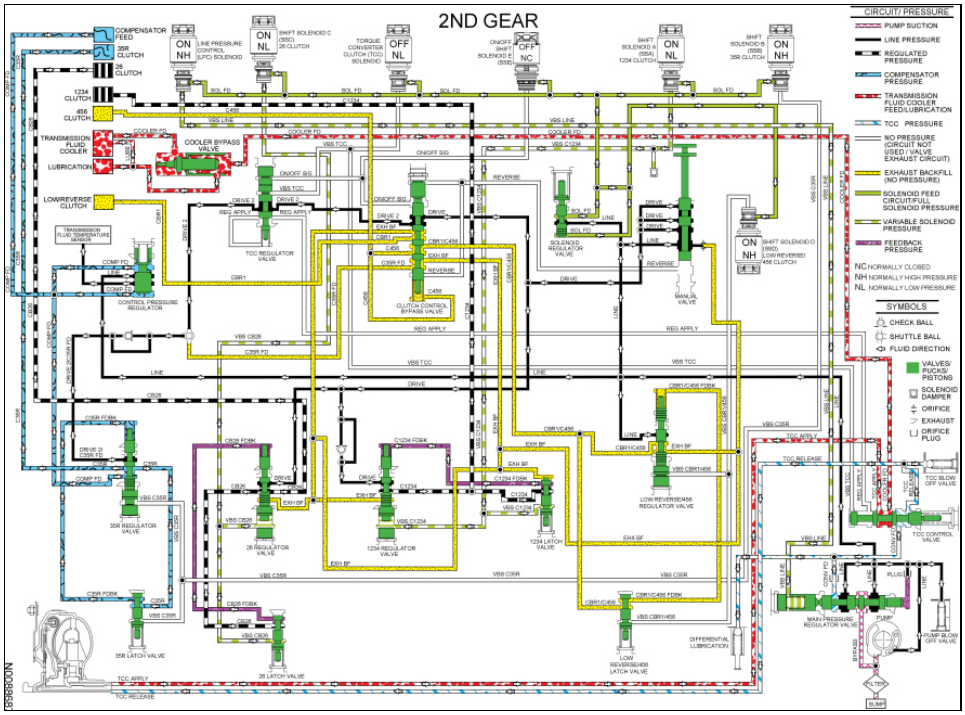
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC	
D	2	On	On	On	On	Off	Off

NC = Normally closed

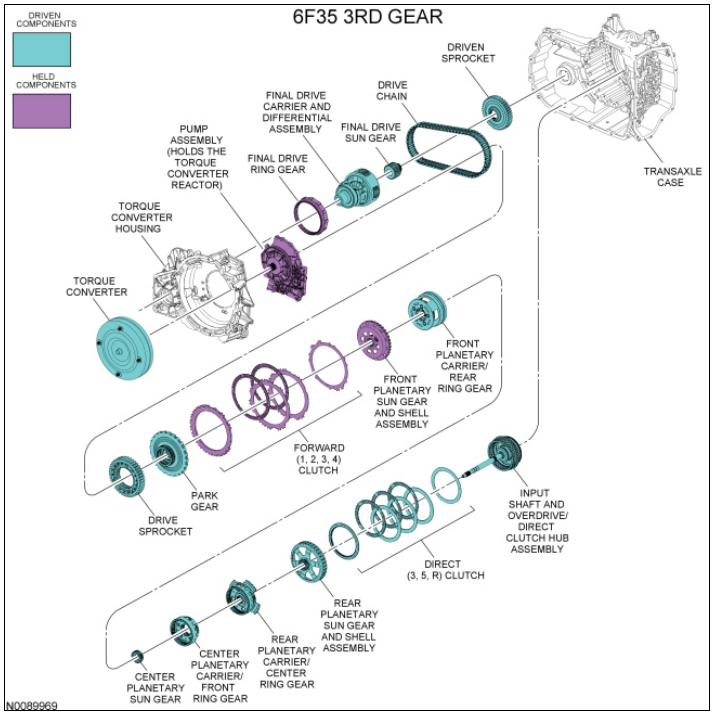
NH = Normally high

NL = Normally low

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3rd Gear



Mechanical Operation

Apply components:

- Forward (1, 2, 3, 4) clutch
- Direct (3, 5, R) clutch

Planetary Gearset Operation

Front planetary gearset driven components:

- Planetary carrier
- Ring gear

Center planetary gearset driven components:

- Sun gear
- Planetary carrier
- Ring gear

Rear planetary gearset driven components:

- Sun gear
- Planetary carrier
- Ring gear

Front planetary gearset held components:

- Sun gear

Center planetary gearset held components:

- None

Rear planetary gearset held components:

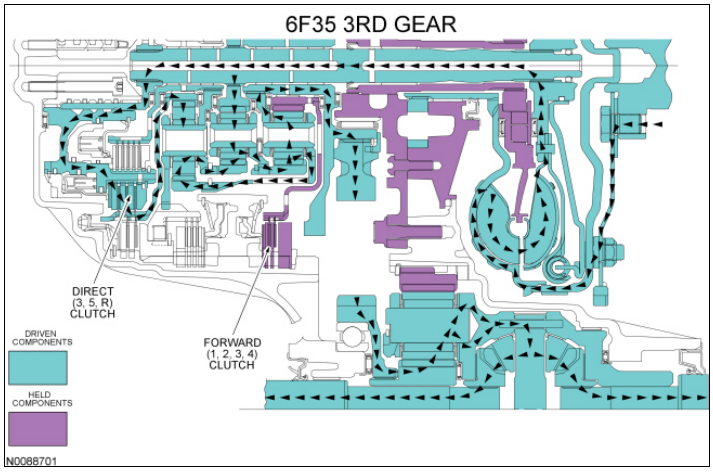
- None

3rd Gear Clutch Application Chart

Gear	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	One-Way
3rd gear	X		X			

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit.

Torque converter circuits:

- Regulated line pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit.
- When the TCC is released, CONV FD pressure is directed to the TCC RELEASE circuit by the TCC control valve. Pressure from the TCC RELEASE circuit releases the TCC .
- Fluid from the TCC RELEASE returns to the TCC control valve through the TCC APPLY circuit.

Cooler and lubrication hydraulic circuits:

- The TCC control valve directs fluid from the TCC APPLY circuit (return circuit from the torque converter when the TCC is released) to the COOLER FD circuit.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies varying pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main pressure regulator valve.
- SSA applies pressure to the 1234 regulator and latch valves to apply the forward (1, 2, 3, 4) clutch.
- SSC releases pressure to the 26 regulator and latch valves to release the intermediate (2, 6) clutch.
- SSB applies pressure to the 35R regulator and latch valves to apply the direct (3, 5, R) clutch.

Clutch hydraulic circuits:

- Line pressure is supplied to the 1234 regulator valve by the manual valve in the DRIVE and LOW position. To apply the forward (1, 2, 3, 4) clutch, SSA supplies varying solenoid pressure to the 1234 regulator and latch valves. As the regulator valve moves, it supplies the forward (1, 2, 3, 4) clutch and latch valve with regulated line pressure through the C1234 circuit. The 1234 latch valve directs the regulated line pressure to the opposite side of the 1234 regulator valve through the C1234 FDBK

circuit for gradual forward (1, 2, 3, 4) clutch engagement.
- Solenoid pressure from SSC is removed from the 26 regulator and latch valves which positions the valves to block line pressure and release the intermediate (2, 6) clutch.
- Line pressure from the pump is directed to the clutch control bypass valve by the manual valve through the DRIVE hydraulic circuit. The clutch control bypass valve directs the pressure to the 35R regulator valve through the TCC regulator valve, DRIVE 2 circuit, DRIVE 2/C35R FD shuttle ball and DRIVE 2/C35R FD circuit. SSB applies varying solenoid pressure to the 35R regulator and latch valves. As the regulator valve moves, it supplies the direct (3, 5, R) clutch and 35R latch valve with regulated line pressure through the C35R circuit. The 35R latch valve directs the regulated line pressure to the opposite side of the 35R regulator valve through the C35R FDBK circuit for gradual direct (3, 5, R) clutch engagement.

For additional hydraulic circuit and information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

3rd Gear Solenoid Operation Chart

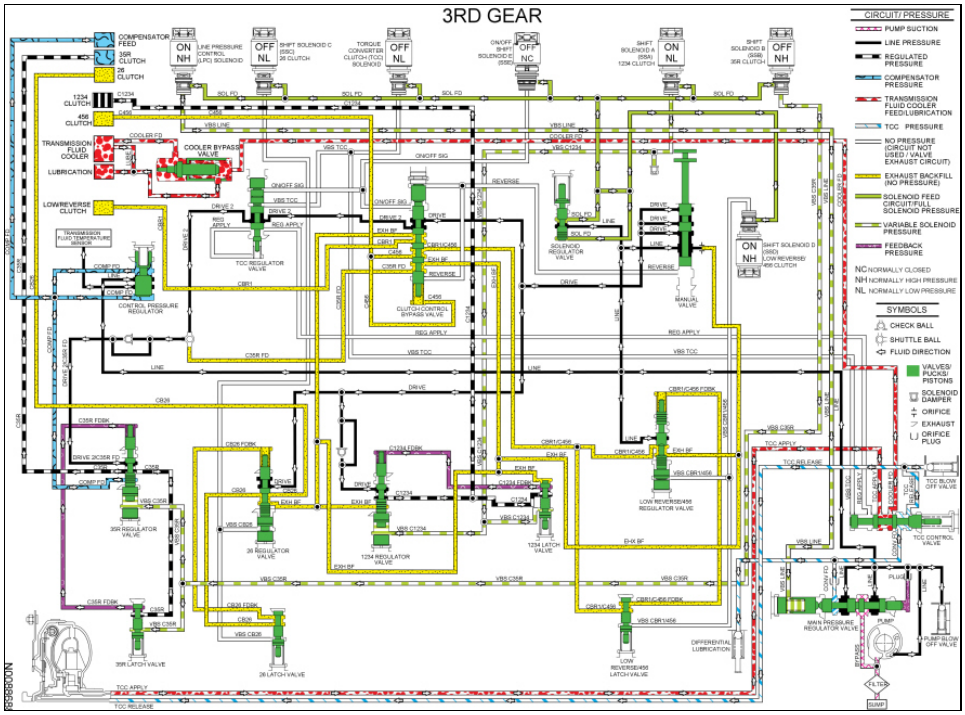
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC	
D	3	On	Off	Off	On	Off	Off

NC = Normally closed

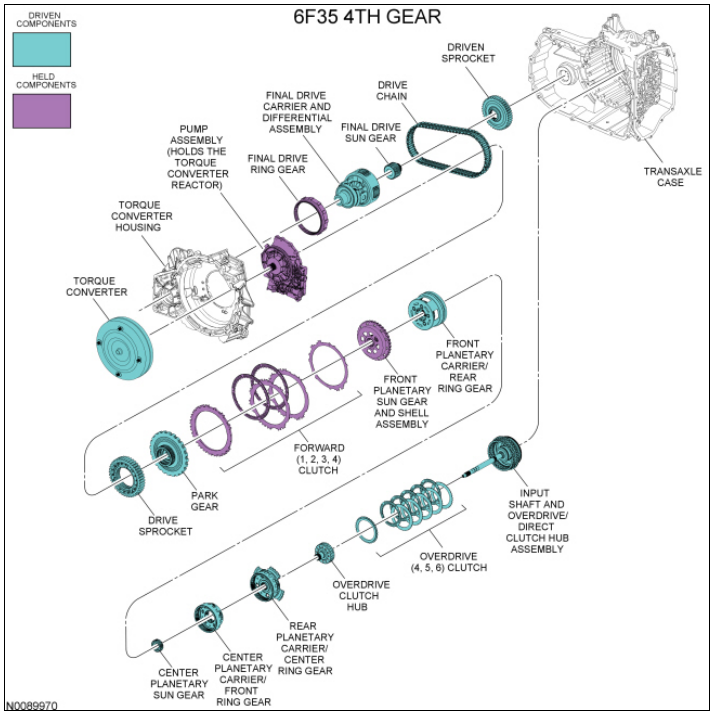
NH = Normally high

NL = Normally low

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4th Gear



Mechanical Operation

Apply components:

- Forward (1, 2, 3, 4) clutch
- O/D (4, 5, 6) clutch

Planetary Gearset Operation

Front planetary gearset driven components:

- Planetary carrier
- Ring gear

Center planetary gearset driven components:

- Sun gear
- Planetary carrier
- Ring gear

Rear planetary gearset driven components:

- Planetary carrier

Front planetary gearset held components:

- Sun gear

Center planetary gearset held components:

- None

Rear planetary gearset held components:

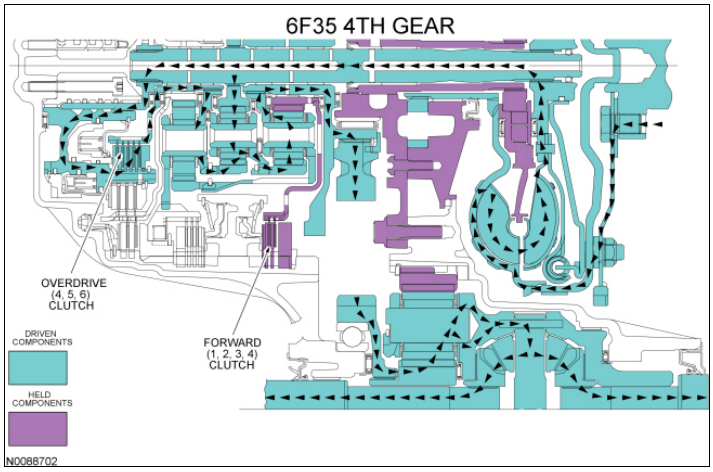
- None

4th Gear Clutch Application Chart

Gear	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	One-Way
4th gear		X	X			

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit.

Torque converter circuits:

- Regulated line pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit.
- When the TCC is released, CONV FD pressure is directed to the TCC RELEASE circuit by the TCC control valve. Pressure from the TCC RELEASE circuit releases the TCC .
- Fluid from the TCC RELEASE circuit returns to the TCC control valve through the TCC APPLY circuit.

Cooler and lubrication hydraulic circuits:

- The TCC control valve directs fluid from the TCC APPLY circuit (return circuit from the torque converter when the TCC is released) to the COOLER FD circuit.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies varying pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main pressure regulator valve.
- SSA applies pressure to the 1234 regulator and latch valves to apply the forward (1, 2, 3, 4) clutch.
- SSB releases pressure to the 35R clutch regulator and latch valves to release the direct (3, 5, R) clutch.
- SSD applies pressure to the low reverse/456 regulator and latch valves to apply the O/D (4, 5, 6) clutch.

Clutch hydraulic circuits:

- Line pressure is supplied to the 1234 regulator valve by the manual valve in the DRIVE and LOW position. To apply the forward (1, 2, 3, 4) clutch, SSA supplies varying solenoid pressure to the 1234

regulator and latch valves. As the regulator valve moves, it supplies the forward (1, 2, 3, 4) clutch and 1234 latch valve with regulated line pressure through the C1234 circuit. The 1234 latch valve directs the regulated line pressure to the opposite side of the 1234 regulator valve through the C1234 FDBK circuit for gradual forward (1, 2, 3, 4) clutch engagement.

- Solenoid pressure from SSB is removed from the 35R regulator and latch valves which positions the valves to block line pressure and release the direct (3, 5, R) clutch.
- Line pressure from the pump is supplied to the low reverse/456 regulator valve. SSD supplies varying solenoid pressure to the low reverse/456 regulator and latch valves. As the regulator valve moves, it supplies the clutch control bypass valve and low reverse/456 latch valve with regulated line pressure through the CBR1/C456 circuit. The low reverse/456 latch valve directs the regulated line pressure to the opposite side of the low reverse/456 regulator valve through the CBR1/C456 FDBK circuit for gradual clutch engagement.
- Regulated line pressure at the clutch control bypass valve in the CBR1/C456 circuit is directed to the O/D (4, 5, 6) clutch through the C456 circuit to apply the clutch.
- Regulated line pressure in the C456 also supplies the latch pressure for the clutch control bypass valve.

For additional hydraulic circuit and information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

4th Gear Solenoid Operation Chart

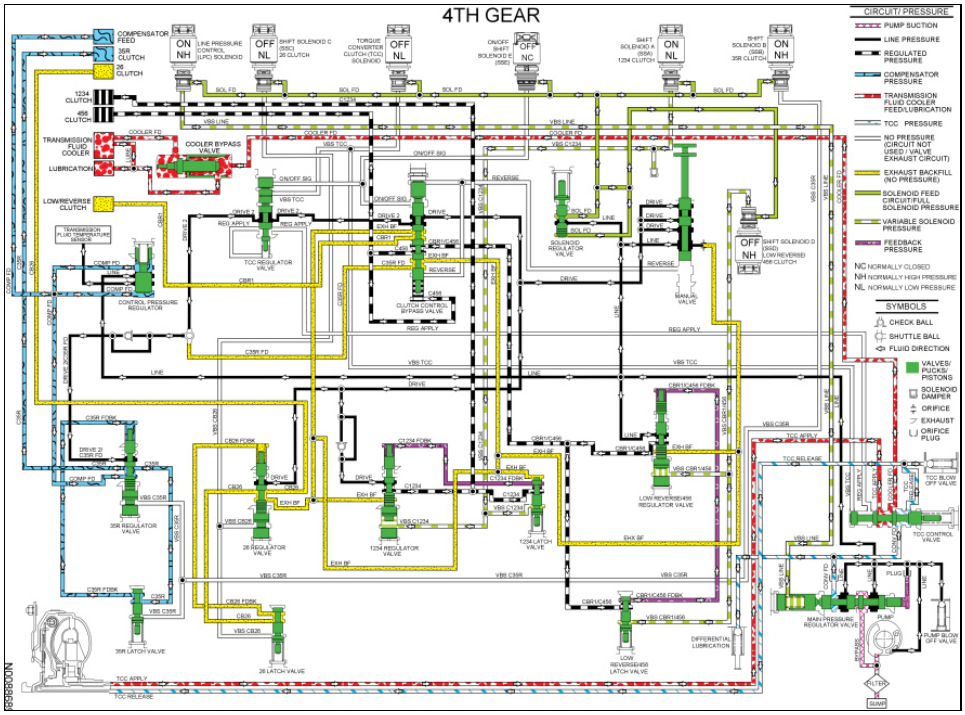
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC	
D	4	On	On	Off	Off	Off	Off

NC = Normally closed

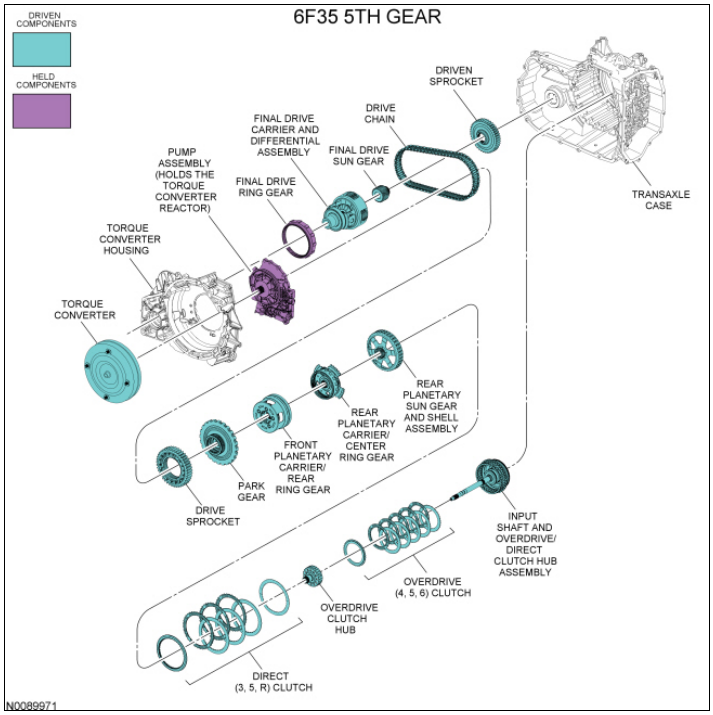
NH = Normally high

NL = Normally low

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5th Gear



Mechanical Operation

Apply components:

- O/D (4, 5, 6) clutch
- Direct (3, 5, R) clutch

Planetary Gearset Operation

Front planetary gearset driven components:

- Planetary carrier

Center planetary gearset driven components:

- Sun gear (does not contribute to power flow)

Rear planetary gearset driven components:

- Sun gear
- Planetary carrier

Front planetary gearset held components:

- None

Center planetary gearset held components:

- None

Rear planetary gearset held components:

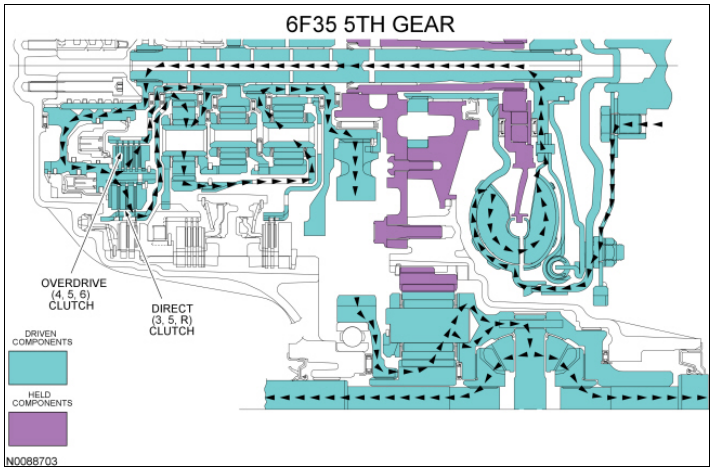
- None

5th Gear Clutch Application Chart

Gear	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	One-Way
5th gear	X	X				

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit.

Torque converter circuits:

- Regulated line pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit.
- When the TCC is released, CONV FD pressure is directed to the TCC RELEASE circuit by the TCC control valve. Pressure from the TCC RELEASE circuit releases the TCC .
- Fluid from the TCC RELEASE returns to the TCC control valve through the TCC APPLY circuit.

Cooler and lubrication hydraulic circuits:

- The TCC control valve directs fluid from the TCC APPLY circuit (return circuit from the torque converter when the TCC is released) to the COOLER FD circuit.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies varying pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main pressure regulator valve.
- SSD applies pressure to the low reverse/456 regulator and latch valves to apply the O/D (4, 5, 6) clutch.
- SSA releases pressure to the 1234 regulator and latch valves to release the forward (1, 2, 3, 4) clutch.
- SSB applies pressure to the 35R regulator and latch valves to apply the direct (3, 5, R) clutch.

Clutch hydraulic circuits:

- Line pressure from the pump is supplied to the low reverse/456 regulator valve. SSD supplies varying solenoid pressure to the low reverse/456 regulator and latch valves. As the regulator valve moves, it supplies the clutch control bypass valve and low reverse/456 latch valve with regulated line pressure through the CBR1/C456 circuit. The low reverse/456 latch valve directs the regulated line pressure to

the opposite side of the regulator valve through the CBR1/C456 FDBK circuit for gradual clutch engagement.
- Regulated line pressure at the clutch control bypass valve in the CBR1/C456 circuit is directed to the O/D (4, 5, 6) clutch through the C456 circuit to apply the clutch.
- Regulated line pressure in the C456 also supplies the latch pressure for the clutch control bypass valve.
- Solenoid pressure from SSA is removed from the 1234 regulator and latch valves which positions the valves to block line pressure and release the forward (1, 2, 3, 4) clutch.
- Line pressure from the pump is directed to the clutch control bypass valve by the manual valve through the DRIVE hydraulic circuit. The clutch control bypass valve directs the pressure to the 35R regulator valve through the TCC regulator valve, DRIVE 2 circuit, DRIVE 2/C35R FD shuttle ball and DRIVE 2/C35R FD circuit. SSB applies varying solenoid pressure to the 35R regulator and latch valves. As the regulator valve moves, it supplies the direct (3, 5, R) clutch and 35R latch valve with regulated line pressure through the C35R circuit. The 35R latch valve directs the regulated line pressure to the opposite side of the 35R regulator valve through the C35R FDBK circuit for gradual direct (3, 5, R) clutch engagement.

For additional hydraulic circuit and information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

5th Gear Solenoid Operation Chart

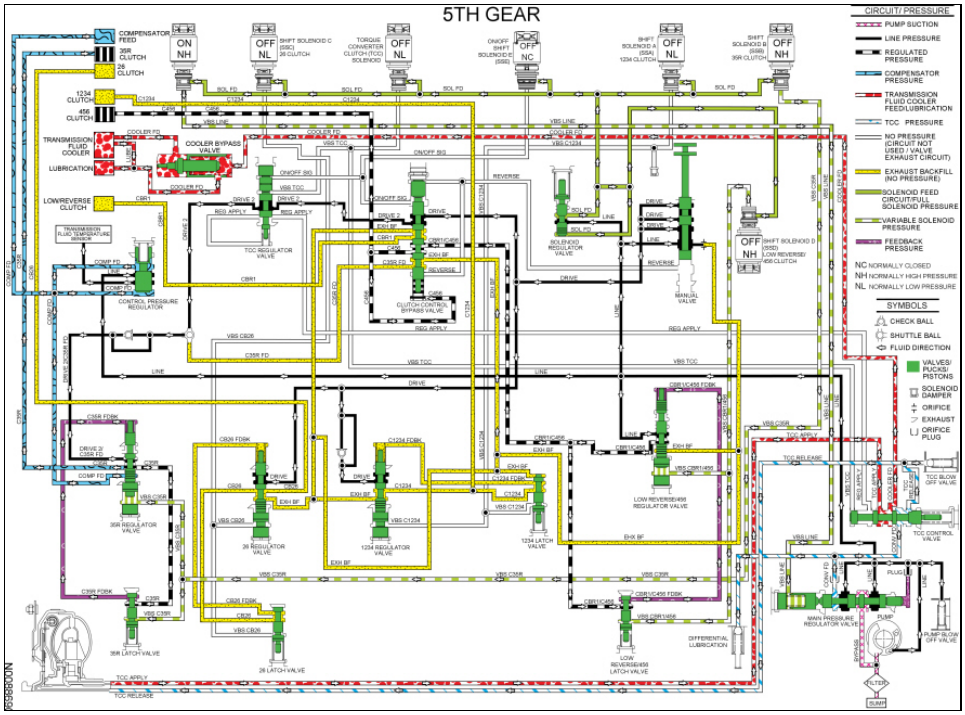
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid				
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC
D	5	Off	Off	Off	Off	Off

NC = Normally closed

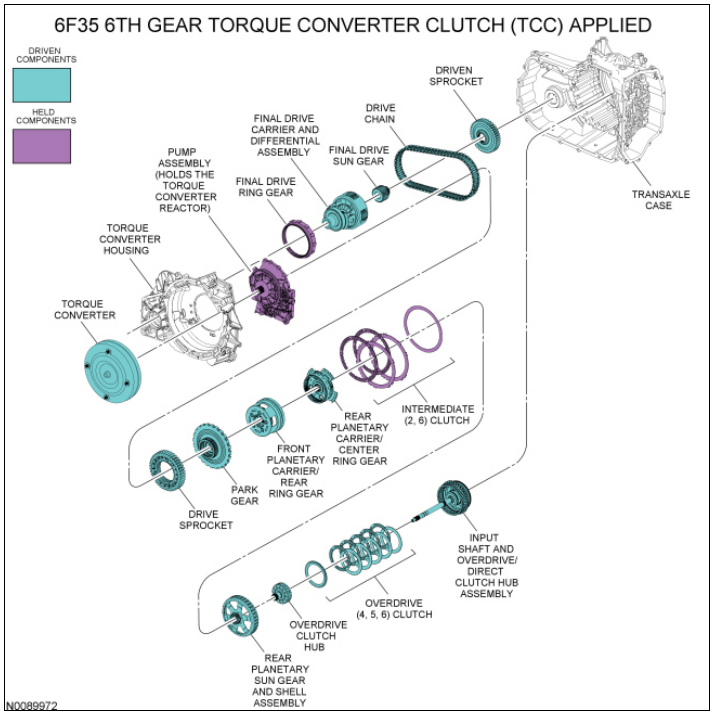
NH = Normally high

NL = Normally low

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6th Gear Torque Converter Clutch (TCC) Applied



Mechanical Operation

Apply components:

- O/D (4, 5, 6) clutch
- Intermediate (2, 6) clutch
- TCC

Planetary Gearset Operation

Front planetary gearset driven components:

- Planetary carrier

Center planetary gearset driven components:

- Sun gear (does not contribute to power flow)

Rear planetary gearset driven components:

- Planetary carrier
- Ring gear

Front planetary gearset held components:

- None

Center planetary gearset held components:

- None

Rear planetary gearset held components:

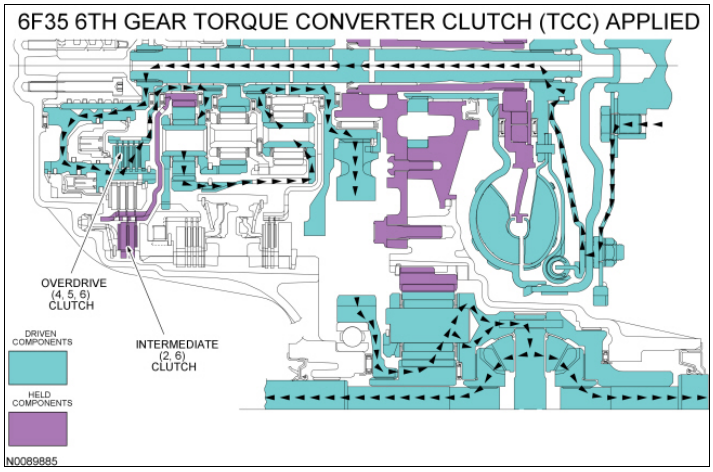
- Sun gear

6th Gear TCC Applied Clutch Application Chart

Gear	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	TCC
6th gear		X			X	X

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit.

Torque converter circuits:

- When the torque converter is applied, line pressure from the manual valve is directed to the TCC regulator valve by the clutch control bypass valve through the DRIVE 2 circuit. The TCC solenoid supplies varying solenoid pressure to the TCC regulator valve and the TCC control valve to position the valves to apply the TCC .
- As the TCC regulator valve moves, it supplies the TCC control valve with regulated line pressure through the REG APPLY circuit. The TCC control valve directs the REG APPLY circuit to the TCC APPLY circuit to apply the TCC .
- Pressure from the torque converter returns to the TCC control valve through the TCC RELEASE circuit.

Cooler and lubrication hydraulic circuits:

- Regulated line pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit. When the TCC is applied, CONV FD pressure supplies the COOLER FD circuit which circulates through the transmission fluid cooler or the thermal bypass valve.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies varying pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main pressure regulator valve.
- SSD applies pressure to the low reverse/456 regulator and latch valves to apply the O/D (4, 5, 6) clutch.
- SSB releases pressure to the 35R regulator and latch valves to release the direct (3, 5, R) clutch.
- SSC applies pressure to the 26 regulator and latch valves to apply the direct (2, 6) clutch.

- The TCC solenoid applies pressure to the TCC control valve and the TCC regulator valve to apply the TCC .

Clutch hydraulic circuits:

- Line pressure from the pump is supplied to the low reverse/456 regulator valve. SSD supplies varying solenoid pressure to the low reverse/456 regulator and latch valves. As the regulator valve moves, it supplies the clutch control bypass valve and low reverse/456 latch valve with regulated line pressure through the CBR1/C456 circuit. The low reverse/456 latch valve directs the regulated line pressure to the opposite side of the low reverse/456 regulator valve through the CBR1/C456 FDBK circuit for gradual clutch engagement.
- Regulated line pressure at the clutch control bypass valve in the CBR1/C456 circuit is directed to the O/D (4, 5, 6) clutch through the C456 circuit to apply the clutch.
- Regulated line pressure in the C456 circuit also supplies the latch pressure for the clutch control bypass valve.
- Solenoid pressure from SSB is removed from the 35R regulator and latch valves which positions the valves to block line pressure and release the direct (3, 5, R) clutch.
- Line pressure is supplied to the 26 regulator valve by the manual valve in the DRIVE and LOW positions. To apply the intermediate (2, 6) clutch, SSC supplies varying solenoid pressure to the 26 regulator and latch valves. As the regulator valve moves, it supplies the intermediate (2, 6) clutch and 26 latch valve with regulated line pressure through the CB26 circuit. The 26 latch valve directs the regulated line pressure to the opposite side of the regulator valve through the CB26 FDBK circuit for gradual intermediate (2, 6) clutch engagement.

For additional hydraulic circuit and information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

6th Gear TCC Applied Solenoid Operation Chart

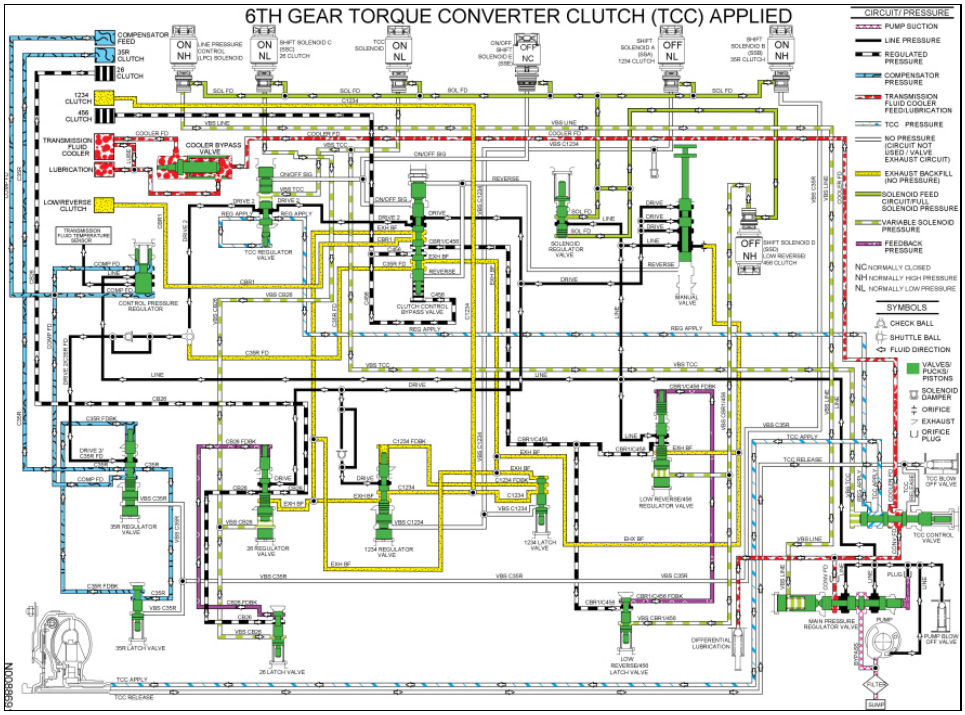
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC	
D	6	Off	On	On	Off	Off	On

NC = Normally closed

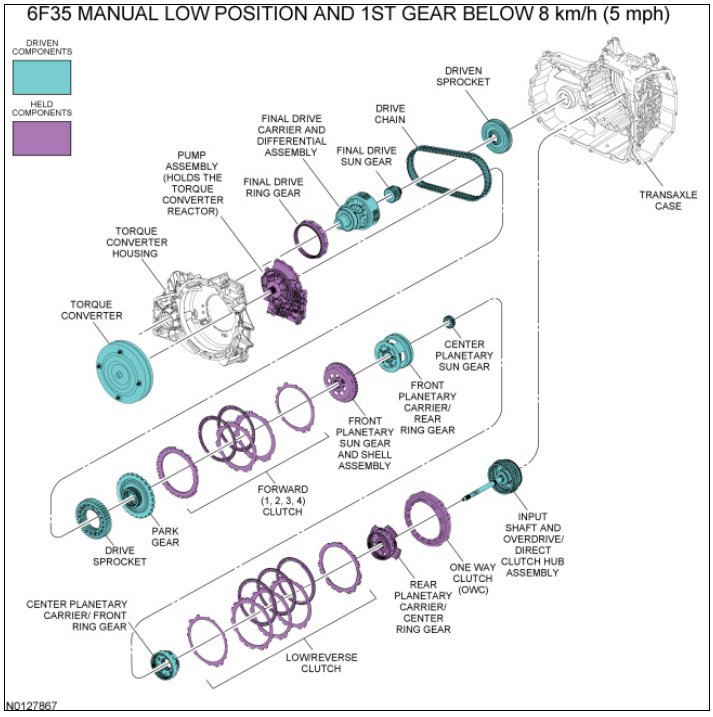
NH = Normally high

NL = Normally low

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Manual LOW Position and 1st Gear Below 8 km/h (5 mph) Solenoid Operation Chart



NOTE: The transaxle operates differently in first gear above and below 8 km/h (5 mph). For transaxle operation above 8 km/h (5 mph), refer to 1st Gear Above 8 km/h (5 mph) in this section.

Mechanical Operation

Apply components:

- Forward (1, 2, 3, 4) clutch
- Low/reverse clutch

- Low OWC

Planetary Gearset Operation

Front planetary gearset driven components:

- Ring gear
- Planetary carrier

Center planetary gearset driven components:

- Sun gear
- Planetary carrier

Rear planetary gearset driven components:

- None

Front planetary gearset held components:

- Sun gear

Center planetary gearset held components:

- Ring gear

Rear planetary gearset held components:

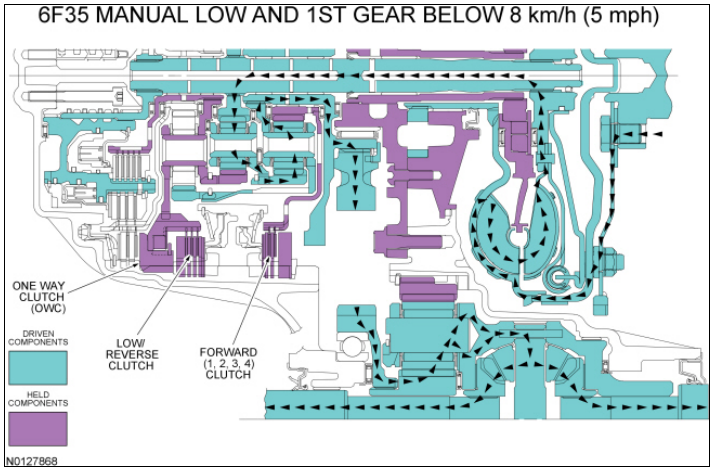
- Rear planetary carrier (does not contribute to power flow)

Manual LOW Position and 1st Gear Below 8 km/h (5 mph) Clutch Application Chart

Gear	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	One-Way
1st gear			X	X		X

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit.

Torque converter circuits:

- Regulated line pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit.
- When the TCC is released, CONV FD pressure is directed to the TCC RELEASE circuit by the TCC control valve. Pressure from the TCC RELEASE circuit releases the TCC .
- Fluid from the TCC RELEASE returns to the TCC control valve through the TCC APPLY circuit.

Cooler and lubrication hydraulic circuits:

- The TCC control valve directs fluid from the TCC APPLY circuit (return circuit from the torque converter when the TCC is released) to the COOLER FD circuit.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies varying pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid regulates line pressure by controlling the position of the main pressure regulator valve.
- SSA applies pressure to the 1234 regulator and latch valves to apply the forward (1, 2, 3, 4) clutch.
- SSD applies pressure to the low reverse/456 regulator and latch valves to apply the low/reverse clutch.
- SSE applies pressure to the clutch control bypass valve to position the valve to direct regulated line pressure in the CBR1/C456 circuit to the low/reverse clutch.

Clutch hydraulic circuits:

- Line pressure is supplied to the 1234 regulator valve by the manual valve in the DRIVE and LOW position. To apply the forward (1, 2, 3, 4) clutch, SSA supplies varying solenoid pressure to the 1234 regulator and latch valves. As the 1234 regulator valve moves, it supplies the forward (1, 2, 3, 4)

clutch and 1234 latch valve with regulated line pressure through the C1234 circuit. The latch valve directs the regulated line pressure to the opposite side of the regulator valve through the C1234 FDBK circuit for gradual forward (1, 2, 3, 4) clutch engagement.

- Line pressure from the pump is supplied to the low reverse/456 regulator valve. To apply the low/reverse clutch, SSD supplies varying solenoid pressure to the low reverse/456 regulator and latch valves. As the regulator valve moves, it supplies the clutch control bypass valve and low reverse/456 latch valve with regulated line pressure through the CBR1/C456 circuit. The low reverse/456 latch valve directs the regulated line pressure to the opposite side of the low reverse/456 regulator valve through the CBR1/C456 FDBK circuit for gradual low/reverse clutch engagement.
- Regulated line pressure at the clutch control bypass valve in the CBR1/C456 circuit is directed to the low/reverse clutch through the CBR1 circuit to apply the clutch.

For additional hydraulic circuit and information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

Manual LOW Position and 1st Gear Below 8 km/h (5 mph) Solenoid Operation Chart

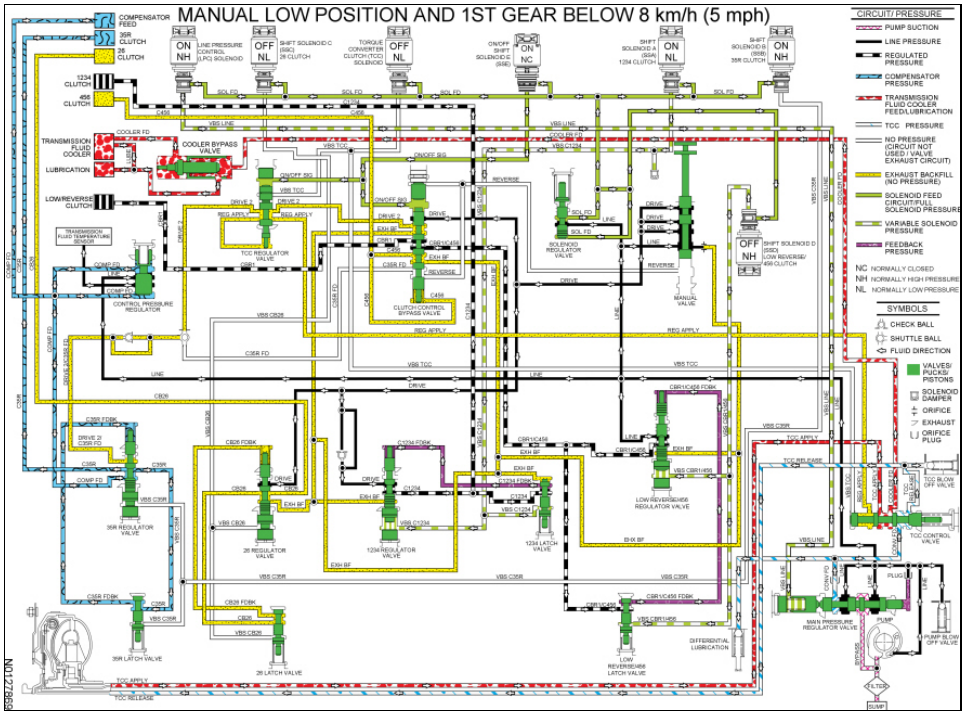
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC	
L	1	On	On	Off	Off	On	Off

NC = Normally closed

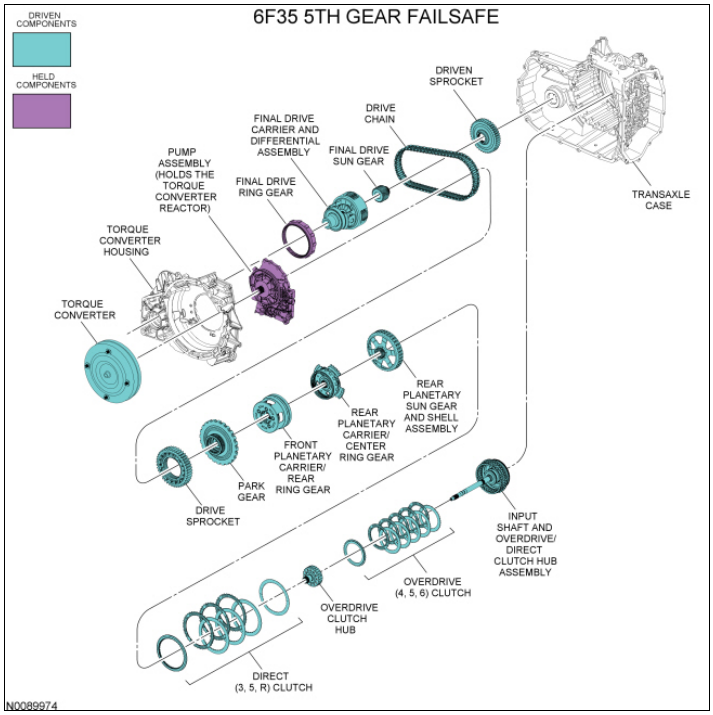
NH = Normally high

NL = Normally low

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5th Gear Failsafe



5th Gear Failsafe Description

When the transaxle has an electrical, hydraulic or mechanical failure, the PCM removes ground (control) from the shift, TCC and LPC solenoids. The uncontrolled solenoids default to their normal states. SSB , SSD and the LPC solenoid are normally high solenoids which means in their normal state, they provide high pressure to the valves they control. This provides only 5th gear with maximum line pressure.

Mechanical Operation

Apply components:

- O/D (4, 5, 6) clutch
- Direct (3, 5, R) clutch

Planetary Gearset Operation

Front planetary gearset driven components:

- Planetary carrier

Center planetary gearset driven components:

- Sun gear (does not contribute to power flow)

Rear planetary gearset driven components:

- Sun gear
- Planetary carrier

Front planetary gearset held components:

- None

Center planetary gearset held components:

- None

Rear planetary gearset held components:

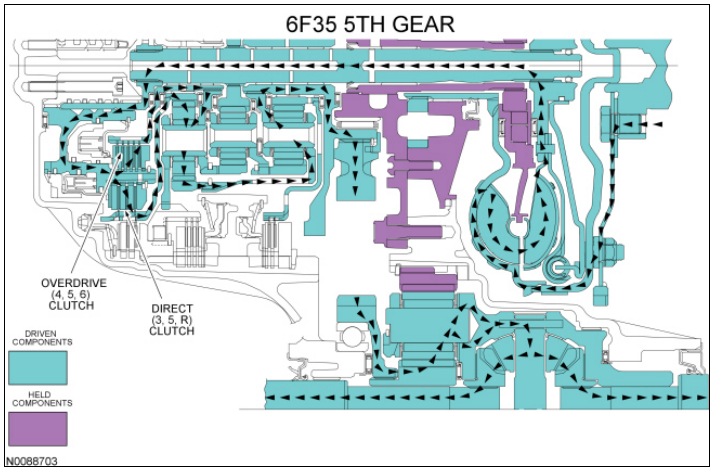
- None

5th Gear Failsafe Clutch Application Chart

Gear	Direct (3, 5, R)	Overdrive (4, 5, 6)	Forward (1, 2, 3, 4)	Low/ Reverse (L, R)	Intermediate (2, 6)	One-Way
5th gear	X	X				

For component information, refer to Mechanical Components and Functions in this section.

Power Flow



Hydraulic Operation

Line pressure hydraulic circuits:

- Line pressure from the pump is supplied to the main pressure regulator valve, low reverse/456 regulator valve, manual valve, solenoid regulator valve and control pressure regulator.
- Line pressure is controlled by the position of the main pressure regulator valve.
- The position of the main pressure regulator valve is controlled by varying pressure from the LPC solenoid through the VBS LINE circuit. In 5th gear failsafe, full solenoid pressure is supplied by the LPC solenoid to the main pressure regulator valve for maximum line pressure.

Torque converter circuits:

- Pressure from the main pressure regulator valve is directed to the TCC control valve through the CONV FD hydraulic circuit.
- When the TCC is released, CONV FD pressure is directed to the TCC RELEASE circuit by the TCC control valve. Pressure from the TCC RELEASE circuit releases the TCC .
- Fluid from the TCC RELEASE circuit returns to the TCC control valve through the TCC APPLY circuit.

Cooler and lubrication hydraulic circuits:

- The TCC control valve directs fluid from the TCC APPLY circuit (return circuit from the torque converter when the TCC is released) to the COOLER FD circuit.
- In the COOLER FD circuit, transmission fluid flows through the transmission fluid cooler or the thermal bypass valve to the LUBE circuit in the input shaft to supply lubrication to the transaxle.

Solenoid hydraulic circuits:

- The LPC solenoid applies maximum solenoid output pressure to the main pressure regulator valve through the VBS LINE hydraulic circuit. The LPC solenoid defaults to maximum output to provide maximum line pressure.
- SSD applies maximum solenoid pressure to the low reverse/456 clutch regulator and latch valves to apply the O/D (4, 5, 6) clutch.
- SSB applies maximum solenoid pressure to the 35R clutch regulator and latch valves to apply the direct (3, 5, R) clutch.

Clutch hydraulic circuits:

- Line pressure from the pump is supplied to the low reverse/456 regulator valve. SSD supplies maximum solenoid pressure to the low reverse/456 regulator and latch valves to provide full line

pressure in the CBR1/C456 circuit.
- Maximum line pressure at the clutch control bypass valve in the CBR1/C456 circuit is directed to the O/D (4, 5, 6) clutch through the C456 circuit to apply the clutch.
- Pressure in the C456 also supplies the latch pressure for the clutch control bypass valve.
- Line pressure from the pump is directed to the clutch control bypass valve by the manual valve through the DRIVE hydraulic circuit. The clutch control bypass valve directs the pressure to the 35R regulator valve through the TCC regulator valve, DRIVE 2 circuit, DRIVE 2/C35R FD shuttle ball and DRIVE 2/C35R FD circuit. SSB applies maximum solenoid pressure to the 35R regulator and latch valves to provide full line pressure to the direct (3, 5, R) clutch.

For additional hydraulic circuit and information, refer to Hydraulic Circuits in this section.

Electrical Operation

Solenoid operation:

5th Gear Failsafe Solenoid Operation Chart

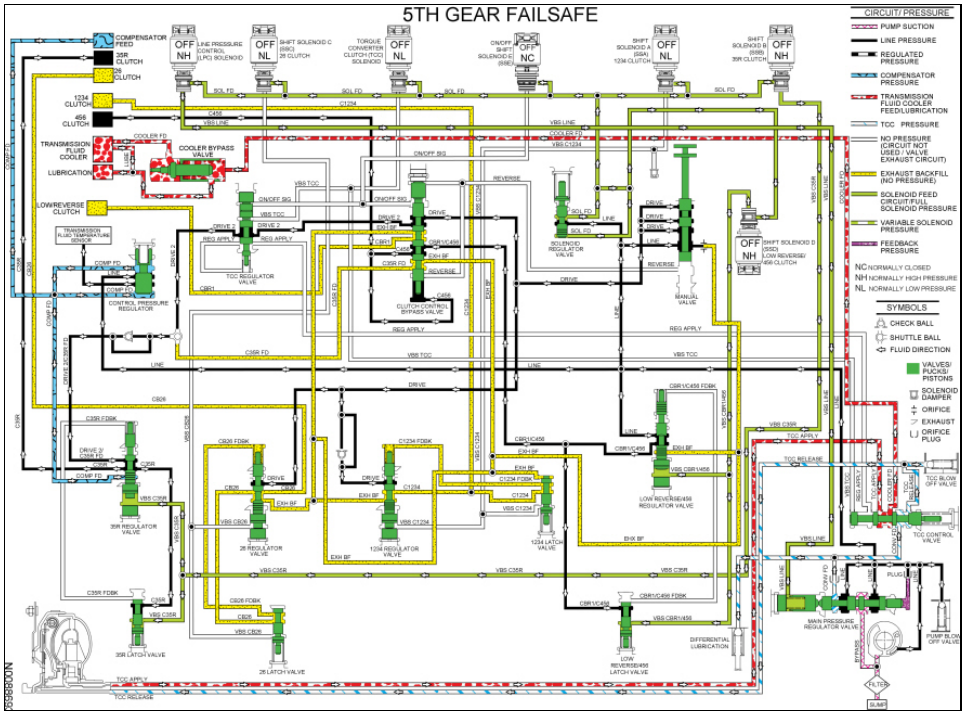
Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid				
		SSA (VFS) NL (1, 2, 3, 4)	SSB (VFS) NH (3, 5, R)	SSC (VFS) NL (2, 6)	SSD (VFS) NH (L, R/4, 5, 6)	SSE (On/Off) NC
D	5	Off	Off	Off	Off	Off

NC = Normally closed

NH = Normally high

NL = Normally low

Printable / zoomable view of this graphic


5TH GEAR FAILSAFE
CIRCUIT/ PRESSURE
PUMP SUCTION
LINE PRESSURE
REGULATED PRESSURE
COMPENSATOR PRESSURE
TRANSMISSION FLUID COOLER FEED/LUBRICATION
TCC PRESSURE
NO PRESSURE (CIRCUIT NOT USED / VALVE EXHAUST CIRCUIT)
EXHAUST BACKFILL (NO PRESSURE)
SOLENOID FEED CIRCUIT/ FULL SOLENOID PRESSURE
VARIABLE SOLENOID PRESSURE
FEEDBACK PRESSURE
NC NORMALLY CLOSED
NH NORMALLY HIGH PRESSURE
NL NORMALLY LOW PRESSURE
SYMBOLS
CHECK BALL
SHUTTLE BALL
FLUID DIRECTION
VALVES/ PLUGS/ PISTONS
SOLENOID DAMPER
ORIFICE
EXHAUST
ORIFICE PLUG
COMPENSATOR FEED
35R CLUTCH
26 CLUTCH
1234 CLUTCH
456 CLUTCH
TRANSMISSION FLUID COOLER
LUBRICATION
LOW/REVERSE CLUTCH
COOLER BYPASS VALVE
TRANSMISSION FLUID TEMPERATURE SENSOR
CONTROL PRESSURE REGULATOR
TCC REGULATOR VALVE
CLUTCH CONTROL BYPASS VALVE
SOLENOID REGULATOR VALVE
MANUAL VALVE
35R REGULATOR VALVE
26 REGULATOR VALVE
1234 REGULATOR VALVE
1234 LATCH VALVE
LOW REVERSE/456 REGULATOR VALVE
TCC BLOW OFF VALVE
TCC CONTROL VALVE
MAIN PRESSURE REGULATOR VALVE
PUMP BLOW OFF VALVE
35R LATCH VALVE
26 LATCH VALVE
LOW REVERSE/456 LATCH VALVE
DIFFERENTIAL LUBRICATION
FILTER
SUMP

Diagnostic Strategy

Troubleshooting an electronically controlled automatic transmission is simplified by using the proven method of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

NOTE: Do not take shortcuts or assume that critical checks or adjustments have already been made.

Follow the procedures as written to avoid missing critical components or steps.

To correctly diagnose a concern, have the following publications available:

- Transmission reference manual
- Powertrain Control/Emissions Diagnosis (PC/ED) manual
- TSBs
- Wiring diagrams manual

These publications provide the information required when diagnosing transmission concerns.

Use the Diagnostic Flow C as a guide and follow the steps as indicated.

Preliminary Inspection

- Know and understand the customer concern.
- Verify the concern by operating the vehicle.
- Check the fluid levels and condition.
- Check for non-factory add-on items.
- Check selector lever linkage for correct adjustment.
- Check TSB messages regarding the concern.

Diagnostics

- Carry out OBD test procedures, KOEO and KOER self-tests.
- Record all DTCs.
- Repair all non-transmission codes first.
- Repair all transmission codes second.
- Clear all continuous codes and attempt to repeat them.
- Repair all continuous codes.
- If only pass codes are obtained, refer to Diagnosis By Symptom for further information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

Diagnostic Flow Chart

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Prior to carrying out the flow test, the following items should be checked:

- Know and understand the customer concern.
- Verify the concern by operating the vehicle.
- Check the transmission fluid level and condition.
- Check for non-factory installed items and verify correct installation.
- Check the selector lever linkage adjustments.
- Check TSB messages for vehicle concerns.
- Carry out both KOEO and KOER self-test.
- Record all DTCs.

Diagnostic Flow Chart

Test	Result	Action
1)â Were any DTCs recorded?	Yes	• REPAIR all hard DTCs. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first, then this workshop manual, GO to Step 2.
	No	• REFER to Diagnosis By Symptom , GO to Step 5.
2)â Are any continuous test memory codes present?	Yes	• CLEAR codes and CARRY OUT drive cycle test, GO to Step 3.
	No	• GO to Step 4.
3)â Did the continuous test memory codes reappear?	Yes	• REPAIR all continuous test memory codes. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, then the transmission reference manual, then this workshop manual, GO to Step 4.
	No	• GO to Step 4.
4)â Is the concern repaired?	Yes	• CARRY OUT the final self-test and verify no DTCs are present. CLEAR memory codes.

	No	• REFER to Diagnosis By Symptom , GO to Step 5.
5)â Are there any electrical concerns?	Yes	• INSTALL the scan tool. CARRY OUT static and drive test with the scan tool, GO to Step 6.
	No	• REFER to the hydraulic and mechanical routine to diagnose and repair the concern, GO to Step 7.
6)â Was the transmission concern corrected when the scan tool was installed?	Yes	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, intermittent fault diagnosis section and use the scan tool to diagnose cause of concern in the processor, vehicle harness or external inputs (sensors or switches).
	No	• REFER to the hydraulic and mechanical routine to diagnose the concern, GO to Step 7.
7)â Is the concern repaired?	Yes	• CARRY OUT the final self-test and verify no DTCs are present. CLEAR memory codes.
	No	• Concern should have been repaired. GO back through the Diagnostic Flow Chart and review other components that may have contributed to the concern. CHECK and DIAGNOSE those components. Get assistance from other sources.

Preliminary Inspection

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

The following items must be checked prior to beginning the diagnostic procedures.

Know and Understand the Concern

In order to correctly diagnose a concern, first understand the customer complaint or condition. Customer contact may be required in order to begin to verify the concern. Understand the conditions as to when the concern occurs. For example:

- Hot or cold vehicle temperature
- Hot or cold ambient temperature
- Vehicle driving conditili>
- Vehicle loaded/unloaded

After understanding when and how the concern occurs, proceed to verifying the concern.

Verification of Condition

This section provides information which is used in determining the actual cause of customer concern and carrying out the appropriate procedures.

The following procedures must be used when verifying customer concerns for the transmission.

Determine Customer Concern

NOTE: Some transaxle conditions may cause engine concerns. The torque converter not disengaging may stall the engine.

Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- Hot or cold vehicle operating temperature
- Hot or cold ambient temperatures
- Type of terrain
- Vehicle loaded/unloaded
- City/highway driving
- Upshift
- Downshift
- Coasting

- Engagement
- Noise/vibration - check for engine rpm , vehicle speed, shift, gear, range or temperature dependencies.

Check Transmission Fluid Level and Condition

NOTICE: **Do not drive the vehicle if the transmission fluid level indicator shows the transmission fluid is below the minimum transmission fluid level mark or internal failure could result.**

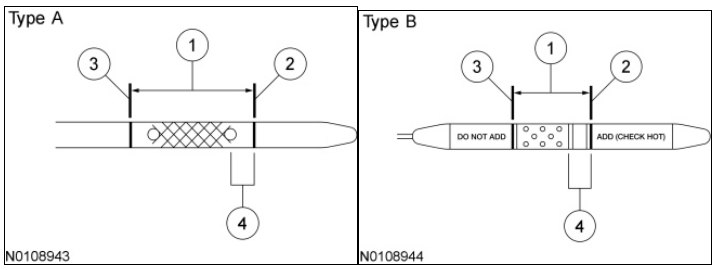
If the vehicle has been operated for an extended period of time at highway speeds, in city traffic, in hot weather or while pulling a trailer, the transmission fluid may need to cool down to obtain an accurate reading.

The transmission fluid level reading on the transmission fluid level indicator will differ depending on operating and ambient temperatures. The correct reading should be within the crosshatch area.

Transmission Fluid Level Check NOTE: Transmission fluid should be checked at normal operating temperature 85°C-93°C (185°F-200°F) on a level surface. Normal operating temperature can be reached after approximately 32 km (20 mi) of driving and can be checked using the scan tool.

Check the transmission fluid level during normal maintenance. If the transaxle starts to slip, shifts slowly or shows signs of leaking, the transmission fluid level should be checked.

1. With the selector lever in PARK, engine at idle, brake pedal applied, move the selector lever through each gear range and allow engagement of each gear. Place the selector lever in the PARK position.
2. Wipe the transmission fluid level indicator cap and remove the transmission fluid level indicator.
3. Wipe the transmission fluid level indicator with a clean cloth.
4. Install the transmission fluid level indicator back in the transmission fluid filler tube until it is fully seated.
5. Remove the transmission fluid level indicator. The transmission fluid level should be within the crosshatch area.



Item	Description
1	Correct transmission fluid level at operating temperature 85°C-93°C (185°F-200°F)
2	Minimum transmission fluid level mark
3	Maximum transmission fluid level mark
4	Flat tow transmission fluid level

High Transmission Fluid Level

High transmission fluid level may cause the transmission fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of transmission fluid from the vent tube and possible transaxle malfunction and/or damage. If an overfill reading is indicated, refer to Transmission Fluid Drain and Refill in this section.

Low Transmission Fluid Level

Low transmission fluid level could result in poor transaxle engagement, slipping, malfunction and/or damage. This could also indicate a leak in one of the transaxle seals or gaskets.

Adding Transmission Fluid

NOTICE: **The use of any type of transmission fluid other than specified could result in transaxle malfunction and/or damage.**

If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pt) increments through the transmission fluid filler tube with the selector lever in PARK and the engine idling. Do not overfill the transmission. For transmission fluid type, refer to Material chart in this section.

Flat Tow Fluid Level

Recreati flat towing of the vehicle may require the transmission fluid to be set to a lower fluid level. This will prevent damage to the transmission. The transmission fluid level is within the normal operating range and will not require the transmission fluid level to be readjusted after recreational towing.

Transmission Fluid Condition Check

1. Check the transmission fluid level.
2. Hold the transmission fluid level indicator over a white facial tissue and allow the transmission fluid to drip onto the facial tissue and examine the stain.
3. Observe the color and the odor. Under normal circumstances, the color should be dark red, not brown or black or have a burnt odor.
4. If evidence of solid material is found, remove the transmission fluid pan for further inspection.
5. If the stain is a foamy pink color, this may indicate coolant or water in the transaxle. Inspect the engine cooling system at this time.
6. If transmission fluid contamination or transaxle failure is confirmed by the sediment in the transmission fluid, disassemble and thoroughly clean the transaxle, including the torque converter, cooler bypass valve, coolers and cooler tubes.
7. Carry out diagnostic checks and adjustments, refer to Diagnosis By Symptom in this section.

Water in Transmission Fluid

To correctly repair a transaxle that had water or coolant introduced into the system, completely disassemble, clean and replace the following parts:

- All internal and external seals
- All friction material; clutches

- Torque converter
- All parts with bonded seals
- All solenoids
- All transmission fluid filters

Prior to installing the transaxle, flush and clean the transmission fluid cooler(s), transmission fluid cooler tubes and transmission fluid cooler hoses.

Solenoid Body Strategy

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Solenoid Body Identification Procedure

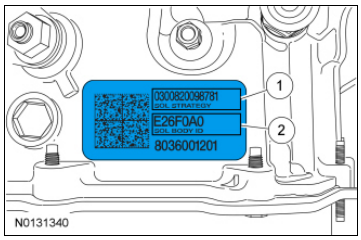
1. Using the scan tool, select Powertrain, Transmission and Transion Solenoid Body Identification from the toolbox icon and follow the instructions displayed on the scan tool.
   The solenoid body identification screen displays solenoid body identification information:
   - Solenoid body identification 7-digits
   - Solenoid body strategy 13-digits

   The next screen displays the current solenoid body identification and strategy data file stored in the TCM . If the solenoid body strategy field is blank, the module contains a partial transmission solenoid body strategy. This is due to a corrupt or missing file at the time the programmable parameters were completed.

2. **NOTE:** The 13-digit solenoid body strategy number consists of only numbers. Letters are not used.

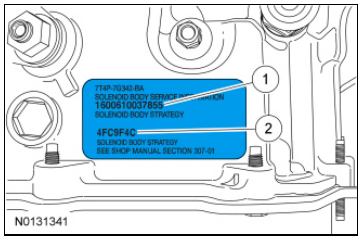
   Compare the solenoid body identification and strategy (if available) to the solenoid body service tag or the replacement solenoid body tag located on top of the transmission case.

Original Solenoid Body Service Tag



Item	Description
1	13-digit solenoid body strategy
2	7-digit solenoid body identification

Replacement Solenoid Body Service Tag



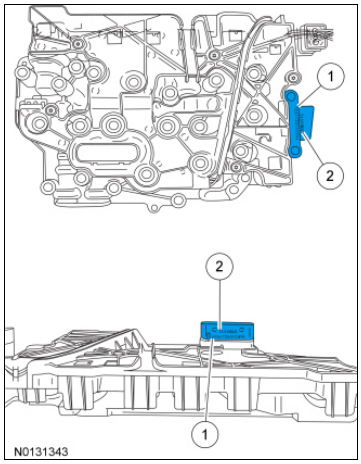
Item	Description
1	13-digit solenoid body strategy
2	7-digit solenoid body identification

3. If the solenoid body identification and strategy on the scan tool match the solenoid body service tag or replacement tag, then the solenoid body identification and strategy are correct for this transmission and a solenoid body strategy download is not required. If the solenoid body service tag or replacement tag is missing or damaged so that it is not readable or does not match the identification or strategy on the scan tool, remove the solenoid body connector and view the solenoid body identification and strategy printed on the solenoid body connector. If it is not readable, remove the main control cover, refer to Main Control Cover .
   The 7-digit identification number and the 13-digit strategy number are stamped on the solenoid body.

4. ***NOTICE:*** **If the solenoid body information does not match the module information, transmission damage or driveability concerns can occur.**

   Inspect the solenoid body identification and strategy printed on the solenoid body connector and compare this to the solenoid body service tag on the transmission case. If the solenoid body identification and strategy printed on the solenoid body connector does not match the solenoid body service tag or if the solenoid body identification and strategy printed on the solenoid body connector match the solenoid body service tag on the transmission case but do not match the solenoid body identification and strategy numbers displayed on the scan tool, a solenoid body strategy data download is required.

Solenoid Body Identification Tag



Item	Description
1	13-digit solenoid body strategy
2	7-digit solenoid body identification

Solenoid Body Strategy Data Download

1. Using the scan tool, select Module Programming and Programmable Parameters under the toolbox icon and select transmission. Follow the instructions displayed on the scan tool.
   There are fields to enter the solenoid body 7-digit identification and 13-digit strategy recorded from the solenoid body.

2. ***NOTICE:*** **If the solenoid body information is not correct, transmission damage or driveability concerns can occur.**

   Enter the solenoid body identification and strategy.
   The scan tool will verify the numbers entered are valid and display a message if the information is not valid.
   The scan tool checks to see if the file is present on the scan tool. If the file is present, the technician may proceed with downloading the file to the TCM . If the file is not present, the scan tool will need to be connected to the PTS server to download the file onto the scan tool.

3. Verify the file is present on the scan tool. If the file is present, go to Step 8. If the file is not present, continue with this procedure.

4. Connect the scan tool to the PTS server.
   The screen will display a progress bar when connecting to the network.

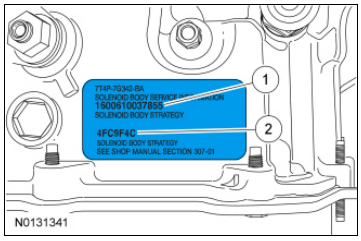
5. Follow the instructions on the network to download the strategy file to the scan tool.
   The screen will display a progress bar when downloading the strategy file to the scan tool and display a message if it is downloaded successfully.

6. If the scan tool cannot connect to the PTS server, download the file from www.motorcraft.com.
   If the scan tool cannot download a strategy from the web site, a partial strategy will automatically be downloaded.

7. Reconnect the scan tool to the vehicle.

8. Follow the instructions displayed on the scan tool.

9. If a new solenoid body was installed, compare the 7-digit identification and the 13-digit strategy fields from the solenoid body to the replacement solenoid body tag provided with the solenoid body service kit and place it over the existing identification tag.
   The scan tool will automatically download the strategy file or partial strategy file to the TCM and will display a progress bar while downloading. The scan tool will display a message when it is finished downloading the data that states that the file was downloaded successfully.



Item	Description

1	13-digit solenoid body strategy
2	7-digit solenoid body identification

10. ***NOTICE:*** **If a drive cycle is not completed, the customer may feel erratic shifts and driveability concerns.**

    Test drive the vehicle. Refer to Solenoid Body Strategy Drive Cycle in this procedure.

Solenoid Body Strategy Drive Cycle

Carry out the drive cycle after downloading the solenoid body strategy data file to the TCM .

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

1. **NOTE:** The engine and transmission must be at normal operating temperature.

   Bring the transmission to normal operating temperature.

2. With the engine running and the brake applied, move the selector lever through the gears in the following order, pausing in each gear for 4 seconds: N, R, N, D, R, D, N. Repeat this pattern 2 times. If any engagements feel soft or harsh, repeat this procedure.

3. Drive the vehicle and accelerate at a moderate throttle so the upshifts occur at 2,000 rpm up to 80 km/h (50 mph) and brake lightly to a stop. Repeat this pattern 2 times.

4. Drive the vehicle and accelerate at a moderate throttle so the upshifts occur at 3,000 rpm up to 80 km/h (50 mph) and brake lightly to a stop. Repeat this pattern 2 times.

5. With the engine running and the brake applied, move the selector lever through the gears in the following order, pausing in each gear for 4 seconds: N, R, N, D, R, D, N. Repeat this pattern 2 times.

6. From a stop, accelerate to 25 mph, then release the throttle. Keeping the throttle closed, pull the selector lever into the "L" position and coast down to 10 mph. Repeat this pattern 2 times.

Road Testing Vehicle

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: If a new or remanufactured transmission assembly is being installed or a new solenoid body is installed, the TCM will have to be re-programed with a new solenoid body strategy and identification data file. The solenoid body strategy drive cycle should also be carried out. Refer to Solenoid Body Strategy .

The Shift Point Road Test and Torque Converter Operation Test provide diagnostic information on shift controls and torque converter operation.

Shift Point Road Test

This test verifies the shift control system is operating correctly.

1. Bring engine and transaxle up to normal operating temperature.
2. Operate vehicle with the selector lever in D range.
3. **NOTE:** Shift speed ranges are approximate for all applications.

   Apply minimum throttle and observe the vehicle speed when an upshift occurs and the torque converter engages using the Shift Speeds chart.

Shift Speeds 2.5L

Throttle Position	Range	Shift	KM/H	MPH
Light	D	1-2	11-16	7-10
Throttle [a]	D	2-3	21-27	13-17
	D	3-4	29-37	18-23
	D	4-5	45-56	28-35
	D	5-6	72-90	45-56
Medium	D	1-2	27-43	17-23
Throttle [a]	D	2-3	42-55	26-34
	D	3-4	58-77	36-48
	D	4-5	77-106	48-66
	D	5-6	135-177	84-110
Heavy	D	1-2	51-66	32-41
Throttle [a]	D	2-3	79-100	49-62
	D	3-4	113-143	70-89
	D	4-5	150-190	93-118
	D	5-6	201-245	125-152

[a] Do not exceed the speed limit.

Shift Speeds 3.0L

Throttle Position	Range	Shift	KM/H	MPH
Light	D	1-2	13-18	8-11
Throttle [a]	D	2-3	19-26	12-16
	D	3-4	29-37	18-23
	D	4-5	45-56	28-35
	D	5-6	72-90	45-56

Medium	D	1-2	32-42	20-26
Throttle [a]	D	2-3	48-61	30-38
	D	3-4	63-82	39-51
	D	4-5	80-108	50-67
	D	5-6	117-159	73-99
Heavy	D	1-2	58-72	36-45
Throttle [a]	D	2-3	85-106	53-66
	D	3-4	126-156	78-97
	D	4-5	151-192	94-119
	D	5-6	217-261	135-162

[a] Do not exceed the speed limit.

4. With vehicle speed above 43 km/h (27 mph), press the accelerator pedal to Wide Open Throttle (WOT). The transaxle should shift from 4th to 3rd, or 4th to 2nd, depending on vehicle speed. The torque converter should disengage.

5. With vehicle speed above 56 km/h (35 mph), move the selector lever from the D range to the L range and remove foot from accelerator pedal. The transaxle should immediately downshift to 2nd gear. When vehicle speed drops below 32 km/h (20 mph), the transaxle should downshift into 1st gear.

6. If the transaxle fails to upshift/downshift or the torque converter does not apply and release, refer to Diagnosis By Symptom in this section for possible causes.

Torque Converter Diagnosis

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Prior to torque converter installation, all diagnostic procedures must be followed. This is to prevent the unnecessary installation of new or remanufactured torque convertAfter a complete diagnostic evaluation can a decision be made to install a new or remanufactured torque converter.

Begin with the normal diagnostic procedures as follows:

1. Preliminary inspection

2. Know and understand the customer concern

3. Verify the concern - carry out the Torque Converter Operation Test

4. Carry out diagnostic procedures:
   - Run OBD . Refer to Diagnostics .
     - Repair all non-transmission related DTCs first.
     - Repair all transmission DTCs.
     - Rerun OBD test to verify repair.
     - Carry out Line Pressure Test. Refer to Special Testing Procedures .
     - Carry out Stall Speed Test. Refer to Special Testing Procedures .
     - Carry out diagnostic routines. Refer to Diagnosis By Symptom .
     - Use the index to locate the appropriate routine that best describes the symptom(s). The routine will list possible components that may cause or contribute to the symptom. Check each component listed, diagnose and repair as required before installing a new torque converter.

Torque Converter Operation Test

This test verifies the TCC control system and the torque converter are operating correctly.

1. Carry out self-test and check for DTCs.

2. Connect the scan tool and monitor engine rpm.

3. Bring the engine to normal operating temperature by driving the vehicle at highway speeds with the selector lever in the (D) position.

4. If the vehicle stalls in (D) at idle with the vehicle at a stop, move the selector lever to manual L position. If the vehicle stalls, see Torque Converter Operation Concerns, refer to Diagnosis By Symptom . Repair as required. If the vehicle does not stall in (D), refer to Diagnosis By Symptom .

Visual Inspection

This inspection will identify modifications or additions to the vehicle operating system that may affect diagnosis. Inspect the vehicle for non-Ford factory add-on devices such as:

- Electronic add-on items:
  - A/C
  - generator (alternators)
  - engine turbo
  - cellular telephone
  - cruise control
  - CB radio
  - linear amplifiers
  - backup alarm signal
  - computer
- Vehicle modification.
- These items, if not installed correctly, will affect PCM or transmission function. Pay particular attention to add-on wiring splices in the PCM harness or transmission wiring harness, abnormal tire size or axle ratio changes.
- Leaks, refer to Leakage Inspection in this section.

Section 307-05A .

Selector Lever Linkage Check

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted. Refer to Section 307-05A for selector lever linkage adjustment.

Check TSBs

Refer to all TSBs which pertain to the concern and follow the procedure.

Carry Out On-Board Diagnostics, Key ON Engine OFF (KOEO), Key ON Engine Running (KOER)

After a road test, with the engine and transmission at normal operating temperature and before disconnecting any connectors, use the scan tool to perform the self-test procedure. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the powertrain control system.

Diagnostics

OBD with Scan Tool

These self-tests should be used to diagnose the TCM and should be carried out in order.

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

1. If the cause is not visually evident, connect the scan tool to the DLC .

NOTE: The VCM LED prove-out confirms power and ground from the DLC to the VCM .

2. If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 to diagnose no power to the scan tool.

3. If the scan tool does not communicate with the vehicle:
   - verify the ignition is in the RUN position.
   - verify scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the TCM .

4. Carry out the network test.
   - If the scan tool responds with no communication from one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

5. Clear the continuous DTCs and carry out the TCM self-test.

6. If DTCs retrieved are related to the concern, GO to the DTC Chart.

7. If no DTCs related to the concern are retrieved, GO to Diagnosis By Symptom .

Output State Control (OSC) Mode

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Description

Output state control allows a diagnostic scan tool direct control of specific transmissiomponents or functions. Output state control allows the technician to control the main functions or components of the transmission to help the technician diagnose the transmission quickly and easily. For example, output state control may be used to change gears or remain in a specific gear. Output state control may be used to control the operation of the TCC to engage or disengage, or to keep the converter clutch from engaging at all. Output state control may be used to help carry out solenoid electrical pinpoint tests by turning a solenoid off or on by controlling the actual current to the VFS solenoid.

Procedure

NOTE: Retrieve Continuous Codes and carry out a KOEO and KOER On-Demand Self Test before using any output state control. Any DTCs related to the TR sensor, the OSS sensor or the TSS sensor must be fixed or the TCM will not allow the output state control to operate.

Output state control is used to test various transmission components and functions when the vehicle is in the service bay or being driven on the road. Specific vehicle conditions are required for output state control to control each specific function or component. The following describes which transmission functions and components output state control may control and the specific vehicle conditions necessary for its operation.

Service Bay - Vehicle State No. 1

Vehicle state No. 1 is functional ONLY when the ignition is in the ON position and the selector lever is in PARK or NEUTRAL with the engine OFF. Vehicle state No. 1 is required when using output state control to carry out electrical pinpoint tests. The following transmission components may be controlled using output state control in vehicle state No. 1.

- SSA_AMP - Controls the current to SSA , VFS
- SSB_AMP - Controls the current to SSB , VFS
- SSC_AMP - Controls the current to SSC , VFS SSD_AMP - Controls the current to SSD , VFS
- SSE - Directs TCM to command SSE OFF or ON
- LPC_AMP - Controls the current to the LPC VFS
- TCC_AMP - Controls the current to the TCC VFS

The vehicle requirements must be met when sending an output state control value to control each component such as the solenoids stated above. If the vehicle requirements are not met when sending the output state

control value, an error message may appear. When an error message appears, output state control is cancelled and should be restarted.

After sending the output state control value, if the vehicle requirements are no longer met, the error message will not appear but the output state control value will be cancelled by the TCM . Use the scan tool to monitor the PID that corresponds to each output state control function or component to determine if the TCM is using the output state control value or normal control.

Output state control may be cancelled at any time, to return the TCM to normal control for a specific output state control function or component. See instructions for specific scan tool.

Service Bay - Vehicle State No. 2

Vehicle state No. 2 is functional ONLY when the engine is running and the selector lever is in PARK or NEUTRAL with engine speed greater than 1,100 rpm. Vehicle state No. 2 is required when using output state control to carry out a line pressure check. Most, but not all, of the solenoids may be controlled during this vehicle state. It is recommended to use vehicle state No. 1 when using output state control to control the solenoids. The following transmission function and components may be controlled using output state control in vehicle state No. 2.

- LINEDSD - Output state control function to command line pressure to a desired pressure
- SSD_AMP - Controls the current to SSD , VFS
- SSC_AMP - Controls the current to SSC VFS
- SSB_AMP - Controls the current to SSB , VFS
- SSA_AMP - Controls the current to SSA , VFS

The vehicle requirements must be met when sending an output state control value to control each component such as the solenoids stated above. If the vehicle requirements are not met when sending the output state control value, an error message may appear. When an error message appears, output state control is cancelled and should be restarted.

After sending the output state control value, if the vehicle requirements are no longer met, the error message will not appear but the output state control value will be cancelled by the TCM . Use the scan tool to monitor the PID that corresponds to each output state control function or component to determine if the TCM is using the output state control value or normal control.

Output state control may be cancelled at any time, to return the TCM to normal control for a specific output state control function or component. See instructions for specific scan tool.

Output state control values for SSA_AMP, SSB_AMP, SSC_AMP, SSD_AMP, LPC_AMP and TCC_AMP to control the current on the VFS solenoids are between zero (0) and one (1) amp. The following are examples.

- 0 - Commands TCM to control current to zero amps
- 0.25 - Commands TCM to control current to 1/4 amp or 250 milliamps
- 0.50 - Commands TCM to control current to 1/2 amp or 500 milliamps
- 0.75 - Commands TCM to control current to 3/4 amp or 750 milliamps
- 1 - Commands TCM to control current to 1 amp or 1,000 milliamps

Output state control aids in testing the electronic functions of the TCM , VFS solenoid and associated circuitry. Output state control allows the technician to control the TCM commanded current of the VFS solenoids and the commanded state of the on/off solenoid. This allows the technician to accurately test the electronic circuitry by comparing the commanded current with the actual current or the on/off state with the

actual voltage. Shifting the transmission through the various gears tests the mechanical operation of the VFS solenoids. When using output state control to control the VFS current, the technician may measure the circuit current using an inductive pickup or measure the circuit voltage drop to help verify the proper electrical operation of each VFS solenoid.

The output state control values for LINEDSD to command a desired line pressure are between 414 kPa (60 psi) and 1,931 kPa (280 psi). The following are examples.

- 60 psi - Commands TCM to control line pressure to 414 kPa (60 psi)
- 100 psi - Commands TCM to control line pressure to 689 kPa (100 psi)
- 150 psi - Commands TCM to control line pressure to 965 kPa (150 psi)
- 200 psi - Commands TCM to control line pressure to 1,517 kPa (200 psi)

NOTICE: **Do NOT command line pressure LOWER then 414 kPa (60 psi) or HIGHER then 1,931 kPa (280 psi) or damage to the transmission can occur.**

Output state control allows the technician to control the TCM commanded line pressure. This allows the technician to accurately test the electronic pressure control system by comparing the output state control commanded line pressure to the actual line pressure indicated on the pressure gauge. The pressure gauge should be connected to the line pressure tap on the transmission. The PID corresponding to the commanded line pressure must be monitored to make sure the TCM is using the output state control value for the commanded line pressure. This test will help verify the correct operation of the transmission pump assembly, pump regulator valve and the operation of the LPC solenoid.

Drive Test

Output state control allows control of 3 transmission functions while driving on the road.h transmission function has a unique set of vehicle operating requirements that the technician is required to meet before the TCM will allow output state control.

- TCC_OSC - Commands the TCM to engage or disengage the TCC
- GEAR_OSC - Commands the TCM to change gears (upshift or down-shift) or remain in a gear
- HRSH_SFT - Commands a slightly higher hydraulic pressure during engagements and upshifts

The vehicle requirements must be met when sending an output state control value to control the specific functions stated above. If the vehicle requirements are not met when sending the output state control value, an error message may appear. When an error message appears, output state control is cancelled and should be restarted.

After sending the output state control value, if the vehicle requirements are no longer met, the error message will not appear but the output state control value is cancelled by the TCM . Use the scan tool to monitor the PID that corresponds to each output state control function or component to determine if the TCM is using the outpte control value or normal control.

Output state control may be cancelled at any time, to return the TCM to normal control for a specific output state control function or component. See instructions for specific scan tool.

Drive Test - Torque Converter Clutch Control

The output state control values for TCC_OSC to engage or disengage the TCC are as follows:

- 0 - TCM in normal control of TCC and output state control is cancelled

- 1 or OFF - Commands TCM to keep the torque converter clutch from engaging
- 2 or ON - Commands TCM to engage the TCC using a normal ramp rate
- 3 or ON - Commands TCM to engage the TCC using a fast ramp rate

Controlling the TCC will assist the technician in testing the operation of the torque converter for engagements and disengagements. Also, the technician may find it easier to evaluate upshifts and downshifts by first using output state control to keep the TCC from engaging.

Vehicle requirements when using TCC_OSC - Controlling the TCC .

When SENDING the TCC_OSC value [1 or OFF], the engine must be running with the transmission in the DRIVE position and the vehicle speed must be greater than 5 km/h (3 mph).

When SENDING the TCC_OSC value [2 or 3 or ON], the engine must be running with the selector lever in the DRIVE position, transmission in 3rd, 4th, 5th or 6th gear, transmission temperature between 4°C (40°F) and 121°C (250°F), the vehicle speed must be below 24 km/h (15 mph) and engine speed greater than 1,100 rpm with minimal engine load.

Drive Test - Upshift and Downshift Control

NOTE: Once output state control has successfully commanded the transmission to shift to the desired output state control gear, the transmission will remain in that gear until output state control commands a different gear or the vehicle conditions are no longer correct.

The output state control values for GEAR_OSC to control the transmission gear changes are as follows:

- 0 - TCM in normal shift control and output state control is cancelled
- 1 - Commands TCM to shift to 1st gear - no engine braking
- 2 - Commands TCM to shift to 2nd gear - with engine braking
- 3 - Commands TCM to shift to 3rd gear - with engine braking
- 4 - Commands TCM to shift to 4th gear - with engine braking
- 5 - Commands TCM to shift to 5th gear - with engine braking
- 6 - Commands TCM to shift to 6th gear - with engine braking

Controlling the gear changes will assist the technician in testing the various clutches and whether the transmission is slipping in any particular gear. Output state control will command the TCM to upshift or downshift depending on the output state control gear value the technician selects. The transmission will remain in the output state control gear selected until another output state conor until output state control is cancelled and/or the vehicle conditions for using output state control are no longer met.

Vehicle requirements when using GEAR_OSC - Controlling Gear Changes

When SENDING a GEAR_OSC value, the engine must be running with the selector lever in the DRIVE position, and the vehicle speed must be greater than 5 km/h (3 mph).

Additional vehicle conditions required for upshifts:

- Vehicle speed must be greater then 32 km/h (20 mph) when commanding an upshift to 5th or 6th gear

Additional vehicle conditions required for downshifts:

- Vehicle speed must be less then 32 km/h (20 mph) when commanding a downshift to 1st gear
- Vehicle speed must be less then 64 km/h (40 mph) when commanding a downshift to 2nd gear

- Vehicle speed must be less then 97 km/h (60 mph) when commanding a downshift to 3rd gear
- Vehicle speed must be less then 129 km/h (80 mph) when commanding a downshift to 4th gear
- Vehicle speed must be less then 161 km/h (100 mph) when commanding a downshift to 5th gear

Drive Test - Pressure Added for Engagements and Upshifts

The output state control values for HRSH_SHFT to command a slight or moderate increase in hydraulic pressure to test for harsh engagements and upshifts are as follows:

- 0 or OFF - TCM in normal pressure control for shifts and engagements and output state control is cancelled
- 1 or ON - Commands TCM to moderately increase hydraulic pressure during engagements and upshifts

Setting HRSH_SFT to 1 or ON allows the tn to moderately increase the pressure when performing engagements such as P-R, P-D, N-R, N-D, R-D and when performing automatic upshifts. This can provide additional diagnostic information to help the technician determine whether the electronic pressure control system is providing at least limited control (a normal shift would become harsh). Using output state control to control HRSH_SHFT [1 or ON] should make a softer engagement or shift more normal and an already normal shift or engagement harsher by slightly increasing the pressure. This test should only be used to provide additional diagnostic information and should not be the only scan tool or test to determine a faulty electronic or hydraulic component.

Using Output State Control and Monitoring PIDs

To confirm that the output state control value was sent by the scan tool and the TCM has accepted the output state control command, a corresponding PID for each output state control parameter must be monitored. After SENDING the output state control value, the corresponding PID value should be the same as the output state control value that was sent. Additional PIDs are listed that may be monitored to help the technician accurately diagnose the transmission.

The following is a list of output state control parameters and their corresponding PIDs:

Output State Control Parameter	Corresponding PID	Additional PIDs
GEAR_OSC	GEAR	GEAR_RAT
HRSH_SHFT	-	GEAR, GEAR_RAT
LINEDSD	LPC	LPC_F
LPC_AMP	LPC	TCCRAT, TCCMCMD, TSLIP
SSA_AMP	SSPCA	SSPCA_F
SSB_AMP	SSPCB	SSPCB_F
SSC_AMP	SSPCC	SSPCC_F
SSD_AMP	SSPCD	SSPCD_F
TCC AMP	TCC	TCC_F, TCC_RAT
TCC_OSC	TCC	TCC_F, TCC_RAT

Diagnostic Parameters Identification (PID) Chart

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

PID Name	PID Description	Units
GEAR	PCM commanded transaxle gear	P, R, N, 1, 2, 3, 4, 5 and 6
GEAR_OSC	Output state control commanded gear	P, R, N, 1, 2, 3, 4, 5 and 6
GEAR_RAT	Transaxle gear ratio	Ratio
HRSH_SHFT	Output state control commanded firm shift	On/Off
IN_GEAR	PCM commanded transaxle gear	P, R, N, 1, 2, 3, 4, 5 and 6
LINEDSD	Output state control commanded line pressure	Pressure
LPC	PCM commanded pressure for the Line Pressure Control (LPC) Variable Force Solenoid (VFS)	Pressure
LPC AMP	Output state control commanded current for the LPC VFS	Amperes
LPC_F	Fault status for the LPC VFS	Fault/No Fault
OSS_F	Fault status for Output Shaft Speed (OSS) sensor	Fault/No Fault
OSS_SRC	Actual speed of the OSS sensor (rpm)	rpm
SSA_AMP	Output state control commanded current for the Shift Solenoid A (SSA)/CB1234 VFS	Amperes
SSB_AMP	Output state control commanded current for the Shift Solenoid B (SSB)/C35R VFS	Amperes
SSC_AMP	Output state control commanded current for the Shift Solenoid C (SSC)/CB26 VFS	Amperes
SSD_AMP	Output state control commanded current for the Shift Solenoid D (SSD)/CBLR, C456 VFS	Amperes
SSPCA	PCM commanded pressure for the SSA /CB1234 VFS	Pressure
SSPCA_F	Fault status for the SSA /CB1234 VFS	Fault/No Fault
SSPCB	Commanded pressure for the SSB /C35R VFS	Pressure
SSPCB_F	Fault status for the SSB /C35R VFS	Fault/No Fault
SSPCC	PCM commanded pressure for the SSC /CB26 VFS	Pressure
SSPCC_F	Fault status for the SSC /CB26 VFS	Fault/No Fault
SSPCD	PCM commanded pressure for the SSD /CBLR, C456 VFS	Pressure
SSPCD_F	Fault status for the SSD /CBLR, C456 VFS	Fault/No Fault

SSPCE_F	Fault status for On/Off Shift Solenoid E (SSE)/CBLR, C456 VFS	Fault/No Fault
TCC	PCM commanded pressure for the Torque Converter Clutch (TCC) VFS	Pressure
TCC AMP	Output state control commanded current for the TCC VFS	Amperes
TCC_F	Fault status for TCC VFS	Fault/No Fault
TCC_OSC	Output state control commanded pressure to the TCC VFS	Pressure
TCC_RAT	Actual speed ratio of torque converter (1.0 = fully engaged)	Ratio
TCIL	Transmission Control Indicator Lamp (TCIL) status	On/Off
TCS_DEPRES	Transmission Control Switch (TCS) status	Depressed/Not Depressed
TCS_STATE	TCS status	On/Off
TCC_SLIPACT	Actual difference between engine speed and turbine speed, measured in rpm	rpm
TCC_SLIPDSD	PCM commanded difference between engine speed and turbine speed, measured in rpm	rpm
TFT	Transmission Fluid Temperature (TFT)	Degrees
TFTV	TFT voltage	Voltage
TFT_F	Fault status for TFT sensor	Fault/No Fault
TR	Transmission Range (TR)	Range (P, R, N, D, L)
TRAN_RAT	Actual transaxle gear ratio	Ratio
TR_CRANK	TR	Range (P, R, N, D, L)
TR_DC	TR Duty Cycle	Frequency
TR_F	Fault status for TR sensor	Fault/No Fault
TR_FREQ	TR Frequency	Frequency
TSS_F	Fault status for Turbine Shaft Speed (TSS) sensor	Fault/No Fault
TSS_SRC	Actual speed of the TSS sensor (rpm)	rpm

Transaxle Drive Cycle Test

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

After carrying out the self-test, use the followinansmission Drive Cycle Test for checking continuous codes:

NOTE: The Transmission Drive Cycle Test must be followed exactly. Malfunctions must occur 4 times consecutively for the shift error DTC to be set. Torque converter failures must occur 5 times consecutively for a continuous DTC to be set.

NOTE: When carrying out the Transmission Drive Cycle Test, see the Solenoid Operation Chart for correct solenoid operation. Refer to Pinpoint Tests - OSC Equipped Vehicle .

1. Record then clear self-test DTCs.
2. Warm engine to normal operating temperature.
3. Make sure transmission fluid level is correct.
4. With transmission in DRIVE, moderately accelerate from stop to 80 km/h (50 mph). This allows the transmission to shift into 6th gear. Hold speed and throttle opening steady for a minimum of 15 seconds.
5. With transmission in 6th gear and maintaining steady speed and throttle opening, lightly apply and release the brake to operate the stoplamps. Hold speed and throttle steady for additional 5 seconds minimum.
6. Brake to a stop and remain stopped for minimum of 20 seconds.
7. Repeat Steps 4 through 6 at least 5 times.
8. Carry out the self-test and record continuous codes.

- If DTCs are present, refer to Diagnostic Trouble Code (DTC) Charts . Service all non-transmission DTCs first as they can directly affect the operation of the transmission. Repeat the self-test and road test the vehicle to verify the correction. Clear the DTCs, carry out drive cycle and repeat the self-test after completing service on the DTCs.
- If the self-test passes and a concern is still present, refer to Diagnosis By Symptom . Check TSBs for diagnostic concern.

After OBD

NOTE: The vehicle wiring harness, TCM and non-transmission sensors may affect transmission operations. Service these concerns first.

After the OBD procedures are complete, service all DTCs.

Begin with non-transmission related DTCs, then service any transmission related DTCs. Refer to the Diagnostic Trouble Code (DTC) Charts for information on condition and symptoms. This chart is helpful referring to the correct manual(s) and to aid in diagnosing internal transmission concerns and external non-transmission inputs. The pinpoint tests are used in diagnosing electrical concerns of the transmission. Make sure the vehicle wiring harness and TCM are diagnosed as well. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosing non-transmission electronic components. The diagnostic routine hydraulic/mechanical charts will help in diagnosing internal transmission concerns and external non-transmission inputs.

Before Pinpoint Tests

NOTE: Prior to entering pinpoint tests, check the TCM wiring harness for correct connections, bent or broken terminals, corrosion, loose wires, correct routing, correct seals and their condition. Check the TCM , sensors and actuators for damage. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

NOTE: If a concern exists after the electrical diagnosis has been carried out, refer to Diagnosis By Symptom .

If DTCs appear while carrying out the OBD test, refer to the Diagnostic Trouble Code (DTC) Charts for the appropriate repair procedure. Prior to entering pinpoint tests, refer to TSBs for transmission concerns.

Diagnostic Trouble Code (DTC) Charts

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

DTC Chart

NOTE: Using a scan tool, retrieve DTCs. Begin with and repair all non-transmission related DTCs. Start with the U-DTCs (communication link codes) and repair any transmission-related DTCs.

DTC	Grouping	Component H>	Description	Condition	Symptom	Action
P0657	-	Transaxle solenoid power control	Actuator supply voltage A circuit/open	Transaxle solenoid power control provides power to all the solenoids. This DTC sets if the transaxle solenoid power control relay circuit is open.	• Harsh engagements. • No voltage to solenoids. • Maximum line pressure. • Only PARK, REVERSE, NEUTRAL and 5th gear available. • No Torque Converter Clutch (TCC). • Poor launch due to 5th gear drive away. • Will	GO to Pinpoint Test E.

					turn on Malfunction Indicator Lamp (MIL).	
P0701	P2700 (Forward Clutch), P2701 (Direct Clutch), P2702 (Intermediate Clutch), P2703 (Low/Reverse Clutch) and P2704 (Overdrive Clutch)	Transmission hydraulic and clutch systems (including non-electrical shift solenoid faults, main control valve body and clutch(s)).	Transmission control system range/performance	The PCM has detected an intermittent clutch on fault and the control system keeps getting stuck on ratio changes but when it turns off the suspected clutch it releases. No stuck on DTCs s.	• Vehicle decelerates during upshifts or hangs in gear • Will turn on wrench lamp.	Non-electrical failure. REPAIR the more specific DTC first. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0706	P1702, P1921	TR sensor	TR sensor A circuit range/performance.	TR sensor frequency out of range. PCM receives a duty cycle at 125 Hz. If the frequency is out of range (75 to 175 Hz is the acceptable range) this DTC will set. Possible wiring, connector or TR sensor issue.	• Possible no crank. • Only PARK, REVERSE, NEUTRAL and 5th gear available. • Harsh engagements. • Extremely delayed engagements (until a DTC is set). • After a DTC is set and the high side opened. ♦ Harsh engagements. ♦ Poor performance (due to a	REPAIR the more specific DTC first. GO to Pinpoint Test D .

					♦ 5th gear drive away). ♦ No shifts. • Will turn on MIL .	
P0707	P1702, P1921	TR sensor	TR sensor A circuit low.	TR sensor circuit duty cycle out of range, low. TR sensor duty cycle below the minimum value for park (possible open circuit, short to ground, wiring, connector or TR sensor issue).	• Possible no crank. • Only PARK, REVERSE, NEUTRAL and 5th gear available. • Harsh engagements. • Extremely delayed engagements (until a DTC is set). • After a DTC is set and the high side opened. ♦ Harsh engagements. ♦ Poor performance (due to a 5th gear drive away). ♦ No shifts. • Will turn on MIL .	REPAIR the more specific DTC first. GO to Pinpoint Test D .
P0708	P1702, P1921	TR sensor	TR sensor A circuit high.	TR sensor duty cycle duty cycle out of range, high. Duty	• Possible no	REPAIR the more specific DTC first. GO

				cycle above the maximum value for LOW (possible short to power, wiring, connector or TR sensor issue).	crank. • Only PARK, REVERSE, NEUTRAL and 5th gear available. • Harsh engagements. • Extremely delayed engagements (until a DTC is set). • After a DTC is set and the high side opened. ♦ Harsh engagements. ♦ Poor performance (due to a 5th gear drive away). ♦ No shifts. • Will turn on MIL .	to Pinpoint Test D .
P0710	P0711, P0712, P0713	Transmission Fluid Temperature (TFT) sensor	TFT sensor A circuit	• TFT sensor voltage input too low or too high. TFT input indicates a short to ground or an open circuit (could be a wiring, connector or sensor issue).	• TCC and stabilized shift schedule may be enabled sooner after cold start. • Harsh or soft shifts.	REPAIR the more specific DTC first. GO to Pinpoint Test B .

				• Also see P0711, P0712 and P0713.	• Will turn on wrench lamp.	
P0711	-	TFT sensor	TFT sensor A circuit range/performance.	PCM has detected no TFT sensor change during operation.	• TCC and stabilized shift schedule may be enabled sooner after a cold start. • Harsh or soft shifts. • Will turn on wrench lamp.	GO to Pinpoint Test B .
P0712	P0710, P0712	TFT sensor	TFT sensor A circuit low.	The PCM has detected a voltage drop across the TFT sensor exceeds a temperature greater than 171°C (340°F) for more then 2.5 seconds (grounded circuit).	• TCC and stabilized shift schedule may be enabled sooner after cold start. • Harsh or soft shifts. • Will turn on MIL .	REPAIR the more specific DTC first. GO to Pinpoint Test B .
P0713	P0710, P0713	TFT sensor	TFT sensor A circuit high.	The PCM has detected a voltage drop across the TFT sensor exceeds a temperature less than -45°C (-50°F) for more then 2.5 seconds (open circuit).	• TCC and stabilized shift schedule may be enabled sooner after cold start.	REPAIR the more specific DTC first. GO to Pinpoint Test B .

					• Harsh or soft shifts. • Will turn on MIL .	
P0715	P0717	Turbine Shaft Speed (TSS) sensor	TSS sensor A circuit.	• PCM has detected TSS sensor signal failed to 0 speed when vehicle conditions (mainly output speed) indicate TSS sensor output should be present. • Electrical failures (open, short) of the TSS sensor wiring, connector or a failure of the sensor itself will cause this failure.	• Failure Mode Effect Management action opens transaxle solenoid power control (removes power from all solenoids). ♦ Provides PARK, REVERSE, NEUTRAL and 5th gear with maximum line pressure and open TCC available (controlled by the manual lever). • Harsh engagements (due to maximum line pressure). • Poor launch performance (due to 5th gear	REPAIR the more specific DTC first. GO to Pinpoint Test F .

					drive away). • Will turn on MIL .	
P0717	P0715	TSS sensor	TSS sensor A circuit no signal.	• Non- MIL sister code to P0715. Used to illuminate the wrench light.	• Failure Mode Effect Management action opens transaxle solenoid power control (removes power from all solenoids). ♦ Provides PARK, REVERSE, NEUTRAL and 5th gear with maximum line pressure and open TCC available (controlled by the manual lever). • Harsh engagements (due to maximum line pressure). • Poor launch performance (due to 5th gear drive	REPAIR the more specific DTC first. GO to Pinpoint Test F .

					away).	
P0718	-	TSS sensor	TSS sensor A circuit intermittent.	PCM has detected an erratic or noisy TSS sensor signal.	Will turn on wrench lamp.	GO to Pinpoint Test F .
P0720	P0722	Output Shaft Speed (OSS) sensor	OSS sensor circuit.	• PCM has detected OSS sensor signal failed to 0 speed when vehicle conditions (mainly turbine speed) indicate OSS sensor output should be present. • Electrical failures (open, short) of the OSS sensor wiring, connector or a failure of the OSS sensor itself will cause this failure.	• Failure Mode Effect Management action opens transaxle solenoid power control (removes power from all solenoids). ♦ provides PARK, REVERSE, NEUTRAL and 5th gear with maximum line pressure and open TCC available (controlled by the manual lever). • Harsh engagements (due to maximum line pressure). • Poor launch performance (due to 5th drive away).	REPAIR the more specific DTC first. GO to Pinpoint Test C .

					• Will turn on MIL .	
P0721	-	OSS sensor	OSS sensor circuit range/performance.	PCM has detected an erratic or noisy OSS sensor signal.	Will turn on wrench lamp.	GO to Pinpoint Test C .
P0722	P0720	OSS sensor	OSS sensor circuit no signal.	• Non- MIL sister code to P0720. Used to illuminate the wrench light.	• Failure Mode Effect Management action opens transaxle solenoid power control (removes power from all solenoids). ♦ Provides PARK, REVERSE, NEUTRAL and 5th gear with maximum line pressure and open TCC available (controlled by the manual lever). • Harsh engagements (due to maximum line pressure). • Poor launch performance (due to 5th gear	REPAIR the more specific DTC first. GO to Pinpoint Test C .

					drive away).	
P0729	-	Transaxle	Gear 6 incorrect ratio	The PCM did not detect a 6th gear ratio. • Shift Solenoid C (SSC) and/or Shift Solenoid D (SSD) stuck off non-electrical fault (no pressure). • Low/reverse clutch and/or overdrive clutch regulator valve stuck in default position. • Low/reverse clutch and/or overdrive clutch boost valve stuck in default position.	• Customer may notice flares or neutral conditions on shifts. • Erratic shifting, flares, neutral conditions while the code is being set. • 6th gear disabled. • Will turn on MIL . • TCIL flashing • Will turn on wrench lamp.	Intermediate (2,6) clutch or overdrive (4,5,6) clutch slip or failed to apply. REFER to the Clutch Application chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0731	-	Transaxle	Gear 1 incorrect ratio	• Forward clutch, low/reverse clutch or One-Way Clutch (OWC) failed to apply. • Shift Solenoid A (A) and/or SSD stuck off non-electrical fault (no pressure). • Forward clutch and/or low/reverse clutch regulator	• Customer might notice flares or neutral conditions, hangs in gear. • Disable 1st gear. • No engine braking. • Will turn on wrench lamp.	Forward (1,2,3,4) clutch, low/reverse (L,R) clutch or OWC slip or failed to apply. REFER to the Clutch Application chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC

				valve stuck in default position. • Forward clutch and/or low/reverse clutch boost valve stuck in default position.		returns, REFER to Diagnosis By Symptom in this section.
P0732	-	Transaxle	Gear 2 incorrect ratio	• Forward clutch or intermediate clutch failed to apply. • SSA and/or SSC stuck off non-electrical fault (no presse). • Forward clutch and/or intermediate clutch regulator valve stuck in default position. • Forward clutch and/or intermediate clutch boost valve stuck in default position.	• Customer might notice flares or neutral condition, hangs in gear. • Disable 2nd gear. • Will turn on wrench lamp.	Forward (1,2,3,4) clutch, or intermediate (2,6) clutch failed to apply. REFER to the Clutch Application chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0733	-	Transaxle	Gear 3 incorrect ratio	• Forward clutch or direct clutch failed to apply. • SSA and/or Shift Solenoid B (SSB) stuck off non-electrical fault (no pressure). • Forward clutch and/or direct clutch regulator valve stuck in	• Customer might notice flares or neutral condition, hangs in gear. • Disable 3rd gear. • Will turn on wrench lamp.	Forward (1,2,3,4) clutch, or direct (3,5,R) clutch failed to apply. REFER to the Ctch Application chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC

				default position. • Forward clutch and/or direct clutch boost valve stuck in default position.		returns, REFER to Diagnosis By Symptom in this section.
P0734	-	Transaxle	Gear 4 incorrect ratio	• Forward clutch or overdrive clutch failed to apply. • SSA and/or SSD stuck off non-electrical fault (no pressure). • Forward clutch and/or overdrive clutch regulator valve stuck in default position. • Forward clutch and/or overdrive clutch boost valve stuck in default position.	• Customer might notice flares or neutral conditions, hangs in gear. • Disable 4th gear. • Will turn on wrench lamp.	Forward (1,2,3,4) clutch, or overdrive (4,5,6) clutch failed to apply. REFER to the Clutch Application chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Diagnosis By Symptom in this section.
P0735	-	Transaxle	Gear 5 incorrect ratio	• Direct clutch or overdrive clutch failed to apply. • SSB and/or SSD stuck off non-electrical fault (no pressure). • Direct clutch, low/reverse clutch and/or overdrive regulator valve stuck in default position.	• Customer might notice flares or neutral conditions, hangs in gear. • Disable 5th gear. • Will turn on wrench lamp.	Direct (3,5,R) clutch, or overdrive (4,5,6) clutch failed to apply. REFER to the Clutch Application chart located in Specifications in this section. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns,

				• Low/reverse clutch and/or overdrive clutch boost valve stuck in default position.		REFER to Diagnosis By Symptom in this section.
P0740	P0743	TCC	TCC solenoid circuit open	Open circuit.	• TCC failed off. • Will turn on MIL . • TCIL flashing	GO to Pinpoint Test A .
P0741	P0748	TCC	TCC solenoid circuit performance/stuck off.	TCC mechanically stuck off.	• Non-electrical TCC solenoid stuck off. • TCC mechanical failure. • TCC regulator apply valve stuck in release position. • TCC control valve stuck in release position. • TCC failed to apply (less than 80 rpm slip error lasting at least 3 seconds when TCC is	DTC P0741 is a non-electrical DTC. CLEAR the DTCs. TEST the system for normal operation. If the DTC returns, REFER to Torque Converter Operation Concerns, No Apply in Diagnosis By Symptom in this section.

					commanded on) 3 consecutive times. • Will turn on MIL . • TCIL flashing	
P0742	P0743	TCC	TCC solenoid circuit stuck on.	Circuit shorted to ground, TCC failed on.	• Failure Mode Effect Management action opens the transaxle solenoid power control, removing power from all solenoids (get PARK, REVERSE, NEUTRAL and 5th gear as the only forward gear with TCC open). • Harsh engagements. • Poor launch performance (due to 5th gear drive away). • No TCC apply. • No shifts.	REPAIR the more specific DTC first. GO to Pinpoint Test A .

					• Will turn on MIL . • TCIL flashing	
P0743	P0740, P0742 or P0744	TCC	TCC solenoid circuit electrical.	Sister code to P0740, P0742 or P0744 used to illuminate the wrench light.	• Will turn on wrench lamp. • TCIL flashing	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0744	P0743	TCC	TCC solenoid circuit intermittent.	Circuit short to power.	• TCC failed off. • Will turn on MIL . • TCIL flashing	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0748	P0960, P0962 and P0963	Line Pressure Control (LPC)	LPC electrical.	LPC circuit failure non- MIL . Sister code to P0960, P0962 and P0963 used to illuminate the wrench light. Additional common fault DTCs, P0750, P0751, P0752.	• Failure Mode Effect Management action, see DTCs P0960, P0962 and P0963. • Will turn on wrench lamp. • TCIL flashing	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0750	P0751	Shift Solenoid A (SSA)	SSA	Open circuit.	• Customer might notice a neutral condition, or a single erratic or unexpected shift. • 5th and 6th	REPAIR the more specific DTC first. GO to Pinpoint Test A .

					gears only. • Poor launch due to 5th gear drive away. • Will turn on MIL .	
P0751	P2700	Forward clutch	SSA performance/stuck off.	Forward (1,2,3,4) clutch failed to apply when commanded. • SSA non-electrical failed stuck off (no pressure). • Forward clutch stuck off due to mechanical failure. • Forward clutch regulator valve stuck in the default position. • Forward clutch boost valve stuck in the default position.	• Customer may notice neutral conditions or flares on downshifts from 5th or 6th gear. • Once the DTC is stored, gears 1 through 4 are disabled - leaving 5th and 6th gears as the only forward gears. • Erratic shifting, harsh engagements, neutral conditions, flares, poor launch performance, harsh	REFER to Diagnosis By Symptom in this section.

					reverse engagements. • Will turn on MIL .	
P0752	-	SSA	SSA stuck o	Forward (1,2,3,4) clutch failed to release when commanded. • SSA non-electrical failed stuck on (pressure). • Forward clutch stuck on due to mechanical failure. • Forward clutch regulator valve stuck in the spring compressed position.	• Customer may notice a vehicle deceleration on a shift into 5th or 6th gear (forward clutch failing to release will cause a tie-up in 5th or 6th gear). • Customer might notice erratic shifting or being stuck in 4th gear. • Once the DTC is stored, 5th and 6th gears are disabled. • Will turn on MIL .	REFER to Diagnosis By Symptom in this section.
P0753	P0750, P0973 and P0974	SSA	SSA electrical.	Sister code to P0750, P0973 and P0974 used to illuminate the wrench light. Additional common	• Failure Mode Effect Management	REPAIR the more specific DTC first. GO to Pinpoint Test A .

				fault DTCs, P0752, P0754, P0755.	action, see DTCs P0750, P0973 and P0974. • Will turn on wrench lamp.	
P0754	-	SSA	SSA intermittent.	Intermittent SSA circuit faults but not lasting long enough to trip DTC, P0750, P0973 or P0974.	• Customer might notice unexpected upshifts, downshifts, flairs or neutral conditions. • Will turn on wrench lamp.	GO to Pinpoint Test A .
P0755	P0756	SSB	SSB .	Open circuit or short to power.	• Customer might notice unexpected upshift. • 3rd and 5th gears available. • Harsh engagements. • Poor launch performance. • Will turn on MIL .	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0756	P2701	Direct clutch	SSB performance/stuck off.	Direct (3,5,R) clutch failed off • Non-electrical failures where SSB direct clutch is stuck off (no pressure). • Direct clutch regulator	• Customer may notice flares or neutral conditions on shifts into 3rd	REFER to Diagnosis By Symptom in this section.

				valve stuck in default position. • Direct clutch mechanical failure.	or 5th gear. • PCM will command 3 shifts into 3rd or 5th gear, and if direct clutch is failed off the customer will notice flares or neutral conditions that last one second or so. • 3rd and 5th gears are disabled, customer might notice transmission hangs in 2nd on acceleration until customer tips out to closed pedal (done to protect overdrive clutch). • Will turn on MIL .	
P0757	P2701	SSB	SSB stuck on.			

				SSB (direct clutch) failed on, causing direct clutch failed on. Since the hydraulic controls prevent direct clutch and low/reverse clutch on together in the forward ranges we can isolate the solenoid from the clutch. This code sets if: • Non-electrical failures where SSB (direct clutch) is stuck on (pressure). • Direct clutch regulator valve stuck in spring compress position.	• Customer may notice a vehicle deceleration on a shift into 2nd, 4th or 6th gear. • Harsh 1-3 shift. • Poor launch performance lack of shifts. • Will turn on MIL .	REFER to Diagnosis By Symptom in this section.
P0758	P0755, P0976 and P0977	SSB	SSB electrical.	Sister code to P0755, P0976 and P0977 used to illuminate the wrench light. Additional common fault DTCs, P0755, P0976, P0977.	• Failure Mode Effect Management action see P0755, P0976 and P0977. • Will turn on wrench lamp.	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0759	-	SSB	SSB intermittent.	Intermittent SSB circuit faults but not lasting long enough to trip DTC, P0755, P0758, P0976 or P0977.	• Customer might notice unexpected upshifts, downshifts, flairs or neutral conditions. • Will turn on	GO to Pinpoint Test A .

					wrench lamp.	
P0760	P0761	SSC	SSC .	Open circuit.	• Customer might notice erratic, delayed or harsh shifts. • Disable 2nd and 6th gears. • Will rn on MIL .	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0761	P2702	Intermediate clutch	SSC performance/stuck off.	Intermediate clutch failed off • Non-electrical failures where SSC intermediate clutch is stuck off (no pressure). • Intermediate clutch stuck off due to mechanical failure. • Intermediate clutch regulator valve stuck in the default position.	• Customer may notice neutral conditions or flares on shifts to 2nd or 6th gear. • Disabled 2nd and 6th gears. • Erratic shifting, neutral conditions, flares, higher engine speeds on highway due to 6th gear being disabled. • Will turn on MIL .	REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P0762	P0763	SSC	SSC stuck on.			

				Intermediate clutch failed on, could be due to: • Intermediate clutch SSC non-electrical failed stuck on (pressure). • Intermediate clutch stuck on due to mechanical failure. • Intermediate clutch regulator valve stuck in the spring compressed position.	• Customer may notice a vehicle deceleration on a shift into 3rd or 5th gear (intermediate clutch failing to release will cause a tie-up in 3rd or 5th gear). • Erratic shifting or being stuck in 6th gear. • 3rd, 4th and 5th gears are disabled. • Hangs in 2nd gear on acceleration since 2nd-6th upshifts only occur at closed pedal (due to energy limitations of overdrive clutch), harsh reverse engagements	REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.

					(since low/reverse clutch is not on in 2nd gear). • Will turn on MIL .	
P0763	P0760, P0979 and P0980	SSC	SSC electrical.	Sister code to P0760, P0979 and P0980 used to illuminate the wrench light. Additional common fault DTCs, P0755, P0976, P0977.	• Failure Mode Effect Management action see P0760, P0979 and P0980. • Will turn on wrench lamp.	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0764	-	SSC	SSC intermittent.	Intermittent SSC circuit faults but not lasting long enough to trip DTC, P0760, P0979 and P0980.	• Customer might notice unexpected upshifts, downshifts, flairs or neutral conditions. • Will turn on wrench lamp.	GO to Pinpoint Test A .
P0765	P0766	SSD	SSD .	Open circuit.	• Overdrive clutch failed on, only 4th, 5th and 6th gears available. • Harsh engagements. • Poor launch due to	REPAIR the more specific DTC first. GO to Pinpoint Test A .

					4th gear drive away. • Will turn on MIL .	
P0766	P2704	Overdrive clutch system fault includes non-electrical SSD fault, main control valve body and clutch	SSD performance stuck off.	Overdrive clutch failed off. • Non-electrical failure where SSD , low/reverse and overdrive clutch is stuck off (no pressure). • Low/reverse clutch/overdrive clutch regulator valve stuck in default position. • Low/reverse clutch/overdrive clutch boost valve stuck in default position.	• Customer may notice flares or neutral conditions on shifts into 4th, 5th or 6th gear. • Erratic shifting, flares, neutral conditions while the code is being set. • 1st, 4th, 5th and 6th gears are disabled - may notice high engine rpm since 3rd is highest available gear. • May get delayed or no reverse engagement (need	REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.

					low/reverse clutch on to achieve reverse). • Will turn on MIL .	
P0767	P07A9, P2704	Overdrive or low/reverse clutch	SSD stuck on.	Overdrive clutch failed on, could be due to: • Low/reverse or overdrive clutch SSD non-electrical failed stuck on (pressure). • Overdrive clutch stuck on due to mechanical failure. • Low/reverse, overdrive clutch regulator valve stuck in the spring-compressed position.	• Customer may notice vehicle deceleration on shifts into 2nd or 3rd gear (overdrive clutch failing to release will cause a tie-up in 2nd or 3rd gear). • 1st, 2nd and 3rd gears are disabled. • Poor launch due to 4th gear drive away. • Harsh engagements. • Will turn on MIL .	REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P0768	P0765, P0982 and P0983	SSD	SSD electrical	Sister code to P0765, P0982 and P0983 used to illuminate the wrench light. Additional common fault DTCs, P0767,	• Failure Mode Effect Management action	REPAIR the more specific DTC first. GO to Pinpoint Test A .

				P0769, P0770.	see P0765, P0982 and P0983. • Will turn on wrench lamp.	
P0769	-	SSD	SSD intermittent.	Intermittent SSD circuit faults but not lasting long enough to trip DTC, P0765, P0768, P0982 and P0983.	• Customer might notice unexpected upshifts, downshifts, flairs or neutral conditions. • Will turn on wrench lamp.	GO to Pinpoint Test A .
P0770	P0773	Shift Solenoid E (SSE)	SSE .	Open, short to ground or short to power.	SSE failed off (no pressure): • Customer might notice 4th gear drive away when 1st gear is commanded. • Failed off (no pressure) then 1st gear with engine braking is disabled. • May or may not notice 2nd gear provided	REPAIR the more specific DTC first. GO to Pinpoint Test A .

					when 1st gear selected in low manual range. • Harsh reverse engagements since low/reverse clutch does not apply in neutral or drive in this failure mode. SSE failed on (pressure): • High side is turned off. • Poor launch performance due to 5th gear drive away. • Harsh engagements. • No TCC apply. • Will turn on MIL .	
P0771	P0984	SSE failed off	SSE performance/stuck off.	• SSE controls the multiplexing of SSD low/reverse and overdrive clutch. If solenoid fails	• If SSE is failed off or valve 2 is stuck in default	REPAIR the more specific DTC first. GO to Pinpoint Test A .

				off (no pressure) then 1st gear is failed to 4th gear. • If clutch select valve 2 sticks in the default position then 1st gear with engine braking is failed to 4th gear and reverse is failed to neutral. • The diagnostic does not distinguish SSE stuck off from valve 2 stuck in default. This code means either: ♦ SSE short to power, failed off (no pressure). ♦ Valve 2 stuck in default position.	position then the customer will get 4th gear when 1st gear is selected. • Will turn on wrench lamp.	
P0772	P0984	SSE failed on	SSE stuck on.	• SSE controls the multiplexing of SSD low/reverse and overdrive clutch. If the solenoid fails on (pressure) then, 1st and 2nd gear are	• If SSE is failed on or valve 2 is stuck in spring compressed position, then 1st	REPAIR the more specific DTC first. GO to Pinpoint Test A .

				the only available gears. 3rd gear is failed to 1st gear, 4th gear is failed to 1st gear, 5th gear is failed to neutral, and 6th gear is a tie-up. • If clutch select valve 2 sticks in the spring-compressed position, the same ratio pattern will occur. This code means either: ♦ SSE short to ground, failed on (pressure). ♦ Valve 2 stuck in spring compressed position.	and 2nd gears are the only available gears. • Customer might notice flares on shifts into 3rd gear. Deceleration on shifts into 4th gear since you get 1st gear or a neutral condition on shifts into 5th gear. High engine rpm since 2nd gear is top available gear. • Will turn on wrench lamp.	
P0773	P0770	SSE	SSE electrical.	Open, short to ground or short to power in solenoid or wiring.	Sister code to P0770 used to illuminate the wrench light. • Failure Mode Effect Management action see	GO to Pinpoint Test A .

					P0770. • Will turn on wrench lamp.	
P0774	-	SSE	SSE intermittent.	Intermittent SSD circuit faults but not lasting long enough to trip DTC, P0770.	• Failure Mode Effect Management action see P0770. • Will turn on wrench lamp.	GO to Pinpoint Test A .
P07A5	-	Direct clutch	Transmission direct clutch stuck on.	Ratio based test. The clutch control bypass valve (multiplex valve) exhausts the direct clutch when the valve is in the compressed position, where SSD points in the low/reverse position, the diagnostic can isolate the direct clutch stuck on from SSB stuck on because getting 3rd gear in 1st when the clutch control bypass valve is in the spring compressed position indicates that SSB cannot be the cause.	• Customer may notice slow acceleration from stop. May be in 3rd gear when 1st gear is commanded. • Once the DTC is stored, 3rd and 5th gears are only available. • Erratic shifting, harsh engagements, poor launch performance. • Will turn on wrench lamp.	REFER to Diagnosis By Symptom in this section.
P07A8	-					

		Low/reverse clutch	Transmission low/reverse clutch performance/stuck off.	SSD is multiplexed through the clutch control bypass valve (multiplex valve) to the low/reverse and overdrive clutch, the diagnostic can isolate the low/reverse clutch failed off from SSD stuck off when the overdrive clutch applies normally and the low/reverse clutch did not.	• Customer may notice no reverse. • Disable 1st gear. • Delayed engagement into drive. • Poor launch performance due to 2nd gear launch. • Will turn on wrench lamp.	REFER to Diagnosis By Symptom in this section.
P07A9	P0767	Low/reverse clutch	Transmission low/reverse clutch stuck on.	SSD is multiplexed through the clutch control bypass valve (multiplex valve) to the low/reverse and overdrive clutch, the diagnostic can isolate the low/reverse stuck on by turning off SSE . If the transaxle shifts into 4th when the clutch control bypass valve moves SSD is stuck on, but if the transaxle stays in 1st then the low/revers is stuck on.	• Low/reverse clutch failed on. • One-Way Clutch (OWC) transmits torque in both directions. • Stuck in 1st gear. • Will turn on wrench lamp.	REFER to Diagnosis By Symptom in this section.
P07AA	-	Overdrive clutch	Transmission overdrive clutch performance/stuck off.	SSD is multiplexed through the clutch control bypass valve (multiplex valve) between the low/reverse and overdrive clutch, the diagnostic can isolate the overdrive clutch failed off from SSD stuck off when the low/reverse clutch	• Overdrive clutch failed off. • Disable 4th, 5th and 6th gears. • Reverse may be delayed	REFER to Diagnosis By Symptom in this section.

				applies normally but the overdrive clutch is stuck off.	or disabled. • High engine rpm. • Will turn on wrench lamp.	
P0815	-	Upshift switch circuit	SelectSwtchTM upshift switch output circuit failure	The associated circuitry to and from the SelectSwtchTM switch, fuse or the SelectSwtchTM switch itself may have an open or is shorted to ground.	• SelectSwtchTM upshift inoperative. • Will turn on wrench lamp.	REFER to Section 307-05A .
P0816	-	Downshift switch circuit	SelectSwtchTM downshift switch output circuit failure	The associated circuitry to and from the SelectSwtchTM switch, fuse or the SelectSwtchTM switch itself may have an open or is shorted to ground.	• SelectSwtchTM downshift inoperative. • Will turn on wrench lamp.	REFER to Section 307-05A .
P0867	-	Transmission hydraulic and clutch systems	Transmission fluid pressure.	The control valve test raissure to insure that the clutch control bypass valve (multiplex valve) is latched, then turns on SSE to test for a stuck TCC control valve under steady state operation in 4th, 5th and 6th gear. If the ratio breaks away the test is aborted. If enough ratio break away occur, the DTC is set.	• Multiplex latch pressure inadequate (valve moves when SSE turns on). • Overdrive clutch pressure issue. • Line pressure issues. • Solenoid regulator valve issues. • Customer may notice flairs during test.	REFER to Diagnosis By Symptom in this section.

					• Will turn on wrench lamp.	
P0960	P0748	LPC	LPC control circuit/open.	LPC circuit has failed to 0 current.	• Failed to maximum line pressure. • Harsh engagements. • Will turn on MIL .	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0961	P0748	LPC	LPC control circuit range/performance.	Intermittent LPC short to ground. Fault present long enough to notice a neutral condition (minimum pressure) but not present long enough to store a DTC.	• Harsh engagement and harsh shifts. • Will turn on wrench lamp.	GO to Pinpoint Test A .
P0962	P0748	LPC	LPC control circuit low.	LPC short to ground circuit failure.	Failed to 0 current, minimum line pressure: • Failure Mode Effect Management action opens the transaxle solenoid power control relay, removing power from all solenoids which provides maximum line pressure. • Harsh engagements.	REPAIR the more specific DTC first. GO to Pinpoint Test A .

					• Poor launch performance (due to 5th gear drive away). • No TCC apply. • No shifts. • Will turn on MIL .	
P0963	P0748	LPC	LPC control circuit high.	LPC short to power circuit fault.	Failed to 0 current, maximum line pressure: • Harsh engagements. • Will turn on MIL .	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0973	P0753	SSA	SSA control circuit low.	Short to ground.	• Failure Mode Effect Management action opens the transaxle solenoid power control relay, removing power from all solenoids (get PARK, REVERSE, NEUTRAL and 5th gear as the only forward gear	REPAIR the more specific DTC first. GO to Pinpoint Test A .

					with TCC open). • Harsh engagements. • Poor launch performance (due to 5th gear drive away). • No TCC apply. • No shifts. • Will turn on MIL .	
P0974	P0753	SSA	SSA control circuit high.	Short to power.	• Forward clutch is failed off - 5th and 6th gears only available forward gears. • Neutral condition or flare when fault occurs. • Poor launch due to 5th gear drive away • Will turn on MIL	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0976	P0758	SSB	SSB control circuit low.	Short to ground.	• Failure Mode Effect	REPAIR the more specific DTC first. GO to Pinpoint

					Management action opens the transaxle solenoid power control relay, removing power from all solenoids (get PARK, REVERSE, NEUTRAL and 5th gear as the only forward gear with TCC open). • Harsh engagements. • Poor launch performance (due to 5th gear drive away). • No TCC apply. • No shifts. • Will turn on MIL .	Test A .
P0977	P0758	SSB	SSB control circuit high.	Short to power.	• Direct clutch failed on - only 3rd and 5th gears	REPAIR the more specific DTC first. GO to Pinpoint Test A .

					available. • Harsh 1-3 shift if failure occurs while in 1st. • Poor launch due to 3rd gear drive away. • Will turn on MIL .	
P0979	P0763	SSC	SSC control circuit low.	ort to ground.	• Failure Mode Effect Management action opens the transaxle solenoid power control relay, removing power from all solenoids (get PARK, REVERSE, NEUTRAL and 5th gear as the only forward gear with TCC open). • Harsh engagements. • Poor launch performance	REPAIR the more specific DTC first. GO to Pinpoint Test A .

					(due to 5th gear drive away). • No TCC apply. • No shifts. • Will turn on MIL .	
P0980	P0763	SSC	SSC control circuit high.	Open circuit.	• If fault occurs while in 2nd or 6th gear, customer might notice a neutral condition before diagnostics disables 2nd and 6th gears. • Erratic, delayed or harsh shifts. • Will turn on MIL .	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0982	P0768	SSD	SSD control circuit low.	Short to ground.	• Failure Mode Effect Management action opens the transaxle solenoid power control relay, removing power	REPAIR the more specific DTC first. GO to Pinpoint Test A .

					from all solenoids (get PARK, REVERSE, NEUTRAL and 5th as the only forward gear with TCC open), harsh engagements. • Poor launch performance (due to 5th gear drive away). • No TCC apply. • No shifts. • Will turn on MIL .	
P0983	P0768	SSD	SSD control circuit high.	Open circuit.	• Only 4th, 5th and 6th gears available. • Harsh engagements. • Poor launch due to 4th gear drive away. • Will turn on MIL .	REPAIR the more specific DTC first. GO to Pinpoint Test A .
P0984	P0771, P0772	SSE	SSE control circuit range/performance.	This DTC sets with either P0771 or P0772.	• Will turn on	REPAIR the more specific DTC first. GO

					wrench lamp.	to Pinpoint Test A .
P1500	P0722	VSS sensor	OSS sensor circuit.	• PCM has detected VSS sensor signal failed to 0 speed when vehicle conditions (mainly turbine speed) indicate OSS sensor output should be present. • Electrical failures (open, short) of the OSS sensor wiring, connector or a failure of the OSS sensor itself will cause this failure.	• Failure Mode Effect Management action opens transaxle solenoid power control (removes power from all solenoids). ♦ provides PARK, REVERSE, NEUTRAL AND 5th gear with maximum line pressure and open TCC available (controlled by the manual lever). • Harsh engagements (due to maximum line pressure). • Poor launch performance (due to 5th drive away). • Will turn on MIL .	REPAIR the more specific DTC first. GO to Pinpoint Test C .

P1636	-	PCM	Inductive signature chip communication error.	Lost communication with solenoid driver. • The solenoid driver is an internal PCM chip that controls the solenoids. The main microchip communicates with the solenoid driver over a serial interface, sending out the desired solenoid state and receiving back a circuit fault status. • If communication is lost with the solenoid driver, the solenoid states become unknown, so the control system forces the transaxle solenoid power control relay off.	• Traaxle solenoid power control relay turned off, providing PARK, REVERSE, NEUTRAL and 5th gear with TCC open and maximum line pressure. • Harsh engagements. • Poor performance launch (due to 5th drive away). • No TCC apply. • No shifts. • Will turn on MIL .	INSTALL a new PCM. REFER to Section 303-14A or Section 303-14B .
P163E	-	TRID block	Transmission control module programming error.	• TRID version incorrect (TRID version does not match version in PCM Calibration). • 7-digit service banding code checksum or total TRID block checksum invalid.	• Costumer may notice, high engine rpm. • 1st and 3rd gear only. • No TCC apply. • Will turn on MIL .	REFER to Solenoid Body Strategy in this section.

				• Solenoid and Clutch characterization data unavailable. • Failure Me Effect Management will increase pressure and allow only PARK, REVERSE, NEUTRAL, 1st and 3rd gear only.		
P163F	-	TRID block	TRID ID block corrupted, not programmed.	• TRID data not programmed. • Solenoid and Clutch strategy data unavailable. • Failure Mode Effect Management will increase pressure and allow only PARK, REVERSE, NEUTRAL, 1st and 3rd only.	• Failure Mode Effect Management action of limits function to 1st and 3rd gear. • High engine rpm, lack of shifts complaints. • No TCC apply. • Will turn on MIL .	REFER to Solenoid Body Strategy in this section.
P1702	P0706, P0707 and P0708	TR sensor	TR sensor circuit intermittent.	Sister code to P0706 P0707 and P0708 used to illuminate the wrench light.	• Possible no crank, only PARK, REVERSE, NEUTRAL and 5th gear available, harsh engagements.	REPAIR the more specific DTC first. GO to Pinpoint Test D .

					• Extremely delayed engagements (until a DTC is set). • After a DTC is set and the high side opened - harsh engagements, poor performance (due to a 5th gear drive away), no shifts. • Will turn on wrench lamp.	
P1705	-	TR sensor	TR circuit not indicating park/neutral during self-test.	TR sensor not indicating Park or Neutral during Key ON Engine OFF (KOEO) or Key ON Engine Running (KOER) self-test.	-	Rerun KOEO or KOER only.
P1711	-	TFT	TFT sensor out of self-test range.	TFT sensor out of self-test range equals less than -1°C (30°F) or greater than 105°C (220°F) during KOEO or KOER> self-test.	-	RERUN KOEO or KOER only.
P1744	P0741	TCC	TCC solenoid circuit.	Sister code to P0741 used to illuminate the wrench light. Additional common DTC, P163F.	Will turn on wrench lamp.	REFER to Diagnosis By Symptom in this section.
P1780	-	Transmission Control Switch (TCS)	TCS (Overdrive (O/D) Cancel) circuit out of self-test range.	TCS did not change states during KOER self-test.	Customer cannot enter or exit the overdrive feature.	REFER to Section 307-05A .
P1783	-	Transmission overtemperature	Transmission over temperature	Transmission over temperature condition		REFER to Diagnosis By

			condition.	(greater than 135°C [275°F] for at least 5 seconds).	• Torque converter lockup happens earlier than expected. • Will turn on wrench lamp.	Symptom in this section.
P1910	-	Reverse lamp control	Reverse lamp control circuit/open.	Reverse lamp control circuit fault. 6F35 TRan> sensor does not have a high current reverse lamp control switch. This has moved to the PCM.	• Reverse lamps do not function correctly. • Will turn on wrench lamp.	REFER to Section 417-01 .
P1921	P0706, P0707 and P0708	TR switch	Transmission range signal	The PCM sets this DTC when the ignition switch is turned to the crank position and before the PCM receives an engine run signal.	• Engine may not crank.	REPAIR the more specific DTC first. GO to Pinpoint Test D .
P2700	P0751 and P0752	Forward clutch system fault	Transmission forward clutch apply time range/performance.	This code sets with either DTC P0751 or P0752.	• Will turn on wrench lamp.	REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P2701	P0756 and P0757	Direct clutch system fault	Transmission direct clutch apply time range/performance.	This code sets with either DTC P0756 or P0757.	• Will turn on wrench lamp.	REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P2702	P0761 and P0762	Intermediate clutch system faults	Transmission intermediate clutch apply time range/performance.	This code sets with either DTC P0761 or P0762.	• Will turn on wrench lamp.	REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.
P2703	P0766 and P2704	Low/Reverse clutch and OWC faults (covers just the clutches)	Transmission low/reverse clutch apply time range/performance.	Low/reverse clutch stuck off with overdrive clutch stuck off. Most likely cause	• Low/reverse clutch off is a	REPAIR the more specific DTC first. REFER to

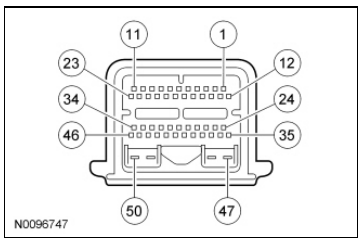
				is SSD non-electrical failure or low/reverse/overdrive regulator valve stuck in default position.	ratio based test. • Low/reverse clutch is only tested for failed off in the low manual lever position. • The customer might notice no engine braking in 1st gear, and erratic shifting as the diagnostics isolates the fault to low/reverse clutch failed off. • Delayed or no reverse engagement. • Will turn on wrench lamp.	Diagnosis By Symptom in this section.
P2704	P0766, P0767 and P2703	Overdrive clutch system faults	Transmission overdrive clutch apply time range/performance.	Overdrive clutch stuck off with low/reverse clutch stuck off. Most likely cause is SSD non-electrical failure or low/reverse/overdrive regulator valve stuck in default position. Overdrive clutch stuck	• Overdrive clutch failed off. • Will turn on wrench lamp.	REPAIR the more specific DTC first. REFER to Diagnosis By Symptom in this section.

				on. Possibly overdrive clutch, SSD , low/reverse/overdrive regulator valve stuck in spring compressed position.		
P2705	-	OWC failed	Transmission OWC apply time range/performance.	• The OWC holds in 1st gear. If the OWC fails off, 1st gear is failed to neutral. • 1st gear is disabled for this failure since low/reverse clutch is not intended to hold power on torque in 1st gear.	• Customer might notice neutral conditions when 1st gear is commanded. • Erratic shifting as the diagnostic isolates the cause of the neutral condition to the OWC being failed. • Poor launch performance (due to 2nd gear drive away). • Harsh engagements. • Will turn on wrench lamp.	REFER to Diagnosis By Symptom in this section.
P2760	P0743 and P0744	TCC solenoid	TCC pressure control solenoid intermittent.	Intermittent TCC solenoid short to ground. A short to ground will cause the TCC to apply, which can stall the engine at low vehicle speeds. The PCM will disable the high side driver until vehicle speed is	• Poor launch performance (due to 5th gear drive away).	REPAIR the more specific DTC first. GO to Pinpoint Test A .

				high enough that the engine won't stall. With the high side driver off the fault can not be detected. If the fault goes away while the high side is off the vehicle will have a 5th gear launch with no DTC. If this occurs 3 times with no DTC P0742 being set, then DTC P2760 will set.	• No TCC apply. • No shifts. • Will turn on wrench lamp.	
P2783	-	Torque converter	Torque converter temperature too high.	• TCC control valve stuck in the apply position. When the TCC is commanded open there will be no flow through the TCC (both apply and release circuits will be exhausted). • Test will run in 3rd gear or higher when valve 2 is in the latched position, pointing SSD at overdrive clutch when the TCC is commanded open. SSE is turned on, if the control valve is stuck, this will cause the TCC to apply even though the TCC solenoid is off.	• Torque converter temperature too high. • Erratic shifts, vehicle disengages at a stop while in drive or low, early TCC apply. • Will turn on MIL .	REFER to Diagnosis By Symptom in this section.

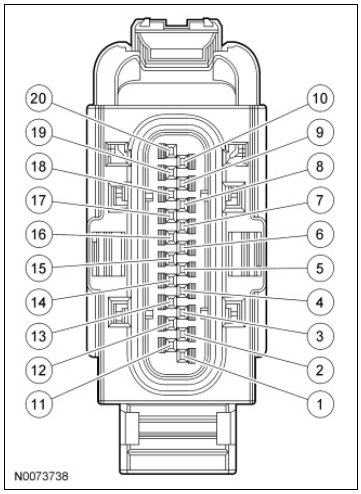
Transaxle Connector Layouts

PCM Transaxle Harness - C175T



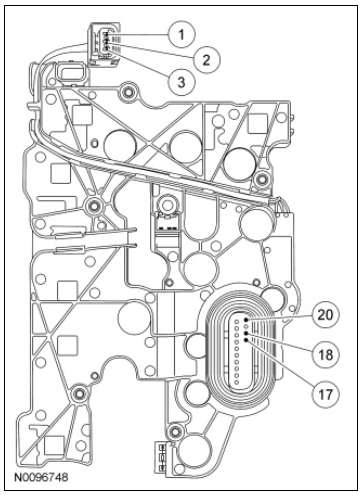
Pin Number	Circuit Function
1	Transmission Range (TR), Output Shaft Speed (OSS) and Turbine Shaft Speed (TSS) voltage supply
10	Shift Solenoid D (SSD) control
11	Shift Solenoid E (SSE) control
16	TSS sensor signal
19	Transmission Fluid Temperature (TFT) sensor signal
25	OSS sensor signal
31	Transmission Control Switch (TCS)
34	Line Pressure Control (LPC) control
36	TR , OSS and TSS sensor ground
39	TR signal
41	TFT ground
43	Shift Solenoid B (SSB) control
44	Shift Solenoid C (SSC) control
45	Shift Solenoid A (SSA) control
46	Torque Converter Clutch (TCC) solenoid control
50	Transaxle solenoid power control voltage

Transaxle Vehicle Harness - C1520A



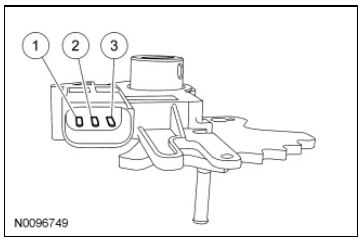
Pin Number	Circuit Function
1	Transmission Fluid Temperature (TFT) ground
2	TFT sensor signal
3	Line Pressure Control (LPC) control
4	Shift Solenoid C (SSC) control
5	Transaxle solenoid power control voltage
6	Torque Converter Clutch (TCC) solenoid control
7	ON/OFF Shift Solenoid E (SSE) control
8	Shift Solenoid A (SSA) control
9	Shift Solenoid B (SSB) control
10	Shift Solenoid D (SSD) control
17	Transmission Range (TR) signal
18	TR and Output Shaft Speed (OSS) sensor power
19	OSS sensor signal
20	TR / OSS sensor ground

Solenoid Body Leadframe-to-Transmission Range (TR) Sensor Internal Circuit Diagram



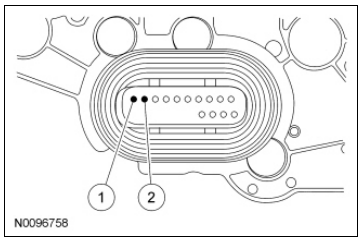
Solenoid Body Leadframe Main Connector Pin Number	TR Sensor Pin Number	Circuit Function
18	1	Transmission Range (TR) power
17	2	TR signal
20	3	TR ground

Transmission Range (TR) Sensor



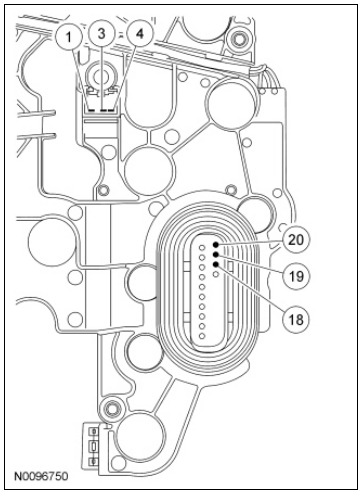
Pin Number	Circuit Function
1	Transmission Range (TR) power
2	TR signal
3	TR ground

Solenoid Body Leadframe Transmission Fluid Temperature (TFT) Sensor Pins



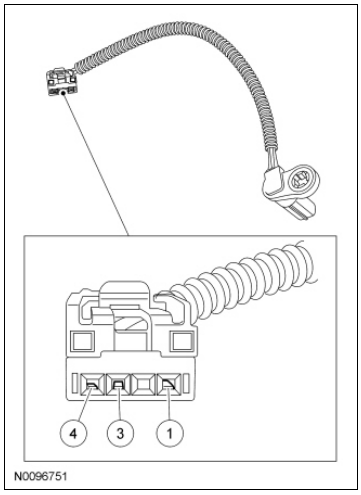
Pin Number	Circuit Function
1	Transmission Fluid Temperature (TFT) signal return
2	TFT signal

Solenoid Body Leadframe-to-Output Shaft Speed (OSS) Sensor Internal Circuit Diagram



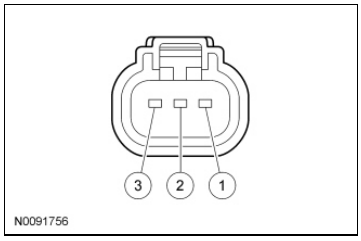
Solenoid Body Leadframe Main Connector Pin Number	Output Shaft Speed (OSS) Sensor Pin Number	Circuit Function
20	1	Transmission Range (TR)/ Output Shaft Speed (OSS) sensor ground circuit
19	3	OSS sensor signal
18	4	TR / OSS sensor power supply

Output Shaft Speed (OSS) Sensor



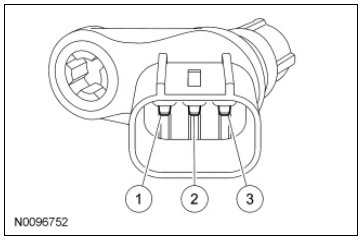
Pin Number	Circuit Function
1	Output Shaft Speed (OSS) sensor ground
3	OSS signal
4	OSS sensor power

Turbine Shaft Speed (TSS) Sensor - C1520B



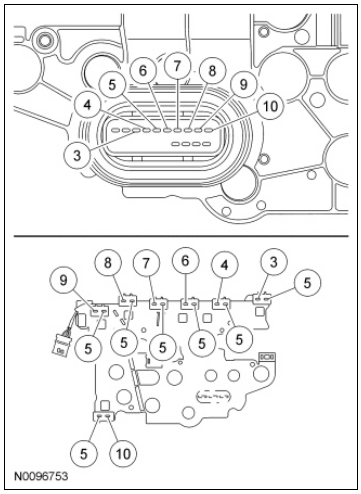
Pin Number	Ciuit Function
1	Turbine Shaft Speed (TSS) sensor ground
2	TSS sensor signal
3	TSS sensor power

Turbine Shaft Speed (TSS) Sensor



Pin Number	Circuit Function
1	Turbine Shaft Speed (TSS) sensor ground
2	TSS sensor signal
3	TSS sensor power

Solenoid Body Leadframe-to-Solenoid Internal Circuit Diagram



Solenoid Body Leadframe Main Connector Pin Number	Circuit Function
3	Line Pressure Control (LPC) control
4	Shift Solenoid C (SSC) control

5	Solenoid power supply circuit
6	Torque Converter Clutch (TCC) solenoid control
7	Shift Solenoid E (SSE) control
8	Shift Solenoid A (SSA) control
9	Shift Solenoid B (SSB) control
10	Shift Solenoid D (SSD) control

Pinpoint Tests - OSC Equipped Vehicle

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

When an electrical conr solenoid body is disconnected, inspect the connector for terminal condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or install new components as required.

Shift Solenoid Pre-Diagnosis

Use the following shift solenoid operation information when carrying out Pinpoint Test A.

Solenoid Operation Chart

Base Selector Lever Position	PCM Commanded Gear	Shift Solenoid					TCC (VFS) NL
		SSA (VFS) NL (CB 1,2,3,4)	SSB (VFS) NH (3,5,R)	SSC (VFS) NL (CB 2,6)	SSD (VFS) NH (CB L,R/C 4,5,6)	SSE (On/Off) NC	
P	P	Off	On	Off	Off	On	Off
R	R	Off	Off	Off	Off	On	Off
N	N	Off	On	Off	Off	On	Off
D	1	On	On	Off	Off [a]	On [b]	Off
	2	On	On	On	On	Off	Off
	3	On	Off	Off	On	Off	Off
	4	On	On	Off	Off	Off	On/Off
	5	Off	Off	Off	Off	Off	On/Off
	6	Off	On	On	Off	Off	On/Off
L	1	On	On	Off	Off	On	Off

[a] Turns on above 8 km/h (5 mph).
[b] Turns off above 8 km/h (5 mph).

CB = Clutch brake

NC = Normally closed

NH = Normally high

NL = Normally low

Shift Solenoid Failure Mode Chart "Failed ON" or "Failed OFF"

Failed ON/OFF due to PCM and/or vehicle wiring concerns and/or solenoid electrically, mechanically or hydraulically stuck on/off.

Shift Solenoid A (SSA)

Gear Commanded	Actual Gears Obtained	
	Failed ON (High Pressure)	**Failed OFF (Low Pressure)**
R	R	R
D	1, 2, 3, 4	5, 6

Shift Solenoid B (SSB)

Gear Commanded	Actual Gears Obtained	
	Failed ON (Low Pressure)	**Failed OFF (High Pressure)**
R	N [a]	R
D	1, 2, 4, 6	3, 5

[a] Reverse is available if the solenoid circuit failed causing transaxle solenoid power control solenoid to remove voltage to all solenoids.

Shift Solenoid C (SSC)

Gear Commanded	Actual Gears Obtained	
	Failed ON (High Pressure)	**Failed OFF (Low Pressure)**
R	R	R
D	2, 6	1, 3, 4, 5

Shift Solenoid D (SSD)

Gear Commanded	Actual Gears Obtained	
	Failed ON (Low Pressure)	**Failed OFF (High Pressure)**
R	N [a]	R

D	1, 2, 3 [b]	4, 5, 6

[a] Reverse is available if the solenoid circuit failed causing transaxle solenoid power control solenoid to remove voltage to all solenoids.
[b] No engine braking.

Shift Solenoid E (SSE)

Gear Commanded	Actual Gears Obtained	
	Failed ON (High Pressure)	Failed OFF (Low Pressure)
R	R	R
D	1, 2	1, 2, 3, 4, 5, 6 [a]

[a] No engine braking.

Pinpoint Tests

Refer to Wiring Diagrams Cell 30 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for schematic and connector information.

PINPOINT TEST A: TRANSAXLE CONTROL SOLENOIDS

NOTE: Refer to the transaxle connector illustrations and solenoid body leadframe internal wiring diagram Transaxle Connector Layouts in this section.

Test Step	Result / Action to Take
A1 ELECTRONIC DIAGNOSTICS	
• Check to make sure the transaxle harness connector is fully seated, terminals are engaged in connector and in good condition before proceeding. • Connect the scan tool. • Carry out the Key ON Engine OFF (KOEO) until continuous DTCs have been displayed. • Enter the Output Test Mode. • Select the mode ALL ON. Push START to turn outputs ON. Push STOP to turn outputs OFF. • **Does vehicle enter Output Test Mode?**	**Yes** GO to A2 . **No** PRESS START. If vehicle does not enter Output Test Mode, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
A2 CHECK THE SOLENOID CIRCUIT FOR AN OPEN	

- Ignition OFF.
- Disconnect: Transaxle Vehicle Harness C1520A.
- Use a mirror to inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals.
- Disconnect: PCM Transaxle Harness C175T .
- Use a mirror to inspect both ends of the connector for damage or pushed out pins, corrosion, loose wires and missing or damaged seals.
- Measure the resistance of the suspect solenoid circuit between the PCM transaxle harness C175T and transaxle vehicle harness C1520A using the following chart.

Shift Solenoid	Transaxle Vehicle Harness	PCM
Shift Solenoid A (SSA) CET05 (BU/GN)	C1520A-8	C175T-45
Shift Solenoid B (SSB) CET06 (GN/BN)	C1520A-9	C175T-43
Shift Solenoid C (SSC) CET07 (GY/OG)	C1520A-4	C175T-44
Shift Solenoid D (SSD) CET08 (BN/WH)	C1520A-10	C175T-10
Shift Solenoid E (SSE) CET18 (GY/YE)	C1520A-7	C175T-11
Line Pressure Control (LPC) CET09 (YE/VT)	C1520A-3	C175T-34
Torque Converter Clutch (TCC) CET10	C1520A-6	C175T-46

Yes
GO to A3 .

No
REPAIR the circuit(s) for an open. RECONNECT all components. TEST the system for normal operation.

(BU/GY)		

- **Is the resistance less than 5 ohms?**

A3 CHECK THE SOLENOID CIRCUIT FOR A SHORT TO GROUND

- Measure the resistance between the transaxle vehicle harness C1520A, harness side and ground using the following chart.

Shift Solenoid	Transaxle Vehicle Harness	Ground
Shift Solenoid A (SSA) CET05 (BU/GN)	C1520A-8	Ground
Shift Solenoid B (SSB) CET06 (GN/BN)	C1520A-9	Ground
Shift Solenoid C (SSC) CET07 (GY/OG)	C1520A-4	Ground
Shift Solenoid D (SSD) CET08 (BN/WH)	C1520A-10	Ground
Shift Solenoid E (SSE) CET18 (GY/YE)	C1520A-7	Ground
Line Pressure Control (LPC) CET09 (YE/VT)	C1520A-3	Ground
Torque Converter Clutch (TCC) CET10 (BU/GY)	C1520A-6	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to A4 .

No
REPAIR the circuit(s) for a short to ground. RECONNECT all components. TEST the system for normal operation.

A4 CHECK THE SOLENOID CIRCUIT FOR A SHORT TO POWER

- Measure the voltage between the transaxle vehicle harness electrical C1520A, harness side and ground using the following chart.

Yes
REPAIR the circuit(s) for a short to power. RECONNECT all components. TEST the system for normal operation.

No
GO to A5 .

Shift Solenoid	Transaxle Vehicle Harness	Ground
Shift Solenoid A (SSA) CET05 (BU/GN)	C1520A-8	Ground
Shift Solenoid B (SSB) CET06 (GN/BN)	C1520A-9	Ground
Shift Solenoid C (SSC) CET07 (GY/OG)	C1520A-4	Ground
Shift Solenoid D (SSD) CET08 (BN/WH)	C1520A-10	Ground
Shift Solenoid E (SSE) CET18 (GY/YE)	C1520A-7	Ground
Line Pressure Control (LPC) CET09 (YE/VT)	C1520A-3	Ground
Torque Converter Clutch (TCC) CET10 (BU/GY)	C1520A-6	Ground

- **Is any voltage present?**

A5 CHECK THE RESISTANCE OF THE SOLENOID FIELD CIRCUIT

- Measure the resistance between the transaxle solenoid body leadframe main electrical connector C1520A-5, component side and the suspect solenoid pin, component side and compare the value to the specifications in the table below.

Shift Solenoid	Solenoid Body Lead - Frame Pin	C1520A-5 (Component Side)
Shift Solenoid A (SSA)	C1520A-8	C1520A-5
Shift Solenoid B (SSB)	C1520A-9	C1520A-5
Shift Solenoid C	C1520A-4	C1520A-5

Yes
INSTALL a new PCM. REFER to Section 303-14A or Section 303-14B . RECONNECT all components. TEST the system for normal operation.

No
REMOVE the main control cover. REFER to Main Control Cover in this section. INSPECT the solenoid body for foreign material such as metal shavings on the exposed metal contacts or other components. CLEAR the solenoid body and RECHECK the resistance values. If the resistance values are still out of specification, GO to A6 . INSTALL a new solenoid(s). REFER to Solenoids in this section. RECONNECT all components. TEST the system for normal operation.

(SSC)		
Shift Solenoid D (SSD)	C1520A-10	C1520A-5
Shift Solenoid E (SSE)	C1520A-7	C1520A-5
Line Pressure Control (LPC)	C1520A-3	C1520A-5
Torque Converter Clutch (TCC)	C1520A-6	C1520A-5

Solenoid Resistance Values: SHIFT SOLENOID A (SSA), SHIFT SOLENOID B (SSB), SHIFT SOLENOID C (SSC), SHIFT SOLENOID D (SSD), TORQUE CONVERTER CLUTCH (TCC) and LINE PRESSURE CONTROL (LPC)

Temperature		Resistance (ohms)
°C	°F	
-20 to -10	-4 to 14	3.24-5.13
-10 to 0	14-32	3.43-5.32
0-10	32-50	3.62-5.51
10-20	50-68	3.81-5.70
20-30	68-86	4.00-5.89
30-40	86-104	4.19-6.08
40-50	104-122	4.38-6.27
50-60	122-140	4.57-6.46
60-70	140-158	4.76-6.65
70-80	158-176	4.95-6.83
80-90	176-194	5.13-7.02
90-100	194-212	5.32-7.21

Solenoid Resistance Values: SHIFT SOLENOID E (SSE) (ON/OFF)

Temperature	Resistance (ohms)

°C	°F	
-20 to -10	-4 to 14	15.45-24.35
-10 to 0	14-32	16.35-25.25
0-10	32-50	17.25-26.15
10-20	50-68	18.15-27.05
20-30	68-86	19.05-27.95
30-40	86-104	19.95-28.85
40-50	104-122	20.85-29.75
50-60	122-140	21.75-30.65
60-70	140-158	22.65-31.54
70-80	158-176	23.54-32.44
80-90	176-194	24.44-33.34
90-100	194-212	25.34-34.24

- **Is the resistance within specifications?**

A6 CHECK THE SOLENOID BODY LEADFRAME FOR AN OPEN

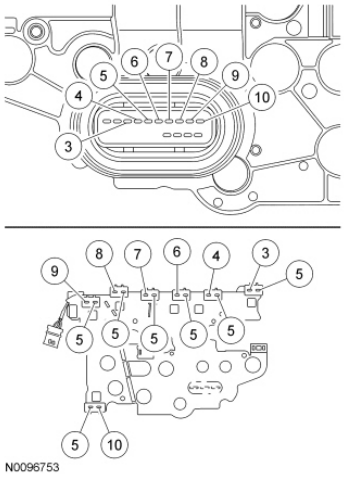
- Remove the solenoid body leadframe. Refer to Solenoid Body Leadframe in this section.
- Measure the resistance between the solenoid body leadframe main electrical connector C1520A, component side and the corresponding solenoid pins using the following chart.

Solenoid Body Leadframe Main Connector Pin Number	Circuit Function
3	Line Pressure Control (LPC) solenoid control
4	Shift Solenoid C (SSC) control
5	Solenoid power supply
6	Torque Converter Clutch (TCC) solenoid control
7	Shift Solenoid E (SSE) control
8	Shift Solenoid A (SSA) control
9	

Yes
INSTALL a new solenoid(s). REFER to Solenoids in this section. RECONNECT all components. TEST the system for normal operation.

No
INSTALL a new solenoid body leadframe. REFER to Solenoid Body Leadframe in this section.

	Shift Solenoid B (SSB) control
10	Shift Solenoid D (SSD) control

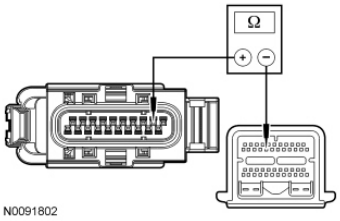
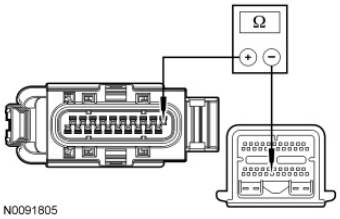
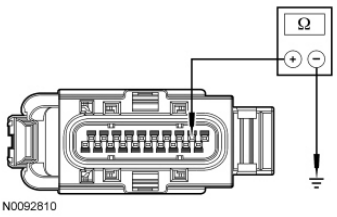
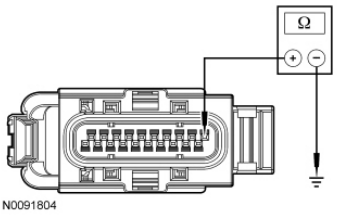


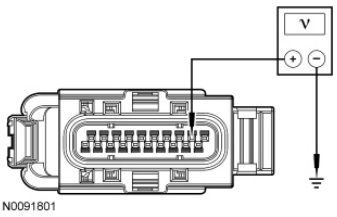
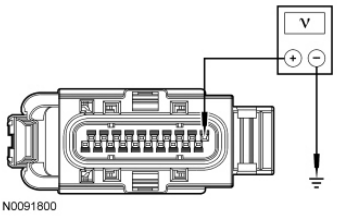
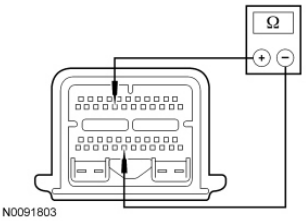
- **Is the resistance less than 5 ohms?**

PINPOINT TEST B: TFT SENSOR

NOTE: Refer to the transaxle connector illustrations and solenoid body leadframe internal wiring diagram Transaxle Connector Layouts in this section.

Test Step	Result / Action to Take
B1 ELECTRONIC DIAGNOSTICS	
• Check to make sure the transaxle vehicle harness C1520A is fully seated, terminals are fully engaged in connector and in good condition before proceeding. • **Have the above items been checked?**	**Yes** GO to B2 . **No** CARRY OUT checks. CLEAR the DTCs. REPEAT the self-test.
B2 CHECK THE TFT SENSOR CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Transaxle Vehicle Harness C1520A. • Disconnect: PCM Transaxle Harness C175T. • Use a mirror to inspect both ends of the connector for damage or pushed-out terminals, corrosion, loose wires and missing or damaged seals. • Measure the resistance between PCM transaxle harness C175T-19, circuit VET27 (BN/YE) and transaxle vehicle harness C1520A-2, circuit VET27 (BN/YE).	**Yes** GO to B3 . **No** REPAIR the circuit(s) for an open. CONNECT all components. TEST the system for normal operation.

 N0091802 • Measure the resistance between PCM transaxle harness C175T-41, circuit RE406 (GY/VT) and transaxle vehicle harness C1520A-1, circuit RE406 (GY/VT).  N0091805 • **Is the resistance less than 5 ohms?**	
B3 CHECK THE TFT SENSOR CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: Catalyst Monitor Sensor (CMS) C141. • Disconnect: CMS C142. • Measure the resistance between transaxle vehicle harness C1520A-2, circuit VET27 (BN/YE) and ground.  N0092810 • Measure the resistance between transaxle vehicle harness C1520A-1, circuit RE406 (GY/VT) and ground.  N0091804 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B4 . **No** REPAIR the circuit(s) for a short to ground. CONNECT all components. TEST the system for normal operation.
B4 CHECK THE TFT CIRCUITS FOR A SHORT TO VPWR	

• Measure the voltage between transaxle vehicle harness C1520A-2, circuit VET27 (BN/YE) and ground.  • Measure the voltage between transaxle vehicle harness C1520A-1, circuit RE406 (GY/VT) and ground.  • **Is any voltage present?**	**Yes** REPAIR the circuit(s) for a short to voltage. CONNECT all components. TEST the system for normal operation. **No** GO to B5 .
B5 CHECK THE RESISTANCE OF THE TFT SENSORS/HARNESS	
• Vehicle must be at normal operating temperature. • Connect: Transaxle Vehicle Harness C1520A. • **TEST 1.** • Measure and record the resistance between PCM transaxle harness C175T-19, circuit VET27 (BN/YE) and C175T-41, circuit RE406 (GY/VT).  • Compare the resistance value to the following table ranges: **TRANSMISSION FLUID TEMPERATURE (TFT)** **°C** / **°F** / **Resistance (Ohms)** -40 to -20 / -40 to -4 / 1076K-269K -19 to -1 / -3 to 31 / 309K-91K 0-20 / 32-68 / 104K-35K 21-40 / 69-104 / 40K-15K	**Yes** INSTALL a new PCM. CONNECT all components. TEST the system for normal operation. **No** INSTALL a new solenoid body leadframe. REFER to Solenoid Body Leadframe in this section. RECONNECT all components. TEST the system for normal operation.

41-70	105-158	17K-4.9K
71-90	159-194	5.6K-2.5K
91-110	195-230	3.0K-1.4K
111-130	231-266	1.7K-0.8K
131-150	267-302	0.97K-0.56K

- **TEST 2.**
- Check for intermittent short or open.
- If the resistance was between 0.8K and 100K ohms carry out the following test. If the transaxle is warm, allow it to cool. Check the TFT sensor resistance again. Compare the resistance with the initial resistance. The resistance should decrease if the transaxle was heated and should increase if the transaxle was allowed to cool. If correct, then change in the resistance occurs, repeat On-Board Diagnostic (OBD).
- **Is the resistance in range?**

PINPOINT TEST C: OSS SENSOR

NOTE: Refer to the transaxle connector illustrations and solenoid body leadframe internal wiring diagram Transaxle Connector Layouts in this section.

NOTE: Output Shaft Speed (OSS) codes may be a result of a bad common power or ground shared between the Transmission Range (TR) sensor, OSS sensor and Turbine Shaft Speed (TSS) sensor.

Test Step	Result / Action to Take
C1 ELECTRONIC DIAGNOSTICS	
• Check to make sure the transaxle vehicle harness C1520A is fully seated, terminals are engaged in connector and in good condition before proceeding. • **Have the items above been checked?**	**Yes** GO to C2 . **No** CARRY OUT the checks. CLEAR the codes. RERUN the On-Board Diagnostic (OBD) tests.
C2 ELECTRONIC DIAGNOSTICS	
• Connect the scan tool. • Monitor the OSS sensor PIDs while test driving the vehicle. • **Is the OSS sensor signal present and consistent?**	**Yes** The condition that set the DTC is intermittent and is not currently present. CLEAR the DTCs. RERUN the OBD tests. **No** GO to C3 .
C3 CHECK THE VEHICLE HARNESS FOR AN OPEN CIRCUIT	
• Disconnect: Transaxle Vehicle Harness C1520A. • Disconnect: PCM Transaxle Harness C175T. • Use a mirror to inspect both ends of the connectors for damage or pushed-out terminals, corrosion, loose wires and missing or damaged seals. • Measure the resistance for the OSS sensor circuit,	**Yes** GO to C4 . **No** REPAIR the circuit(s) for an open. CONNECT all components. TEST the system for normal operation.

between the transaxle vehicle harness C1520A and the PCM transaxle harness C175T, harness using the following chart.

Output Shaft Speed Sensor Circuit	Transaxle Vehicle Harness	PCM
Output Shaft Speed (OSS) sensor power supply LE111 (VT/GN)	C1520A-18	C175T-1
OSS sensor ground RET24 (BN/BU)	C1520A-20	C175T-36
OSS sensor signal VET26 (BN/GN)	C1520A-19	C175T-25

- **Is the resistance less than 5 ohms?**

C4 CHECK THE VEHICLE HARNESS FOR A SHORT TO GROUND

- Disconnect: Transaxle Vehicle Harness C1520B.
- Measure the resistance for the OSS sensor circuit between the transaxle vehicle harness C1520A and ground using the following chart.

Output Shaft Speed Sensor Circuit	Transaxle Vehicle Harness	Ground
Transmission Range (TR)/ OSS sensor power supply LE111 (VT/GN)	C1520A-18	Ground
TR / OSS sensor ground RET24 (BN/BU)	C1520A-20	Ground
OSS sensor signal VET26 (BN/GN)	C1520A-19	Ground

- **Is the resistance greater than 10,000 ohms?**

Yes
GO to C5 .

No
REPAIR the circuit(s) for a short to ground. CONNECT all components. TEST the system for normal operation.

C5 CHECK THE VEHICLE HARNESS FOR A SHORT TO VPWR

- Check for voltage between the OSS sensor circuits and the transaxle vehicle harness C1520A using the following chart.

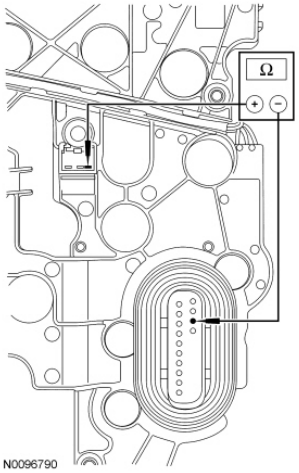
Yes
REPAIR the circuit(s) for a short to voltage. CONNECT all components. TEST the system for normal operation.

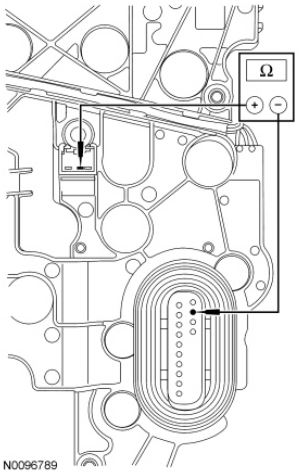
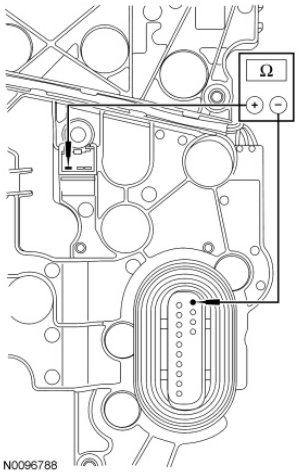
No

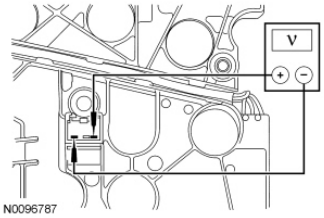
	GO to C6 .

Output Shaft Speed Sensor Circuit	Transaxle Vehicle Harness	Ground
Transmission Range (TR)/ OSS sensor power supply LE111 (VT/GN)	C1520A-18	Ground
TR / OSS sensor ground RET24 (BN/BU)	C1520A-20	Ground
OSS sensor signal VET26 (BN/GN)	C1520A-19	Ground

- **Is any voltage present?**

C6 CHECK THE SOLENOID BODY FOR AN INTERNAL OPEN CIRCUIT	
• Remove the main control cover. Refer to Main Control Cover in this section. • Disconnect: TR Sensor. • Disconnect: OSS Sensor. • Use a mirror to inspect both ends of the connectors for damage or pushed-out terminals, corrosion, loose wires and missing or damaged seals. • Measure the resistance of the solenoid body internal sensor power circuit between the main solenoid body leadframe connector pin 18, leadframe side and the OSS sensor connector pin 4, leadframe side.  • Measure the resistance of the solenoid body internal sensor signal circuit between the main solenoid body leadframe connector pin 19, leadframe side and the OSS sensor connector pin 3, leadframe side.	**Yes** GO to C7 . **No** INSTALL a new solenoid body leadframe. REFER to Solenoid Body Leadframe in this section. CONNECT all components. TEST the system for normal operation.

 • Measure the resistance of the solenoid body internal sensor ground circuit between the main solenoid body leadframe connector pin 20, leadframe side and the OSS sensor connector pin 1, leadframe side.  • **Is the resistance less than 5 ohms?**	
C7 CHECK FOR VOLTAGE AND GROUND AT THE OSS SENSOR CONNECTOR	
• Connect: PCM C175T. • Connect: Transaxle Vehicle Harness C1520A. • Ignition ON. • Measure the voltage on the solenoid body leadframe between OSS sensor connector pins 1 and 4.	**Yes** INSTALL a new speed sensor. REFER to Output Shaft Speed (OSS) Sensor in this section. TEST the system for normal operation. If the condition is still present, INSTALL a new PCM. REFER to Section 303-14A or Section 303-14B . **No** INSTALL a new PCM. REFER to Section 303-14A or Section 303-14B . CONNECT all components. TEST the system for normal operation.

 • **Is the voltage greater than 10 volts?**	

PINPOINT TEST D: TR SENSOR

NOTE: Refer to the transaxle connector illustrations and solenoid body leadframe internal wiring diagram Transaxle Connector Layouts in this section.

NOTE: Transmission Range (TR) codes may be a result of a bad common power and ground shared between the TR sensor, Output Shaft Speed (OSS) sensor and Turbine Shaft Speed (TSS) sensor.

Test Step	Result / Action to Take
D1 VERIFY DTCs	
• Ignition OFF. • Select PARK. • Start the engine. • Carry out the On-Board Diagnostic (OBD) Test. DTCs P0706, P0707 and P0708 cannot be set by an incorrectly adjusted selector lever cable. • **Are only TR DTC codes present?**	**Yes** GO to D3 . **No** GO to D2 .
D2 VERIFY SELECTOR LEVER CABLE/LINKAGE ADJUSTMENT	
• Verify that the selector lever cable/linkage is correctly adjusted. Refer to Section 307-05A . • **Is the selector lever cable/linkage correctly adjusted?**	**Yes** GO to D3 . **No** ADJUST the selector lever cable/linkage. REFER to Section 307-05A . GO to D4 .
D3 CHECK THE ELECTRICAL SIGNAL OPERATION	
• Select PARK. • Disconnect: PCM Transaxle C175T. • Disconnect: Transaxle Vehicle Harness C1520A. • Use a mirror to inspect both ends of the connectors for damaged or pushed-out terminals, corrosion, loose wires and missing or damaged seals. • **Is there damage to the connectors, terminals or harness?**	**Yes** REPAIR as required. CLEAR the DTCs and RERUN OBD tests. **No** GO to D4 .
D4 CHECK ELECTRICAL SYSTEM OPERATION (TR AND PCM)	

• Ignition OFF. • Connect the scan tool. • Connect: PCM Transaxle Harness C175T. • Connect: Transaxle Vehicle Harness C1520A. • Ignition ON. • Enter the following diagnostic mode on the scan tool: TR PIDs TR_DC and TR_FREQ. • Move the selector lever into each gear and stop. • Observe the following PIDs; TR_DC and TR_FREQ while wiggling harness or driving the vehicle. • Monitor PID: TR_FREQ. • Compare the PID: TR_DC to the TR position Duty Cycle Chart. **Selector Lever Position / Range (% Duty Cycle)** P: 8.0 - 25.8 R: 37.50 - 49.31 N: 54.54 - 62.49 D: 67.35 - 81.15 L: 81.15 - 92 • **Is PID TR_FREQ between 100 to 150 Hz?** **Is PID TR_DC in range?** **Do the PIDs TR_DC and TR_FREQ remain steady when the harness is wiggled or the vehicle driven?**	**Yes** The problem is not in the TR sensor system. REFER to Diagnosis By Symptom in this section for further diagnosis. **No** If the PIDs change when wiggling the harness or driving the vehicle, the problem may be intermittent. GO to D5 .
D5 CHECK THE TRANSAXLE VEHICLE HARNESS FOR AN OPEN	
• Disconnect: PCM Transaxle Harness C175T. • Disconnect: Transae Harness C1520A. • Measure the resistance for the TR sensor circuits between the transaxle vehicle harness C1520A and the PCM transaxle harness C175T using the following chart. **Transmission Range Sensor Circuit / Transaxle Vehicle Harness / PCM** TR Ground RET24 (BN/BU) / C1520A-20 / C175T-36	**Yes** GO to D6 . **No** REPAIR the circuit. CONNECT all components. TEST the system for normal operation.

TR Signal VET32 (VT)	C1520A-17	C175T-39
TR Power LE111 (VT/GN)	C1520A-18	C175T-1

- **Is the resistance less than 5 ohms?**

D6 CHECK THE TRANSAXLE VEHICLE HARNESS FOR A SHORT TO GROUND

- Disconnect: Transaxle Vehicle Harness C1520B.
- Measure the resistance for the TR sensor circuits between the transaxle vehicle harness C1520A and ground using the following chart.

Transmission Range Sensor Circuit	Transaxle Vehicle Harness	Ground
TR Ground RET24 (BN/BU)	C1520A-20	Ground
TR Signal VET32 (VT)	C1520A-17	Ground
TR Power LE111 (VT/GN)	C1520A-18	Ground

- **Are all resistances greater than 10,000 ohms?**

Yes
GO to D7 .

No
REPAIR shorted circuit(s). RECONNECT all components. TEST the system for normal operation.

D7 CHECK THE TRANSAXLE VEHICLE HARNESS FOR A SHORT TO POWER

- Measure the voltage for the TR sensor circuits between the transaxle vehicle harness C1520A and ground using the following chart.

Transmission Range Sensor Circuit	Transaxle Vehicle Harness	Ground
TR Ground RET24 (BN/BU)	C1520A-20	Ground
TR Signal VET32 (VT)	C1520A-17	Ground
TR Power LE111 (VT/GN)	C1520A-18	Ground

- **Is any voltage present?**

Yes
REPAIR shorted circuit(s). RECONNECT all components. TEST the system for normal operation.

No
GO to D8 .

D8 CHECK FOR A SHORT BETWEEN TR /PCM INPUT SIGNAL CIRCUITS

- Measure the resistance between TR sensor circuits at the transaxle vehicle harness C1520A using the following chart.

Transaxle Vehicle Harness	TR Sensor Circuit	Transaxle Vehicle Harness
C1520A-20	TR Ground RET24 (BN/BU)	C1520A-17 and C1520A-18
C1520A-17	TR Signal VET32 (VT)	C1520A-18 and C1520A-20
C1520A-18	TR Power LE111 (VT/GN)	C1520A-17 and C1520A-20

- **Are all resistances greater than 10,000 ohms?**

Yes
GO to D9 .

No
REPAIR shorts on circuits having less than 10,000 ohms between other TR /PCM input signal circuits. RECONNECT all components. TEST the system for normal operation.

D9 CHECK FOR AN INTERNAL SOLENOID BODY OPEN FOR THE TR SENSOR CIRCUITS

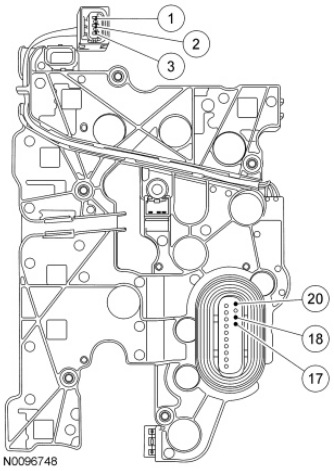
- Remove the main control cover. Refer to Main Control Cover in this section.
- Disconnect: TR Sensor Connector.
- Use a mirror to inspect both ends of the connector for damage or pushed-out terminals, corrosion, loose wires and missing or damaged seals.
- Measure the resistance of the TR sensor circuits between the solenoid body leadframe main connector, component side and the TR sensor connector, leadframe side.

Solenoid Body Leadframe Main Connector Pin Number	TR Sensor Pin Number	Circuit Function (Wire Color)
18	1	Transmission Range (TR) power (RD)
17	2	TR signal (WH)

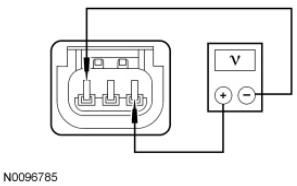
Yes
GO to D10 .

No
INSTALL a new solenoid body leadframe. REFER to Solenoid Body Leadframe in this section. RECONNECT all components. TEST the system for normal operation.

20	3	TR ground (BK)



- **Is the resistance less than 5 ohms?**

D10 CHECK FOR VOLTAGE AND GROUND AT THE TR SENSOR CONNECTOR	
• Connect: PCM C175T. • Connect: Transaxle Vehicle Harness C1520A. • Ignition ON. • Measure the voltage on the solenoid body leadframe between TR sensor connector pins 1 (RD) and 3 (BK) solenoid body leadframe side.  • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new TR sensor. REFER to Digital Transmission Range (TR) Sensor in this section. TEST the system for normal operation. If the condition is still present, INSTALL a new PCM. REFER to Section 303-14A or Section 303-14B . **No** INSTALL a new PCM. REFER to Section 303-14A or Section 303-14B . CONNECT all components. TEST the system for normal operation.

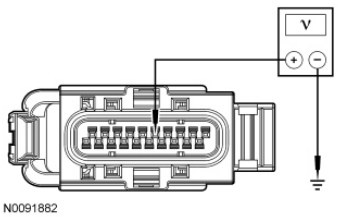
PINPOINT TEST E: TRANSAXLE SOLENOID PRESSURE CONTROL CIRCUIT

NOTE: Refer to the Transaxle Vehicle Harness Connector illustration Transaxle Connector Layouts in this section.

Test Step	Result / Action to Take
E1 CHECK FOR VOLTAGE AT THE TRANSAXLE VEHICLE HARNESS CONNECTOR	

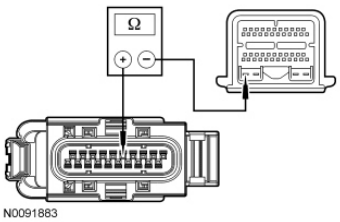
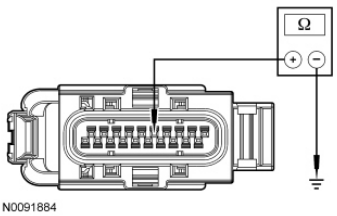
NOTICE: **Do not use a solenoid control circuit that may be at fault. Failure to jump pin 5 to a known good solenoid control circuit can cause incorrect diagnostic results. For additional information, REFER to Diagnostic Trouble Code (DTC) Charts in this section for a fault listing.** • Ignition OFF. • Disconnect: Transaxle Vehicle Harness C1520A. • Inspect the connector for damaged or pushed out terminals, corrosion, loose wires and missing or damaged seals. • Using the chart, connect a fused jumper between one of the 7 solenoid control circuit pins on the transmission vehicle harness C1520A and C1520A-5.	**Yes** INSTALL a new Line Pressure Control (LPC) solenoid. REFER to Solenoids in this section. RECONNECT all components. TEST the system for normal operation. **No** GO to E2 .

Transmission Vehicle Harness C1520A	Solenoid Control Circuit
C1520A-8	Shift Solenoid A (SSA) CET05 (BU/GN)
C1520A-9	Shift Solenoid B (SSB) CET06 (GN/BN)
C1520A-4	Shift Solenoid C (SSC) CET07 (GY/OG)
C1520A-10	Shift Solenoid D (SSD) CET08 (BN/WH)
C1520A-7	Shift Solenoid E (SSE) CET18 (GY/YE)
C1520A-3	Line Pressure Control (LPC) solenoid CET09 (YE/VT)
C1520A-6	Torque Converter Clutch (TCC) solenoid CET10 (BU/GY)



- Ignition ON.
- Measure the voltage between the transaxle vehicle harness C1520A-5 circuit CET25 (BU/GN) harness side to ground.
- **Is the voltage greater than 10 volts?**

E2 CHECK THE TRANSAXLE SOLENOID PRESSURE CONTROL CIRCUIT FOR AN OPEN	

• Ignition OFF. • Disconnect: PCM Transaxle Harness C175T. • Measure the resistance between the PCM transaxle C175T-50, circuit CET25 (BU/GN) and transaxle vehicle harness C1520A-5, circuit CET25 (BU/GN).  • **Is the resistance less than 5 ohms?**	**Yes** GO to E3 . **No** REPAIR circuit CET25 (BU/GN) for an open. RECONNECT all components. TEST the system for normal operation.
E3 CHECK THE TRANSAXLE SOLENOID POWER CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between the transaxle vehicle harness C1520A-5, circuit CET25 (BU/GN) and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A or Section 303-14B . RECONNECT all components. TEST the system for normal operation. **No** REPAIR circuit CET25 (BU/GN) for a short to ground. RECONNECT all components. TEST the system for normal operation.

PINPOINT TEST F: TSS SENSOR

NOTE: Refer to the transaxle connector illustrations and solenoid body leadframe internal wiring diagram Transaxle Connector Layouts in this section.

NOTE: Turbine Shaft Speed (TSS) sensor codes may be a result of bad power and ground circuits shared between the Transmission Range (TR) sensor, Output Shaft Speed (OSS) sensor and TSS sensor.

Test Step	Result / Action to Take
F1 ELECTRONIC DIAGNOSTICS	
• Check to make sure the transaxle vehicle harness C1520A is fully seated, terminals are engaged in connector and in good condition before proceeding. • **Have the items above been checked?**	**Yes** GO to F2 . **No** CARRY OUT the checks. CLEAR the DTCs. RERUN the On-Board Diagnostic (OBD) tests.

<table>
<tr><td>F2 ELECTRONIC DIAGNOSTICS</td><td></td></tr>
<tr><td>• Connect the scan tool.
• Monitor the TSS sensor PIDs while test driving the vehicle.
• Is the TSS sensor signal present and consistent?</td><td>Yes
The condition that set the DTC is intermittent and is not currently present. CLEAR the DTCs. RERUN the OBD tests.

No
GO to F3 .</td></tr>
<tr><td>F3 CHECK THE TRANSAXLE VEHICLE HARNESS FOR AN OPEN CIRCUIT</td><td></td></tr>
<tr><td>• Disconnect: TSS Sensor C1520B.
• Disconnect: PCM Transaxle Harness C175T.
• Use a mirror to inspect both ends of the connectors for damage or pushed-out terminals, corrosion, loose wires and missing or damaged seals.
• Measure the resistance between the TSS C1520B and the PCM transaxle C175T.

<table><tr><th>Turbine Shaft Speed (TSS) Sensor Circuit</th><th>Turbine Shaft Speed (TSS) Sensor</th><th>PCM</th></tr><tr><td>TSS sensor power supply LE111 (VT/GN)</td><td>C1520B-3</td><td>C175T-1</td></tr><tr><td>TSS sensor ground RET24 (BN/BU)</td><td>C1520B-1</td><td>C175T-36</td></tr><tr><td>TSS sensor signal VET33 (WH/OG)</td><td>C1520B-2</td><td>C175T-16</td></tr></table>
• Is the resistance less than 5 ohms?</td><td>Yes
GO to F4 .

No
REPAIR the circuit(s) for an open. CONNECT all components. TEST the system for normal operation.</td></tr>
<tr><td>F4 CHECK THE TRANSAXLE VEHICLE HARNESS FOR A SHORT TO GROUND</td><td></td></tr>
<tr><td>• Disconnect: Transaxle Vehicle Harness Connector C1520A.
• Measure the resistance between TSS sensor C1520B and ground.

<table><tr><th>Turbine Shaft Speed (TSS) Sensor Circuit</th><th>Turbine Shaft Speed (TSS) Sensor</th><th>Ground</th></tr><tr><td>TSS sensor ground RET24 (BN/BU)</td><td>C1520B-1</td><td>Ground</td></tr><tr><td></td><td>C1520B-2</td><td>Ground</td></tr></table></td><td>Yes
GO to F5 .

No
REPAIR the circuit(s) for a short to ground. CONNECT all components. TEST the system for normal operation.</td></tr>
</table>

TSS sensor signal VET33 (WH/OG)		
TSS sensor power supply LE111 (VT/GN)	C1520B-3	Ground

- **Is the resistance greater than 10,000 ohms?**

F5 CHECK THE TRANSAXLE VEHICLE HARNESS FOR A SHORT TO POWER

- Check for voltage between the TSS sensor C1520B and ground.

Turbine Shaft Speed (TSS) Sensor Circuit	Turbine Shaft Speed (TSS) Sensor	Ground
TSS sensor ground RET24 (BN/BU)	C1520B-1	Ground
TSS sensor signal VET33 (WH/OG)	C1520B-2	Ground
TSS sensor power supply LE111 (VT/GN)	C1520B-3	Ground

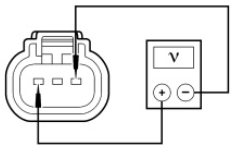
- **Is any voltage present?**

Yes
REPAIR the circuit(s) for a short to voltage. CONNECT all components. TEST the system for normal operation.

No
GO to F6 .

F6 CHECK FOR VOLTAGE AND GROUND AT THE TSS SENSOR CONNECTOR

- Connect: PCM C175T.
- Ignition ON.
- Measure the voltage between TSS sensor C1520B-1 and C1520B-3.



N0096786

- **Is the voltage greater than 10 volts?**

Yes
INSTALL a new speed sensor. REFER to Turbine Shaft Speed (TSS) in this section. TEST the system for normal operation. If the condition is still present, INSTALL a new PCM. REFER to Section 303-14A or Section 303-14B .

No
INSTALL a new PCM. REFER to Section 303-14A or Section 303-14B . CONNECT all components. TEST the system for normal operation.

Special Testing Procedures

Special Tool(s)

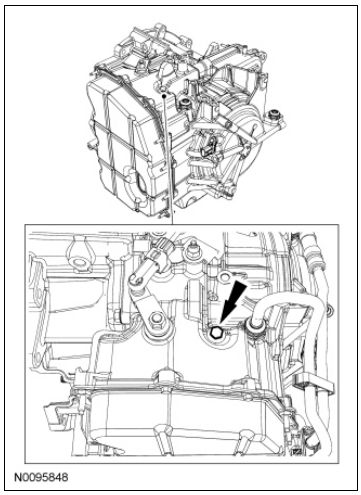
 ST1565-A	Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)
	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portions of the transaxle.

Engine Idle Speed Check

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the engine idle speed.

Line Pressure Test



NOTICE: **Carry out the Line Pressure Test prior to carrying out the Stall Speed Test. If the line pressure is low at stall, do not carry out the Stall Speed Test or further transaxle damage will occur. Do not maintain Wide Open Throttle (WOT) in any range for more than 5 seconds.**

This test verifies that the line pressure is within specification.

1. Connect the Transmission Fluid Pressure Gauge to the line pressure tap.
2. Start the engine and check the line pressures. Refer to the Line Pressure Chart to determine if the line pressure is within specification.

Line Pressure Chart

Gear	Line
Pressures at Idle [a]	
P	338-379 kPa (49-55 psi)
R	621-689 kPa (90-100 psi)
N	338-379 kPa (49-55 psi)
D	338-379 kPa (49-55 psi)
L	338-379 kPa (49-55 psi)
Pressure at Wide Open Throttle (WOT) Stall [a]	
P	N/A
R	1,868-2,068 kPa (271-300 psi)
N	N/A
D	1,868-2,068 kPa (271-300 psi)
L	1,868-2,068 kPa (271-300 psi)

[a] All pressures are approximate.

3. If the line pressure is not within specification, see the Line Pressure Diagnosis Chart for line pressure concern causes.

4. When the pressure tests are complete, install the line pressure tap plug.
   - Tighten to 12 Nm (106 lb-in).

Line Pressure Diagnosis Chart

Test Results	Possible Source
HIGH at IDLE - ALL RANGES	Wiring Harnesses Line Pressure Control (LPC) Solenoid Main Regulator Valve
LOW at IDLE - ALL RANGES	Low Transmission Fluid Fluid Inlet Filter/Seal Main Control Body Cross Leaks

	Gaskets Pump Separator Plate
LOW in Park ONLY	Valve Body
LOW in Reverse ONLY	Separator Plate Reverse Clutch Valve Body Forward Clutch
LOW in Neutral ONLY	Valve Body
LOW in Drive O/D ONLY	Forward Clutch Valve Body
LOW in Manual Low ONLY	Forward Clutch Valve Body

Stall Speed Test

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

NOTICE: **Carry out the Line Pressure Test prior to carrying out the Stall Speed Test. If the line pressure is low at stall, do not carry out the Stall Speed Test or further transaxle damage will occur.**

The Stall Speed Test checks:

- torque convertor operation and installation.
- holding ability of the forward clutch.
- reverse clutch.
- planetary One-Way Clutch (OWC).
- engine driveability concerns.

Conduct this test with the engine coolant and transmission fluid at correct levels and at normal operating temperature.

Apply the park brake firmly for each Stall Speed Test.

Stall Speed Chart

Selector Lever	Engine	rpm
Drive	2.5	2,200-2,500

Drive	3.0	2,400-2,500

1. Connect the scan tool.
2. **NOTE:** If the recorded rpm exceeds the maximum limits, release the accelerator pedal immediately, clutch slippage is indicated.

   In each of the following ranges D, L and R, press the accelerator pedal to Wide Open Throttle (WOT). Do not hold the throttle open for more than 5 seconds at a time.
3. Note the results in each range.
4. After each range, move the selector lever to NEUTRAL and run the engine at 1,000 rpm for about 15 seconds to cool the torque converter before going to the next test.
5. Use the stall speed diagnosis chart for corrective actions.
6. If stall speeds were too high, see the Stall Speed Diagnosis Chart. If stall speeds were too low, first check engine idle speed and tune up. If engine is OK, remove torque converter and check TCC for slippage.

Stall Speed Diagnosis Chart

Range	Possible Source
D, L	Forward Clutch Low/Reverse Clutch Low/One-Way Clutch
R	Low/Reverse Clutch Direct Clutch

Leakage Inspection

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Dye-Lite® ATF/Power Steering Fluid Leak Detection Dye 164-R3701 (Rotunda)	-
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

NOTICE: **Do not try to stop the fly increasing the torque beyond specifications. This may cause damage to the case threads.**

Leaks at the transaxle main control cover-to-transaxle often can be stopped by tightening the attaching bolts to 12 Nm (106 lb-in). If necessary, remove the main control cover and inspect for damage. Refer to Main Control Cover in this section.

Check the transmission fluid filler tube connection at the transmission case. If leakage is found here, install a new grommet.

Check transmission fluid tubes and fittings between the transmission and the cooler in the radiator tank for wear or damage. When transmission fluid is found leaking between the case and the transmission fluid cooler tube fitting, check for a missing or damaged O-ring, then tighten the fitting to specification.

If the leak continues, install a new transmission fluid cooler tube fitting and tighten to specification. The same procedure should be followed for transmission fluid leaks between the radiator cooler and the transmission fluid cooler tube fittings. Refer to Section 307-02A .

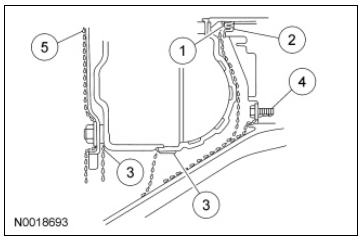
Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator is probably leaking. The cooler can be further checked for leaks by disconnecting the transmission fluid cooler tubes from the cooler fittings and applying no more than 345 kPa (50 psi) air pressure to the fittings. Remove the coolant recovery cap to relieve the pressure at the exterior of the transmission fluid cooler tank. If the cooler is leaking and/or will not hold pressure, install a new cooler.

If transmission fluid leakage is found at the transaxle range selector lever, install a new seal.

If transmission fluid leakage is found at the transaxle internal harness connector, install a new O-ring.

Fluid Leakage in Torque Converter Area

Diagnosing and correcting fluid leaks in the torque converter area, use the following procedures to locate the exact cause of the leakage. Leaks at the front of the transaxle, as evidenced by fluid around the torque converter housing, may have several sources. By careful observation it is possible to pinpoint the source of the leak before removing the transaxle from the vehicle. The paths which the fluid takes to reach the bottom of the torque converter housing are shown in the illustration. The 5 steps following correspond with the numbers in the illustration.



1. Transmission fluid leaking by the converter hub seal lip will tend to move along the drive hub and onto the back of the torque converter. Except in the case of a total seal failure, transmission fluid leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing.

2. Transmission fluid leakage by the outside diameter of the converter impeller hub seal and the case will follow the same path that leaks by the ID of the converter hub seal follow.

3. Transmission fluid leakage from the converter cover weld or the converter-to-flexplate stud weld will appear at outside diameter of torque converter on the back face of the flexplate and in the converter housing only near the flexplate. If a converter-to-flexplate lug, lug weld or converter cover weld leak is suspected, remove the converter and pressure check.

4. Transmission fluid leakage from the bolts inside the converter housing will flow down the back of the torque converter housing. Leakage may be from loose or missing bolts.

5. Engine oil leaks are sometimes incorrectly diagnosed as transaxle converter hub seal leaks. The following areas of possible leakage should also be checked to determine if engine oil leakage is causing the concern.
    1. Leakage at the valve cover gasket may allow engine oil to flow over the torque converter housing or seep down between the torque converter housing and cylinder block causing oil to be present in or at the bottom of the torque converter housing.
    2. Oil galley plug leaks will allow engine oil to flow down the rear face of the cylinder block to the bottom of the torque converter housing.
    3. Leakage at the crankshaft rear oil seal will work back to the flexplate, and then into the torque converter housing.
    4. Leakage at oil pressure sensor will allow engine oil to flow down the rear face of the cylinder block to the bottom of the torque converter housing.

Leak Check Test

1. Remove the transmission fluid level indicator and note the color of the transmission fluid.

2. Remove the torque converter housing cover. Clean off any transmission fluid from the top and bottom of the torque converter housing, the front of the case and rear face of the engine and oil pan. Clean the torque converter area by washing with a suitable nonflammable solvent and blow-dry with compressed air.

3. Wash the torque converter housing, the front of the flexplate and the converter drain plugs. The torque converter housing may be washed out using cleaning solvent and a squirt-type oil can. Blow-dry all washed areas with compressed air.

4. Using the scan tool, start and run the engine until the transaxle reaches its normal operating temperature. Observe the back of the cylinder block and top of the torque converter housing for evidence of transmission fluid leakage. Raise the vehicle on a hoist and run the engine at fast idle, then at low idle, occasionally shifting to the OVERDRIVE and REVERSE ranges to increase pressure within the transaxle. Observe the front of the flexplate, back of the cylinder block (in as far as possible) and inside the torque converter housing and front of the case. Run the engine until transmission fluid leakage is evident and the probable source of leakage can be determined.

Leak Check Test With Black Light

NOTE: Use Dye-Lite® ATF/Power Steering Fluid Leak Detection Dye to detect a transmission fluid leak.

1. Add dye to the transmission fluid. Use one 30 ml (1 oz) bottle of dye solution for every 3.8L (4 qt) of transmission fluid.

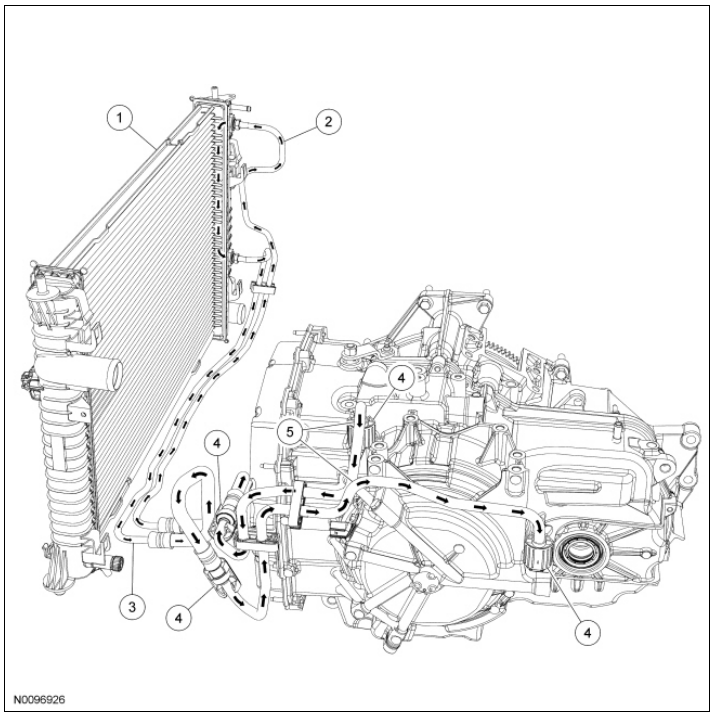
2. Using the scan tool, start and run the engine until the transaxle reaches its normal operating temperature. Using a suitable tool, observe the back of the cylinder block and top of the torque converter housing for evidence of fluid leakage. Raise the vehicle on a hoist and run the engine at fast idle, then at low idle, occasionally shifting to the DRIVE and REVERSE ranges to increase pressure within the transaxle. Observe the front of the flexplate, back of the cylinder block (in as far as possible), inside the torque converter housing and the entire case until fluid leakage is evident and theprobable source of leakage can be determined.

Transmission Fluid Cooler

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Transaxle Cooling - 6F35



Item	Part Number	Description
1	8005	Radiator
2	7R081	Transmission fluid cooler supply tube assembly (supplies transmission fluid to the transmission fluid cooler from the transaxle)
3	7R081	Transmission fluid cooler return tube assembly (transmission fluid return tube from the transmission fluid cooler to the transaxle)
4	7J081	Secondary latches
5	7H420	Transaxle mounted transmission fluid cooler tubes

When internal wear or damage has occurred in the transaxle, metal particles or clutch plate material may have been carried into the torque converter and transaxle fluid cooler. These contaminants are a major cause of recurring transaxle issues and must be removed from the system before the transaxle is put back into use.

Refer to Transmission Fluid Cooler Backflushing and Cleaning in this section.

Transmission Fluid Cooler Flow Test

NOTE: The selector lever linkage, selector lever cable adjustment, transmission fluid level and line pressure must be within specification before carrying out this test. Refer to Section 307-05A for selector lever linkage and selector lever cable adjustment and refer to Special Testing Procedures in this section for line pressure test. The transmission fluid must be above 85°C (185°F) for the cooler by-pass to open to carry out this test.

1. Using a scan tool, run the engine to establish the correct transmission fluid temperature of 85°C (185°F).
2. Remove the transmission fluid level indicator from the transmission fluid filler tube.
3. Place funnel in the transmission fluid filler tube.
4. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 .
5. Remove the transmission fluid cooler return tube (rear fitting) from the fitting on the transaxle case.
6. Connect one end of a hose to the cooler return tube and route other end of the hose up to a point where it can be inserted into the funnel at the transmission fluid filler tube.
7. Start the engine and run it at idle with the transmission in NEUTRAL.
8. When transmission fluid flowing from hose is in a steady stream, a liberal amount of transmission fluid should be observed. "Liberal" is described as about 1L (1 qt) delivered in 30 seconds. If a liberal flow is observed, the test is cote.
9. If the flow is not liberal, stop the engine. Disconnect the hose from the cooler return tube and connect it to the converter outlet tube fitting (front fitting) on the transaxle case.
10. Repeat Steps 7 and 8. If flow is now approximately 1L (1 qt) in 30 seconds, refer to Transmission Fluid Cooler Backflushing and Cleaning . If the flow is still not approximately 1L (1 qt) in 30 seconds, repair the pump and/or the torque converter.
    If new transmission fluid cooler tubes need to be installed, refer to Section 307-02A .

Diagnosis By Symptom

The Diagnostic Routines give the technician diagnostic information, direction and suggest possible components, using a symptom as a starting point.

The Diagnostic Routines are divided into 2 categories: Electrical Routines, indicated by 200 series numbers, and Hydraulic/Mechanical Routines, indicated by 300 series numbers. The Electrical Routines list the possible electrical components that may cause or contribute to the symptom described. The Hydraulic/Mechanical Routines list the possible hydraulic or mechanical components that may cause or contribute to the symptom described.

Diagnosis by Symptom Index Directions

1. Using the Symptom Index, select the Concern/Symptom that best describes the condition.

2. See the routine indicated in the Diagnosis By Symptom Index.

3. Always begin diagnosis of a symptom with:
    1. Preliminary inspections.
    2. Verifications of condition.
    3. Checking the fluid levels.
    4. Carry out other test procedures as directed.

4. **NOTE:** Not all concerns and conditions with electrical components sets a DTC. Be aware that the components listed may be the cause. Verify correct function of these components prior to proceeding to the Hydraulic/Mechanical Routine.

   Begin with the Electrical Routine, if indicated. Follow the Reference/Action statements. Always carry out the OBD tests as required. Never skip steps. Repair as required. If the concern is still present after electrical diagnosis, then proceed to the Hydraulic/Mechanical Routine.

5. The Hydraulic/Mechanical Routines list possible hydraulic or mechanical components that could cause the concern. These components are listed in the removal sequence and by most probable cause. All components listed must be inspected to verify a correct repair.

Diagnosis by Symptom Index

Title	Routines	
	Electrical (1)	Hydraulic/ Mechanical
Engagement Concerns		
No Forward	201	301
No Reverse	202	302
Harsh Reverse	203	303
Harsh Forward	204	304
Delayed/Soft Reverse	205	305
Delayed/Soft Forward	206	306

No Forward and No Reverse	207	307
Delayed/Soft Forward and Reverse	209	309
Shift Concerns		
Some or All Shifts Missing	210	310
Timing â Early/Late	211	311
Timing â Erratic/Hunting	212	312
Soft/Slipping	213	313
Harsh	214	314
No 1st Gear, Engages in Higher Gear	215	315
No Manual Low â 1st Gear	216	316
No 1-2 Shift (Automatic)	220	320
No 2-3 Shift (Automatic)	221	321
No 3-4 Shift (Automatic)	222	322
No 4-5 Shift (Automatic)	223	323
No 5-6 Shift (Automatic)	224	324
No 6-5 Shift (Automatic)	225	325
No 5-4 Shift (Automatic)	226	326
No 4-3 Shift (Automatic)	227	327
No 3-2 Shift (Automatic)	228	328
No 2-1 Shift (Automatic)	229	329
Soft/Slipping 1-2 Shift (Automatic)	230	330
Soft/Slipping 2-3 Shift (Automatic)	231	331
Soft/Slipping 3-4 Shift (Automatic)	232	332
Soft/Slipping 4-5 Shift (Automatic)	233	333
Soft/Slipping 5-6 Shift (Automatic)	234	334
Soft/Slipping 6-5 Shift (Automatic)	235	335
Soft/Slipping 5-4 Shift (Automatic)	236	336
Soft/Slipping 4-3 Shift (Automatic)	237	337
Soft/Slipping 3-2 Shift (Automatic)	238	338
Soft/Slipping 2-1 Shift (Automatic)	239	339
Harsh 1-2 Shift (Automatic)	240	340
Harsh 2-3 Shift (Automatic)	241	341
Harsh 3-4 Shift (Automatic)	242	342
Harsh 4-5 Shift (Automatic)	243	343
Harsh 5-6 Shift (Automatic)	244	344
Harsh 6-5 Shift (Automatic)	245	345
Harsh 5-4 Shift (Automatic)	246	346
Harsh 4-3 Shift (Automatic)	247	347
Harsh 3-2 Shift (Automatic)	248	348
Harsh 2-1 Shift (Automatic)	249	349
Torque Converter Operation Concerns		
Torque Converter: No Apply	250	350
Torque Converter: Always Applied/Stalls Vehicle	251	351
Torque Converter: Cycling/Shudder/Chatter	252	352

Other Concerns		
No Engine Braking in 1st Gear, Manual 1st Position	260	360
Selector Lever Efforts High	261	361
External Leaks	262	362
Vehicle Driveability Concerns	263	363
Noise/Vibration â Forward or Reverse	264	364
Engine Will Not Crank	265	365
No Park Range	266	366
Overheating	267	367

(1) Carry out electrical routine first.

Diagnostic Routines

Engagement Concern: No Forward

Possible Component	Reference/Action
201 â ELECTRICAL ROUTINE	
Powertrain Control System	
• No electrical concerns	
301 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid Level	
• Low transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Selector Lever Linkage (Internal/External)	
• Damaged or out of adjustment	• INSPECT for damage. REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Incorrect Pressures	
• LPC solenoid stuck â low	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Tests and Stall Speed Tests. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specification. If pressures are low, CHECK the following possible components: ♦ Main control valve body ♦ Pump assembly ♦ LPC solenoid
Main Control Valve Body	

• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Manual control valve â damaged	• INSTALL new as required.
Pump Assembly	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Porosity/cross leaks/ball missing or leaking	• INSTALL a new pump as required.
• Components â damaged	• INSTALL a new pump as required.

Engagement Concern: No Reverse

Possible Component	Reference/Action
202 â ELECTRICAL ROUTINE	
Powertrain Control System	
• No electrical concerns	
302 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid Level	
• Low transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Transmission fluid condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Selector Lever Linkage (Internal/External)	

• Damaged or out of adjustment	• REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Incorrect Pressures	
• Line pressure â low	• CARRY OUT Line Pressure and Stall Speed Tests. REFER to Special Testing Procedures . CHECK pressure at line pressure tap. SEE the Line Pressure Chart for specifications. If pressures are low, CHECK the following possible components: ♦ Main control valve body ♦ Pump assembly ♦ Low/reverse clutch assembly ♦ Direct clutch assembly ♦ SSB , SSD and SSE
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gasket and separator plate â damaged, off location	• INSTALL new as required.
• Manual control valve, springs â stuck, damaged	• INSTALL new as required.
• Multiplex valve, springs â stuck, damaged	• INSTALL new as required.
• Low/reverse clutch valve, springs â stuck, damaged	• INSTALL new as required.
• Direct clutch valve, springs â stuck, damaged	• INSTALL new as required.
Pump Assembly	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Porosity/cross leaks, pump	• INSTALL a new pump as required.

assembly leaking, plugged hole	
• Components damaged	• INSTALL a new pump as required.
Low/Reverse Clutch Assembly	
• SSD stuck â low	• INSTALL a new SSD as required. REFER to Solenoids .
• Low/reverse regulator valve stuck	• REPAIR as required.
• Seals, piston, springs â damaged	• REPAIR as required.
• Clearance check out of specification	• CARRY OUT clearance checks.
• Friction elements â damaged or worn	• REPAIR as required.
Direct Clutch Assembly	
• Seals, piston, spring â damaged	• REPAIR or install new as required.
• SSB	• INSTALL a new SSB as required. REFER to Solenoids .
• Direct clutch regulator valve	• REPAIR or install new as required.
• Clearance check out of specification	• CARRY OUT clearance checks.
• Friction elements â damaged, clearance check incorrect	• REPAIR as required.

Engagement Concern: Harsh Reverse

Possible Component	Reference/Action
203 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , MAF sensor, IAT sensor, TP sensor, ISC , PSP sensor, engine rpm, LPC solenoid, TFT sensor, TSS sensor, OSS sensor, TR sensor, SSB , SSD or transmission solenoid power control circuit open/shorted	• RUN OBD . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint Test B , GO to Pinpoint Test C , GO to Pinpoint Test D and GO to Pinpoint Test E .
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM , download new identification and strategy as necessary. REFER to Solenoid Body Strategy .
303 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure â high	• CARRY OUT Line Pressure and Stall Speed Tests. REFER to Special Testing Procedures . CHECK pressure at line pressure tap. SEE the Line Pressure Chart for specifications. If high, CHECK the main control valve body.
Pump Assembly	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Porosity/cross leaks, pump assembly leaking, plugged hole	• INSTALL a new pump as required.
• Components damaged	• INSTALL a new pump as required.
• Main regulator valve â stuck, damaged	• INSTALL new as required.
Main Controls	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gasket and separator plate â damaged, off location	• INSTALL new as required.
• Low/reverse regulator valve â stuck, damaged	• INSTALL new as required.
• Low/Reverse latch valve â stuck, damaged	• INSTALL new as required.
• Direct regulator valve â stuck, damaged	• INSTALL new as required.

• Direct latch valve â stuck, damaged	• INSTALL new as required.
• SSB mechanically stuck â high	• INSTALL a new SSB as required. REFER to Solenoids .
• SSD mechanically stuck â high	• INSTALL a new SSD as required. REFER to Solenoids .
Low/Reverse Clutch Assembly	
• SSD stuck â low	• INSTALL a new SSD as required. REFER to Solenoids .
• Low/reverse regulator valve stuck	• INSTALL a new solenoid body as required.
• Seals, piston, springs â damaged	• REPAIR as required.
• Clearance check out of specification	• CARRY OUT clearance checks.
• Friction elements â damaged or worn	• REPAIR as required.
Direct Clutch Assembly	
• Seals, piston, spring â damaged	• REPAIR or INSTALL new as required.
• SSB stuck	• INSTALL a new SSB as required. REFER to Solenoids .
• Direct clutch regulator valve	• REPAIR or INSTALL new as required.
• Clearance check out of specification	• CARRY OUT clearance checks.
• Friction elements â damaged, clearance check incorrect	• REPAIR or INSTALL new as required.

Engagement Concern: Harsh Forward

Possible Component	Reference/Action
204 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , MAF sensor, IAT sensor, TP sensor, ISC , PSP sensor, engine rpm, LPC solenoid, TFT sensor, TSS sensor, OSS sensor, TR sensor, SSA and or transmission solenoid power control circuit open/shorted	• RUN OBD . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint Test B , GO to Pinpoint Test C , GO to Pinpoint Test D and GO to Pinpoint Test E .
Solenoid Body	

• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM , download new identification and strategy as necessary. REFER to Solenoid Body Strategy .
304 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure â high	• CARRY OUT Line Pressure and Stall Speed Tests. REFER to Special Testing Procedures . Check pressure at line pressure tap. SEE the Line Pressure Chart for specifications. If pressures are high, CHECK the main control valve body, pump assembly.
Pump Assembly	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Porosity/cross leaks, pump assembly leaking, plugged hole	• INSTALL a new pump as required.
• Components damaged	• INSTALL a new pump as required.
• Main regulator valve â stuck, damaged	• INSTALL new as required.
Main Controls	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gasket and separator plate â damaged, off location	• INSTALL new as required.
• Forward clutch seal â leaking between valve body and case	• INSTALL new as required.
• Forward clutch regulator valve â stuck, damaged	• INSTALL new as required.
• Forward clutch latch valve â stuck, damaged	• INSTALL new as required.
Forward Clutch Assembly	
• Seals, piston â worn, damaged	• INSTALL new as required.
• Friction elements â damaged	• INSTALL new as required.
• Wave spring â damaged	• INSTALL new as required.

Engagement Concern: Delayed/Soft Reverse

Possible Component	Reference/Action
205 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , LPC solenoid, TFT sensor	• RUN OBD . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test B .
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM , download new identification and strategy as necessary. REFER to Solenoid Body Strategy .
305 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid Level	
• Low transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Transmission fluid condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Selector Lever Linkage (Internal/External)	
• Damaged, out of adjustment	• REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Incorrect Pressures	
• Line pressure â low	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure and Stall Speed Tests. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If pressures are low, CHECK the following possible components: main control valve body, pump assembly, low/reverse clutch assembly, direct clutch assembly.
Main Controls	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Low/reverse regulator valve â stuck, damaged	• INSTALL new as required.
	• INSTALL new as required.

• Low/reverse latch valve â stuck, damaged	
• Direct regulator valve â stuck, damaged	• INSTALL new as required.
• Direct latch valve â stuck, damaged	• INSTALL new as required.
• Manual control valve, springs â missing, damaged, misassembled	• REPAIR or INSTALL new as required.
• SSB stuck â low	• INSPECT for damage. GO to Pinpoint Test A . INSTALL a new SSB as required. REFER to Solenoids .
• SSD stuck â low	• INSTALL a new SSD as required. REFER to Solenoids .
Pump Assembly	
• Pump Assembly â worn/cross leaks, leaking	• INSTALL new as required.
• Main regulator valve â stuck, damaged	• INSTALL new as required.
Low/Reverse Clutch Assembly	
• SSD stuck â low	• INSTALL a new SSD as required. REFER to Solenoids .
• Low/reverse regulator valve stuck	• INSTALL new as required.
• Seals, piston, springs â damaged	• REPAIR as required.
• Clearance check out of specification	• CARRY OUT clearance checks.
• Friction elements â damaged or worn	• REPAIR as required.
Direct Clutch Assembly	

• Seals, piston, spring â damaged	• REPAIR or INSTALL new as required.
• SSB stuck	• INSTALL a new SSB as required. REFER to Solenoids .
• Direct clutch regulator valve	• REPAIR or INSTALL new as required.
• Clearance check out of specification	• CARRY OUT clearance checks.
• Friction elements â damaged, clearance check incorrect	• REPAIR as required.

Engagement Concern: Delayed/Soft Forward

Possible Component	Reference/Action
206 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , LPC solenoid, TFT sensor and TSS sensor	• RUN OBD . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint Test B and GO to Pinpoint Test C .
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM , download new identification and strategy as necessary. REFER to Solenoid Body Strategy .
306 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid Level	
• Low transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Transmission fluid condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Selector Lever Linkage	
• Damaged, out of adjustment	• REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Incorrect Pressures	
• Line pressure â low	

	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure and Stall Speed Tests. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If pressures are low, CHECK the following possible components: main control valve body, pump assembly, and forward clutch.
Main Controls	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Forward clutch regulator valve stuck or damaged	• INSTALL new as required.
• Forward clutch latch valve stuck or damaged	• INSTALL new as required.
• LPC solenoid stuck â low	• INSTALL a new LPC as required. REFER to Solenoids .
• SSA stuck â low	• INSTALL a new SSA as required. REFER to Solenoids .
Pump Assembly	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Worn/cross leaks	• INSTALL new as required.
• Main regulator valve â stuck, damaged, missing	• REPAIR as required.
Forward Clutch Assembly	
• Clutch plates, seals, piston â worn, damaged	• INSTALL new as required.
• Wave spring â damaged	• INSTALL new as required.

Engagement Concern: No Forward and No Reverse

Possible Component	Reference/Action

207 â ELECTRICAL ROUTINE	
• No electrical concerns	
307 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid Level	
• Low transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Transmission fluid condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Halfshaft	
• Splines â worn, damaged	• REPAIR as required.
• Shaft â misassembled, incorrect	• REPAIR as required.
Selector Lever Linkage (Internal/External)	
• Damaged, out of adjustment	• REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Incorrect Pressures	
• Line pressure â low	• CHECK pressure at the line pressure tap. CARRY OUT Line Pressure and Stall Tests. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If pressures are low, CHECK the following possible components: transmission fluid filter and seal assembly, main control, pump assembly, low/reverse clutch assembly, forward clutch assembly.
Transmission Fluid Filter and Seal Assembly	
• Plugged, damaged, not correctly seated	• INSTALL a new filter and seal assembly.
• Filter, seal â damaged	• INSTALL a new filter and seal assembly.
Main Controls	
• Manual valve	• INSTALL new as required.
• Shift valves	• INSTALL new as required.
• Bolts out of torque	• TIGHTEN bolts to specification.

specification	
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Components â damaged, check balls stuck	• REPAIR as required.
Pump Assembly	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Porosity/cross leaks â leaking, plugged hole	• INSTALL a new pump assembly.
• Main regulator valve (only if line pressure is out of specification) â damaged	• REPAIR as required.
Output Shaft	
• Splines â damaged	• REPAIR as required.
Other Possible Components	
• Turbine shaft	• REPAIR as required.
• Flexplate	• REPAIR as required.
• Sun gear and shell assemblies	• REPAIR as required.
• Planetaries	• REPAIR as required.
• Final drive assembly	• REPAIR as required.

Engagement Concern: Delayed/Soft Forward and Reverse

Possible Component	Reference/Action

209 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM TFT sensor, TSS sensor, LPC solenoid	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint Test B and GO to Pinpoint Test C .
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM , download new identification and strategy as necessary. REFER to Solenoid Body Strategy .
309 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid Level	
• Low transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Transmission fluid condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Selector Lever Linkage (Internal/External)	
• Damaged, out of adjustment	• REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Incorrect Pressures	
• Line pressure â low	• CARRY OUT Line Pressure and Stall Speed Tests. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If pressures are low, CHECK the following possible components: main control, pump assembly and LPC solenoid.
Transmission Fluid Filter and Seal Assembly	
• Plugged, damaged, not correctly seated	• INSTALL a new filter and seal assembly.
• Filter, seal â damaged	• INSTALL a new filter and seal assembly.
Main Controls	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Seals, manual valve	• REPAIR or INSTALL new as required.

Pump Assembly	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Worn/cross leaks â leaking	• INSTALL a new pump assembly.
• Components damaged	• INSTALL new as required.
• Main regulator valve â missing, damaged or misassembled	• REPAIR as required.

Shift Concerns: Some or All Shifts Missing

Possible Component	Reference/Action
210 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSA , SSB , SSC , SSD , SSE , TP sensor, MAF sensor, OSS sensor, TSS sensor, TR sensor and LPC solenoid	• RUN OBD . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint Test C and GO to Pinpoint Test D .
310 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid Level	
• Incorrect transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Transmission fluid condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Selector Lever Linkage (Internal/External)	
• Damaged, out of adjustment	• REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Vehicle Speed Input	
• Insufficient, erratic or no input received by the TCM from the OSS sensor	• REPAIR as required. GO to Pinpoint Test C .
Transmission Fluid Filter and Seal Assembly	
• Plugged, damaged, not correctly seated	• INSTALL a new filter and seal assembly.
• Filter, seal â damaged	• INSTALL a new filter and seal assembly.

Main Controls	
• Regulator and/or latch valves â stuck, damaged, misassembled	• REPAIR or install new as required.
• Plugged solenoid body filter	• INSTALL new as required.
Planetary Gear Sets	
• Damaged	• REPAIR as required.
Other Components	
• Clutches	• REPAIR as required.
• Output shafts (differential)	• REPAIR as required.
• Powerflow components	• REPAIR as required.
• Go to shift concerns:	• See the appropriate shift concern and routine: ♦ Shift Concern: No 1-2, Routine 220/320 ♦ Shift Concern: No 2-3, Routine 221/321 ♦ Shift Concern: No 3-4, Routine 222/322 ♦ Shift Concern: No 4-5, Routine 223/323 ♦ Shift Concern: No 5-6, Routine 224/324 ♦ Shift Concern: No 6-5, Routine 225/325 ♦ Shift Concern: No 5-4, Routine 226/326 ♦ Shift Concern: No 4-3, Routine 227/327 ♦ Shift Concern: No 3-2, Routine 228/328 ♦ Shift Concern: No 2-1, Routine 229/329

Shift Concerns: Timing â Early/Late

Possible Component	Reference/Action
211 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSA , SSB , SSC , SSD , SSE , TP sensor, MAF sensor, OSS sensor, TSS sensor, IAT sensor, ECT sensor and LPC solenoid	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint Test B and GO to Pinpoint Test C .
	• CARRY OUT Shift Point Road Test. REFER to Shift Point Road Test . CARRY OUT Torque Converter Operation Test. REFER to Torque Converter Diagnosis .
Solenoid Body	

• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM , download new identification and strategy as necessary. REFER to Solenoid Body Strategy .
311 â HYDRAULIC/MECHANICAL ROUTINE	
Other	
• Tire size	• SEE the specification decal and verify vehicle has original equipment. Changes in tire size will affect shift timing.
Transmission Fluid Level	
• Low transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Transmission fluid condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Selector Lever Linkage (Internal/External)	
• Damaged, out of adjustment	• REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Main Controls	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Valves, accumulators, seals, springs, clips, check balls â damaged, missing, misassembled	• REPAIR as required.
One-Way Clutch Assembly	
• Damaged	• REPAIR or INSTALL new as required.
Other Components	
• Clutches	• REPAIR or INSTALL new as required.
Vehicle Speed Input	
• Insufficient, erratic or no input received by the TCM from the OSS or TSS sensors	• REPAIR as required. GO to Pinpoint Test C .
Transmission Fluid Filter and Seal Assembly	
• Plugged, damaged, not correctly seated	• INSTALL a new filter and seal assembly.
• Filter, seal â damaged	• INSTALL a new filter and seal assembly.

Shift Concerns: Timing â Erratic/Hunting

Possible Component	Reference/Action
212 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , TCC solenoid, SSA , SSB , SSC , SSD , SSE , TP sensor, OSS sensor, ECT sensor, IAT sensor, MAF sensor, TR sensor, TFT sensor and TSS sensors	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint Test B , GO to Pinpoint Test C , GO to Pinpoint Test D and GO to Pinpoint Test E .
	• CARRY OUT Shift Point Road Test. REFER to Shift Point Road Test . CARRY OUT Torque Converter Operation Test. REFER to Torque Converter Diagnosis .
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM , download new identification and strategy as necessary. REFER to Solenoid Body Strategy .
312 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid Level	
• Low transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Transmission fluid condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Selector Lever Linkage (Internal/External)	
• Damaged, out of adjustment	• REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Valves, seals, clips, check ball â stuck, damaged, contaminated	• REPAIR or INSTALL new as required.
Vehicle Speed Input	

• Insufficient, erratic or no input received by the TCM from the OSS sensor or TSS sensor	• REPAIR as required. GO to Pinpoint Test C .
TCC	
	• SEE Torque Converter Cycling (Routine 254/354).
Planetary Gear Sets	
• Damaged	• REPAIR as required.
Clutch Assemblies	
• Damaged clutch plates, pistons, seals, return springs	• REPAIR or INSTALL new as required.
Transmission Fluid Filter and Seal Assembly	
• Plugged, damaged, not correctly seated	• INSTALL a new filter and seal assembly.
• Filter, seal â damaged	• INSTALL a new filter and seal assembly.
For Diagnosis Related to a Specific Shift	
	• SEE the appropriate shift concern and routine for further diagnosis:
	♦ Shift Concern: No 1-2, Routine 220/320 ♦ Shift Concern: No 2-3, Routine 221/321 ♦ Shift Concern: No 3-4, Routine 222/322 ♦ Shift Concern: No 4-5, Routine 223/323 ♦ Shift Concern: No 5-6, Routine 224/324 ♦ Shift Concern: No 6-5, Routine 225/325 ♦ Shift Concern: No 5-4, Routine 226/326 ♦ Shift Concern: No 4-3, Routine 227/327 ♦ Shift Concern: No 3-2, Routine 228/328 ♦ Shift Concern: No 2-1, Routine 229/329 ♦ Shift Concern: Soft/Slip 1-2, Routine 230/330 ♦ Shift Concern: Soft/Slip 2-3, Routine 231/331 ♦ Shift Concern: Soft/Slip 3-4, Routine 232/332 ♦ Shift Concern: Soft/Slip 4-5, Routine 233/333 ♦ Shift Concern: Soft/Slip 5-6, Routine 234/334 ♦ Shift Concern: Soft/Slip 6-5, Routine 235/335 ♦ Shift Concern: Soft/Slip 5-4, Routine 236/336 ♦ Shift Concern: Soft/Slip 4-3, Routine 237/337 ♦ Shift Concern: Soft/Slip 3-2, Routine 238/338 ♦ Shift Concern: Soft/Slip 2-1, Routine 239/339 ♦ Shift Concern: Harsh 1-2, Routine 240/340 ♦ Shift Concern: Harsh 2-3, Routine 241/341 ♦ Shift Concern: Harsh 3-4, Routine 242/342 ♦ Shift Concern: Harsh 4-5, Routine 243/343 ♦ Shift Concern: Harsh 5-6, Routine 244/344 ♦ Shift Concern: Harsh 6-5, Routine 245/345 ♦ Shift Concern: Harsh 5-4, Routine 246/346

	♦ Shift Concern: Harsh 4-3, Routine 247/347 ♦ Shift Concern: Harsh 3-2, Routine 248/348 ♦ Shift Concern: Harsh 2-1, Routine 249/349

Shift Concerns: Feel â Soft/Slipping

Possible Component	Reference/Action
213 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , LPC solenoid, MAF sensor, TP sensor, ECT sensor, IAT sensor, TFT sensor, OSS sensor and TSS sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint Test B and GO to Pinpoint Test C .
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM , download new identification and strategy as necessary. REFER to Solenoid Body Strategy .
313 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid	
• Low transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Transmission fluid condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Selector Lever Linkage (Internal/External)	
• Damaged, out of adjustment	• REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Incorrect Pressures	
• Line pressure â low	• CARRY OUT Line Pressure and Stall Speed Tests. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If pressures are low or all shifts are soft/slipping. REFER to Main Control Valve Body .
	• If pressures are OK and a specific shift is soft/slipping, SEE the following chart: ♦ Soft/Slipping Shift 1-2, Routine 230/330 ♦ Soft/Slipping Shift 2-3, Routine 231/331 ♦ Soft/Slipping Shift 3-4, Routine 232/332 ♦ Soft/Slipping Shift 4-5, Routine 233/333 ♦ Soft/Slipping Shift 5-6, Routine 234/334

	♦ Soft/Slipping Shift 6-5, Routine 235/335 ♦ Soft/Slipping Shift 5-4, Routine 236/336 ♦ Soft/Slipping Shift 4-3, Routine 237/337 ♦ Soft/Slipping Shift 3-2, Routine 238/338 ♦ Soft/Slipping Shift 2-1, Routine 239/339
Transmission Fluid Filter and Seal Assembly	
• Plugged, damaged, not correctly seated	• INSTALL a new filter and seal assembly.
• Filter, seal â damaged	• INSTALL a new filter and seal assembly.
Main Controls	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Sticking or binding valves, check balls, clips, springs â damaged, missing	• REPAIR or INSTALL new as required.
Pump Assembly	
• Pump assembly â worn/cross leaks, leaking	• INSTALL new as required.

Shift Concerns: Feel â Harsh

Possible Component	Reference/Action
214 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , LPC solenoid, MAF sensor, TP sensor, OSS sensor, TSS sensor, ECT sensor, IAT sensor, PSP switch, TFT sensor, TR sensor SSA , SSB , SSC , SSD and SSE	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint Test B , GO to Pinpoint Test C and GO to Pinpoint Test D .
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM , download new identification and strategy as necessary. REFER to Solenoid Body Strategy .
314 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid Level	

• Low transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Incorrect Pressures	
• Line pressure â high	• CARRY OUT Line Pressure and Stall Speed Tests. REFER to Special Testing Procedures . CHECK pressure at line pressure tap. SEE the Line Pressure Chart for specifications. If pressures are high or all shifts are harsh, CHECK the main control. REFER to Main Control Valve Body . If pressures are OK and a specific shift is harsh. SEE the appropriate shift routine in the following chart: ♦ Shift 1-2, Routine 240/340 ♦ Shift 2-3, Routine 241/341 ♦ Shift 3-4, Routine 242/342 ♦ Shift 4-5, Routine 243/343 ♦ Shift 5-6, Routine 244/344 ♦ Shift 6-5, Routine 245/345 ♦ Shift 5-4, Routine 246/346 ♦ Shift 4-3, Routine 247/347 ♦ Shift 3-2, Routine 248/348 ♦ Shift 2-1, Routine 249/349
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Valves, springs, clips, check balls â stuck, damaged	• REPAIR or INSTALL new as required.
Pump Assembly	
• Pump assembly â worn/cross leaks, leaking	• INSTALL new as required.

Shift Concerns: No 1st Gear, Engages in Higher Gear

Possible Component	Reference/Action
215 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSA , SSB , SSC , SSD , SSE , OSS sensor, TSS sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint

and transmission solenoid power control circuit â no voltage at transmission connector	Test C and GO to Pinpoint Test E . REPAIR as required. CLEAR the DTCs. ROAD TEST and RERUN OBD .
315 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Forward clutch regulator valve, springs, clips â stuck, damaged, missing, misassembled	• REPAIR as required.
• Shift solenoid â stuck, damaged	• REPAIR as required. GO to Pinpoint Test A . ACTIVATE solenoid using output state control. REPAIR as required.
• For diagnosis related to a specific gear, use the scan tool to select the gear	• SEE the following routines: ♦ Shift 1-2, Routine 220/320 ♦ Shift 2-3, Routine 221/321 ♦ Shift 3-4, Routine 222/322 ♦ Shift 4-5, Routine 223/323 ♦ Shift 5-6, Routine 224/324
Mechanical	
• Clutches or seals â damaged or worn	• REPAIR or INSTALL new as required.
Low One-Way Clutch Assembly	
• Not overrunning, damaged	• INSTALL new as required.

Shift Concerns: No Manual Low â 1st Gear

Possible Component	Reference/Action
216 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSA , SSD , SSE and TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D . REPAIR as required. CLEAR the DTCs. ROAD TEST and RERUN OBD .
316 â HYDRAULIC/MECHANICAL ROUTINE	
Selector Lever Linkage (Internal/External)	

• Damaged or out of adjustment	• REPAIR as required. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Incorrect Pressures	
• Line pressure â low	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure and Stall Speed Tests. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If pressures are low, CHECK the following possible components: main control. REFER to Main Control Valve Body .
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Forward latch, forward regulator, low/reverse latch, low/reverse regulator valves, clips â stuck, damaged, missing	• REPAIR as required.
• Multiplex shift valve clips â stuck, damaged, missing	• CHECK 4th gear ratio. REPAIR as required.
• Check ball â damaged, missing	• REPAIR as required.
Low/Reverse Clutch Assembly	
• Seals, piston, spring â damaged	• REPAIR or INSTALL new as required.
• Clutches â damaged, burnt, worn	• INSTALL new as required.
• Worn, damaged, misassembled	• REPAIR as required.
Forward Clutch Assembly	
• Seals, piston, spring â damaged	• REPAIR or INSTALL new as required.
• Clutches â damaged, burnt, worn	• INSTALL new as required.
	• REPAIR as required.

• Worn, damaged, misassembled	
• Case â damaged	• REPAIR as required.

Shift Concerns: No 1-2 Shift (Automatic)

Possible Component	Reference/Action
220 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSC and TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D .
320 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control. REFER to Main Control Valve Body .
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator valve, springs, clips â loose, stuck, missing, misassembled stuck off	• REPAIR or INSTALL new as required.
• SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly â Failed Off	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
	• INSTALL new as required.

• Friction â damaged, worn	
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Low/Reverse Clutch Assembly â Failed On	
• Piston â damaged	• INSTALL new as required.
• Friction â overheated	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Pump Assembly	
• Worn/cross leaks	• INSTALL new as required.
• Component damaged	• INSTALL a new pump assembly as required.
Low One-Way Clutch Assembly	
• Not overrunning, damaged	• INSTALL new as required.

Shift Concerns: No 2-3 Shift (Automatic)

Possible Component	Reference/Action
221 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSB failed, SSC stuck on and TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D .
321 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure	• CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . CHECK pressure at line pressure tap. SEE the Line Pressure Chart for specifications. If not OK, CHECK main control. REFER to Main Control Valve Body .

Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, stuck off	• REPAIR or INSTALL new as required.
• Intermediate regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, stuck on	• REPAIR or INSTALL new as required.
• SSB or SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly â Failed Off	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Intermediate Clutch Assembly â Failed On	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: No 3-4 Shift (Automatic)

Possible Component		Reference/Action
222 â ELECTRICAL ROUTINE		
Powertrain Control System		
	• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSD failed, SSB stuck on and TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D .
322 â HYDRAULIC/MECHANICAL ROUTINE		
Main Control Valve Body		
	• Bolts out of torque specification	• TIGHTEN bolts to specification.
	• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
	• Overdrive regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed off	• REPAIR or INSTALL new as required.
	• Direct regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed on	• REPAIR or INSTALL new as required.
	• SSD not functioning correctly, SSB stuck on	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Overdrive Clutch Assembly â Failed Off		
	• Seals â damaged	• INSTALL new as required.
	• Piston â damaged	• INSTALL new as required.
	• Friction â damaged, worn	• INSTALL new as required.
	• Cylinder hub â damaged	• INSTALL new as required.
	• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly â Failed On		
	• Seals â damaged	• INSTALL new as required.

	• Piston â damaged	• INSTALL new as required.
	• Friction â damaged, worn	• INSTALL new as required.
	• Cylinder hub â damaged	• INSTALL new as required.
	• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: No 4-5 Shift (Automatic)

Possible Component	Reference/Action
223 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSB failed, SSA stuck on and TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D .
323 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed off	• REPAIR or INSTALL new as required.
• Forward regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed on	• REPAIR or INSTALL new as required.
• SSB not functioning correctly, SSA stuck on	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly â Failed Off	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.

• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Forward Clutch Assembly â Failed On	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: No 5-6 Shift (Automatic)

Possible Component	Reference/Action
224 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSC failed, SSB stuck on and TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D .
TCS / O/D Cancel Switch	
• Switch control circuit open/shorted, switch damaged	• REFER to Section 307-05A .
324 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed off	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch	• REPAIR or INSTALL new as required.

failed on	
• SSC not functioning correctly, SSB stuck on	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly â Failed Off	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly â Failed On	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: No 6-5 Shift (Automatic)

Possible Component	Reference/Action
225 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSB failed, SSC stuck on and TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D .
325 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.

• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed on	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed off	• REPAIR or INSTALL new as required.
• SSC not functioning correctly, SSB stuck on	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly â Failed On	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly â Failed Off	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: No 5-4 Shift (Automatic)

Possible Component	Reference/Action
226 â ELECTRICAL ROUTINE	

Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSA failed, SSB stuck on and TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D .
326 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed on	• REPAIR or INSTALL new as required.
• Forward regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed off	• REPAIR or INSTALL new as required.
• SSA not functioning correctly, SSB stuck on	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly â Failed On	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Forward Clutch Assembly â Failed Off	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.

• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: No 4-3 Shift (Automatic)

Possible Component	Reference/Action
227 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSB failed, SSD stuck on and TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D .
327 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Overdrive regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed on	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed off	• REPAIR or INSTALL new as required.
• SSB not functioning correctly, SSD stuck on	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Overdrive Clutch Assembly â Failed On	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
	• INSTALL new as required.

	• Return spring assembly â damaged	
Direct Clutch Assembly â Failed Off		
	• Seals â damaged	• INSTALL new as required.
	• Piston â damaged	• INSTALL new as required.
	• Friction â damaged, worn	• INSTALL new as required.
	• Cylinder hub â damaged	• INSTALL new as required.
	• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: No 3-2 Shift (Automatic)

Possible Component		Reference/Action
228 â ELECTRICAL ROUTINE		
Powertrain Control System		
	• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSC failed, SSB stuck on, TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D .
328 â HYDRAULIC/MECHANICAL ROUTINE		
Incorrect Pressures		
	• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control. REFER to Main Control Valve Body .
Main Control Valve Body		
	• Bolts out of torque specification	• TIGHTEN bolts to specification.
	• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
	• Direct regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, stuck on	• REPAIR or INSTALL new as required.
	• Intermediate regulator and latch valves, springs, clips â loose,	• REPAIR or INSTALL new as required.

	stuck, missing, misassembled, stuck off	
	• SSB or SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly â Failed On		
	• Seals â damaged	• INSTALL new as required.
	• Piston â damaged	• INSTALL new as required.
	• Friction â damaged, worn	• INSTALL new as required.
	• Cylinder hub â damaged	• INSTALL new as required.
	• Return spring assembly â damaged	• INSTALL new as required.
Intermediate Clutch Assembly â Failed Off		
	• Seals â damaged	• INSTALL new as required.
	• Piston â damaged	• INSTALL new as required.
	• Friction â damaged, worn	• INSTALL new as required.
	• Cylinder hub â damaged	• INSTALL new as required.
	• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: No 2-1 Shift (Automatic)

Possible Component	Reference/Action
229 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , SSC stuck on and TR sensor	• RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A and GO to Pinpoint Test D .
329 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line

	Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control valve body.
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator valve, springs, clips â loose, stuck, missing, misassembled, stuck on	• REPAIR or INSTALL new as required.
• SSC not functioning correctly, stuck on	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly â Failed On	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Low One-Way Clutch Assembly	
• Damaged â not holding	• INSTALL new as required.
Planetary Carrier	
• Damaged	• INSTALL new as required.

Shift Concerns: Soft/Slipping 1-2 Shift (Automatic)

Possible Component	Reference/Action
230 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary.

TCM	REFER to Solenoid Body Strategy .
330 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control valve body.
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator valve, springs, clips â loose, stuck, missing, binding, misassembled	• REPAIR or INSTALL new as required.
• SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. Refer to Solenoids .
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Pump Assembly	
• Worn/cross leaks	• INSTALL new as required.
• Component damaged	• INSTALL a new pump assembly if required.

Shift Concerns: Soft/Slipping 2-3 Shift (Automatic)

Possible Component	Reference/Action
231 â ELECTRICAL ROUTINE	

Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
331 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control. REFER to Main Control Valve Body .
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Intermediate regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Multiplex valve, springs, clips â loose, stuck, missing, binding misassembled	• REPAIR or INSTALL new as required.
• SSB or SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
	• INSTALL new as required.

• Return spring assembly â damaged	
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Soft/Slipping 3-4 Shift (Automatic)

Possible Component	Reference/Action
232 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
332 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Overdrive regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSD or SSB not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .

Overdrive Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Soft/Slipping 4-5 Shift (Automatic)

Possible Component	Reference/Action
233 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
333 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.

• Forward regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSB or SSA not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Forward Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Soft/Slipping 5-6 Shift (Automatic)

Possible Component	Reference/Action
234 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
334 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	

• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSC or SSB not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Soft/Slipping 6-5 Shift (Automatic)

Possible Component	Reference/Action
235 â ELECTRICAL ROUTINE	

Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
335 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSC or SSB not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â	• INSTALL new as required.

damaged	

Shift Concerns: Soft/Slipping 5-4 Shift (Automatic)

Possible Component	Reference/Action
236 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
336 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed on	• REPAIR or INSTALL new as required.
• Forward regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed off	• REPAIR or INSTALL new as required.
• SSA not functioning correctly, SSB stuck on	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Forward Clutch Assembly	

• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Soft/Slipping 4-3 Shift (Automatic)

Possible Component	Reference/Action
237 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
337 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Overdrive regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled, clutch failed off	• REPAIR or INSTALL new as required.
• SSB or SSD not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Overdrive Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.

• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Soft/Slipping 3-2 Shift (Automatic)

Possible Component	Reference/Action
238 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
338 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control valve body.
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.

• Intermediate regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSB or SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Soft/Slipping 2-1 Shift (Automatic)

Possible Component	Reference/Action
239 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
339 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	

• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control valve body.
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator valve, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Low One-Way Clutch Assembly	
• Damaged â not holding	• INSTALL new as required.
Planetary Carrier	
• Damaged	• INSTALL new as required.

Shift Concerns: Harsh 1-2 Shift (Automatic)

Possible Component	Reference/Action
240 â ELECTRICAL ROUTINE	
Solenoid Body	

• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
340 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control valve body.
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator valve, springs, clips â loose, stuck, missing, binding, misassembled	• REPAIR or INSTALL new as required.
• SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Pump Assembly	
• Worn/cross leaks	• INSTALL new as required.
• Component damaged	• INSTALL a new pump assembly if required.

Shift Concerns: Harsh 2-3 Shift (Automatic)

Possible Component	Reference/Action
241 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
341 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control valve body.
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Intermediate regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Multiplex valve, springs, clips â loose, stuck, missing, binding misassembled	• REPAIR or INSTALL new as required.
• SSB or SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.

• Return spring assembly â damaged	• INSTALL new as required.
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Harsh 3-4 Shift (Automatic)

Possible Component	Reference/Action
242 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
342 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Overdrive regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSD or SSB not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Overdrive Clutch Assembly	

• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Harsh 4-5 Shift (Automatic)

Possible Component	Reference/Action
243 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
343 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Forward regulator and latch	• REPAIR or INSTALL new as required.

valves, springs, clips â loose, stuck, binding, missing, misassembled	
• SSB or SSA not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Forward Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Harsh 5-6 Shift (Automatic)

Possible Component	Reference/Action
244 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
344 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.

• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSC or SSB not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Harsh 6-5 Shift (Automatic)

Possible Component	Reference/Action
245 â ELECTRICAL ROUTINE	
Solenoid Body	

• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
346 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSC or SSB not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Harsh 5-4 Shift (Automatic)

Possible Component	Reference/Action
246 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
346 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed on	• REPAIR or INSTALL new as required.
• Forward regulator and latch valves, springs, clips â loose, stuck, missing, misassembled, clutch failed off	• REPAIR or INSTALL new as required.
• SSA not functioning correctly, SSB stuck on	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Forward Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.

	• Friction â damaged, worn	• INSTALL new as required.
	• Cylinder hub â damaged	• INSTALL new as required.
	• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Harsh 4-3 Shift (Automatic)

Possible Component	Reference/Action
247 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
347 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Overdrive regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled, clutch failed off	• REPAIR or INSTALL new as required.
• SSB or SSD not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Overdrive Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.

• Return spring assembly â damaged	• INSTALL new as required.
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Harsh 3-2 Shift (Automatic)

Possible Component	Reference/Action
248 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
348 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control valve body.
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Direct regulator and latch valves, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Intermediate regulator and latch valves, springs, clips â loose, stuck, binding,	• REPAIR or INSTALL new as required.

missing, misassembled	
• SSB or SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Direct Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Shift Concerns: Harsh 2-1 Shift (Automatic)

Possible Component	Reference/Action
249 â ELECTRICAL ROUTINE	
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
349 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK

	main control valve body.
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Intermediate regulator valve, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSC not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Intermediate Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.
Low One-Way Clutch Assembly	
• Damaged â not holding	• INSTALL new as required.

Torque Converter Operation Concerns: No Apply

Possible Component	Reference/Action
250 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , TCC solenoid, TP sensor, TFT sensor, TSS sensor, OSS sensor and shorted shift solenoid	• CARRY OUT Torque Converter Operation Test. REFER to Torque Converter Diagnosis . RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A , GO to Pinpoint Test B and GO to Pinpoint Test C .
350 â HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	

• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for specifications. If not OK, CHECK main control valve body.
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• TCC control valve, springs, clips â loose, stuck, missing, misassembled	• REPAIR or INSTALL new as required.
• TCC solenoid â not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Turbine Shaft	
• Seals â damaged, missing	• INSTALL new as required.
• Holes â missing, plugged	• REPAIR as required.
Pump Assembly	
• Seals â damaged, missing	• INSTALL new as required.
• Holes â missing, plugged	• REPAIR as required.
• Torque converter hub bushing worn	• INSTALL a new torque converter as required.
• Torque converter worn	• INSTALL a new torque converter as required.

Torque Converter Operation Concern: Always Applied/Stalls Vehicle

Possible Component	Reference/Action
251 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , TCC Solenoid	• CARRY OUT Torque Converter Operation Test. REFER to Torque Converter Diagnosis . RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A . REPAIR as required. CLEAR the DTCs. ROAD TEST and RERUN OBD .
351 â HYDRAULIC/MECHANICAL ROUTINE	

Main Controls	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• REPAIR as required.
• TCC regulator valve, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• TCC solenoid â not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .

Torque Converter Operation Concern: Cycling/Shudder/Chatter

Possible Component	Reference/Action
252 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM and TCC solenoid	• CARRY OUT Torque Converter Operation Test. REFER to Torque Converter Diagnosis . RUN OBD . REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test A . REPAIR as required. CLEAR the DTCs. ROAD TEST and RERUN OBD .
Solenoid Body	
• Incorrect solenoid body strategy data stored in the TCM	• VERIFY solenoid body strategy data stored in the TCM . DOWNLOAD new identification and strategy as necessary. REFER to Solenoid Body Strategy .
352 â HYDRAULIC/MECHANICAL ROUTINE	
• Transmission fluid condition	• Prior to carrying out this action, make sure all electrical diagnostics have been carried out. INSPECT transmission fluid condition. If burnt, drain transmission fluid and converter. INSTALL new transmission fluid and transmission fluid filter assembly. Bring vehicle to normal operating temperature. CARRY OUT Transmission Drive Cycle Test. RERUN OBD . If condition still exists, continue diagnostics.
Incorrect Pressures	
• Line pressure	• CHECK pressure at line pressure tap. CARRY OUT Line Pressure Test. REFER to Special Testing Procedures . SEE the Line Pressure Chart for

	specifications. If not OK, CHECK Main Control. REFER to Main Control Valve Body .
Main Controls	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• REPAIR as required.
• TCC regulator valve, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• TCC solenoid â not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Turbine Shaft	
• Seals â damaged, missing	• INSTALL new as required.
Torque Converter	
• Torque converter damaged	• REFER to Torque Converter Contamination Inspection .
Pump Assembly	
• Stator support assembly â worn, damaged	• INSTALL new as required.
• Stator support seals â worn, damaged, leaking	• INSTALL new as required.

Other Concerns: No Engine Braking In Manual Low Position

Possible Component	Reference/Action
260 â ELECTRICAL ROUTINE	
• No electrical concerns	

360 â HYDRAULIC/MECHANICAL ROUTINE	
Main Control Valve Body	
• Bolts out of torque specification	• TIGHTEN bolts to specification.
• Gaskets and separator plate â damaged, off location	• INSTALL new as required.
• Low/reverse regulator valve, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• Low/reverse latch valve, springs, clips â loose, stuck, binding, missing, misassembled	• REPAIR or INSTALL new as required.
• SSD not functioning correctly	• ACTIVATE solenoid using scan tool. REFER to Output State Control (OSC) Mode . GO to Pinpoint Test A . INSTALL a new solenoid as required. REFER to Solenoids .
Low/Reverse Clutch Assembly	
• Seals â damaged	• INSTALL new as required.
• Piston â damaged	• INSTALL new as required.
• Friction â damaged, worn	• INSTALL new as required.
• Cylinder hub â damaged	• INSTALL new as required.
• Return spring assembly â damaged	• INSTALL new as required.

Other Concerns: Selector Lever Efforts High

Possible Component	Reference/Action
261 â ELECTRICAL ROUTINE	
• No electrical concerns	
361 â HYDRAULIC/MECHANICAL ROUTINE	
Selector Lever Linkage (Internal, External)	
• Damaged or out of adjustment	• INSPECT for damage. VERIFY selector lever

		adjustment. REFER to Section 307-05A .
Manual Control Lever		
	• External retaining pin â damaged, nut â loose, detent springâ bent, damaged; or park mechanism â damaged, incorrect lever used	• REPAIR or INSTALL new as required.
Main Control Valve Body		
	• Manual valve â stuck	• REPAIR or INSTALL new as required.
	• Bolts out of torque specification	• TIGHTEN bolts to specification.
Brake Shift Interlock		
	• Mechanically damaged	• REFER to Section 307-05A .
	• TR sensor indicating park	• GO to Pinpoint Test D .

Other Concerns: External Leaks

Possible Component	Reference/Action
262 â ELECTRICAL ROUTINE	
• No electrical concerns	
362 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid Level	
• High transmission fluid level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
• Condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Seals, Gaskets	
• Leaks: converter, TSS sensor, halfshaft axles, gasket/seal manual lever, fluid level indicator, main control cover, incorrect hub seal	• LOCATE source of leak. REPAIR as required.
Other	
• Leaks: cooler fitting, pressure taps, transmission connector, transmission pan, cooler tubes, case porosity, case cracked	• LOCATE source of leak. REPAIR as required.

	• Vent â blocked damaged	• REPAIR as required.

Other Concerns: Poor Vehicle Performance

Possible Component	Reference/Action
263 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , TCC Solenoid, TP sensor, OSS sensor, MAF sensor, IAT sensors, internal wiring harness	• RUN OBD . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. GO to Pinpoint Test C . REPAIR as required. CLEAR the DTCs. ROAD TEST and RERUN OBD .
	• CARRY OUT Shift Point Road Test. REFER to Shift Point Road Test and CARRY OUT Torque Converter Operation Test. REFER to Torque Converter Diagnosis .
363 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid	
• Low level	• CHECK transmission fluid level and adjust as necessary. REFER to Preliminary Inspection .
Verify Correct Shift Scheduling, Engagements, Line Pressures and Stall Speed	
	• GO to appropriate Diagnostic Routines per index.
Converter Clutch Always Applied	
	• GO to Routine 351.

Other Concerns: Noise/Vibration â Forward Or Reverse

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

Possible Component	Reference/Action
264 â ELECTRICAL ROUTINE	
• No electrical concerns	

364 â HYDRAULIC/MECHANICAL ROUTINE		
For Noises/Vibrations That Change With Engine Speed		
	• Converter components	• LOCATE source of disturbance. REPAIR as required.
		• Transmission fluid level (low) â pump cavitation.
		• Pump assembly.
	• Engine drive accessories	
	• Transmission fluid cooler tubes grounding out	
	• Flexplate	
For Noises/Vibrations That Change With Vehicle Speed		
	• Engine mounts â loose or damaged	• LOCATE source of disturbance. REPAIR as required.
	• Driveline concerns: ♦ Halfshaft shudder ♦ CV joints ♦ Suspension ♦ Modifications	
	• Output/halfshaft splines â worn or damaged	
	• TSS sensor â incorrectly installed	• REPAIR as required.
Other Noises/Vibrations		
	• Main controls â valve resonance	• LOCATE source of disturbance. REPAIR as required.
	• Selector lever cable â vibration, grounding	• LOCATE source of disturbance. REPAIR as required.
	• Transmission fluid cooler tubes â grounding	• LOCATE source of disturbance. REPAIR as required.
	• ABS	• REFER to Section 206-09 .
	• Power steering pump	• REFER to Section 211-02 .

Other Concerns: Engine Will Not Crank

Possible Component	Reference/Action
265 â ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, TCM , TR sensor	• CARRY OUT Torque Converter Operation Test. REFER to Torque Converter Diagnosis . RUN OBD . REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis.
365 â HYDRAULIC/MECHANICAL ROUTINE	
Selector Lever Linkage (Internal, External)	
• Damaged or out of adjustment	• INSPECT for damage. VERIFY selector lever cable adjustment. REFER to Section 307-05A .

Other Concerns: No Park Range

Possible Component	Reference/Action
266 â ELECTRICAL ROUTINE	
• No electrical concerns	
366 â HYDRAULIC/MECHANICAL ROUTINE	
Selector Lever Linkage (Internal/External)	
• Damaged or out of adjustment	• INSPECT for damage. VERIFY selector lever cable adjustment. REFER to Section 307-05A .
Park Mechanism	
• Park brake pawl, park pawl return spring, park rod abutment, park pawl shaft, park pawl actuating rod, manual control lever, manual lever detent spring â damaged	• REPAIR as required.

Other Concerns: Transmission Overheating

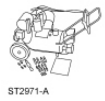
Possible Component	Reference/Action
267 â ELECTRICAL ROUTINE	
• No electrical concerns	

367 â HYDRAULIC/MECHANICAL ROUTINE	
Transmission Fluid	
• Incorrect transmission fluid level	• CHECK transmission fluid level. ADJUST as necessary. REFER to Preliminary Inspection .
• Condition	• CARRY OUT transmission fluid condition check. REFER to Preliminary Inspection .
Transmission Fluid Cooler Tubes	
• Damaged, blocked, reversed, leaking	• REPAIR as required.
Auxiliary Cooler	
• Damaged, blocked, restricted or incorrectly installed	• REPAIR as required.
Vehicle Concerns Causing Engine Overheating	
	• REFER to Section 303-03A .
Main Control Valve Body	
• Torque converter regulator valve/spring â stuck, damaged	• REPAIR as required.
• Torque converter control valve/spring â stuck, damaged	• REPAIR as required.
Torque Converter Not Applying	
• Seized converter one-way clutch	• SEE Routine 250/350. INSPECT for damage. REPAIR as required.
Excessive Towing Loads	
	• CHECK GVW .
Idle or Driveability Concern	

	• REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
Incorrect Clutch Application or Oil Pressure Control System	
	• CARRY OUT line pressure tests. REFER to Special Testing Procedures and carry out shift point road test. REFER to Shift Point Road Test . REPAIR as required. SEE the Line Pressure Chart, and Clutch Application Chart for specifications. REPAIR as required.

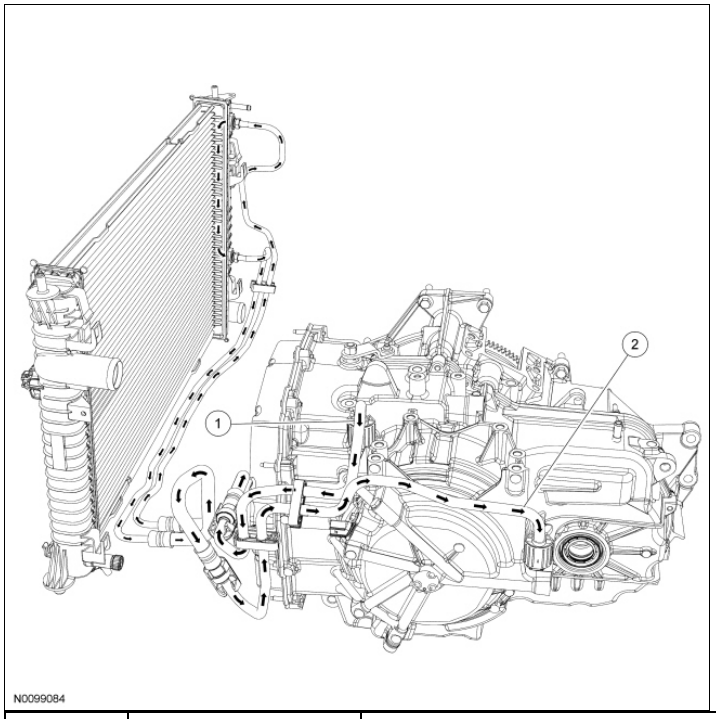
Transmission Fluid Cooler Backflushing and Cleaning

Special Tool(s)

 ST2971-A	Turbo-Tank Heated Cooler Line Flusher 222-00004 or equivalent

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV



Item	Part Number	Description
1	-	Transmission fluid pressure tube (outlet)
2	-	Transmission fluid return tube (inlet)

NOTE: Transmission fluid cooler backflushing will be carried out using the Turbo-Tank Heated Cooler Line Flusher or equivalent. Follow the manufacturer's instructions included with the machine. Test the equipment to make sure that a vigorous fluid flow is present before proceeding.

1. Check and top off fluid level of the Turbo-Tank Heated Cooler Line Flusher or equivalent tank with transmission fluid.

2. Allow the fluid in the Turbo-Tank Heated Cooler Line Flusher or equivalent 15-30 minutes to heat up to 60°C (140°F) before using.

3. Install the line adapters into the transmission cooler lines.

4. **NOTE:** The TOP transaxle cooler tube on the transaxle is the pressure line.

   Attach the Turbo-Tank Heated Cooler Line Flusher or equivalent red line to the transmission fluid cooler pressure line quick disconnect fitting.

5. Attach the Turbo-Tank Heated Cooler Line Flusher or equivalent blue line to the transmission fluid cooler return line quick disconnect fitting.

6. Follow the equipment instructions to purge the cooler lines and cooler prior to starting the flushing procedure.

7. Allow the cooling system to backflush for 10-15 minutes, then flush the cooler in a normal flow direction for an additional 10-15 minutes.

8. Clean the transaxle mounted fluid cooler tubes by hand.

Transmission Fluid Drain and Refill

Material

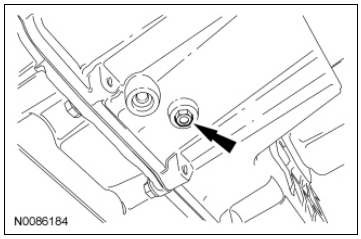
Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

NOTE: In order to completely clean the torque converter, this procedure needs to be carried out 3 times.

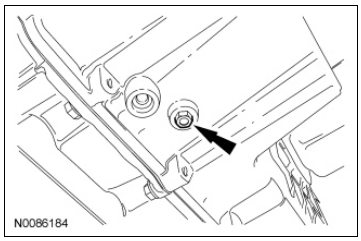
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** If an internal problem is suspected, drain the transmission fluid through a paper filter. A small amount of metal or friction particles may be found from normal wear. If an excessive amount of metal or friction material ent, the transaxle will need to be overhauled.

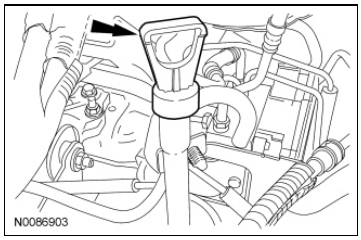
   Remove the transmission fluid drain plug and allow the transmission fluid to drain.



3. Install the transmission fluid drain plug.
   - Tighten to 12 Nm (106 lb-in).



4. Fill the transaxle with clean transmission fluid.



5. Start the engine and let it run for 3 minutes. Move the range selector lever into each gear position. Repeat Steps 2, 3, 4 and 5 two more times.

6. After the transmission fluid has been changed a total of 3 times, using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

P>

Transmission Fluid Exchange

Special Tool(s)

 ST3088-A	ATF Fluid Exchanger W/Power Steering Fluid Exchanger 199-00059 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

NOTICE: **Use transmission fluid specific for this transmission. Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products can cause internal transmission components to fail, which will affect the operation of the transmission.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Use the ATF Fluid Exchanger W/Power Steering Fluid Exchanger to change the fluid.
3. Connect the ATF Fluid Exchanger W/Power Steering Fluid Exchanger to the transmission fluid cooler tube after the transmission fluid cooler on the return tube. This will help remove any foreign material trapped in the transmission fluid coolers.
4. Perform the transmission fluid exchange using the ATF Fluid Exchanger W/Power Steering Fluid Exchanger. Follow the manufacturer's instructions included with the machine.
5. Once the transmission fluid exchange is completed, disconnect the ATF Fluid Exchanger W/Power Steering Fluid Exchanger. Reconnect any disconnected transmission fluid cooler tubes.
6. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid ised, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

Torque Converter Contamination Inspection

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

1. A new or remanufactured torque converter must be installed if one or more of the following statements is true:
   - A torque converter malfunction has been determined based on complete diagnostic procedures.
   - The torque converter stud or studs, impeller hub or bushing are damaged.
   - The torque converter exhibits external discoloration (due to overheating).
   - There is evidence of transmission assembly or fluid contamination due to the following transmission or converter failure modes.
     - ♦ Major metallic failure
     - ♦ Multiple clutch plates or band failures

     ficient component wear which results in metallic contamination
   - ♦ Water or antifreeze contamination

2. If none of the above conditions are present, continue with the following fluid inspection.

3. Pour a small amount of transmission fluid from the torque converter onto an absorbent white tissue or through a paper filter.

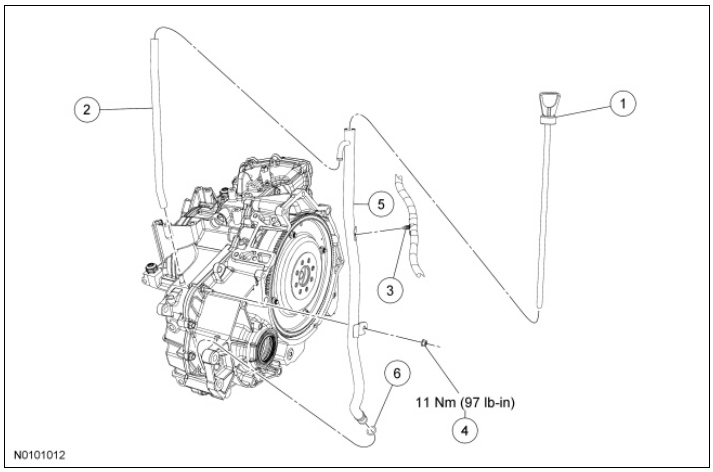
4. Examine the fluid for contaminants. The fluid must be free of metallic contaminants.

5. ***NOTICE:*** **Do not use water-based cleaners or mineral spirits to clean or flush the torque converter or transmission damage will occur.**

   If the fluid passed inspection:

   - drain the remaining fluid from the torque converter.
   - using only the recommended transmission fluid, add 1.9L (2 qt) of clean fluid into the converter and agitate by hand.
   - thoroughly drain the fluid.

Transaxle Filler Tube

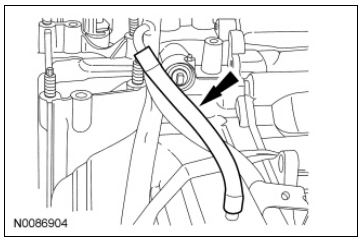


Item	Part Number	Description
1	7A020	Transmission fluid level indicator
2	-	Transaxle vent tube (part of 7A228)
3	13A506	Wiring harness retainer
4	N805320	Transaxle filler tube nut
5	7A228	Transaxle filler tube
6	-	Transaxle filler tube O-ring

Removal

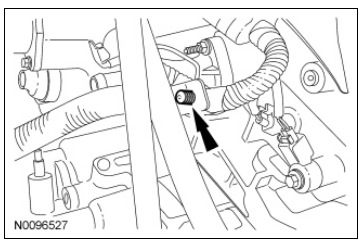
All vehicles

1. Remove the transaxle vent hose from the transaxle filler tui>



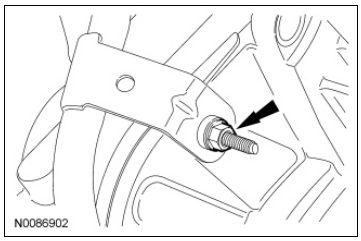
Vehicles equipped with a 3.0L engine

2. Disconnect the wiring harness retainer from the transmission fluid filler tube.

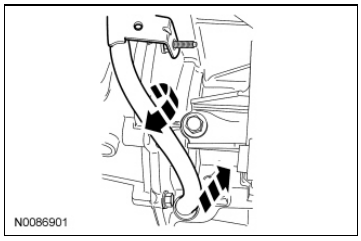


All vehicles

3. Remove the transaxle filler tube nut.
   - To install, tighten to 11 Nm (97 lb-in).

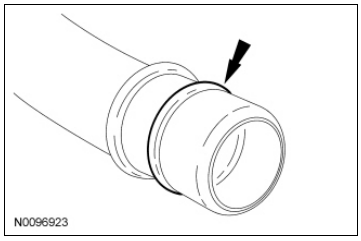


4. Pull and rotate the transaxle filler tube clockwise and remove the transaxle filler tube.



Installation

1. Inspect the O-ring seal on the transaxle filler tube for damage and install a new O-ring if needed. Lubricate the O-ring seal with clean automatic transmission fluid.

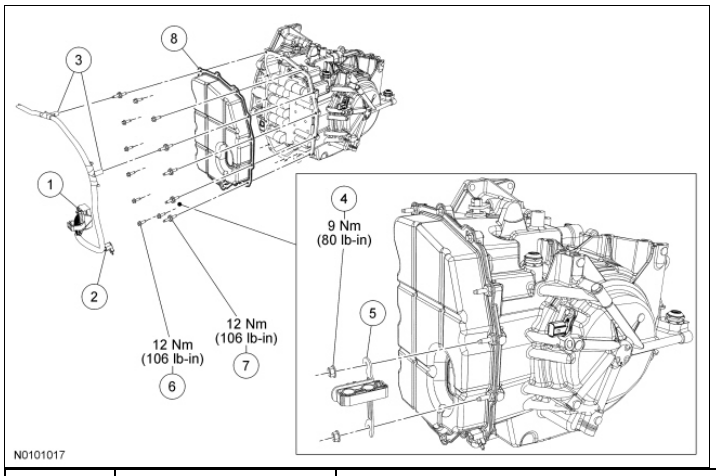


2. To install, reverse the removal procedure.

Main Control Cover

Material

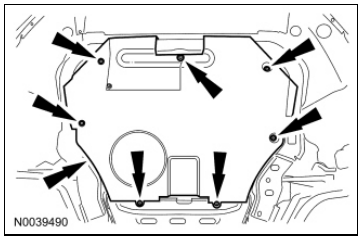
Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Ultra Silicone Sealant TA-29	-



Item	Part Number	Description
1	14A464	Transaxle main harness electrical connector
2	9S318	Wiring harness retainer
3	14A163	Wiring harness retainer
4	N805320	Transmission fluid cooler tube nut
5	7H420	Transmission fluid cooler tube bracket
6	W500213	Main control cover bolt
7	W705619	Main control cover studbolt
8	7G004	Main control cover

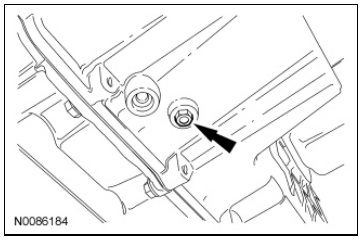
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the screws and the underbody cover.

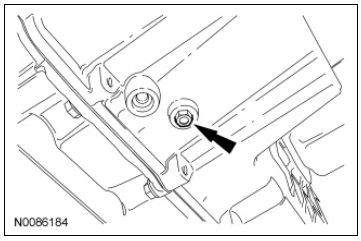


3. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A or Section 303-12B .

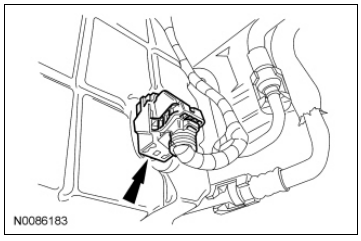
4. Remove the transmission fluid drain plug and allow the transmission fluid to drain.



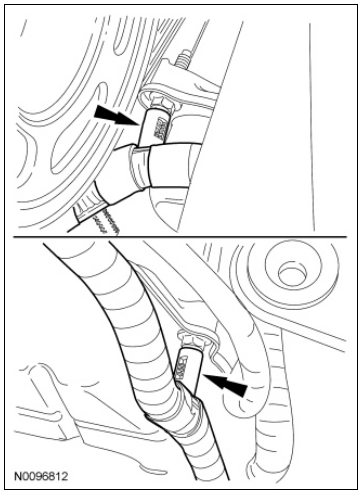
5. Install the transmission fluid drain plug.
   - Tighten to 12 Nm (106 lb-in).



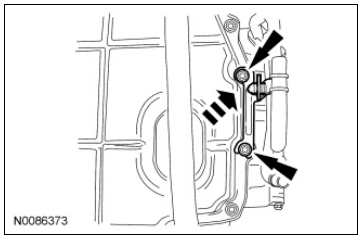
6. Disconnect the transaxle electrical connector.



7. Remove the transaxle electrical wiring harness retainers from the main control cover stud bolts.

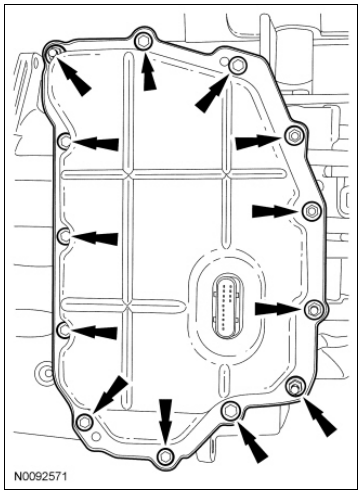


8. Remove the 2 nuts, pull the transmission fluid cooler tube bracket and tubes away from the transaxle and position it aside.



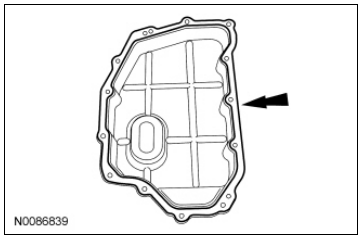
9. **NOTE:** Note the location of the stud bolts for assembly.

   Remove the 8 bolts, 5 stud bolts and the main control cover.

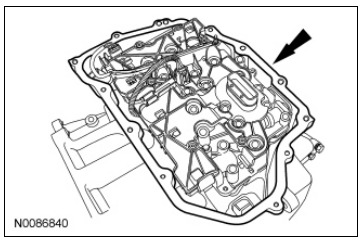


Installation

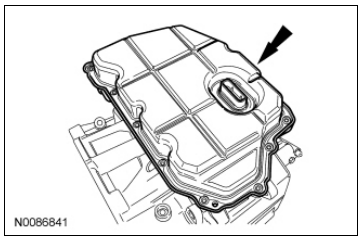
1. Clean the main control cover sealing surface and inspect for damage.



2. Apply silicone to the main control sealing surface of the transaxle case.



3. Position the main control cover in place.

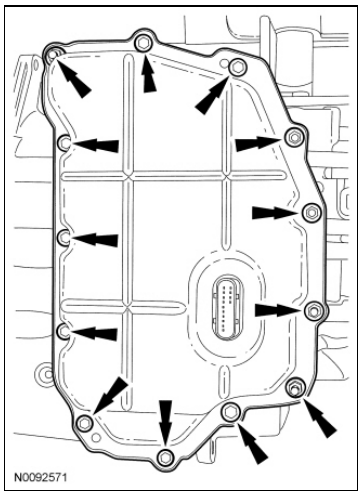


4. ***NOTICE:*** **Inspect the main control-to-main control cover grommet to make sure that the seals is on the inside of the main control cover. Transmission fluid leak will occur.**

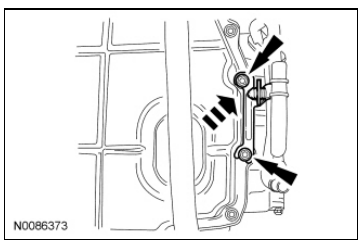
   NOTE: Install the stud bolts in the locations noted during disassembly.

   Tighten the 8 main control cover bolts and 5 stud bolts.

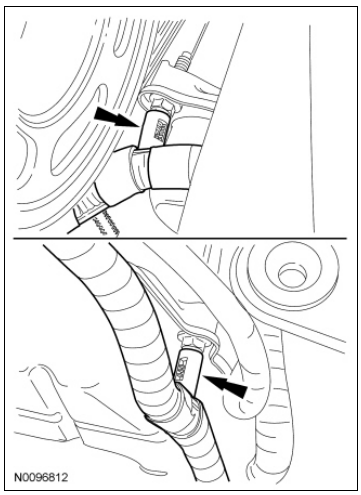
   - Tighten to 12 Nm (106 lb-in).



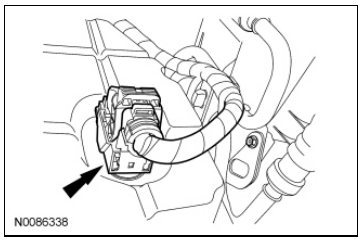
5. Position the transmission fluid cooler tube bracket and transmission fluid cooler tube assembly in place and install the 2 nuts.
   - Tighten to 9 Nm (80 lb-in).



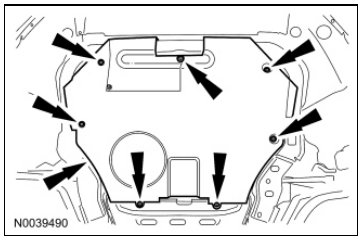
6. Connect the transaxle electrical wiring harness retainers to the main control cover stud bolts.



7. Connect the transaxle electrical connector.

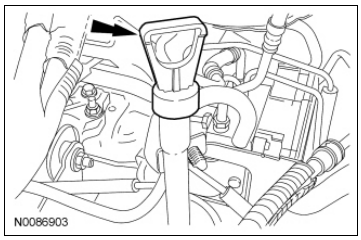


8. Install the underbody cover and the screws.



9. Install the ACL assembly. For additional information, refer to Section 303-12A or Section 303-12B .

10. Fill the transaxle with clean transmission fluid.

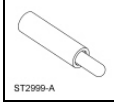


11. Start the engine and move the range selector lever into each gear position.

12. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

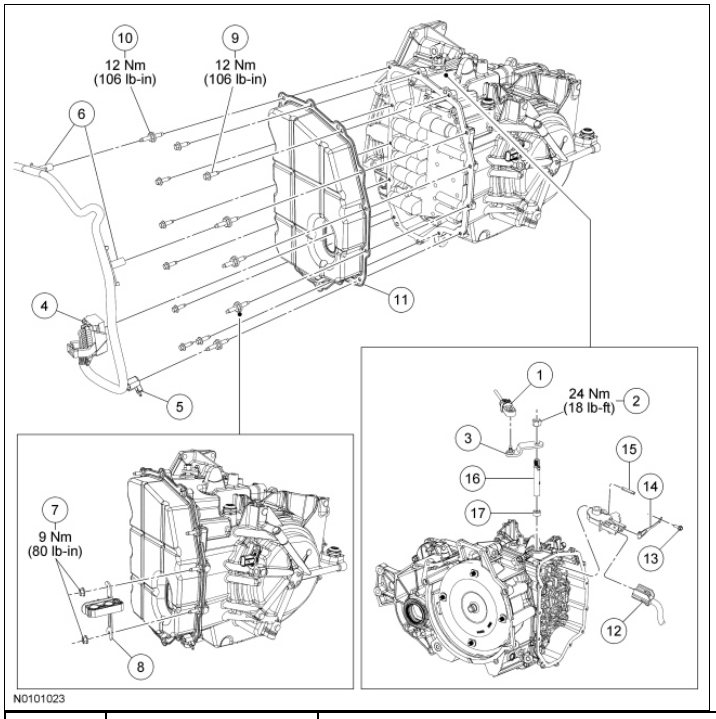
Manual Control Lever Shaft Seal

Special Tool(s)

 ST2999-A	Manual Lever Seal Installer 307-581

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Ultra Silicone Sealant TA-29	-



Item	Part Number	Description
1	7E395	Selector lever cable
2	W708455	Manual control lever nut
3	7A256	Manual control lever
4	14A464	Transaxle main harness electrical connector
5	9S318	Wiring harness retainer
6	14A163	Wiring harness retainer
7	N805320	Transmission fluid cooler tube nuts

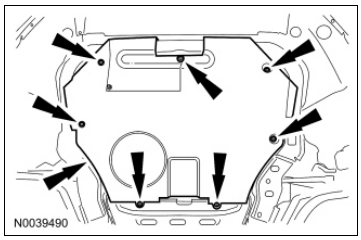
8	7H420	Transmission fluid cooler tube bracket
9	W500213	Main control cover bolts
10	W705619	Main control cover studbolts
11	7G004	Main control cover
12	7G276	Transmission Range (TR) electrical connector
13	W711235	Manual valve detent spring bolt
14	7E332	Manual valve detent spring
15	7G100	Manual control shaft pin
16	7C493	Manual control shaft
17	7F337	Manual control shaft seal

Removal

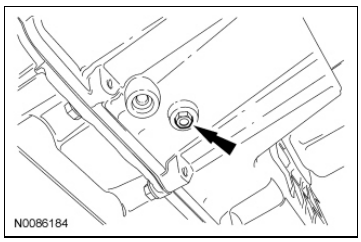
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A or Section 303-12B .

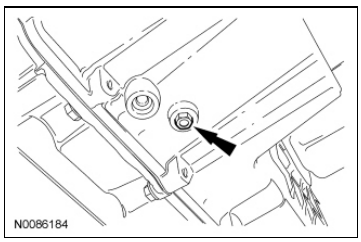
3. Remove the screws and the underbody cover.



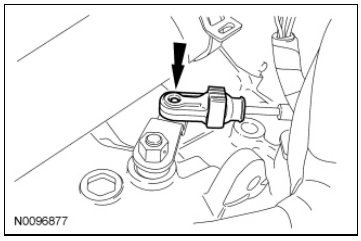
4. Remove the transmission fluid drain plug and allow the transmission fluid to drain.



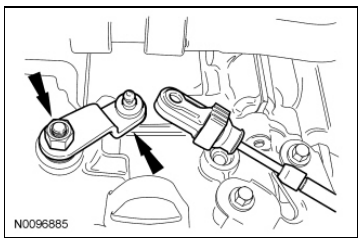
5. Install the transmission fluid drain plug.
   - Tighten to 12 Nm (106 lb-in).



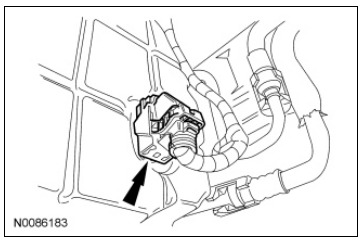
6. Disconnect the selector lever cable end from the manual control lever.



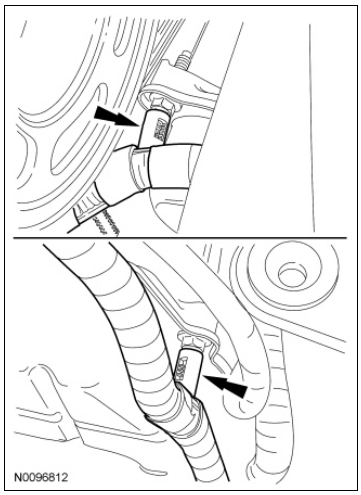
7. Remove the nut and the manual control lever.



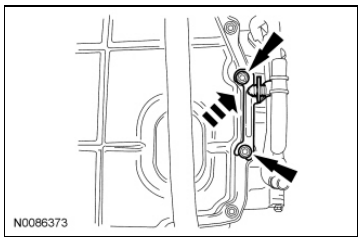
8. Disconnect the transaxle electrical connector.



9. Remove the transaxle electrical wiring harness retainers from the main control cover stud bolts.

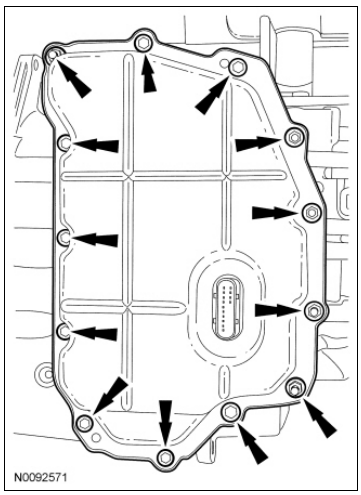


10. Remove the 2 nuts, pull the transmission fluid cooler tube bracket and tubes away from the transaxle and position it aside.

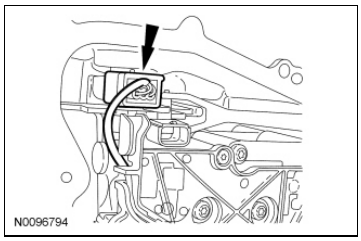


11. **NOTE:** Note the location of the stud bolts for assembly.

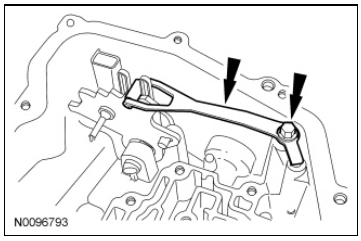
Remove the 8 bolts, 5 stud bolts and the main control cover.



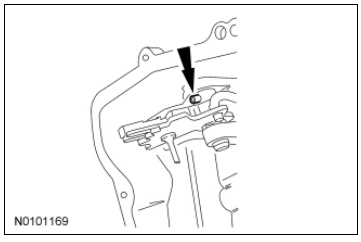
12. Disconnect the Transmission Range (TR) sensor electrical connector.



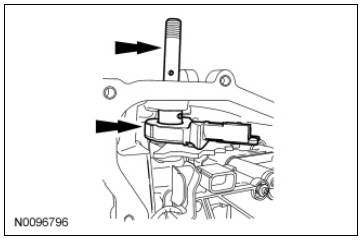
13. Remove the bolt and the TR sensor detent spring.



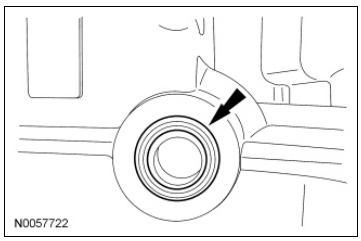
14. Using a small pair of Vise Grips® or an equivalent suitable tool, remove and discard the TR sensor locking pin.



15. Slide the manual shaft out of the transaxle case.

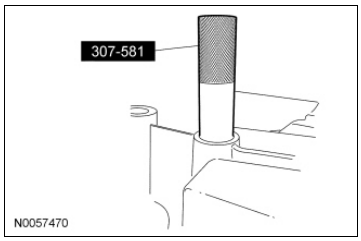


16. Using a suitable tool, remove the manual control lever shaft seal.

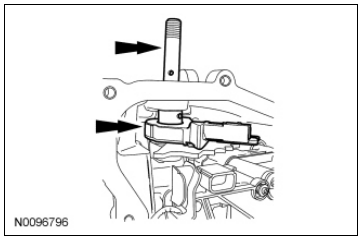


Installation

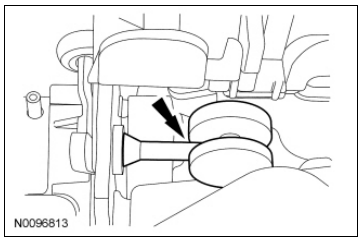
1. Using the Manual Lever Seal Installer, install a new manual control lever shaft seal.



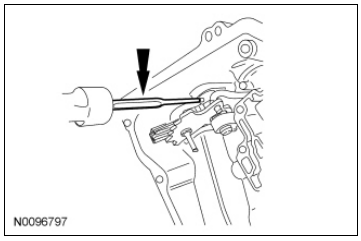
2. Install the manual control lever shaft in the transaxle case and through the TR sensor.



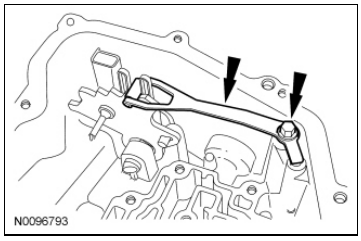
3. Inspect the manual pin to make sure it is correctly installed in the manual valve. If it is not, pull the manual control lever shaft out and correctly install the manual pin in the manual valve and position the manual control lever shaft in place.



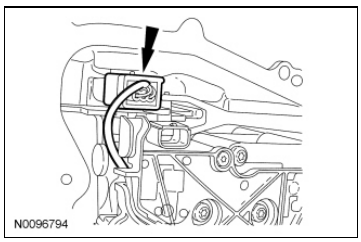
4. Using a suitable tool, install a new TR sensor roll pin.



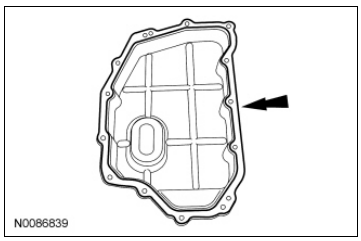
5. Install the TR sensor detent spring and the bolt.
    - Tighten to 13 Nm (115 lb-in).



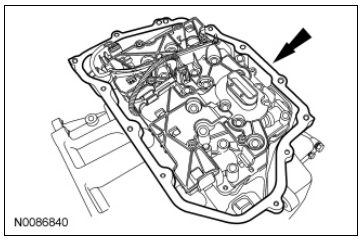
6. Connect the TR sensor electrical connector.



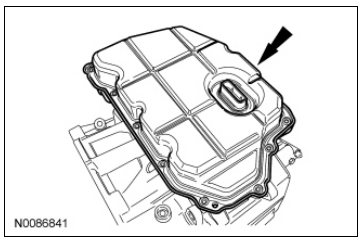
7. Clean the main control cover sealing surface.



8. Apply silicone to the main control sealing surface of the transaxle case.



9. Position the main control cover in place.

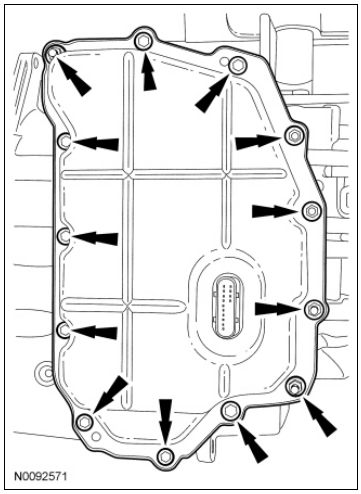


10. ***NOTICE:*** **Inspect the main control-to-main control cover grommet to make sure that the seal is on the inside of the main control cover. Transmission fluid leak will occur.**

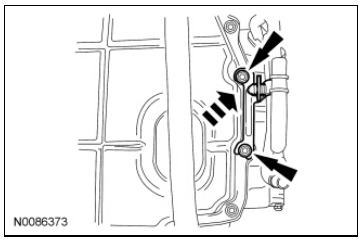
    NOTE: Install the stud bolts in the locations noted during disassembly.

    Tighten the 8 main control cover bolts and 5 stud bolts.

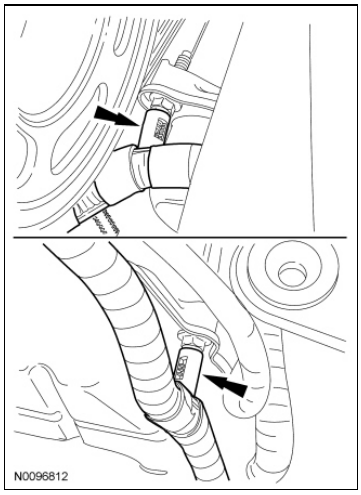
    - Tighten to 12 Nm (106 lb-in).



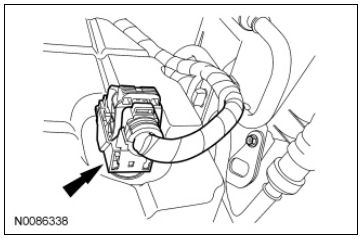
11. Position the transmission fluid cooler tube bracket and transmission fluid cooler tube assembly in place and install the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



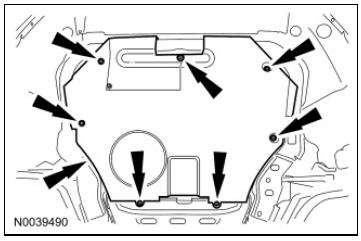
12. Connect the transaxle electrical wiring harness retainers to the main control cover stud bolts.



13. Connect the transaxle electrical connector.



14. Install the underbody cover and the screws.

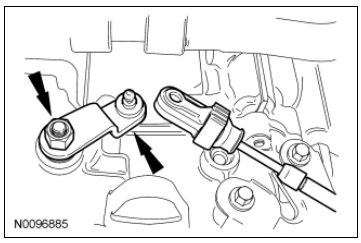


15. ***NOTICE:*** **Make sure that when installing the manual control lever it is fully seated onto the manual control lever shaft or damage to the manual control lever shaft will occur and the lever will come loose.**

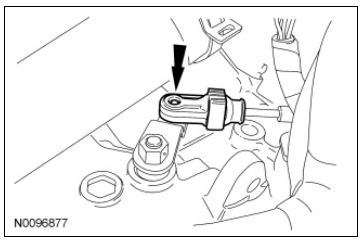
    NOTICE: **Make sure to hold the manual control lever while tightening the manual control lever nut or damage to the manual control lever and park components will occur.**

    Install the manual control lever and the nut.

    - Tighten to 24 Nm (18 lb-ft).

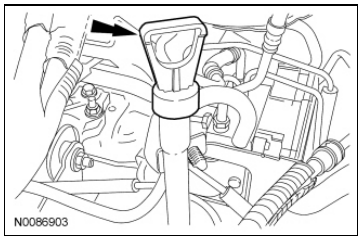


16. Connect the selector lever cable end to the manual control lever with the manual control lever and selector lever in DRIVE. Check selector lever cable adjustment. For additional information, refer to Section 307-05A



17. Install the ACL assembly. For additional information, refer to Section 303-12A or Section 303-12B .

18. Fill the transaxle with clean transmission fluid.



19. Start the engine and move the range selector lever into each gear position.

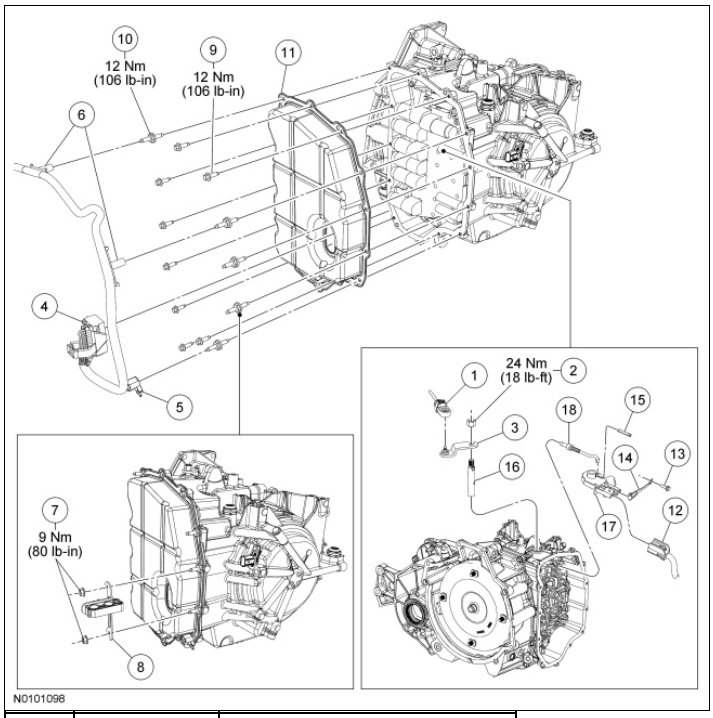
20. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt)

until the correct level is achieved.

Digital Transmission Range (TR) Sensor

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Ultra Silicone Sealant TA-29	-



Item	Part Number	Description
1	7E395	Selector lever cable
2	W708455	Manual control lever nut
3	7A256	Manual control lever
4	14A464	Transaxle main harness electrical connector
5	9S318	Wiring harness retainer
6	14A163	Wiring harness retainer
7	N805320	Transmission fluid cooler tube nuts
8	7H420	Transmission fluid cooler tube bracket

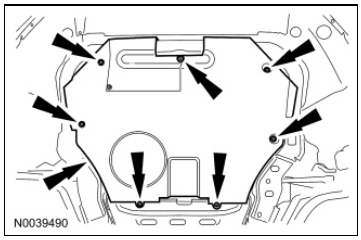
9	W500213	Main control cover bolts
10	W705619	Main control cover studbolts
11	7G004	Main control cover
12	7G276	Transmission Range (TR) electrical connector
13	W711235	Manual valve detent spring bolt
14	7E332	Manual valve detent spring
15	7G100	Manual control shaft pin
16	7C493	Manual control shaft
17	7H155	TR sensor
18	7A232	Park pawl actuator rod

Removal

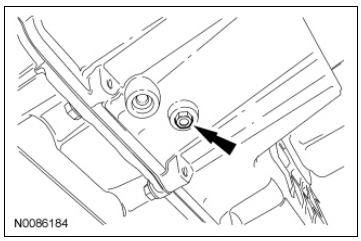
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A or Section 303-12B .

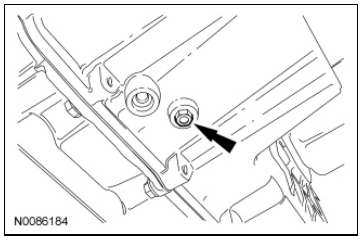
3. Remove the screws and the underbody cover.



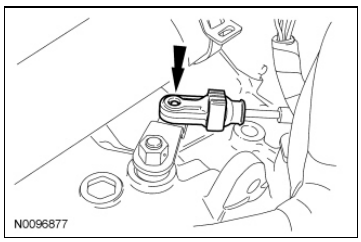
4. Remove the transmission fluid drain plug and allow the transmission fluid to drain.



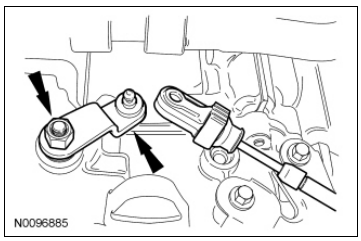
5. Install the transmission fluid drain plug.
   - Tighten to 12 Nm (106 lb-in).



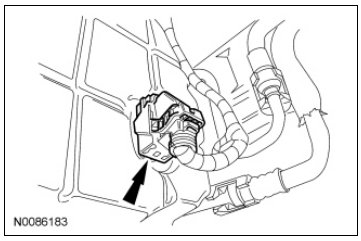
6. Disconnect the selector lever cable end from the manual control lever.



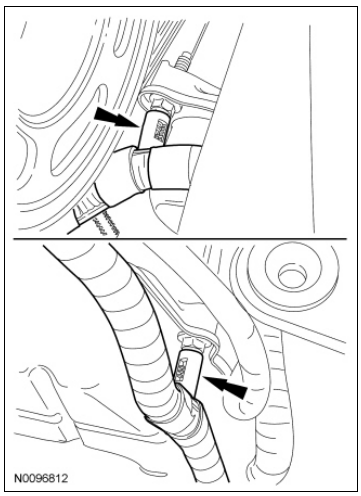
7. Remove the nut and the manual control lever.



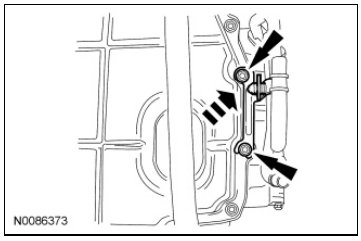
8. Disconnect the transaxle electrical connector.



9. Remove the transaxle electrical wiring harness retainers from the main control cover stud bolts.

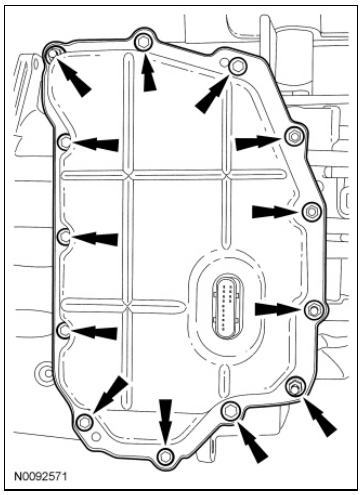


10. Remove the transmission fluid cooler tube bracket nuts from the main control cover studs and position the transmission fluid cooler tubes and bracket aside.

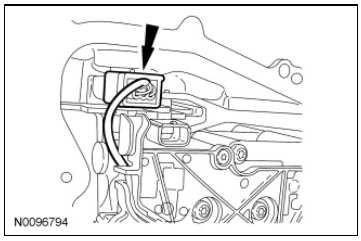


11. **NOTE:** Note the location of the stud bolts for assembly.

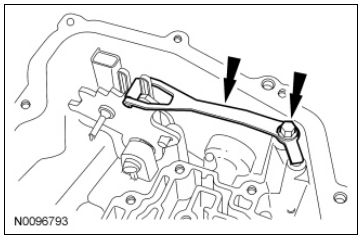
    Remove the 8 bolts, 5 stud bolts and the main control cover.



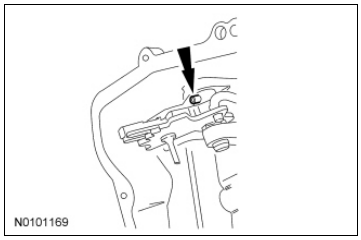
12. Disconnect the Transmission Range (TR) sensor electrical connector.



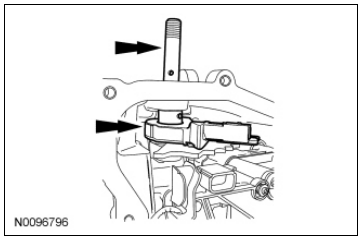
13. Remove the bolt and the TR sensor detent spring.



14. Using a small pair of Vise Grips® or an equivalent suitable tool, remove and discard the TR sensor locking pin.

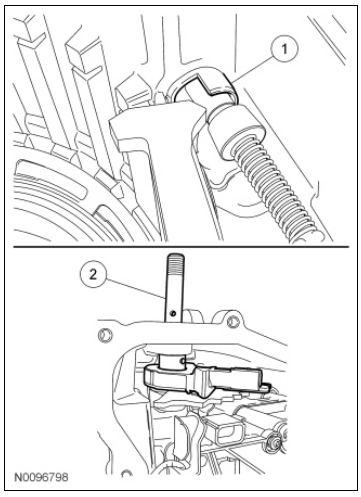


15. Remove the TR sensor in the following sequence.
    1. Hold the TR sensor in place and slide the manual shaft outward until the manual shaft is out of the transaxle case.
    2. Remove the TR sensor from the transaxle, leaving the park pawl actuating rod attached to the TR sensor.

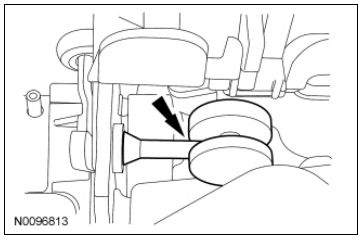


Installation

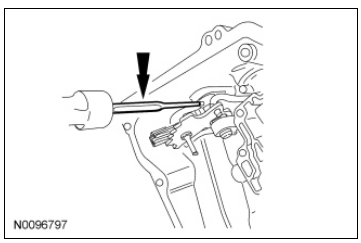
1. Install the TR sensor.
    1. Install the TR sensor and park pawl actuating rod in the transaxle case.
    2. Install the manual shaft in the transaxle case through the TR sensor.



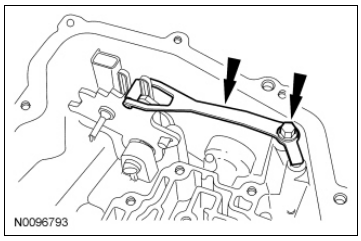
2. Inspect the manual pin to make sure it is correctly installed in the manual valve. If it is not, pull the manual control lever shaft out and correctly install the manual pin in the manual valve and position the manual control lever shaft in place.



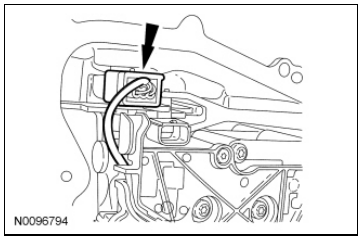
3. Using a suitable tool, install a new TR sensor locking pin.



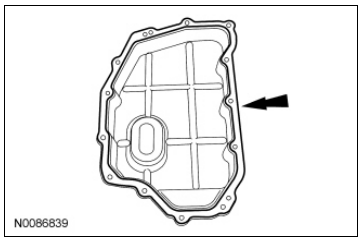
4. Install the TR sensor detent spring and the bolt.
    - Tighten to 13 Nm (115 lb-in).



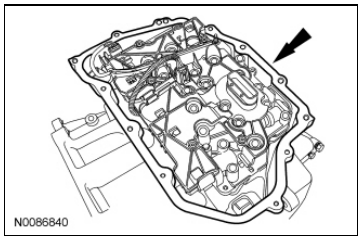
5. Connect the TR sensor electrical connector.



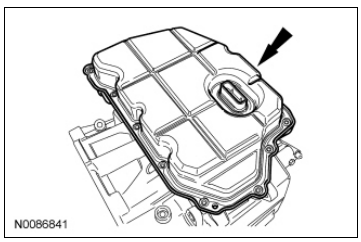
6. Clean the main control cover sealing surface.



7. Apply silicone to the main control sealing surface of the transaxle case.



8. Position the main control cover in place.

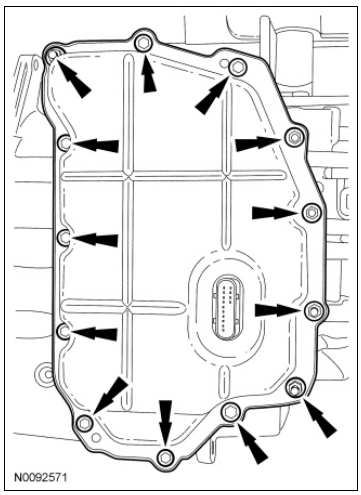


9. ***NOTICE:*** **Inspect the main control cover grommet to make sure that the seal is on the inside of the main control cover. Transmission fluid leak will occur.**

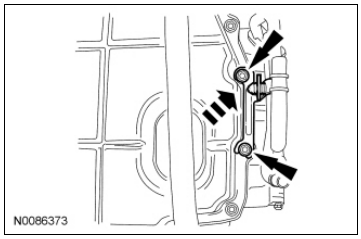
   NOTE: Install the stud bolts in the locations noted during disassembly.

   Install the main control cover 8 bolts and 5 stud bolts.

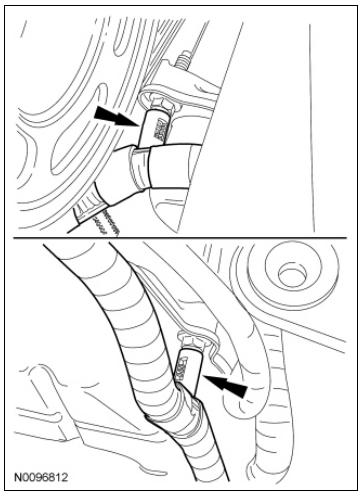
- Tighten to 12 Nm (106 lb-in).



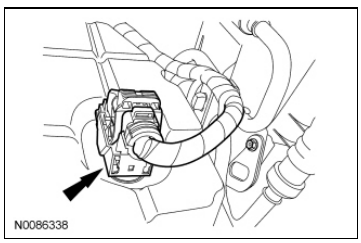
10. Position the transmission fluid cooler tube bracket and transmission fluid cooler tubes in place and install the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



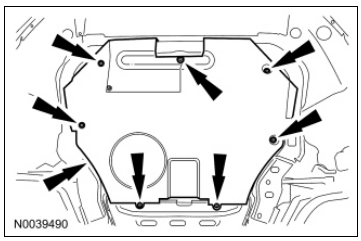
11. Connect the transaxle electrical wiring harness retainers to the main control cover stud bolts.



12. Connect the transaxle electrical connector.



13. Install the underbody cover and the screws.

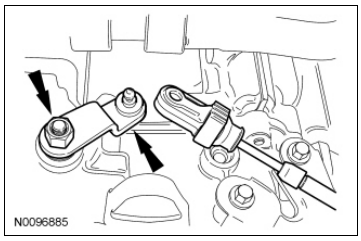


14. ***NOTICE:*** **Make sure that when installing the manual control lever it is fully seated onto the manual control lever shaft or damage to the manual control lever shaft will occur and the lever will come loose.**

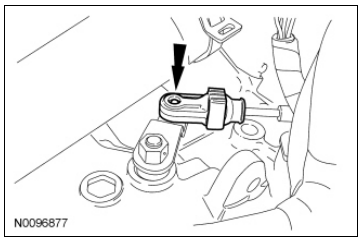
    NOTICE: **Make sure to hold the manual control lever while tightening the manual control lever nut or damage to the manual control lever and park components will occur.**

    Install the manual control lever and the nut.

    - Tighten to 24 Nm (18 lb-ft).

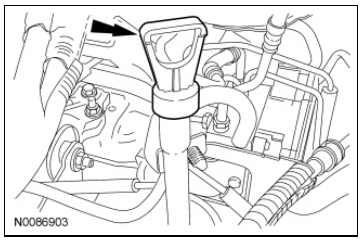


15. Connect the selector lever cable end to the manual control lever with the manual control lever and selector lever in DRIVE. Check selector lever cable adjustment. For additional information, refer to Section 307-05A .



16. Install the ACL assembly. For additional information, refer to Section 303-12A or Section 303-12B .

17. Fill the transaxle with clean transmission fluid.



18. Start the engine and move the range selector lever into each gear position.

19. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

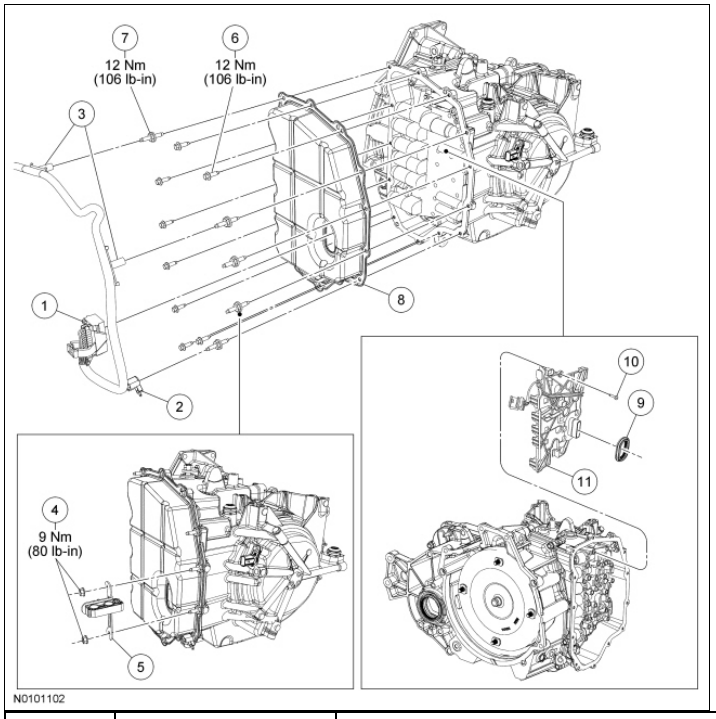
Solenoid Body Leadframe

Special Tool(s)

 ST3066-A	Pins, Leadframe Guide 307-636

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Ultra Silicone Sealant TA-29	-



Item	Part Number	Description
1	14A464	Transaxle main harness electrical connector
2	9S318	Wiring harness retainer
3	14A163	Wiring harness retainer
4	N805320	Transmission fluid cooler tube nuts
5	7H420	Transmission fluid cooler tube bracket
6	W500213	Main control cover bolts
7	W705619	Main control cover studbolts

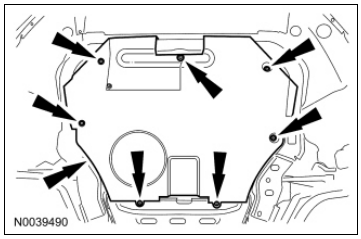
8	7G004	Main control cover
9	7B329	Main control-to-cover seal
10	W505513	Main control leadframe screw (5 required)
11	7G276	Main control leadframe

Removal

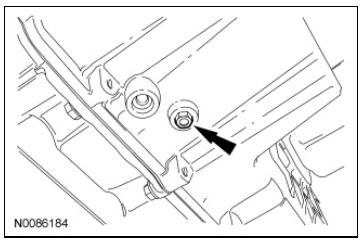
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A or Section 303-12B .

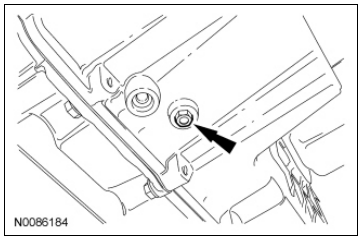
3. Remove the screws and the underbody cover.



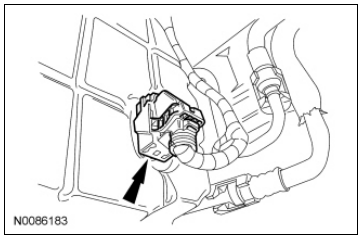
4. Remove the transmission fluid drain plug and allow the transmission fluid to drain.



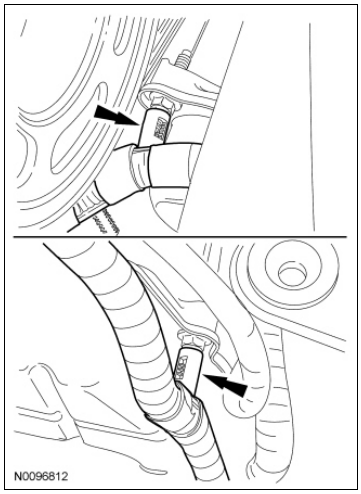
5. Install the transmission fluid drain plug.
   - Tighten to 12 Nm (106 lb-in).



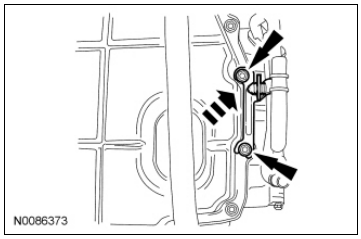
6. Disconnect the transaxle electrical connector.



7. Remove the transaxle electrical wiring harness retainers from the main control cover stud bolts.

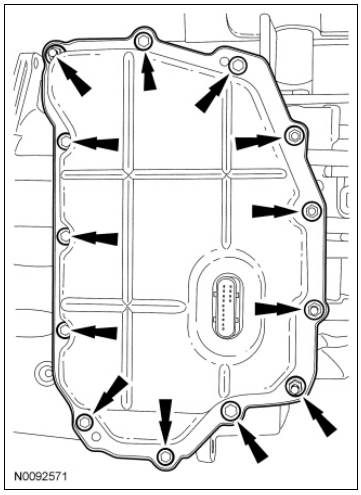


8. Remove the 2 nuts, pull the transmission fluid cooler tube bracket and tubes away from the transaxle and position it aside.

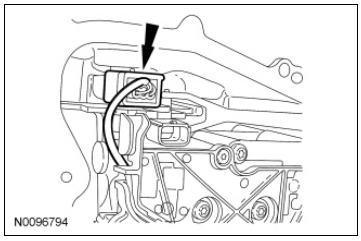


9. **NOTE:** Note the location of the stud bolts for assembly.

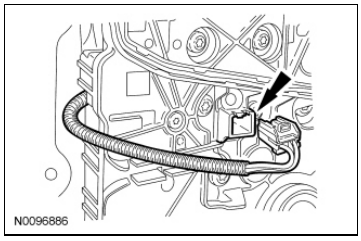
   Remove the 8 bolts, 5 stud bolts and the main control cover.



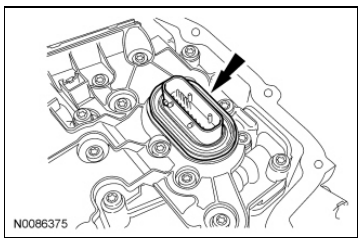
10. Disconnect the Transmission Range (TR) sensor electrical connector.



11. Disconnect the Output Shaft Speed (OSS) sensor electrical connector.

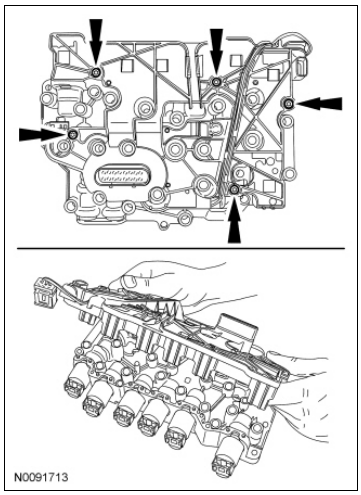


12. Remove the main control cover grommet.



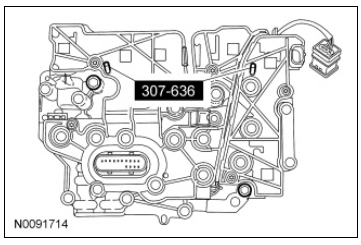
13. ***NOTICE:*** **Be careful not to bend or twist the leadframe or the solenoid terminals when removing the leadframe or damage can occur to the leadframe or the solenoids.**

    Remove the 5 screws and the leadframe from the solenoids by lifting it straight up evenly.



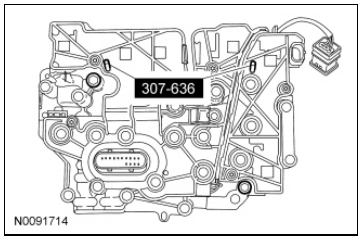
Installation

1. Install the Leadframe Guide Pins in the solenoid body to align the lead frame for installation.

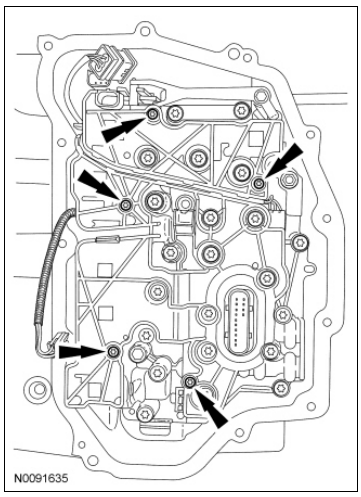


2. Position the leadframe on the Leadframe Guide Pins and carefully install the leadframe by pushing straight down into the solenoids.

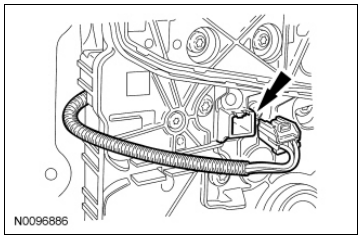
3. Remove the Leadframe Guide Pins.



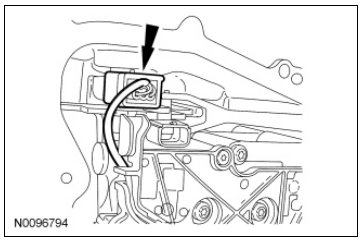
4. Install the 5 leadframe screws.



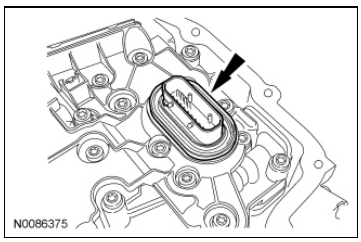
5. Connect the OSS sensor electrical connector.



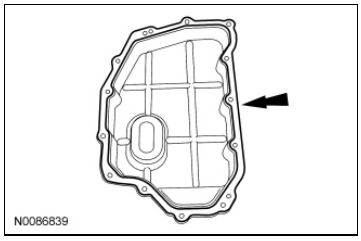
6. Connect the TR sensor electrical connector.



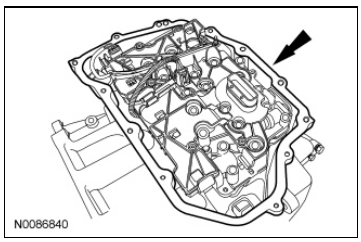
7. Install the main control cover grommet.



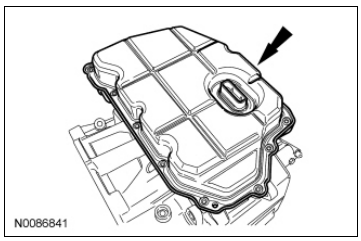
8. Clean the main control cover sealing surface and inspect for damage.



9. Apply silicone to the main control sealing surface of the transaxle case.



10. Position the main control cover in place.

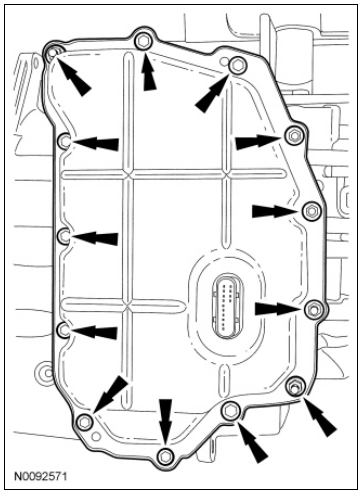


11. ***NOTICE:*** **Inspect the main control cover grommet to make sure that the seal is on the inside of the main control cover. Transmission fluid leak will occur.**

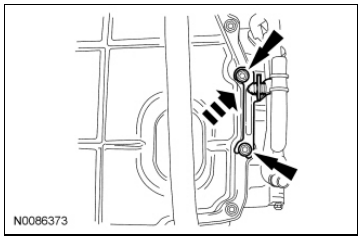
    NOTE: Install the stud bolts in the locations noted during disassembly.

    Tighten the 8 main control cover bolts and 5 stud bolts.

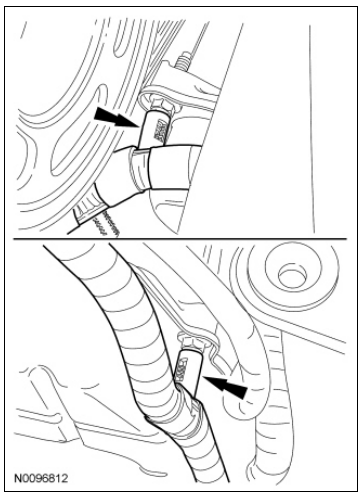
    - Tighten to 12 Nm (106 lb-in).



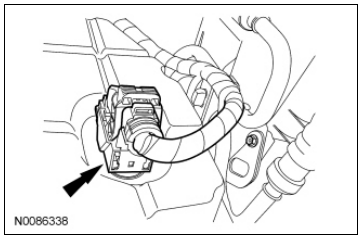
12. Position the transmission fluid cooler tube bracket and transmission fluid cooler tube assembly in place and install the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



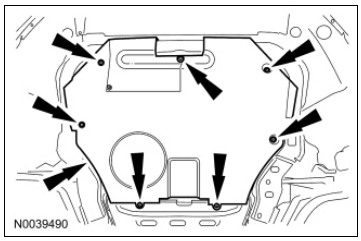
13. Connect the transaxle electrical wiring harness retainers to the main control cover stud bolts.



14. Connect the transaxle electrical connector.

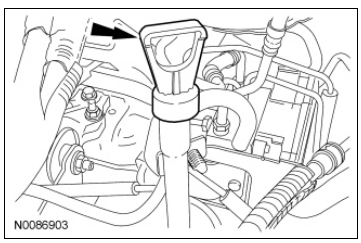


15. Install the underbody cover and the screws.



16. Install the ACL assembly. For additional information, refer to Section 303-12A or Section 303-12B .

17. Fill the transaxle with clean transmission fluid.



18. Start the engine and move the range selector lever into each gear position.

19. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

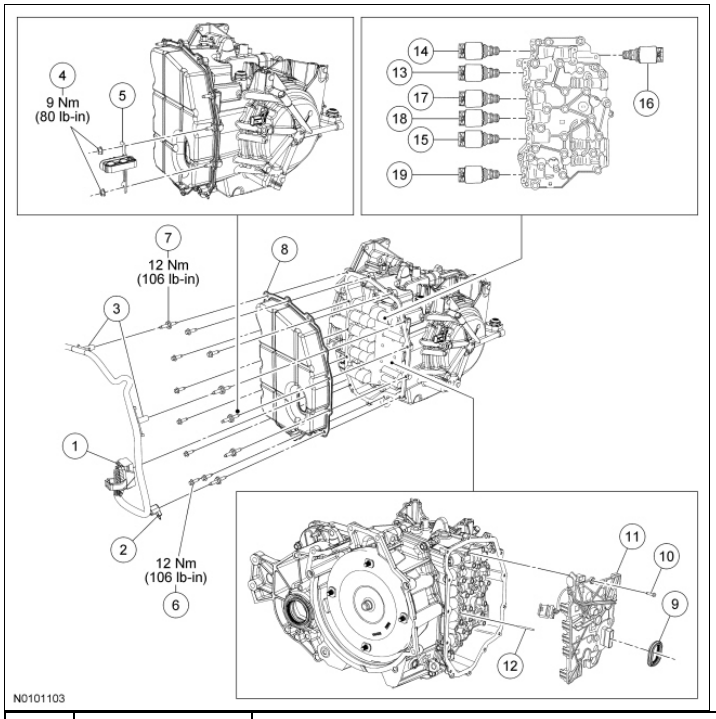
Solenoids

Special Tool(s)

 ST3066-A	Pins, Leadframe Guide 307-636

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Ultra Silicone Sealant TA-29	-



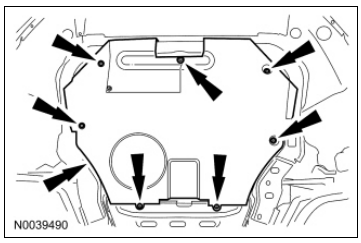
Item	Part Number	Description
1	14A464	Transaxle main harness electrical connector
2	9S318	Wiring harness retainer
3	14A163	Wiring harness retainer
4	N805320	Transmission fluid cooler tube nuts
5	7H420	Transmission fluid cooler tube bracket
6	W500213	Main control cover bolts
7	W705619	Main control cover studbolts

8	7G004	Main control cover
9	7B329	Main control-to-cover seal
10	W505513	Main control leadframe screw (5 required)
11	7G276	Main control leadframe
12	7H111	Solenoid retaining pin (14 required)
13	7G136	Shift Solenoid A (SSA) (normally low)
14	7G383	Shift Solenoid B (SSB) (normally high)
15	7G136	Shift Solenoid C (SSC) (normally low)
16	7G383	Shift Solenoid D (SSD) (normally high)
17	7G484	Shift Solenoid E (SSE) (normally closed [OFF])
18	7G136	Torque Converter Clutch (TCC) solenoid (normally low)
19	7G383	Line Pressure Control (LPC) solenoid (normally high)

Removal

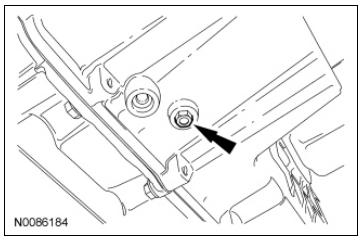
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the screws and the underbody cover.

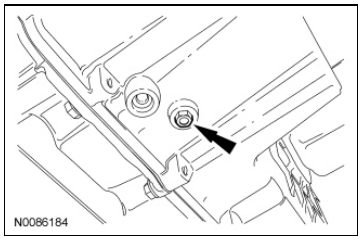


3. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A or Section 303-12B .

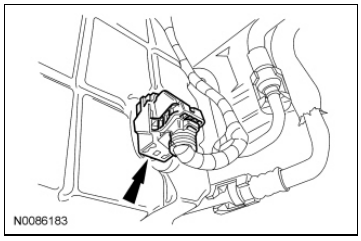
4. Remove the transmission fluid drain plug and allow the transmission fluid to drain.



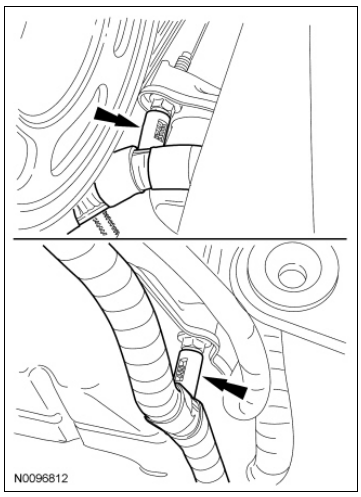
5. Install the transmission fluid drain plug.
   - Tighten to 12 Nm (106 lb-in).



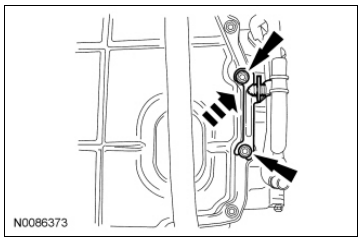
6. Disconnect the transaxle electrical connector.



7. Remove the transaxle electrical wiring harness retainers from the main control cover stud bolts.

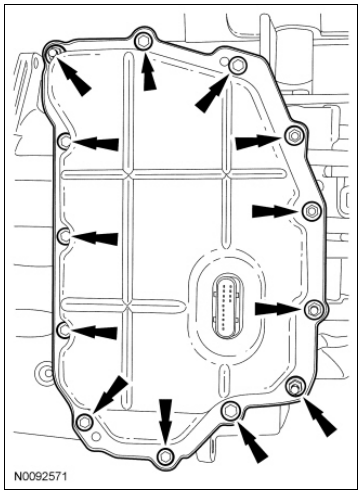


8. Remove the 2 nuts, pull the transmission fluid cooler tube bracket and tubes away from the transaxle and position it aside.

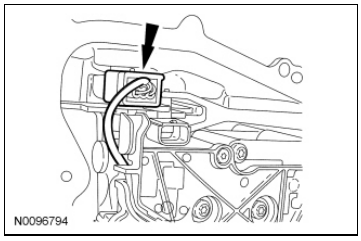


9. **NOTE:** Note the location of the stud bolts for assembly.

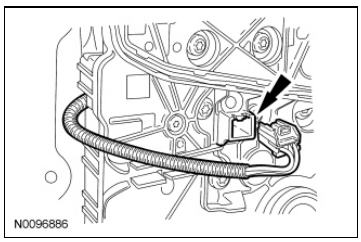
   Remove the 8 bolts, 5 stud bolts and the main control cover.



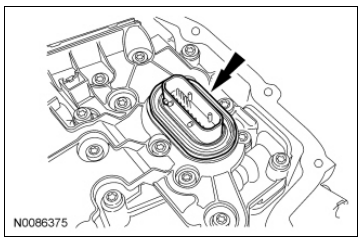
10. Disconnect the Transmission Range (TR) sensor electrical connector.



11. Disconnect the Output Shaft Speed (OSS) sensor electrical connector.

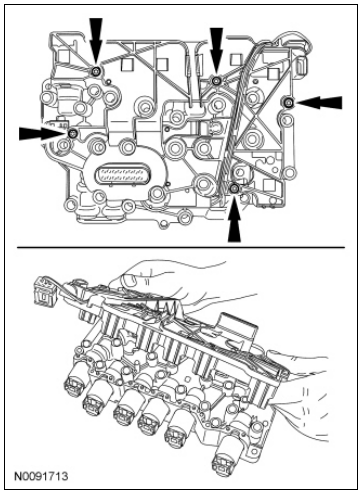


12. Remove the main control cover grommet.

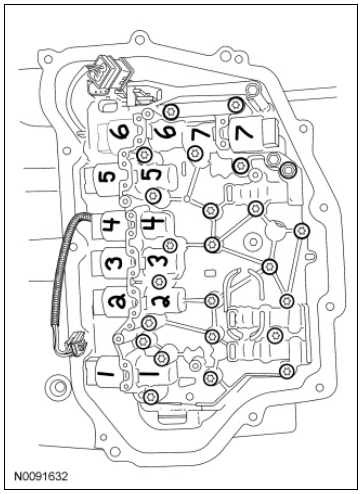


13. ***NOTICE:*** **Be careful not to bend or twist the leadframe or the solenoid terminals when removing the leadframe or damage can occur to the leadframe or the solenoids.**

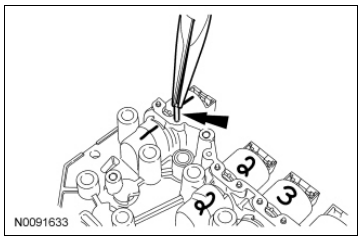
    Remove the 5 screws and the leadframe from the solenoids by lifting it straight up evenly.



14. Using a paint pen, number the solenoids and solenoid body to clearly mark which solenoid was removed from which bore in the solenoid body.



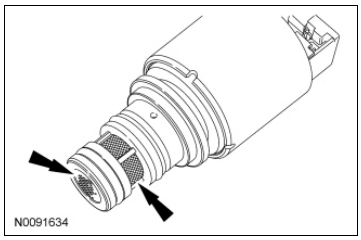
15. Remove the solenoid retaining pin(s).



16. Remove the solenoid(s) from the solenoid body.

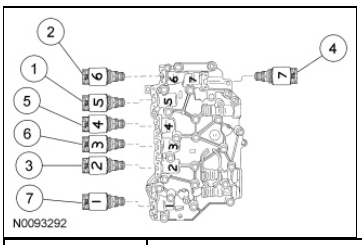
Installation

1. Inspect the solenoid(s) for damage.



2. If a new solenoid is not being installed, install the solenoid(s) into the bore from which it was removed.

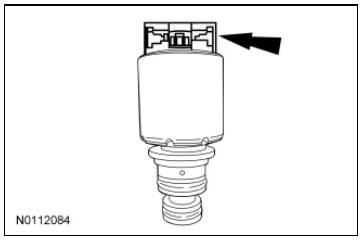
3. If installing a new Variable Force Solenoid (VFS), determine the base part number of the solenoid(s). The Torque Converter Clutch (TCC) solenoid, Shift Solenoid A (SSA) and Shift Solenoid C (SSC) are all normally low pressure solenoids. The Line Pressure Control (LPC) solenoid, Shift Solenoid B (SSB) and Shift Solenoid D (SSD) are all normally high pressure solenoids. Shift Solenoid E (SSE) is not a VFS , it is an ON/OFF solenoid.



Item	Part Number	Description

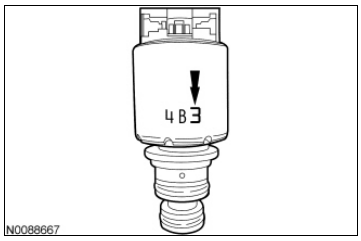
1	7G136	SSA (normally low)
2	7G383	SSB (normally high)
3	7G136	SSC (normally low)
4	7G383	SSD (normally high)
5	7G484	SSE (normally closed [OFF])
6	7G136	TCC solenoid (normally low)
7	7G383	LPC solenoid (normally high)

4. If installing a new LPC solenoid, SSB or SSD , note the color of the electrical terminal area of the solenoid. The color will be blue or green and the solenoid can only be replaced with the same color solenoid. If a new solenoid with that color is not available, install a new solenoid body, refer to Solenoid Body Assembly in this section.

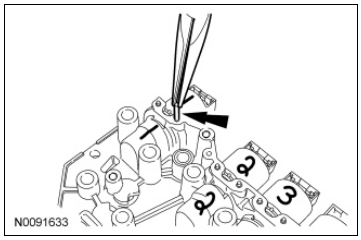


5. Determine the part number suffix by checking the solenoid service band number etched on the side of the solenoid. The band number is the third digit on the side of the solenoid and will be a 1, 2, 3, 4 or 5. Use the following table to determine the part number suffix and match the new solenoid base part number and suffix with the old solenoid. Install the solenoid in the solenoid body.

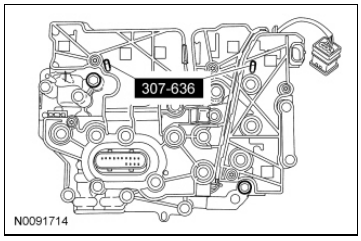
Solenoid Band Number	Part Number Suffix
1	B
2	C
3	D
4	E
5	F



6. Install the solenoid retaining pin(s).

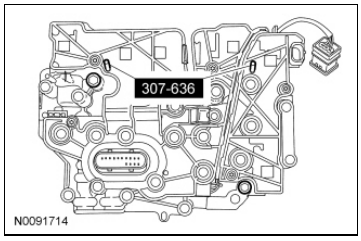


7. Install the Leadframe Guide Pins in the solenoid body to align the lead frame for installation.

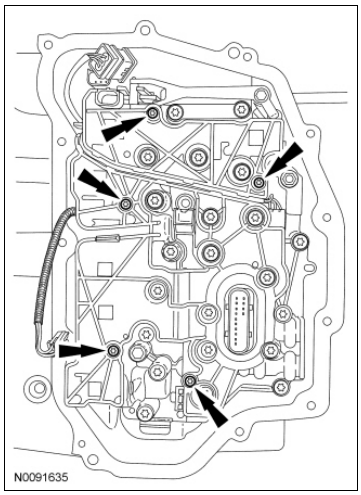


8. Position the leadframe on the Leadframe Guide Pins and carefully install the leadframe by pushing straight down into the solenoids.

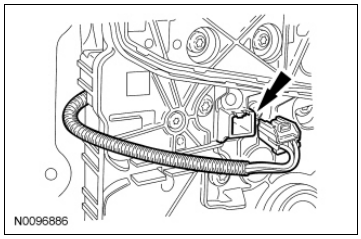
9. Remove the Leadframe Guide Pins.



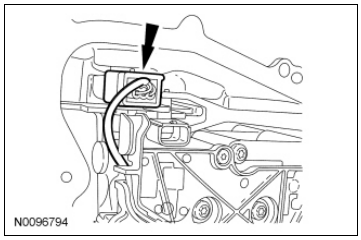
10. Install the 5 leadframe screws.



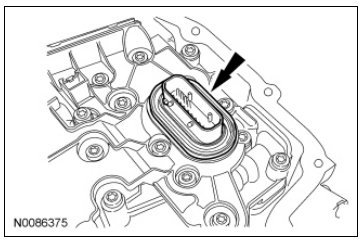
11. Connect the OSS sensor electrical connector.



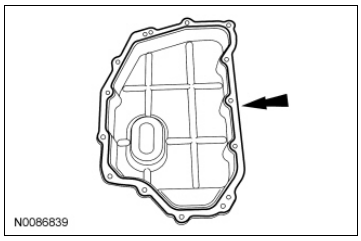
12. Connect the TR sensor electrical connector.



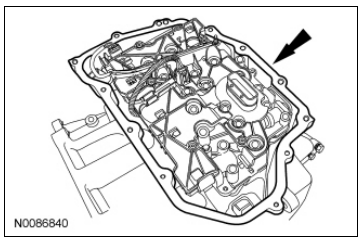
13. Install the main control cover grommet.



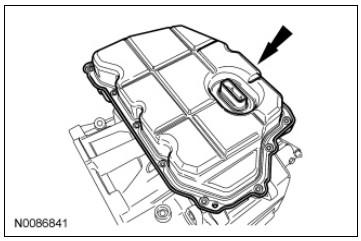
14. Clean the main control cover sealing surface and inspect for damage.



15. Apply silicone to the main control sealing surface of the transaxle case.



16. Position the main control cover in place.

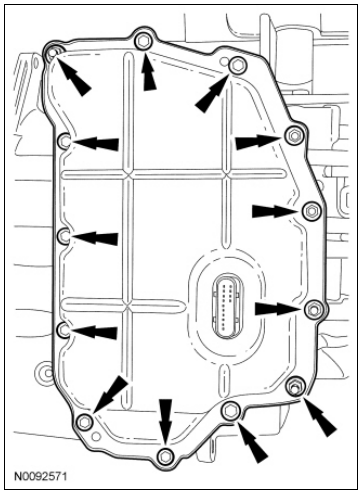


17. ***NOTICE:*** **Inspect the main control cover grommet to make sure that the seal is on the inside of the main control cover, or a transmission fluid leak will occur.**

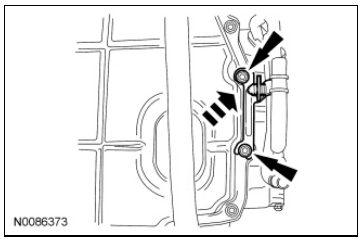
    NOTE: Install the stud bolts in the locations noted during disassembly.

    Tighten the 8 main control cover bolts and 5 stud bolts.

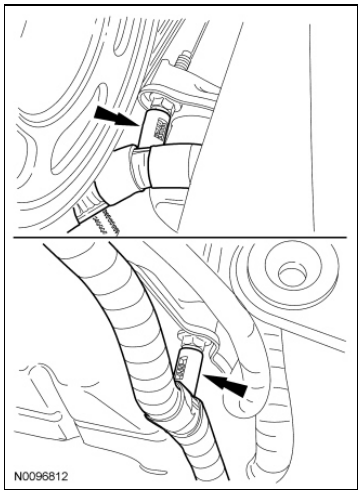
    - Tighten to 12 Nm (106 lb-in).



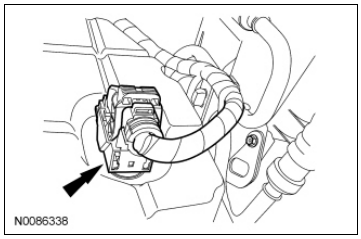
18. Position the transmission fluid cooler tube bracket and transmission fluid cooler tube assembly in place and install the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



19. Connect the transaxle electrical wiring harness retainers to the main control cover stud bolts.

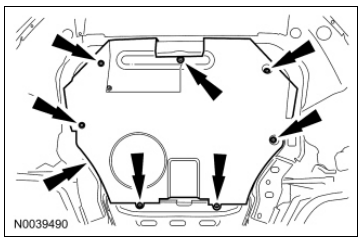


20. Connect the transaxle electrical connector.

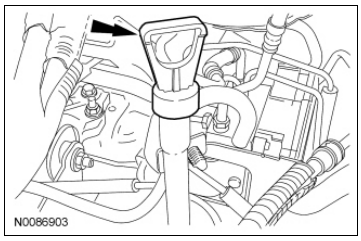


21. Install the ACL assembly. For additional information, refer to Section 303-12A or Section 303-12B .

22. Install the underbody cover and the screws.



23. Fill the transaxle with clean transmission fluid.



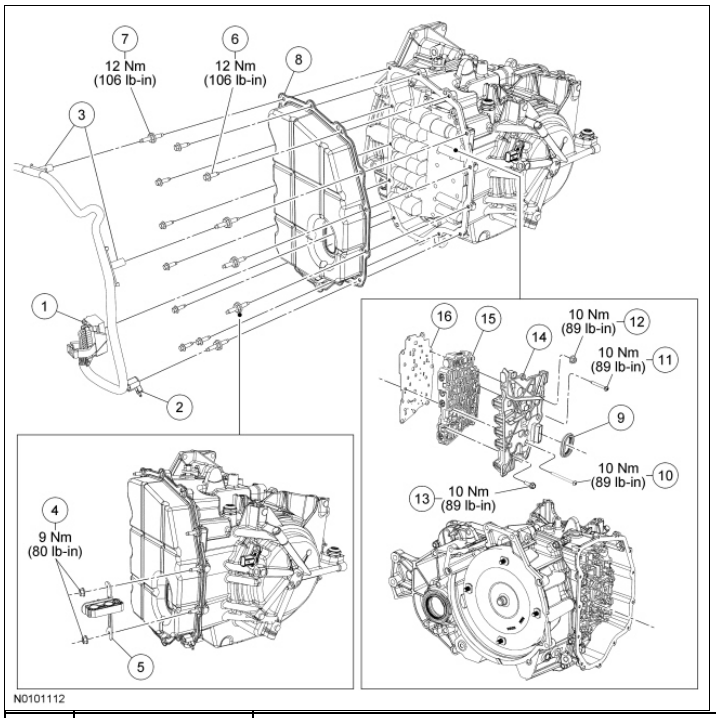
24. Start the engine and move the range selector lever into each gear position.

25. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

Main Control Valve Body

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Ultra Silicone Sealant TA-29	-



Item	Part Number	Description
1	14A464	Transaxle main harness electrical connector
2	9S318	Wiring harness retainer
3	14A163	Wiring harness retainer
4	N805320	Transmission fluid cooler tube nuts
5	7H420	Transmission fluid cooler tube bracket
6	W500213	Main control cover bolts
7	W705619	Main control cover studbolts
8	7G004	Main control cover
9	7B329	Main control-to-cover seal
10	W302863	Main control-to-transaxle case bolt (long) (10 required)
11	W302862	Main control-to-transaxle case bolt (short) (12 required)

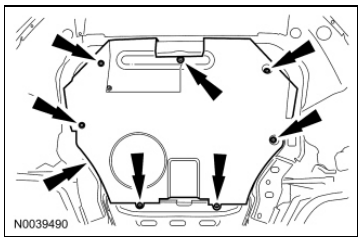
12	W520412	Main control nut
13	W500303	Solenoid body-to-valve body bolt (2 required)
14	7G391	Solenoid body assembly
15	7A100	Valve body assembly
16	7Z490	Main control-to-transaxle case separator plate

Removal

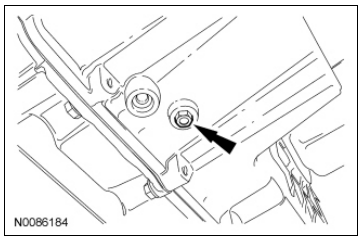
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A or Section 303-12B .

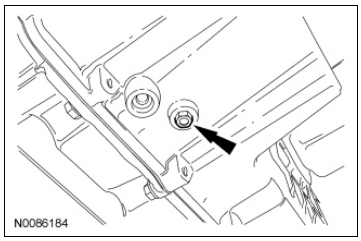
3. Remove the screws and the underbody cover.



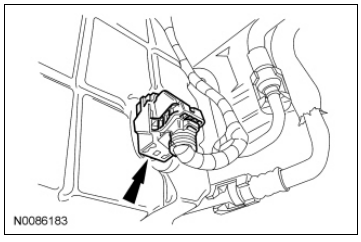
4. Remove the transmission fluid drain plug and allow the transmission fluid to drain.



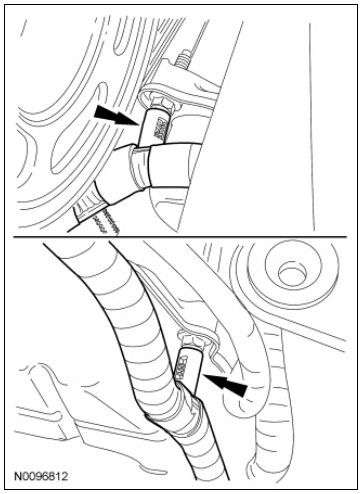
5. Install the transmission fluid drain plug.
   - Tighten to 12 Nm (106 lb-in).



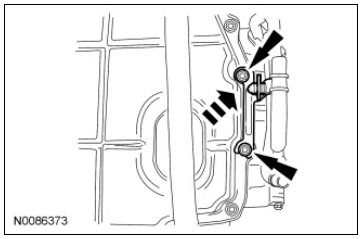
6. Disconnect the transaxle electrical connector.



7. Connect the transaxle electrical wiring harness retainers to the main control cover stud bolts.

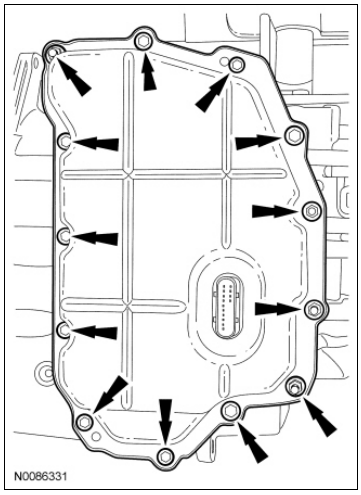


8. Remove the 2 nuts, pull the transmission fluid cooler tube bracket and tubes away from the transaxle and position it aside.

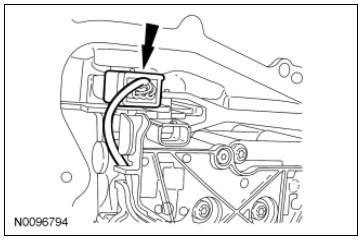


9. **NOTE:** Note the location of the stud bolts for assembly.

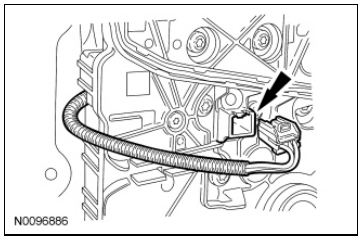
   Remove the 8 bolts, 5 stud bolts and the main control cover.



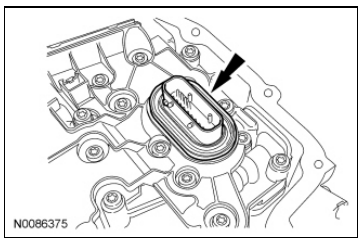
10. Disconnect the Transmission Range (TR) sensor electrical connector.



11. Disconnect the Output Shaft Speed (OSS) sensor electrical connector.



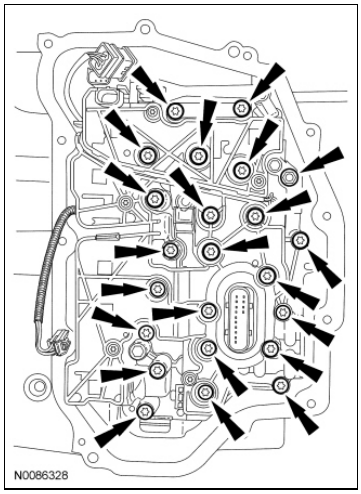
12. Remove the main control-to-main control cover grommet.



13. ***NOTICE:*** **The main control should be handled with care or damage to the main control may occur.**

    NOTE: Note the location of the different length bolts for assembly.

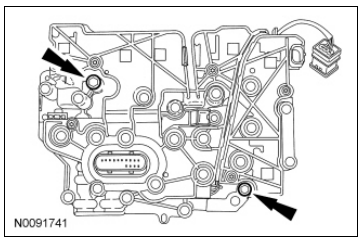
    Remove the nut, 22 bolts and the main control.



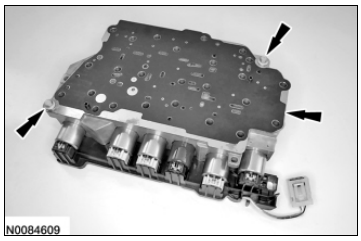
14. Remove and discard the main control-to-transaxle case separator plate.



15. Remove the 2 bolts and separate the solenoid body assembly from the main control valve body.

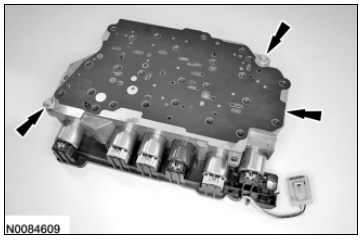


16. Remove the 2 bolts and remove and discard the separator plate.



Installation

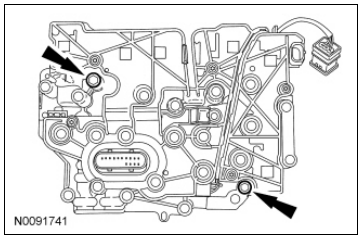
1. Install the new separator plate and the 2 separator bolts.
   - Tighten to 10 Nm (89 lb-in).



2. **NOTE:** If cleaning the main control assembly or inspecting the valves, refer to Main Control Valve Body in this section. If installing a new main control assembly, continue with this procedure.

   Install the solenoid body assembly onto the main control valve body. Install the 2 bolts.

   - Tighten to 10 Nm (89 lb-in).

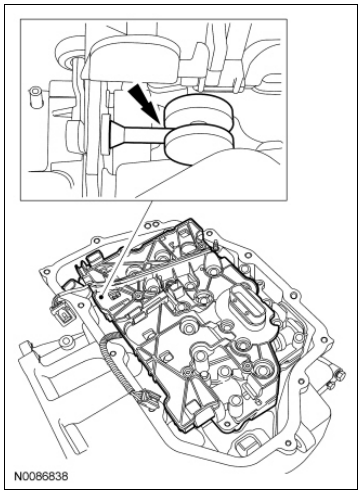


3. Position the OSS and TR sensor wiring harnesses aside and install the new main control-to-transaxle case separator plate.



4. **NOTE:** Make sure that the manual lever pin (part of the TR sensor) is correctly installed in the manual valve.

   Install the main control.

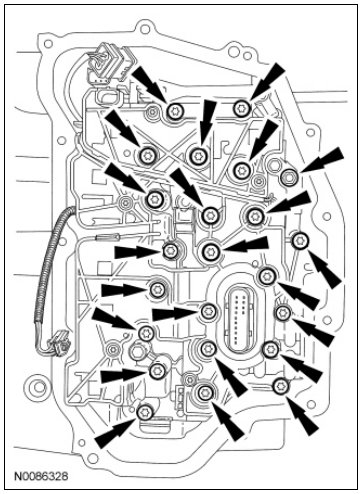


5. ***NOTICE:*** **Make sure not to pinch the Output Shaft Speed (OSS) or Transmission Range (TR) sensor wiring harnesses when installing the main control.**

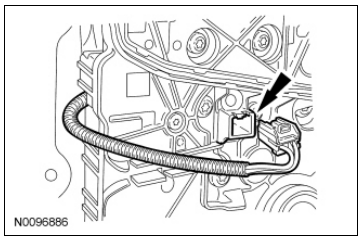
   NOTE: Install the different length bolts in the locations noted during disassembly.

   Install the main control stud nut and 22 main control valve body bolts. Tighten in a crisscross pattern.

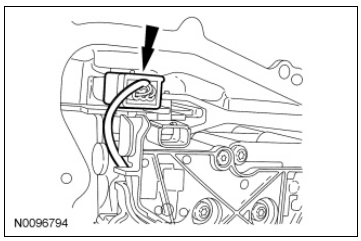
   - Tighten to 10 Nm (89 lb-in).



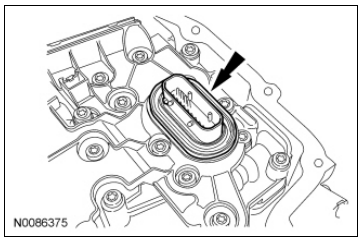
6. Connect the OSS sensor electrical connector.



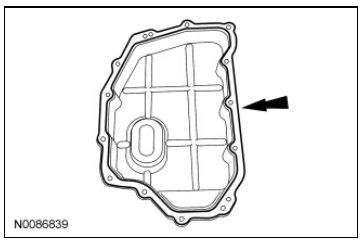
7. Connect the TR sensor electrical connector.



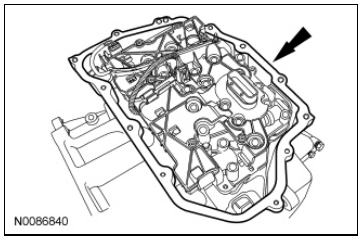
8. Install the main control-to-main control cover grommet.



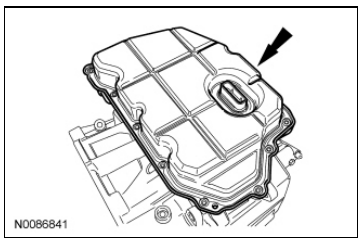
9. Clean the main control cover sealing surface.



10. Apply silicone to the main control sealing surface of the transaxle case.



11. Position the main control cover in place.

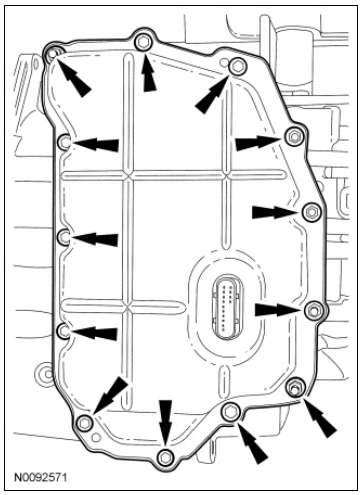


12. ***NOTICE:*** **Inspect the main control-to-main control cover grommet to make sure that the seal is on the inside of the main control cover. Transmission fluid leak will occur.**

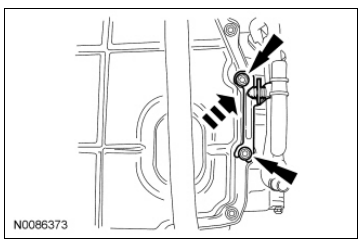
    NOTE: Install the stud bolts in the locations noted during disassembly.

    Tighten the 8 main control cover bolts and 5 stud bolts.

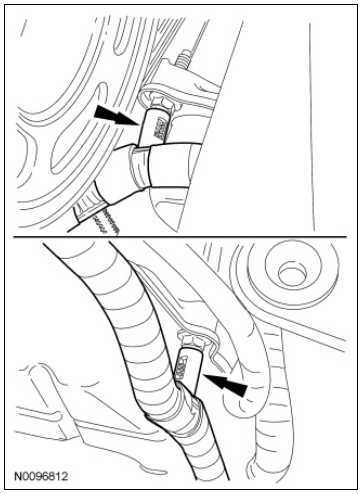
    - Tighten to 12 Nm (106 lb-in).



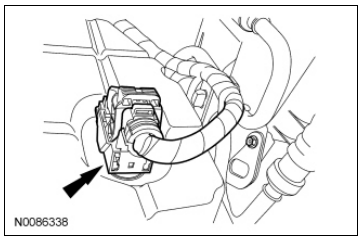
13. Position the transmission fluid cooler tube bracket and transmission fluid cooler tube assembly in place and install the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



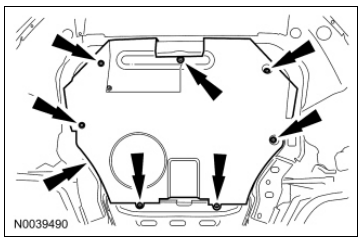
14. Connect the transaxle electrical wiring harness retainers to the main control cover studbolts.



15. Connect the transaxle electrical connector.

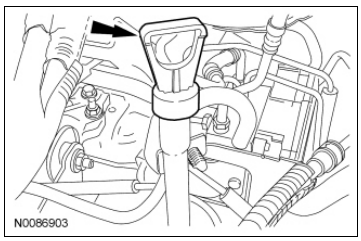


16. Install the underbody cover and the screws.



17. Install the ACL assembly. For additional information, refer to Section 303-12A or Section 303-12B .

18. Fill the transaxle with clean transmission fluid.



19. Start the engine and move the range selector lever into each gear position.

20. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

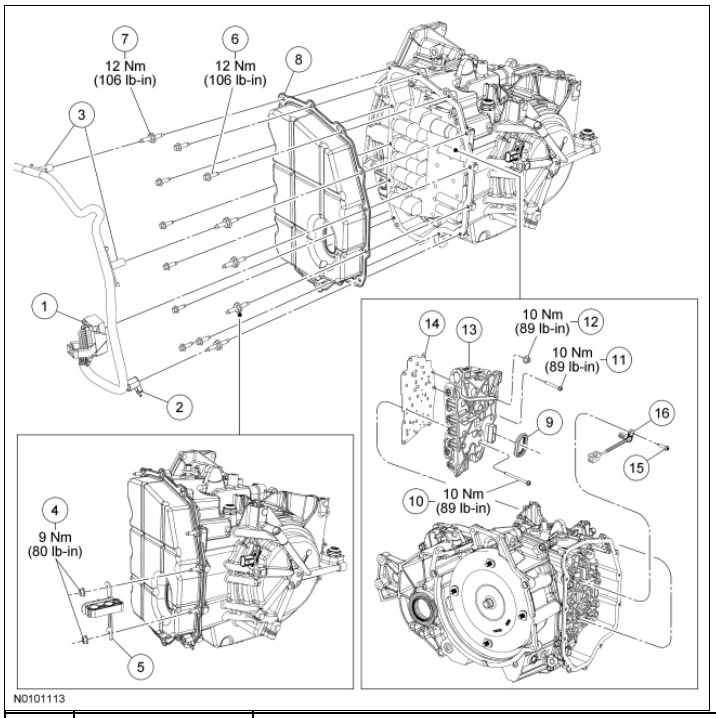
21. If a new solenoid body is installed, the solenoid body strategy and solenoid body identification will need to be updated. For additional information, refer to Solenoid Body Strategy in this section

22. If a replacement transaxle assembly is being installed or a new solenoid body is installed, the PCM will have to be reflashed with a new solenoid body strategy and identification data file. For additional information, refer to Solenoid Body Strategy in this section.

Output Shaft Speed (OSS) Sensor

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Ultra Silicone Sealant TA-29	-



Item	Part Number	Description
1	14A464	Transaxle main harness electrical connector
2	9S318	Wiring harness retainer
3	14A163	Wiring harness retatd>
4	N805320	Transmission fluid cooler tube nuts
5	7H420	Transmission fluid cooler tube bracket
6	W500213	Main control cover bolts
7	W705619	Main control cover studbolts
8	7G004	Main control cover
9	7B329	Main control-to-cover seal
10	W302863	Main control-to-transaxle case bolt (long) (10 required)
11	W302862	Main control-to-transaxle case bolt (short) (12 required)

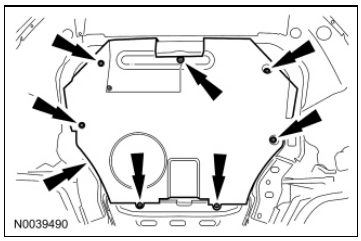
12	W520412	Main control nut
13	7A100	Main control assembly
14	7Z490	Main control-to-transaxle case separator plate
15	W713644	Output Shaft Speed (OSS) sensor bolt
16	7H103	OSS sensor

Removal

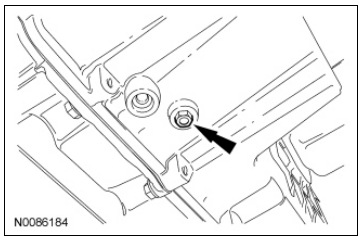
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A or Section 303-12B .

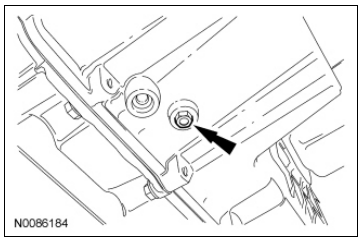
3. Remove the screws and the underbody cover.



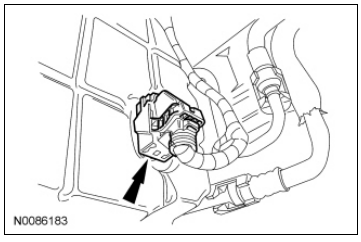
4. Remove the transmission fluid drain plug and allow the transmission fluid to drain.



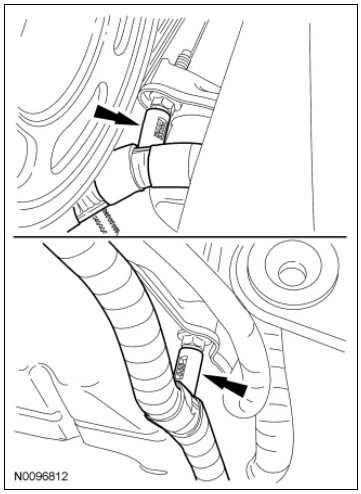
5. Install the transmission fluid drain plug.
   - Tighten to 12 Nm (106 lb-in).



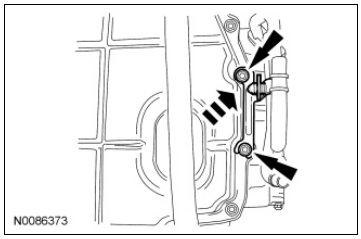
6. Disconnect the transaxle electrical connector.



7. Connect the transaxle electrical wiring harness retainers to the main control cover stud bolts.

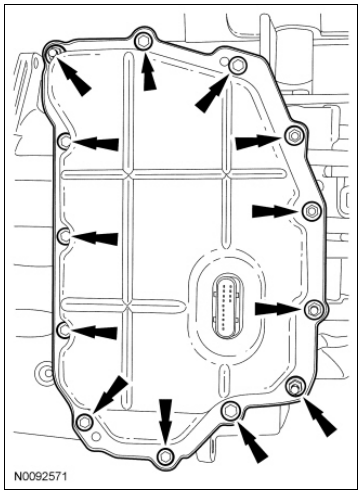


8. Remove the 2 nuts, pull the transmission fluid cooler tube bracket and tubes away from the transaxle and position it aside.

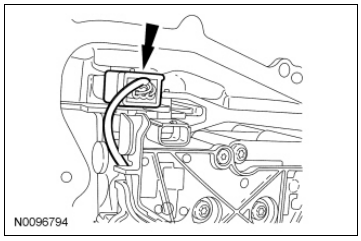


9. **NOTE:** Note the location of the stud bolts for assembly.

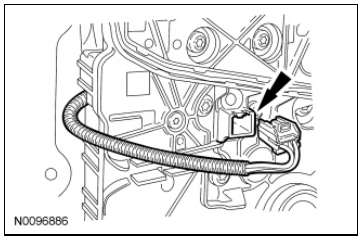
   Remove the 8 bolts, 5 stud bolts and the main control cover.



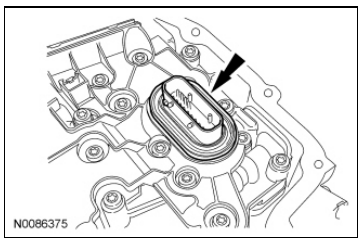
10. Disconnect the Transmission Range (TR) sensor electrical connector.



11. Disconnect the Output Shaft Speed (OSS) sensor electrical connector.



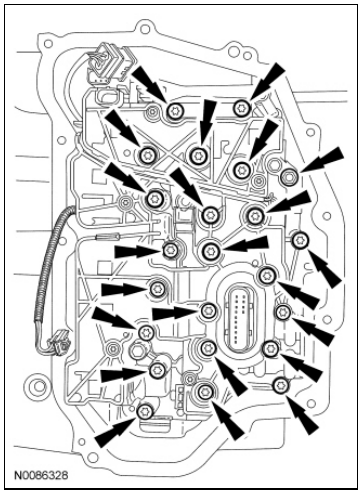
12. Remove the main control-to-main control cover grommet.



13. ***NOTICE:*** **The main control should be handled with care or damage to the main control may occur.**

    NOTE: Note the location of the different length bolts for assembly.

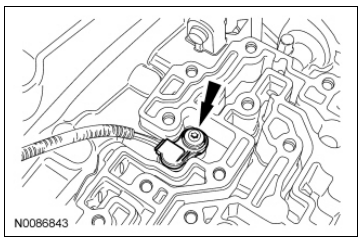
    Remove the nut, 22 bolts and the main control.



14. Remove the main control-to-transaxle separator plate.

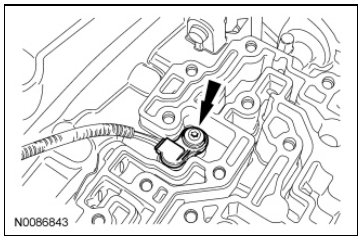


15. Remove the bolt and the OSS sensor.

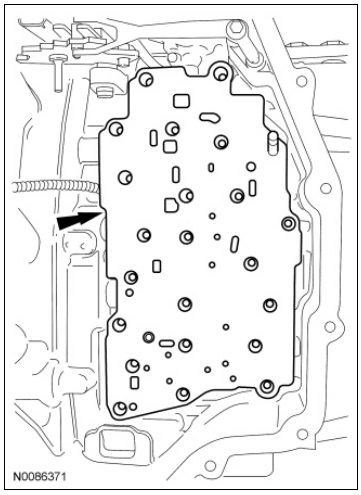


Installation

1. Install the OSS sensor and the bolt.
   - Tighten to 10 Nm (89 lb-in).

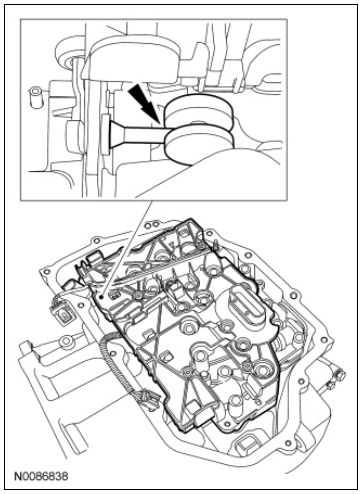


2. Position the OSS and TR sensor wiring harnesses aside and install the main control-to-transaxle separator plate.



3. **NOTE:** Make sure that the manual lever pin (part of the TR sensor) is correctly installed in the manual valve.

   Install the main control.

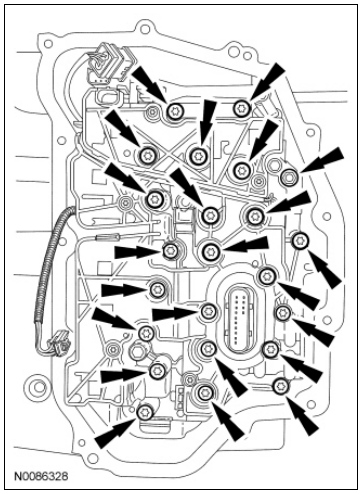


4. ***NOTICE:*** **Make sure not to pinch the Output Shaft Speed (OSS) or Transmission Range (TR) sensor wiring harnesses when installing the main control.**

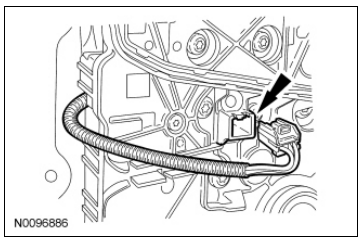
   NOTE: Install the different length bolts in the locations noted during disassembly.

   Install the main control stud nut and 22 main control valve body bolts. Tighten in a crisscross pattern.

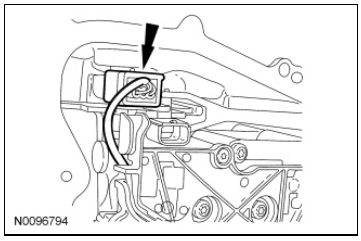
   - Tighten to 10 Nm (89 lb-in).



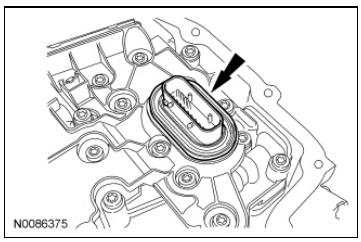
5. Route the OSS sensor wiring harness and connect the electrical connector.



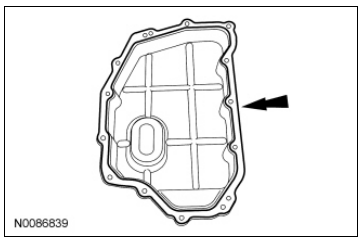
6. Connect the TR sensor electrical connector.



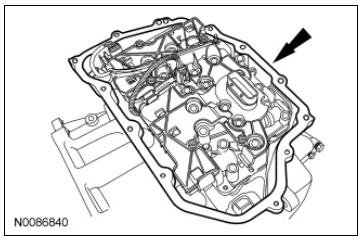
7. Install the main control-to-main control cover grommet.



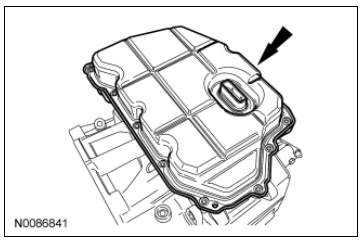
8. Clean the main control cover sealing surface and inspect for damage.



9. Apply silicone to the main control sealing surface of the transaxle case.



10. Position the main control cover in place.

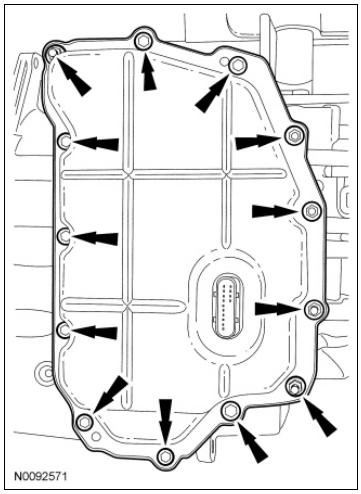


11. ***NOTICE:*** **Inspect the main control-to-main control cover grommet to make sure that the seal is on the inside of the main control cover or a transmission fluid leak will occur.**

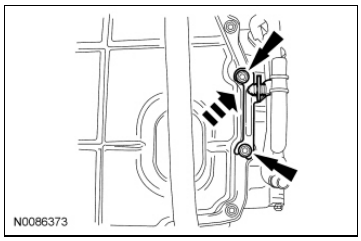
    NOTE: Install the stud bolts in the locations noted during disassembly.

    Install the 8 main control cover bolts and 5 stud bolts.

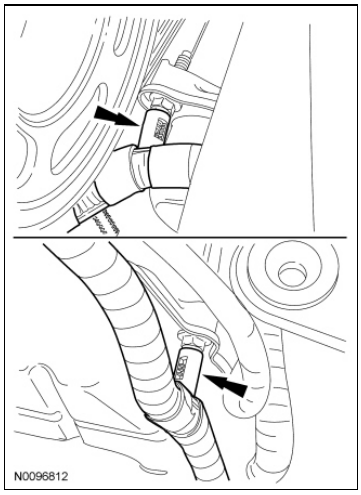
    - Tighten to 12 Nm (106 lb-in).



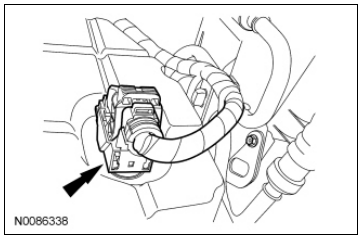
12. Position the transmission fluid cooler tube bracket and transmission fluid cooler tube assembly in place and install the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



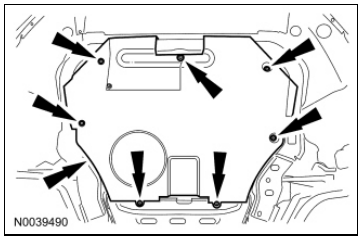
13. Connect the transaxle electrical wiring harness retainers to the main control cover studbolts.



14. Connect the transaxle electrical connector.

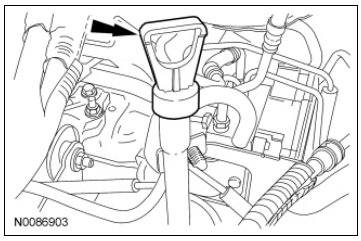


15. Install the underbody cover and the screws.



16. Install the ACL assembly. For additional information, refer to Section 303-12A or Section 303-12B .

17. Fill the transaxle with clean transmission fluid.



18. Start the engine and move the range selector lever into each gear position.

19. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

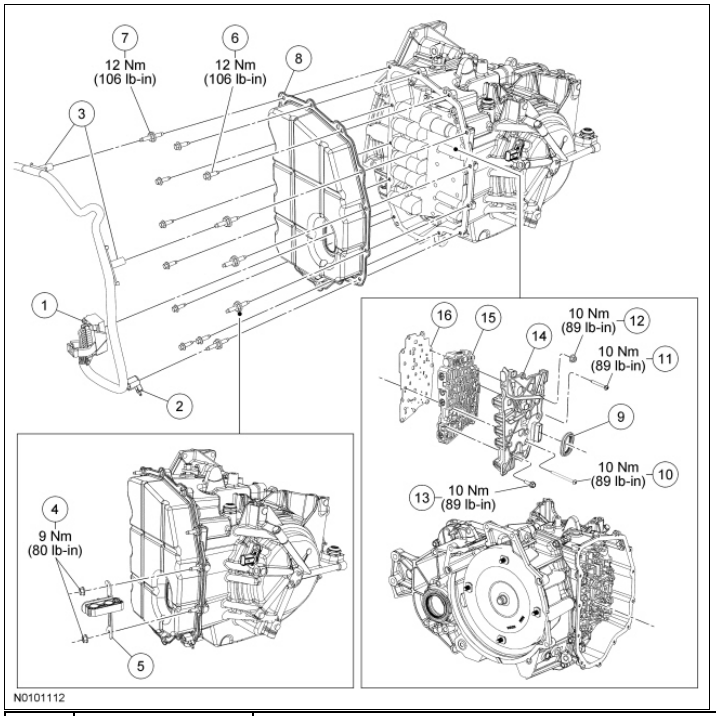
Solenoid Body Assembly

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Ultra Silicone Sealant TA-29	-



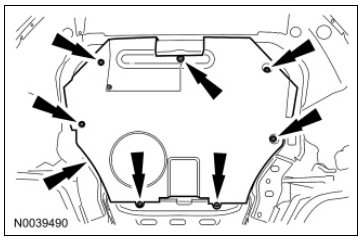
Item	Part Number	Description
1	14A464	Transaxle main harness electrical connector
2	9S318	Wiring harness retainer
3	14A163	Wiring harness retainer
4	N805320	Transmission fluid cooler tube nuts
5	7H420	Transmission fluid cooler tube bracket
6	W500213	Main control cover bolts

7	W705619	Main control cover studbolts
8	7G004	Main control cover
9	7B329	Main control-to-cover seal
10	W302863	Main control-to-transaxle case bolt (long) (10 required)
11	W302862	Main control-to-transaxle case bolt (short) (12 required)
12	W520412	Main control nut
13	W500303	Solenoid body-to-valve body bolt (2 required)
14	7G391	Solenoid body assembly
15	7A100	Valve body assembly
16	7Z490	Main control-to-transaxle case separator plate

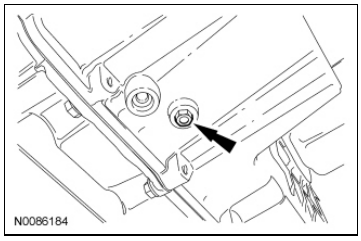
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A or Section 303-12B .

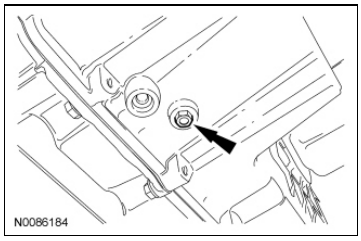
3. Remove the screws and the underbody cover.



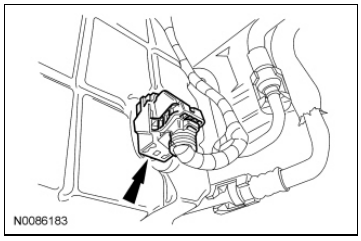
4. Remove the transmission fluid drain plug and allow the transmission fluid to drain.



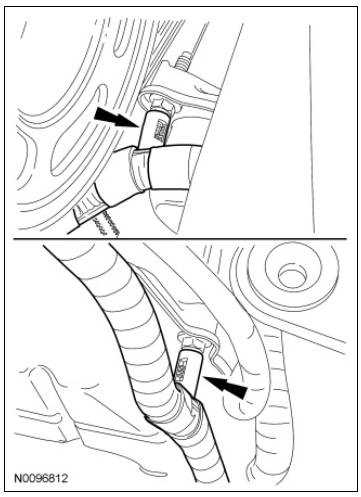
5. Install the transmission fluid drain plug.
   - Tighten to 12 Nm (106 lb-in).



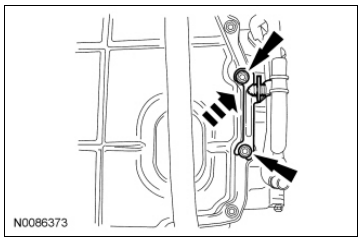
6. Disconnect the transaxle electrical connector.



7. Disconnect the transaxle electrical wiring harness retainers from the main control cover stud bolts.

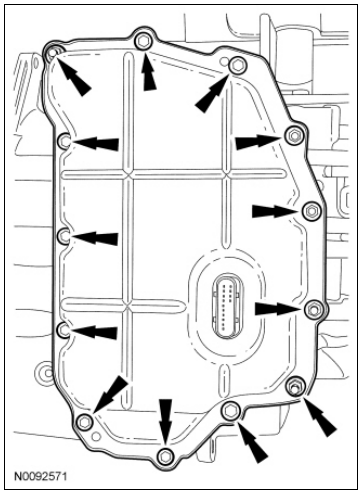


8. Remove the 2 nuts, pull the transmission fluid cooler tube bracket and tubes away from the transaxle and position it aside.

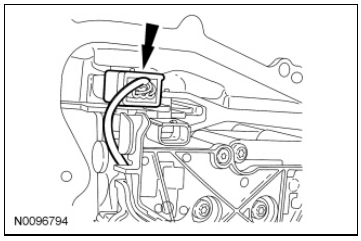


9. **NOTE:** Note the location of the stud bolts for assembly.

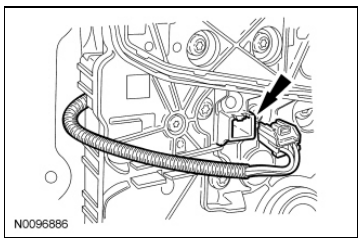
   Remove the 8 bolts, 5 stud bolts and the main control cover.



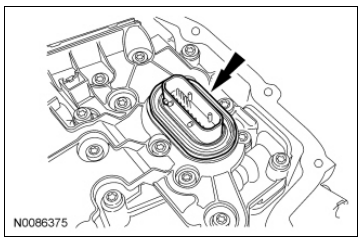
10. Disconnect the Transmission Range (TR) sensor electrical connector.



11. Disconnect the Output Shaft Speed (OSS) sensor electrical connector.



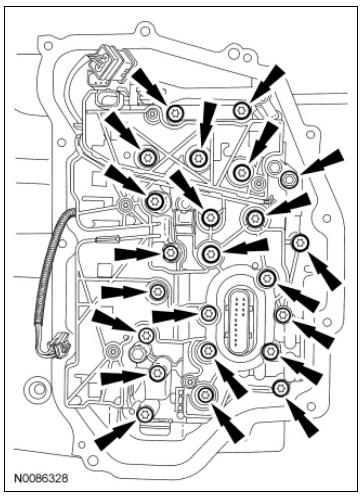
12. Remove the main control cover grommet.



13. ***NOTICE:*** **The main control should be handled with care or damage to the main control may occur.**

    NOTE: Note the location of the different length bolts for assembly.

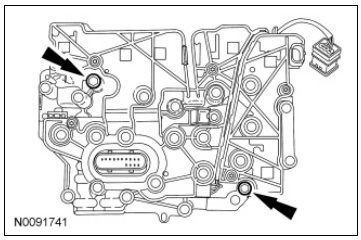
    Remove the nut, 22 bolts and the main control.



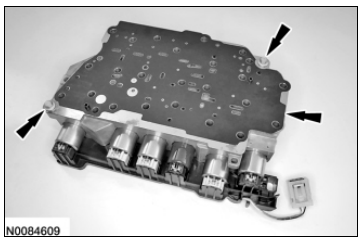
14. Remove and discard the main control-to-transaxle case separator plate.



15. Remove the 2 bolts and separate the solenoid body from the main control valve body.

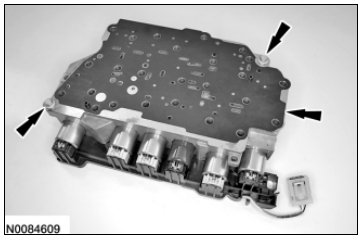


16. Remove the 2 bolts and remove and discard the separator plate.



Installation

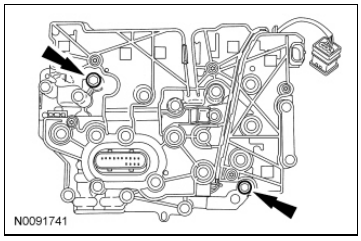
1. Install the new separator plate and the 2 separator bolts.
   - Tighten to 10 Nm (89 lb-in).



2. **NOTE:** If cleaning the solenoid body assembly or inspecting the valves, refer to Solenoid Body Assembly in this section. If installing a new solenoid body assembly, continue with this procedure.

   Install the solenoid body onto the main control valve body. Install the 2 bolts.

   - Tighten to 10 Nm (89 lb-in).

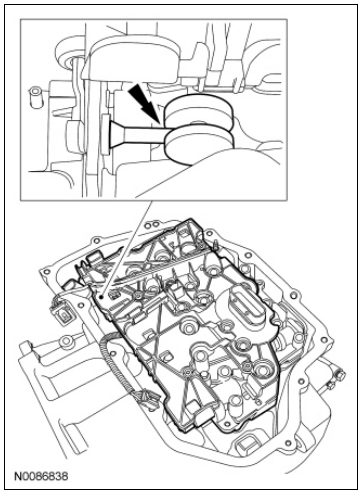


3. Position the OSS and TR sensor wiring harnesses aside and install the new main control-to-transaxle case separator plate.



4. **NOTE:** Make sure that the manual lever pin (part of the TR sensor) is correctly installed in the manual valve.

   Install the main control.

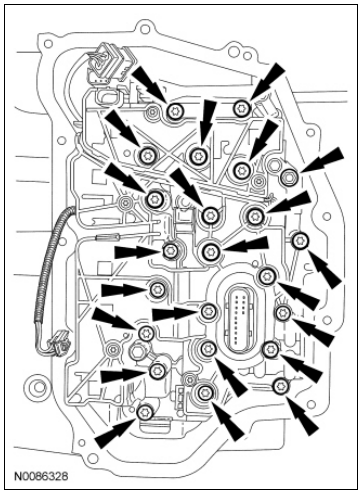


5. ***NOTICE:*** **Make sure not to pinch the Output Shaft Speed (OSS) or Transmission Range (TR) sensor wiring harnesses when installing the main control.**

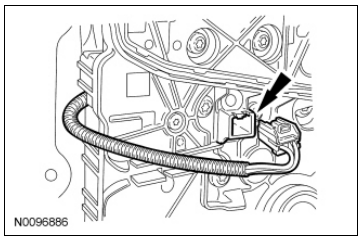
   NOTE: Install the different length bolts in the locations noted during disassembly.

   Install the main control stud nut and 22 main control valve body bolts. Tighten in a crisscross pattern.

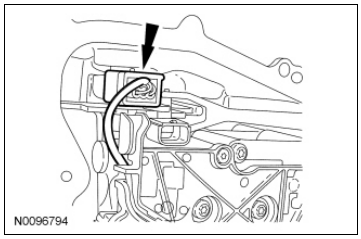
   - Tighten to 10 Nm (89 lb-in).



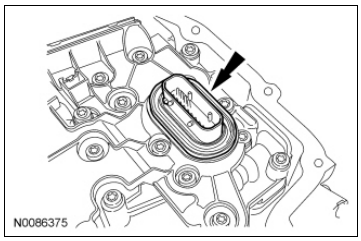
6. Route the OSS sensor wiring harness and connect the electrical connector.



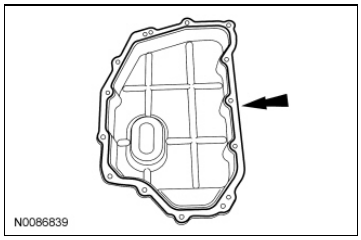
7. Connect the TR sensor electrical connector.



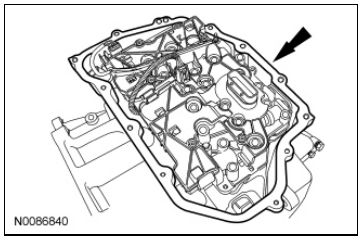
8. Install the main control cover grommet.



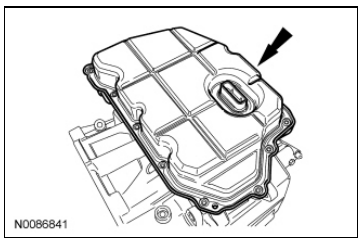
9. Clean the main control cover sealing surface.



10. Apply silicone to the main control sealing surface of the transaxle case.



11. Position the main control cover in place.

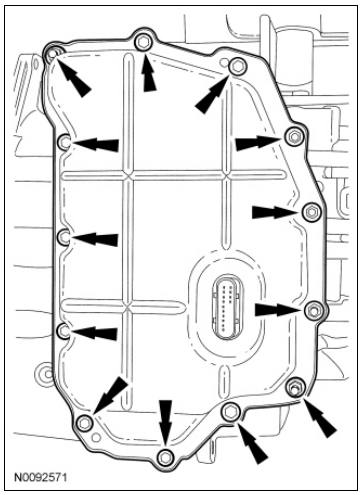


12. ***NOTICE:*** **Inspect the main control-to-main control cover grommet to make sure that the seal is on the inside of the main control cover or a transmission fluid leak will occur.**

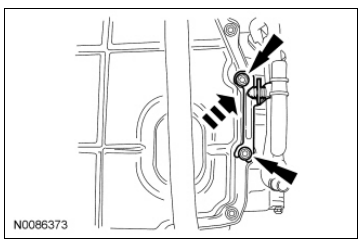
    NOTE: Install the stud bolts in the locations noted during disassembly.

    Tighten the 8 main control cover bolts and 5 stud bolts.

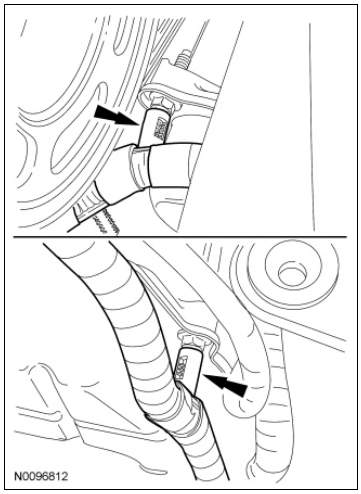
    - Tighten to 12 Nm (106 lb-in).



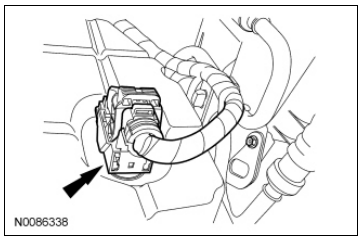
13. Position the transmission fluid cooler tube bracket and transmission fluid cooler tube assembly in place and install the 2 nuts.
    - Tighten to 9 Nm (80 lb-in).



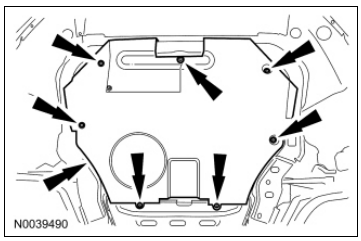
14. Connect the transaxle electrical wiring harness retainers to the main control cover stud bolts.



15. Connect the transaxle electrical connector.

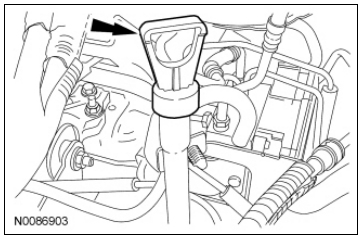


16. Install the underbody cover and the screws.



17. Install the ACL assembly. For additional information, refer to Section 303-12A or Section 303-12B .

18. Fill the transaxle with clean transmission fluid.



19. Start the engine and move the range selector lever into each gear position.

20. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

21. Download a new solenoid body strategy to the PCM. For additional information, refer to Solenoid Body Strategy in this section.

22. Using the scan tool, select Module Programming and Programmable Parameters under the tool box icon and select Transmission. Follow the instructions displayed on the scan tool.
    There are fields to enter the solenoid body 7-digit identification and 13-digit strategy recorded from the solenoid body.

23. ***NOTICE:*** **If the solenoid body information is not correct, transaxle damage or driveability concerns can occur.**

    Enter the solenoid body identification and strategy.
    The scan tool will verify that the numbers entered are valid and display a message if the information is not valid.
    The scan tool checks to see if the file is present on the scan tool. If the file is present, the technician may proceed with downloading the file to the PCM. If the file is not present, the scan tool will need to be connected to the Professional Technician Society (PTS) server to download the file ontohe scan tool.

24. Verify that the file is present on the scan tool. If the file is present, go to Step 25. If the file is not present, continue with this procedure.

25. Connect the scan tool to the PTS server.
    The screen will display a progress bar when connecting to the network.

26. Follow the instructions on the network to download the strategy file to the scan tool.
    The screen will display a progress bar when downloading the strategy file to the scan tool and display a message if it is downloaded successfully.

27. If the scan tool cannot connect to the PTS server, download the file from www.motorcraft.com.
    If the scan tool cannot download a strategy from the web site, a partial strategy will automatically be downloaded.

28. Reconnect the scan tool to the vehicle.

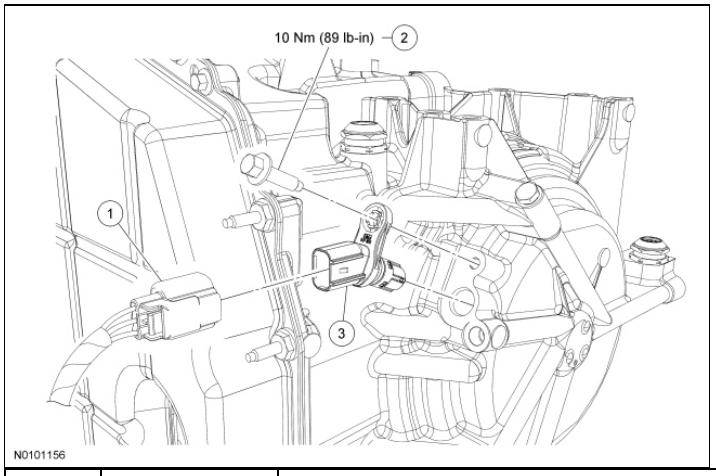
29. Follow the instructions displayed on the scan tool.

30. If a new solenoid body was installed, compare the 7-digit identification and the 13-digit strategy fields from the solenoid body to the replacement solenoid body tag provided with the solenoid body service kit and place it over the existing identification tag.
    The scan tool will automatically download the strategy file or partial strategy file to the PCM and will display a progress bar while downloading. The scan tool will display a message when it is finished downloading the data that states that the file was downloaded successfully.

Turbine Shaft Speed (TSS) Sensor

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

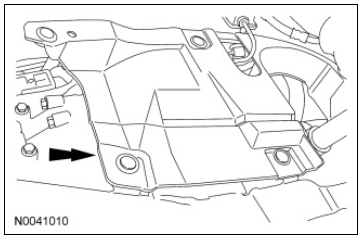


Item	Part Number	Description
1	14A464	Turbine Shaft Speed (TSS) sensor electrical connector
2	W500214	TSS sensor bolt
7M101	TSS sensor	

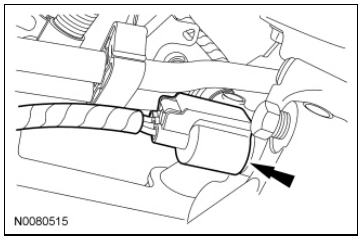
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

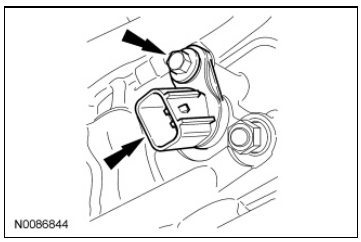
2. Remove the 6 pin-type retainers and the LH front structure-to-subframe splash shield.



3. Disconnect the Turbine Shaft Speed (TSS) sensor electrical connector.

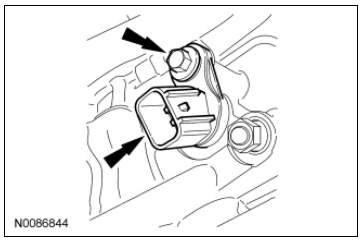


4. Remove the bolt and the TSS sensor.

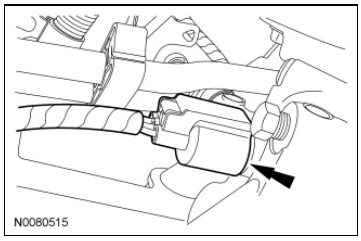


Installation

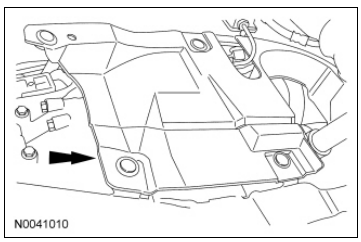
1. Install the TSS sensor and the bolt.
   - Tighten to 10 Nm (89 lb-in).



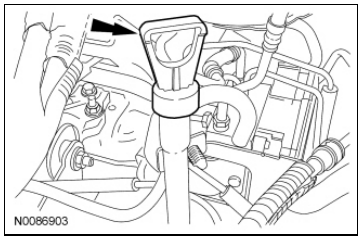
2. Connect the TSS sensor electrical connector.



3. Install the LH front structure-to-subframe splash shield and the 6 pin-type retainers.



4. Fill the transaxle with clean transmission fluid.



5. Start the engine and move the range selector lever into each gear position.

6. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

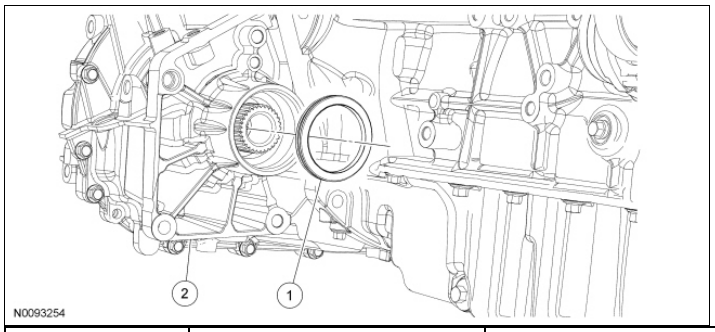
Halfshaft Seal - RH, All Wheel Drive (AWD)

Special Tool(s)

 ST2572-A	Installer, Halfshaft Oil Seal 308-431
 ST2525-A	Installer, Halfshaft Oil Seal 307-428

Material

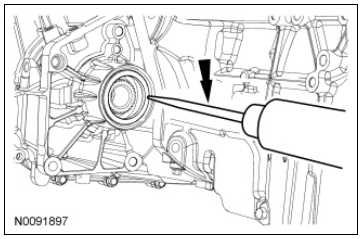
Item	
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV



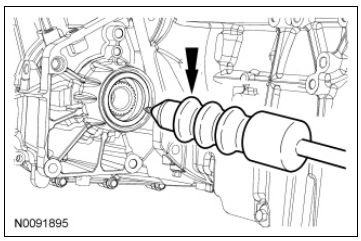
Item	Part Number	Description
1	1177	Seal assembly - halfshaft
2	7000	Transaxle

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the Power Transfer Unit (PTU). For additional information, refer to Section 308-07B .
3. Using a suitable awl, poke a small hole in the RH transaxle differential seal.

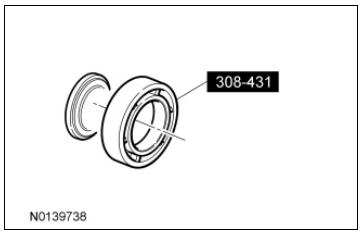


4. Using a suitable dent puller, remove the halfshaft seal.

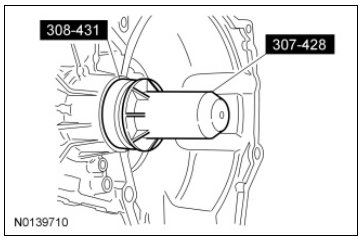


Installation

1. Install a new halfshaft seal on the Halfshaft Oil Seal Installer.

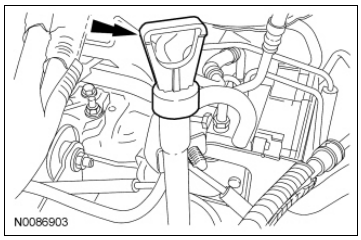


2. Using the RH Halfshaft Oil Seal Installers, install the RH halfshaft seal onto the transaxle case.



3. Install the PTU . For additional information, refer to Section 308-07B .

4. Fill the transaxle with clean transmission fluid.

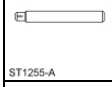


5. Start the engine and move the range selector lever into each gear position.

6. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

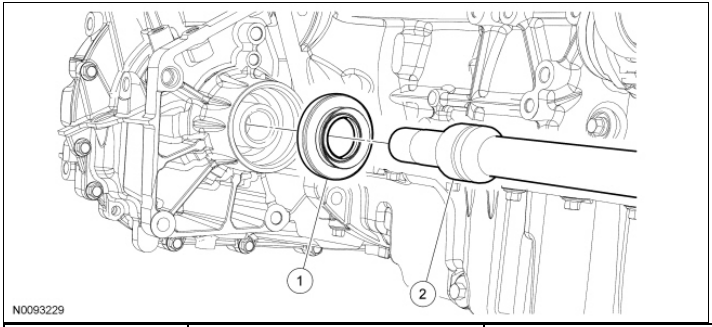
Halfshaft Seal - RH, Front Wheel Drive (FWD)

Special Tool(s)

 ST1255-A	Handle 205-153 (T80T-4000-W)
 ST3070-A	Installer, Seal 307-626

Material

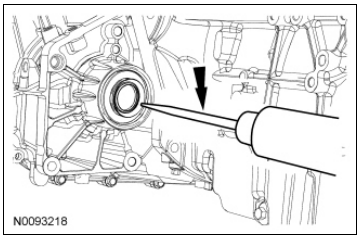
Item	Specification
Motorcraft® MERCON® LV Automatic Transmid XT-10-QLVC	MERCON® LV



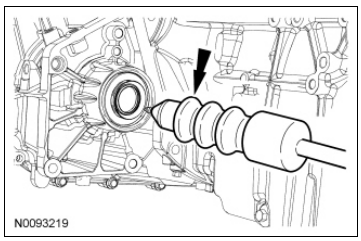
Item	Part Number	Description
1	1177	Seal assembly - halfshaft
2	3K183	Intermediate shaft

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the front RH halfshaft. For additional information, refer to Section 205-04 .
3. Using a suitable awl, poke a small hole in the halfshaft seal.

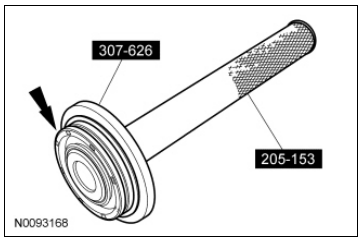


4. Using a suitable dent puller, remove the halfshaft seal.

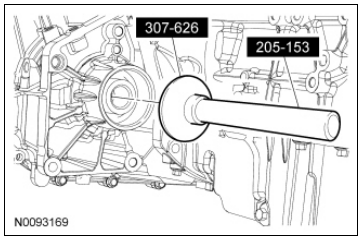


Installation

1. Install a new halfshaft seal on the Seal Installer and Handle.

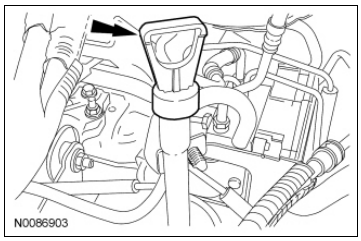


2. Using the Seal Installer and Handle, install the RH halfshaft seal.



3. Install the front RH halfshaft. For additional information, refer to Section 205-04 .

4. Fill the transaxle with clean transmission fluid.

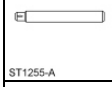


5. Start the engine and move the range selector lever into each gear position.

6. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

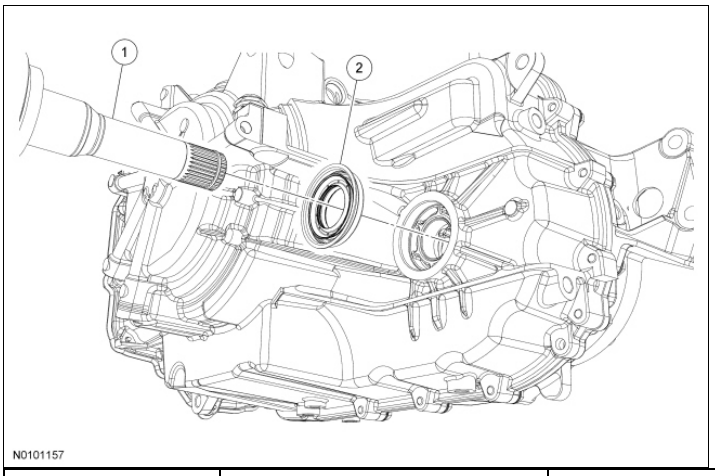
Halfshaft Seal - LH

Special Tool(s)

 ST1255-A	Handle 205-153 (T80T-4000-W)
 ST3070-A	Installer, Differential Seal 307-626

Material

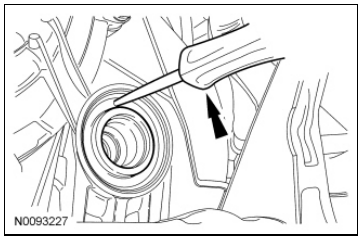
Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV



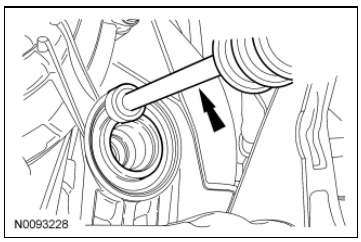
Item	Part Number	Description
1	3A428	LH halfshaft
2	1177	LH halfshaft seal

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the front LH halfshaft. For additional information, refer to Section 205-04 .
3. Using a suitable awl, poke a small hole in the halfshaft seal.

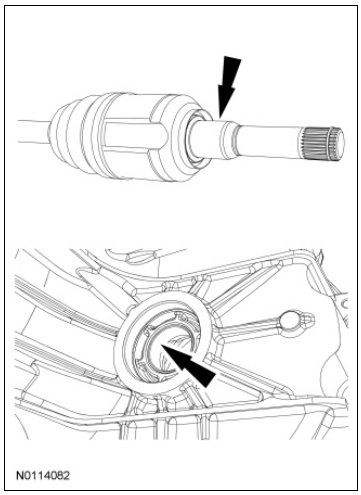


4. Using a suitable dent puller, remove the halfshaft seal.

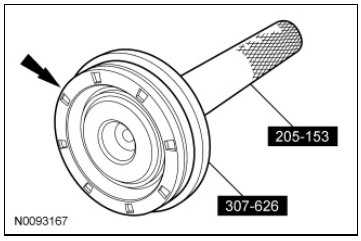


Installation

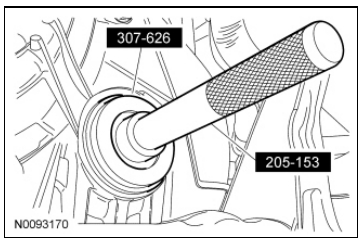
1. Inspect the bushing surface on the LH halfshaft and the LH halfshaft bushing in the transaxle case for damage or excessive wear. If the LH halfshaft or the LH halfshaft bushing shows signs of excessive wear or damage, inspect the transaxle case for damage. Install a new LH halfshaft. Install a new LH halfshaft bushing. For additional information, refer to Transaxle case bushing in this section.
    - If the LH halfshaft or the LH halfshaft bushing shows signs of excessive wear or damage but the transaxle case does not, install a new LH halfshaft. Install a new LH halfshaft bushing. For additional information, refer to Transaxle case bushing in this section.
    - If the transaxle case is damaged, install a new LH halfshaft. Install a new transaxle case. For additional information, refer to Transaxle - 2.5L or Transaxle - 3.0L and Transaxle in this section.
    - If the bushing is not damaged or worn excessively, clean the area behind the seal and install a new seal following this procedure.



2. Install a new halfshaft seal on the Differential Seal Installer and Handle.

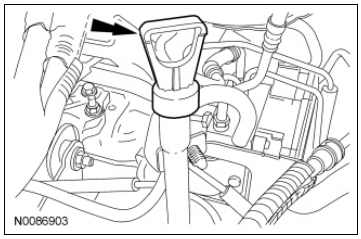


3. Using the Differential Seal Installer and Handle, install the LH halfshaft seal.



4. Install the front LH halfshaft. For additional information, refer to Section 205-04 .

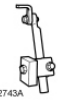
5. Fill the transaxle with clean transmission fluid.



6. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

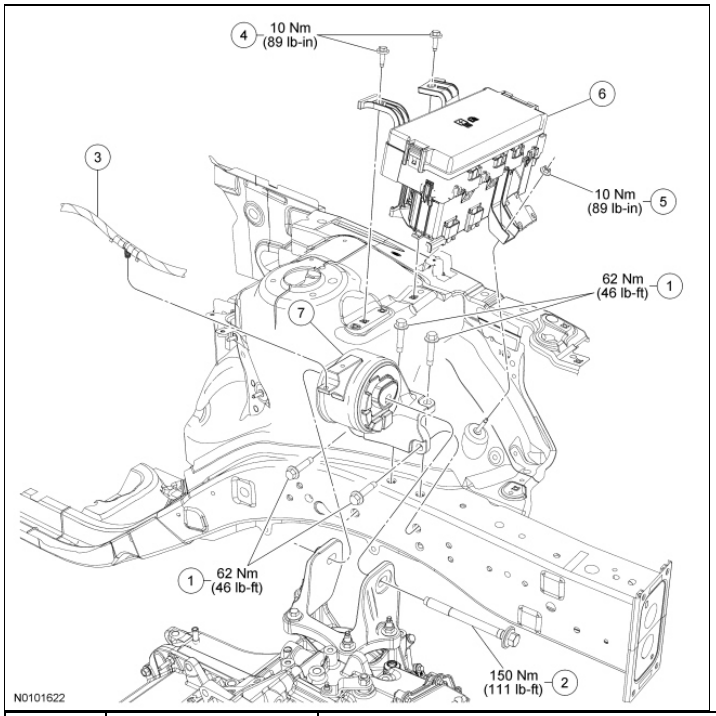
Transaxle Support Insulator - 3.0L

Special Tool(s)

 ST2793-A	Lifting Bracket, Engine 303-050 (T70P-6000)
 ST2363-A	Support Bar, Engine 303-F072
 ST2743A	Universal Adapter Brackets 014-0001

Material

Item	Specification
Threadlock and Sealer TA-25	WSK-M2G351-A5

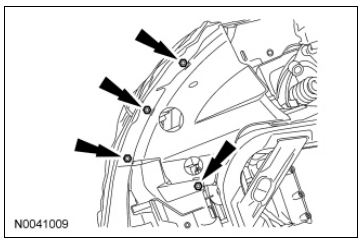


Item	Part Number	Description
1	W709234	Transaxle support insulator-to-frame rail bolts
2	W711873	Transaxle support insulator through bolt
3	13A506	Wiring harness retainer
4	W702434	Power Distribution Box (PDB) bolts

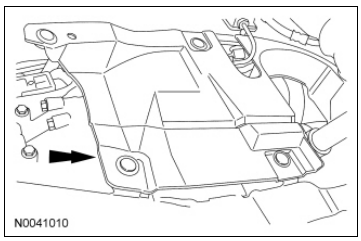
5	N806543	PDB nut
6	180101	PDB
7	6F020	Transaxle support insulator

Removal

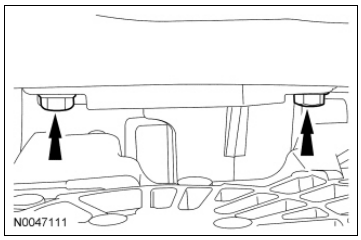
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the Air Cleaner (ACL) and the outlet pipe. For additional information, refer to Section 303-12B .
3. Remove the battery and battery tray. For additional information, refer to Section 414-01 .
4. Remove the 4 screws and position the LH fender splash shield aside.



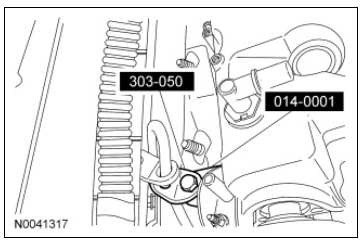
5. Remove the 6 pin-type retainers and the LH front structure-to-subframe splash shield.



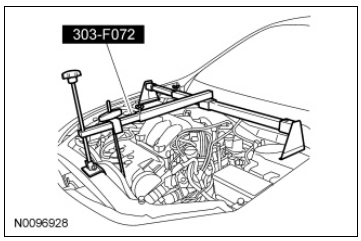
6. Remove the lower 2 transaxle insulator-to-frame bolts.



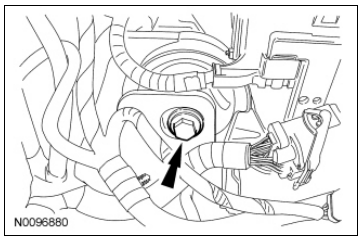
7. Remove the cooling fan motor and shroud. For additional information, refer to Section 303-03A .
8. Install the Engine Lifting Bracket and Universal Adapter Bracket "L" hook on the LH side of the engine.



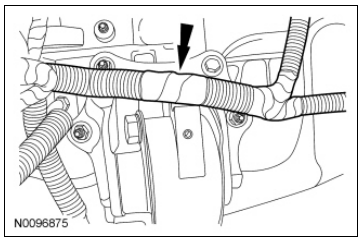
9. Install the Engine Support Bar to support the engine.



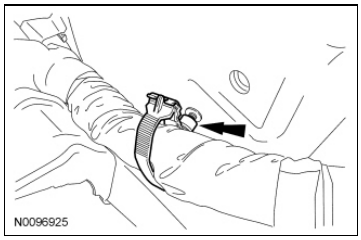
10. Remove the transaxle support insulator through bolt.



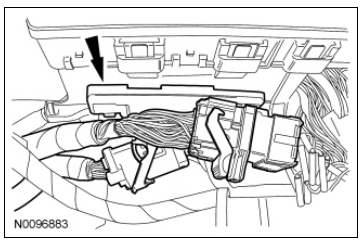
11. Remove the wiring harness retainer from the transaxle support insulator and position the wiring harness aside.



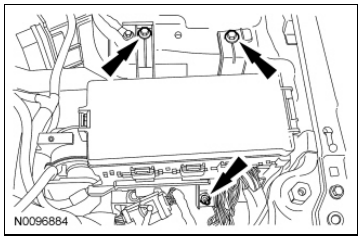
12. Disconnect the wiring harness retainer from the LH shock tower.



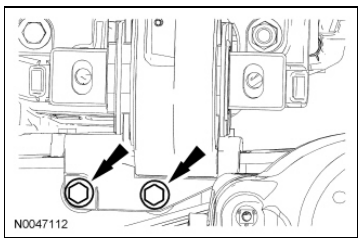
13. Remove the electrical connector bracket from the Battery Junction Box (BJB).



14. Remove the 2 bolts and the nut and position the BJB aside far enough to gain access to the top 2 transaxle support insulator bolts.



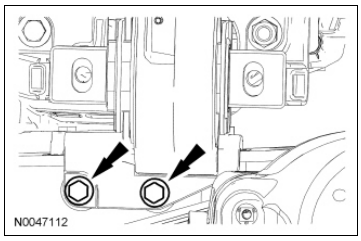
15. Remove the top 2 transaxle support insulator bolts and remove the transaxle support insulator.



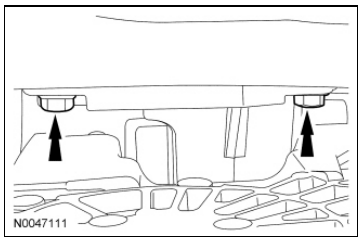
Installation

1. Clean the rear transaxle support insulator bolts using a wire brush and apply new threadlock to the threads.

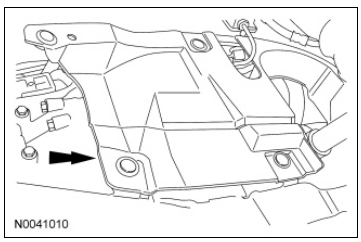
2. Position the transaxle support insulator in place and install the upper 2 transaxle support insulator bolts.
    - Tighten to 62 Nm (46 lb-ft).



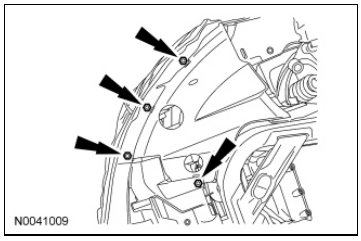
3. Install the lower 2 transaxle insulator-to-frame bolts.
    - Tighten to 62 Nm (46 lb-ft).



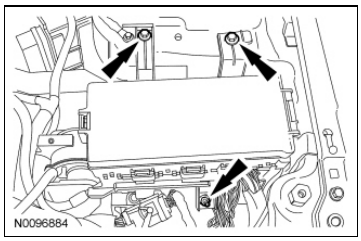
4. Position the LH front structure-to-subframe splash shield in place and install the 6 pin-type retainers.



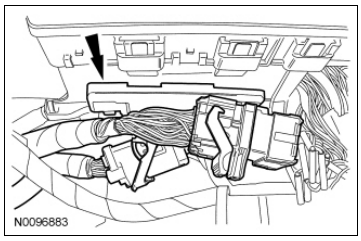
5. Position the LH splash shield in place and install the 4 screws.



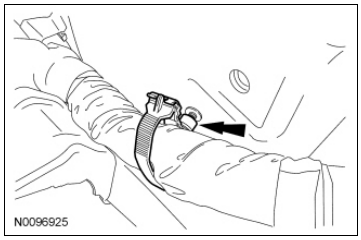
6. Position the BJB and bracket in place and install the 2 bolts and the nut.
    - Tighten to 10 Nm (89 lb-in).



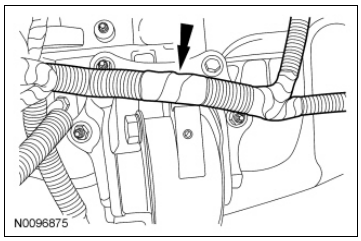
7. Install the electrical connector bracket on the BJB .



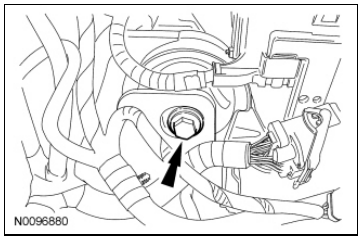
8. Connect the wiring harness retainer on the LH shock tower.



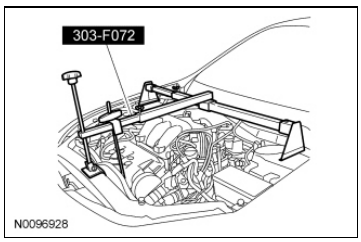
9. Position the wiring harness in place and install the retainer on the transaxle support insulator.



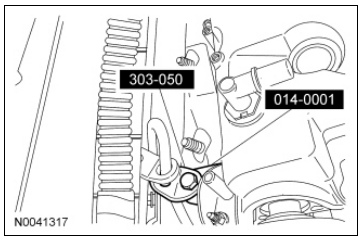
10. Install the through bolt.
    - Tighten to 150 Nm (111 lb-ft).



11. Remove the Engine Support Bar.



12. Remove the Engine Lifting Bracket and the Universal Adapter Bracket "L" hook from the from the LH side of the engine.



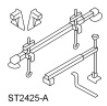
13. Install the cooling fan motor and shroud. For additional information, refer to Section 303-03A .

14. Install the battery and battery tray. For additional information, refer to Section 414-01 .

15. Install the ACL and the outlet pipe. For additional information, refer to Section 303-12B .

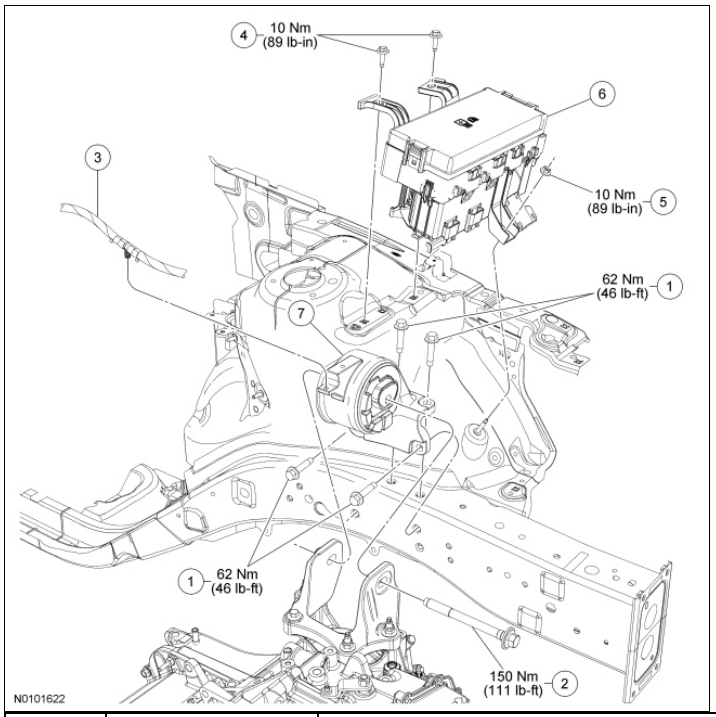
Transaxle Support Insulator - 2.5L

Special Tool(s)

 ST2425-A	Support Bar, Engine 303-F072

Material

Item	Specification
Threadlock and Sealer TA-25	WSK-M2G351-A5



Item	Part Number	Description
1	W709234	Transaxle support insulator-to-frame rail bolts
2	W711873	Transaxle support insulator through bolt
3	13A506	Wiring harness retainer
4	W702434	Power Distribution Box (PDB) bolts
5	N806543	PDB nut
6	180101	PDB
7	6F020	Transaxle support insulator

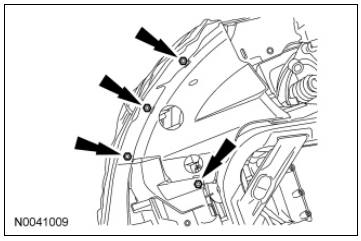
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

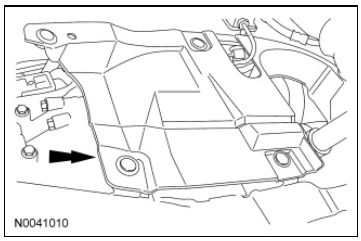
2. Remove the Air Cleaner (ACL) and the outlet pipe. For additional information, refer to Section 303-12A .

3. Remove the battery and battery tray. For additional information, refer to Section 414-01 .

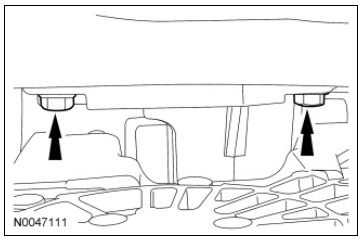
4. Remove the 4 screws and position the LH fender splash shield aside.



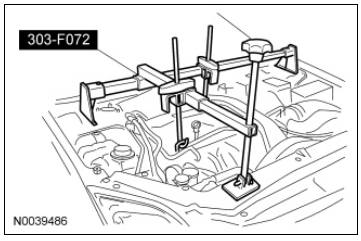
5. Remove the 6 pin-type retainers and the LH front structure-to-subframe splash shield.



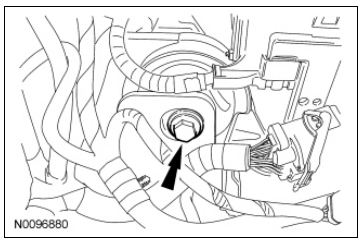
6. Remove the lower 2 transaxle insulator-to-frame bolts.



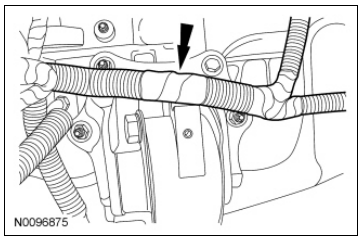
7. Using the Engine Support Bar, support the engine.



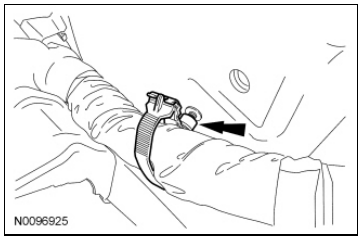
8. Remove the transaxle support insulator through bolt.



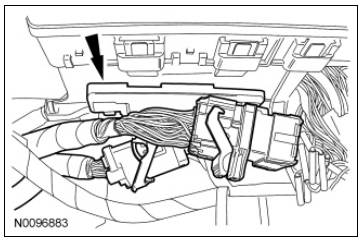
9. Remove the wiring harness retainer from the transaxle support insulator and position the wiring harness aside.



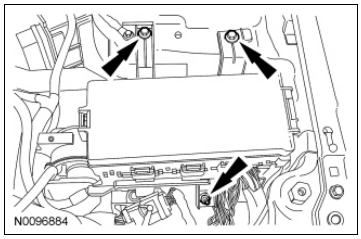
10. Disconnect the wiring harness retainer from the LH shock tower.



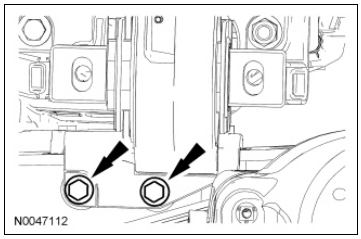
11. Remove the electrical connector bracket from the Battery Junction Box (BJB).



12. Remove the 2 bolts and the nut and position the BJB aside far enough to gain access to the top 2 transaxle support insulator bolts.



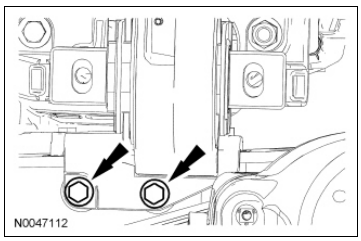
13. Remove the top 2 transaxle support insulator bolts and remove the transaxle support insulator.



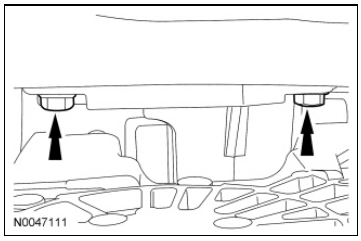
Installation

1. Clean the transaxle support insulator frame bolts using a wire brush and apply new threadlock to the threads.

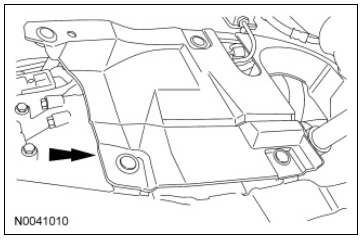
2. Position the transaxle support insulator in place and install the upper 2 transaxle support insulator bolts.
    - Tighten to 62 Nm (46 lb-ft).



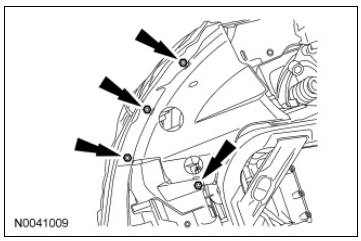
3. Install the lower 2 transaxle support insulator bolts.
    - Tighten to 62 Nm (46 lb-ft).



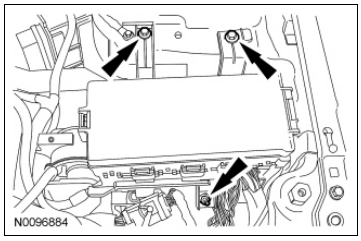
4. Position the LH front structure-to-subframe splash shield in place and install the 6 pin-type retainers.



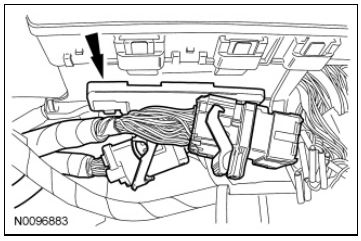
5. Position the LH splash shield in place and install the 4 screws.



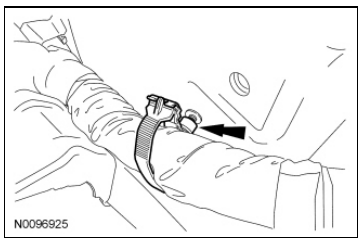
6. Position the BJB and bracket in place and install the 2 bolts and the nut.
    - Tighten to 10 Nm (89 lb-in).



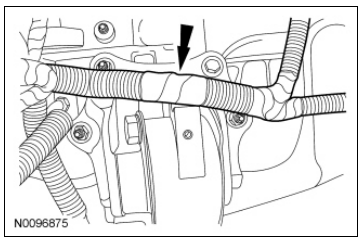
7. Install the electrical connector bracket on the BJB .



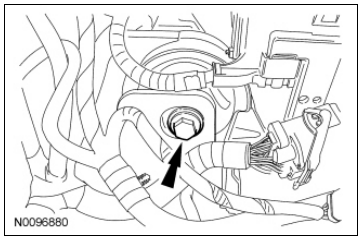
8. Connect the wiring harness retainer on the LH shock tower.



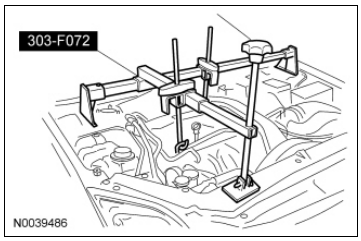
9. Position the wiring harness in place and install the retainer on the transaxle support insulator.



10. Install the through bolt.
    - Tighten to 150 Nm (111 lb-ft).



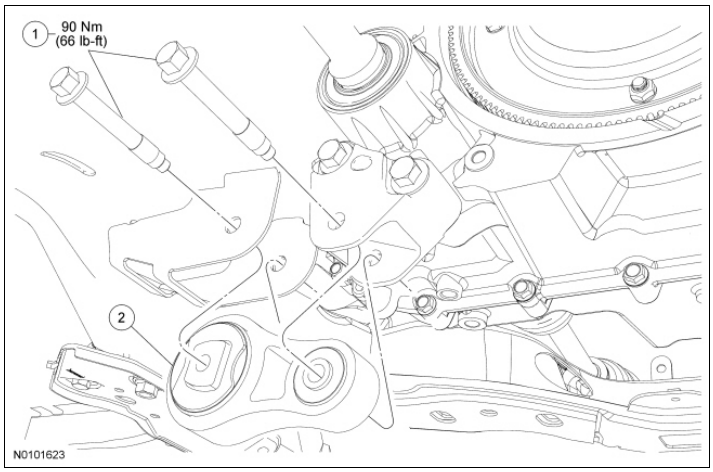
11. Remove the Engine Support Bar.



12. Install the battery and battery tray. For additional information, refer to Section 414-01 .

13. Install the ACL and the outlet pipe. For additional information, refer to Section 303-12A .

Transaxle Support Insulator - Anti-Roll



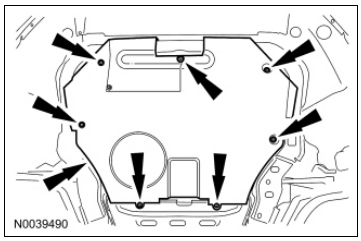
Item	Part Number	Description
1	W711575	Roll restrictor bolts
2	6P082	Roll restrictor

Removal

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the screws and the underbody cover.

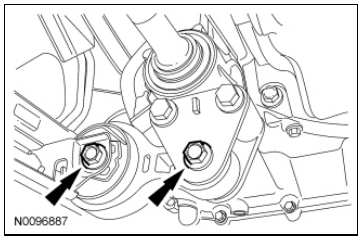


Vehicles equipped with a 3.0L engine

3. Remove the Y-pipe. For additional information, refer to Section 309-00 .

All vehicles

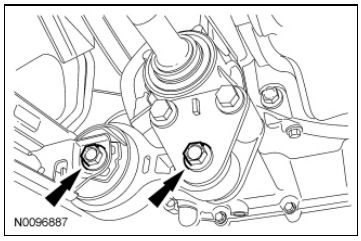
4. Remove the 2 bolts and remove the roll restrictor.



Installation

All vehicles

1. Position the roll restrictor in place and install the bolts.
    - Tighten to 90 Nm (66 lb-ft).

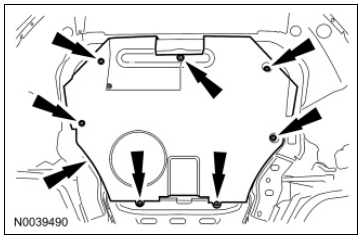


Vehicles equipped with a 3.0L engine

2. Install the Y-pipe. For additional information, refer to Section 309-00 .

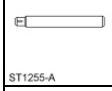
All vehicles

3. Install the underbody cover and the screws.



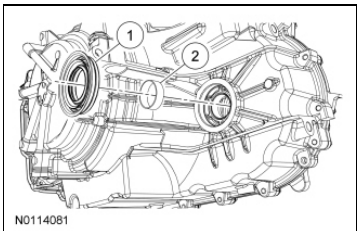
Transaxle Case Bushing

Special Tool(s)

 ST1255-A	Handle 205-153 (T80T-4000-W)
 ST3070-A	Installer, Seal 307-626
 ST1652-A	Step Plate 205-D015 (D80L-630-4) or equivalent
 ST1194-A	Remover, Transmission Extension Housing Bushing 308-070 (T77L-7697-E)
 ST3229-A	Installer, Bushing 307-664

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV



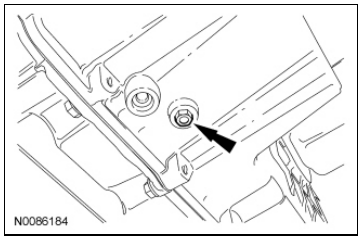
Item	Part Number	Description
1	1177	LH halfshaft seal
2	7025	LH halfshaft bushing

Removal

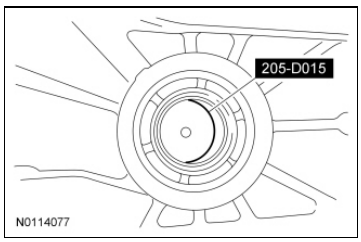
1. Remove the fronH halfshaft seal. For additional information, refer to Halfshaft Seal - LH in this section.

2. **NOTE:** Leave the drain plug out after the transmission fluid drains. The drain plug will need to remain out to clean any debris from the damaged or worn bushing.

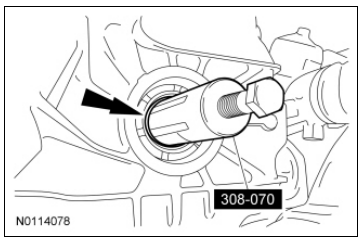
   Remove the drain plug and drain the transmission fluid.



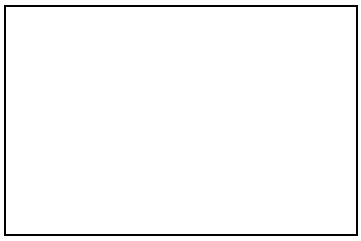
3. Install the Step Plate in the differential carrier.



4. Using the Transmission Extension Housing Bushing Remover remove the LH halfshaft bushing.



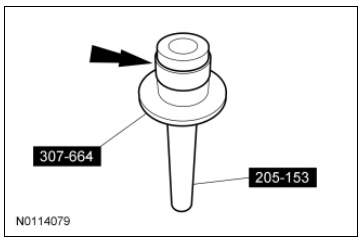
5. Remove the Step Plate from the differential carrier.



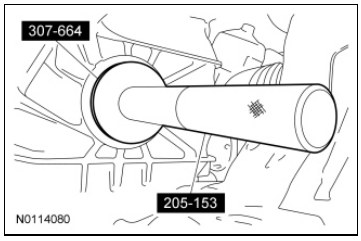
Installation

1. Clean the halfshaft bushing area of the transaxle case.

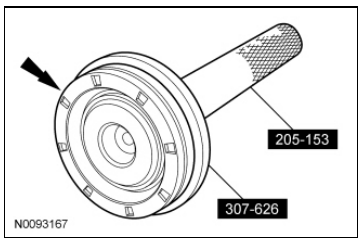
2. Assemble the Handle and the Bushing Installer and install a new bushing on the Bushing Installer.



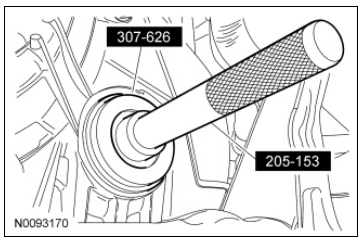
3. Using the Handle and the Bushing Installer, install a new bushing in the transaxle case.



4. Install a new halfshaft seal on the Seal Installer and Handle.

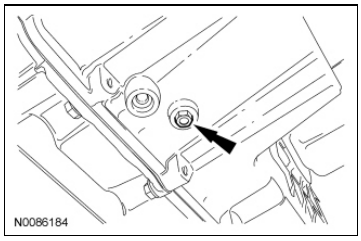


5. Using the Seal Installer and Handle, install the LH halfshaft seal.

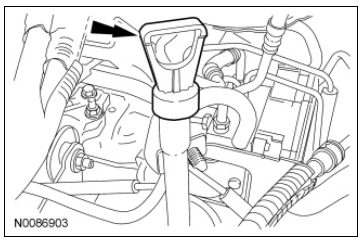


6. Install a new LH halfshaft. For additional information, refer to Section 205-04 .

7. Install the transmission fluid drain plug.
   - Tighten to 12 Nm (106 lb-in).



8. Fill the transaxle with clean transmission fluid. For additional information, refer to Transmission Fluid Drain and Refill in this section.



9. Start the engine and let it run for 5 minutes.

10. Remove the transmission fluid drain plug and drain the transmission fluid a second time.

11. Install the transmission fluid drain plug.

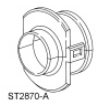
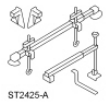
- Tighten to 12 Nm (106 lb-in).

12. Fill the transaxle with clean transmission fluid.

13. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

Transaxle - 2.5L

Special Tool(s)

 ST2870-A	Disconnect Tool, Transmission Cooler Line 307-569
 ST1293-A	Powertrain Lift With Tilting Plate 300-OTC-1585AE
 ST1636-A	Retainer, Torque Converter 307-566
 ST2425-A	Support Bar, Engine 303-F072

Removal

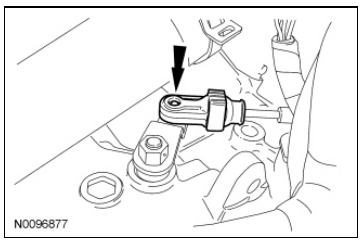
NOTE: Refer to the Transmission Cooler Flushing Job Aid on the FMCDealer website.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

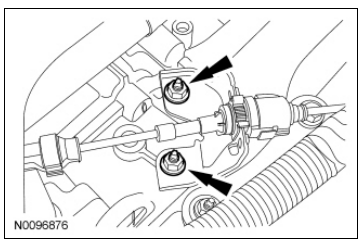
2. Remove the Air Cleaner (ACL) and the outlet pipe. For additional information, refer to Section 303-12A .

3. Remove the battery and battery tray. For additional information, refer to Section 414-01 .

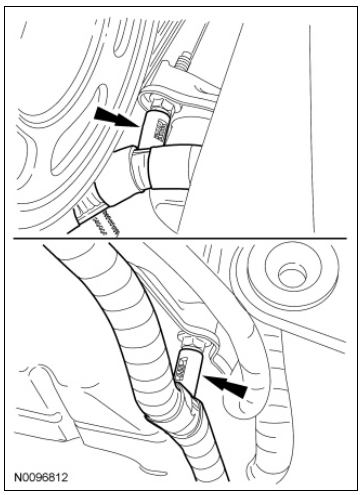
4. Disconnect the selector lever cable end from the manual control lever.



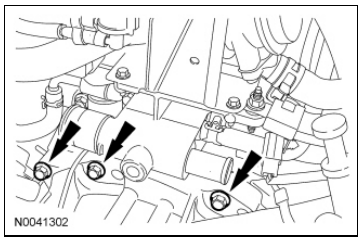
5. Remove the 2 nuts and position the selector lever cable and bracket aside.



6. Disconnect the wiring harness retainers from the main control cover studbolts.

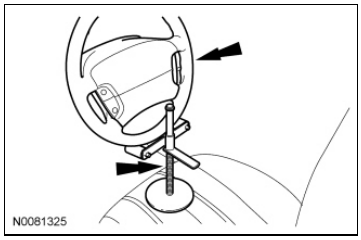


7. Remove the 3 top bellhousing bolts.

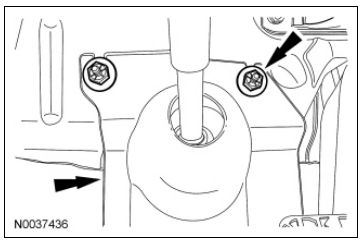


8. **NOTE:** Use a steering wheel holding device such as Hunter® 28-75-1 or equivalent, to hold the steering wheel.

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.

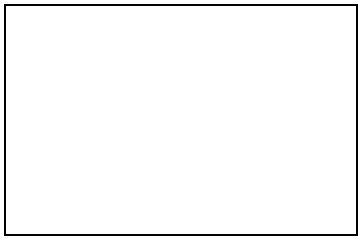


9. Remove the 2 nuts and the steering joint cover.

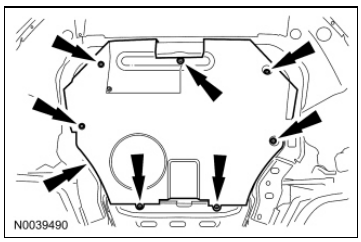


10. ***NOTICE:*** **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

    Remove and discard the bolt and disconnect the steering column shaft from the steering gear.

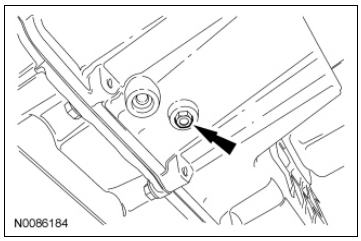


11. If equipped, remove the 7 screws and the underbody cover.

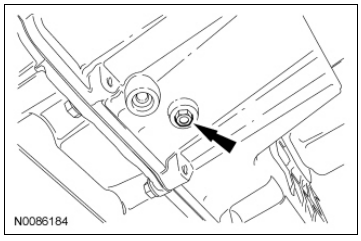


12. **NOTE:** If transaxle disassembly or installation of a new transaxle is necessary, drain the transmission fluid.

    Remove the drain plug and allow the transmission fluid to drain.

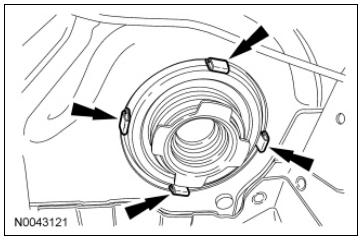


13. Install the transmission fluid drain plug.
    - Tighten to 12 Nm (106 lb-in).

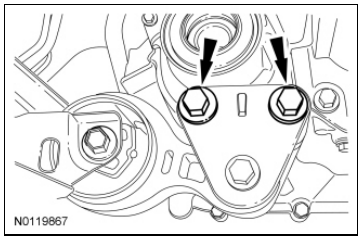


14. ***NOTICE:*** **Remove the steering gear/dash seal or damage to the seal may occur.**

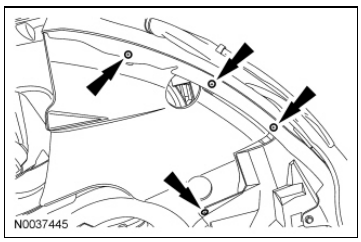
    Release the 4 clips and slide the steering gear/dash seal off of the steering gear.



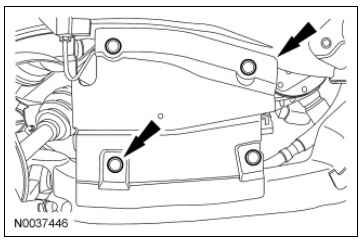
15. Remove the 2 roll restrictor bracket bolts.



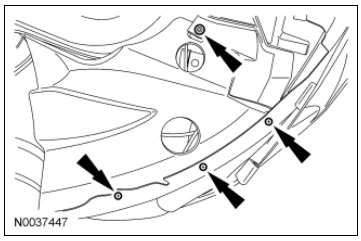
16. Remove the 4 screws and position the RH fender splash shield aside.



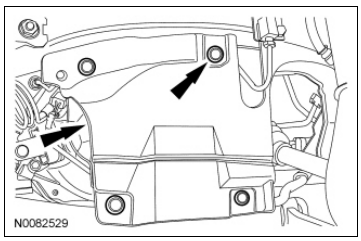
17. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



18. Remove the 4 screws and position the LH fender splash shield aside.

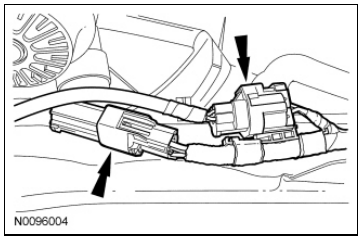


19. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.

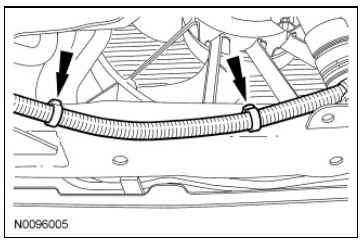


20. Remove the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

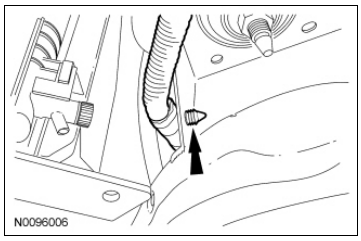
21. Disconnect the 2 in-line Electronic Power Assist Steering (EPAS) system electrical connectors at the front of the subframe.



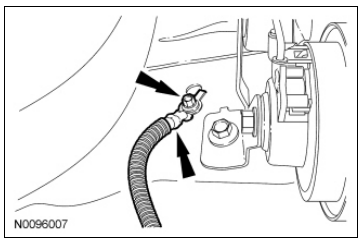
22. Detach the 2 EPAS system wiring harness pin-type retainers from the subframe.



23. Detach the EPAS system wiring harness pin-type retainer from the subframe under the LH fender splash shield.

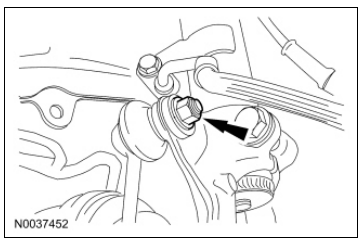


24. Remove the bolt and the EPAS system wiring harness ground from behind the RH splash shield.

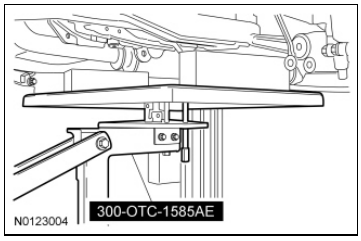


25. **NOTE:** LH shown, RH similar.

    Remove the nuts and separate the sway bar links from the struts.

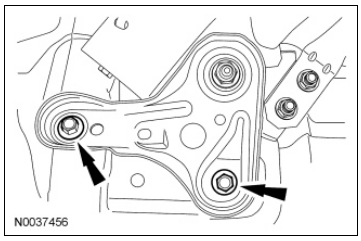


26. Position the Powertrain Lift With Tilting Plate under the subframe assembly.



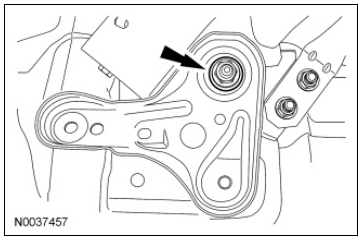
27. **NOTE:** LH shown, RH similar.

    Remove the subframe bracket-to-body bolts.



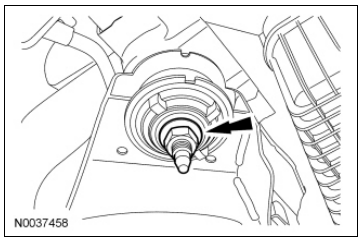
28. **NOTE:** LH shown, RH similar.

    Remove the subframe nuts and the subframe brackets.



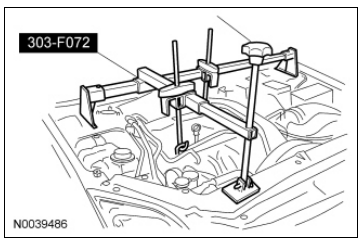
29. **NOTE:** LH shown, RH similar.

    Remove the front subframe nuts.

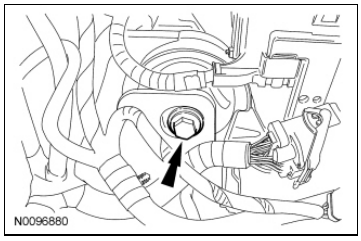


30. Lower the subframe assembly from the vehicle.

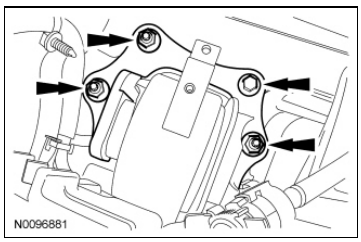
31. Install the Engine Support Bar and support the engine and transaxle.



32. Remove the transaxle support insulator through bolt and lower the transaxle 19 mm (0.748 in).

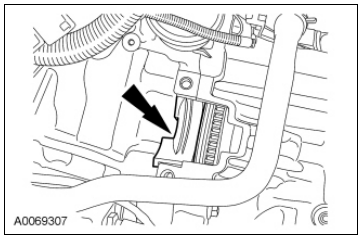


33. Remove the 3 nuts, the bolt and remove the transaxle support insulator bracket.



34. Remove the starter motor. For additional information, refer to Section 303-06 .

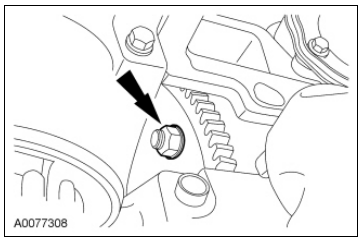
35. Remove the rubber insulator from the bellhousing.



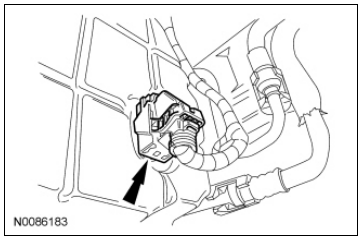
36. ***NOTICE:*** **Only rotate the engine in a clockwise direction or engine damage will occur.**

    NOTE: Mark one stud and the flexplate for assembly reference.

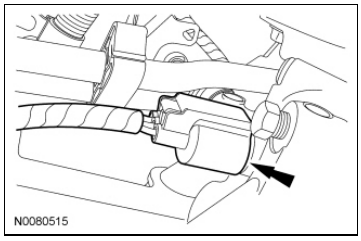
    Remove and discard the 4 torque converter nuts.



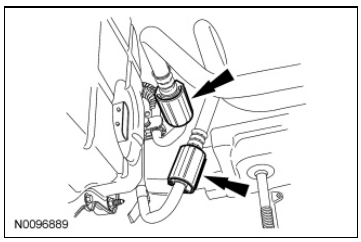
37. Disconnect the transaxle main electrical connector.



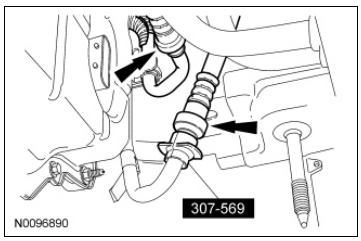
38. Disconnect the Turbine Shaft Speed (TSS) electrical connector.



39. Remove the transmission fluid cooler tube secondary latches.

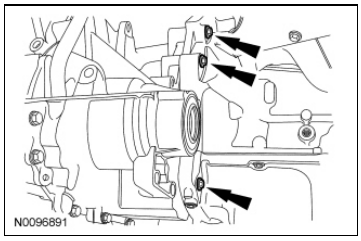


40. Using the Transmission Cooler Line Disconnect Tool, disconnect the transmission fluid cooler tubes.

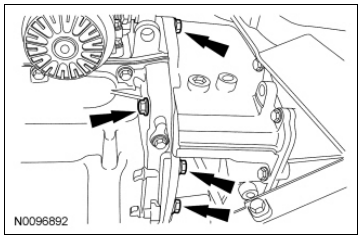


41. Support the transaxle with a suitable transmission jack. Secure the transaxle to the transmission jack with a safety strap.

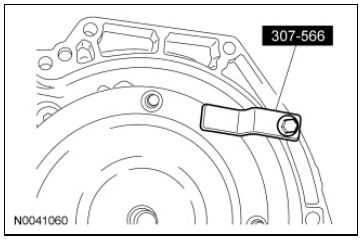
42. Remove the 3 rear torque converter housing bolts.



43. Remove the 4 front torque converter housing bolts.

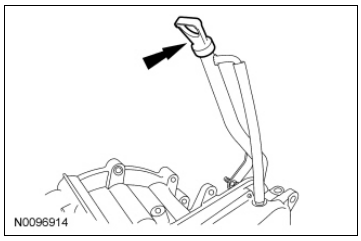


44. Separate the transaxle from the engine and install the Torque Converter Retainer.

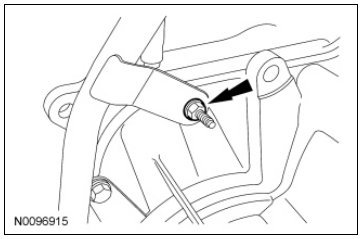


45. Remove the transaxle from the vehicle.

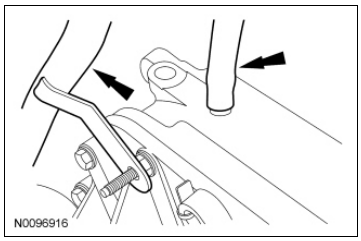
46. Remove the transmission fluid level indicator.



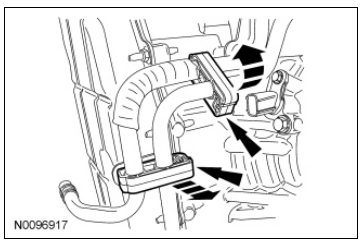
47. Remove the transmission fluid filler tube nut.



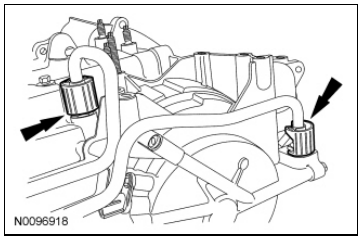
48. Remove the transaxle vent tube from the transaxle case and remove the transmission fluid filler tube.



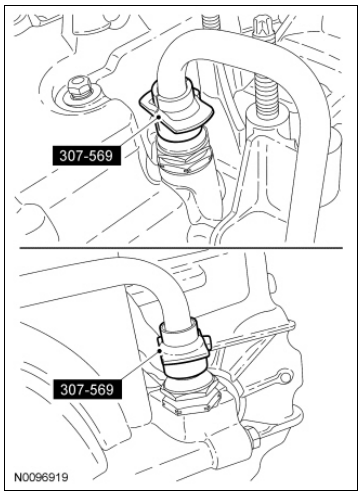
49. Open the transmission fluid cooler tube retainers.



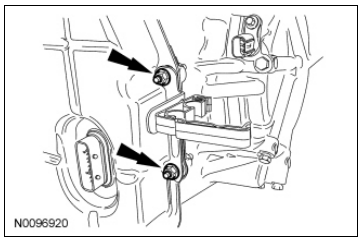
50. Remove the 2 secondary latches.



51. Using the Transmission Cooler Line Disconnect Tool, disconnect and remove the transmission fluid cooler tubes from the transaxle.



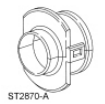
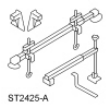
52. Remove the 2 nuts and remove the transmission fluid cooler tube bracket.



53. If installing a new transaxle or overhauling the transaxle, the transmission fluid cooler will need to be backflushed and cleaned. Carry out transmission fluid cooler backflushing and cleaning. For additional information, refer to Transmission Fluid Cooler Backflushing and Cleaning in this section. Clean the transaxle-mounted transmission fluid cooler tubes by hand.

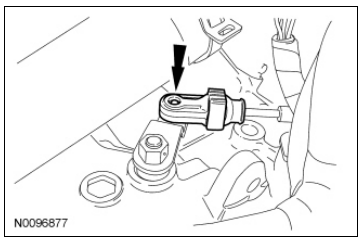
Transaxle - 3.0L

Special Tool(s)

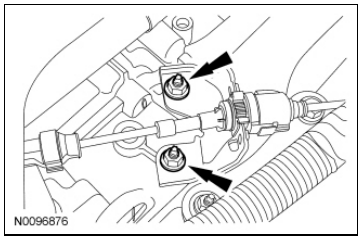
 ST2870-A	Disconnect Tool, Transmission Cooler Line 307-569
 ST2873-A	Engine Lifting Bracket Set 303-1140
 ST2793-A	Lifting Bracket, Engine 303-050 (T70P-6000)
 ST1293-A	Powertrain Lift 014-00765 or equivalent
 ST1636-A	Retainer, Torque Converter 307-566
 ST2425-A	Support Bar, Engine 303-F072

All vehicles

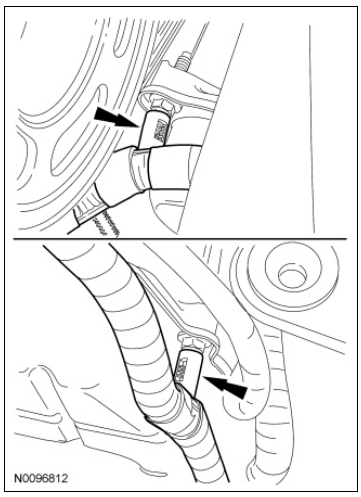
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the Air Cleaner (ACL) and the outlet pipe. For additional information, refer to Section 303-12B .
3. Remove the starter motor. For additional information, refer to Section 303-06 .
4. Disconnect the selector lever cable end from the manual control lever.


N0096877

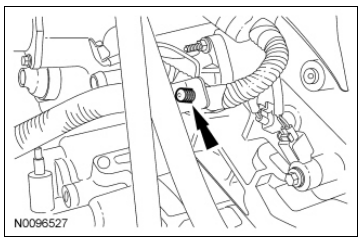
5. Remove the 2 nuts and position the selector lever cable and bracket aside.



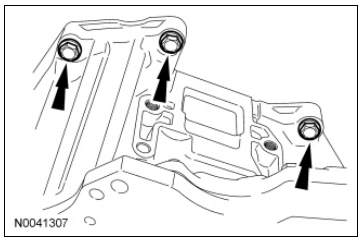
6. Disconnect the wiring harness retainers from the main control cover stud bolts.



7. Disconnect the wiring harness retainer from the transmission fluid filler tube.

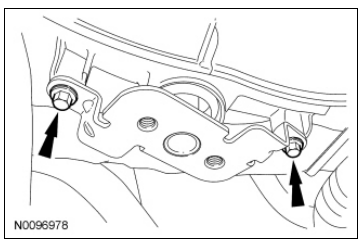


8. Remove the 3 upper torque converter housing bolts.

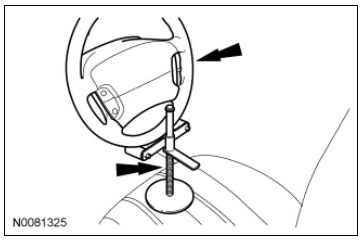


9. Remove the EGR valve and tube. For additional information, refer to Section 303-08B .

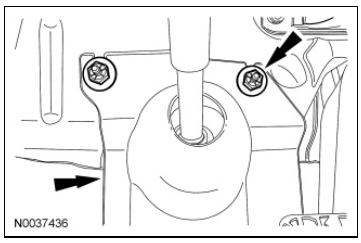
10. Remove the 2 bolts and the EGR valve bracket.



11. **NOTE:** Use a steering wheel holding device such as Hunter® 28-75-1 or equivalent, to hold the steering wheel. Using a suitable holding device, hold the steering wheel in the straight-ahead position.

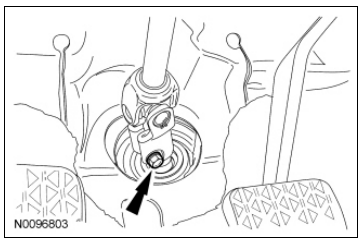


12. Remove the 2 nuts and the steering joint cover.

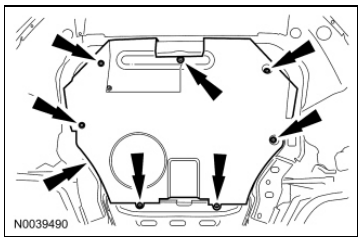


13. ***NOTICE:*** **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

    Remove and discard the bolt and disconnect the steering column shaft from the steering gear.

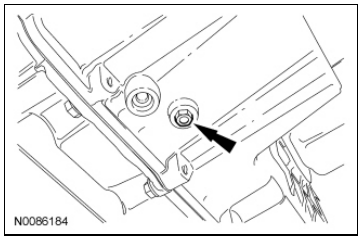


14. If equipped, remove the 7 screws and the underbody cover.

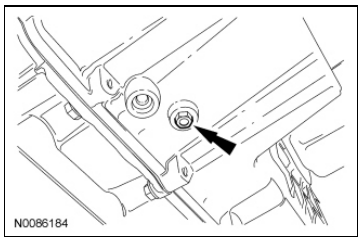


15. **NOTE:** If transaxle disassembly or installation of a new transaxle is necessary, drain the transmission fluid.

    Remove the drain plug and allow the transmission fluid to drain.

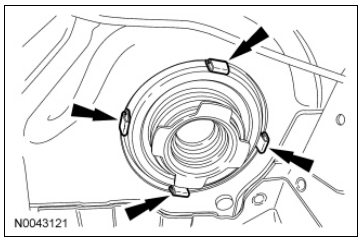


16. Install the transmission fluid drain plug.
    - Tighten to 12 Nm (106 lb-in).

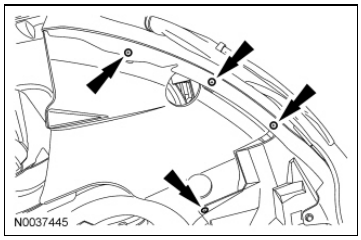


17. ***NOTICE:*** **Remove the steering gear/dash seal or damage to the seal may occur.**

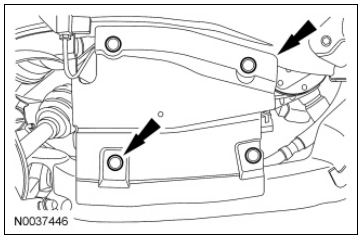
    Release the 4 clips and slide the steering gear/dash seal off of the steering gear.



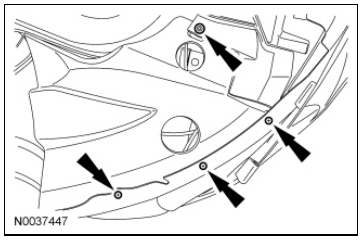
18. Remove the 4 screws and position the RH fender splash shield aside.



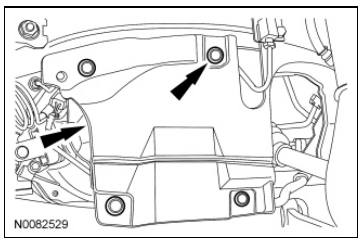
19. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



20. Remove the 4 screws and position the LH fender splash shield aside.



21. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.



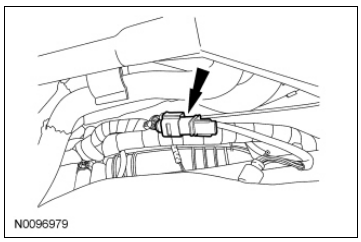
22. Remove the LH halfshaft. For additional information, refer to Section 205-04 .

Front Wheel Drive (FWD) vehicles

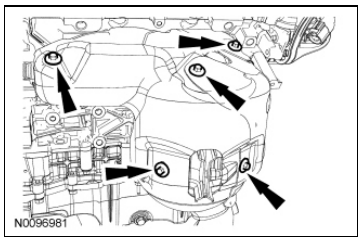
23. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .

24. Remove the intermediate shaft. For additional information, refer to Section 205-04 .

25. Disconnect the RH O2 sensor electrical connector.



26. Remove the 5 bolts and position the RH exhaust manifold heat shield aside.

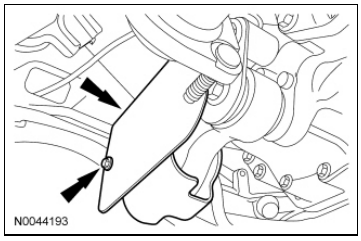


All-Wheel Drive (AWD) vehicles

27. Remove the Power Transfer Unit (PTU). For additional information, refer to Section 308-07B .

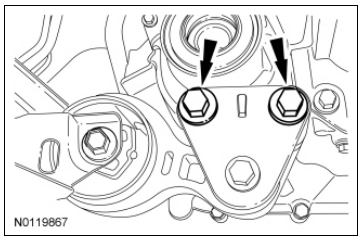
All vehicles

28. If equipped, remove the 2 bolts and the heat shield.

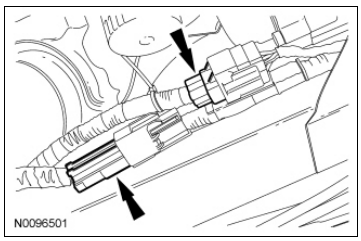


29. **NOTE:** Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.

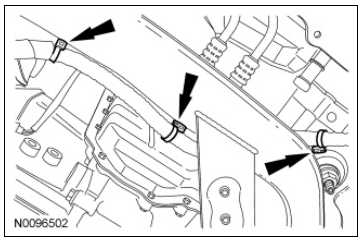
    Remove the 2 roll restrictor bracket bolts.



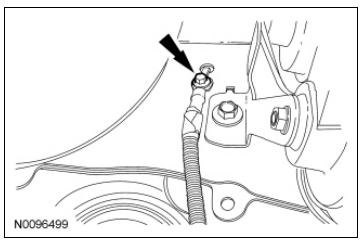
30. Disconnect the 2 in-line EPAS system electrical connectors at the front of the subframe.



31. Detach the 3 wiring harness retainers from the LH front of the subframe.

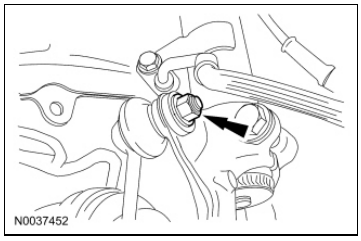


32. Remove the bolt and the Electronic Power Assist Steering (EPAS) system wiring harness ground from behind the RH splash shield.

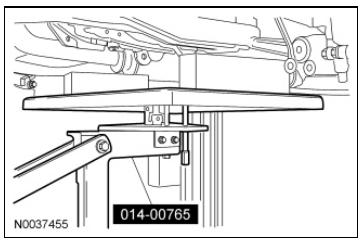


33. **NOTE:** RH shown, LH similar.

    Remove the nuts and separate the stabilizer bar links from the struts.

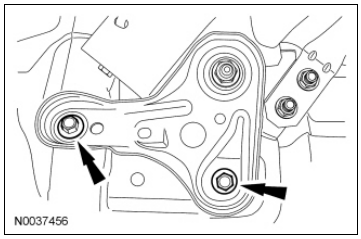


34. Position the Powertrain Lift under the subframe assembly.



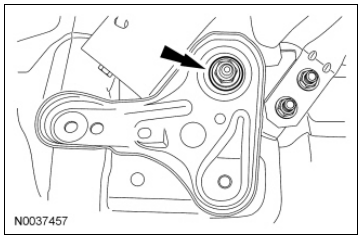
35. **NOTE:** LH shown, RH similar.

    Remove the subframe bracket-to-body bolts.



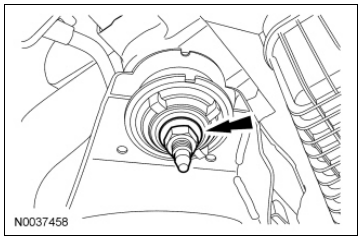
36. **NOTE:** LH shown, RH similar.

    Remove the subframe nuts and the subframe brackets.



37. **NOTE:** LH shown, RH similar.

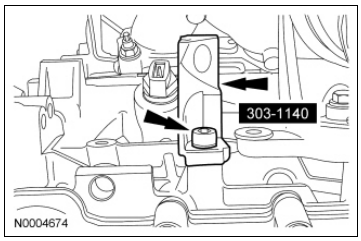
    Remove the front subframe nuts.



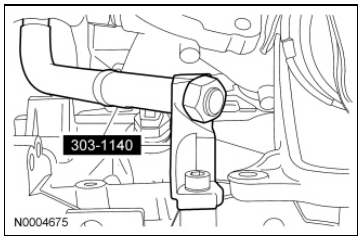
38. Lower the subframe assembly from the vehicle.

39. **NOTE:** When installing the Engine Lifting Bracket Set, it will be easier to loosely install the upper bolt first, then install the lower bolt.

    Install the lower half of the Engine Lifting Bracket Set.

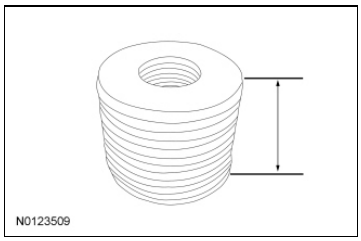


40. Install the upper half of the Engine Lifting Bracket Set.



41. **NOTE:** The washers are used to space the Engine Lifting Bracket far enough from the RH cylinder head so that the Engine Support Bar can clear the RH valve cover. The washers used must fit on a 12 mm X 1.75 bolt.

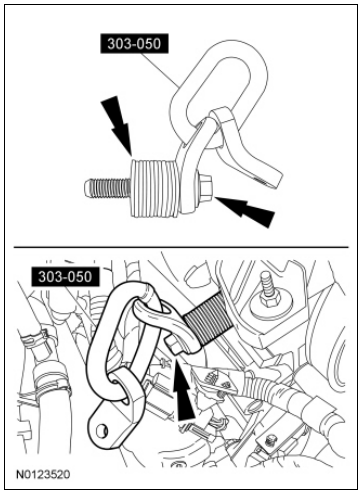
    Stack washers together to reach a 25.4 mm (1 in) to 28.575 mm (1.125 in) height.



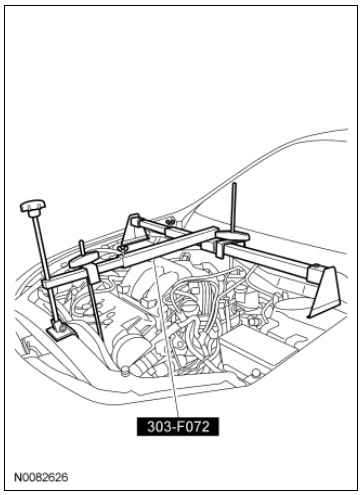
42. **NOTE:** The bolt hole in the LH cylinder head that is used to install the Engine Lifting Bracket is a 12 mm X 1.75 thread.

    NOTE: The bolt used to install the Engine Lifting Bracket must be between 65 mm (2.5 in) and 70 mm (2.75 in) long.

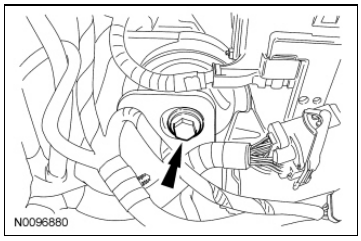
    Assemble a 12 mm X 1.75 bolt with the Engine Lifting Bracket and the washers and install the bolt in the threaded hole on the LH cylinder head with the lifting hook facing up.



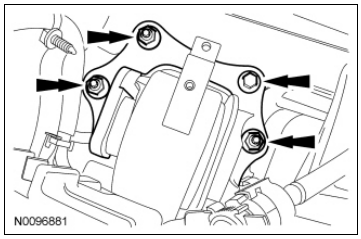
43. Install the Engine Support Bar to support the engine.



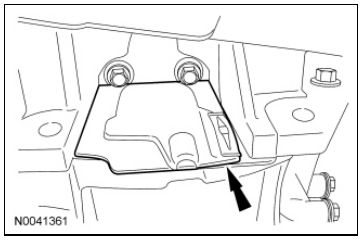
44. Remove the transaxle support insulator through bolt and lower the transaxle 19 mm (0.748 in).



45. Remove the 3 nuts, the bolt and remove the transaxle support insulator bracket.

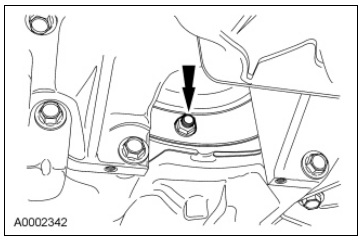


46. Remove the inspection cover.

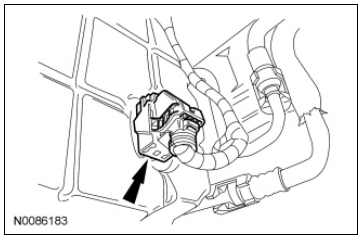


47. **NOTE:** Mark one stud and the flexplate for assembly reference.

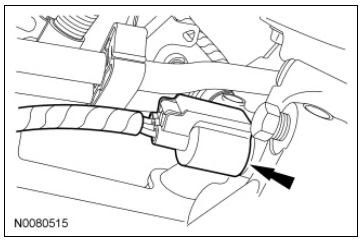
    Remove and discard the 4 torque converter nuts.



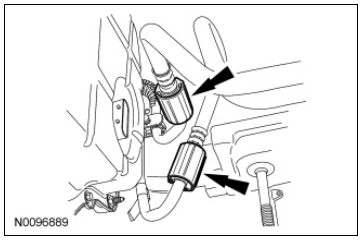
48. Disconnect the transaxle main electrical connector.



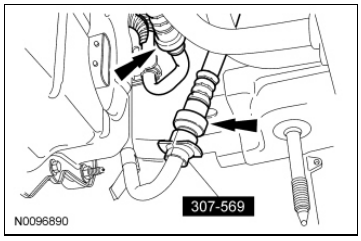
49. Disconnect the Turbine Shaft Speed (TSS) sensor electrical connector.



50. Remove the transmission fluid cooler tube secondary latches.

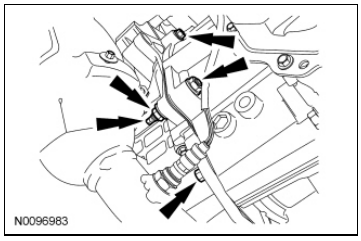


51. Using the Transmission Cooler Line Disconnect Tool, disconnect the transmission fluid cooler tubes.

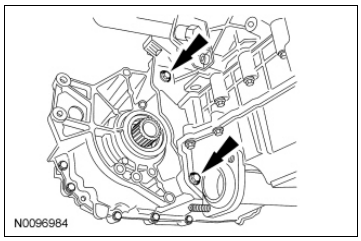


52. Support the transaxle with a suitable transmission jack. Secure the transaxle to the transmission jack with a safety strap.

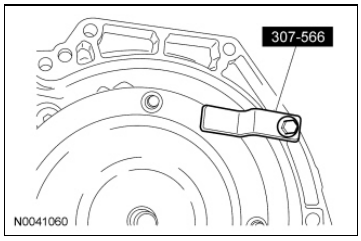
53. Remove the 2 bolts, 2 nuts and the stud from the front of the torque converter housing.



54. Remove the 2 back torque converter housing bolts and remove the transaxle from the dowel pins.

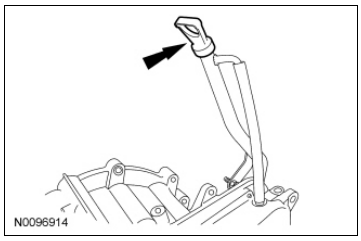


55. Separate the transaxle from the engine and install the Torque Converter Retainer.

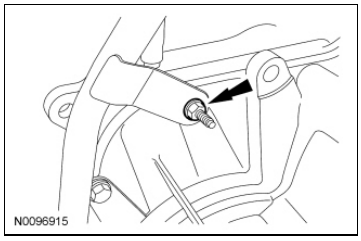


56. Remove the transaxle from the vehicle.

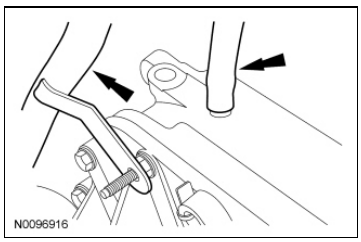
57. Remove the transmission fluid level indicator.



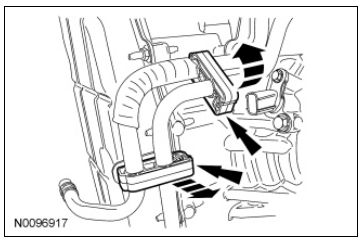
58. Remove the transmission fluid filler tube nut.



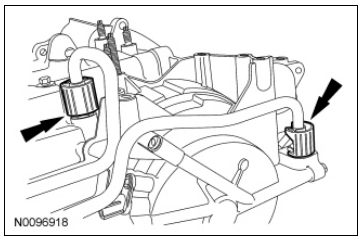
59. Remove the transaxle vent tube from the transaxle case and remove the transmission fluid filler tube.



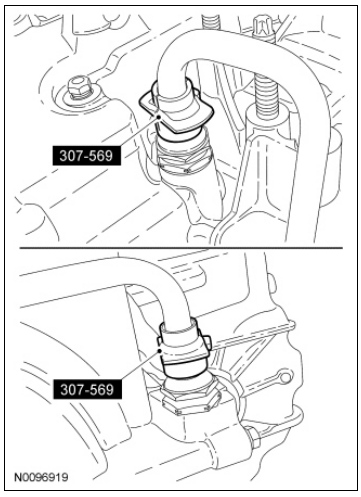
60. Open the transmission fluid cooler tube retainers.



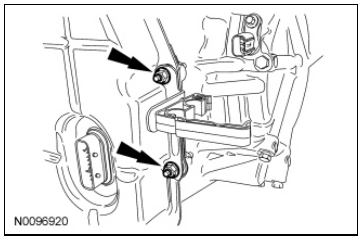
61. Remove the 2 secondary latches.



62. Using the Transmission Cooler Line Disconnect Tool, disconnect and remove the transmission fluid cooler tubes from the transaxle.



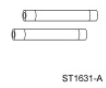
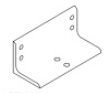
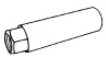
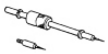
63. Remove the 2 nuts and remove the transmission fluid cooler tube bracket.



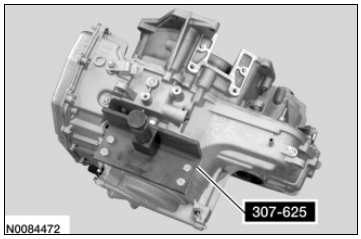
64. If installing a new transaxle, the transmission fluid cooler will need to be backflushed and cleaned. Carry out transmission fluid cooler backflushing and cleaning. For additional information, refer to Transmission Fluid Cooler Backflushing and Cleaning in this section.

Transaxle

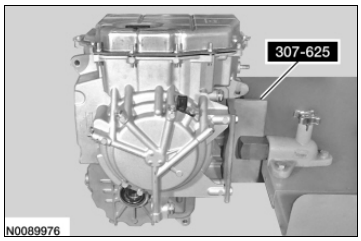
Special Tool(s)

 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST3069-A	Holding Fixture 307-625
 ST1515-A	Installer, Wheel Speed Sensor Ring 206-084/2
 ST1634-A	Remover, Roll Pin 211-061 (T78P-3504-N1)
 ST1636-A	Retainer, Torque Converter 307-566

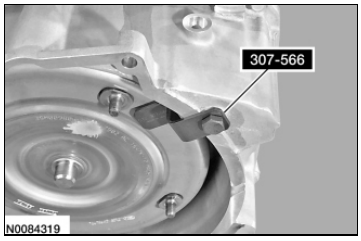
1. Install the Holding Fixture 307-625.



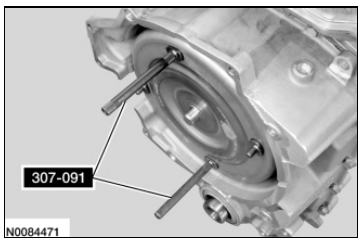
2. Using the Holding Fixture 307-625, install the transaxle on a bench-mounted holding fixture.



3. Remove the Torque Converter Retainer 307-566.

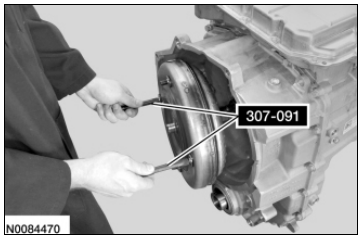


4. Install the Torque Converter Handle 307-091.



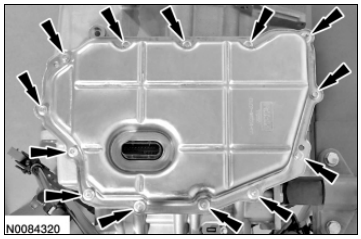
5. ***NOTICE:*** **The torque converter is heavy. Be careful not to drop it or damage will result.**

   Using Torque Converter Handle 307-091, remove the torque converter from the transaxle.

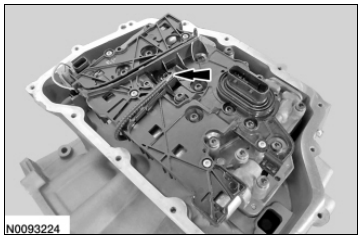


6. **NOTE:** Note the location of the stud bolts for assembly.

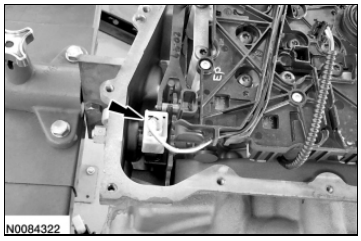
   Remove the 13 bolts and the main control cover.



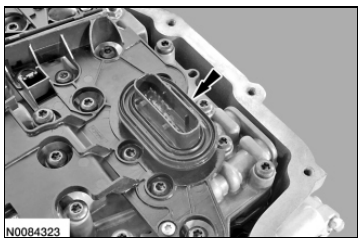
7. Disconnect the Output Shaft Speed (OSS) sensor electrical connector.



8. Disconnect the Transmission Range (TR) sensor electrical connector.

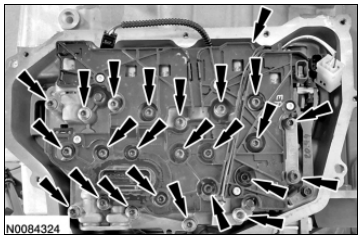


9. Remove the solenoid body-to-main control cover grommet.

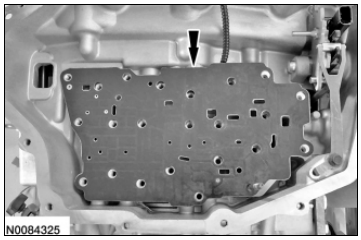


10. **NOTE:** Note the location of the short and long main control bolts for reassembly.

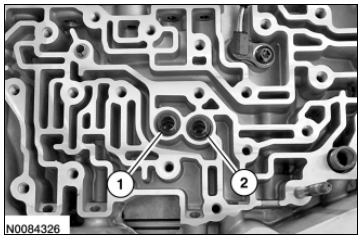
    Remove the nut and the 22 Torx bolts and remove the main control assembly.



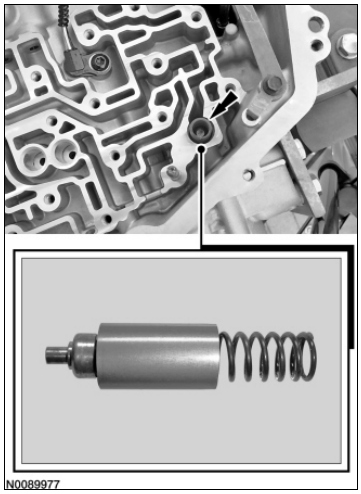
11. Remove and discard the main control-to-transaxle case separator plate.



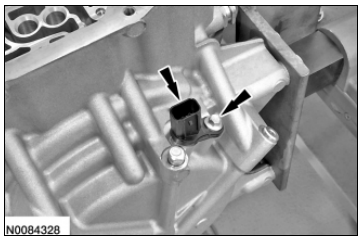
12. Remove and discard the forward (1, 2, 3, 4) clutch and low/reverse clutch transaxle case-to-center support seals.
    1. Forward (1, 2, 3, 4) clutch transaxle case-to-center support seal.
    2. Low/reverse clutch transaxle case-to-center support seal.



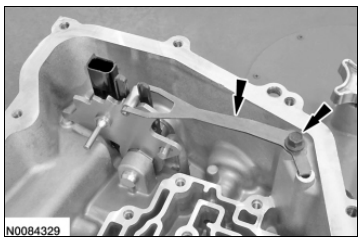
13. Remove the internal cooler bypass spring, sleeve and valve.



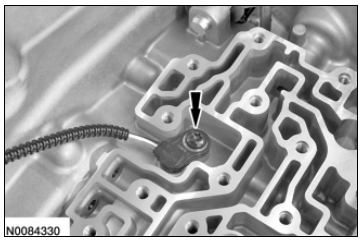
14. Remove the bolt and the Turbine Shaft Speed (TSS) sensor.



15. Remove the bolt and the TR sensor detent spring.

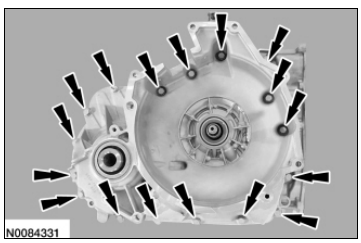


16. Remove the bolt and the OSS sensor.

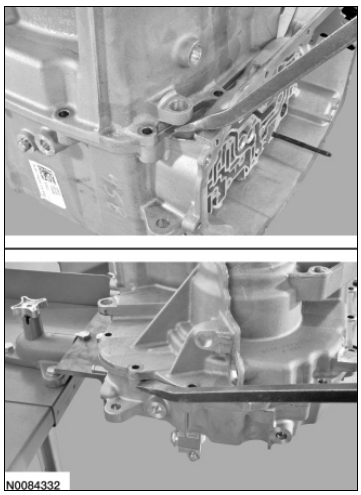


17. **NOTE:** Note the location of the stud bolts for assembly.

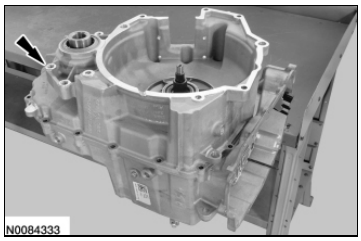
    Remove the 17 torque converter housing bolts.



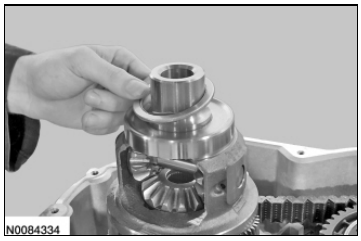
18. Using a suitable tool, pry the torque converter housing loose from the transaxle case.



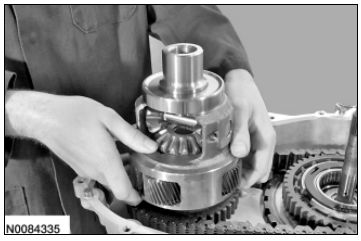
19. Remove the torque converter housing from the transaxle case.



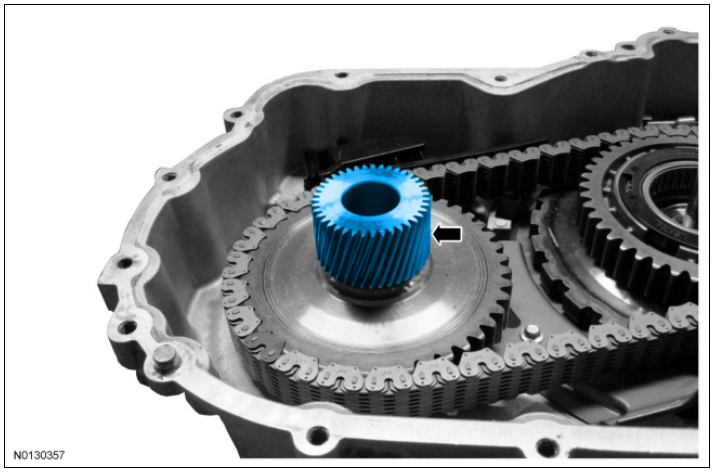
20. Remove the No. 15 differential thrust bearing.



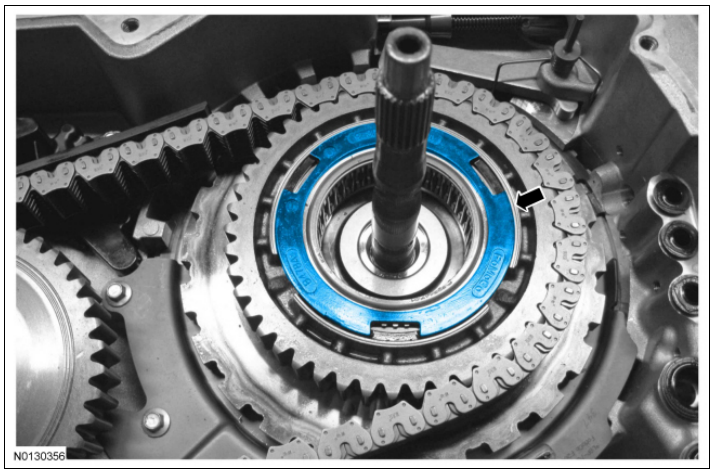
21. Remove the differential.



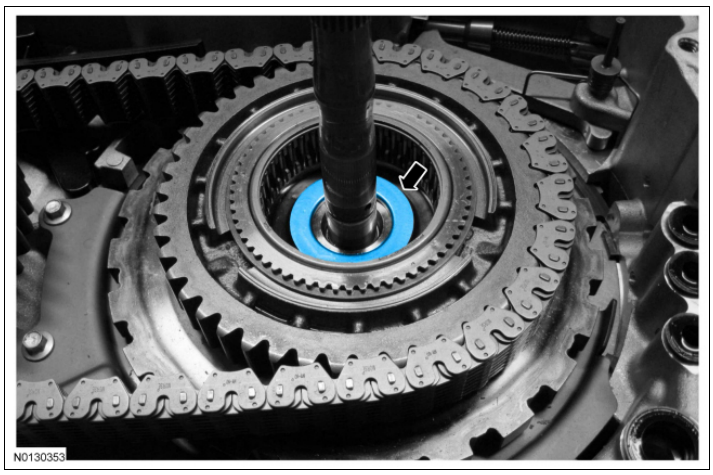
22. Remove the differential planetary sun gear.



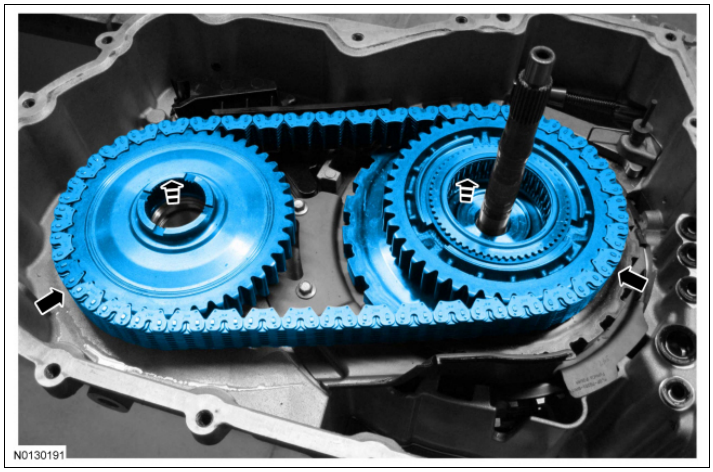
23. Remove the No. 13 thrust washer.



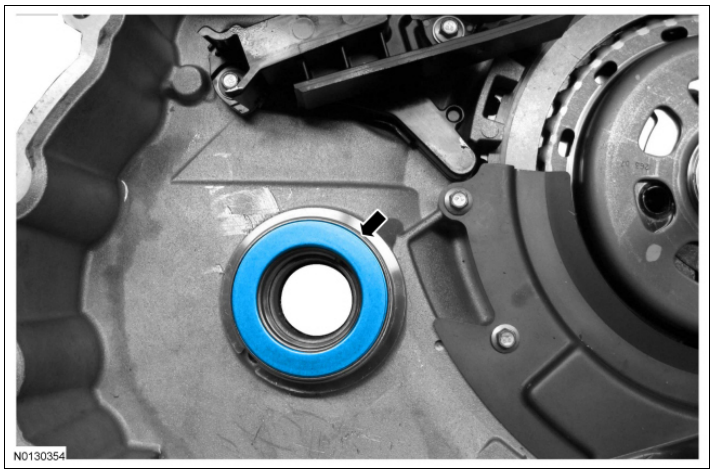
24. Remove the No. 11 drive sprocket thrust bearing.



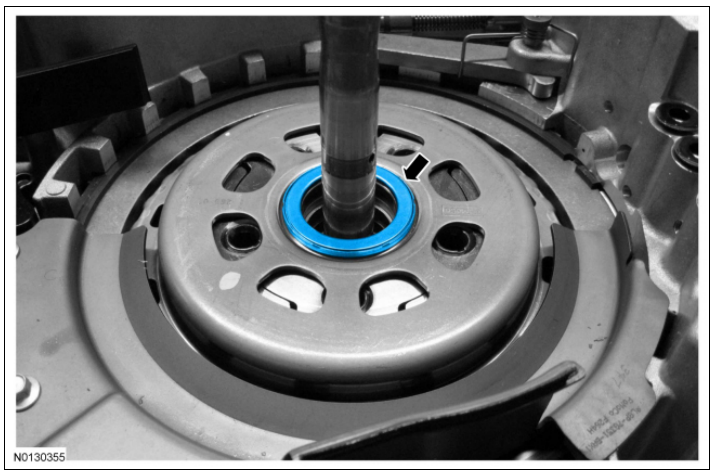
25. Simultaneously remove the drive and driven sprockets and the chain.



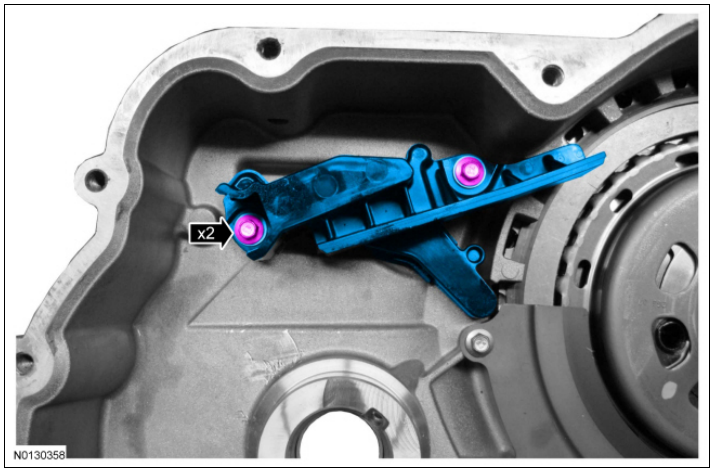
26. Remove the No. 12 driven sprocket thrust bearing.



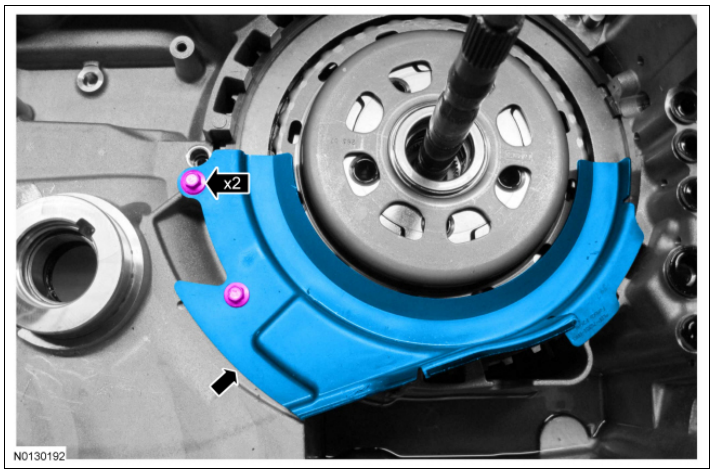
27. Remove the No. 10 front sun gear and shell assembly thrust bearing.



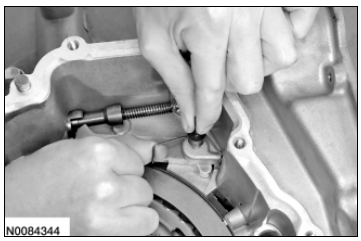
28. Remove the 2 bolts and the transmission fluid reservoir.



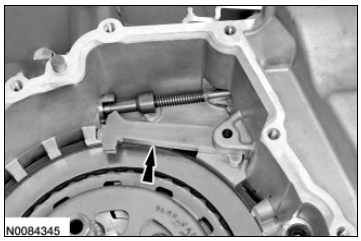
29. Remove the 2 bolts and the transmission fluid baffle.



30. Remove the park pawl pin and spring.



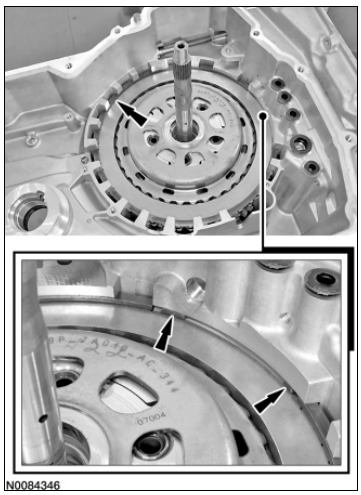
31. Remove the park pawl.



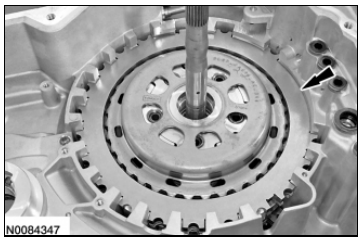
32. **NOTE:** The forward (1, 2, 3, 4) clutch snap ring is beveled. The beveled side of the snap ring goes up (flat side down).

    NOTE: The forward (1, 2, 3, 4) clutch snap ring gap faces the front of the transmission.

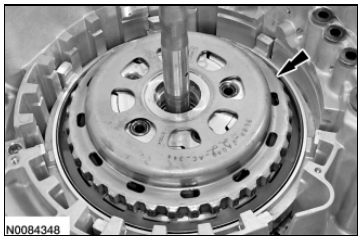
Remove the forward (1, 2, 3, 4) clutch snap ring.



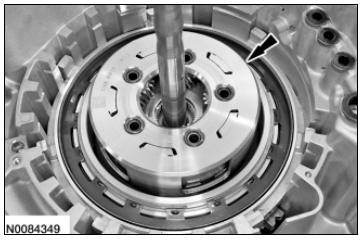
33. Remove the forward (1, 2, 3, 4) clutch pressure plate, clutch assembly and wave spring.



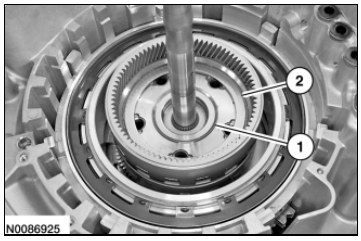
34. Remove the front sun gear and shell assembly.



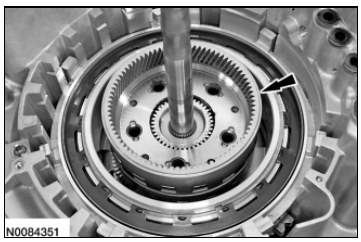
35. Remove the front planetary carrier/rear ring gear assembly.



36. Remove the No. 7 and No. 8 thrust bearings.
    1. No. 7 thrust bearing
    2. No. 8 thrust bearing



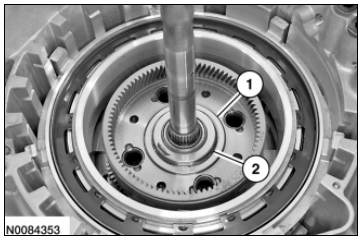
37. Remove the center planetary carrier/front ring gear assembly.



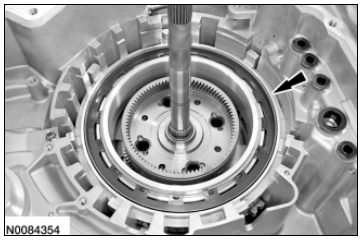
38. Remove the center planetary sun gear.



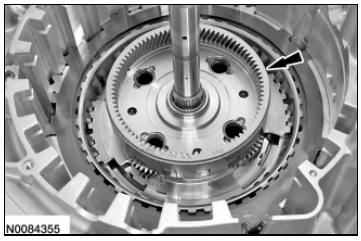
39. Remove the No. 5 and No. 6 thrust bearings.
    1. No. 5 thrust bearing
    2. No. 6 thrust bearing



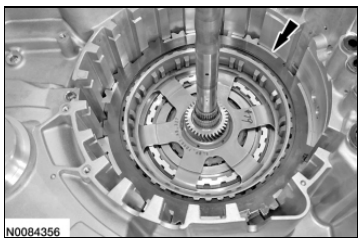
40. Remove the center support assembly.



41. Remove the rear planetary carrier/center ring gear assembly.



42. Remove the low/reverse wave spring, clutch pack and pressure plate.

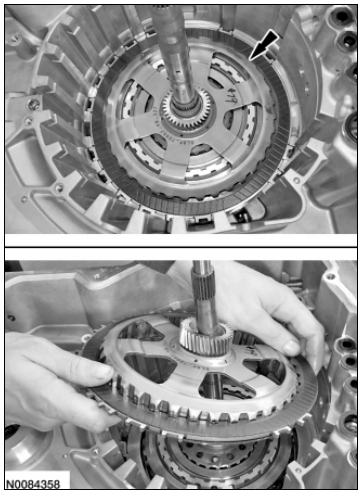


43. Remove the low One-Way Clutch (OWC).

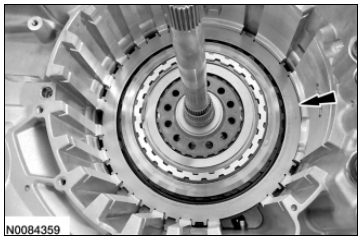


44. **NOTE:** The intermediate (2, 6) clutch is removed with the rear planetary sun gear and shell assembly.

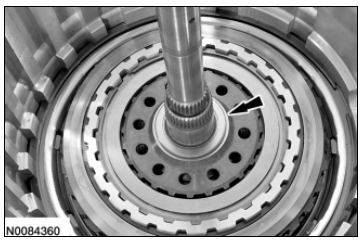
    Remove the rear planetary sun gear and shell assembly and remove the intermediate (2, 6) clutch from the assembly.



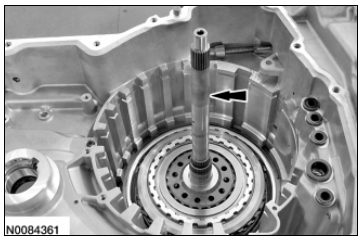
45. Remove the pressure plate and the wave spring.



46. Remove the No. 3 thrust bearing.

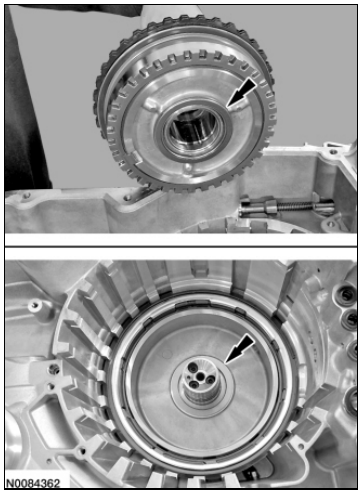


47. Remove the overdrive/direct clutch assembly.

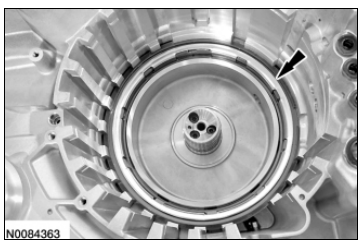


48. **NOTE:** If the No. 1 thrust bearing is stuck to the overdrive/direct clutch assembly, remove the No. 1 thrust bearing from the overdrive/direct clutch assembly.

    Remove the No. 1 thrust bearing.



49. Remove the intermediate (2, 6) clutch apply ring.

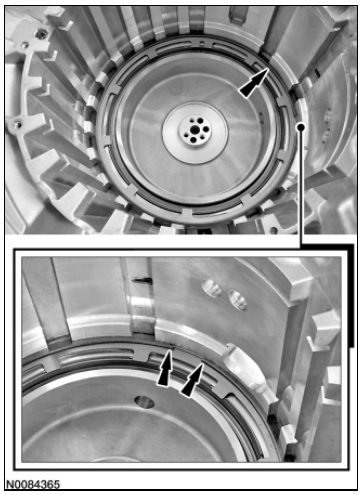


50. Remove the 3 bolts and the clutch support tower.



51. **NOTE:** Note the location of the snap ring gap for assembly.

    Remove the intermediate (2, 6) clutch return spring snap ring.



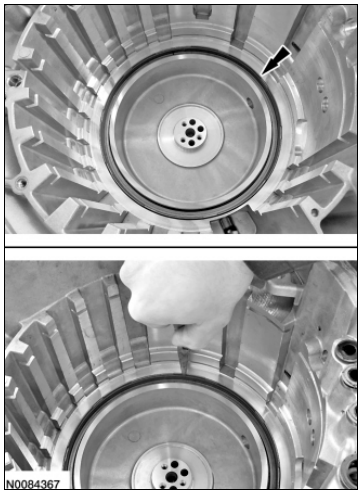
52. **NOTE:** Note the position of the return spring for assembly.

    Remove the intermediate (2, 6) clutch return spring.

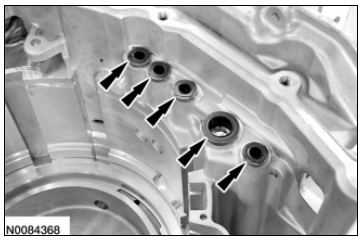


53. **NOTE:** Note the position of the intermediate clutch piston for assembly.

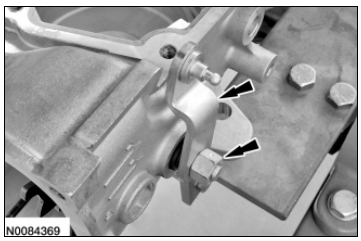
    Remove the intermediate (2, 6) clutch piston.



54. Remove and discard the 5 clutch feed seals.

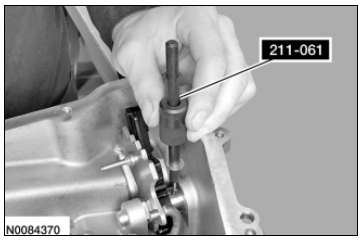


55. Remove the nut and the manual control lever from the manual shaft.

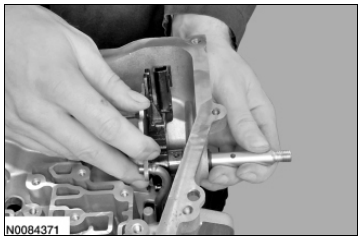


56. ***NOTICE:*** **Do not drive the roll pin through the manual shaft. The roll pin will contact the transaxle case causing damage to the transaxle case.**

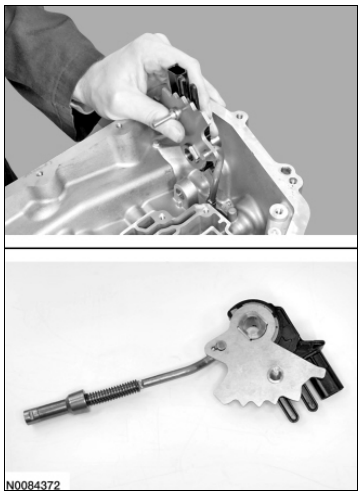
    Using Roll Pin Remover 211-061, pull the roll pin out of the manual shaft.



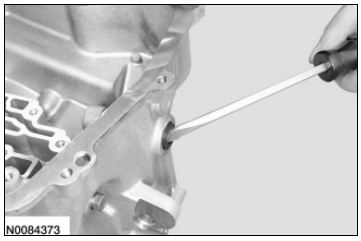
57. Remove the manual shaft.



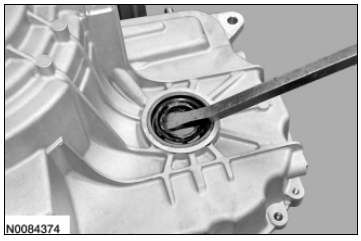
58. Remove the TR sensor and the park pawl actuator rod and remove the park pawl actuator rod from the TR sensor.



59. Using a suitable tool, remove and discard the manual shaft seal.

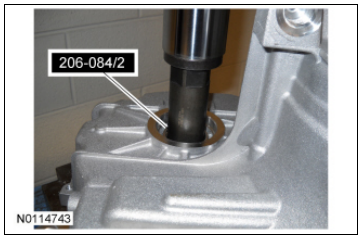


60. Using a suitable tool, remove and discard the LH halfshaft seal.

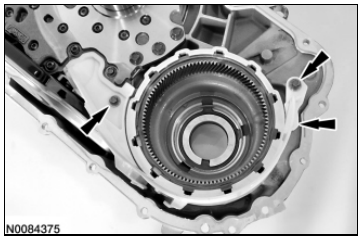


61. **NOTE:** Press the bushing out of the transaxle case from the outside to the inside so that the transaxle case rests on a flat surface.

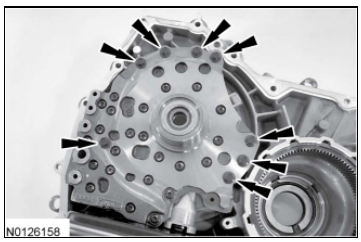
    Using the Wheel Speed Sensor Ring Installer 206-084/2 and a suitable press, remove and discard the LH transaxle case bushing from the transaxle case.



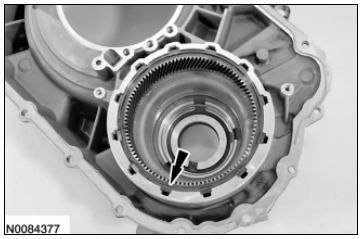
62. Remove the 2 bolts and the oil baffle from the torque converter housing.



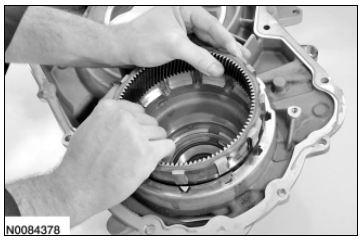
63. Remove the 8 bolts and the pump and filter assembly.



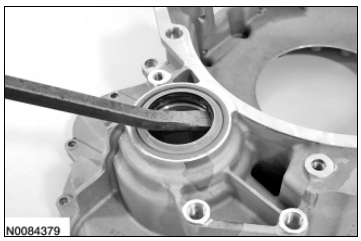
64. Remove the differential ring gear snap ring.



65. Remove the differential ring gear.



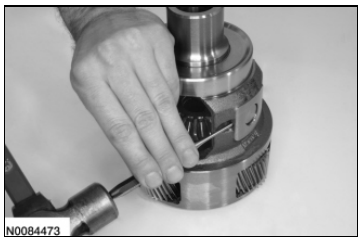
66. Using a suitable tool, remove and discard the RH halfshaft seal.



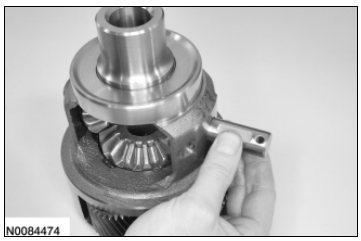
Final Drive Carrier and Differential Assembly

Disassembly

1. Using a suitable tool, drive the roll pin out of the differential. Discard the roll pin.



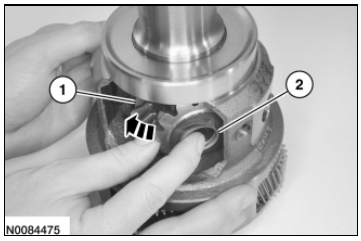
2. Remove the differential pin.



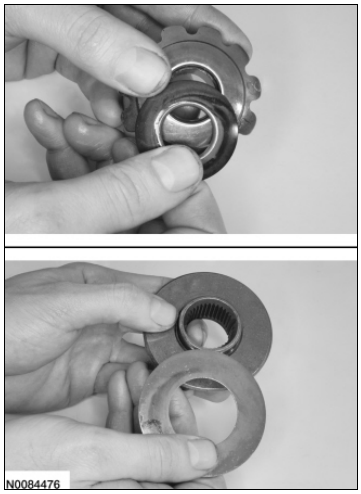
3. ***NOTICE:*** **Do not mix up the washers from the side or spider gears that they were originally assembled with. Assembly of the differential with the wrong washcan cause excessive wear to the differential carrier, spider or side gears.**

   Rotate the side gears along with the spider gears and remove the side gears and the spider gears.

   1. Side gear
   2. Spider gear

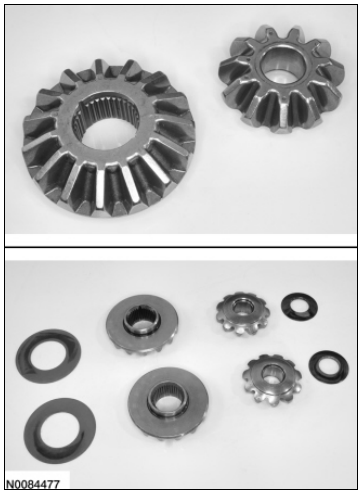


4. Remove the washers from the side and spider gears, but keep the washers with the gear that it was originally assembled with.

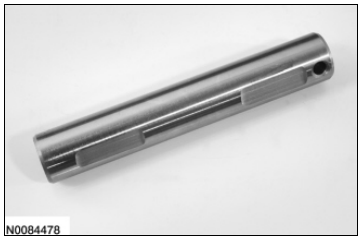


Assembly

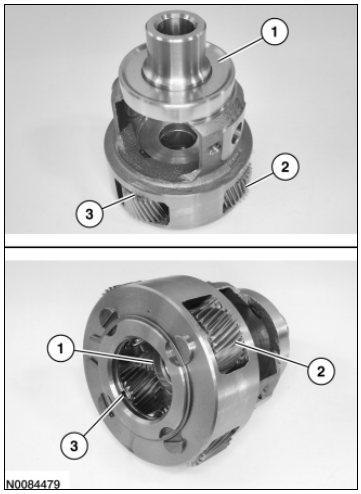
1. Clean and inspect the side gears and spider gears and washers for damage or excessive wear and install new components as necessary.



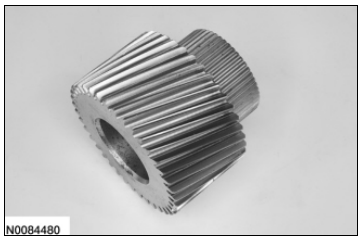
2. Clean and inspect the differential pin for damage or excessive wear and install new if necessary.



3. Clean and inspect the differential for damage and install new if necessary.
    1. Inspect the thrust bearing surfaces.
    2. Inspect the differential planetary gear teeth.
    3. Inspect the differential planetary gear teeth to be sure they spin freely and do not move back and forth or side to side excessively.

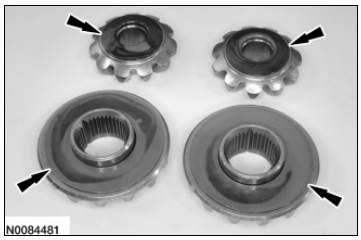


4. Clean and inspect the differential sun gear for damage or excessive wear and install new if necessary.

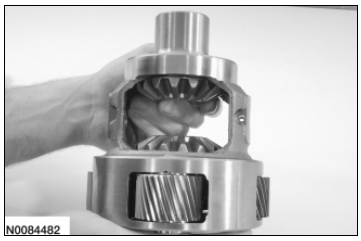


5. ***NOTICE:*** **Do not mix up the washers from the side or spider gears that they were originally assembled with. Assembly of the differential with the wrong washers can cause excessive wear to the differential carrier, spider or side gears.**

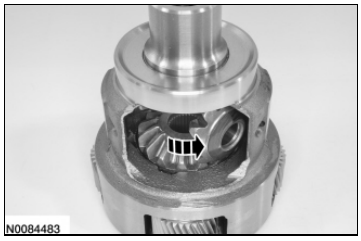
   Install the washers on the side or spider gears that they were removed from.



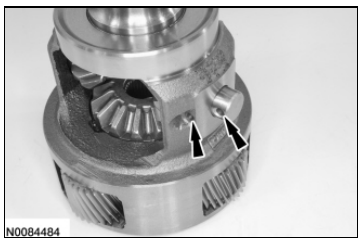
6. Position the side gears in the differential carrier.



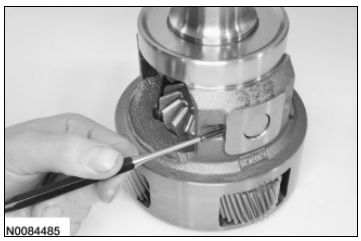
7. Place the spider gears in the differential carrier and rotate the side gears with the spider gears until the differential pin hole lines up to the holes in the spider gears.



8. Install the differential pin with the roll pin holes aligned.

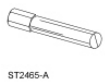


9. Using a suitable tool, install a new roll pin.



Pump and Filter Assembly

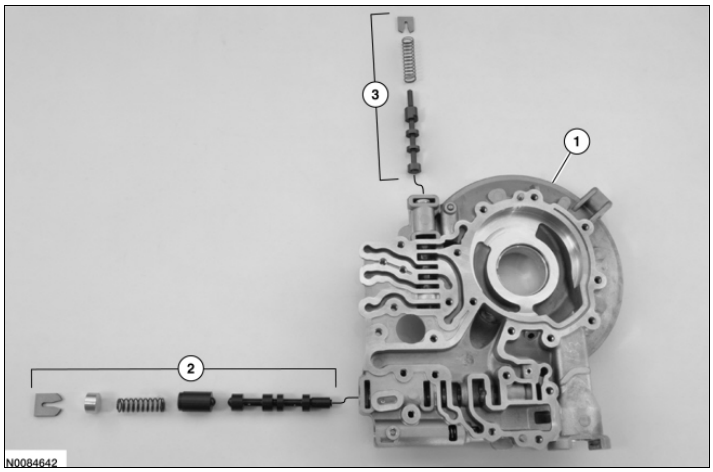
Special Tool(s)

 ST2465-A	Collet, 3/4 Inch to 7/8 Inch 303-D019 (D80L-100-Q)
 ST3071-A	Installer, Converter Seal 307-627
 ST3064-A	Seal Installer, Turbine Shaft 307-634
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

Pump Assembly



Item	Part Number	Description
1	7A103	Pump housing
2	-	Main pressure regulator valve assembly
3	-	

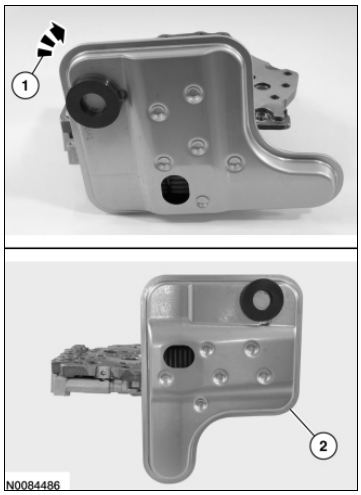
		Torque Converter Clutch (TCC) control valve assembly

Disassembly

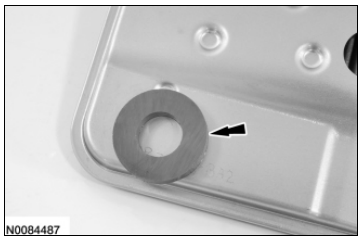
1. **NOTE:** Note the orientation of the fluid filter to the fluid pump.

   Remove the filter from the pump.

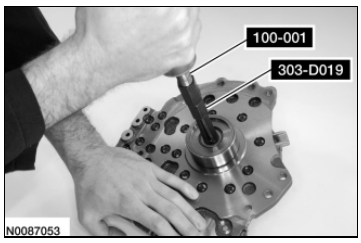
   1. Rotate the filter 90 degrees clockwise.
   2. Pull the filter out pump.



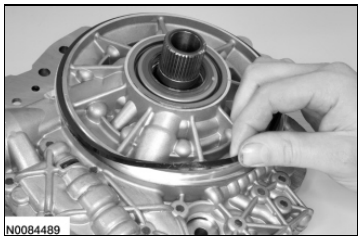
2. Remove the magnet from the filter.



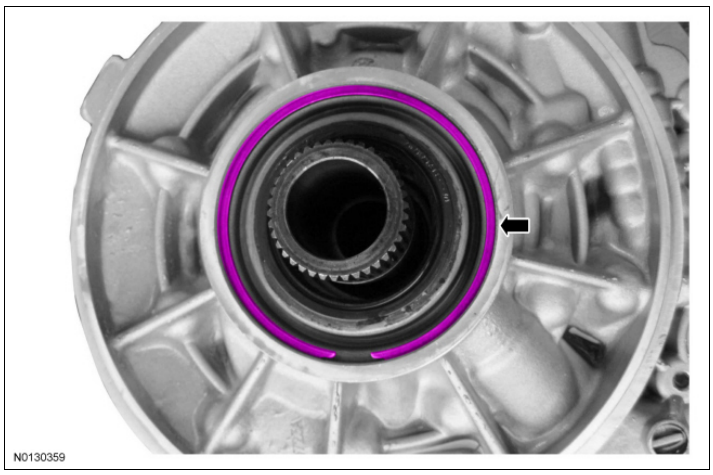
3. Assemble the Slide Hammer 100-001 and 3/4 Inch to 7/8 Inch Collet 303-D019 and remove and discard the input shaft seal.



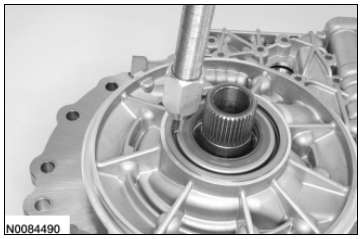
4. Remove the pump-to-torque converter housing seal.



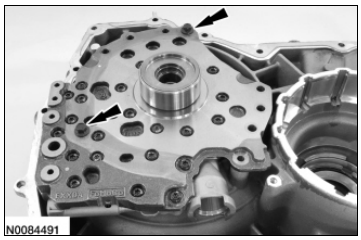
5. If equipped, remove the torque converter hub seal snap ring.



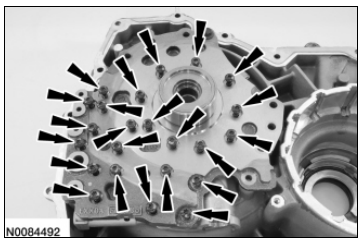
6. Using a suitable dent puller, remove the torque converter hub seal.



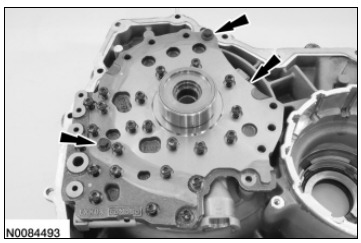
7. Position the pump assembly in the torque converter housing and install 2 pump-to-torque converter housing bolts hand-tight.



8. Loosen the 23 pump bolts.



9. Remove the 2 bolts and the pump from the torque converter housing.

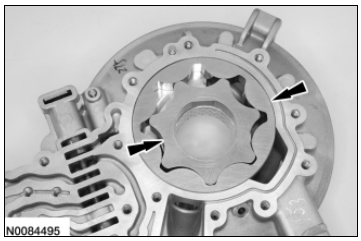


10. Remove the 23 pump bolts and separate the pump halves.

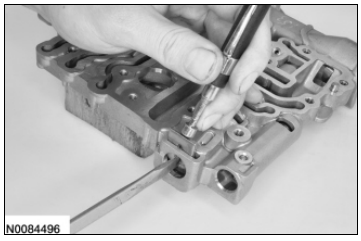


11. **NOTE:** The dot on the inner pump gear faces up.

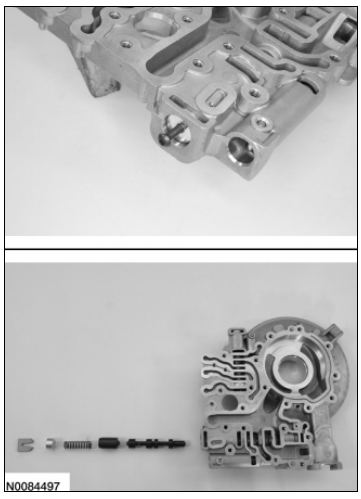
    Remove the pump gears.



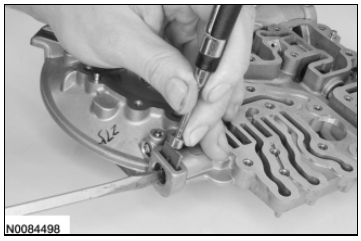
12. Compress the main pressure regulator valve spring with a screwdriver and remove the retainer with a magnet.



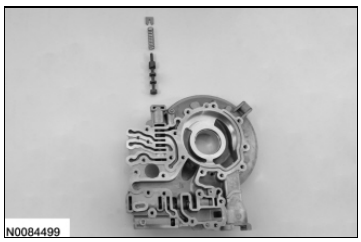
13. Install an M4 bolt in the valve and remove the main pressure regulator valve assembly.



14. Compress the Torque Converter Clutch (TCC) control valve spring with a screwdriver and remove the retainer with a magnet.



15. Remove the TCC control valve assembly.

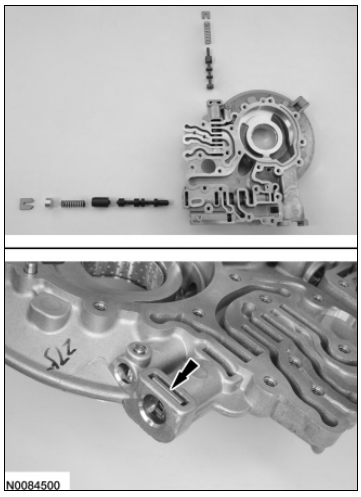


Assembly

1. Clean and inspect the components of the pump assembly for wear or damage. Inspect the fluid drained from the pump for excessive metal or foreign material. If excessive wear, damage or excessive metal is found, replace the fluid pump as an assembly.

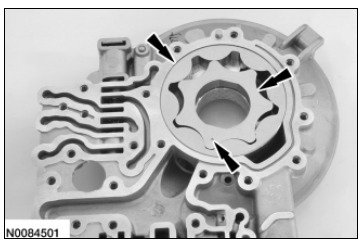
2. **NOTE:** TCC control valve retainer shown assembled in the pump body, main pressure regulator valve retainer similar.

   Assemble the TCC control valve and main pressure regulator valve and install the valves in the pump. Compress the valve springs with a screwdriver and install the retainers.



3. **NOTE:** The dot on the inner pump gear faces up.

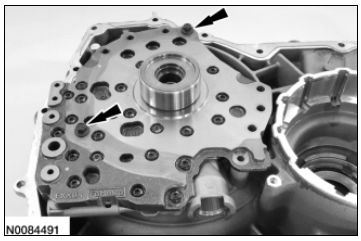
   Install the pump gears.



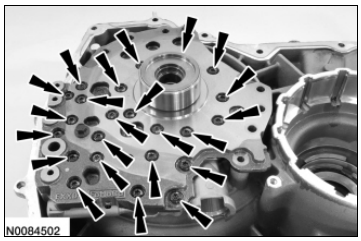
4. Position the stator support on the pump housing and install the 23 bolts hand-tight.



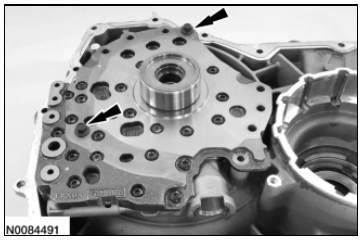
5. Install the pump assembly in the torque converter housing and install 2 bolts hand-tight.



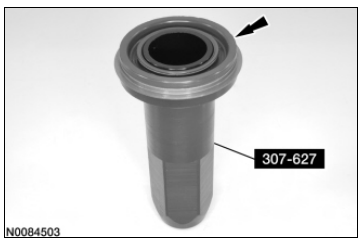
6. Tighten the 23 pump housing bolts.
   - Tighten to 10 Nm (89 lb-in).



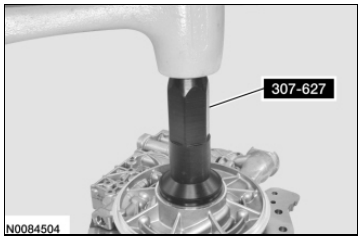
7. Remove the 2 bolts and the pump assembly from the torque converter housing.



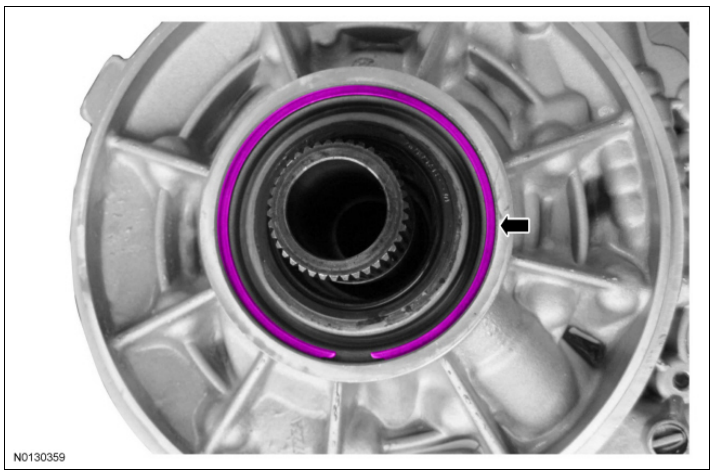
8. Install a new torque converter hub seal on Converter Seal Installer 307-627.



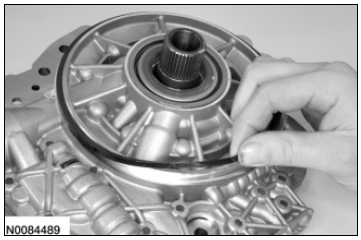
9. Using the Converter Seal Installer 307-627, install a new torque converter hub seal.



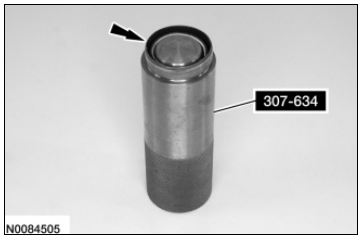
10. If equipped, install the torque converter hub seal snap ring.



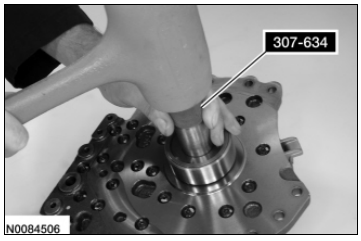
11. Install a new pump-to-torque converter housing seal.



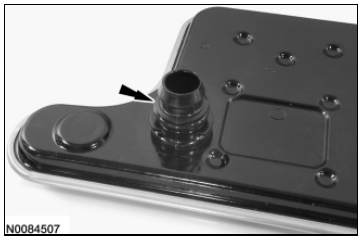
12. Install a new turbine shaft seal on Turbine Shaft Seal Installer 307-634.



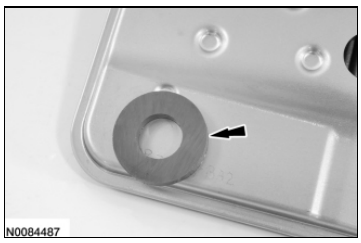
13. Using Turbine Shaft Seal Installer 307-634, install the turbine shaft seal.



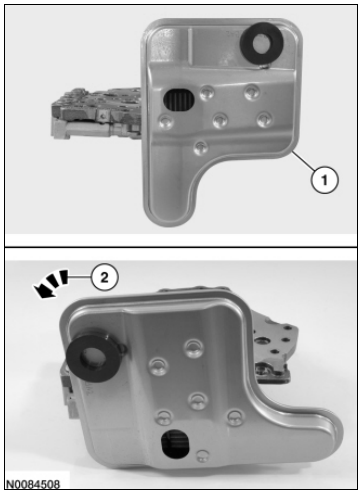
14. Install a new O-ring on a new filter and lubricate it with clean automatic transmission fluid.



15. Install the magnet on the filter.



16. Install the filter.
    1. Position the filter in the pump.
    2. Rotate the filter counterclockwise 90 degrees.



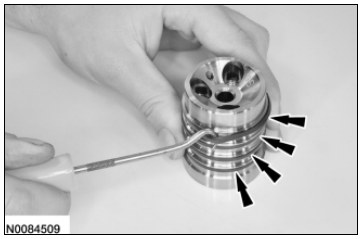
Clutch Support Tower

Special Tool(s)

 ST2996-A	Input Shaft Support Seal Installer (Back Plate, Multiple Rings) 307-578 (includes 307-578/1, 307-578/2 and 307-578/3)

Disassembly

1. Using a suitable tool, remove and discard the 4 Teflon® seals.


N0084509

2. Clean and inspect the clutch support towerdamage. Install a new clutch support tower if damaged.


N0084510

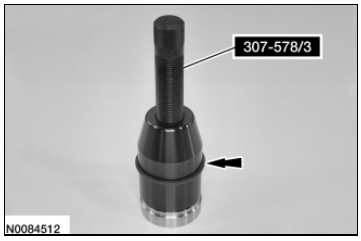
Assembly

1. Install the Input Shaft Support Seal Installer 307-578/3 on the clutch support tower and adjust the Input Shaft Support Seal Installer to align the bottom edge of the tool with the top edge of the bottom Teflon® seal groove.



N0084511

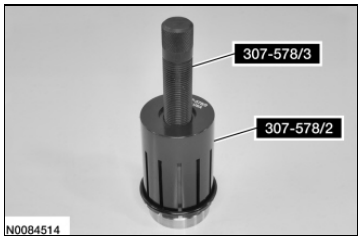
2. Install a new Teflon® seal on the Input Shaft Support Seal Installer 307-578/3.



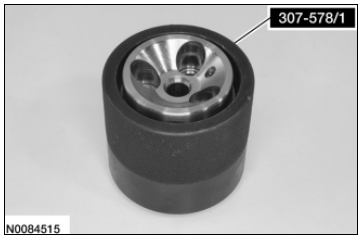
3. Install the Input Shaft Support Seal Installer 307-578/2 over 307-578/3. Using the Input Shaft Support Seal Installer 307-578/2, slide the Teflon® seal over the clutch support tower and into the groove.



4. Remove the Input Shaft Support Seal Installer 307-578/2 and 307-578/3.
    - Repeat Steps 1 through 4 for the other 3 Teflon® seals.

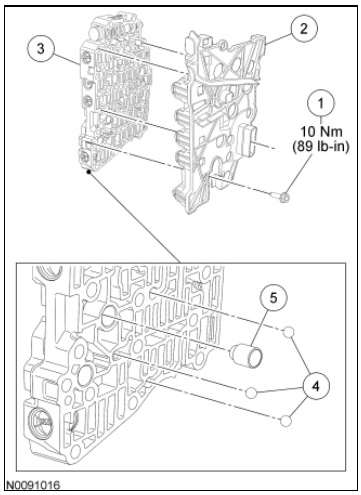


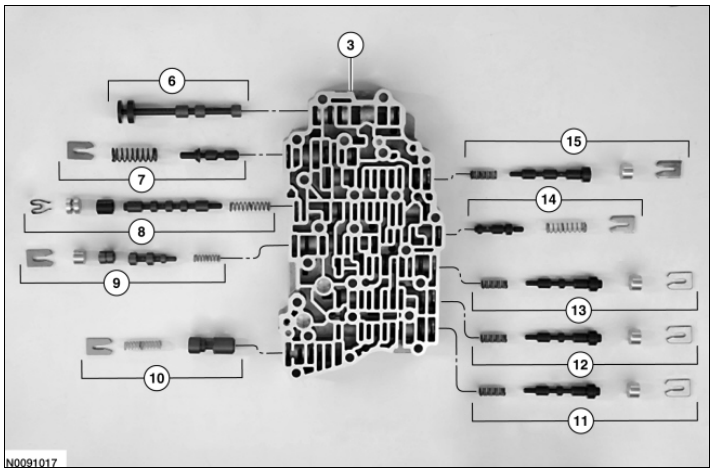
5. Install the Input Shaft Support Seal Installer 307-578/1 on the clutch support tower to size the 4 Teflon® seals.



Main Control Valve Body

Main Control Valve Body



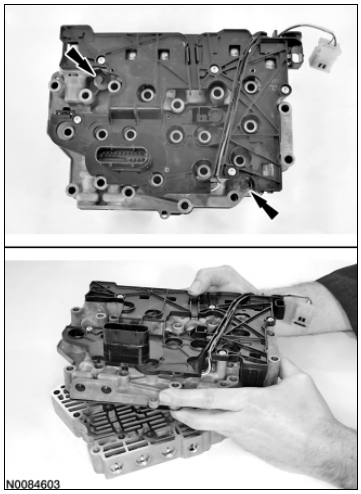


Item	Part Number	Description
1	W500303	Solenoid body-to-valve body bolt
2	7G391	Solenoid body
3	7A100	Main control valve body
4	7E195	Check balls
5	7J191	Solenoid damper (Shift Solenoid A (SSA))
6	7C389	Manual valve
7	7G473	Solenoid pressure regulator valve assembly
8	7G179	Clutch bypass valve
9	7G307	Torque Converter Clutch (TCC) regulator valve
10	7B200	Control pressure regulator
11	7D102	Direct (3, 5, R) clutch regulator valve
12	7D102	Intermediate (2, 6) clutch regulator valve

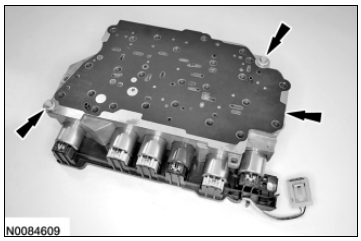
13	7D102	Forward (1, 2, 3, 4) clutch regulator valve
14	7J187	Forward (1, 2, 3, 4) clutch latch valve
15	7D102	Low reverse/overdrive (4, 5, 6) clutch regulator valve

Disassembly

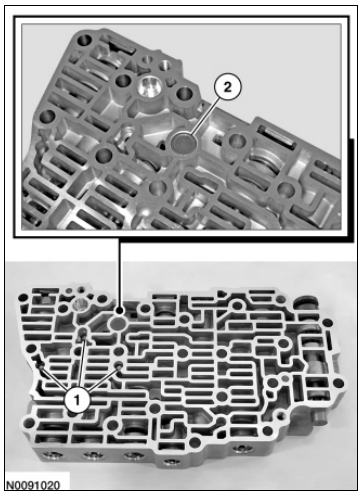
1. Remove the 2 bolts and separate the solenoid body from the valve body.



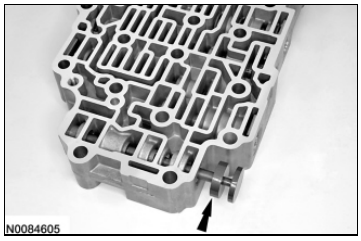
2. Remove the 2 bolts and remove and discard the separator plate.



3. Remove the 3 check balls and the damper.
    1. Check balls
    2. Solenoid damper



4. Remove the manual valve.

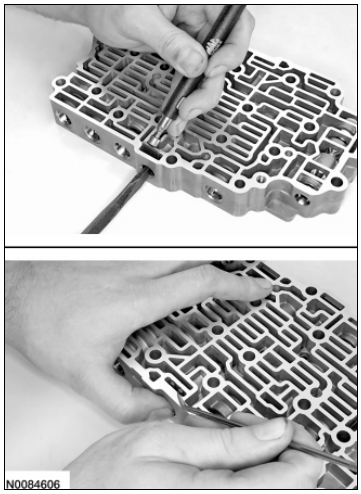


5. ***NOTICE:*** **Remove the valves by tapping the valve body on the palm of the hand to slide the valves out of the bores or by threading a 4-mm bolt into the valves and pulling them out. It may be necessary to remove the valves and springs using a pick. If it is necessary to use a pick, use extreme caution to prevent damaging the valves or valve bores. If necessary, disassemble parts of the main control valve body in small groups. Take special care when handling the main control components, since they are the most precise and delicate parts of the transaxle. Neatly arrange the parts as they are removed to avoid mixing similar pieces.**

   NOTICE: **Do not stone or polish any valves or damage to the valves can occur. If the valves do not move freely, install a new assembly.**

   NOTE: The bypass valve is held in with a spring-loaded retainer. Be careful not to lose the retainer when removing it.

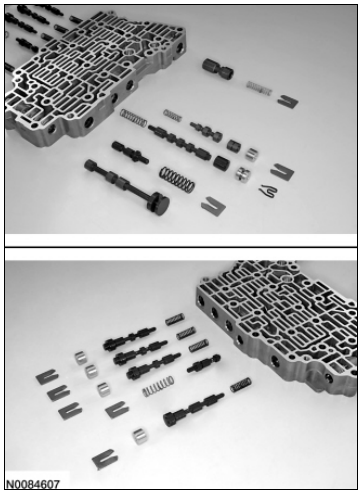
   Compress the valve springs with a screwdriver and remove the retainers with a magnet. Use a pick to remove the bypass valve retainer. Remove the individual valves and springs from the main control valve body by tapping the valve body on the palm of the hand to slide the valves out of the bores. If needed, use a 4-mm bolt to thread into the valves to remove the valves. See the Valve Body illustration for valve and spring locations. Clean valves, springs and main control valve body.



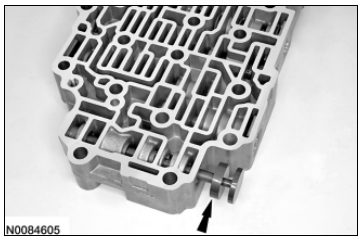
Assembly

1. ***NOTICE:*** **Do not stone or polish any valves or damage to the valves can occur. If the valves do not move freely during assembly, install a new valve body.**

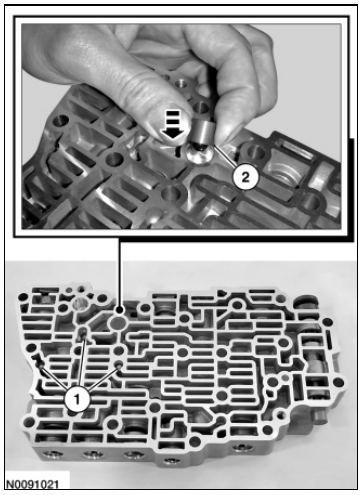
   Install the valve body valves, springs and retaining clips in the main control valve body. See the Valve Body illustration at the beginning of this procedure for valve and spring locations.



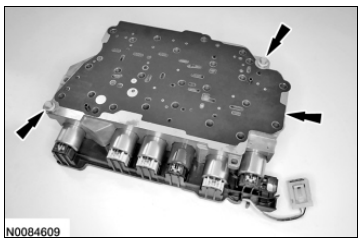
2. Install the manual valve in the valve body.



3. Install the 3 check balls and the damper.
    1. Check balls
    2. Solenoid damper

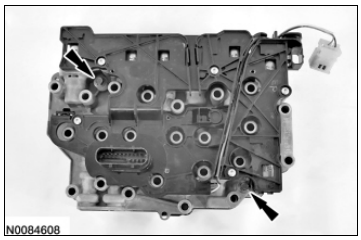


4. Install the new separator plate and the 2 separator bolts.
    - Tighten to 10 Nm (89 lb-in).



5. For disassembly and assembly of the solenoid body, refer to Solenoid Body Assembly in this section.

6. Position the solenoid body assembly on the valve body and install the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

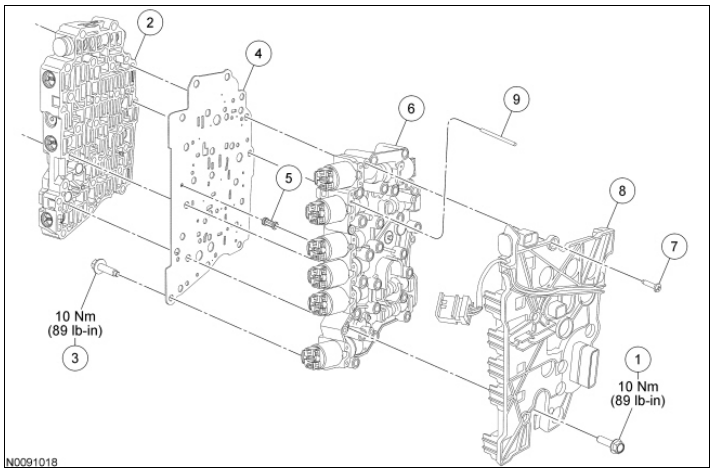


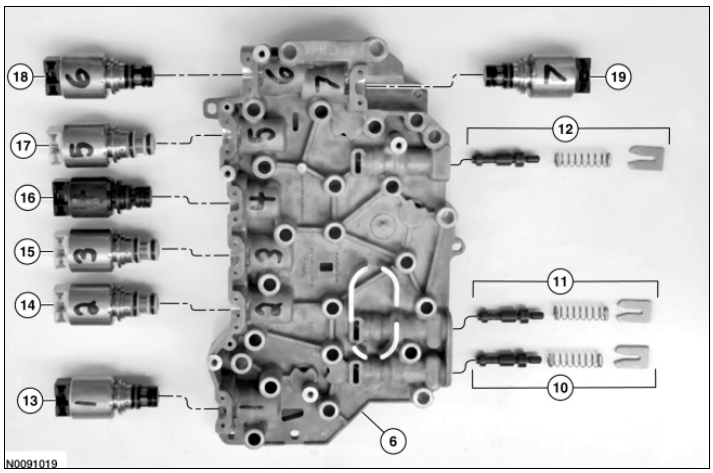
Solenoid Body Assembly

Special Tool(s)

 ST3066-A	Pins, Leadframe Guide 307-636

Solenoid Body



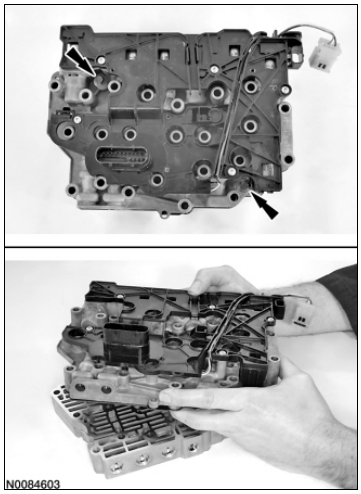


Item	Part Number	Description
1	W500303	Solenoid body-to-valve body bolt
2	7A100	Main control valve body
3	N605770	Solenoid body-to-valve body separator plate bolt (2 required)
4	7Z490	Solenoid body-to-valve body separator plate

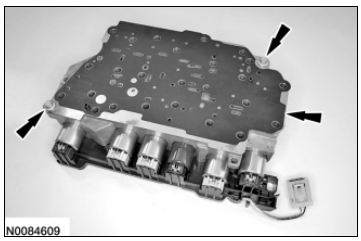
5	7K221	Circuit filter
6	7G391	Solenoid body
7	W505513	Leadframe screw (5 required)
8	7G276	Leadframe
9	7H111	Solenoid retaining pin (14 required)
10	7J187	Direct (3, 5, R) clutch latch valve
11	7J187	Intermediate (2, 6) clutch latch valve
12	7J187	Low reverse/overdrive (4, 5, 6) clutch latch valve
13	7G383	Line Pressure Control (LPC) solenoid
14	7G136	Shift Solenoid C (SSC)
15	7G136	Torque Converter Clutch (TCC) solenoid
16	7G484	Shift Solenoid E (SSE) ON/OFF solenoid
17	7G136	Shift Solenoid A (SSA)
18	7G383	Shift Solenoid B (SSB)
19	7G383	Shift Solenoid D (SSD)

Disassembly

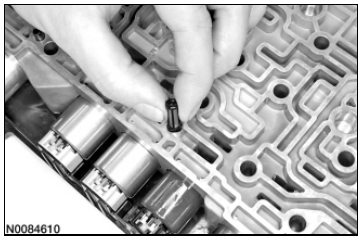
1. If not previously done, remove the 2 bolts and separate the solenoid body from the valve body.



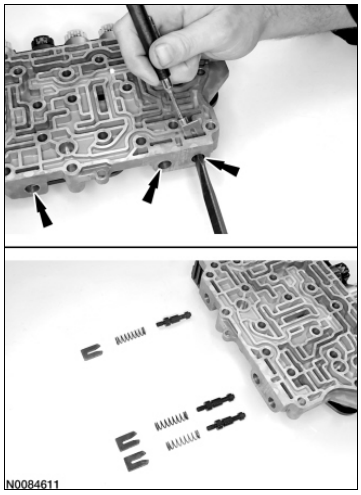
2. Remove the 2 bolts and remove and discard the separator plate.



3. Remove and discard the circuit filter.

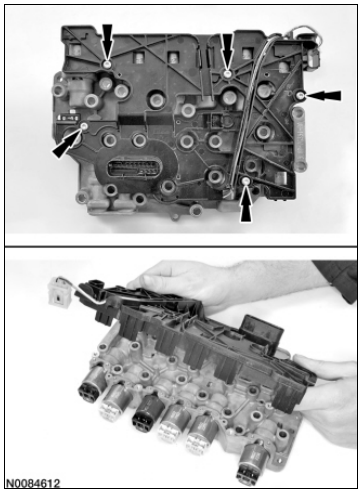


4. Compress the valve springs with a screwdriver and remove the retainers with a magnet. Remove the individual valves and springs from the solenoid body by tapping it on the palm of the hand to slide the valves out of the bores. See the Solenoid Body illustration at the beginning of this procedure for valve and spring locations.



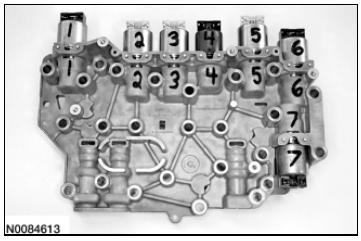
5. ***NOTICE:*** **Be careful not to bend or twist the solenoid body leadframe or the solenoid terminals when removing the leadframe or damage can occur to the leadframe or the solenoids.**

   Remove the 5 screws and carefully remove the leadframe from the solenoids by lifting it straight up evenly.

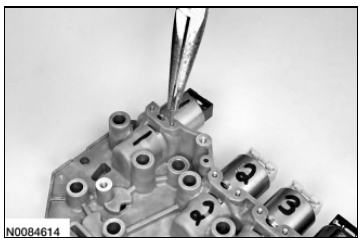


6. ***NOTICE:*** **The solenoids are calibrated from the factory and are not all the same. Failure to mark the solenoids to the ports they were originally in can result in mixing the solenoids and can cause damage to the transaxle or a harsh shift.**

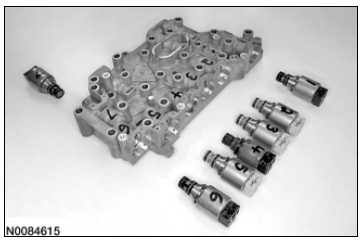
   Using a paint marker, number the solenoids and the solenoid body to correspond with the ports from which the solenoids are located in the solenoid body.



7. Remove the solenoid retaining pins.



8. Remove the solenoids from the solenoid body.



Assembly

1. ***NOTICE:*** **Be careful not to wash the numbers from the solenoids or the solenoid body. Failure to install the solenoids in the ports they were originally in can result in damage to the transaxle or a harsh shift.**

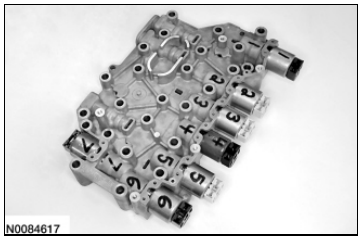
   NOTICE: **Do not stone or polish any valves or damage to the valves can occur. If the valves do not move freely during assembly, install a new solenoid body.**

   Clean and inspect the solenoid body, solenoids and valve assemblies for damage. Inspect the solenoid screens for debris that may restrict fluid flow through the screen.

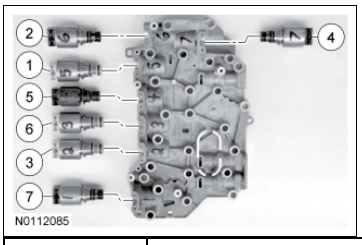


2. ***NOTICE:*** **The solenoids are calibrated from the factory and are not all the same. Failure to install the solenoids in the ports they were originally in can result in damage to the transaxle or a harsh shift.**

   If new solenoid(s) are not being installed, position the solenoids in the solenoid body ports from which their numbers correspond.

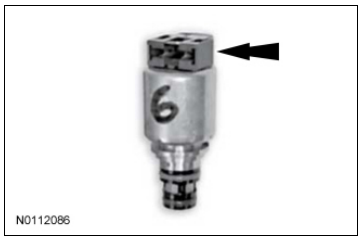


3. If installing a new Variable Force Solenoid (VFS), determine the base part number of the solenoid(s). The Torque Converter Clutch (TCC) solenoid, Shift Solenoid A (SSA) and Shift Solenoid C (SSC) are all normally low pressure solenoids. The Line Pressure Control (LPC) solenoid, Shift Solenoid B (SSB) and Shift Solenoid D (SSD) are all normally high pressure solenoids. Shift Solenoid E (SSE) is not a VFS ; it is an ON/OFF solenoid.



Item	Part Number	Description
1	7G136	SSA (normally low)
2	7G383	SSB (normally high)
3	7G136	SSC (normally low)
4	7G383	SSD (normally high)
5	7G484	SSE (normally closed [OFF])
6	7G136	TCC solenoid (normally low)
7	7G383	LPC solenoid (normally high)

4. If installing a new LPC solenoid, SSB or SSD , note the color of the electrical terminal area of the solenoid. The color will be blue or green and the solenoid can only be replaced with the same color solenoid. If a new solenoid with that color is not available, install a new solenoid body, refer to Solenoid Body Assembly in this section.



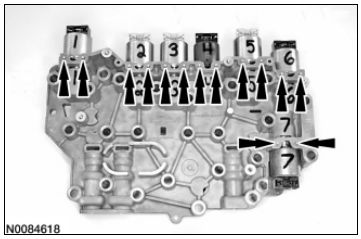
5. Determine the part number suffix by checking the solenoid service band number etched on the side of the solenoid. The band number is the third digit on the side of the solenoid and will be a 1, 2, 3, 4 or 5. Use the following table to determine the part number suffix and match the new solenoid base part number and suffix with the old solenoid. Install the solenoid in the solenoid body.

Solenoid Band Number	Part Number Suffix
1	B
2	C
3	D
4	E

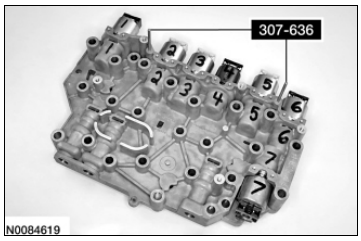
5	F



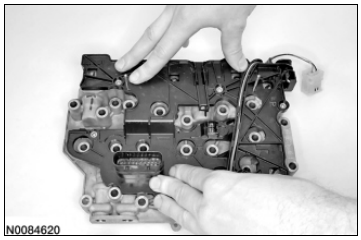
6. Install the solenoid retaining pins.



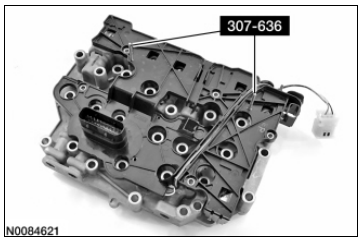
7. Install Leadframe Guide Pins 307-636 in the solenoid body to align the leadframe for installation.



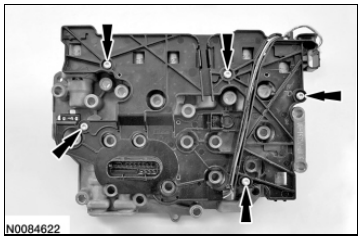
8. Position the leadframe on the guide pins and carefully install the leadframe by pushing it straight down into the solenoids.



9. Remove Leadframe Guide Pins 307-636.

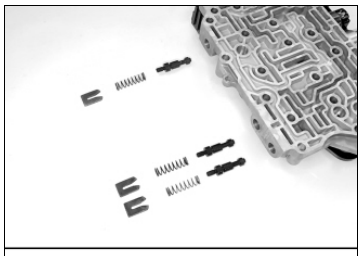


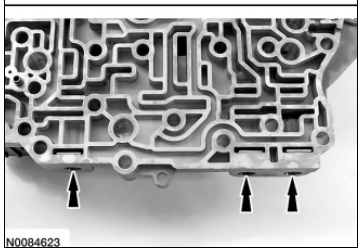
10. Install the 5 leadframe screws.



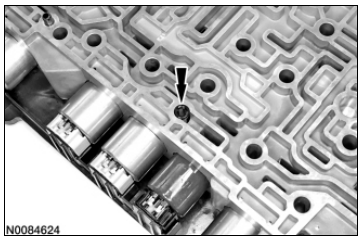
11. ***NOTICE:*** **If the valves do not move freely during assembly, install a new solenoid body. Failure to install a new solenoid body can result in a harsh shift or damage to the transaxle.**

    Install the solenoid body valves, springs and retaining clips in the solenoid body. See the Solenoid Body illustration at the beginning of this procedure for valve and spring locations.

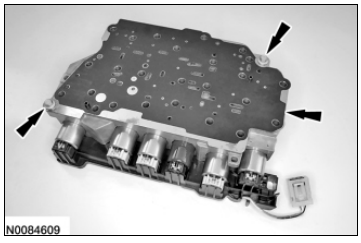




12. Install the circuit filter.

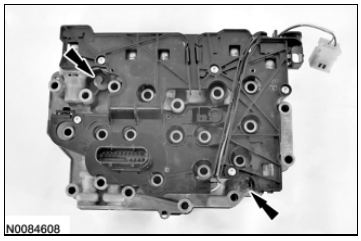


13. Install the new separator plate and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).



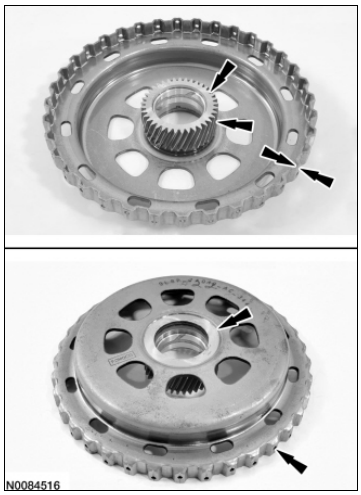
14. If not previously done, refer to Main Control Valve Body in this section for disassembly and assembly of the valve body.

15. Position the solenoid body assembly on the valve body and install the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).


N0084608

Planetary Gearsets And Chain Drive Parts

1. Clean and inspect the front planetary sun gear and shell assembly for damage or wear and install new, as necessary.
    - Gear teeth
    - Shell-to-clutch pack surfaces
    - Thrust bearing surfaces

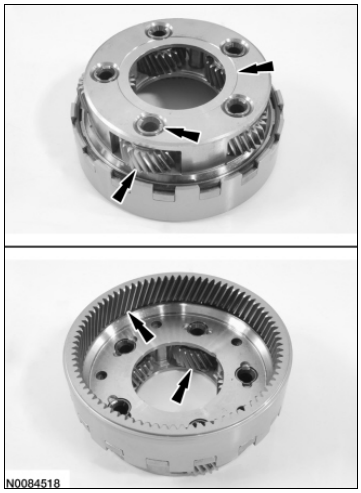


2. Clean and inspect the front planetary gear carrier/rear ring gear assembly for damage or excessive wear and install new, as necessary.
    - Pinion gear teeth
    - Pinion gear surfaces
    - Pinion gear bearings
    - Spline teeth
    - Thrust bearing
    - Thrust bearing surfaces <
    - Ring gear teeth

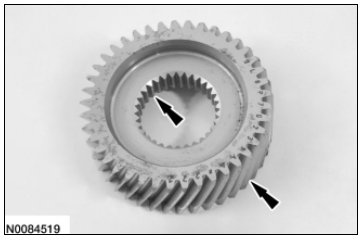


3. Clean and inspect the center planetary gear carrier/front ring gear assembly for damage or excessive wear and install new, as necessary.

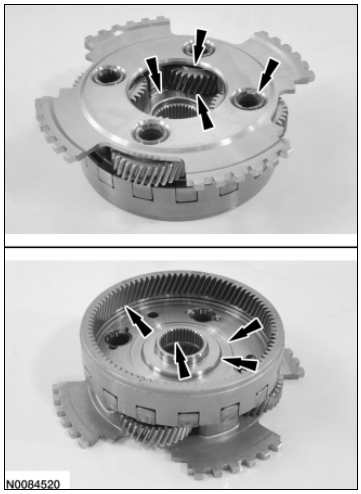
- Pinion gear teeth
- Pinion gear surfaces
- Pinion gear bearings
- Spline teeth
- Thrust bearing surfaces
- Ring gear teeth



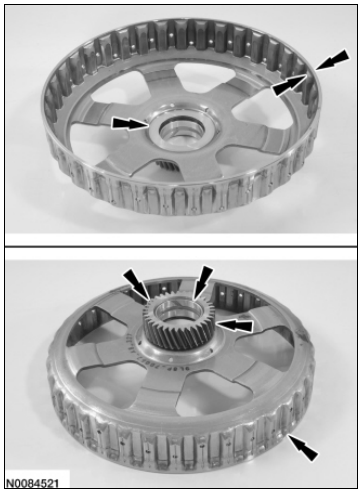
4. Clean and inspect the center planetary sun gear for damage or excessive wear and install new, as necessary.
    - Sun gear teeth
    - Spline teeth



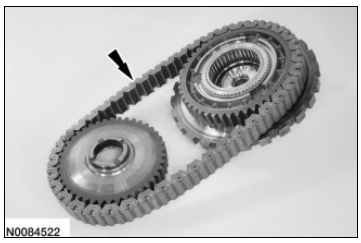
5. Clean and inspect the rear planetary gear carrier/center ring gear assembly for damage or excessive wear and install new, as necessary.
    - Pinion gear teeth
    - Pinion gear surfaces
    - Pinion gear bearings
    - Spline teeth
    - Thrust bearing surfaces
    - Thrust bearing
    - Ring gear teeth



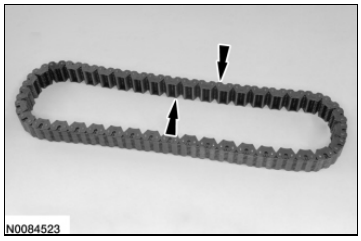
6. Clean and inspect the rear planetary sun gear and shell assembly for damage or wear and install new, if necessary.
    - Sun gear teeth
    - Shell-to-clutch pack surfaces
    - Bearing surfaces



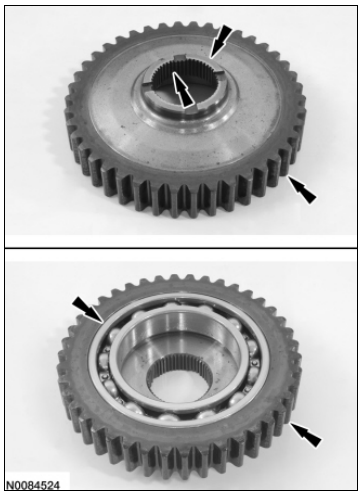
7. Remove the drive chain from the drive and driven sprockets.



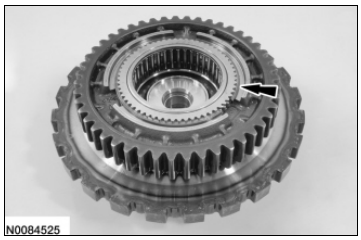
8. Clean and inspect the drive chain for damage or excessive wear and install new, if necessary.
    - Check the drive chain for wear, stretching or tightness of the chain links.
    - Check that the chain moves freely.



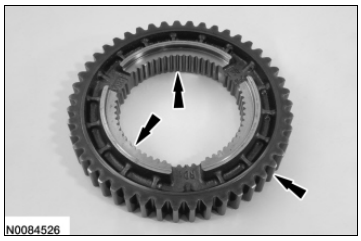
9. Inspect the driven sprocket for damage or excessive wear and install new, if necessary.
    - Chain teeth
    - Spline teeth
    - Thrust bearing surfaces
    - Bearing



10. Remove the snap ring and remove the drive sprocket from the front planetary hub/park gear assembly.

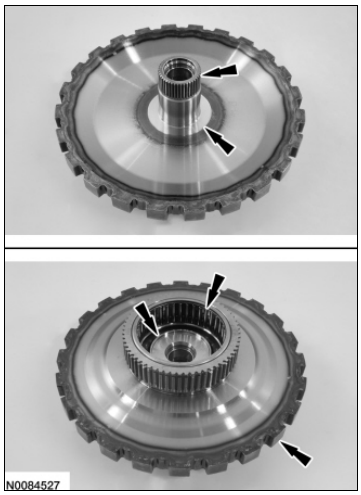


11. Inspect the drive sprocket for damage or excessive wear and install new, if necessary.
    - Chain teeth
    - Spline teeth
    - Thrust washer surface

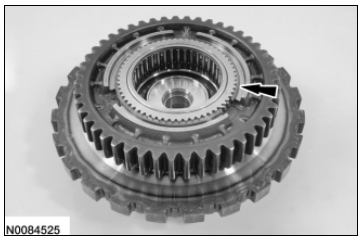


12. Inspect the front planetary hub/park gear assembly for damage or excessive wear and install new, if necessary.
    - Park gear teeth
    - Spline teeth

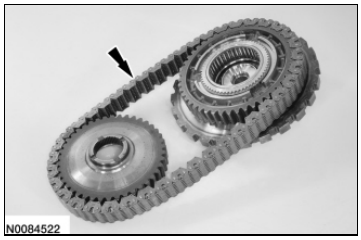
- Thrust washer surface
- Thrust bearing surface
- Bearing surfaces
- Needle bearing



13. Install the drive sprocket on the front planetary hub/park gear assembly and install the snap ring.



14. Install the drive chain on the drive and driven sprockets.

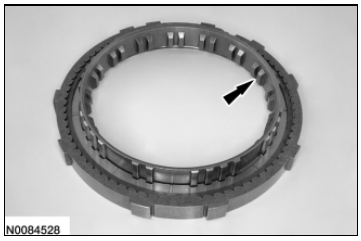


Low One-Way Clutch

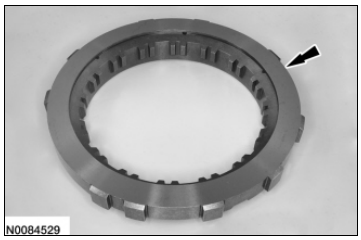
1. ***NOTICE:*** **Do not clean in water or with water-based solvents. Damage to the component may occur.**

   NOTE: The low One-Way Clutch (OWC) should not be disassembled.

   Clean and inspect the low OWC for cracks and damaged splines. The internal splined section should rotate clockwise and lock when rotated counterclockwise. If any damage is found or the clutch does not rotate or lock, install a new low OWC .

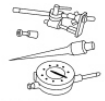


2. Inspect the intermediate () clutch surface for damage. If the surface is burned or worn excessively, install a new OWC .



Overdrive/Direct Clutch Assembly

Special Tool(s)

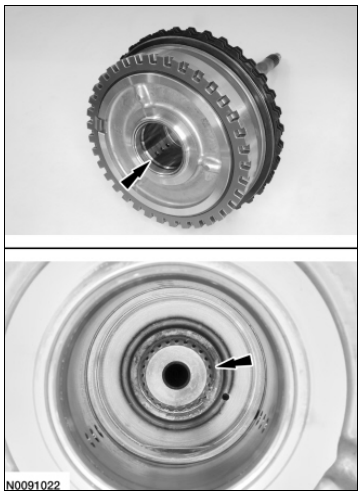
 ST3029-A	Compressor, Forward/Intermediate Spring 307-584 (includes 307-584/1 and 307-584/2)
 ST2994-A	Compressor, Overdrive Clutch, Balance Piston and Direct Clutch 307-589 (includes 307-589/1 and 307-589/2)
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST2996-A	Input Shaft Support Seal Installer (Back Plate, Multiple Rings) 307-578 (includes 307-578/1, 307-578/2 and 307-578/3)

Material

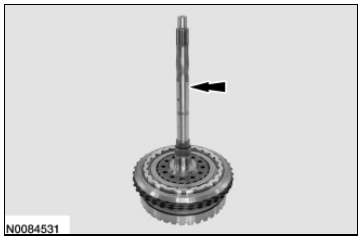
Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

Disassembly

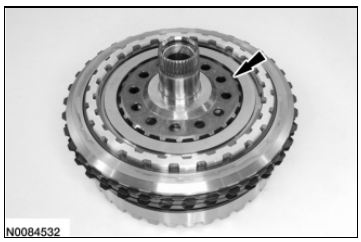
1. Remove the input shaft snap ring.



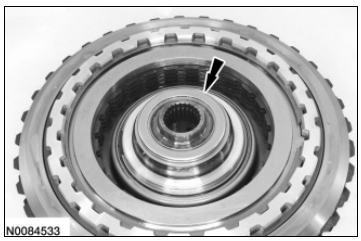
2. Remove the input shaft.



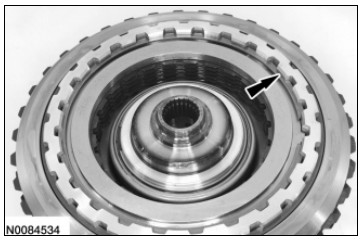
3. Remove thverdrive (O/D) (4, 5, 6) clutch hub.



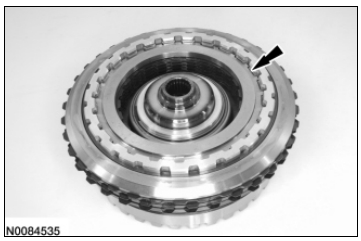
4. Remove the O/D (4, 5, 6) clutch hub, No. 2 thrust bearing.



5. Remove the O/D (4, 5, 6) clutch snap ring.



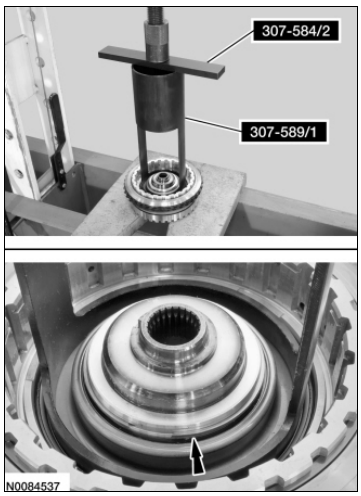
6. Remove the O/D (4, 5, 6) clutch pressure plate and clutch assembly.



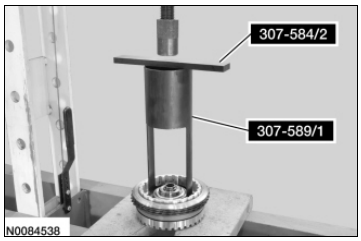
7. Install the Overdrive Clutch, Balance Piston and Direct Clutch Compressor 307-589/1 and Forward/Intermediate Spring Compressor 307-584/2 on the balance piston.



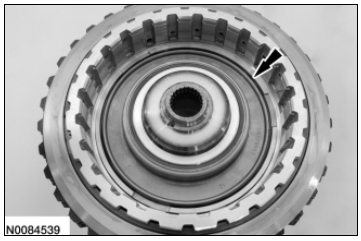
8. Using a press, compress the O/D (4, 5, 6) clutch return spring and remove the snap ring.



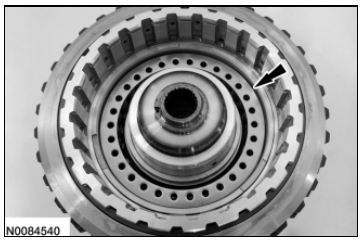
9. Remove the Overdrive Clutch, Balance Piston and Direct Clutch Compressor 307-589/1 and Forward/Intermediate Spring Compressor 307-584/2.



10. Remove and discard the balance piston.



11. Remove the O/D (4, 5, 6) piston return spring.



12. Install the clutch support tower in the transmission case and install the 3 bolts.

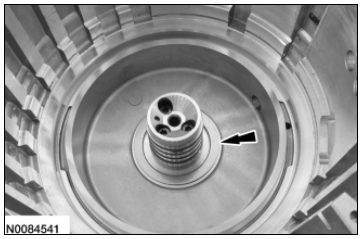
- Tighten to 12 Nm (106 lb-in).



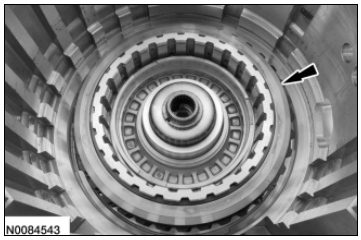
13. Remove the Input Shaft Support Seal Installer 307-578/1 (sizer).



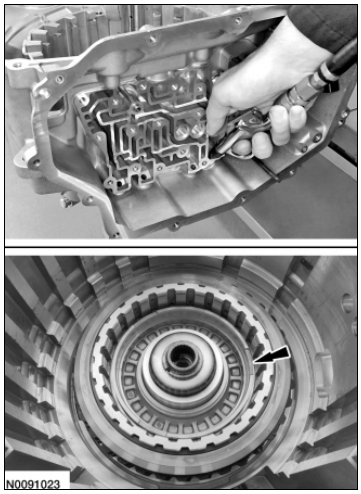
14. Install the No. 1 O/D /direct clutch assembly thrust bearing.



15. Position the O/D /direct clutch assembly in the transaxle case.



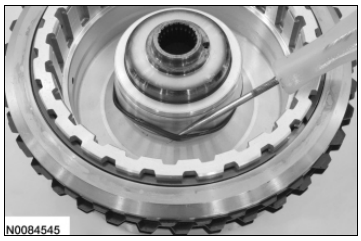
16. Apply compressed air to the O/D (4, 5, 6) clutch piston port and remove the O/D (4, 5, 6) clutch piston.



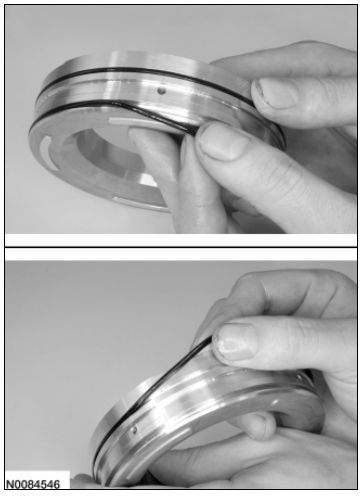
17. Remove the O/D /direct clutch assembly from the transaxle case.



18. Remove the O/D (4, 5, 6) clutch piston seal from the O/D /direct clutch assembly.



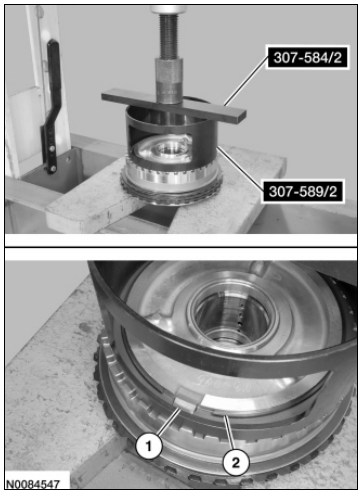
19. Remove the 2 seals from the O/D (4, 5, 6) clutch piston.



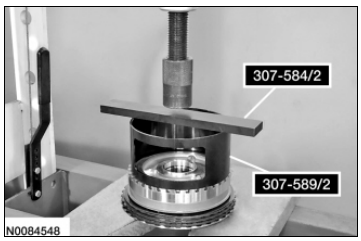
20. ***NOTICE:*** **Only compress the direct clutch piston return spring far enough to take the tension from the direct clutch cylinder off the snap ring. If the piston is compressed too far, the piston alignment tab may be broken off.**

    Install the Overdrive Clutch, Balance Piston and Direct Clutch Compressor 307-589/2 and Forward/Intermediate Spring Compressor 307-584/2 on the direct (3, 5, R) clutch cylinder. Using a press, compress the direct (3, 5, R) clutch piston return spring, and remove the snap ring.

    1. Do not contact the O/D /direct clutch hub and shaft assembly with the direct (3, 5, R) clutch cylinder.
    2. Remove the snap ring.



21. Remove the Overdrive Clutch, Balance Piston and Direct Clutch Compressor 307-589/2 and Forward/Intermediate Spring Compressor 307-584/2.



22. Remove the direct (3, 5, R) clutch cylinder.

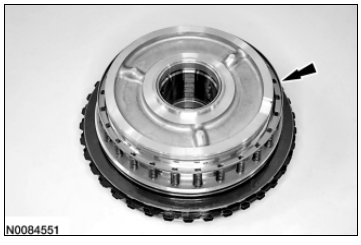


23. Remove and discard the direct (3, 5, R) clutch piston.

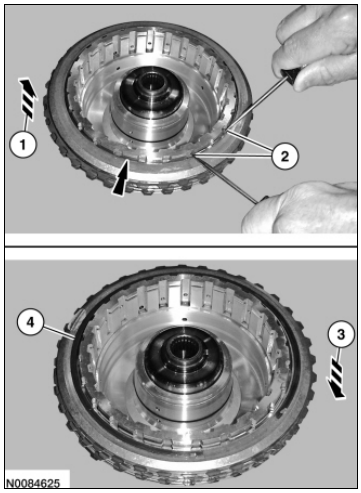


24. **NOTE:** Note the position of the return spring for assembly. The flat side faces down.

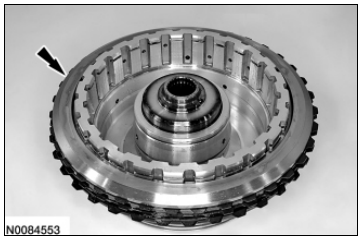
    Remove the direct (3, 5, R) clutch piston return spring.



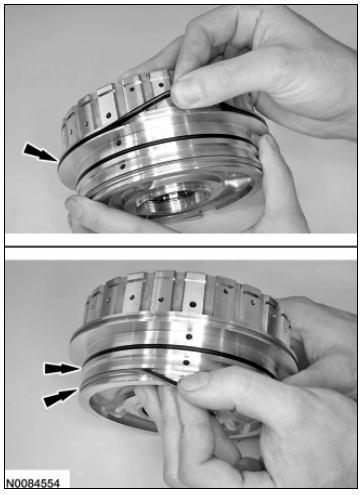
25. Remove the direct (3, 5, R) clutch snap ring.
    1. Slightly lift up on the direct (3, 5, R) clutch so that the snap ring floats freely.
    2. Using a suitable tool, compress the snap ring.
    3. Allow the direct (3, 5, R) clutch and pressure plate to drop so that the snap ring is out of the pressure plate groove.
    4. Remove the snap ring.



26. Remove the direct (3, 5, R) clutch pressure plate, clutch pack and wave spring.



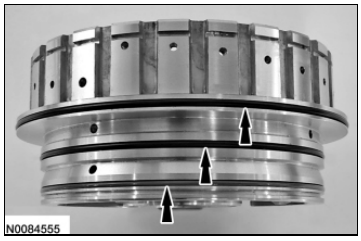
27. Remove and discard the 3 direct (3, 5, R) clutch piston seals.



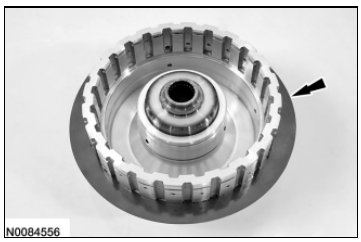
Assembly

1. Clean and inspect the O/D /direct clutch assembly for damage or excessive wear and install new components as necessary.

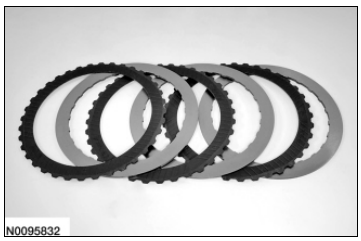
2. Install new direct (3, 5, R) clutch piston seals and lubricate the seals with petroleum jelly.



3. Install the direct (3, 5, R) clutch wave spring.



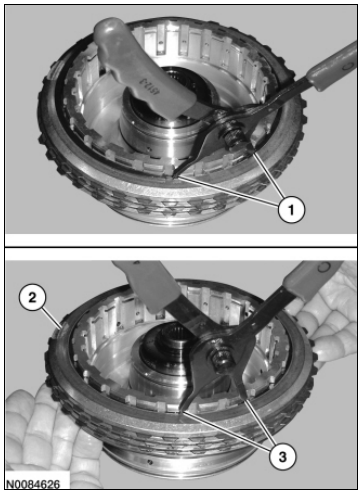
4. Soak the direct (3, 5, R) clutch pack in clean automatic transmission fluid.



5. Install the direct (3, 5, R) clutch assembly and pressure plate.

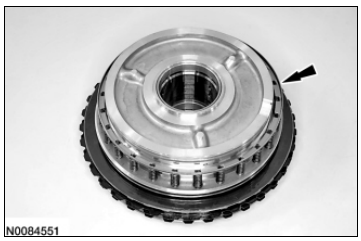


6. Install the direct (3, 5, R) clutch snap ring.
    1. Using a suitable tool, compress the snap ring.
    2. Lift the direct (3, 5, R) clutch so that the snap ring is in the groove of the pressure plate.
    3. Release the tension on the snap ring.

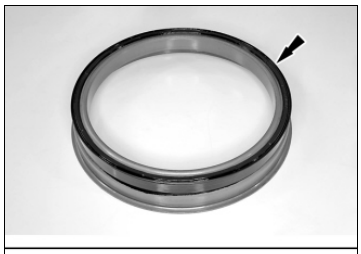


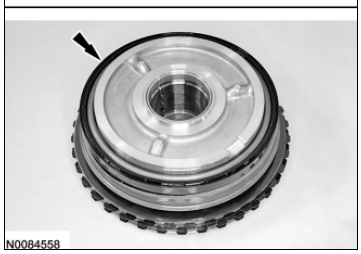
7. **NOTE:** Install the direct (3, 5, R) clutch piston return spring with the flat side facing down.

   Install the direct (3, 5, R) clutch piston return spring.



8. Lubricate a new direct (3, 5, R) clutch piston with petroleum jelly and install the piston.





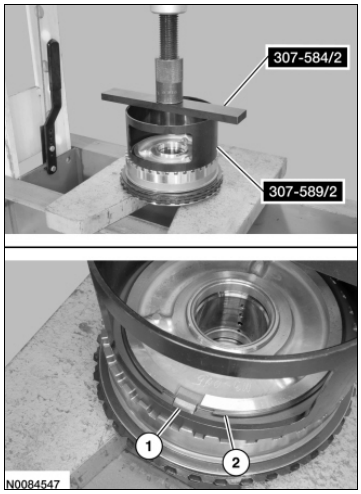
9. Install the direct (3, 5, R) clutch cylinder.



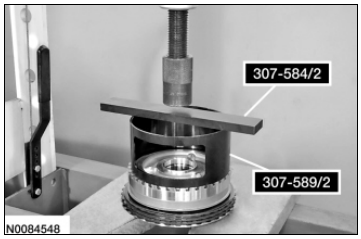
10. ***NOTICE:*** **Only compress the direct clutch piston return spring far enough to take the tension from the direct clutch cylinder off the snap ring. If the piston is compressed too far, the piston alignment tab may be broken off.**

    Install the Overdrive Clutch, Balance Piston and Direct Clutch Compressor 307-589/2 and Forward/Intermediate Spring Compressor 307-584/2 on the direct (3, 5, R) clutch cylinder. Using a press, compress the direct (3, 5, R) clutch piston return spring, and install the snap ring.

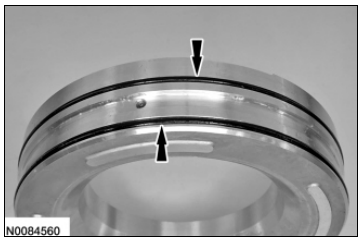
    1. Do not contact the O/D /direct clutch hub and shaft assembly with the direct (3, 5, R) clutch cylinder.
    2. Install the snap ring.



11. Remove the Overdrive Clutch, Balance Piston and Direct Clutch Compressor 307-589/2 and Forward/Intermediate Spring Compressor 307-584/2.



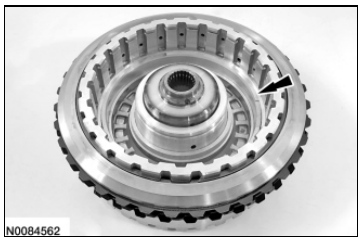
12. Install 2 new seals on the O/D (4, 5, 6) clutch piston and lubricate the seals with petroleum jelly.



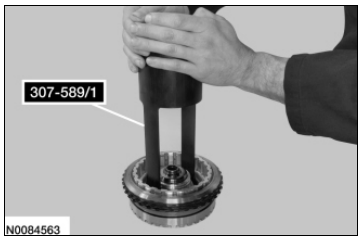
13. Install a new O/D (4, 5, 6) clutch piston inner seal and lubricate the seal with petroleum jelly.



14. Position the O/D (4, 5, 6) clutch piston in place.

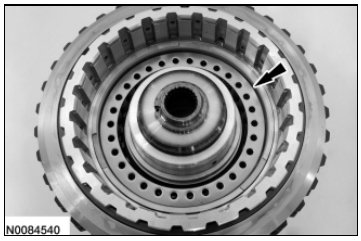


15. Using the Overdrive Clutch, Balance Piston, and Direct Clutch Compressor 307-589/1, install the O/D (4, 5, 6) clutch piston into the O/D /direct clutch assembly by hand.

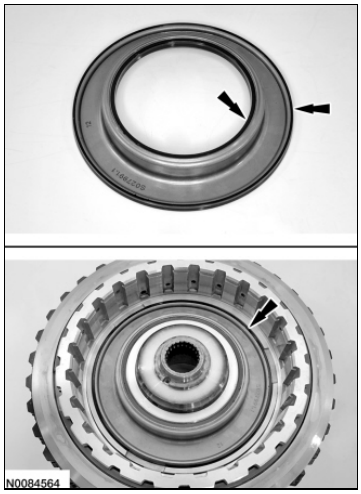


16. **NOTE:** Holes face up on the O/D (4, 5, 6) clutch piston return spring.

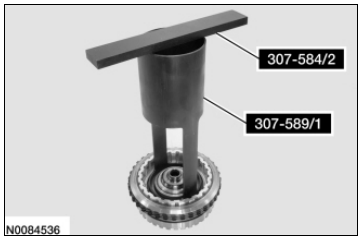
    Install the O/D (4, 5, 6) clutch piston return spring.



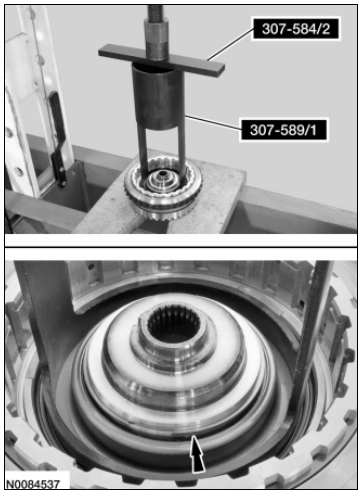
17. Lubricate the seals on a new balance piston and position the piston in place.



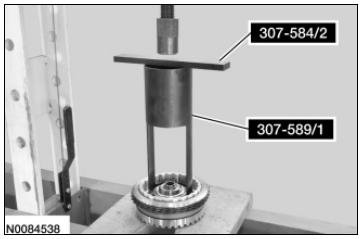
18. Install the Overdrive Clutch, Balance Piston and Direct Clutch Compressor 307-589/1 and Forward/Intermediate Spring Compressor 307-584/2 on the balance piston.



19. Using a press, compress the O/D (4, 5, 6) clutch return spring and install the snap ring.



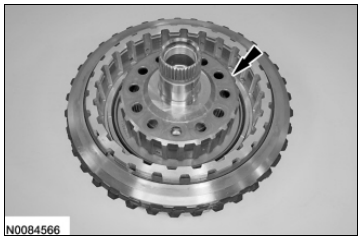
20. Remove the Overdrive Clutch, Balance Piston and Direct Clutch Compressor 307-589/1 and Forward/Intermediate Spring Compressor 307-584/2.



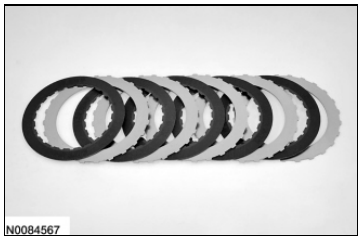
21. Install the No. 2 thrust bearing.



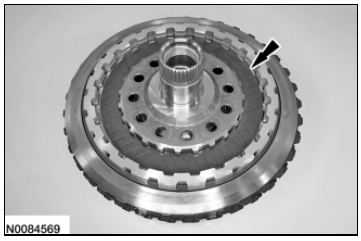
22. Install the O/D (4, 5, 6) clutch hub.



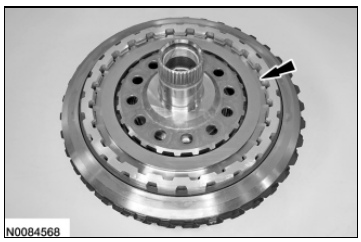
23. Soak the O/D (4, 5, 6) clutch pack in clean automatic transmission fluid.



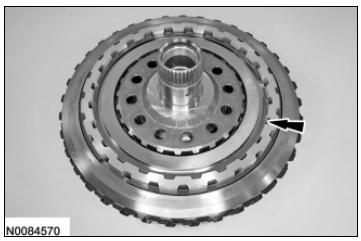
24. Install the O/D (4, 5, 6) clutch pack.



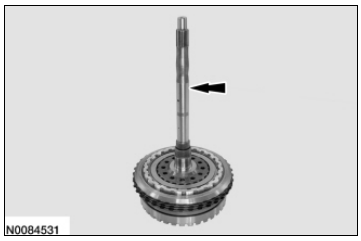
25. Install the O/D (4, 5, 6) clutch pressure plate.



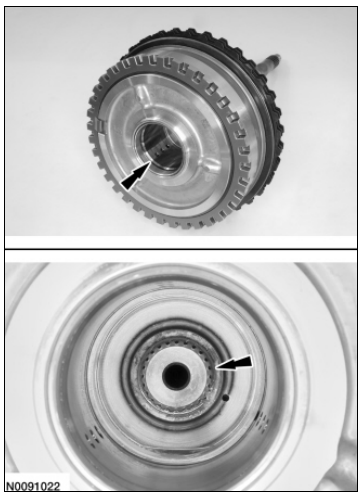
26. Install the O/D (4, 5, 6) clutch snap ring.



27. Install the input shaft.

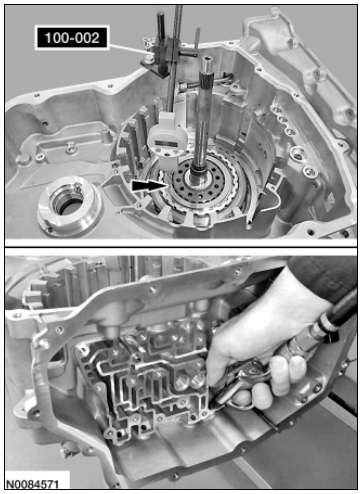


28. While holding the input shaft in place, install the snap ring.

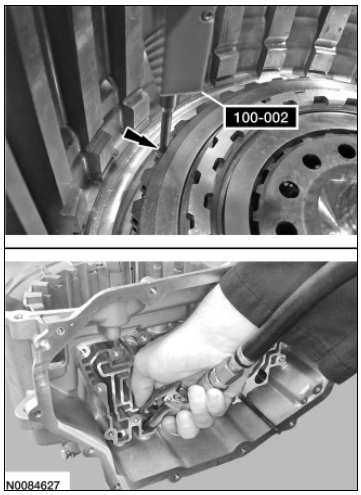


29. Position the O/D /direct clutch assembly in the transaxle case, install Dial Indicator Gauge With Holding Fixture 100-002 or a suitable dial indicator and position the plunger on the O/D (4, 5, 6)

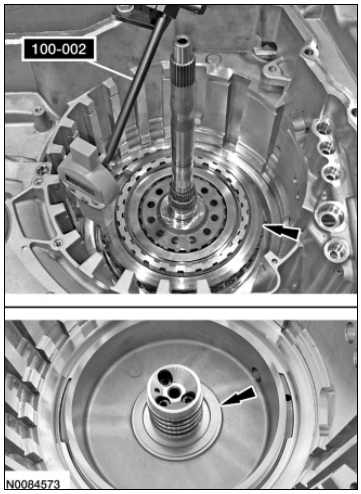
clutch pressure plate. Apply 483 kPa (70 psi) of air pressure to the O/D (4, 5, 6) clutch piston port while recording the clutch pack clearance on the Dial Indicator. The clearance should be between 0.950 mm (0.037 in) and 1.778 mm (0.07 in). If the clearance is out of range, check the O/D (4, 5, 6) clutch pack for correct installation. If the O/D (4, 5, 6) clutch pack is correctly installed, install a new O/D (4, 5, 6) clutch pack.



30. Position the plunger on one of the top direct (3, 5, R) clutch plate tabs. Apply 483 kPa (70 psi) of air pressure to the direct (3, 5, R) clutch piston port while recording the clutch pack clearance on Dial Indicator Gauge With Holding Fixture 100-002. The clearance should be between 0.412 mm (0.016 in) and 1.728 mm (0.068 in). If the clearance is out of range, check the direct (3, 5, R) clutch pack for correct installation. If the direct (3, 5, R) clutch pack is correctly installed, install a new direct (3, 5, R) clutch pack.



31. Remove Dial Indicator Gauge With Holding Fixture 100-002, O/D /direct clutch assembly and the No. 1 O/D /direct clutch assembly thrust bearing.


100-002
N0084573

Center Support

Special Tool(s)

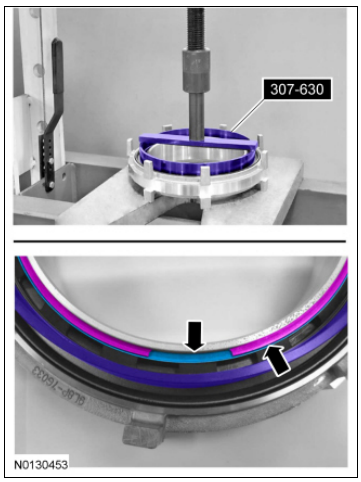
 ST3068-A	Compressor, Center Support Piston Spring 307-630
 ST3067-A	Seal Protector, Low Reverse Piston 307-628 (includes 307-628/1 and 307-628/2)
 ST3062-A	Seal Protector, Low Reverse / 1-2-3-4 Piston 307-629

Disassembly

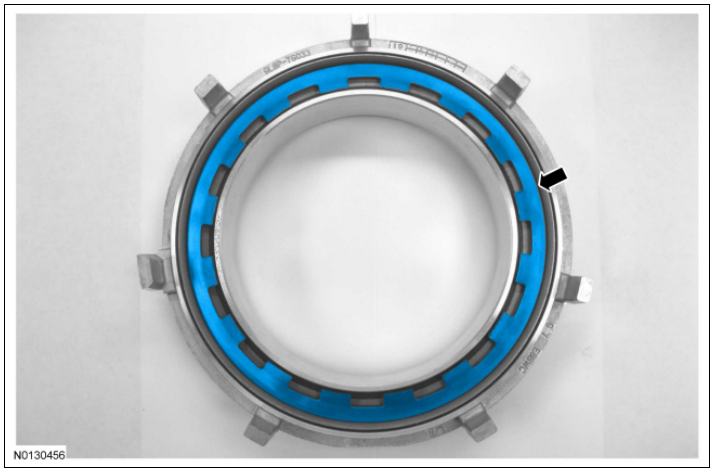
NOTICE: **The piston return spring, snap ring or snap ring retainer from the low/reverse clutch side of the center support are not interchangeable with the forward clutch side of the center support. When disassembling the center support, be careful not to mix the components from the low/reverse clutch side with the forward clutch side of the center support. Failure to assemble the center support with the components in the correct side will result in damage to the center support, low/reverse or forward clutch.**

1. **NOTE:** The low/reverse clutch piston in the center support is the side of the center support with the long legs.

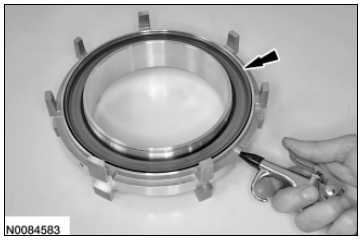
   Using the Center Support Piston Spring Compressor 307-630 and a press, compress the low/reverse clutch return spring and remove the snap ring and the snap ring retainer.



2. Remove the low/reverse clutch return spring.

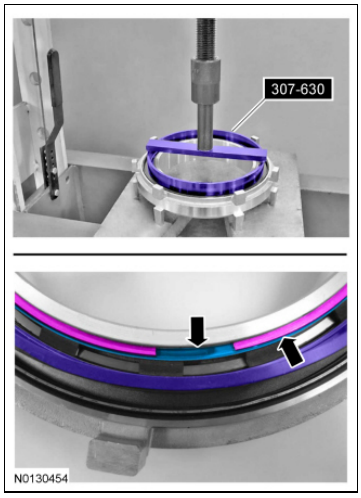


3. Apply 483 kPa (70 psi) of air pressure to the low/reverse clutch piston port and remove the low/reverse clutch piston.

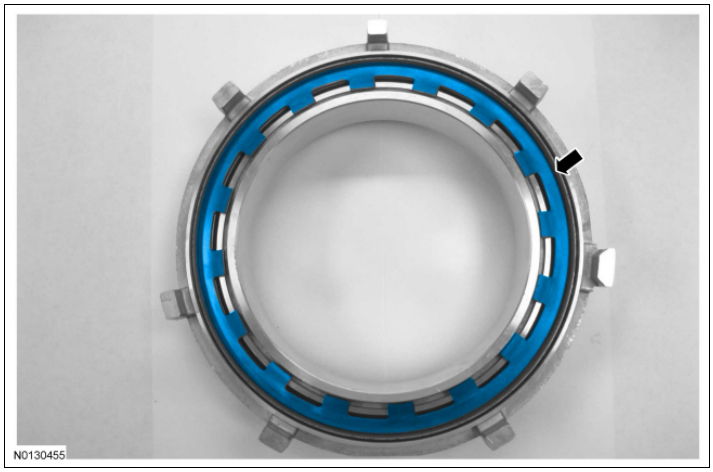


4. **NOTE:** The forward clutch piston in the center support is the side of the center support with the short legs.

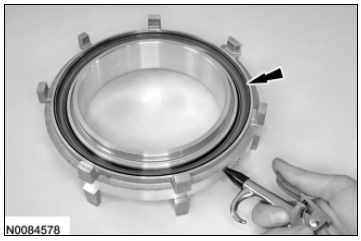
   Using the Center Support Piston Spring Compressor 307-630 and a press, compress the forward (1, 2, 3, 4) clutch return spring and remove the snap ring and the snap ring retainer.



5. Remove the return spring from the forward (1, 2, 3, 4) clutch piston.



6. Apply 483 kPa (70 psi) of air pressure to the forward (1, 2, 3, 4) clutch piston port and remove the forward (1, 2, 3, 4) clutch piston.



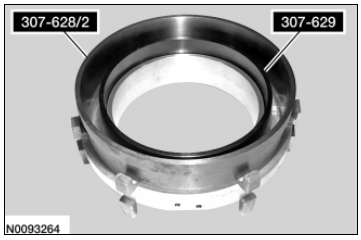
Assembly

NOTICE: **The piston return spring, snap ring or snap ring retainer from the low/reverse clutch side of the center support are not interchangeable with the forward clutch side of the center support. When assembling the center support, be careful not to mix the components from the low/reverse clutch side with the forward clutch side of the center support. Failure to assemble the center support with the components in the correct side will result in damage to the center support, low/reverse or forward clutch.**

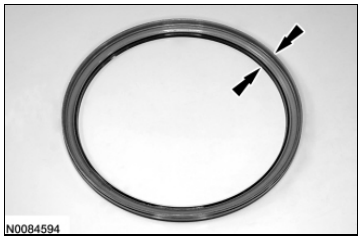
1. Clean and inspect the center support for damage. Install a new center support if necessary.

2. **NOTE:** The forward clutch piston in the center support is the side of the center support with the short legs.

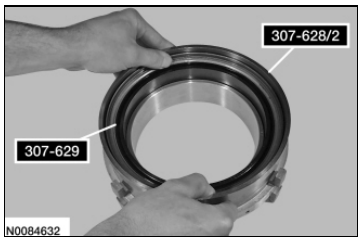
   Install the Low Reverse Piston Seal Protector 307-628/2 and the Low Reverse / 1-2-3-4 Piston Seal Protector 307-629 on the forward clutch piston side of the center support.



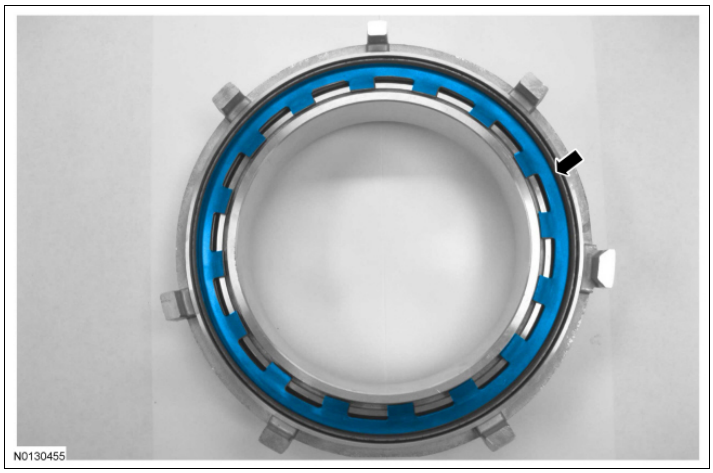
3. Lubricate the sealing surfaces of the forward (1, 2, 3, 4) clutch piston with petroleum jelly.



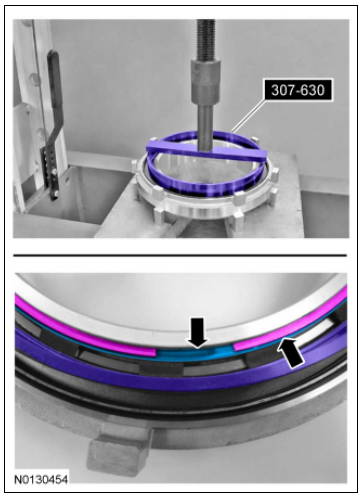
4. Position the forward (1, 2, 3, 4) clutch piston on Low Reverse Piston Seal Protector 307-628/2 and the Low Reverse / 1-2-3-4 Piston Seal Protector 307-629 and push it down into the center support.



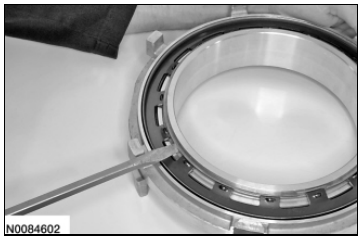
5. Install the forward (1, 2, 3, 4) clutch piston return spring.



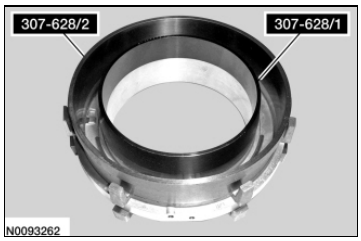
6. Using the Center Support Piston Spring Compressor 307-630 and a press, compress the forward (1, 2, 3, 4) clutch return spring and install the snap ring retainer and the snap ring.



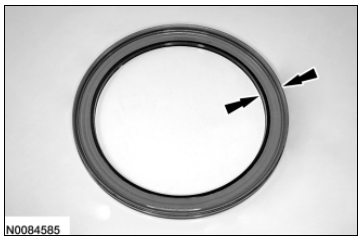
7. Inspect the snap ring to be sure it is seated in the groove on the center support.



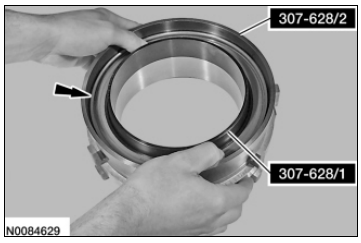
8. Turn the center support over and install the Low Reverse Piston Seal Protector 307-628/1 and 307-628/2 on the low/reverse piston side of the center support.



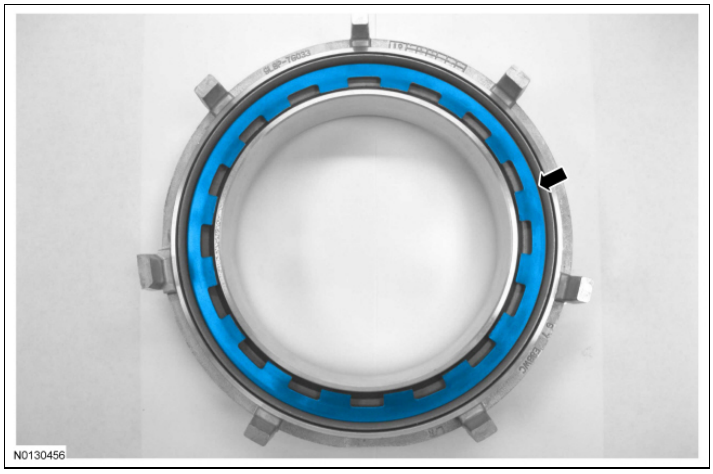
9. Lubricate the sealing surfaces of the low/reverse piston with petroleum jelly.



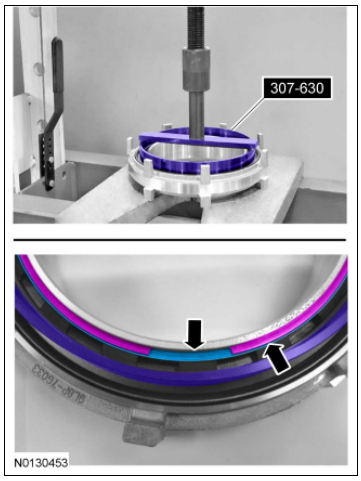
10. Position the low/reverse clutch piston on the Low Reverse Piston Seal Protector 307-628/1 and 307-628/2 and push it down into the center support.



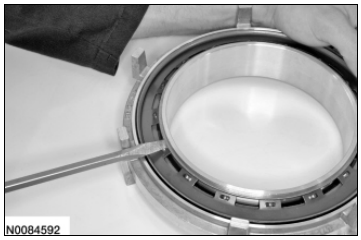
11. Install the low/reverse piston return spring.



12. Using the Center Support Piston Spring Compressor 307-630 and a press, compress the low/reverse clutch return spring and install the snap ring retainer and the snap ring.

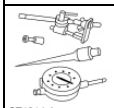
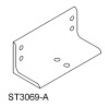
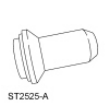


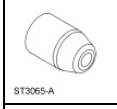
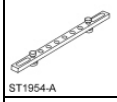
13. Inspect the snap ring to be sure it is seated in the groove on the center support.



Transaxle

Special Tool(s)

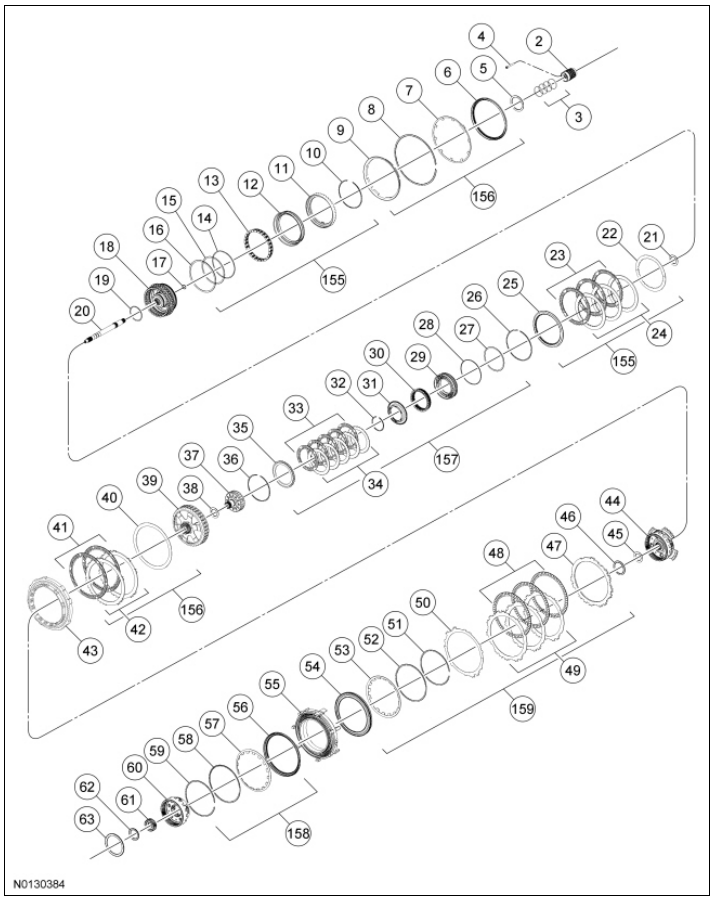
 ST2987-A	Compressor, Forward Clutch Spring 307-574 (includes 307-574/1 and 307-574/2)
 ST3029-A	Compressor, Forward/Intermediate Spring 307-584 (includes 307-584/1 and 307-584/2)
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1255-A	Handle 205-153 (T80T-4000-W)
 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST3069-A	Holding Fixture 307-625
 ST2996-A	Input Shaft Support Seal Installer (Back Plate, Multiple Rings) 307-578 (includes 307-578/1, 307-578/2 and 307-578/3)
 ST3229-A	Installer, Bushing 307-664
 ST3070-A	Installer, Differential Seal 307-626
 ST2525-A	Installer, RH Halfshaft Fluid Seal 307-428
 ST2999-A	Manual Lever Seal Installer 307-581
 ST1636-A	Retainer, Torque Converter 307-566
 ST3062-A	Seal Protector, 2-6 Piston 307-632

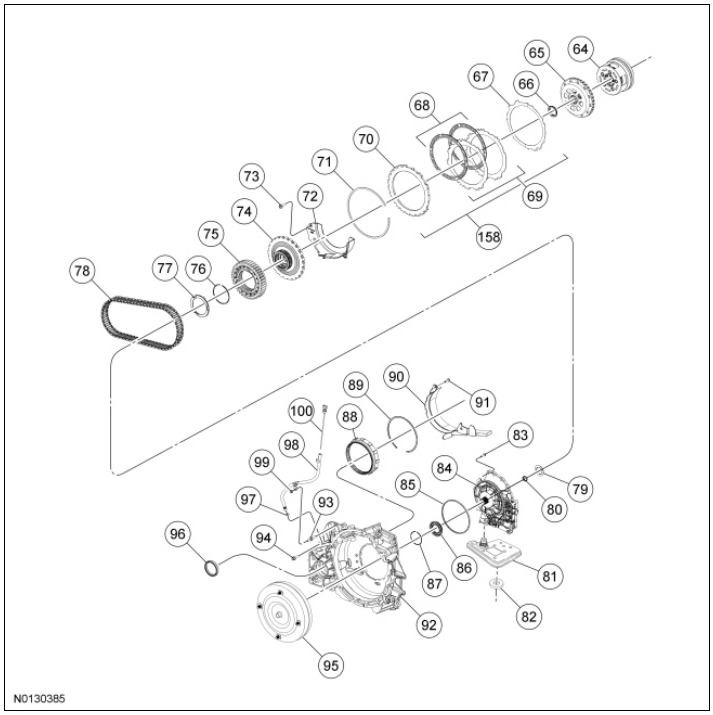
 ST3065-A	Seal Protector, Turbine Shaft 307-635
 ST1954-A	Shim Selection Gauge 307-300 (T94P-77000-Q) (17-055)
 ST3063-A	Spring Compressor, 2-6 Piston Return 307-633 (Includes 307-633/1 and 307-633/2)

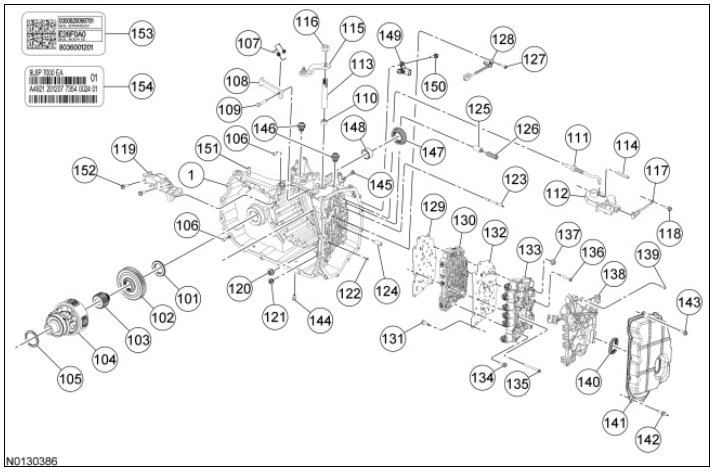
Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Ultra Silicone Sealant TA-29	-

Disassembled Views







Item	Part Number	Description
1	7005	Transaxle case
2	7A130	Clutch support tower
3	7D019	Clutch support tower seals (4 required)
4	W302855	Clutch support tower bolt (3 required)
5	7F242	No. 1 thrust bearing
6	7E005	Intermediate (2, 6) clutch piston
7	7B070	Intermediate (2, 6) clutch piston return spring
8	7D483	Intermediate (2, 6) clutch return spring snap ring
9	7E005	Intermediate (2, 6) clutch apply ring
10	7C122	Direct (3, 5, R) clutch cylinder snap ring
11	7F283	Direct (3, 5, R) clutch cylinder
12	7A262	Direct (3, 5, R) clutch piston
13	7F235	Direct (3, 5, R) clutch piston return spring
14	7C099	Direct (3, 5, R) clutch piston inner (rear) seal

15	7C099	Direct (3, 5, R) clutch piston inner (front) seal
16	7A548	Direct (3, 5, R) clutch piston outer seal
17	7C122	Input shaft snap ring
18	7G384	Direct (3, 5, R)/Overdrive (O/D) (4, 5, 6) clutch cylinder and hub assembly
19	7A548	O/D (4, 5, 6) clutch piston inner seal
20	7F213	Input shaft
21	7D234	No. 2 thrust bearing
22	7B070	Direct (3, 5, R) clutch wave spring
23	7B164	Direct (3, 5, R) clutch friction plates (3 required)
24	7B442	Direct (3, 5, R) clutch steel plates (3 required)
25	7B066	Direct (3, 5, R) clutch pressure plate
26	7D483	Direct (3, 5, R) clutch snap ring
27	7A548	O/D (4, 5, 6) clutch piston outer (rear) seal
28	7A548	O/D (4, 5, 6) clutch piston outer (front) seal
29	7A262	O/D (4, 5, 6) clutch piston
30	7F222	O/D (4, 5, 6) clutch piston return spring
31	7H360	O/D (4, 5, 6) clutch balance piston
32	7C122	O/D (4, 5, 6) clutch piston snap ring
33	7B164	O/D (4, 5, 6) clutch friction plates (5 required)
34	7B442	O/D (4, 5, 6) clutch steel plates (5 required)
35	7B066	O/D (4, 5, 6) clutch pressure plate
36	7D483	O/D (4, 5, 6) clutch snap ring
37	7H351	O/D (4, 5, 6) clutch hub
38	7D234	No. 3 thrust bearing
39	7A019	Rear planetary sun gear and shell assembly
40	7E085	Intermediate (2, 6) clutch wave spring
41	7B164	Intermediate (2, 6) clutch friction plates (2 required)
42	7B442	Intermediate (2, 6) clutch steel plates (2 required)
43	7A089	One-Way Clutch (OWC)
44	7D491	Rear planet carrier/center ring gear
45	7C096	No. 6 thrust bearing
46	7G177	No. 5 thrust bearing
47	7B066	Low/reverse clutch pressure plate
48	7B164	Low/reverse clutch friction plates (3 required)
49	7B442	Low/reverse clutch steel plates (3 required)
50	7E085	Low/reverse clutch wave spring
51	7C122	Low/reverse clutch piston snap ring
52	7H318	Low/reverse clutch piston snap ring retainer
53	7B070	Low/reverse clutch piston return spring
54	7D402	Low/reverse clutch piston
55	7L328	Center support

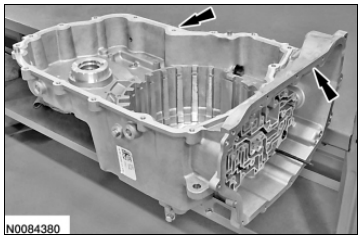
56	7A262	Forward (1, 2, 3, 4) clutch piston
57	7B070	Forward (1, 2, 3, 4) clutch piston return spring
58	7D041	Forward (1, 2, 3, 4) clutch piston snap ring retainer
59	7H365	Forward (1, 2, 3, 4) clutch piston snap ring
60	7D491	Center planetary carrier/front ring gear
61	7D063	Center planetary sun gear
62	7C096	No. 7 thrust bearing
63	7C096	No. 8 thrust bearing
64	7D491	Front planetary carrier/rear ring gear
65	7A019	Front planetary sun gear and shell assembly
66	7D234	No. 10 thrust bearing
67	7B070	Forward (1, 2, 3, 4) clutch wave spring
68	7B164	Forward (1, 2, 3, 4) clutch friction plates (2 required)
69	7B442	Forward (1, 2, 3, 4) clutch steel plates (2 required)
70	7B066	Forward (1, 2, 3, 4) clutch pressure plate
71	7D483	Forward (1, 2, 3, 4) clutch snap ring
72	7978	Transmission fluid baffle
73	W500214	Transmission fluid baffle bolt (2 required)
74	7060	Park gear
75	7G132	Drive chain drive sprocket
76	7C122	Drive sprocket snap ring
77	7G099	No. 13 thrust washer
78	7G249	Drive chain
79	7D234	No. 11 thrust washer
80	7048	Input shaft seal
81	7A098	Transmission fluid filter
82	7L027	Magnet
83	W302860	Pump-to-torque converter housing bolt (8 required)
84	7A103	Pump assembly
85	7A248	Pump assembly-to-torque converter housing O-ring seal
86	7A248	Torque converter hub seal
87	7P113	Torque converter hub seal retainer
88	7F343	Different ring gear
89	7C122	Differential ring gear snap ring
90	7H245	Differential transmission fluid baffle
91	W500214	Differential transmission fluid baffle bolt (2 required)
92	7975	Torque converter housing
93	W701606	Torque converter housing stud bolt
94	7A443	Torque converter housing bolt (16 required)

95	7902	Torque converter
96	1177	RH halfshaft seal
97	391308-S	Transaxle filler tube O-ring
98	7A228	Transaxle filler tube
99	W520101	Transaxle filler tube nut
100	7A020	Transmission fluid level indicator
101	7G355	No. 12 thrust bearing
102	7G132	Drive chain driven sprocket
103	7F342	Differential sun gear
104	7F465	Differential assembly
105	7G112	No. 15 thrust bearing
106	7B362	Torque converter housing-to-transaxle case guide pins
107	7D070	Park pawl spring
108	7A441	Park pawl
109	7D071	Park pawl pin
110	7F337	Manual control shaft seal
111	7A232	Park pawl actuator rod
112	7H557	Transmission Range (TR) sensor
113	7C493	Manual control shaft
114	7G100	Manual control shaft pin
115	7A256	Manual control lever
116	W708455	Manual control lever nut
117	7E332	Manual valve detent spring
118	W711235	Manual valve detent spring bolt
119	7J387	Lubrication funnel
120	7A248	Torque converter housing-to-transaxle case seal (large)
121	7A248	Torque converter housing-to-transaxle case seal (small) (4 required)
122	7B431	Main control alignment pin
123	7C207	Main control stud
124	7G199	Main control-to-center support seal (2 required)
125	7H322	Thermal bypass valve and sleeve
126	-	Thermal bypass valve spring (part of 7H322)
127	W713644	Output Shaft Speed (OSS) sensor bolt
128	7H103	OSS sensor
129	7Z490	Main control-to-transaxle case separator plate
130	7A100	Main control valve body
131	N605770	Separator plate-to-soledoid body bolt (2 required)
132	7Z490	Main control valve body-to-solenoid body separator plate
133	7G391	Solenoid body
134	W500303	Solenoid body-to-valve body bolt (2 required)

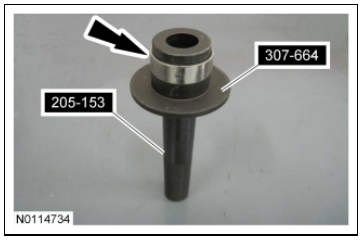
135	W302863	Main control-to-transaxle case bolt (long) (10 required)
136	W302862	Main control-to-transaxle case bolt (short) (12 required)
137	W520412	Main control nut
138	7G276	Main ctrol leadframe
139	W505513	Main control leadframe screw (5 required)
140	7B329	Main control-to-cover seal
141	7G004	Main control cover
142	W714629	Main control cover stud bolt (5 required)
143	W500214	Main control cover bolt (8 required)
144	7010	Drain plug
145	7H398	Line pressure tap
146	7D273	Transmission fluid cooler tube fittings (2 required)
147	1177	LH halfshaft seal
148	7025	LH halfshaft bushing
149	7M101	Turbine Shaft Speed (TSS) sensor
150	W500214	TSS bolt
151	7A246	Vent tube
152	W500214	Lubrication funnel bolts
153	7G342	Solenoid body strategy tag
154	7B148	Transaxle service identification tag
155	-	Direct clutch (3, 5, R)
156	-	Intermediate clutch (2, 6)
157	-	O/D clutch (4, 5, 6)
158 td>-	Forward clutch (1, 2, 3, 4)	
159	-	Low/reverse clutch

All vehicles

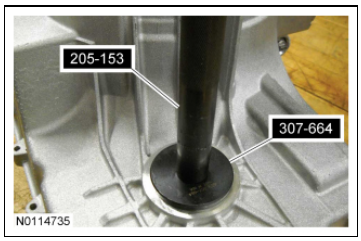
1. Clean and inspect the transaxle case for damage. Clean the silicone from the transaxle case-to-torque converter housing sealing surface and the main control cover sealing surface.



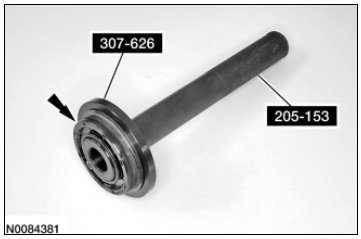
2. Assemble the Handle 205-153 and the Bushing Installer 307-664 and install a new bushing on the Bushing Installer.



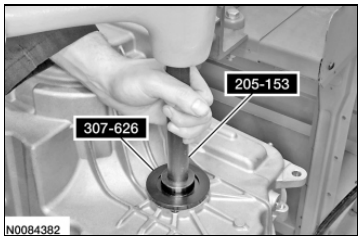
3. Using the Handle 205-153 and the Bushing Installer 307-664, install the new bushing in the transaxle case.



4. Assemble the Handle 205-153 and Seal Installer 307-626. Install a new LH halfshaft seal on the Differential Seal Installer 307-626.



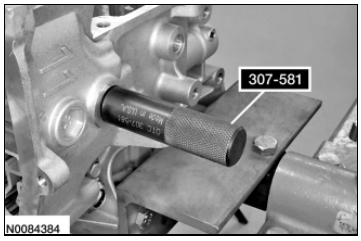
5. Using the Differential Seal Installer 307-626 and Handle 205-153, install the new LH halfshaft seal in the transaxle case.



6. Install a new manual control shaft seal on Manual Lever Seal Installer 307-581.



7. Using the Manual Lever Seal Installer 307-581, install the new manual control shaft seal in the transaxle case.



8. If not previously installed, install the clutch support tower and the 3 bolts.
   - Tighten to 12 Nm (106 lb-in).



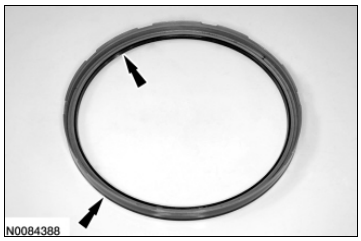
9. Remove Input Shaft Support Seal Installer 307-578/1.



10. Install 2-6 Piston Seal Protector 307-632.

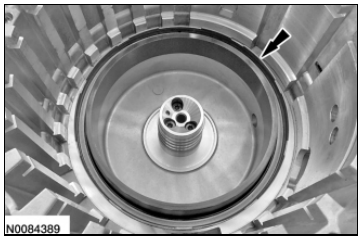


11. Lubricate the seals on the intermediate (2, 6) clutch piston with clean transmission fluid.

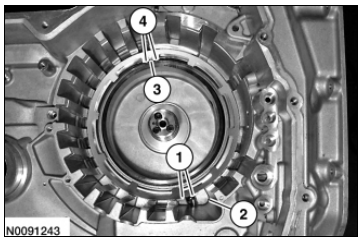


12. ***NOTICE:*** **Be sure the bleed hole is aligned in the correct position as noted during disassembly or damage to the transaxle can occur.**

    Install the intermediate (2, 6) clutch piston on the seal protector with the bleed hole aligned at the top of the transaxle case.



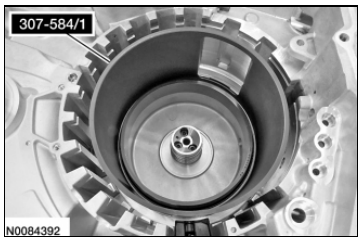
13. Position the intermediate (2, 6) clutch piston return spring on the piston to align the piston before pushing it in its bore. The tabs of the return spring should fit into the indentions of the piston and the 2 outer tabs should be at the clockwise most position of the open area at the bottom of the transaxle case. The bleed hole on the piston should be aligned between the inner double tabs of the return spring.
    1. Outer tabs
    2. Open area at the bottom of the transaxle case
    3. Bleed hole
    4. Inner double tabs



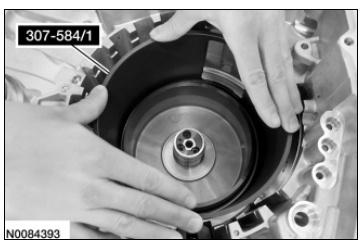
14. Remove the intermediate (2, 6) clutch piston return spring.



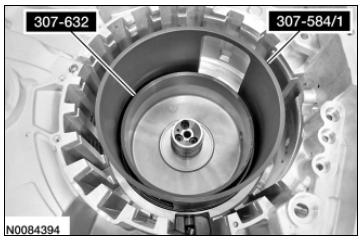
15. Install Forward/Intermediate Spring Compressor 307-584/1 on the intermediate (2, 6) clutch piston.



16. Using Forward/Intermediate Spring Compressor 307-584/1, push the intermediate (2, 6) clutch piston into the clutch cylinder by hand.



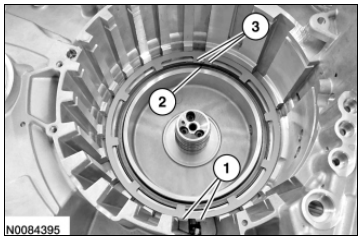
17. Remove Forward/Intermediate Spring Compressor 307-584/1 and Clutch Piston Seal Protector 307-632.



18. ***NOTICE:*** **Be sure the return spring is positioned correctly with the forward clutch bleed hole aligned between the inner double tabs and the outer tab in the clockwise most position of the slot at the bottom of the case or damage to the transaxle can occur.**

    Install the intermediate (2, 6) clutch piston return spring. The tabs of the return spring should fit into the indentions of the piston and the 2 outer tabs should be at the clockwise most position of the slot at the bottom of the case. The bleed hole on the piston should be aligned between the inner double tabs of the return spring.

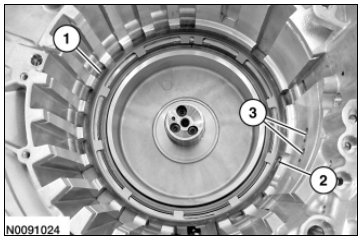
    1. Outer tabs
    2. Bleed hole
    3. Inner double tabs



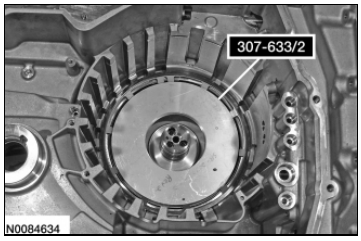
19. ***NOTICE:*** **Be sure the snap ring is aligned with the gap facing the front of the transaxle or damage to the transaxle can occur. The front of the transaxle is where the low/reverse and forward (1, 2, 3, 4) clutch hydraulic ports are located.**

    Position the snap ring in place. Align the gap of the snap ring to face the front of the transaxle.

    1. Snap ring
    2. Snap ring gap
    3. Low/reverse and forward (1, 2, 3, 4) clutch hydraulic ports (located at the front of the transaxle case)



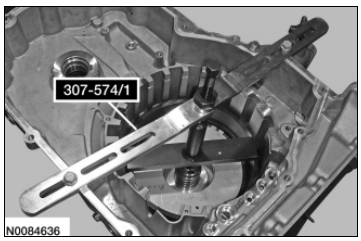
20. Install the 2-6 Piston Return Spring Compressor 307-633/2 on the transaxle case to center the intermediate (2, 6) clutch return spring.



21. Install the 2-6 Piston Return Spring Compressor 307-633/1 on the snap ring.

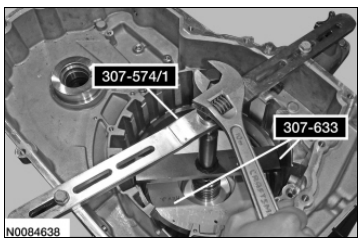


22. Install Forward Clutch Spring Compressor 307-574/1 on the transaxle case.

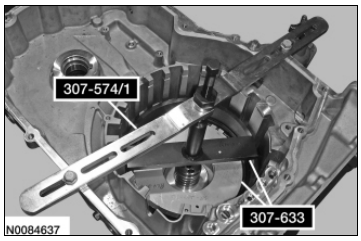


23. ***NOTICE:*** **Be sure the return spring is centered or it can bind on the snap ring groove and cause damage to the transaxle case.**

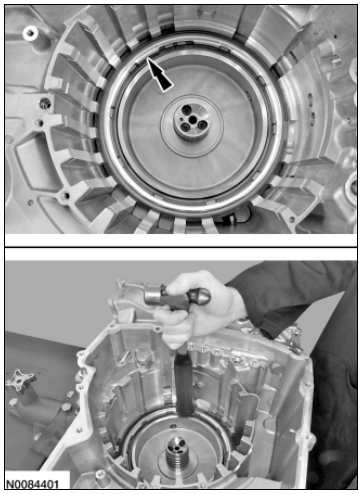
    Using the Forward Clutch Spring Compressor 307-574/1 and the 2-6 Piston Return Spring Compressor 307-633, install the intermediate (2, 6) clutch snap ring in the groove.



24. Remove the Forward Clutch Spring Compressor 307-574/1 and the 2-6 Piston Return Spring Compressor 307-633.

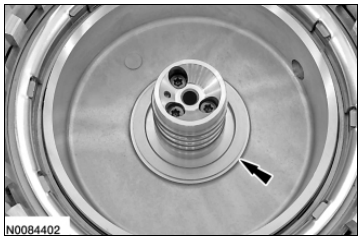


25. Install the intermediate (2, 6) clutch apply ring. Tap the ring in place using a suitable tool.

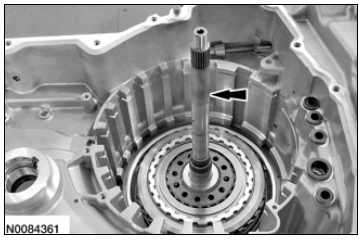


26. ***NOTICE:*** **Be sure to install the No. 1 thrust bearing with the flat side facing up or damage to the transaxle can occur.**

    Install the No. 1 thrust bearing with the flat side facing up.

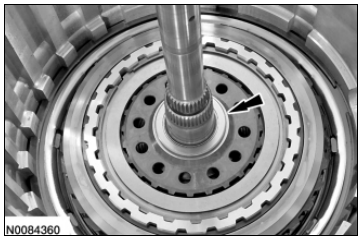


27. Install the overdrive/direct clutch assembly.



28. ***NOTICE:*** **Be sure to install the No. 3 thrust bearing with the flat side facing down or damage to the transaxle can occur.**

    Install the No. 3 thrust bearing with the flat side facing down.



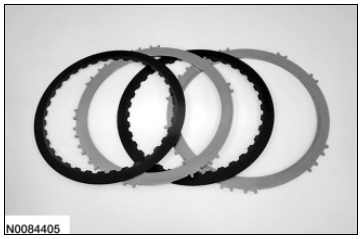
29. Install the direct/intermediate clutch hub and rear sun gear assembly.



30. Install the intermediate (2, 6) wave spring assembly.



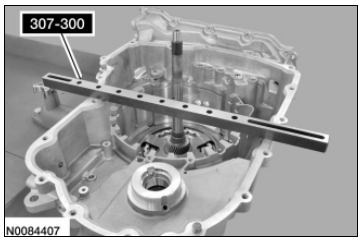
31. Soak the intermediate (2, 6) clutch assembly in clean transmission fluid.



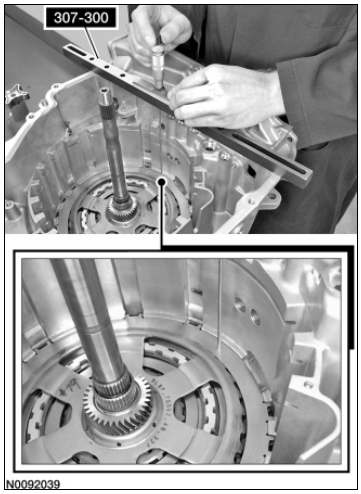
32. Install the intermediate (2, 6) clutch assembly, temporarily reversing the top friction and steel plates for the clutch stack-up measurement.



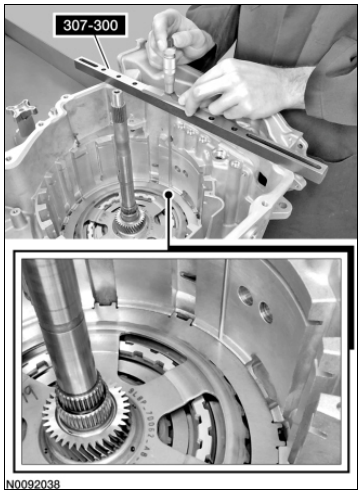
33. Install the Shim Selection Gauge 307-300 on the transaxle case.



34. Using a suitable depth gauge, measure and record as measurement A, the distance from the Shim Selection Gauge 307-300 to the top of the intermediate (2, 6) clutch pack at 3 different points and average the 3 distances.



35. Using a suitable depth gauge, measure and record as measurement B, the distance from the top of Shim Selection Gauge 307-300 to the transaxle case step above the intermediate (2, 6) clutch.

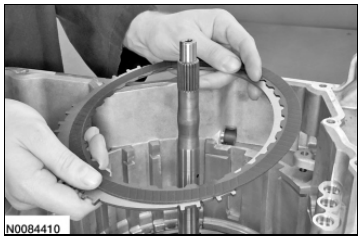


36. Subtract measurement B from measurement A The clearance should be between 0.240 mm (0.009 in) and 2.60 mm (0.102 in). If the clearance is out of range, check the intermediate (2, 6) clutch pack for correct installation. If the intermediate (2, 6) clutch pack is correctly installed, install a new clutch pack.

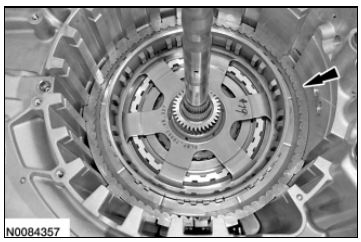
Description	Reading
Measurement A	
Measurement B	
Subtract measurement B from measurement A and check to see if it is within range of 0.240 mm (0.009 in) and 2.60 mm (0.102 in)	

37. **NOTE:** When the intermediate (2, 6) clutch is correctly installed, a friction plate is on top.

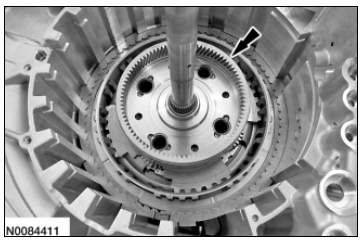
    Remove the top intermediate (2, 6) clutch friction and steel plate and correctly install the plates back in the transaxle case.



38. Install the One-Way Clutch (OWC) assembly.



39. Install the rear planetary carrier/center ring gear assembly.

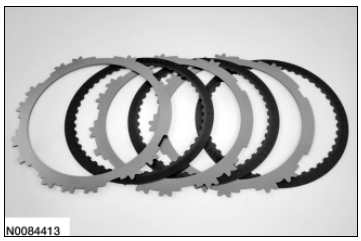


40. **NOTE:** Note the position of the low/reverse pressure plate. When installing the center support, the long support legs must fit through the low/reverse pressure plate and rest on the OWC .

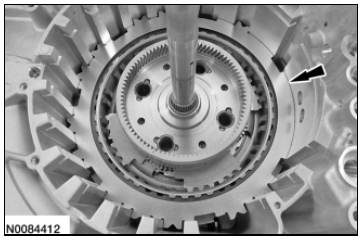
    Position the low/reverse pressure plate so that the center support legs fit through the pressure plate and rest on the OWC and install the low/reverse pressure plate.



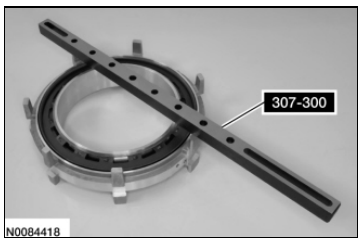
41. Soak the low/reverse clutch in clean automatic transmission fluid.



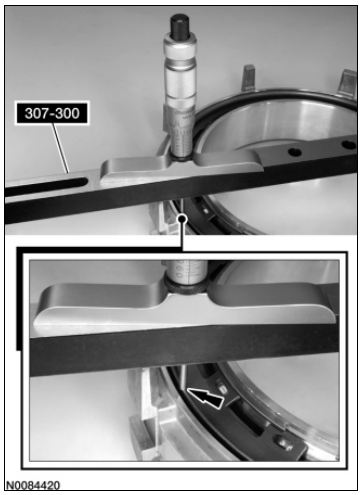
42. Align the low/reverse clutch pack with the pressure plate and install it in the transaxle case temporarily reversing the wave spring and top steel plate.



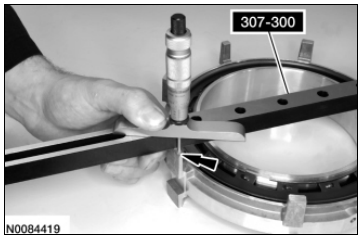
43. Install the Shim Selection Gauge 307-300 on the side of the center support with the long support legs.



44. Using a suitable depth gauge, measure and record as measurement A, the distance from the top of Shim Selection Gauge 307-300 to the contact surface of the low/reverse clutch piston.



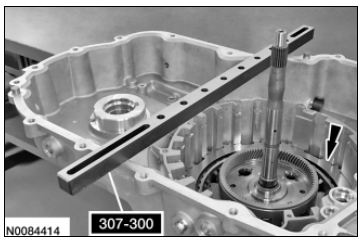
45. Using a suitable depth gauge, measure and record as measurement B, the distance from the top of Shim Selection Gauge 307-300 to the leg surface of the center support.



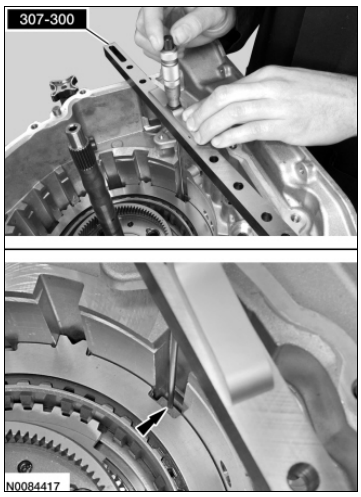
46. Subtract measurement B from measurement A and record as measurement C.

Description	Reading
Measurement A	
Measurement B	
Subtract measurement B from measurement A and record as measurement C.	

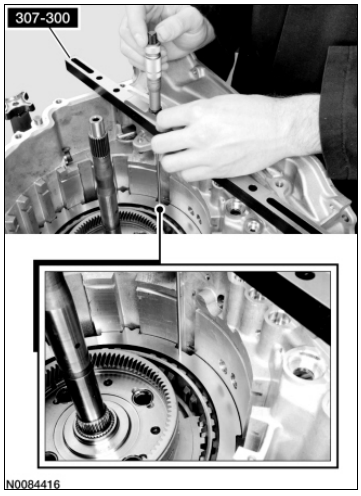
47. Install the Shim Selection Gauge 307-300 on the transaxle case.



48. Using a suitable depth micrometer, measure and record as measurement D, the distance from the Shim Selection Gauge 307-300 to the top of the OWC .



49. Using a suitable depth gauge, measure and record as measurement E, the distance from the top of Shim Selection Gauge 307-300 to the top of the low/reverse clutch at 3 different points and average the 3 distances.



50. Subtract measurement E from measurement D and record as measurement F.

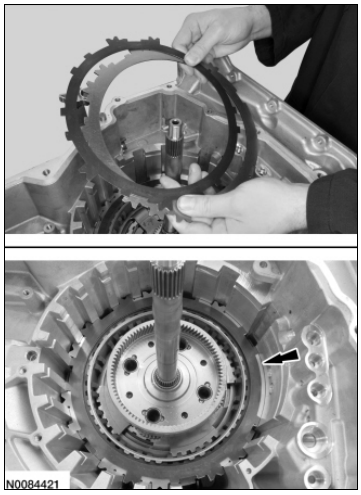
Description	Reading
Measurement D	
Measurement E	
Subtract measurement E from measurement D and record as measurement F	

51. Subtract measurement F from measurement C to get the low/reverse clutch clearance. The clearance should be between 0.406 mm (0.015 in) and 2.000 mm (0.078 in). If the clearance is out of range, check the low/reverse clutch pack for correct installation. If the low/reverse clutch pack is correctly installed, install a new clutch pack.

Description	Reading
Measurement C	
Measurement F	
Subtract measurement F from measurement C and check to see if it is within range of 0.406 mm (0.015 in) and 2.000 mm (0.078 in)	

52. **NOTE:** When the low/reverse clutch is correctly installed, the wave spring is on top.

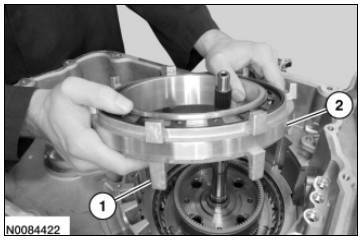
    Remove the top low/reverse clutch steel plate and wave spring and correctly install the plates back in the transaxle case.



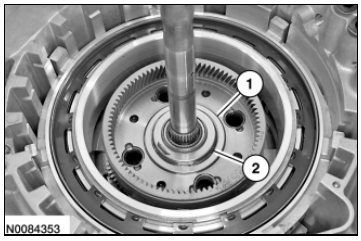
53. **NOTE:** Be sure the center support is installed with the long support legs facing down and the feed holes facing the front of the transaxle.

    Install the center support with the long legs facing down and the feed holes aligned with the feed holes in the transaxle case.

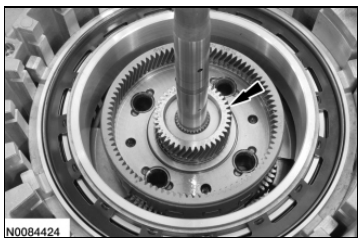
    1. Long center support legs face down
    2. Feed holes face the front of the transaxle case



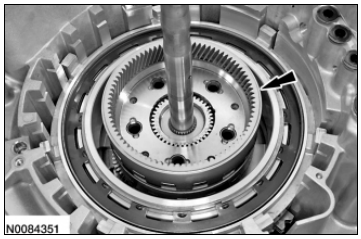
54. Install the No. 5 and No. 6 thrust bearings.
    1. No. 5 thrust bearing
    2. No. 6 thrust bearing



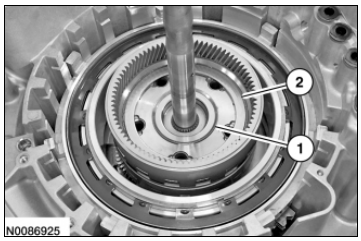
55. Install the center sun gear.



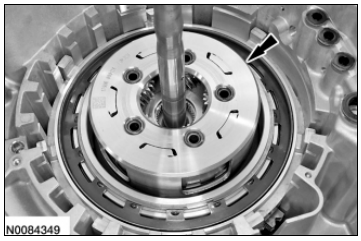
56. Install the center carrier/front ring gear assembly.



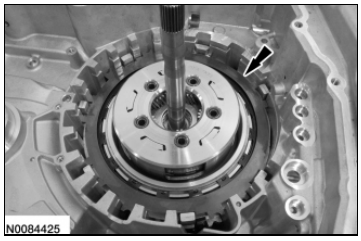
57. Install the No. 7 and No. 8 thrust bearings.
    1. No. 7 thrust bearing
    2. No. 8 thrust bearing



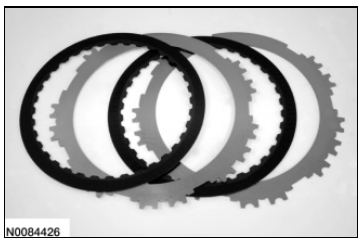
58. Install the front planetary/rear ring gear assembly.



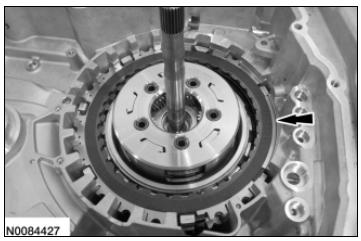
59. Install the forward (1, 2, 3, 4) clutch wave spring.



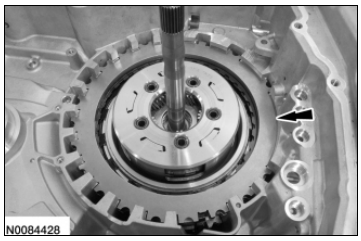
60. Soak the forward (1, 2, 3, 4) clutch pack in clean automatic transmission fluid.



61. Install the forward (1, 2, 3, 4) clutch pack.



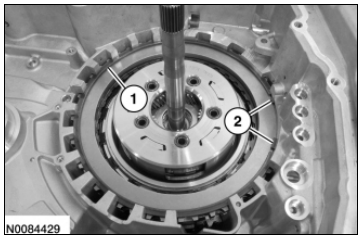
62. Install the forward (1, 2, 3, 4) clutch pressure plate.



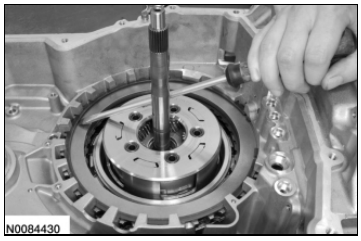
63. ***NOTICE:*** **Be sure to install the forward (1, 2, 3, 4) clutch beveled snap ring with the flat side facing down or the snap ring can come loose, causing damage to the transaxle.**

    Install the forward (1, 2, 3, 4) clutch beveled snap ring with the flat side down with the gap facing the front of the transaxle.

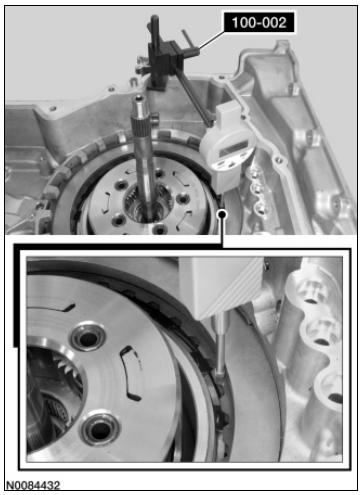
    1. Forward (1, 2, 3, 4) clutch snap ring
    2. Forward (1, 2, 3, 4) clutch snap ring gap



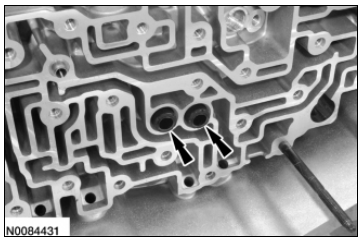
64. Using a suitable tool, seat the snap ring in the snap ring groove.



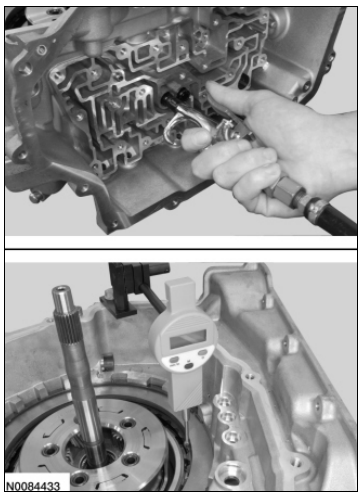
65. Install Dial Indicator Gauge With Holding Fixture 100-002 or a suitable dial indicator on the transaxle case and position the plunger on the top forward (1, 2, 3, 4) clutch friction plate.



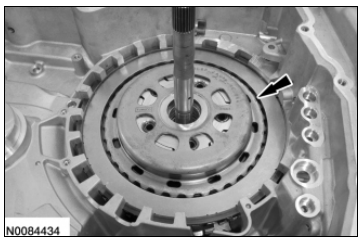
66. Install the new low/reverse and forward (1, 2, 3, 4) clutch feed seals in the transaxle case.



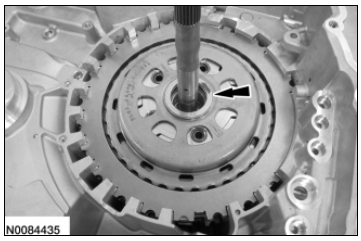
67. Apply 483 kPa (70 psi) of air pressure to the forward (1, 2, 3, 4) clutch piston port while recording the clutch pack clearance on the dial indicator. The clearance should be between 0.076 mm (0.002 in) and 1.840 mm (0.072 in). If the clearance is out of range, check the forward (1, 2, 3, 4) clutch pack for correct installation and the transaxle for correct assembly. If the forward (1, 2, 3, 4) clutch pack is correctly installed, install a new forward (1, 2, 3, 4) clutch pack.



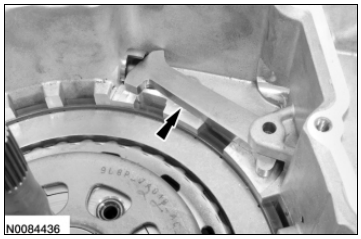
68. Install the front planetary sun gear and shell assembly.



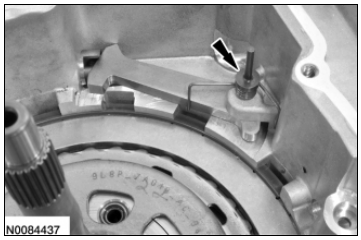
69. Install the No. 10 thrust bearing.



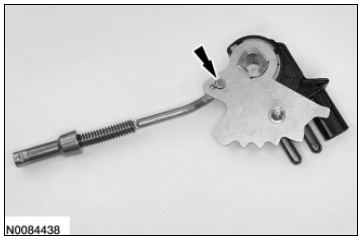
70. Install the park pawl.



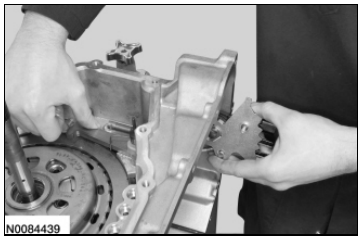
71. Install the park pawl pin and spring.



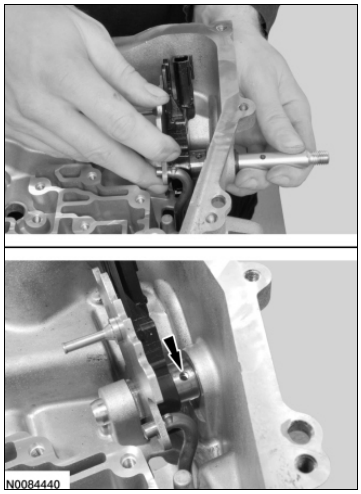
72. Install the park pawl actuator rod in the Transmission Range (TR) sensor.



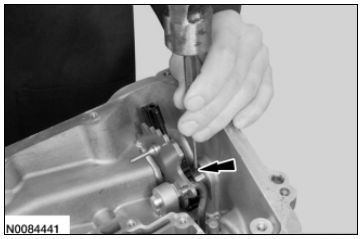
73. Position the park pawl aside and position the park pawl actuator rod and the TR sensor in the transaxle case.



74. Install the manual control shaft and align the roll pin holes.



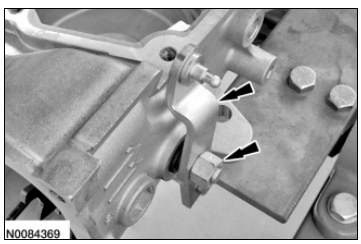
75. Install the manual control shaft roll pin.



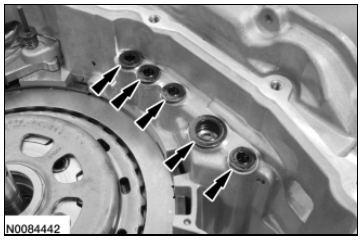
76. ***NOTICE:*** **Make sure to hold the manual control lever while tightening the manual control lever nut or damage to the manual control lever and park components will occur.**

    Install the manual control lever and the nut.

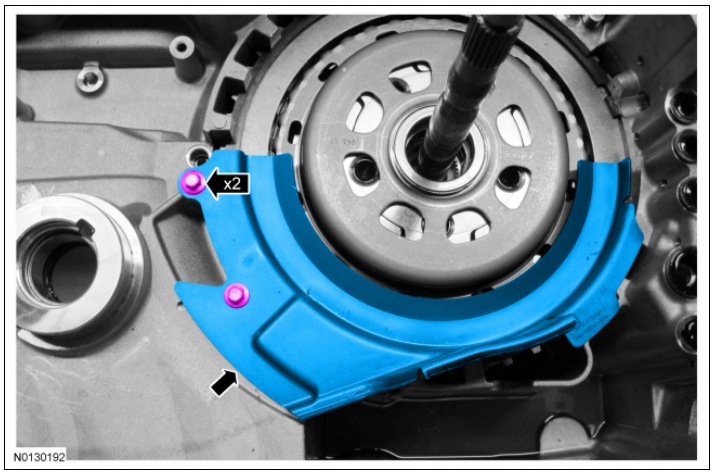
    - Tighten to 24 Nm (18 lb-ft).



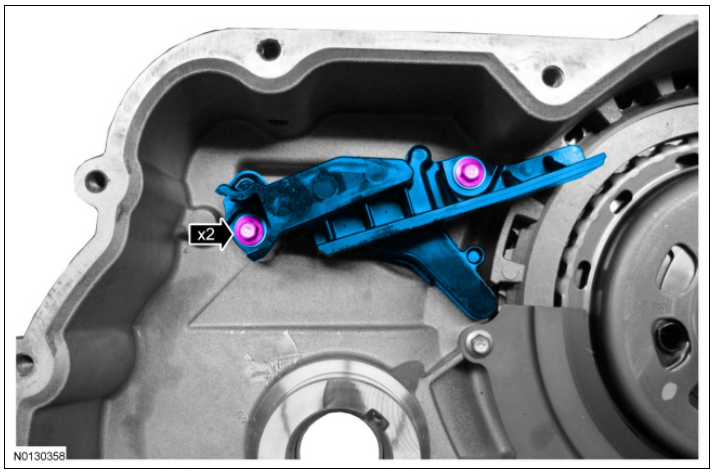
77. Install the 5 new clutch feed seals.



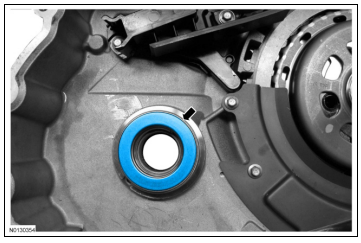
78. Position the transmission fluid baffle in place and install the 2 bolts.
    - Tighten to 12 Nm (106 lb-in).



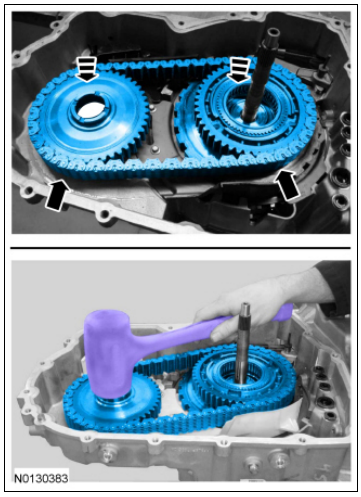
79. Position the lube funnel in place and install the 2 bolts.
    - Tighten to 12 Nm (106 lb-in).



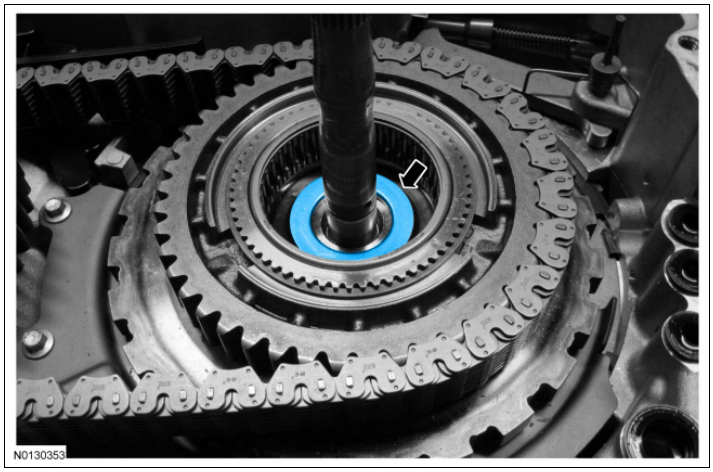
80. Install the No. 12 thrust bearing.



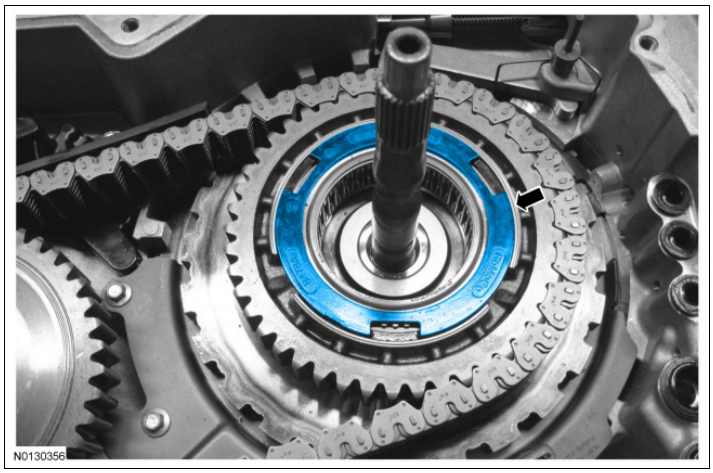
81. Simultaneously install the drive/driven sprocket and chain assembly. Lightly tap on the driven sprocket to be sure it is fully seated in the case.



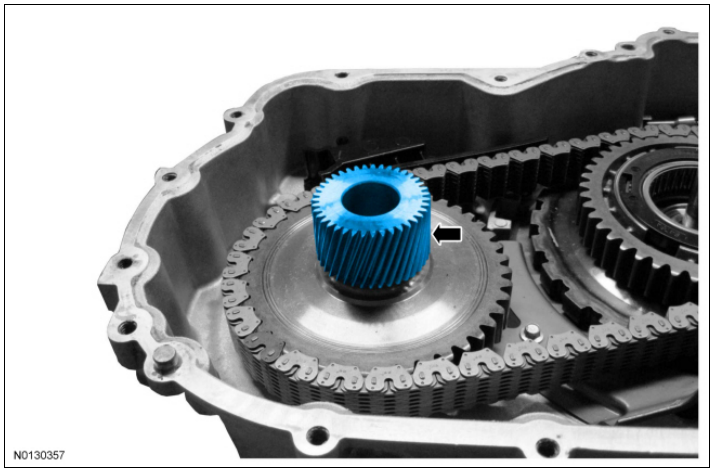
82. Install the No. 11 thrust bearing.



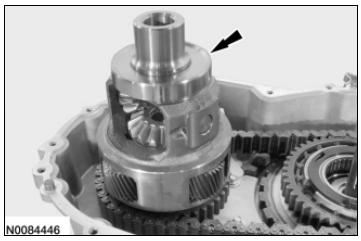
83. Install the No. 13 thrust washer.



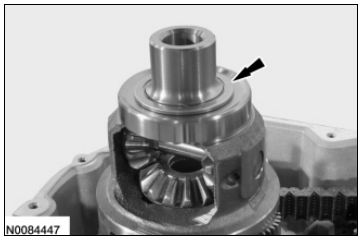
84. Install the final drive sun gear.



85. Install the differential assembly.



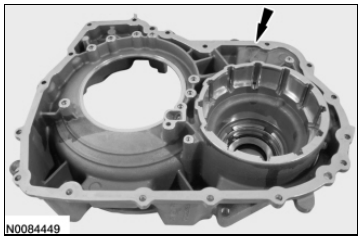
86. Install the No. 15 thrust bearing.



87. Install the Turbine Shaft Seal Protector 307-635 on the input shaft.

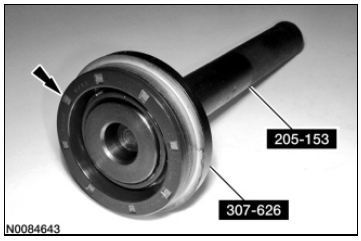


88. Clean the torque converter housing sealing surface.

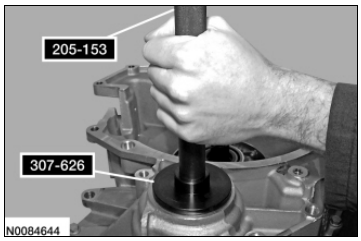


Front Wheel Drive (FWD) vehicles

89. Assemble the Handle 205-153 and Differential Seal Installer 307-626. Install a new RH seal on the Seal Installer 307-626.

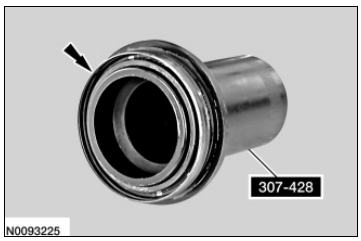


90. Using the Handle 205-153 and Differential Seal Installer 307-626, install the new RH halfshaft seal.



All-Wheel Drive (AWD) vehicles

91. Install a new RH seal on the RH Halfshaft Fluid Seal Installer 307-428.

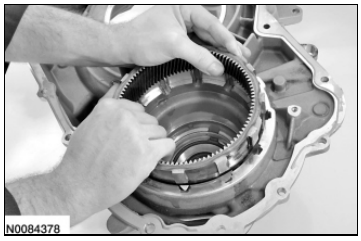


92. Using the RH Halfshaft Fluid Seal Installer 307-428, install the new RH halfshaft seal.



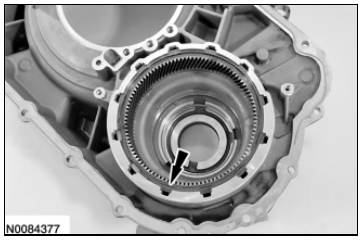
All vehicles

93. Install the differential ring gear in the torque converter housing.

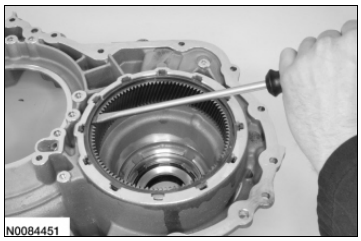


94. ***NOTICE:*** **Be sure the flat side of the beveled snap ring is facing down or the ring can come loose, causing damage to the transaxle.**

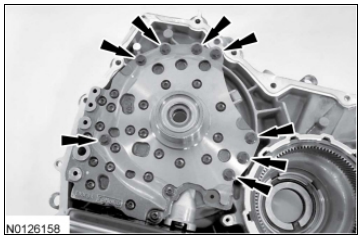
    Install the beveled differential ring gear snap ring with the flat side facing down.



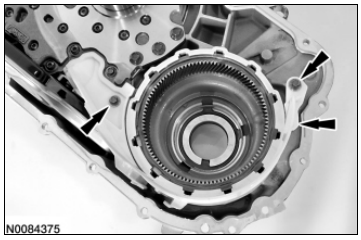
95. Seat the snap ring using a suitable tool.



96. Install the pump and filter assembly in the torque converter housing and install the 8 pump bolts.
    - Tighten to 35 Nm (26 lb-ft).

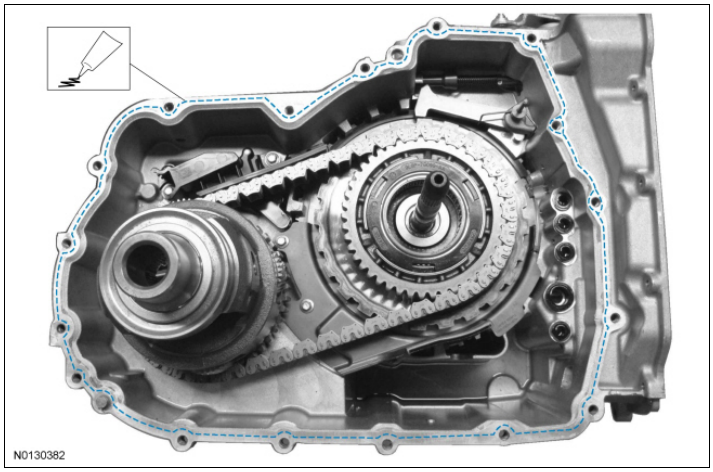


97. Install the transmission fluid baffle and the 2 bolts.
    - Tighten to 12 Nm (106 lb-in).



98. **NOTE:** Be sure the sealing surfaces of the torque converter housing and the transaxle housing are free of oil before applying silicone.

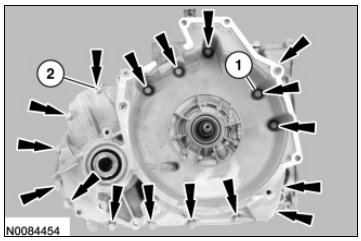
    Apply silicone to the sealing surface of the transaxle case.



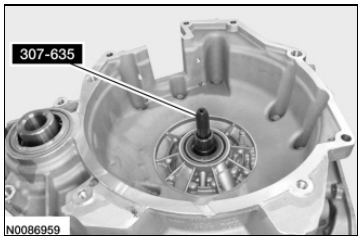
99. **NOTE:** Be sure the stud bolt is in the correct location as noted during disassembly.

    Install the torque converter housing on the transaxle case and install the 17 transaxle case-to-torque converter housing bolts.

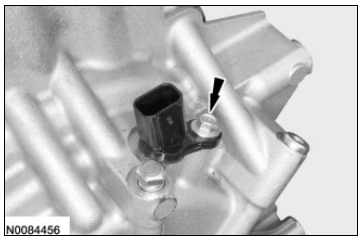
    1. Tighten to 24 Nm (18 lb-ft).
    2. Stud bolt location.



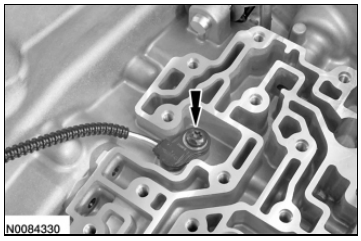
100. Remove the Turbine Shaft Seal Protector 307-635.



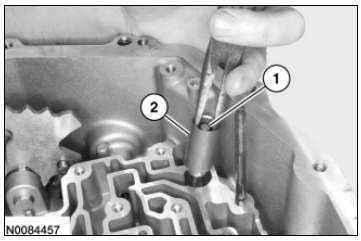
101. Install the Turbine Shaft Speed (TSS) sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).



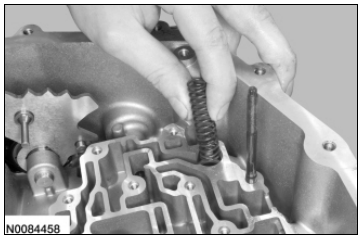
102. Install the Output Shaft Speed (OSS) sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).



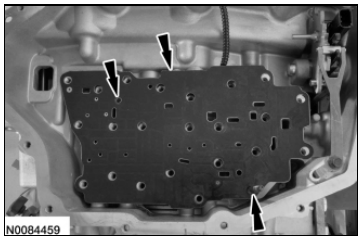
103. Assemble the bypass valve in the sleeve and install the assembly in the case.
    1. Bypass valve
    2. Bypass valve sleeve



104. Install the bypass valve spring.

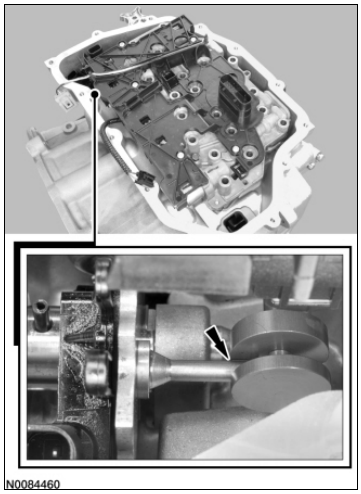


105. Install the new main control-to-transaxle case separator plate and align it on the stud and the guide pin.

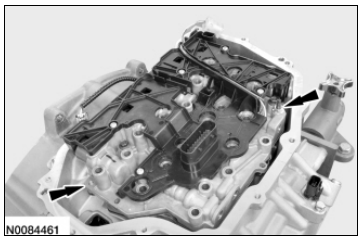


106. **NOTE:** Be sure that the manual pin (part of the TR sensor) is correctly installed in the manual valve.

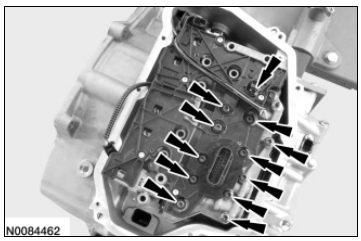
    Position the main control assembly in place and align the manual valve on the TR sensor.



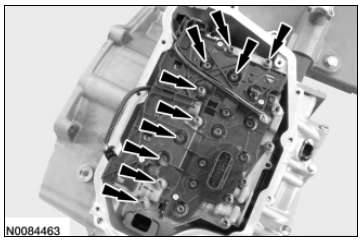
107. Install the nut hand-tight.



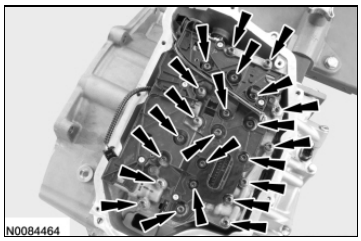
108. Install the short bolts hand-tight.



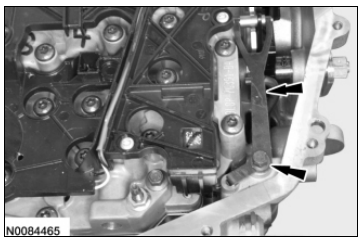
109. Install the long bolts hand-tight.



110. Tighten the main control bolts and the nut in a crisscross pattern.
    - Tighten to 10 Nm (89 lb-in).

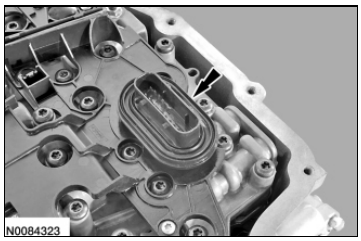


111. Position the TR sensor detent spring in place with the alignment tab in the alignment hole and install the bolt.
    - Tighten to 13 Nm (115 lb-in).

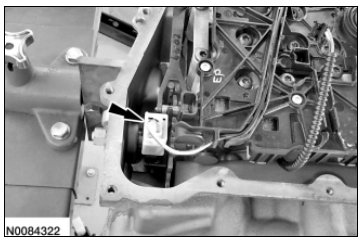


112. **NOTE:** Be sure the solenoid body-to-main control cover seal is installed with the holes facing up.

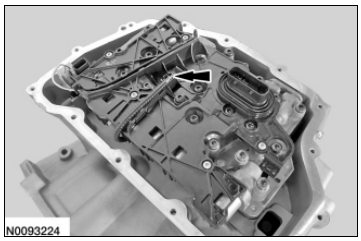
    Install the solenoid body-to-main control cover seal.



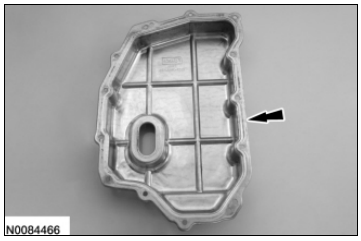
113. Connect the TR sensor electrical connector.



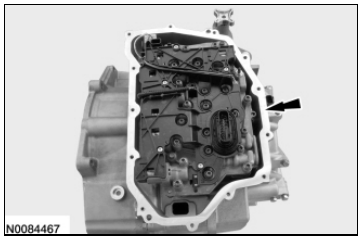
114. Connect the OSS sensor electrical connector.



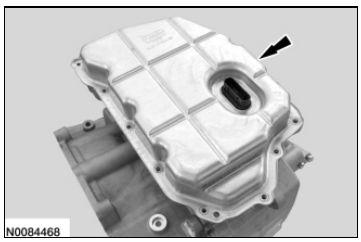
115. Clean the main control cover sealing surface.



116. Apply silicone to the main control sealing surface of the transaxle case.



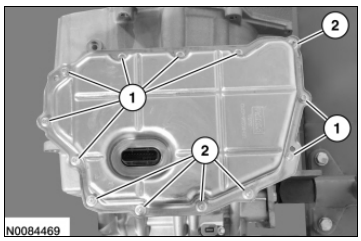
117. Position the main control cover in place.



118. **NOTE:** Install the main control cover stud bolts in the correct location as noted during disassembly.

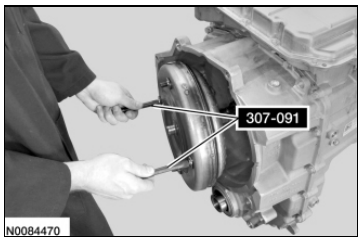
    Install the main control cover bolts.

    1. Bolt location
    2. Stud bolt location
    - Tighten to 12 Nm (106 lb-in).

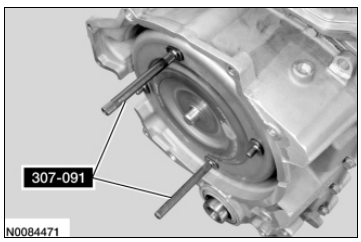


119. ***NOTICE:*** **The torque converter is heavy. Be careful not to drop it or damage will result.**

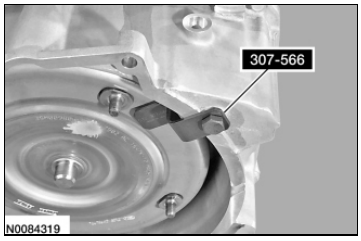
    Using the Torque Converter Handle 307-091, install the torque converter.



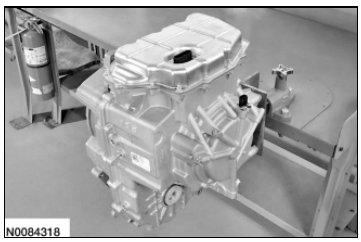
120. Remove the Torque Converter Handle 307-091.



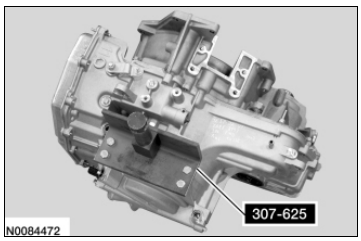
121. Install the Torque Converter Retainer 307-566.



122. Remove the transaxle from the bench-mounted holding fixture.

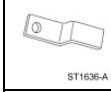
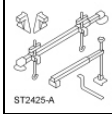
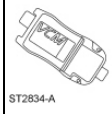


123. Remove the Holding Fixture 307-625.



Transaxle - 2.5L

Special Tool(s)

 ST1293-A	Powertrain Lift With Tilting Plate 300-OTC-1585AE
 ST1636-A	Retainer, Torque Converter 307-566
 ST2425-A	Support Bar, Engine 303-F072
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

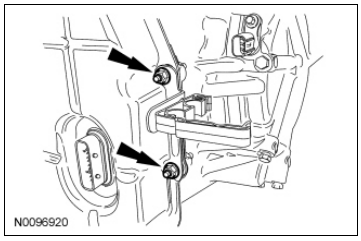
Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B
Threadlock and Sealer TA-25	WSK-M2G351-A5

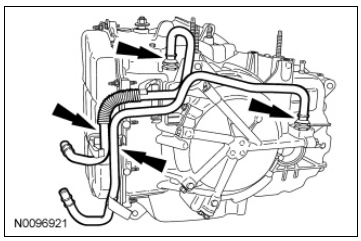
Installation

NOTE: If the transaxle was overhauled, or if installing a new transaxle and the transmission fluid cooler has not been flushed, flush the transmission fluid cooler at this time. For additional information, refer to Transmission Fluid Cooler Backflushing and Cleaning in this section. Clean the transaxle-mounted transmission fluid cooler tubes by hand.

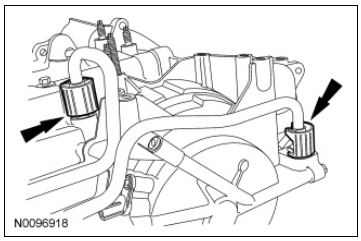
1. Install the transmission fluid cooler tube bracket and the 2 nuts.
2. Tighten to 9 Nm (80 lb-in).


N0096920

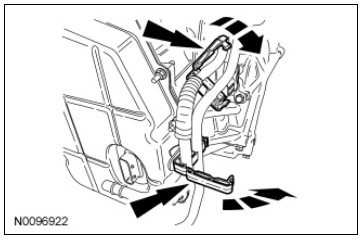
2. Install the transmission fluid cooler tubes in the transaxle by inserting the tube into the fitting until a click is heard/felt. Pull back to confirm connection is secure and position them in the retainer mounted on the main control cover studbolts.



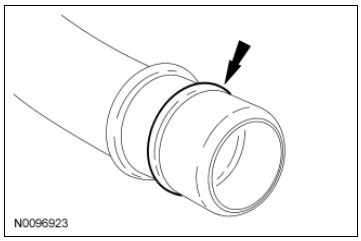
3. Install the 2 secondary latches.



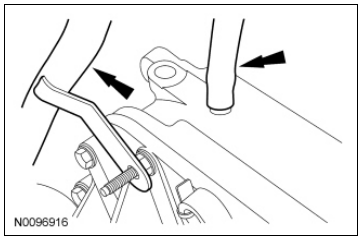
4. Position the transmission fluid cooler tubes in the retainers and close the 2 transmission fluid cooler tube retainers.



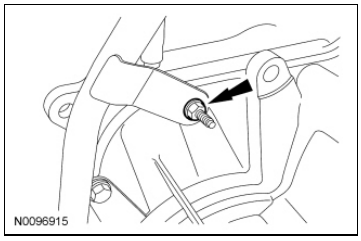
5. Inspect the O-ring seal on the transaxle filler tube for damage and install a new O-ring if needed. Lubricate the O-ring seal with clean automatic transmission fluid.



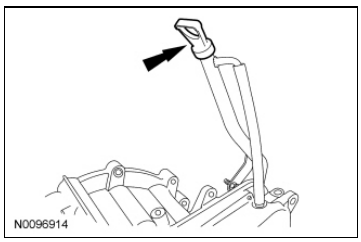
6. Position the transmission fluid cooler tube in place and install the vent tube.



7. Install the transmission fluid filler tube nut.
    - Tighten to 11 Nm (97 lb-in).

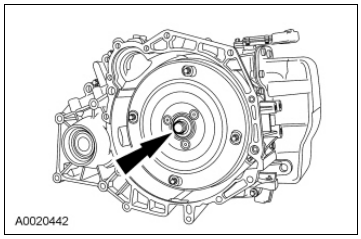


8. Install the transmission fluid level indicator.

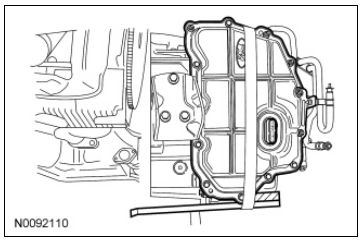


9. Secure the transaxle to a suitable transmission jack with a safety strap.

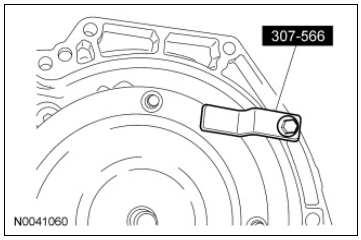
10. Prior to installing the transaxle, apply multi-purpose grease to the torque converter pilot hub.



11. Position the transaxle into the engine compartment.



12. Remove the Torque Converter Retainer.



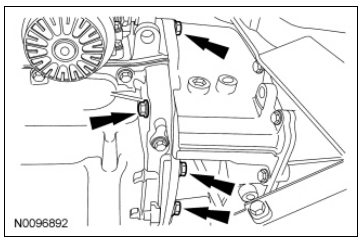
13. **NOTE:** Make sure that the dowel pins are installed in the engine block prior to installing the transaxle.

    Position the transaxle on the dowel pins.

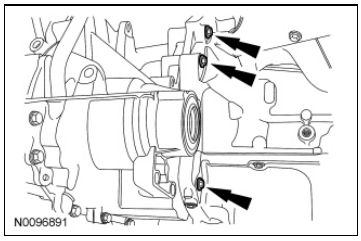
14. **NOTE:** Note the location of the different length bolts.

Install the 4 front torque converter housing bolts.

- Tighten to 48 Nm (35 lb-ft).

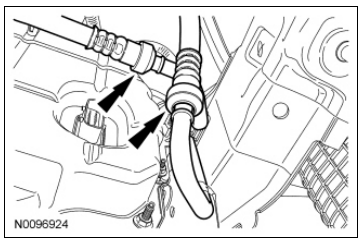


15. Install the 3 rear torque converter housing bolts.
    - Tighten to 48 Nm (35 lb-ft).

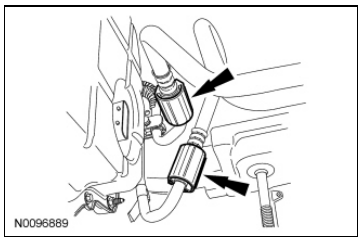


16. Remove the transmission jack.

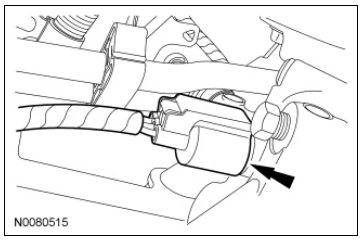
17. Connect the transmission fluid cooler tubes by inserting the tube into the fitting until a click is heard/felt. Pull back to confirm that the connection is secure.



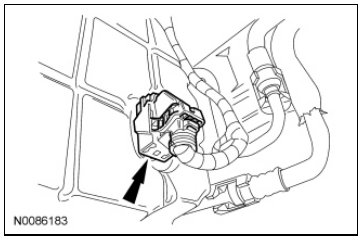
18. Install the transmission fluid cooler tube secondary latches.



19. Connect the Turbine Shaft Speed (TSS) electrical connector.



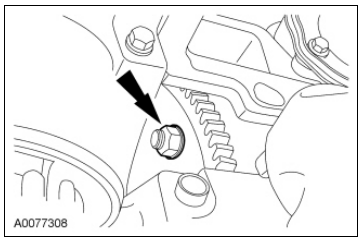
20. Connect the transaxle main electrical connector.



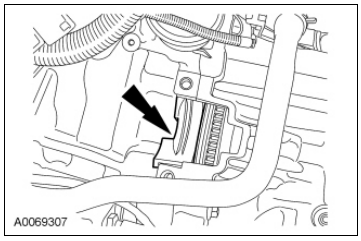
21. ***NOTICE:*** **Rotate the engine in a clockwise direction only or engine damage will occur.**

    Install 4 new torque converter nuts.

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

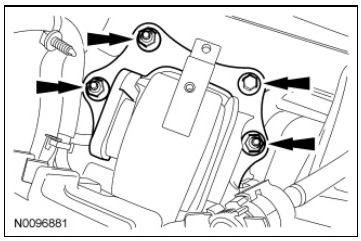


22. Install the rubber insulator in the bellhousing.

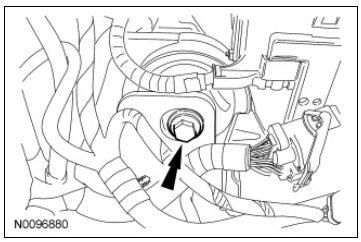


23. Install the starter motor. For additional information, refer to Section 303-06 .

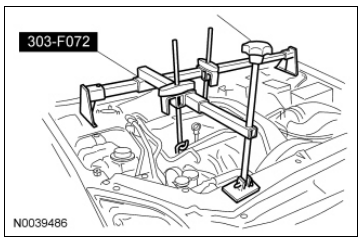
24. Apply threadlock and sealer to the threads and install the transaxle support insulator bracket, the 3 nuts and the bolt.
    - Tighten to 63 Nm (46 lb-ft).



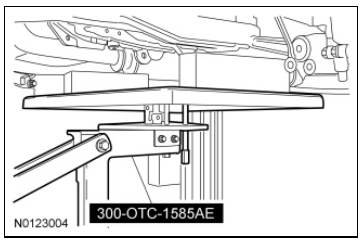
25. Lift the transaxle until the transaxle support insulator bracket is aligned with the transaxle support insulator, apply threadlock and sealant to the threads and install the through bolt.
    - Tighten to 150 Nm (111 lb-ft).



26. Remove the Engine Support Bar.



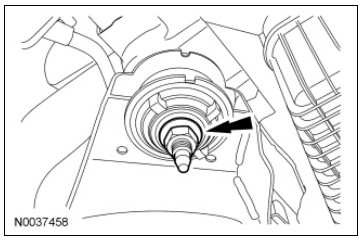
27. Place the subframe assembly on the Powertrain Lift With Tilting Plate and raise the subframe into the installed position.



28. **NOTE:** LH shown, RH similar.

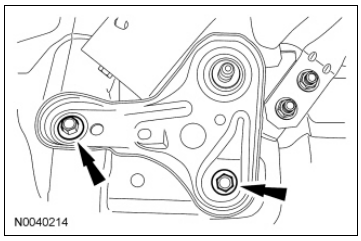
    Install the front subframe nuts.

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



29. **NOTE:** LH shown, RH similar.

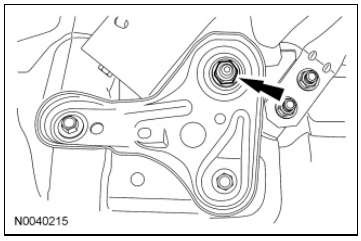
    Position the subframe brackets and install the bolts finger-tight.



30. **NOTE:** LH shown, RH similar.

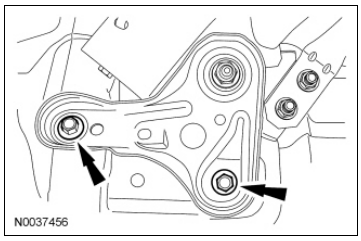
    Install the subframe nuts.

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



31. **NOTE:** LH shown, RH similar.

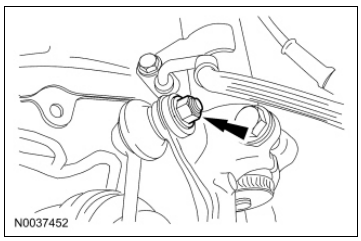
    Tighten the subframe bracket-to-body bolts to 103 Nm (76 lb-ft).



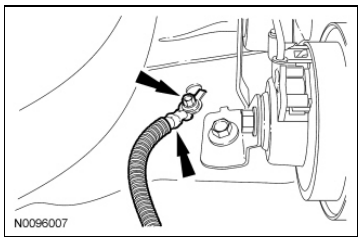
32. **NOTE:** LH shown, RH similar.

    Install the sway bar links and nuts to the struts.

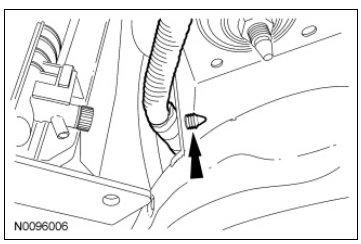
    - Tighten to 40 Nm (30 lb-ft).



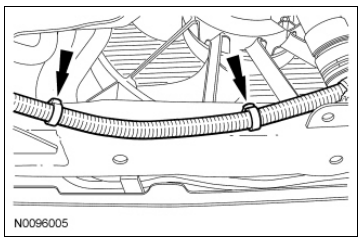
33. Install the Electronic Power Assist Steering (EPAS) system wiring harness ground and the bolt behind the RH splash shield.
    - Tighten to 12 Nm (106 lb-in).



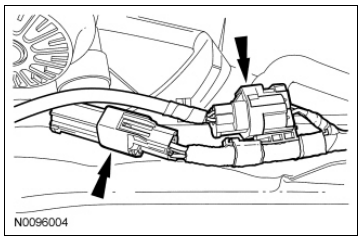
34. Attach the EPAS system wiring harness pin-type retainer to the subframe under the LH fender splash shield.



35. Attach the 2 EPAS system wiring harness pin-type retainers to the subframe.

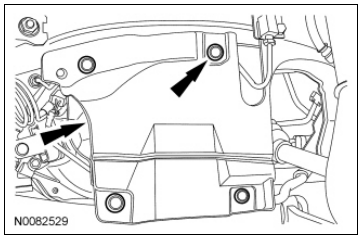


36. Connect the 2 in-line EPAS system electrical connectors at the front of the subframe.

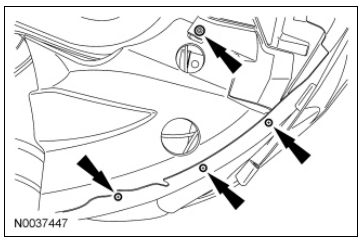


37. Install the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

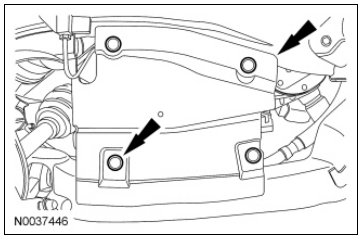
38. Install the LH splash shield and the 6 pin-type retainers (4 shown).



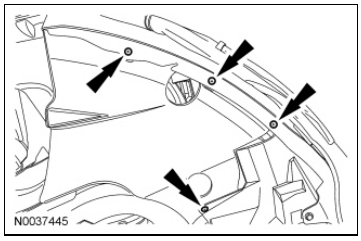
39. Position the LH fender splash shield and install the 4 screws.



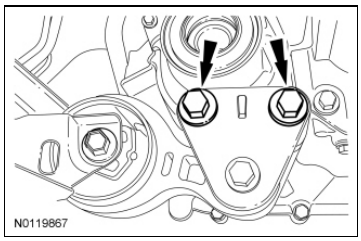
40. Install the RH splash shield and the 6 pin-type retainers (4 shown).



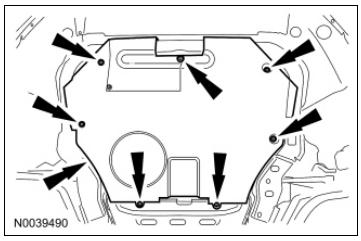
41. Position the RH fender splash shield and install the 4 screws.



42. Install the 2 roll restrictor bracket bolts.
    - Tighten to 90 Nm (66 lb-ft).



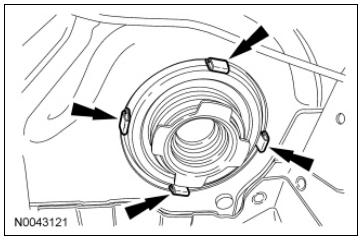
43. If equipped, install the 7 screws and the underbody cover.



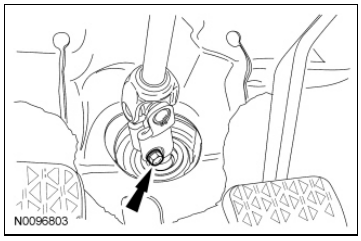
44. ***NOTICE:*** **The steering gear/dash seal must be fully seated in the steering valve tower groove before the retaining clips are fully engaged into the body. If the steering gear/dash seal is not seated to the steering gear valve tower groove and the clips are not fully engaged to the body, water and foreign material may enter the passenger compartment and damage the vehicle interior can occur.**

    Install the steering gear/dash seal.

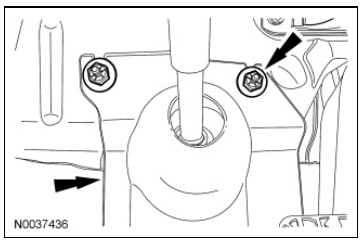
    - Apply hand force to the center of the seal, install the steering gear/dash seal onto the steering gear valve tower until the seal is fully seated in the valve tower groove. Install the steering gear/dash seal until the retaining clips are fully engaged into the body.



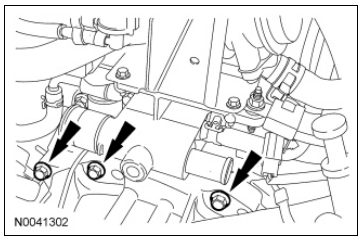
45. Install the steering column shaft onto the steering gear and install a new bolt.
    - Tighten to 20 Nm (177 lb-in).



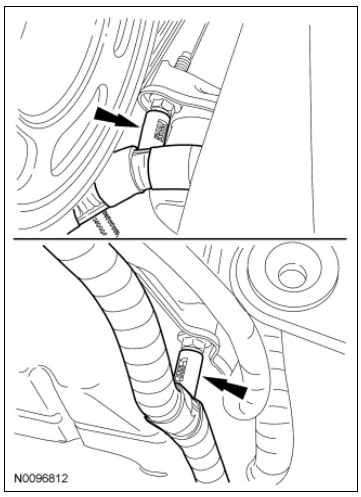
46. Install the steering joint cover and the 2 nuts.



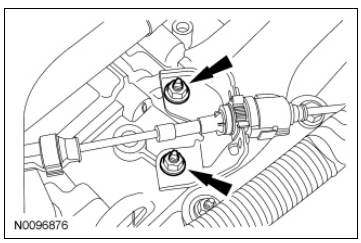
47. Install the 3 top torque converter housing bolts.
    - Tighten to 48 Nm (35 lb-ft).



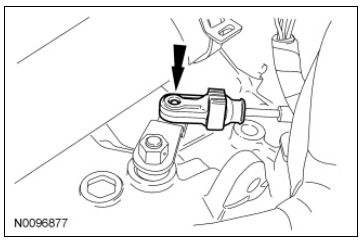
48. Connect the wiring harness retainers to the main control cover studbolts.



49. Position the selector lever cable bracket in place and install the 2 nuts.
    - Tighten to 12 Nm (106 lb-in).



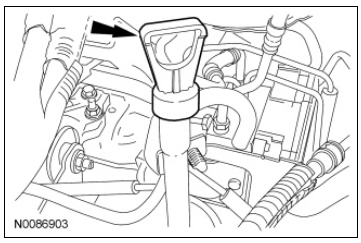
50. Connect the selector lever cable end to the manual control lever with the manual control lever and selector lever in DRIVE. Check selector lever cable adjustment. For additional information, refer to Section 307-05A .



51. Install the battery and battery tray. For additional information, refer to Section 414-01 .

52. Install the Air Cleaner (ACL) and the outlet pipe. For additional information, refer to Section 303-12A .

53. Fill the transaxle with clean transmission fluid.



54. Start the engine and move the range selector lever into each gear position.

55. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

56. If a replacement transaxle assembly is being installed or a new solenoid body is installed, the PCM will have to be reflashed with a new solenoid body strategy and identification data file. For additional information, refer to Solenoid Body Strategy in this section.

57. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

Transaxle - 3.0L

Special Tool(s)

 ST2873-A	Engine Lifting Bracket Set 303-1140
 ST2793-A	Lifting Bracket, Engine 303-050 (T70P-6000)
 ST1293-A	Powertrain Lift 014-00765
 ST1636-A	Retainer, Torque Converter 307-566
 ST2425-A	Support Bar, Engine 303-F072

Material

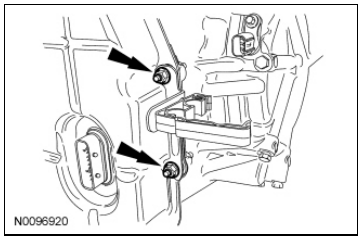
Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B
Threadlock and Sealer TA-25	WSK-M2G351-A5

NOTICE: **The use of any transmission fluid other than what is recommended for this transaxle will cause transaxle damage.**

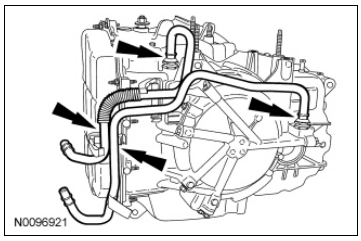
NOTE: If the transaxle was overhauled, or if installing a new transaxle and the transmission fluid cooler has not been flushed, flush the transmission fluid cooler at this time. For additional information, refer to Transmission Fluid Cooler Backflushing and Cleaning in this section.

All vehicles

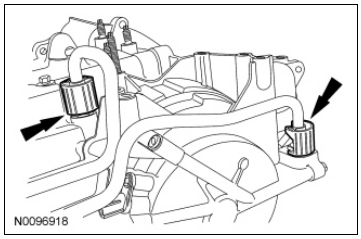
1. Install the transmission fluid cooler tube bracket and the 2 nuts.
   - Tighten to 9 Nm (80 lb-in).



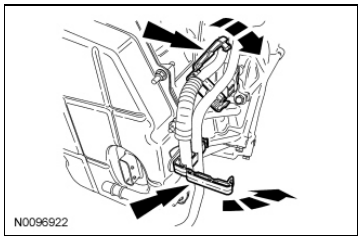
2. Install the transmission fluid cooler tubes in the transaxle by inserting the tube into the fitting until a click is heard/felt. Pull back to confirm connection is secure and position them in the retainer mounted on the main control cover studbolts.



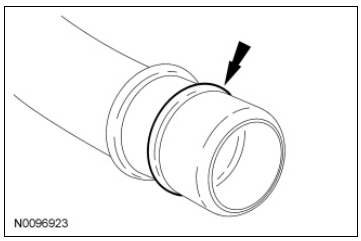
3. Install the 2 secondary latches.



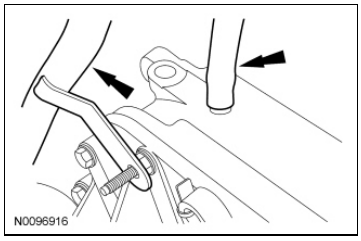
4. Position the transmission fluid cooler tubes in the retainers and close the 2 transmission fluid cooler tube retainers.



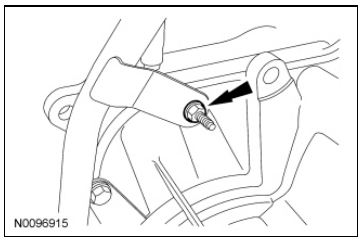
5. Inspect the O-ring seal on the transaxle filler tube for damage and install a new O-ring if needed. Lubricate the O-ring seal with clean automatic transmission fluid.



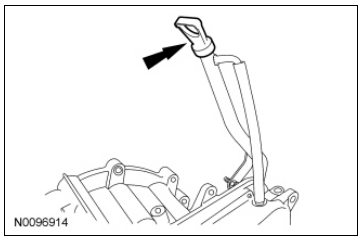
6. Position the transmission fluid filler tube in place and install the vent tube.



7. Install the transmission fluid filler tube nut.
   - Tighten to 11 Nm (97 lb-in).

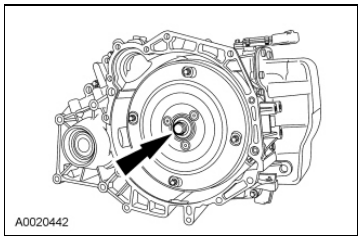


8. Install the transmission fluid level indicator.

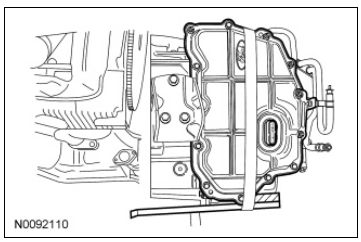


9. Secure the transaxle to a suitable transmission jack with a safety strap.

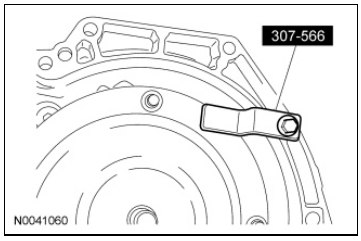
10. Prior to installing the transaxle, apply multi-purpose grease to the torque converter pilot hub.



11. Position the transaxle into the engine compartment.



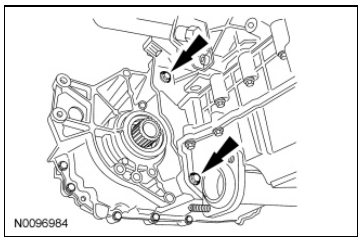
12. Remove the Torque Converter Retainer.



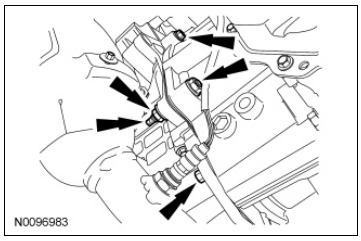
13. **NOTE:** Make sure that the dowel pins are installed in the engine block prior to installing the transaxle.

    Position the transaxle on the dowel pins of the engine.

14. Install the 2 back torque converter housing bolts.
    - Tighten to 48 Nm (35 lb-ft).

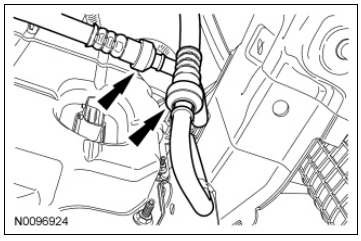


15. Install the 2 bolts, 2 nuts and the stud in the front of the torque converter housing.
    - Tighten to 48 Nm (35 lb-ft).

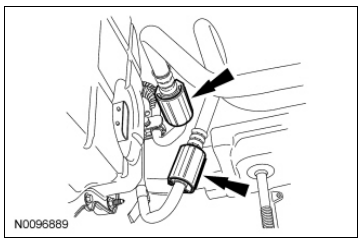


16. Remove the transmission jack.

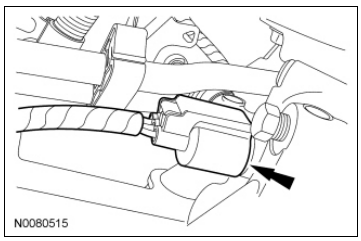
17. Connect the transmission fluid cooler tubes by inserting the tube into the fitting until a click is heard/felt. Pull back to confirm connection is secure.



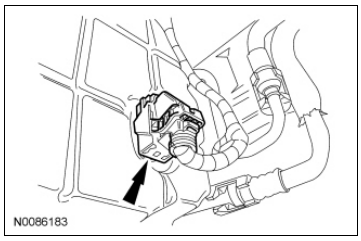
18. Install the transmission fluid cooler tube secondary latches.



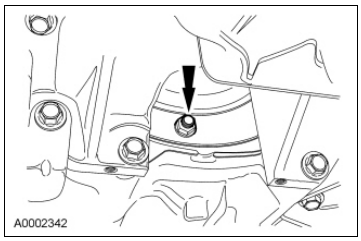
19. Connect the Turbine Shaft Speed (TSS) electrical connector.



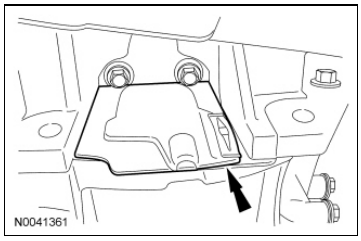
20. Connect the transaxle main electrical connector.



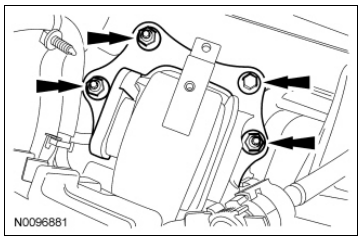
21. Install 4 new torque converter nuts.
    - Tighten to 40 Nm (30 lb-ft).



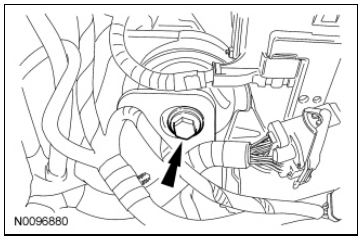
22. Install the inspection cover.



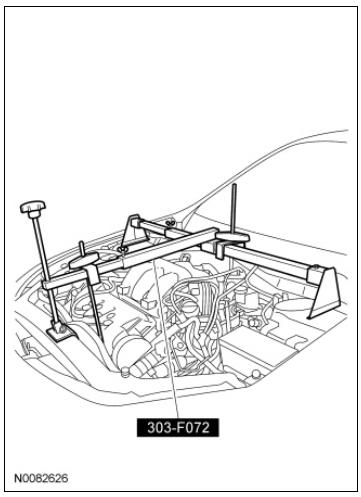
23. Apply threadlock and sealer to the threads and install the transaxle support insulator bracket, the 3 nuts and the bolt.
    - Tighten to 63 Nm (46 lb-ft).



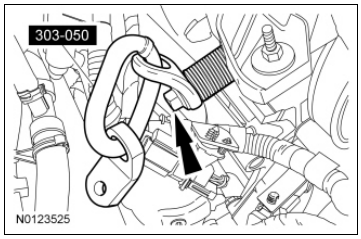
24. Lift the transaxle until the transaxle support insulator bracket is aligned with the transaxle support insulator, apply threadlock and sealant to the threads and install the through bolt.
    - Tighten to 150 Nm (111 lb-ft).



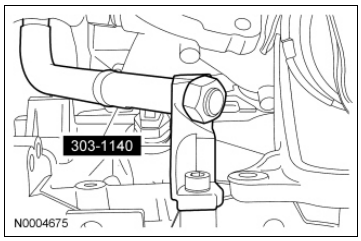
25. Remove the Engine Support Bar.



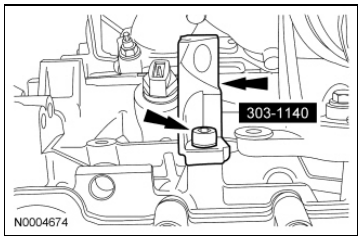
26. Remove the bolt and the Engine Lifting Bracket from the LH cylinder head.



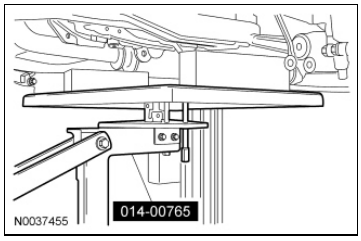
27. Remove the upper half of the Engine Lifting Bracket Set.



28. Remove the lower half of the Engine Lifting Bracket Set.



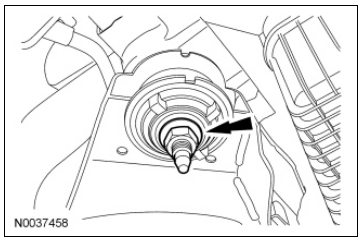
29. Place the subframe assembly on the Powertrain Lift and raise the subframe into the installed position.



30. **NOTE:** LH shown, RH similar.

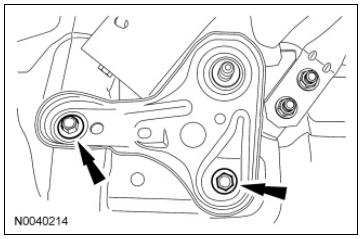
    Install the front subframe nuts.

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



31. **NOTE:** LH shown, RH similar.

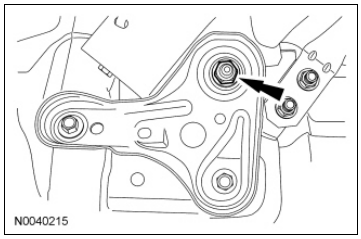
    Position the subframe brackets and install the bolts finger-tight.



32. **NOTE:** LH shown, RH similar.

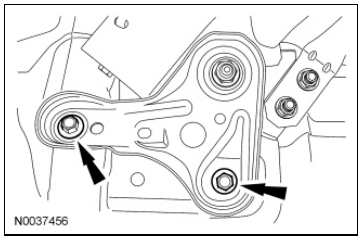
    Install the subframe nuts.

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



33. **NOTE:** LH shown, RH similar.

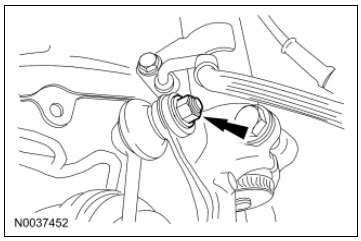
    Tighten the subframe bracket-to-body bolts to 103 Nm (76 lb-ft).



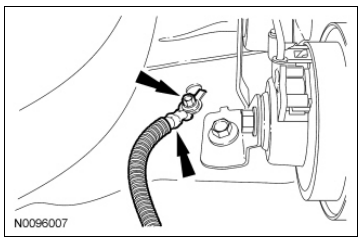
34. **NOTE:** LH shown, RH similar.

    Install the stabilizer bar links and nuts to the struts.

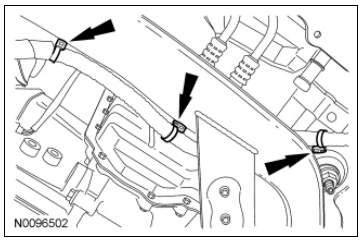
    - Tighten to 40 Nm (30 lb-ft).



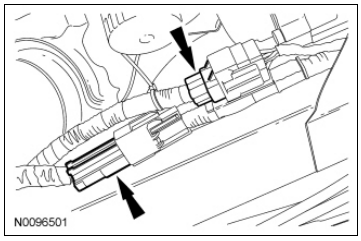
35. Install the Electronic Power Assist Steering (EPAS) system wiring harness ground and the bolt behind the RH splash shield.
    - Tighten to 12 Nm (106 lb-in).



36. Attach the 3 wiring harness retainers to the LH front of the subframe.



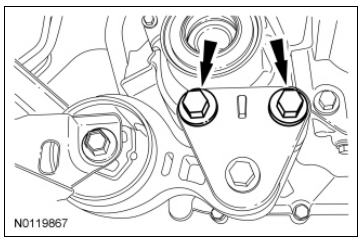
37. Connect the 2 in-line EPAS system electrical connectors at the front of the subframe.



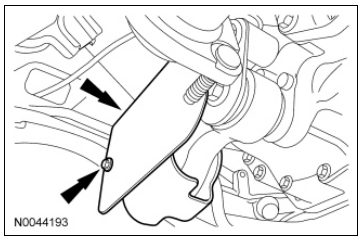
38. **NOTE:** Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.

    Install the 2 roll restrictor bracket bolts.

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



39. If equipped, install the heat shield and the 2 bolts.

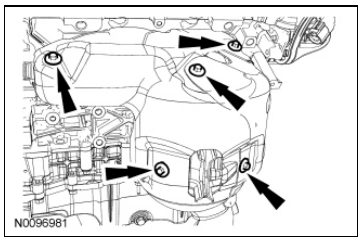


All-Wheel Drive (AWD) vehicles

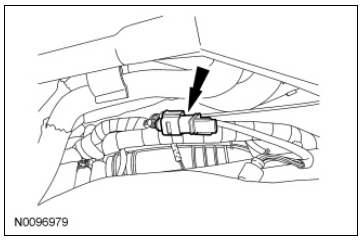
40. Install the Power Transfer Unit (PTU). For additional information, refer to Section 308-07B .

Front Wheel Drive (FWD) vehicles

41. Install the RH exhaust manifold heat shield on the manifold and install the 5 bolts.
    - Tighten to 11 Nm (97 lb-in).



42. Connect the RH Heated Oxygen Sensor (HO2S) electrical connector.



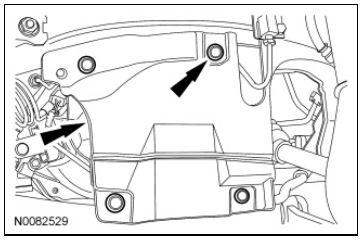
43. Install the intermediate shaft. For additional information, refer to Section 205-04 .

44. Install the exhaust flexible pipe. For additional information, refer to Section 309-00 .

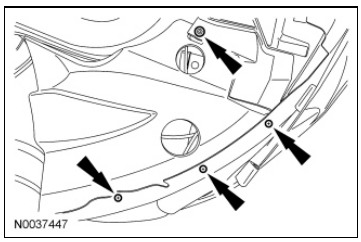
All vehicles

45. Install the LH halfshaft. For additional information, refer to Section 205-04 .

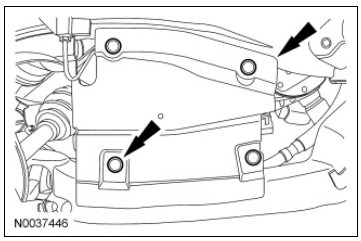
46. Install the LH splash shield and the 6 pin-type retainers (4 shown).



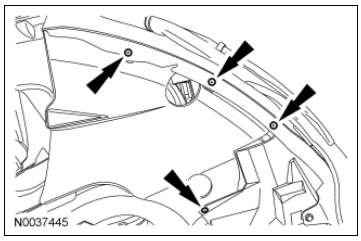
47. Position the LH fender splash shield and install the 4 screws.



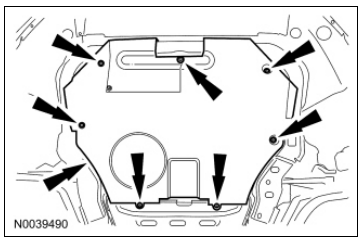
48. Install the RH splash shield and the 6 pin-type retainers (4 shown).



49. Position the RH fender splash shield and install the 4 screws.



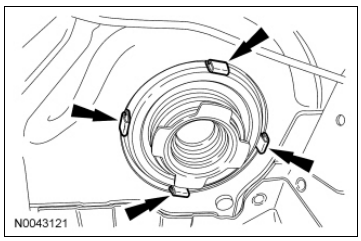
50. If equipped, install the 7 screws and the underbody cover.



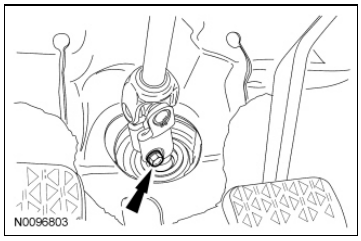
51. ***NOTICE:*** **The steering gear/dash seal must be fully seated in the steering valve tower groove before the retaining clips are fully engaged into the body. If the steering gear/dash seal is not seated to the steering gear valve tower groove and the clips are not fully engaged to the body, water and foreign material may enter the passenger compartment and damage the vehicle interior can occur.**

    Install the steering gear/dash seal.

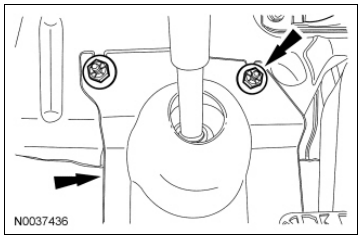
- Apply hand force to the center of the seal, install the steering gear/dash seal onto the steering gear valve tower until the seal is fully seated in the valve tower groove. Install the steering gear/dash seal until the retaining clips are fully engaged into the body.



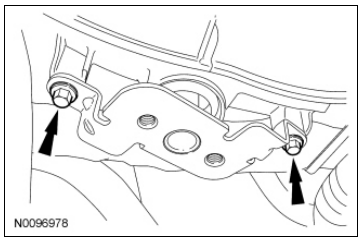
52. Install the steering intermediate shaft onto the steering gear and install a new bolt.
    - Tighten to 20 Nm (177 lb-in).



53. Install the steering joint cover and the 2 nuts.

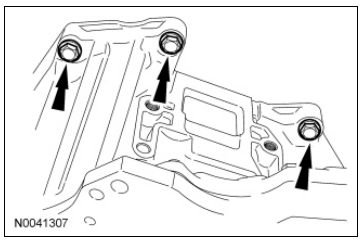


54. Install the EGR valve bracket and install the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

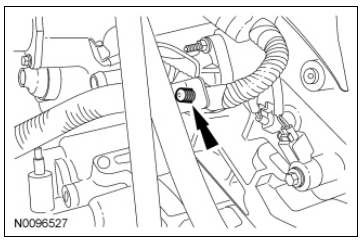


55. Install the EGR valve and tube. For additional information, refer to Section 303-08B .

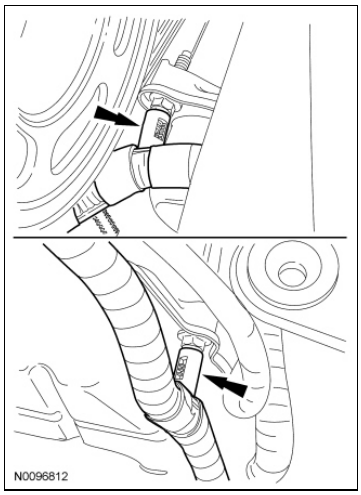
56. Install the 3 upper torque converter housing bolts.
    - Tighten to 48 Nm (35 lb-ft).



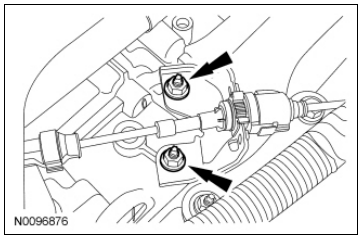
57. Connect the wiring harness retainer on the transmission fluid filler tube.



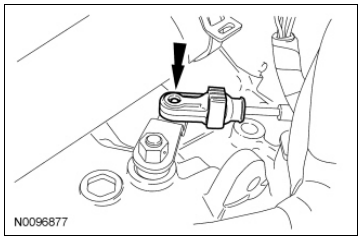
58. Connect the wiring harness retainers to the main control cover studbolts.



59. Position the selector lever cable bracket in place and install the 2 nuts.
    - Tighten to 12 Nm (106 lb-in).



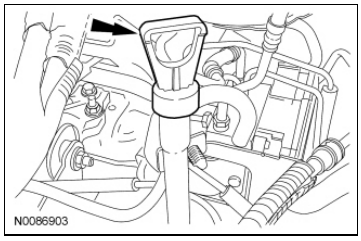
60. Connect the selector lever cable end to the manual control lever with the manual control lever and selector lever in DRIVE. Check selector lever cable adjustment. For additional information, refer to Section 307-05A .



61. Install the starter motor. For additional information, refer to Section 303-06 .

62. Install the Air Cleaner (ACL) and the outlet pipe. For additional information, refer to Section 303-12B .

63. Fill the transaxle with clean transmission fluid.



64. Start the engine and move the range selector lever into each gear position.

65. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

66. If a replacement transaxle assembly is being installed or a new solenoid body is installed, the PCM will have to be reflashed with a new solenoid body strategy and identification data file. For additional information, refer to Solenoid Body Strategy in this section.

Material

Item	Specification	Fill Capacity
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV	4.05L (4.28 qt) [a] [b]

[a] Transmission filled for life.

[b] The correct transaxle fill level is to the bottom of the fill plug, which is the upper plug.

General Specifications

Item	Specification
Weight	
Engine and transaxle assembly weight	257 kg (567 lb)
Transaxle weight	136 kg (300 lb)

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery Junction Box (BJB) bolt	10	-	89
Battery Junction Box (BJB) nut	10	-	89
Drain plug	40	30	-
Fill plug	40	30	-
Manual control lever nut	12	-	106
Roll restrictor bolts	90	66	-
Transaxle support insulator nuts	90	66	-
Transmission Range (TR) sensor bolts	5	-	44

nbsp;

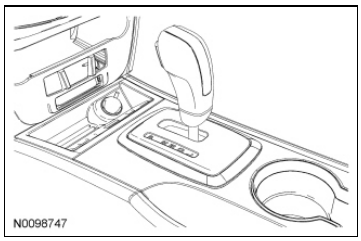
Transaxle Description

Transaxle Components

The Electronically Controlled Continuously Variable Transmission (eCVT) has the following internal components:

- Traction motor
- Generator
- Planetary gearset

Range Selection



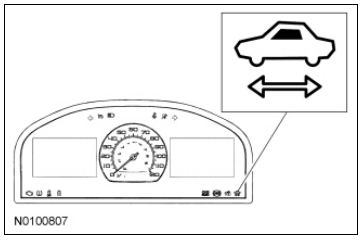
Park

With the range selector in PARK:

- the parking pawl locks the output shaft to the case.
- the ignition key can be removed.
- the ignition switch can be cycled from OFF to START or RUN. The ready indicator l will illuminate on the Instrument Cluster (IC) when the ignition switch is cycled to the START postion.

The ready indicator light is located on the lower right hand corner of the IC .

Ready Indicator Light



Reverse

With the range selector in REVERSE:

- the vehicle may be operated in a rearward direction.

- reversing lamps are illuminated.
- if the ready indicator light is not illuminated, which lights when the ignition switch is cycled to the START position, there is no reverse gear engagement.

Neutral

With the range selector in NEUTRAL:

- no power flows through the transmission.
- the output shaft is disengaged from the drive wheels.

Drive

The range selector DRIVE position provides:

- low speed driving.
- acceleration.
- cruise conditions.
- deceleration.
- maximum fuel economy during normal operation.

If the ready indicator light is not illuminated, which lights when the ignition switch is cycled to the START position, there is no forward gear engagement.

Low

The range selector LOW position provides:

- engine braking.
- improved traction on slippery roads.

If the ready indicator light is not illuminated, which lights when the ignition switch is cycled to the START position, there is no forward gear engagement.

Brake Shift Interlock System

The brake shift interlock system prevents a shift out of PARK unless the brake pedal is depressed. The brake shift interlock system has a Brake Shift Interlock Actuator (BSIA) mounted on the floor selector lever assembly. If the ignition switch is in the RUN position, the BSIA is continually on unless the brake pedal is depressed.

External Controls

The external control of the eCVT is mechanically controlled by a selector lever cable connected to the floor selector lever. The floor selector lever position determines PARK, REVERSE, NEUTRAL, DRIVE and low modes.

Motor Electronics Cooling System (MECS)

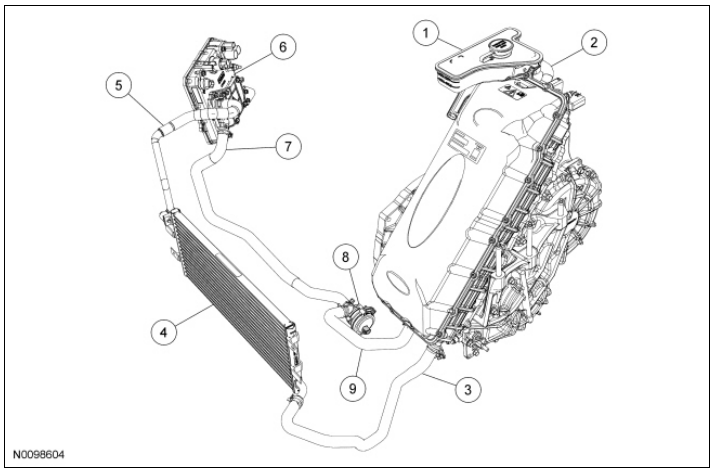
The vehicle uses a pump driven cooling system, referred to as the Motor Electronics Cooling System (MECS) pump, to transfer heat generated by the eCVT and the Hybrid Electric Vehicle (HEV) DC/DC converter to the atmosphere. The system uses a coolant-to-air radiator design.

The MECS pump is an electric pump that runs any time the ignition is in the ON position. Unlike traditional cooling systems, there is no thermostat in the MECS , so coolant flow should be continuous and considerably less than traditional powertrain cooling systems.

The flow direction is from the DC/DC converter to the MECS pump through the eCVT , then through the MECS cooler from the LH to RH side of the vehicle back to the DC/DC converter.

The MECS cooling pump will make an audible noise if it is running and a slight vibration may be felt by touch.

The MECS cooling system has a coolant expansion tank mounted on top of the transaxle.



Item	Part Number	Description
1	8C045	Motor Electronics Cooling System (MECS) coolant expansion tank
2	8C351	MECS coolant expansion tank outlet hose
3	8B273	Electronically Controlled Continuously Variable Transmission (eCVT)-to- MECS cooler hose
4	8005	MECS cooler
5	8B274	MECS cooler-to-DC/DC converter tube/hose assembly
6	14B227	DC/DC converter
7	15179	DC/DC converter-to- MECS pump hose
8	8C419	MECS pump
9	8A567	MECS pump-to- eCVT hose

Diagnostics

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

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

Condition	Possible Sources	Action
• Clunk - occurs when shifting from PARK to a DRIVE or REVERSE position	• Damaged transmission insulators	• INSPECT the transmission insulators for damage. INSTALL new insulators as necessary. REFER to Transaxle Support Insulator or Transaxle Support Insulator - Anti-Roll in this section.

Transmission Fluid Drain and Refill

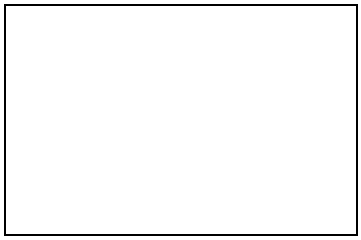
Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

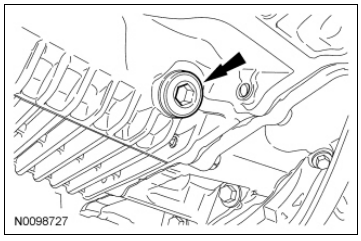
2. Turn the ignition to the OFF position.

3. Remove the 7 screws and the underbody cover.

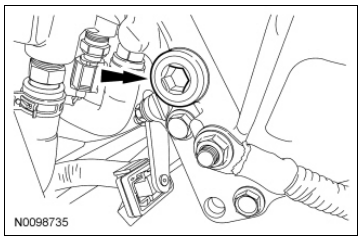


4. **NOTE:** If an integral problem is suspected, drain the transmission fluid through a paper filter. A small amount of metal particles may be found from normal wear. However, if excessive metal particles are present, internal service will be required.

   Remove the drain plug and drain the transmission fluid.



5. Remove the fill plug on the side of the transaxle.



6. **NOTE:** After the transmission fluid has been drained, clean the drain plug threads.

   NOTE: Inspect the plug and washer for damage and install a new plug if necessary.

   Install the drain plug.

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

7. ***NOTICE:*** **Use only clean transmission fluid specific for this transmission. Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products can cause internal transmission components to fail, which will affect the operation of the transmission.**

   Fill the transaxle with clean transmission fluid as specified until the level reaches the bottom of the fill plug hole.

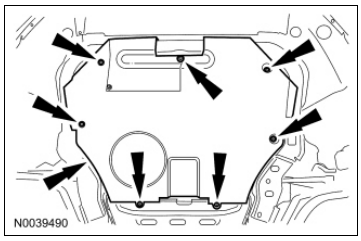
8. **NOTE:** Clean the area around the fill plug removing transmission fluid that may have spilled on the transaxle case.

   NOTE: Inspect the plug and washer for damage and install a new plug if necessary.

   Install the fill plug.

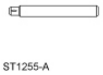
   - Tighten to 40 Nm (30 lb-ft).

9. Install the underbody cover and 7 screws.



Differential Seals - LH

Special Tool(s)

 ST1255-A	Handle 205-153 (T80T-4000-W)
 ST2840-A	Installer, Differential Seals RH and LH 307-665
	Remover, Input Shaft Oil Seal 308-375
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

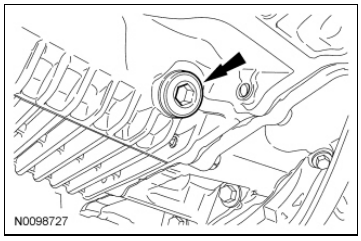
Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

Removal

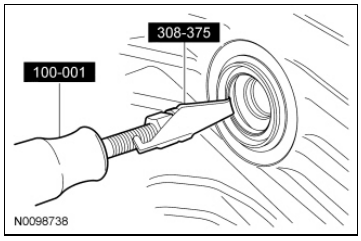
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Turn the ignition to the OFF position.
3. Remove the 7 screws and the underbody cover.

4. Remove the drain plug and drain the transmission fluid.



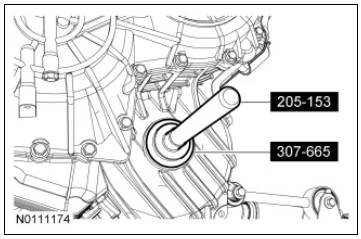
5. Remove the LH halfshaft. For additional Information, refer to Section 205-04 .

6. Using the Slide Hammer and Input Shaft Oil Seal Remover, remove and discard the LH differential seal.



Installation

1. Using the Differential Seal RH and LH Installer (two sided tool eCVT) and Handle, install the LH differential seal.

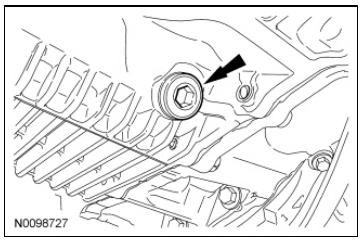


2. Install the LH halfshaft. For additional information, refer to Section 205-04 .

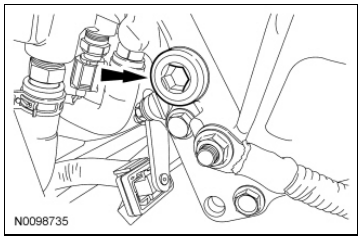
3. **NOTE:** Inspect the plug and washer for damage and install a new plug if necessary.

   Clean the drain plug threads and install the drain plug.

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



4. Remove the fill plug on the side of the transaxle.



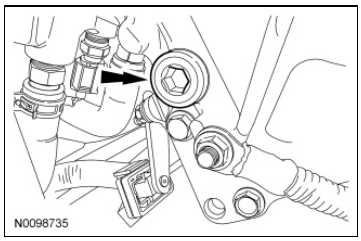
5. Fill the transaxle with clean transmission fluid as specified until the level reaches the bottom of the fill plug hole.

6. **NOTE:** Clean the area around the fill plug removing transmission fluid that may have spilled on the transaxle case.

   NOTE: Inspect the plug and washer for damage and install a new plug if necessary.

   Install the fill plug.

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

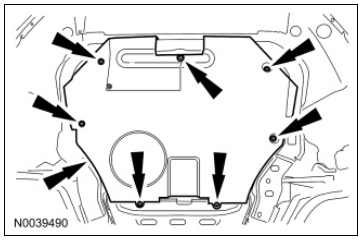


7. **NOTE:** The check and fill plug is located on the left side of the transaxle near the front.

   NOTE: The transmission fluid is checked and filled by removing the fill plug and adding transmission fluid to the bottom of the fill plug hole.

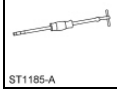
   Start the engine and check for correct forward and reverse operation.

8. Install the underbody cover and 7 screws.



Differential Seals - RH

Special Tool(s)

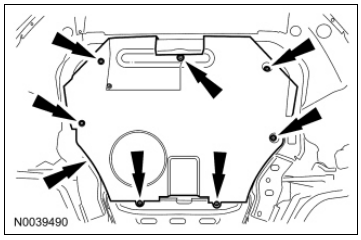
 ST3082-A	Handle, Driver 32 in 205-907
 ST2840-A	Installer, Differential Seals RH and LH 307-665
	Remover, RH Halfshaft Fluid Seal 307-429
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

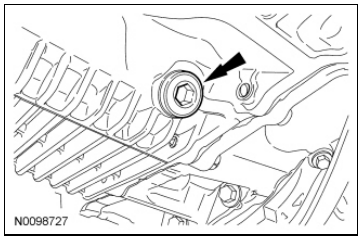
Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Turn the ignition to the OFF position.
3. Remove the 7 screws and the underbody cover.

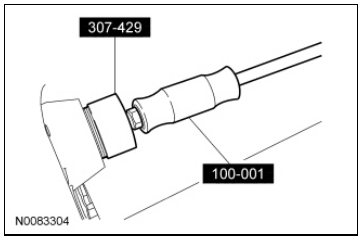

N0039490

4. Remove the drain plug and drain the transmission fluid.



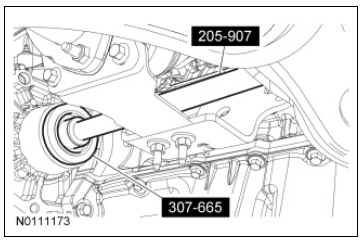
5. Remove the intermediate shaft. For additional information, refer to Section 205-04 .

6. Using the Slide Hammer and RH Halfshaft Fluid Seal Remover, remove and discard the RH differential seal.



Installation

1. Using the Differential Seal RH and LH Installer (two sided tool eCVT) and Driver 32 Inch Handle, install the RH differential seal.

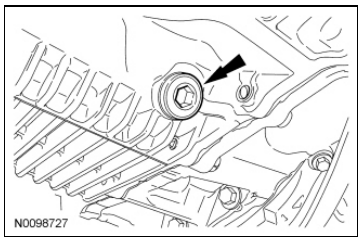


2. Install the intermediate shaft. For additional information, refer to Section 205-04 .

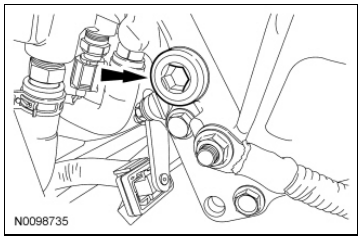
3. **NOTE:** Inspect the plug and washer for damage and install a new plug if necessary.

   Clean the drain plug threads and install the drain plug.

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



4. Remove the fill plug on the side of the transaxle.



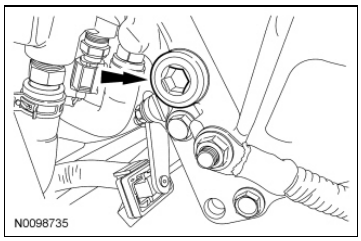
5. Fill the transaxle with clean transmission fluid as specified until the level reaches the bottom of the fill plug hole.

6. **NOTE:** Clean the area around the fill plug removing transmission fluid that may have spilled on the transaxle case.

   NOTE: Inspect the plug and washer for damage and install a new plug if necessary.

   Install the fill plug.

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

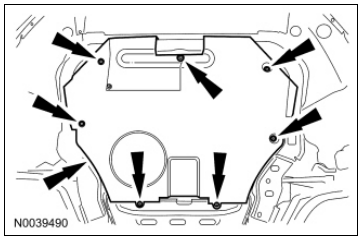


7. **NOTE:** The check and fill plug is located on the left side of the transaxle near the front.

   NOTE: The transmission fluid is checked and filled by removing the fill plug and adding transmission fluid to the bottom of the fill plug hole.

   Start the engine and check for correct forward and reverse operation.

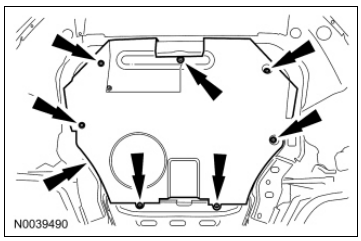
8. Install the underbody cover and 7 screws.



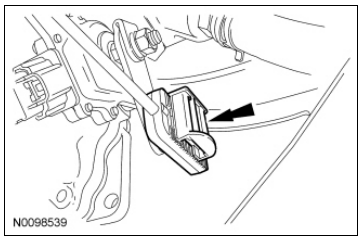
Transmission Range (TR) Sensor

Removal

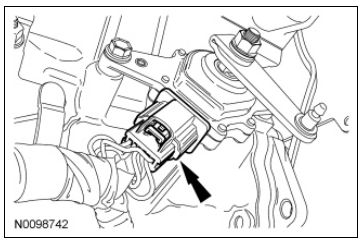
1. Remove the 7 screws and the underbody cover.



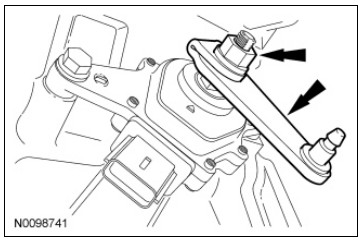
2. Disconnect the selector lever cable end from the manual control lever.



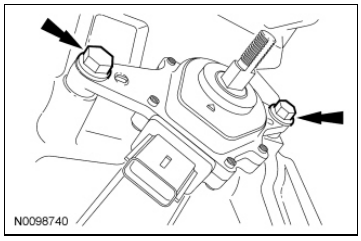
3. Disconnect the Transmission Range (TR) sensor electrical cotor.



4. Remove the nut and the manual lever.

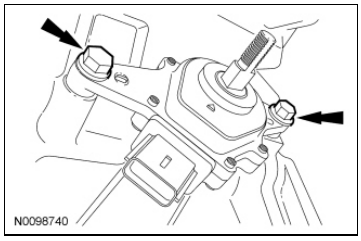


5. Remove the 2 bolts, slide the TR sensor off of the manual shaft and remove the TR sensor.

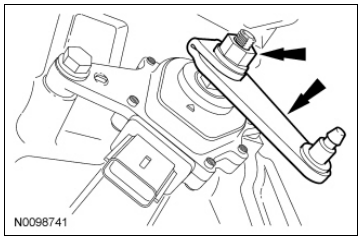


Installation

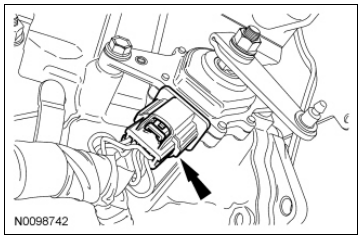
1. Position TR sensor on the manual shaft, align the 2 TR sensor bolt holes and install the 2 bolts.
   - Tighten to 5 Nm (44 lb-in).



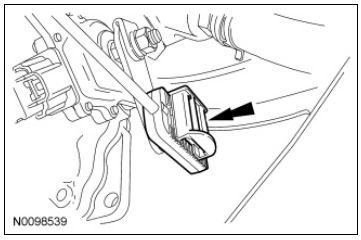
2. Install the manual control lever and the nut.
   - Tighten to 12 Nm (106 lb-in).



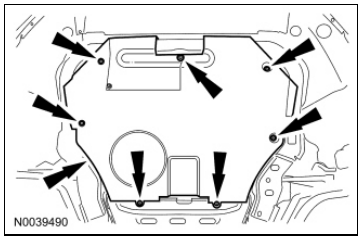
3. Connect the TR sensor electrical connector.



4. Adjust the selector lever cable. For additional information, refer to Section 307-05B . Connect the selector lever cable end.

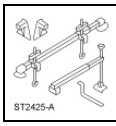


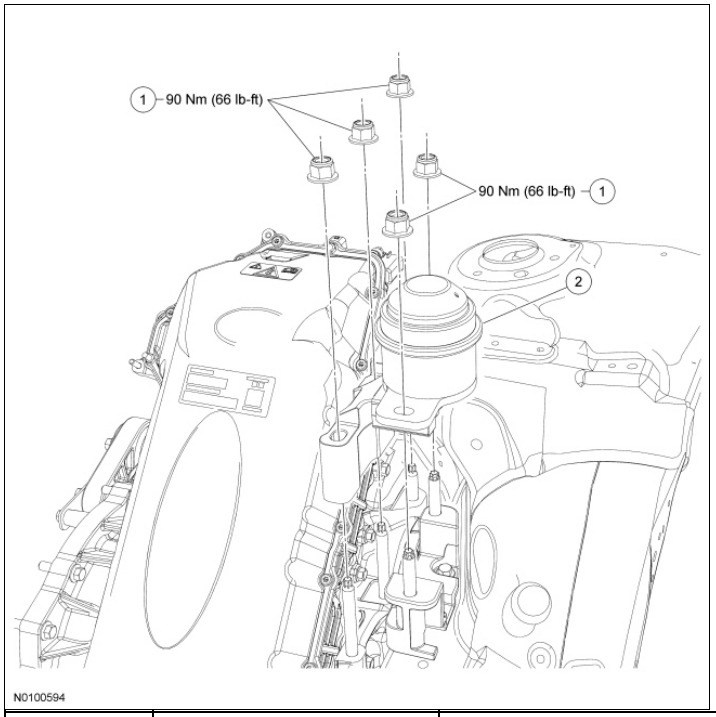
5. Install the underbody cover and 7 screws.


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Transaxle Support Insulator

Special Tool(s)

 ST2425-A	Support Bar, Engine 303-F072

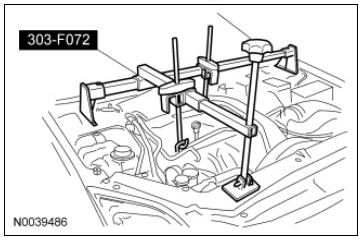


Item	Part Number <	Description
1	W520214	Transaxle support insulator nuts
2	14A464	Transaxle support insulator

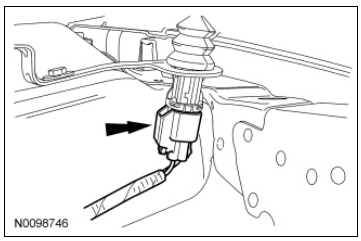
Removal and Installation

1. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12D .

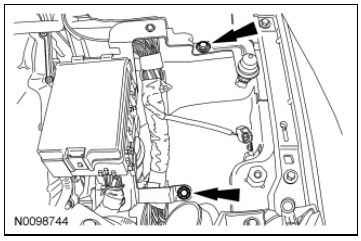
2. Install the Engine Support Bar and support the engine and transaxle.



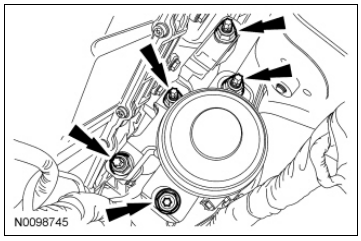
3. Disconnect the hood ajar electrical connector.



4. Remove the bolt and the nut and position aside the Battery Junction Box (BJB).
    - To install, tighten to 10 Nm (89 lb-in).

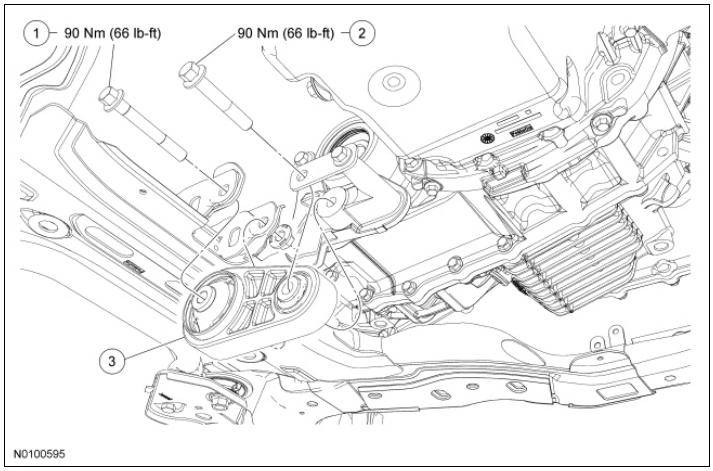


5. Remove the 5 nuts and remove the transaxle support insulator and the bracket.
    - To install, tighten to 90 Nm (66 lb-ft).



6. To install, reverse the removal procedure.

Transaxle Support Insulator - Anti-Roll

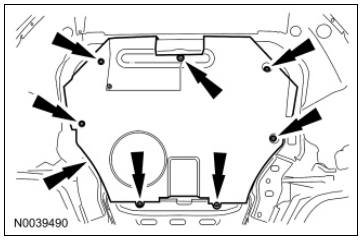


Item	Part Number	Description
1	W706674	Rear roll restrictor bolt
2	W500545	Front roll restrictor bolt
3	6P082	Roll restrictor assembly

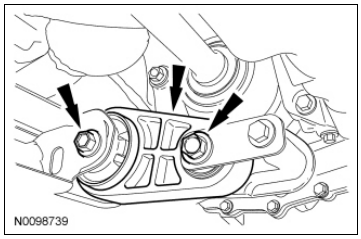
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 7 screws and the underbody cover.



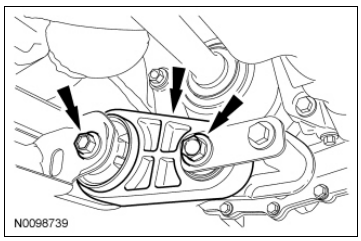
3. Remove the 2 bolts and remove the roll restrictor.



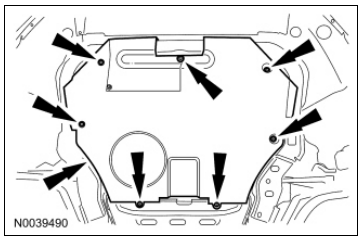
Installation

1. Position the roll restrictor in place and install the 2 bolts.

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



2. Install the underbody cover and 7 screws.



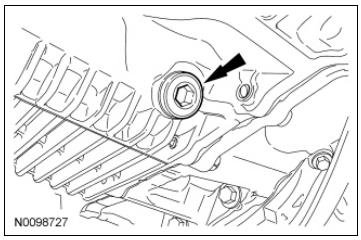
Transaxle

1. ***NOTICE:*** **Do not drain the oil when removing the engine to service the transaxle.**

   NOTE: Inspect the plug and washer for damage and install a new plug if necessary.

   To remove the transaxle, follow the engine removal procedure. For additional information, refer to Section 303-01D . Before removing the engine and transaxle from the vehicle, remove the drain plug and drain the transmission fluid.

   - To install, tighten to 40 Nm (30 lb-ft).



SECTION 307-01C: Automatic Transaxle/Transmission - Electronically Controlled Continuously Variable Transmission (eCVT)

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Workshop Manual

INSTALLATION

Procedure revision date: 06/03/2011

Transaxle

1. To install the transaxle, follow the engine installation procedure. For additional information, refer to Section 303-01D .

Material

Item	Specification	Fill Capacity
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLV	MERCON® LV	8.5L (9 qt) [a]
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A	7.0L (7.4 qt) [b]

[a] 6F35 Transaxle
[b] Aisin AW21 Transaxle

General Specifications

Item	Specification
Fluid	
The use of any transmission fluid other than what is recommended for this transaxle will cause transaxle damage. Refer to the material specificatthe correct fluid. The transmission fluid should be changed every 96,560 km (60,000 mi) regardless of normal or special operating conditions.	
NOTICE: **The transmission fluids used in the 6F35 and AW21 transaxles are unique and are not interchangeable.**	

NOTICE: **Do not use water-based cleaners to clean or flush the transmission fluid cooler tubes or transmission damage will occur. Mineral spirits can be used to clean the transmission fluid cooler tubes, providing the transmission fluid cooler tubes are flushed with clean automatic transmission fluid and blown dry with shop air. Use only clean automatic transmission fluid designated for this transaxle and torque converter being serviced.**

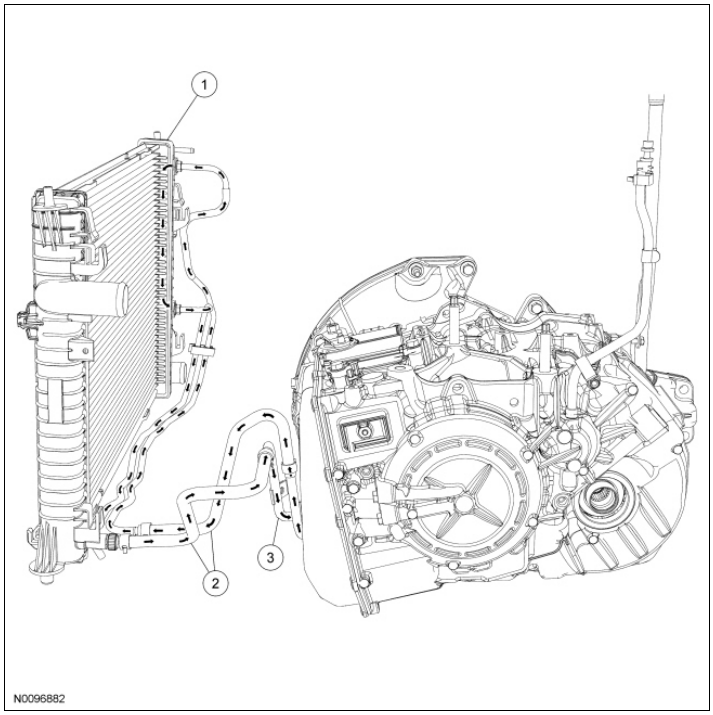
Torque Specifications

Description	Nm	lb-ft	lb-in
Transmission fluid cooler tubes	10	-	89
Transmission fluid cooler tubes (at the radiator)	20	-	177
Transmission fluid fill plug (Aisin AW21)	39	29	-

Transaxle Cooling - Aisin AW21

These vehicles are equipped with an internal transmission fluid cooler. The transmission fluid cooler is mounted in the engine radiator tank. During operation, transmission fluid travels from the transaxle to the transmission fluid cooler, then back to the transaxle. The transmission fluid cooler transfers heat from the transmission fluid to the engine coolant.

Transaxle Cooling - Aisin AW21

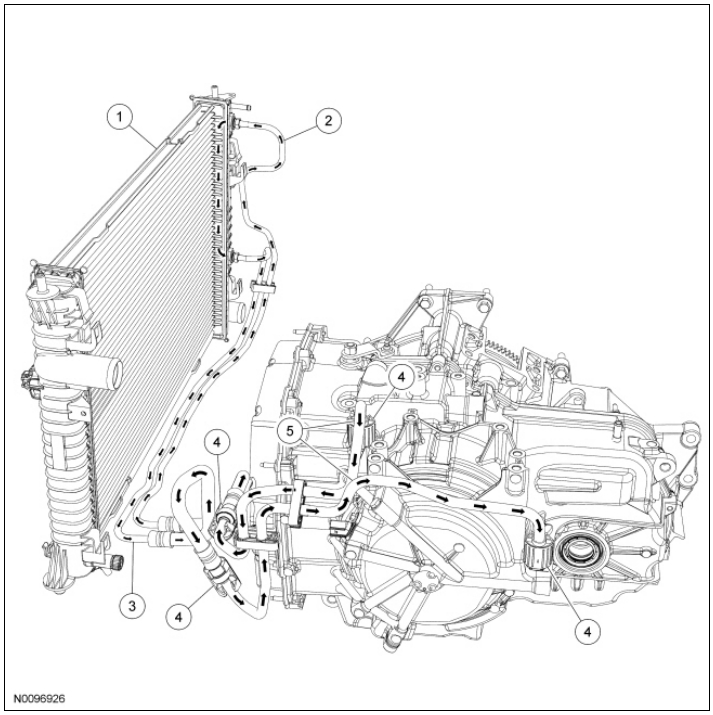


Item	Part Number	Description
1	8005	Radiator
2	7H420	Transmission fluid e assembly
3	19710-A	Transmission mounted fluid cooler tube

Transaxle Cooling - 6F35

These vehicles are equipped with an internal transmission fluid cooler. The transmission fluid cooler is mounted in the engine radiator tank. During operation, transmission fluid travels from the transaxle to the transmission fluid cooler, then back to the transaxle. The transmission fluid cooler transfers heat from the transmission fluid to the engine coolant.

Transaxle Cooling



Item	Part Number	Description
1	8005	Radiator
2	7R081	Transmission fluid cooler supply tube assemblyes transmission fluid to the transmission fluid cooler from the transaxle)
3	7R081	Transmission fluid cooler return tube assembly (transmission fluid return tube from the transmission fluid cooler to the transaxle)
4	7J081	Transmission fluid cooler tube secondary latches
5	7H420	Transaxle mounted transmission fluid cooler tubes

Transaxle Cooling - Aisin AW21

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

Inspection and Verification

1. Verify mer concern by operating the vehicle to duplicate the condition.
2. If the inspection reveals an obvious concern(s) that can be readily identified, repair as necessary.
3. Install new components if a transmission fluid leak is found in any of the transaxle cooling components.
4. If the concern(s) remains after the inspection, determine the symptom(s). GO to Symptom Chart - Transaxle Cooling or GO to Symptom Chart - NVH .

Symptom Chart - Transaxle Cooling

Symptom Chart - Transaxle Cooling

Symptom Chart - NVH

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

ConditionPossible SourcesAction

- Vibration - a high frequency (20-80 Hz) that is felt through the seat or selector lever. Changes with engine speed
- Transmission fluid cooler tubes grounded
- CHECK the transmission fluid cooler tubes. REPAIR as necessary.

Check Transmission Fluid Level and Condition

NOTICE: **The vehicle should not be driven if the transmission fluid level indicator shows the transmission fluid below the minimum fluid level mark or internal failure may result.**

If the vehicle has been operated for an extended period of time at highway speeds, in city traffic, in hot weather or while pulling a trailer, the transmission fluid may need to cool down to obtain an accurate reading.

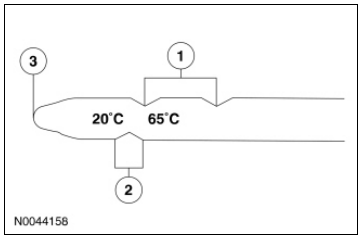
The transmission fluid level reading on the transmission fluid level indicator will differ depending on operating and ambient temperatures. The correct reading should be within the normal operating temperature range.

Transmission Fluid Level Check

NOTE: The transmission fluid should be checked at normal operating temperature 60°C-70°C (140°F-158°F) on a level surface. Normal operating temperature can be reached after approximately 32 km (20 mi) of driving and can be checked using the scan tool.

Under normal circumstances the transmission fluid level should be checked during normal maintenance. If the transaxle starts to slip, shifts slowly or shows signs of transmission fluid leaking, the transmission fluid level should be checked.

1. With the transaxle in PARK, the engine at idle, foot pressed on the brake, move the selector lever through each gear and allow engagement of each gear. Place the selector lever in the PARK position.
2. Wipe the transmission fluid level indicator cap and remove the transmission fluid level indicator.
3. Wipe the transmission fluid level indicator with a clean cloth.
4. Install the transmission fluid level indicator back in the fluid indicator tube until it is fully seated, then remove the indicator. The transmission fluid level should be within the normal operating range.



Item	Part Number	Description
1	-	Transmission fluid level at operating temperature 60°C-70°C (140°F-158°F)

2	-	Transmission fluid level cool 15°C-25°C (59°F-77°F)
3	-	Do not drive mark

High Transmission Fluid Level

A transmission fluid level that is too high may cause the transmission fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of transmission fluid from the vent tube and possible transaxle malfunction and/or damage. If an overfill reading is indicated, refer to Section 307-01A .

Low Transmission Fluid Level

A low transmission fluid level could result in poor transaxle engagement, slipping, malfunction and/or damage. This could also indicate a leak in one of the transaxle seals or gaskets.

Adding Transmission Fluid

NOTICE: **The use of any fluid other than what is recommended for this transaxle will cause transaxle damage.**

If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pt) increments through the indicator tube. Do not overfill the transaxle. For transmission fluid type, refer to the specification chart in this section.

Transmission Fluid Condition Check

1. Check the transmission fluid level.
2. Observe the color and the odor. The color under normal circumstances should be a dark red color, not brown or black or have a burnt odor.
3. Hold the transmission fluid level indicator over a white facial tissue and allow the transmission fluid to drip onto the facial tissue and examine the stain.
4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.
5. If the stain is a foamy pink color, this may indicate coolant in the transaxle. The engine cooling system should also be inspected at this time.
6. If transmission fluid contamination or transaxle failure is confirmed by the sediment in the bottom of the fluid pan, install a new transaxle. If installing a new transaxle, the transmission fluid cooler and transmission fluid cooler tubes should be cleaned.
7. If the transaxle is to be overhauled or if installing a new transaxle, the fluid cooler must be backflushed. Refer to Section 307-01A .

Transaxle Cooling - 6F35

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLV	MERCON® LV

Inspection and Verification

1. Verify the customer concern by operating tto duplicate the condition.
2. If the inspection reveals obvious concern(s) that can be readily identified, repair as necessary.
3. Install new components if a transmission fluid leak is found in any of the transaxle cooling components.
4. If the concern(s) remains after the inspection, determine the symptom(s). GO to Symptom Chart - Transaxle Cooling or GO to Symptom Chart - NVH .

Symptom Chart - Transaxle Cooling

Symptom Chart - Transaxle Cooling

Symptom Chart - NVH

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

ConditionPossible SourcesAction

- Vibration - a high frequency (20-80 Hz) that is felt through the seat or selector lever. Changes with engine speed
- Transmission fluid cooler tubes grounded
- CHECK the transmission fluid cooler tubes. REPAIR as necessary.

Check Transmission Fluid Level and Condition (All Vehicles)

NOTICE: **The vehicle should not be driven if the transmission fluid level indicator shows the transmission fluid below the minimum transmission fluid level mark or internal failure could result.**

If the vehicle has been operated for an extended period of time, at highway speeds, in city traffic, in hot weather or while pulling a trailer, the transmission fluid may need to cool down to obtain an accurate reading.

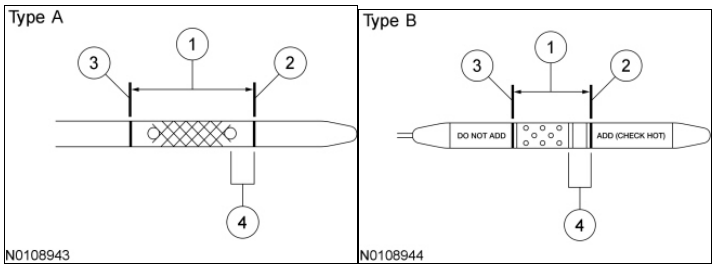
The transmission fluid level reading on the transmission fluid level indicator will differ depending on operating and ambient temperatures. The correct reading should be within the normal operating temperature range.

Transmission Fluid Level Check

NOTE: The transmission fluid should be checked at normal operating temperature 85°C-93°C (185°F-200°F) on a level surface. Normal operating temperature can be reached after approximately 32 km (20 mi) of driving and can be checked using the scan tool.

Under normal circumstances the transmission fluid level should be checked during normal maintenance. If the transaxle starts to slip, shifts slowly or shows signs of transmission fluid leaking, the transmission fluid level should be checked.

1. With the transaxle in PARK, gine at idle, foot pressed on the brake, move the selector lever through each gear and allow engagement of each gear. Place the selector lever in the PARK position.
2. Wipe the transmission fluid level indicator cap and remove the transmission fluid level indicator.
3. Wipe the transmission fluid level indicator with a clean cloth.
4. Install the transmission fluid level indicator back in the transmission fluid filler tube until it is fully seated, then remove the indicator. The transmission fluid level should be within the crosshatch.



Item	Description
1	Correct transmission fluid level at operating temperature 85°C-93°C (185°F-200°F)
2	Minimum transmission fluid level mark
3	Maximum transmission fluid level mark

4	Flat tow transmission fluid level

High Transmission Fluid Levelb>

A transmission fluid level that is too high may cause the transmission fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of transmission fluid from the vent tube and possible transaxle malfunction and/or damage. If an overfill reading is indicated, refer to Section 307-01B .

Low Transmission Fluid Level

A low transmission fluid level could result in poor transaxle engagement, slipping, malfunction and/or damage. This could also indicate a leak in one of the transaxle seals or gaskets.

Adding Transmission Fluid

NOTICE: **Automatic transmission fluids are not interchangeable. The use of any fluid other than what is recommended for this transaxle will cause transaxle damage.**

If transmission fluid needs to be added, add transmission fluid in 0.25L (1/2 pt) increments through the transmission fluid level indicator tube with the selector lever in PARK and the engine idling. Do not overfill the transmission fluid. For transmission fluid type, refer to the material chart in this section.

Flat Tow Fluid Level

Recreational flat towing of the vehicle may require the transmission fluid to be set to a lower fluid level. This will prevent damage to the transmission. The transmission fluid level is within the normal operating range and will not require the transmission fluid level to be readjusted after recreational towing.

Transmission Fluid Condition Check

1. Check the transmission fluid level.
2. Observe the color and the odor. The color under normal circumstances should be a dark red color, not brown or black or have a burnt odor.
3. Hold the transmission fluid level indicator over a white facial tissue and allow the transmission fluid to drip onto the facial tissue and examine the stain.
4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.
5. If transmission fluid contamination or transaxle failure is confirmed by the sediment in the bottom of the transmission fluid pan, repair the transaxle and clean the transmission fluid cooler tubes and the transmission fluid cooler.
6. If the transaxle is to be overhauled or if installing a new transaxle, the transmission fluid cooler must be backflushed. Refer to Section 307-01B .

Transmission Fluid Cooler

1. **NOTE:** The transmission fluid cooler is mounted in the radiator tank and cannot be serviced separately.

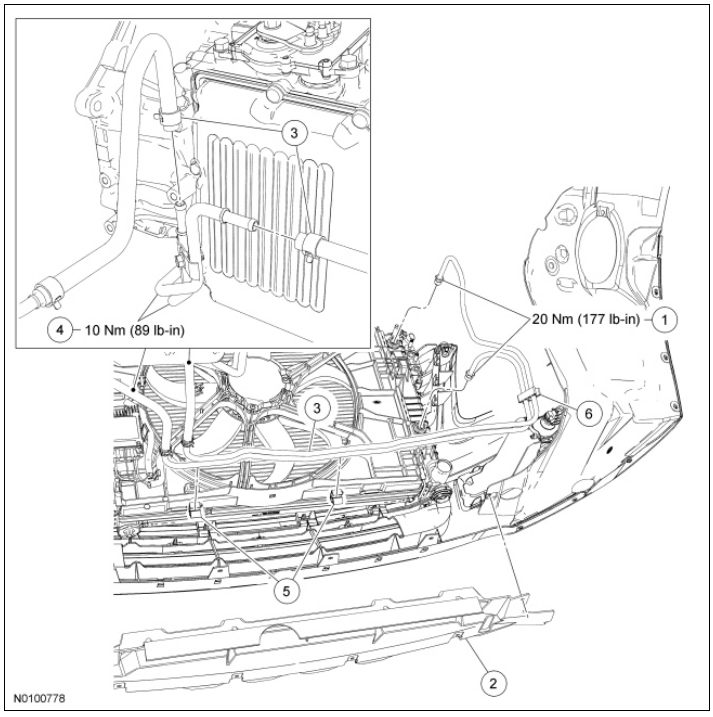
   Install a new radiator. For additional information, refer to Section 303-03A .

Transmission Fluid Cooler Tubes - Aisin AW21

Material

Item	Specification
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A

Transmission Fluid Cooler Tubes - Aisin AW21



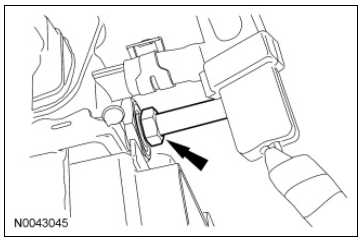
Item	Part Number	Description
1	M52923	Transmission fluid cooler tube radiator fittings
2		
3	7H420	Transmission fluid cooler tube assembly
4	19710-A	Transmission fluid cooler tube fittings at the transaxle
5	256844	Transmission fluid cooler tube retaining clips
6	256679	Transmission fluid cooler tube retaining clip

Removal

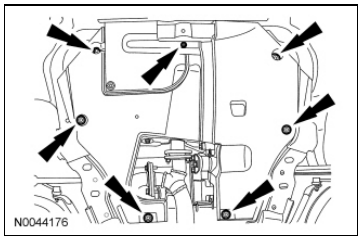
NOTICE: **The use of any transmission fluid other than what is recommended for this transaxle will cause transaxle damage.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

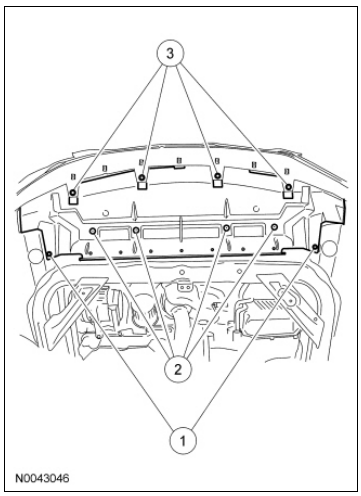
2. Disconnect the upper transmission fluid cooler tube from the radiator.



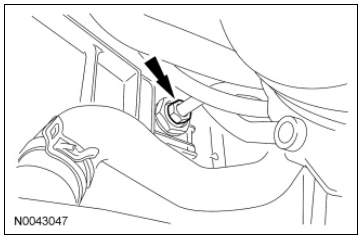
3. Remove the bolts and the splash shield.



4. Remove the front splash shield.
    1. Remove the 2 screws.
    2. Remove the 4 retainers.
    3. Remove the 4 bolts and the splash shield.



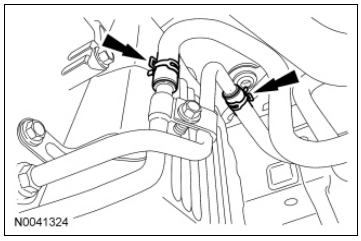
5. Disconnect the lower transmission fluid cooler tube from the radiator.



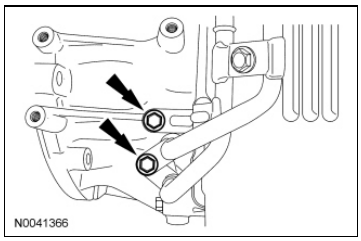
6. ***NOTICE:*** **Use care not to overstretch or extend the hose clamps as damage may occur to the hose clamp and cause a leak.**

NOTICE: **The hose clamps are held on the hose with a special epoxy. Damage may occur to the hose if the clamp is removed from the hose. If the clamp or hose is damaged, install a new fluid cooler tube.**

Disconnect the transmission fluid cooler hoses from the transmission fluid cooler tubes.

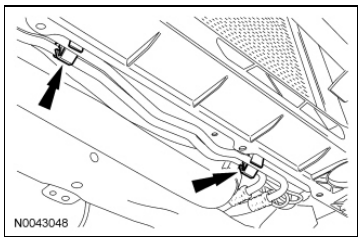


7. Remove the 2 bolts and remove the transmission fluid cooler tubes.

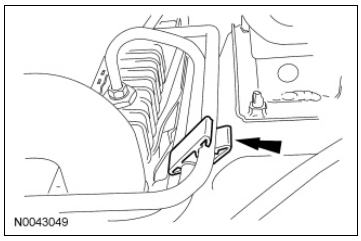


8. **NOTE:** When removing the transmission fluid cooler tubes from the retainers, do not remove the retainers from the shroud.

   Remove the transmission fluid cooler tubes from the retainers.

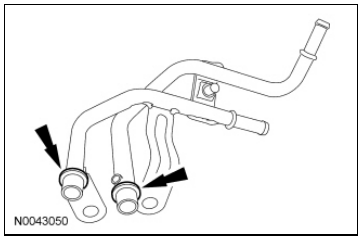


9. Remove the transmission fluid cooler tube retainer and remove the transmission fluid cooler tubes.

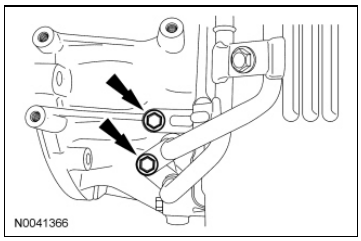


Installation

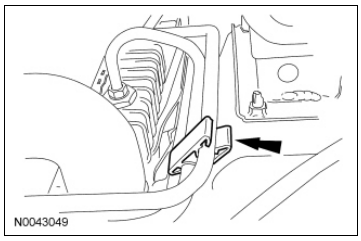
1. Install new O-rings on the transmission fluid cooler tubes.



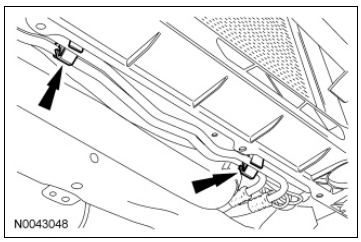
2. Install the transmission fluid cooler tubes.
    - Tighten to 10 Nm (89 lb-in).



3. Position the transmission fluid cooler tubes in place and install the retainer.

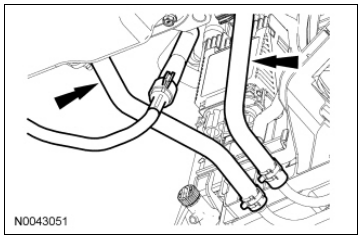


4. Install the transmission fluid cooler tubes in the retainers.



5. **NOTE:** The power steering hose is routed between the 2 transmission fluid cooler hoses.

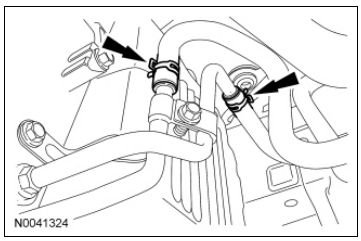
   Position the transmission fluid cooler hoses in place.



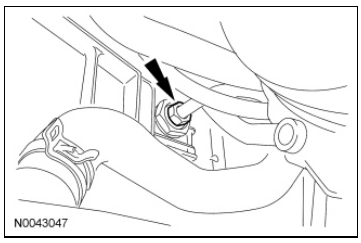
6. ***NOTICE:*** **Use care not to overstretch or extend the hose clamps as damage may occur to the hose clamp and cause a leak.**

   NOTICE: **The hose clamps are held on the hose with a special epoxy. Damage may occur to the hose if the clamp is removed from the hose. If the clamp or hose is damaged, install a new fluid cooler tube.**

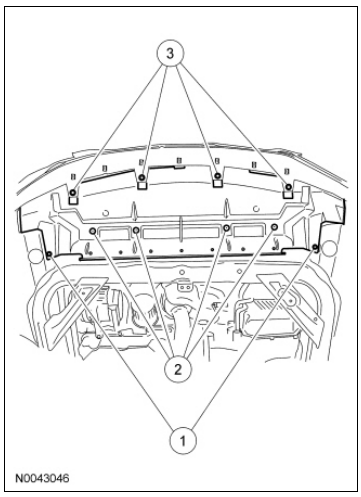
Connect the transmission fluid cooler hoses to the transmission fluid cooler tubes.



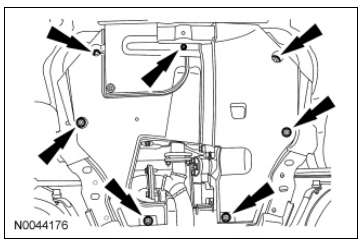
7. Install the lower transmission fluid cooler tube in the radiator.
    - Tighten to 20 Nm (177 lb-in).



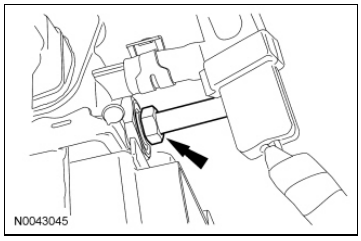
8. Install the front splash shield.
    1. Position the splash shield in place and install the 2 screws.
    2. Install the 4 retainers.
    3. Install the 4 bolts.



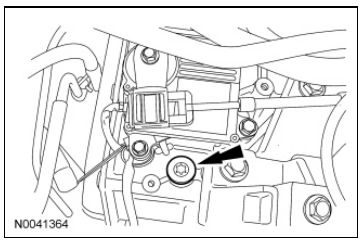
9. Install the bolts and the splash shield.



10. Install the upper transmission fluid cooler tube in the radiator.
    - Tighten to 20 Nm (177 lb-in).

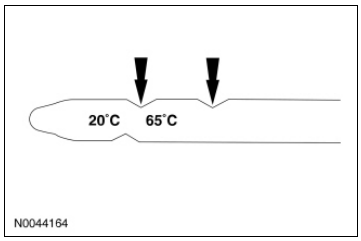


11. Remove the transmission fluid fill plug.

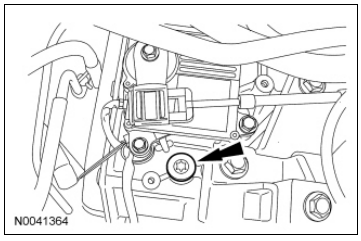


12. **NOTE:** Transmission fluid level at normal operating temperature is between the top 2 marks on the fluid level indicator.

    Check the transmission fluid level and add transmission fluid as necessary.

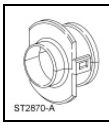


13. Install the transmission fluid fill plug.
    - Tighten to 39 Nm (29 lb-ft).



Transmission Fluid Cooler Tubes - 6F35

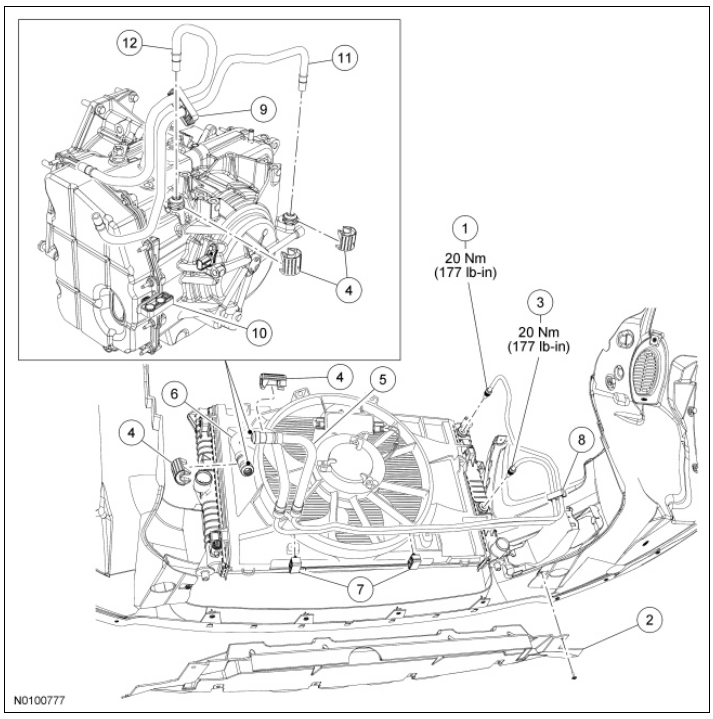
Special Tool(s)

 ST2870-A	Disconnect Tool, Transmission Cooler Line 307-569

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLV	MERCON® LV

Transmission Fluid Cooler Tubes



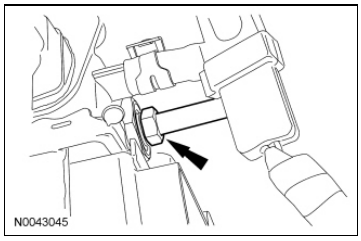
Item	Part Number	Description
1	-	Transmission fluid cooler tube nut (part of 7H420)
2	7B407	Radiator splash shield
3	-	Transmission fluid cooler tube nut (part of 7H420)
4	7J081	Transmission fluid cooler tube secondary latches
5	7R081	Transmission fluid cooler supply tube
6	7R081	Transmission fluid cooler return tube

7	256844	Transmission fluid cooler tube retaining clips
8	256679	Transmission fluid cooler tube retaining clip
9	-	Transmission fluid cooler tube retainer (part of 7H420)
10	-	Transmission fluid cooler tube retainer (part of 7H420)
11	7H420	Transaxle mounted transmission fluid cooler return tube
12	7H420	Transaxle mounted transmission fluid cooler supply tube

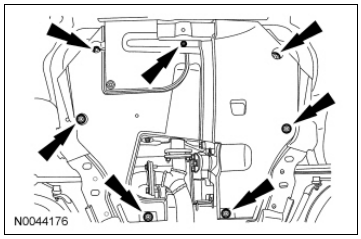
Removal

NOTICE: **Automatic transmission fluids are not interchangeable. The use of any fluid other than what is recommended for this transaxle will cause transaxle damage.**

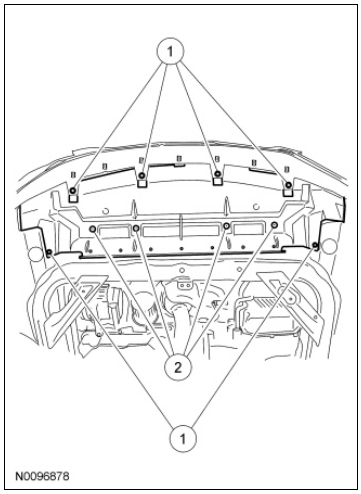
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to
2. Disconnect the upper transmission fluid cooler tube from the radiator.



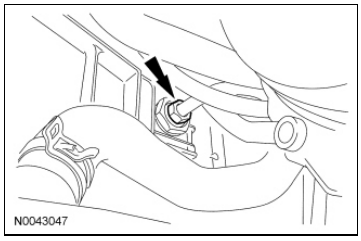
3. Remove the bolts and the splash shield.



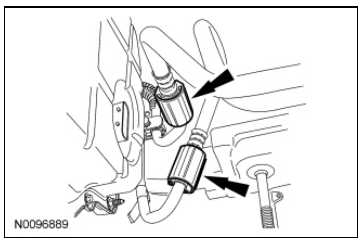
4. Remove the radiator splash shield.
    1. Remove the 6 screws.
    2. Remove the 4 retainers.



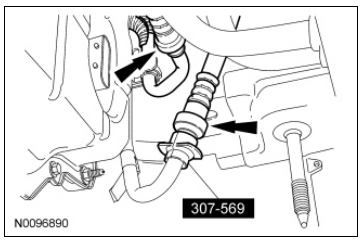
5. Disconnect the lower transmission fluid cooler tube from the radiator.



6. Remove the transmission fluid cooler tube secondary latches.

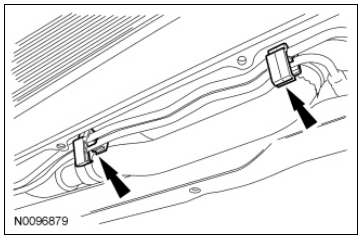


7. Using the Transmission Cooler Line Disconnect Tool, disconnect the transmission fluid cooler tubes.

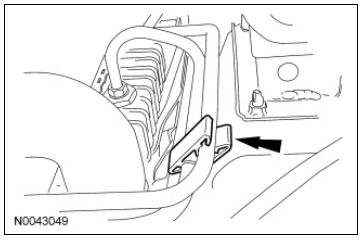


8. **NOTE:** When removing the transmission fluid cooler tubes from the retainers, do not remove the retainers from the shroud.

   Release the transmission fluid cooler tube retainers and remove the transmission fluid cooler tubes from the retainers.



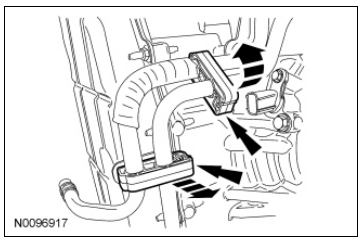
9. Remove the transmission fluid cooler tube retainer and remove the transmission fluid cooler tubes from the vehicle.



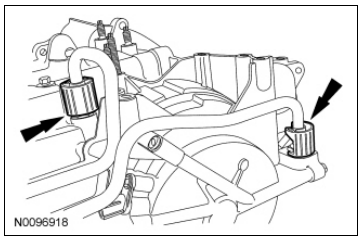
10. Remove the Air Cleaner (ACL) and the outlet pipe. For additional information, refer to Section 303-12A or Section 303-12B .

11. Remove the battery and battery tray. For additional information, refer to Section 414-01 .

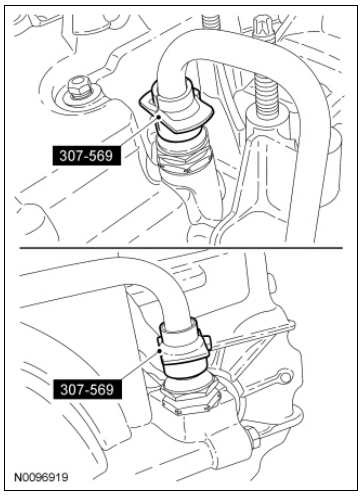
12. Open the transmission fluid cooler tube retainers.



13. Remove the 2 transmission fluid cooler tube secondary latches.

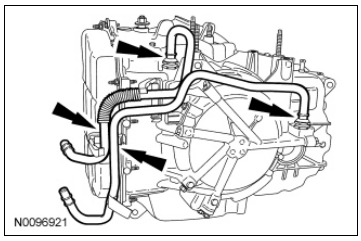


14. Using the Transmission Cooler Line Disconnect Tool, disconnect and remove the transmission fluid cooler tubes from the transaxle.

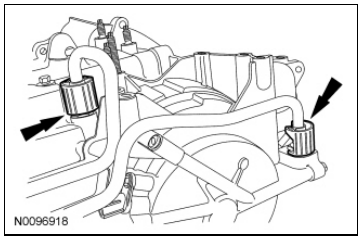


Installation

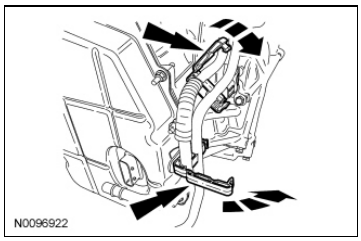
1. Install the transmission fluid cooler tubes in the transaxle by inserting the tube into the fitting until a click is heard/felt. Pull back to confirm connection is secure and position them in the retainer mounted on the main control cover studbolts.



2. Install the 2 transmission fluid cooler tube secondary latches.



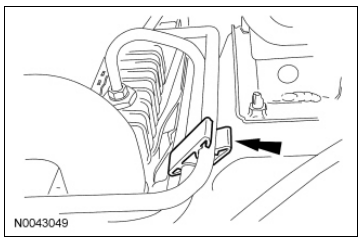
3. Position the transmission fluid cooler tubes in the retainers and close the 2 transmission fluid cooler tube retainers.



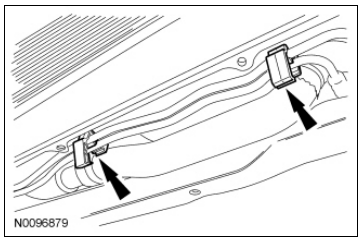
4. Install the battery and battery tray. For additional information, refer to Section 414-01 .

5. Install the ACL and the outlet pipe. For additional information, refer to Section 303-12A or Section 303-12B .

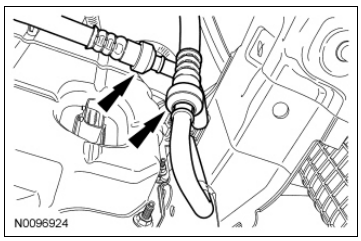
6. Position the transmission fluid cooler tubes in place in the vehicle and install the retainer.



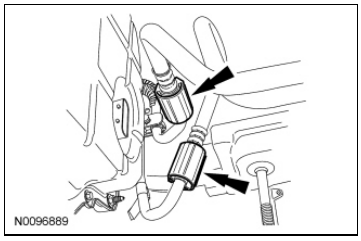
7. Position the transmission fluid cooler tubes in the retainers and close the retainers.



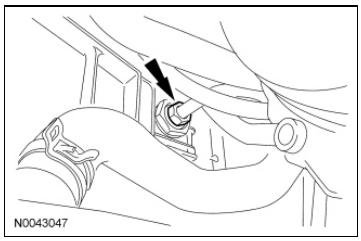
8. Connect the transmission fluid cooler tubes by inserting the tube into the fitting until a click is heard/felt. Pull back to confirm that the connection is secure.



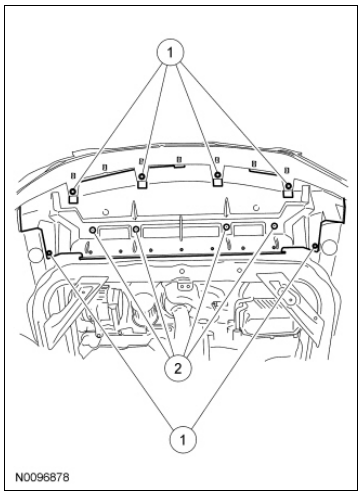
9. Install the transmission fluid cooler tube secondary latches.



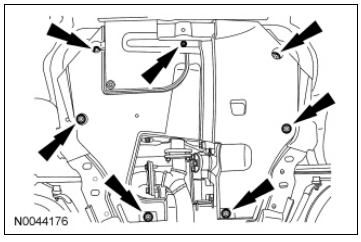
10. Install the lower transmission fluid cooler tube in the radiator.
    - Tighten to 20 Nm (177 lb-in).



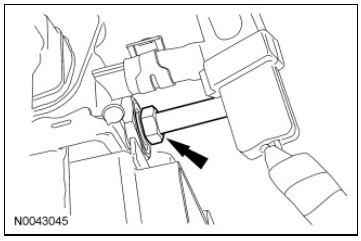
11. Install the radiator splash shield
    1. Install the 6 screws.
    2. Install the 4 retainers.



12. If equipped, install the bolts and the splash shield.



13. Install the upper transmission fluid cooler tube in the radiator.
    - Tighten to 20 Nm (177 lb-in).



14. Fill the transaxle with clean transmission fluid.

15. Using the scan tool with the engine running, check and make sure that the transmission is at normal operating temperature 85-93°C (185-200°F). Check and adjust the transmission fluid level and check for any leaks. If transmission fluid is needed, add transmission fluid in increments of 0.24L (0.5 pt) until the correct level is achieved.

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bsp;

Material

Item	Specification	Fill Capacity
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A	2.75L (2.9 qt) approximate dry fill capacity [a] [b]
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D	2.75L (2.9 qt) approximate dry fill capacity [a]

[a] Vehicles (built on or after July 6, 2009 through June 5, 2011) cooling systems are filled with Motorcraft® Specialty Green Engine Coolant. Vehicles (built on or after June 6, 2011) are filled with Motorcraft® Specialty Orange Engine Coolant. Mixing coolant types degrades the corrosion protection of the coolant. Do not mix coolant types. Failure to follow these instructions may result in engine or cooling system damage.
[b] Genuine Mazda® Extended Life Coolant and Motorcraft® Specialty Green Engine Coolant are very sensitive to light. Do NOT allow these products to be exposed to ANY LIGHT for a day or two. Extended light exposure causes these products to degrade.

Torque Specifications

Description	Nm	lb-in
Motor Electronics Cooling System (MECS) bleed screw	3	27
MECS cooler hose bolt	15	133
MECS coolant expansion tank bolt	8	71
MECS coolant expansion tank nut	8	71
MECS radiator bolts	8	71

Transaxle Cooling

Motor Electronics Cooling System (MECS)

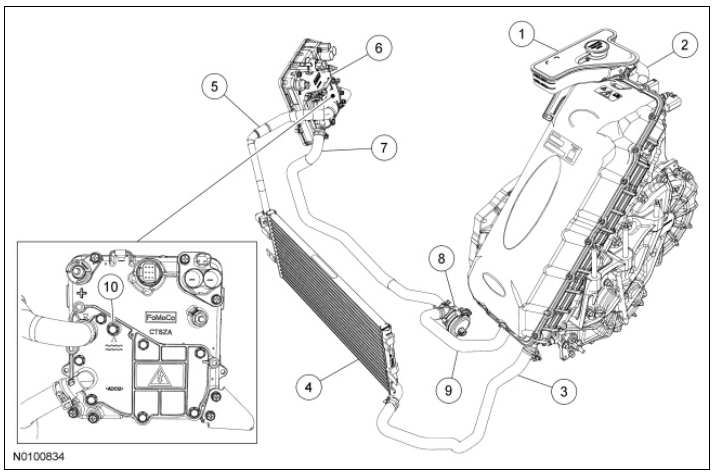
The vehicle uses a pump driven cooling system, referred to as the Motor Electronics Cooling System (MECS) pump, to transfer heat generated by the Electronically Controlled Continuously Variable Transmission (eCVT) and the Hybrid Electric Vehicle (HEV) DC/DC converter to the atmosphere. The system uses a coolant-to-air radiator design.

The MECS pump is an electric pump that runs any time the ignition is in the ON position. Unlike traditional cooling systems, there is no thermostat in the MECS , so coolant flow should be continuous and considerably less than traditional powertrain cooling systems.

The flow direction is from the DC/DC converter to the MECS pump through the eCVT , then through the MECS cooler from the LH to RH side of the vehicle back to the DC/DC converter.

The MECS cooling pump will make an audible noise if it is running and a slight vibration may be felt by touch.

The MECS cooling system has a coolant expansion tank mounted on top of the transaxle.



Item	Part Number	Description
1	8C045	Motor Electronics Cooling System (MECS) coolant expansion tank
2	8C351	MECS coolant expansion tank outlet hose
3	8B273	Electronically Controlled Continuously Variable Transmission (eCVT)-to- MECS cooler hose
4	8005	MECS radiator
5	8B274	MECS cooler-to-DC/DC converter tube/hose assembly
6	14B227	DC/DC converter
7	15179	DC/DC converter-to- MECS pump hose
8	8C419	MECS pump

9	8A567	MECS pump-to- eCVT hose
10	W710743	MECS bleed screw

Transaxle Cooling

Special Tool(s)

 ST2574-A	Flex Probe Kit 105-R025D
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Motor Electronics Cooling System (MECS) component damage: ♦ Motor electronics radiator ♦ MECS coolant hoses ♦ MECS coolant pump • Coolant leaks	• Battery Junction Box (BJB) fuse 13 (15A) • BJB fuse 47 (10A) • MECS cooling pump relay (BJB relay 44) • Wiring harness • Connector • Circuitry

Symptom Chart - Transaxle Cooling

Symptom Chart - Transaxle Cooling

Symptom Chart - NVH

Symptom Chart - NVH
NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is

possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

ConditionPossible SourcesAction

- Vibration - a high frequency (20-80 Hz) that is felt through the seat or selector lever
- Motor Electronics Cooling System (MECS) pump
- CHECK the MECS pump. INSTALL a new pump as necessary.

Pinpoint Tests

Pint Test A: MECS Cooling Pump Fault

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Control for schematic and connector information.

Normal Operation

The Motor Electronics Cooling System (MECS) pump is electrically driven and controlled by the PCM through the MECS pump relay. The PCM energizes the MECS pump relay by pulling the MECS pump output to ground when the ignition is in the ON position.

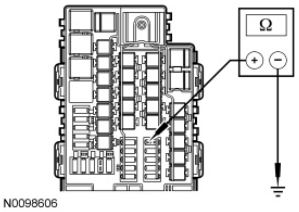
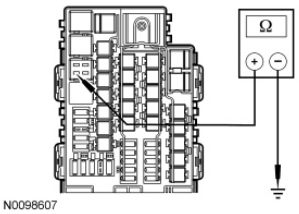
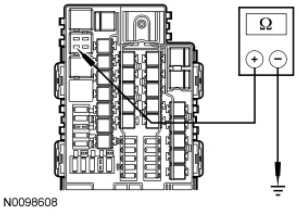
This pinpoint test is intended to diagnose the following:

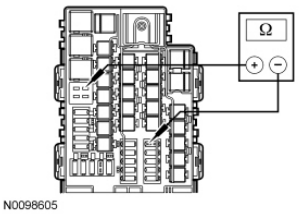
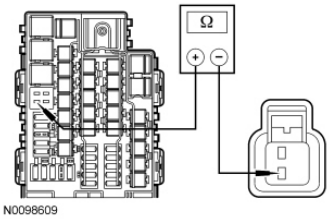
- Battery Junction Box (BJB) fuse 13 (15A)
- BJB fuse 47 (10A)
- MECS coolant pump
- Wiring
- MECS coolant pump relay

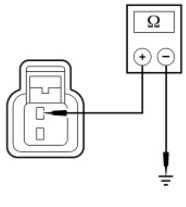
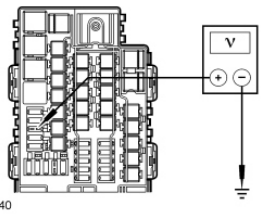
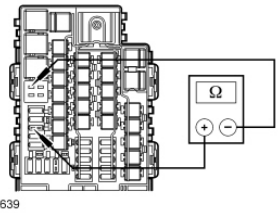
PINPOINT TEST A: MECS COOLING PUMP FAULT

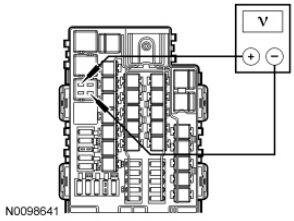
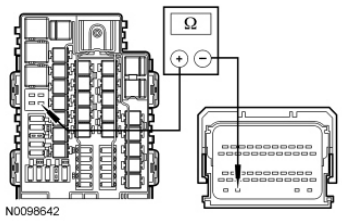
NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
A1 CHECK FOR DTCs	
• Connect the scan tool. • Enter the following diagnostic mode on the scan tool: RETRIEVE. • Carry out the PCM on-demand self test. • **Are DTCs retrieved?**	**Yes** REFER to Section 307-01C . **No** GO to A2 .
A2 CHECK BJB FUSE 13 (15A)	
• Check fuse: BJB 13 (15A). • **Is the resistance less than 5 ohms?**	**Yes** GO to A5 .

	No GO to A3 .
A3 CHECK THE MECS COOLANT PUMP RELAY POWER SUPPLY CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: BJB Fuse 13 (15A). • Disconnect: BJB Relay 44. • Disconnect: BJB Relay 42. • Measure the resistance between the output side of BJB fuse 13 (15A) and ground.  N0098606 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A4 . **No** REPAIR circuit SBB13 (GY/RD) for a short to ground. CONNECT all components. TEST the system for normal operation.
A4 CHECK THE MECS COOLANT PUMP AND HEATER PUMP POWER SUPPLY CIRCUITS FOR A SHORT TO GROUND	
• Disconnect: MECS Coolant Pump C1466. • Disconnect: Heater Pump Motor C1450. • Measure the resistance between BJB relay 44 pin 5 circuit CE621 (YE/GY), BJB side and ground.  N0098607 • Measure the resistance between BJB relay 42 pin 5 circuit CHC01 (BN/YE), BJB side and ground.  N0098608 • **Are the resistances greater than 10,000 ohms?**	**Yes** The condition that caused BJB fuse 13 (15A) to blow is not present. Inspect the wiring harness for an intermittent condition. Repeat test Steps A3 and A4 while wiggling the vehicle wiring harness and visually checking for damage. **No** REPAIR circuit CE621 (YE/GY) or CHC01 (BN/YE) for a short to ground. CONNECT all components. TEST the system for normal operation.
A5 CHECK THE MECS COOLANT PUMP RELAY (BJB RELAY 44)	

• Carry out the relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Is MECS pump relay (BJB relay 44) OK?**	**Yes** GO to A6 . **No** INSTALL a new MECS pump relay (BJB relay 44). TEST the system for normal operation.
A6 CHECK THE MECS COOLANT PUMP RELAY POWER SUPPLY CIRCUIT FOR AN OPEN	
• Measure the resistance between BJB fuse 13 (15A) circuit CE621 (YE/GY), BJB side and BJB relay 44 pin 5 circuit CE621 (YE/GY), BJB side.  N0098605 • **Is the resistance less than 5 ohms?**	**Yes** GO to A7 . **No** REPAIR circuit CE621 (YE/GY) for an open. CONNECT all components. TEST the system for normal operation.
A7 CHECK THE MECS COOLANT PUMP POWER SUPPLY CIRCUIT FOR AN OPEN	
• Measure the resistance between BJB relay 44 pin 5 circuit CE621 (YE/GY), BJB side and MECS coolant pump C1466-2, circuit CE621 (YE/GY).  N0098609 • **Is the resistance less than 5 ohms?**	**Yes** GO to A8 . **No** REPAIR circuit CE621 (YE/GY) for an open. CONNECT all components. TEST the system for normal operation.
A8 CHECK THE MECS COOLANT PUMP GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between MECS coolant pump 1466-1 circuit GD121 (BK/YE) and ground.	**Yes** GO to A9 . **No** REPAIR circuit GD121 (BK/YE). CONNECT all components. TEST the system for normal operation.

 N0098638 • **Is the resistance less than 5 ohms?**	
A9 CHECK BJB FUSE 47 (10A)	
• Check fuse: BJB 47 (10A). • **Is the resistance less than 5 ohms?**	**Yes** GO to A10 . **No** REPAIR circuit CBK03 (GY) for a short to ground. CONNECT all components. TEST the system for normal operation.
A10 CHECK FOR VOLTAGE SUPPLIED TO BJB FUSE 47 (10A)	
• Disconnect: BJB Fuse 47 (10A). • Ignition ON. • Measure the voltage at the supply side of BJB fuse 47 (10A).  N0098640 • **Is the voltage greater than 10 volts?**	**Yes** GO to A11 . **No** REPAIR circuit CE612 (GY/VT) for an open. CONNECT all components. TEST the system for normal operation.
A11 CHECK THE MECS COOLANT PUMP RELAY CONTROL POWER SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between the output side of BJB fuse 47 (10A), circuit CBK03 (GY) and BJB relay 44 pin 1 circuit CBK03 (GY).  N0098639 • **Is the resistance less than 5 ohms?**	**Yes** GO to A12 . **No** REPAIR circuit CBK03 (GY) for an open. CONNECT all components. TEST the system for normal operation.

A12 CHECK FOR GROUND AT THE MECS COOLANT PUMP RELAY	
• Connect: BJB fuse 47 (10A). • Ignition ON. • Measure the voltage between BJB relay 44 pins 1 and 2, BJB side.  • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new MECS pump. REFER to Motor Electronics Pump in this section. CONNECT all components. TEST the system for normal operation. **No** GO to A13 .
A13 CHECK THE MECS COOLANT PUMP RELAY CONTROL GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PCM C175T. • Measure the resistance between BJB relay 44 pin 2, BJB side circuit CE318 (VT) and PCM C175T-49 circuit CE318 (VT).  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14D . CONNECT all components. TEST the system for normal operation. **No** REPAIR circuit CE318 (VT) for an open. CONNECT all components. TEST the system for normal operation.

Motor Electronics Cooling System Draining and Filling

Material

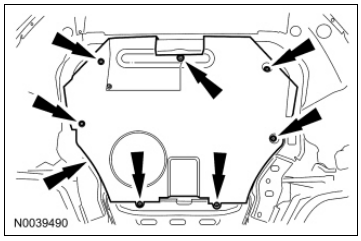
Item	Specification
Motorcraft® Specialty Green Engine Coolant VC-10-A2 (US); CVC-10-A (Canada)	WSS-M97B55-A
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D

Draining

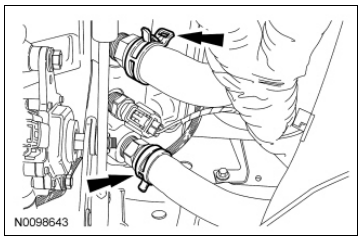
NOTICE: **The coolant must be recovered in a suitable, clean container for reuse or damage can occur to the transaxle cooling system. If the coolant is contaminated, it must be recycled or disposed of correctly.**

NOTICE: **Always refill the Motor Electronics Cooling System (MECS) with the same type of coolant that was drained from the system. Do not mix coolant types. Mixing coolant types may cause MECS damage.**

1. he vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Turn the ignition to the OFF position.
3. Remove the screws and the underbody cover.

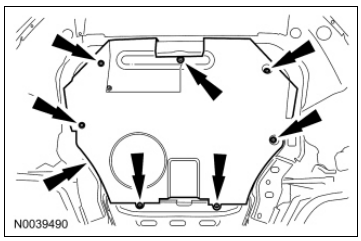


4. Compress the constant tension clamps and remove the hoses from the transaxle to allow the coolant to drain.



5. Connect the hoses to the transaxle and install the hose clamps.

6. Install the underbody cover and the screws.



Filling and Bleeding

NOTICE: **Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle. When adding engine coolant, use a 50/50 mixture of engine coolant and distilled water.**

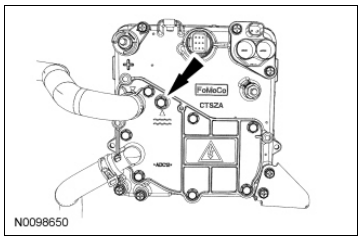
To maintain the integrity of the coolant and the cooling system:

- Vehicle cooling systems are filled with Motorcraft® Specialty Green Engine Coolant or Motorcraft® Specialty Orange Engine Coolant. Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.
- Do not add alcohol, methanol or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Ford Motor Company does NOT recommend the use of recycled engine coolant since a Ford-approved recycling process is not yet available.
- Used engine coolant should be disposed of in an appropriate manner. Follow community regulations and standards for recycling and disposing of automotive fluids.

1. ***NOTICE:*** **Adhesives, stop-leak pellets or small foreign material in the Motor Electronics Cooling System (MECS) can cause poor performance or temporary blockage of the motor electronics pump. Only use clean, approved coolant when filling the system.**

   Loosen the Motor Electronics Cooling System (MECS) bleed screw on the DC/DC converter and slowly fill the coolant expansion tank with coolant until it begins to flow out of the bleed hole. Then, close the bleed screw.

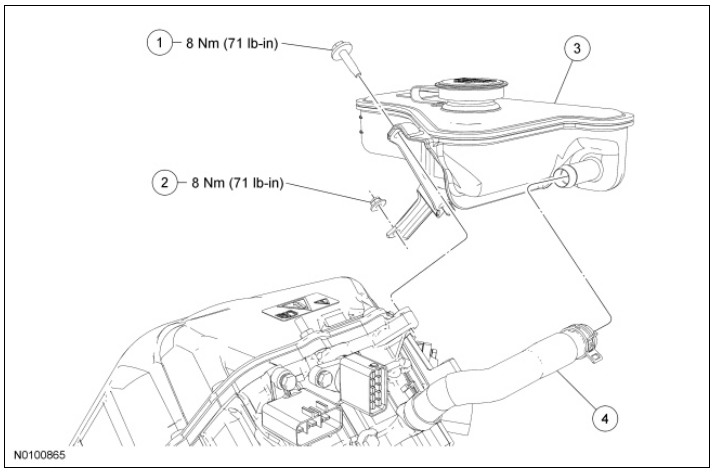
   - Tighten to 3 Nm (27 lb-in).



2. Turn the ignition to the ON position to actuate the MECS coolant pump and continue to fill the coolant expansion tank to the FULL COLD level labeled on the side of the tank.

3. To bleed air from the MECS , turn the ignition switch to the OFF position. Loosen the MECS bleed screw on the DC/DC converter and allow air to escape the MECS .

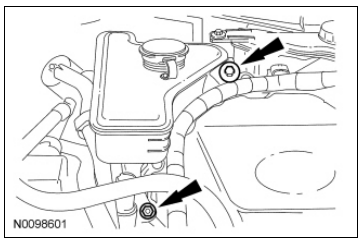
Motor Electronics Coolant Expansion Tank



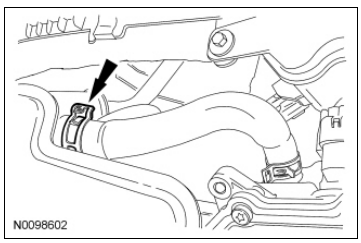
Item	Part Number	Description
1	W505424	Motor Electronics Cooling System (MECS) coolant expansion tank bolt
2	W701152	MECS coolant expansion tank nut
3	W701152	MECS coolant expansion tank
4	8C045	MECS coolant expansion tank outlet hose

1. Drain the Motor Electronics Cooling System (MECS). For additional information, refer to Motor Electronics Cooling System Draining and Filling in this section.

2. Remove the nut and the bolt and position the MECS coolant expansion tank aside.
   - To install, tighten to 8 Nm (71 lb-in).

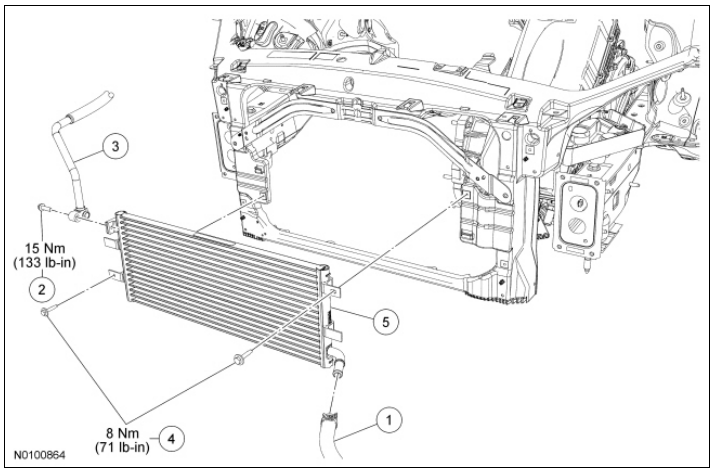


3. Compress the constant tension clamp and remove the MECS hose from the coolant expansion tank.



4. To install, reverse the removal procedure.

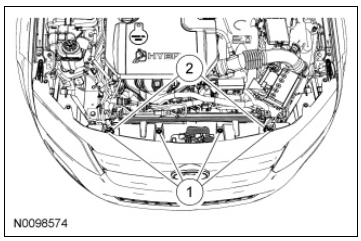
Motor Electronics Cooler



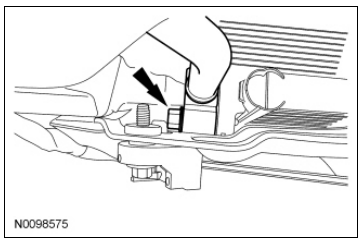
Item	Part Number	Description
1	8B273	Motor Electronics Cooling System (MECS) radiator inlet hose
2	N808349	MECS radiator outlet tube bolt
3	8B274	MECS radiator outlet ho
4	W711685-S	MECS radiator bolts
5	8005	MECS radiator

1. Drain the Motor Electronics Cooling System (MECS). For additional information, refer to Motor Electronics Cooling System Draining and Filling in this section.

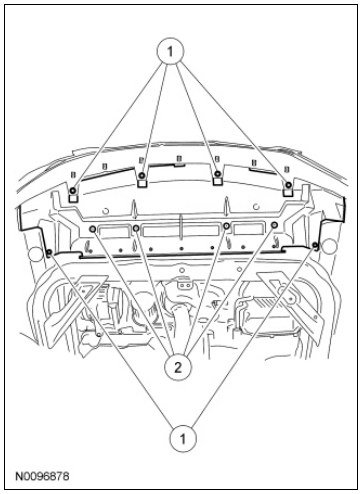
2. Remove the 4 bolts and the 2 retainers and position the front grille aside far enough to gain access to the MECS radiator. For additional information, refer to Section 501-19 .



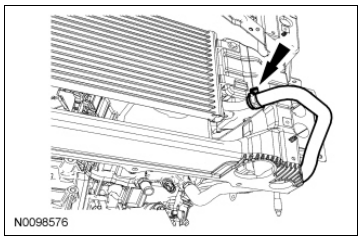
3. Remove the bolt and remove the upper MECS radiator tube from the MECS cooler.
   - To install, tighten to 15 Nm (133 lb-in).



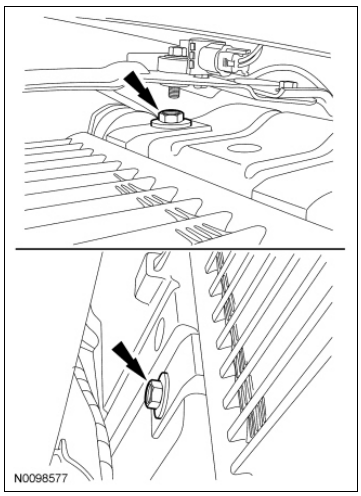
4. Remove the radiator splash shield.
    1. Remove the 6 screws.
    2. Remove the 4 retainers.



5. Compress the constant tension clamp and disconnect the MECS radiator hose from the MECS radiator.

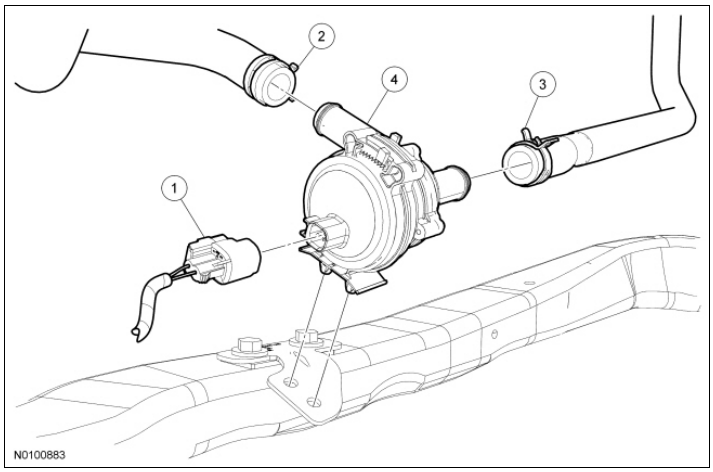


6. Remove the MECS radiator bolts and remove the radiator.
    - To install, tighten to 8 Nm (71 lb-in).



7. To install, reverse the removal procedure.

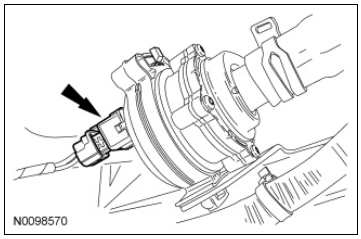
Motor Electronics Pump



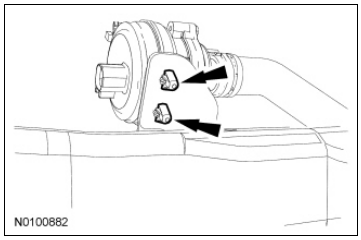
Item	Part Number	Description
1	14A464	Motor Electronics Cooling System (MECS) coolant pump electrical connector
2	8A567	MECS coolant pump outlet hose
3	15179	MECS coolant punlet hose
4	8C419	MECS pump

1. Drain the Motor Electronics Cooling System (MECS). For additional information, refer to Motor Electronics Cooling System Draining and Filling in this section.

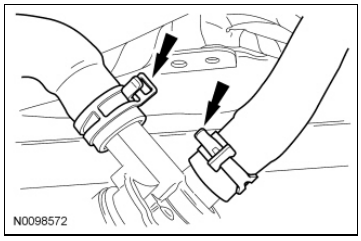
2. Disconnect the MECS cooling pump electrical connector.



3. Compress the 2 retainers, remove the MECS pump from the bracket and pull the MECS pump down to gain access to the constant tension clamps that hold the hoses on.



4. Compress the constant tension clamps and disconnect the inlet and outlet hoses from the MECS pump.

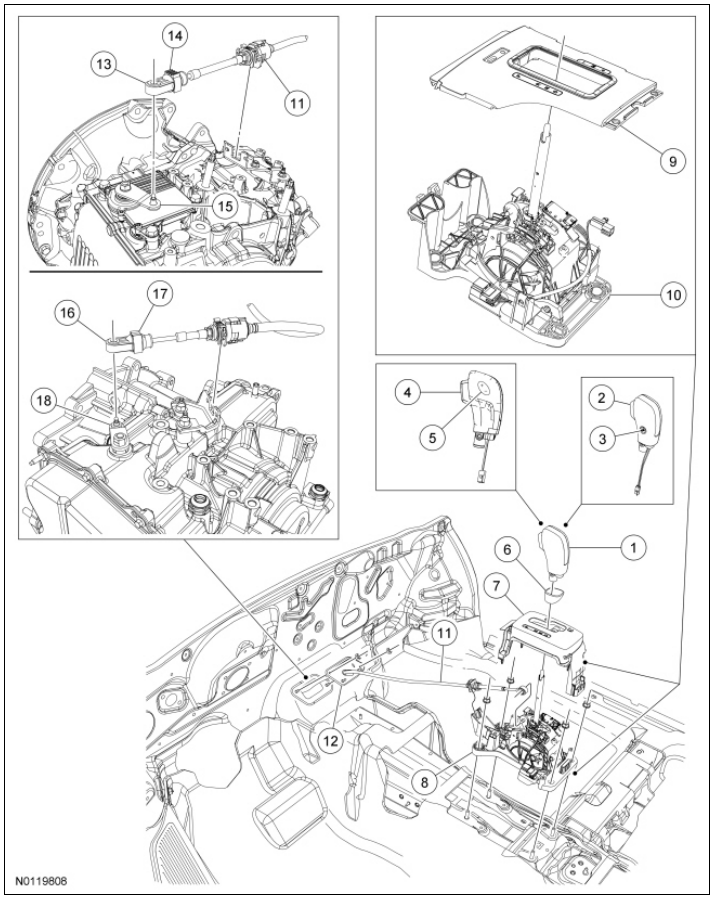


5. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Selector lever cable grommet nuts	9	80
Selector lever nuts	20	177

External Controls



Item	Part Number	Description
1	7L010	Selector lever knob (vehicles equipped with a 3.5L engine)
2	7L010	Selector lever knob (vehicles equipped with a 2.5L engine)
3	-	Transmission Control Switch (TCS) (2.5L engine) (part of 7L010)
4	7L010	Selector lever knob (vehicles equipped with a 2.5L or 3.0L (4V) engine)
5	-	SelectShiftTM switch (2.5L or 3.0L (4V) engine) (part of 7L010)
6	-	Lower selector lever knob bezel (part o
7	7E034	Selector lever bezel (Fusion)
8	7K004	Selector lever assembly (Fusion)
9	7E034	Selector lever bezel (MKZ)
10	7K004	Selector lever assembly (MKZ)
11	7E395	Selector lever cable

12	57809	Selector lever cable grommet
13	-	Selector lever cable end (Aisin AW21) (part of 7E395)
14	-	Selector lever cable adjustment lock tab (Aisin AW21) (part of 7E395)
15	7A257	Manual control lever (Aisin AW21)
16	-	Selector lever cable end (6F35) (part of 7E395)
17	-	Selector lever cable adjustment lock tab (6F35) (part of 7E395)
18	7A257	Manual control lever (6F35)

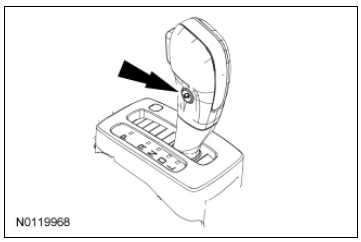
The transaxle selector lever control linkage consists of:

- a selector lever cable that connects the transaxle range selector lever to the selector lever assembly.
- a Brake Shift Interlock Actuator (BSIA) that is integral to the selector lever assembly.

The selector lever assembly:

- locks the transaxle range selector lever in the PARK position when the ignition switch is in the lock position.
- requires the transaxle range selector lever to be in the PARK position to turn the ignition switch to the lock position.

Transmission Control Switch (TCS)-2.5L



Vehicles equipped with a Transmission Control Switch (TCS) have a momentary contact switch located on the selector lever knob that allows the driver to cancel the operation of Overdrive (O/D) and provides grade assist.

Grade Assist

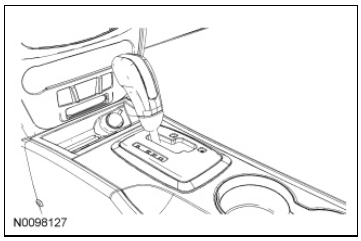
- Improves vehicle handling in hilly terrain or mountainous areas by providing additional engine braking and extends lower gear operation on uphill climbs.
- Additional engine braking is provided through the automatic transaxle shift strategy which reacts to vehicle inputs including vehicle acceleration, accelerator pedal, brake pedal and vehicle speed.
- The transaxle will select gears that will provide the engine braking desired, based on the vehicle inputs, this will increase engine rpm during engine braking.

It is recommended to return to DRIVE mode on flat terrain to provide the best fuel economy and transaxle function. The transaxle returns to O/D and grade assist is cancelled when the TCS is pressed again.

Range Selection-SelectShiftTM

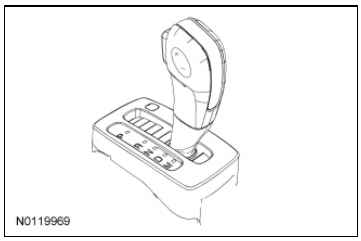
The H-gate selector lever has 5 fixed range positions: P, R, N, D, M and 2 spring-loaded manual positions (-) and (+).

H-Gate Selector-3.5L



The SelectShiftTM switch selector lever has 5 fixed range positions: P, R, N, D, M and a (-) and (+) SelectShiftTM switch.

SelectShiftTM Switch Selector-2.5L, 3.0L (4V)



Park

In the P position:

- the transaxle is locked and prevents the wheels from turning.
- there is no powerflow through the transaxle.
- the parking pawl locks the final drive.
- the engine may be started.
- the ignition key may be removed.

Reverse

In the R position:

- the vehicle may be operated in a backward direction, at a reduced gear ratio.
- engine braking will occur.

Neutral

In the N position:

- the vehicle is able to roll.
- there is no powerflow through the transaxle.
- the output shaft is not held and is free to turn.
- the engine may be started.

Drive

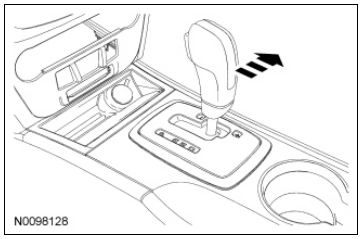
D is the normal position for most forward driving.

D provides:

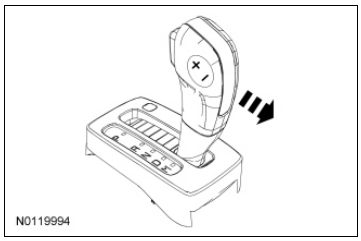
- automatic shifts - 1st through 6th gears, which includes O/D .
- apply and release of the Torque Converter Clutch (TCC).
- maximum fuel economy during normal operation.

Ma/b>

H-Gate



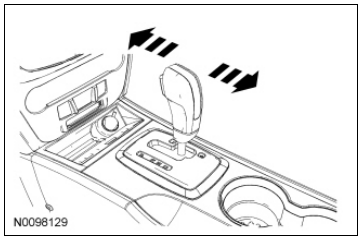
SelectShiftTM Switch



In the M position:

- O/D is cancelled.
- the 6F35 transaxle operates in gears 1st through 5th and the Aisin AW21 operates in gears 1st through 4th.
- grade assist is activated.
- some engine braking may occur.

SelectShiftTM Shift Transmission Selector Lever-H-Gate



The SelectShiftTM shift transmission selector lever gives the driver the ability to change gears up or down manually as desired.

- M +

- O/D can be selected.

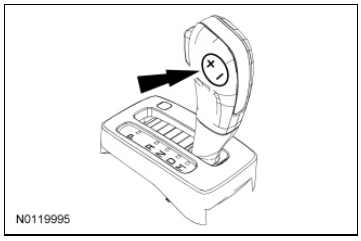
- Moving the selector lever to the forward (-) or backward (+) position will allow the transmission to utilize the Manual for SelectShiftTM shifting.
- Moving the spring-loaded selector lever forward into (-) in the gate and releasing the selector lever, the selector lever will return to the M position and the transmission will down shift.
- Moving the spring loaded selector lever backward into (+) in the gate and releasing the selector lever, the selector lever will return to the M position and the transmission will up shift.

When selecting the appropriate gear in SelectShiftTM transmission mode, the instrument cluster will display the current selected gear.

The SelectShiftTM shift transmission will make some shifts automatically, primarily to protect the engine from stalling.

The transmission will not up shift if the redline is approached and must be shifted manually by moving the selector lever back into (+) and releasing.

SelectShiftTM Transmission Selector Lever-SelectShiftTM Switch



The SelectShiftTM transmission selector lever gives the driver the ability to change gears up or down manually as desired.

- M +

- O/D can be selected.
- Moving the selector lever to M position will allow the transmission to utilize the Manual Mode for SelectShiftTM shifting.
- Pressing the SelectShiftTM switch (-) on the selector lever, the transmission will down shift.
- Pressing the SelectShiftTM switch (+) on the selector lever, the transmission will up shift.

When selecting the appropriate ectShiftTM transmission mode, the message center will display the current selected gear.

The SelectShiftTM shift transmission will make some shifts automatically, primarily to protect the engine from stalling.

The transmission will not up shift if the redline is approached and must be shifted manually by pressing the SelectShiftTM switch (+) on the selector lever and releasing.

Gear Availability

MANUAL LEVER POSITION	TRANSAXLE GEAR OPERATION	DESCRIPTION
D Grade Assist	1 ⇆ 2 ⇆ 3 ⇆ 4 ⇆ 5 ← 6	1st through 5th gears are available. Transaxle shifts to 5th gear if the TCS button is pressed when the transaxle is in 6th gear. Transaxle provides engine braking. Grade assist is activated.
M Aisin AW21	1 ⇆ 2 ⇆ 3 ⇆ 4 ← 5 ← 6	1st through 4th gears are available. Transaxle shifts to 4th gear if the selector lever is moved to the M position when the transaxle is in 5th or 6th gear. Transaxle provides engine braking.
M 6F35	1 ⇆ 2 ⇆ 3 ⇆ 4 ⇆ 5 ← 6	1st through 5th gears are available. Transaxle shifts to 5th gear if the selector lever is moved to the M position when the transaxle is in 6th gear. Transaxle provides engine braking.
(-) (+) 6F35	1 ⇆ 2 ⇆ 3 ⇆ 4 ⇆ 5 ⇆ 6	1st through 5th gears are available upon deceleration. The transaxle will make all downshifts. Up shifts will have to be shifted manually. Transaxle will upshift into 6th gear.
(-) (+) Aisin AW21	1 ⇆ 2 ⇆ 3 ⇆ 4 ⇆ 5 ⇆ 6	1st through 6th gears are available upon deceleration. The transaxle will make downshifts to first gear if a stop from 4th, 5th or 6th gear occurs. The transaxle also makes downshifts if the accelerator pedal is depressed past 90%. Upshifts are done manually with the selector lever. Transaxle can start in 1st, 2nd or 3rd gear.

N0127262

External Controls

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Inspection and Verification

1. Verify the customer concern by operating the system.

<

2. Visually inspect for obvious signs of mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, correct the cause before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom. GO to Symptom Chart - External Controls or GO to Symptom Chart - NVH .

Visual Inspection Chart

Mechanical	Electrical
• Transmission selector lever cable • Manual control lever • Selector lever or selector lever knob	• Smart Junction Box (SJB) fuse 5 (10A) • Battery Junction Box (BJB) fuse 47 (10A) • Connections • Wiring harness • Brake Pedal Position (BPP) switch • Brake Shift Interlock Actuator (BSIA) • SelectShiftTM switch • Transmission Control Switch (TCS) (vehicles equipped with a 2.5L engine)

Diagnostic Trouble Code Chart

DTC	Component	Description	Condition	Symptom	Action
B2572					

	Brake Shift Interlock	Brake Shift Interlock Output Circuit Failure	The associated circuitry connected to the Smart Junction Box (SJB) or fuse, or the SJB itself may have an issue causing a brake shift interlock concern.	Brake shift interlock is inoperative or does not operate correctly.	GO to Pinpoint Test A .
P0815	SelectShiftTM Switch	SelectShiftTM Switch Output Circuit Failure	The associated circuitry connected to the SelectShiftTM switch or fuse, or the SelectShiftTM switch itself may have an issue causing a fault.	SelectShiftTM operation is inoperative or does not operate correctly.	GO to Pinpoint Test C .
P0816	SelectShiftTM Switch	SelectShiftTM Switch Output Circuit Failure	The associated circuitry connected to the SelectShiftTM switch or fuse, or the SelectShiftTM switch itself may have an issue causing a fault.	SelectShiftTM operation is inoperative or does not operate correctly.	GO to Pinpoint Test C .
P0819	SelectShiftTM Switch	Up And Down Shift Switch To Transmission Range (TR) Correlation	The associated circuitry connected to the SelectShiftTM switch or fuse, or the SelectShiftTM switch itself may have an issue causing a fault.	SelectShiftTM operation is inoperative or does not operate correctly.	GO to Pinpoint Test D .

Symptom Chart - External Controls

Symptom Chart - External Controls

Symptom Chart - NVH

Symptom Chart - NVH

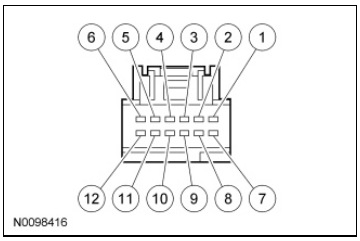
NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary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

ConditionPossible SourcesAction

- Vibration - a high frequency (20-80 Hz) that is felt through the seat or selector lever. Changes with engine speed
- Selector lever cable incorrectly routed, grounded out or loose
- CHECK the selector lever cable. REPAIR as necessary.

Electrical Connectors

Selector Lever Harness C3233



Pin Number	Circuit	Circuit Function
1	CET53 (BU/OG)	Brake Shift Interlock Actuator (BSIA) solenoid power circuit
2	CET22 (GY/BN)	Park position signal to ignition switch
3	CET52 (GN)	Park position signal to Instrument Cluster (IC)
4	VLN04 (VT/GY)	Power to PRNDL LED illumination (Fusion/Milan)
4	VLN37 (BU/WH)	Power to PRNDL white lighting illumination (MKZ)
5	GD116 (BK/VT)	Ground
6	CET34 (BN/GN)	Transmission Control Switch (TCS)/Grade Assist button signal return (vehicles equipped with a 2.5L engine)
7	CBK03 (GY)	TCS /Grade Assist power supply from Battery Junction Box (BJB) fuse 47 (10A) (vehicles equipped with a 2.5L engine)
8	CBK03 (GY)	SelectShiftTM sensor power supply from BJB fuse 47 (10A)
9	CET43 (GY)	SelectShiftTM sensor upshift circuit
10	CET42 (GN/VT)	SelectShiftTM sensor downshift circuit
11	RE407 (YE/VT)	SelectShiftTM sensor ground circuit (Fusion/ Milan)
11	GD116 (BK/VT)	SelectShiftTM sensor ground circuit (MKZ)
12	-	Empty

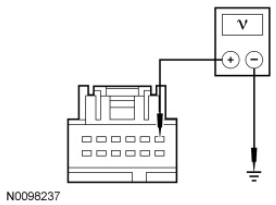
Pinpoint Tests

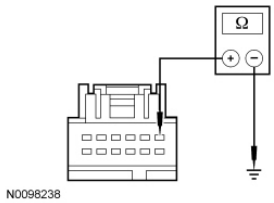
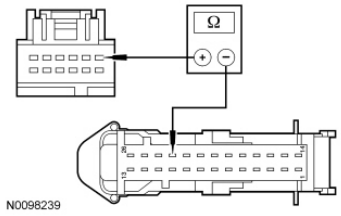
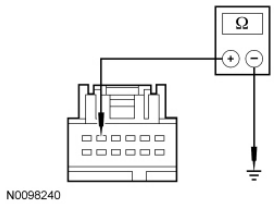
Refer to Wiring Diagrams Cell 29 (Fusion/MKZ , Fusion Hybridybrid), Transmission Controls -Aisin AW21 for schematic and connector information.

Refer to Wiring Diagrams Cell 30 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Transmission Controls-6F35 for schematic and connector information.

Refer to Wiring Diagrams Cell 37 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Shift Interlock for schematic and connector information.

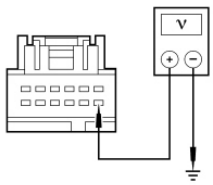
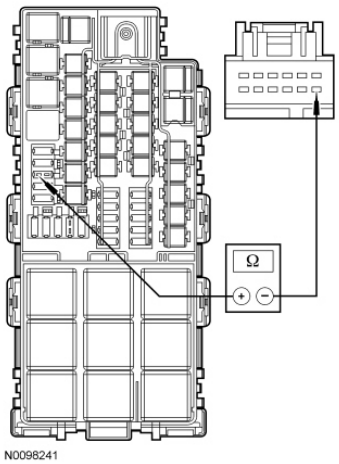
PINPOINT TEST A: THE BRAKE SHIFT INTERLOCK SYSTEM DOES NOT RELEASE/LOCK CORRECTLY

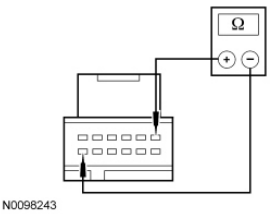
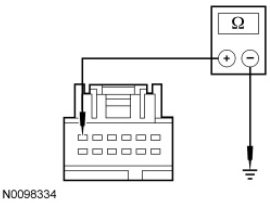
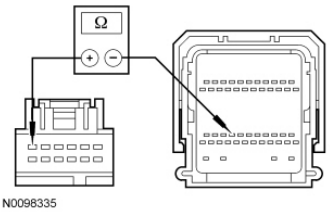
Test Step	Result / Action to Take
A1 CHECK DTCs	
♦ Ignition ON. ♦ Connect the scan tool. ♦ **Is DTC B2575 set?**	**Yes** GO to A2 . **No** The issue may not be in the Brake Shift Interlock Actuator (BSIA) electrical system. GO to Symptom Chart - External Controls in this section.
A2 CHECK FUSE 5 (10A)	
♦ Ignition OFF. ♦ Remove Smart Junction Box (SJB) fuse 5 (10A). ♦ Check fuse: SJB 5 (10A). ♦ **Is the resistance less than 5 ohms?**	**Yes** GO to A3 . **No** GO to A4 .
A3 CHECK THE POWER CIRCUIT FOR VOLTAGE	
♦ Disconnect: Selector Lever C3233. ♦ Ignition ON. ♦ Measure the voltage between selector lever harness C3233-1, circuit CET53 (BU/OG), vehicle harness side and ground, while applying the brake pedal.  N0098237 ♦ **Is the voltage greater than 10 volts?**	**Yes** GO to A6 . **No** GO to A5 .
A4 CHECK THE POWER CIRCUIT FOR A SHORT TO GROUND	
♦ Ignition OFF. ♦ Disconnect: SJB C2280C. ♦ Measure the resistance between selector lever harness C3233-1, circuit CET53 (BU/OG), vehicle harness side and ground.	**Yes** GO to A5 . **No** REPAIR circuit CET53 (BU/OG) for a short to ground. CLEAR the DTCs. TEST the system for normal operation.

 N0098238 ♦ **Is the resistance greater than 10,000 ohms?**	
A5 CHECK THE POWER CIRCUIT FOR AN OPEN	
♦ Ignition OFF. ♦ Measure the resistance between the selector lever harness C3233-1, circuit CET53 (BU/OG), vehicle harness side and SJB C2280C-23, circuit CET53 (BU/OG), vehicle harness side.  N0098239 ♦ **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new SJB . CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR circuit CET53 (BU/OG) for an open. CLEAR the DTCs. TEST the system for normal operation.
A6 CHECK THE GROUND CIRCUIT FOR AN OPEN	
♦ Ignition OFF. ♦ Measure the resistance between selector lever harness C3233-5, circuit GD116 (BK/VT), vehicle harness side and ground.  N0098240 ♦ **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new selector lever. REFER to Selector Lever - Fusion or Selector Lever - MKZ in this section. **No** REPAIR circuit GD116 (BK/VT) for an open. CLEAR the DTCs. TEST the system for normal operation.

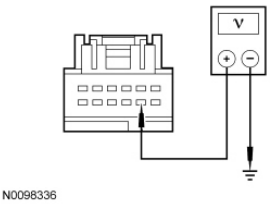
PINPOINT TEST B: TCS DOES NOT OPERATE CORRECTLY (VEHICLES EQUIPPED WITH A 2.5L ENGINE ONLY)

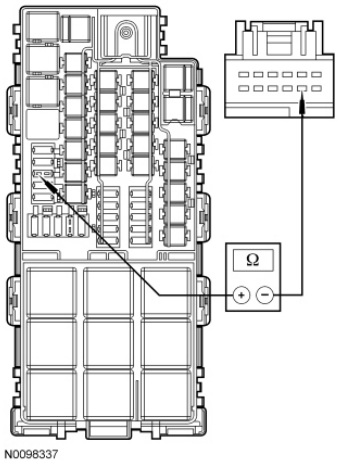
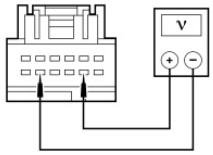
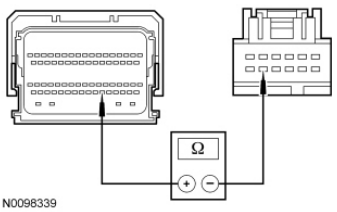
Test Step	Result / Action to Take
B1 CHECK THE IC	
♦ Connect the scan tool. ♦ Using the scan tool, monitor the TCS PID while cycling the Transmission Control Switch (TCS). ♦ **Does the TCS PID cycle from**	**Yes** REFER to Section 413-01 for diagnosis of the Instrument Cluster (IC) illumination. **No**

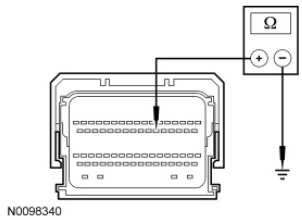
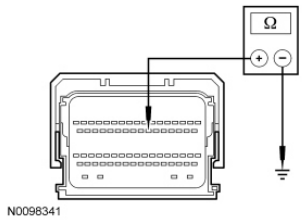
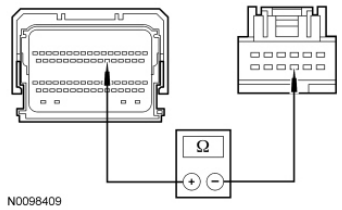
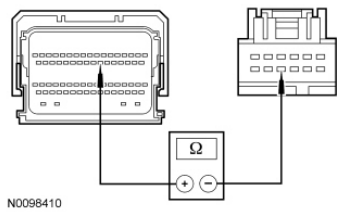
depressed to not depressed?	GO to B2 .
B2 CHECK FUSE 47 (10A)	
♦ Check fuse: Battery Junction Box (BJB) fuse 47 (10A). ♦ **Is the resistance less than 5 ohms?**	**Yes** GO to B3 . **No** GO to B6 .
B3 CHECK THE POWER CIRCUIT FOR VOLTAGE	
♦ Disconnect: Selector Lever C3233. ♦ Ignition ON. ♦ Measure the voltage between selector lever harness C3233-7, circuit CBK03 (GY), vehicle harness side and ground.  N0098242 ♦ **Is the voltage greater than 10 volts?**	**Yes** GO to B5 . **No** GO to B4 .
B4 CHECK THE POWER CIRCUIT FOR AN OPEN	
♦ Ignition OFF. ♦ Disconnect: BJB fuse 47 (10A). ♦ Measure the resistance between the output side of BJB fuse 47 (10A) and selector lever harness C3233-7 circuit CBK03 (GY), vehicle harness side.  N0098241 ♦ **Is the resistance less than 5 ohms?**	**Yes** Install a new BJB . **No** REPAIR circuit CBK03 (GY) for an open. TEST the system for normal operation.
B5 CHECK THE TCS	

♦ Measure the resistance between selector lever harness C3533 pins 6 and 7, component side, while cycling the TCS .  N0098243 ♦ **Is the resistance less than 5 ohms when pressed and greater than 10,000 ohms when released?**	**Yes** GO to B7 . **No** INSPECT the selector lever wiring harness for damage. REPAIR the wiring harness as required. If the selector lever wiring harness is not damaged, INSTALL a new selector lever knob. REFER to Selector Lever Knob in this section. TEST the system for normal operation.
B6 CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND	
♦ Ignition OFF. ♦ Disconnect: PCM C175T. ♦ Measure the resistance between selector lever harness C3233-6, circuit CET34 (BN/GN) and ground.  N0098334 ♦ **Is the resistance greater than 10,000?**	**Yes** REPAIR circuit CBK03 (GY) for a short to ground. INSTALL a new fuse. TEST the system for normal operation. **No** REPAIR circuit CET34 (BN/GN) for a short to ground. INSTALL a new fuse. TEST the system for normal operation.
B7 CHECK THE SIGNAL CIRCUIT FOR AN OPEN	
♦ Disconnect: PCM C175T. ♦ Measure the resistance between selector lever harness C3233-6, circuit CET34 (BN/GN) and PCM C175T-31, circuit CET34 (BN/GN).  N0098335 ♦ **Is the resistance less then 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A . **No** REPAIR circuit CET34 (BN/GN) for an open. TEST the system for normal operation.

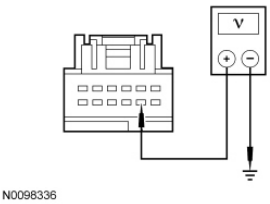
PINPOINT TEST C: SELECTSHIFTTM DOES NOT OPERATE CORRECTLY

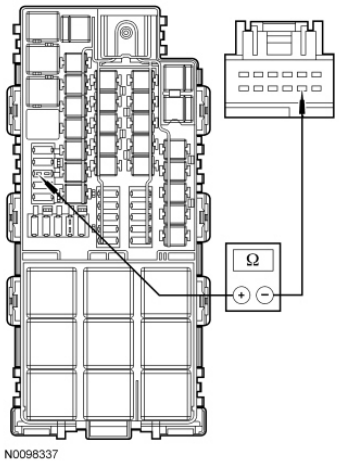
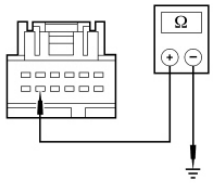
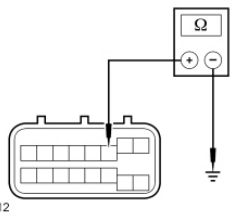
Test Step	Result / Action to Take
C1 CHECK FUSE 47 (10A)	
♦ Check fuse: Battery Junction Box (BJB) 47 (10A). ♦ **Is the resistance less than 5 ohms?**	**Yes** GO to C2 . **No** REPAIR circuit CBK03 (GY) for a short to ground. INSTALL a new fuse. CLEAR the DTCs. TEST the system for normal operation.
C2 CHECK THE POWER CIRCUIT FOR VOLTAGE	
♦ Disconnect: Selector Lever C3233. ♦ Ignition ON. ♦ Measure the voltage between selector lever harness C3233-8, circuit CBK03 (GY), vehicle harness side and ground.  N0098336 ♦ **Is the voltage greater than 10 volts?**	**Yes** GO to C4 . **No** GO to C3 .
C3 CHECK THE POWER CIRCUIT FOR AN OPEN	
♦ Ignition OFF. ♦ Disconnect: BJB Fuse 47 (10A). ♦ Measure the resistance between the output side of BJB fuse 47 (10A) and selector lever harness C3233-8 circuit CBK03 (GY), vehicle harness side.	**Yes** INSTALL a new BJB . **No** REPAIR circuit CBK03 (GY) for an open. CLEAR the DTCs. TEST the system for normal operation.

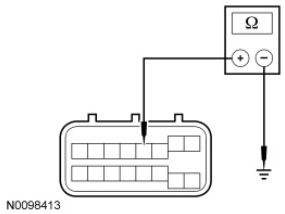
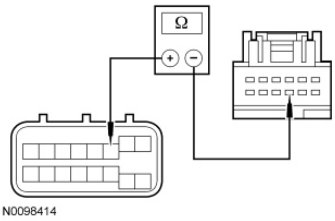
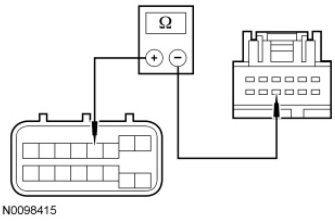
 N0098337 ♦ **Is the resistance less than 5 ohms?**	
C4 CHECK THE GROUND CIRCUIT	
♦ Measure the voltage between selector lever C3233-8, CBK03 (GY), vehicle harness side and C3233-11, circuit RE407 (YE/VT), vehicle harness side.  N0098338 ♦ **Is the voltage greater than 10 volts?**	**Yes** GO to C6 . **No** GO to C5 .
C5 CHECK THE GROUND CIRCUIT FOR AN OPEN	
♦ Disconnect: PCM C175B. ♦ Measure the resistance between selector lever C3233-11, circuit RE407 (YE/VT) and PCM C175B-56, circuit RE407 (YE/VT).  N0098339 ♦ **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14B . **No** REPAIR circuit RE407 (YE/VT) for an open. CLEAR the DTCs. TEST system for normal operation.
C6 CHECK CIRCUITS FOR A SHORT TO GROUND	

♦ Disconnect: PCM C175B. ♦ Measure the resistance between PCM C175B-23, circuit CET43 (GY) and ground.  N0098340 ♦ Measure the resistance between PCM C175B-24, circuit CET42 (GN/VT) and ground.  N0098341 ♦ **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C7 . **No** REPAIR circuit CET43 (GY) or circuit CET42 (GN/VT) for a short to ground. CLEAR the DTCs. TEST system for normal operation.
C7 CHECK CIRCUITS FOR AN OPEN	
♦ Measure the resistance between PCM C175B-23, circuit CET43 (GY) and selector lever C3233-9.  N0098409 ♦ Measure the resistance between PCM C175B-24, circuit CET43 (GY) and selector lever C3233-10.  N0098410 ♦ **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new selector lever. REFER to Selector Lever - Fusion in this section. CLEAR the DTCs. TEST the system for normal operation. If the condition still exists, INSTALL a new PCM. REFER to Section 303-14B . **No** REPAIR circuit CET43 (GY) or circuit CET42 (GN/VT) for an open. CLEAR the DTCs. TEST system for normal operation.

PINPOINT TEST D: SELECTSHIFTTM DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
D1 CHECK FUSE 47 (10A)	
♦ Check fuse: Battery Junction Box (BJB) 47 (10A). ♦ **Is the resistance less than 5 ohms?**	**Yes** GO to D2 . **No** REPAIR circuit CBK03 (GY) for a short to ground. INSTALL a new fuse. CLEAR the DTCs. TEST the system for normal operation.
D2 CHECK THE POWER CIRCUIT FOR VOLTAGE	
♦ Disconnect: Selector Lever C3233. ♦ Ignition ON. ♦ Measure the voltage between selector lever harness C3233-8, circuit CBK03 (GY), vehicle harness side and ground.  N0098336 ♦ **Is the voltage greater than 10 volts? /b>**	**Yes** GO to D4 . **No** GO to D3 .
D3 CHECK THE POWER CIRCUIT FOR AN OPEN	
♦ Ignition OFF. ♦ Disconnect: BJB Fuse 47 (10A). ♦ Measure the resistance between the output side of BJB fuse 47 (10A) and selector lever harness C3233-8 circuit CBK03 (GY), vehicle harness side.	**Yes** INSTALL a new BJB . **No** REPAIR circuit CBK03 (GY) for an open. CLEAR the DTCs. TEST the system for normal operation.

 N0098337 ♦ **Is the resistance less than 5 ohms?**	
D4 CHECK THE GROUND CIRCUIT	
♦ Measure the resistance between selector lever C3233-11, circuit RE407 (YE/VT) (Fusion) or circuit GD116 (BK/VT) (MKZ) and ground.  N0098411 ♦ **Is the resistance less than 5 ohms?**	**Yes** GO to D5 . **No** REPAIR circuit RE407 (YE/VT) (Fusion) or circuit GD116 (BK/VT) (MKZ) for an open. CLEAR the DTCs. TEST system for normal operation.
D5 CHECK CIRCUITS FOR A SHORT TO GROUND	
♦ Disconnect: Transmission Control Module (TCM) C1533. ♦ Measure the resistance between TCM C1533-3, circuit CET43 (GY) and ground.  N0098412 ♦ Measure the resistance between TCM C1533-4, circuit CET42 (GN/VT) and ground.	**Yes** GO to D6 . **No** REPAIR circuit CET43 (GY) or circuit CET42 (GN/VT) for a short to ground. CLEAR the DTCs. TEST system for normal operation.

 N0098413 ♦ **Is the resistance greater than 10,000 ohms?**	
D6 CHECK CIRCUITS FOR AN OPEN	
♦ Measure the resistance between TCM C1533-3, circuit CET43 (GY) and selector lever C3233-9.  N0098414 ♦ Measure the resistance between TCM C1533-4, circuit CET43 (GY) and selector lever C3233-10.  N0098415 ♦ **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new selector lever. REFER to Selector Lever - Fusion or Selector Lever - MKZ in this section. CLEAR the DTCs. TEST the system for normal operation. If the condition still exists, INSTALL a new TCM. REFER to Section 307-01A . **No** REPAIR circuit CET43 (GY) or circuit CET42 (GN/VT) for an open. CLEAR the DTCs. TEST system for normal operation.

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Brake Shift Interlock Override

NOTE: If it is necessary to use the override procedure to move the selector lever out of the PARK position, it is possible that a fuse has blown and the brake lights are not operational. Before driving the vehicle, verify that the brake lights are working.

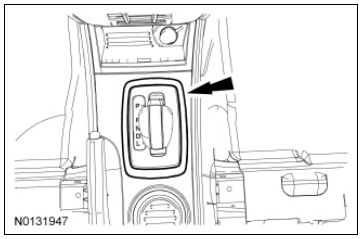
This vehicle is equipped with a brake shift interlock feature that prevents the selector lever from being moved out of PARK when the ignition is in the ON position unless the brake pedal is depressed.

If the selector lever cannot be moved out of the PARK position when the ignition is in the ON position and the brake pedal is depressed, carry out the following procedure.

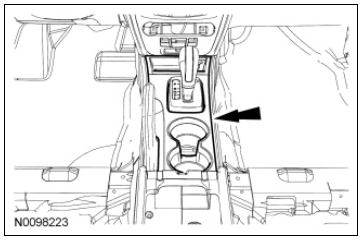
Fusion

1. Apply the parking brake.

2. Remove the selector lever trim ring.

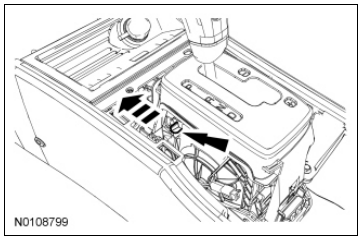


3. Remove tenter console trim panel



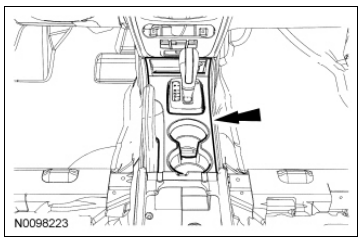
4. **NOTE:** Vehicles equipped with a 3.0L/3.5L shown, vehicles equipped with a 2.5L similar.

   Using a suitable tool, push the brake shift interlock override forward, apply the brake, press the selector lever knob button and move the selector lever into NEUTRAL.

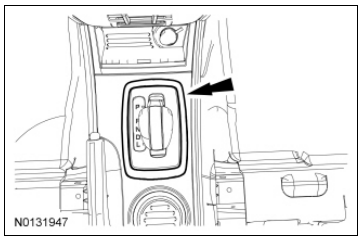


5. Start the vehicle.

6. Install the center console trim panel.

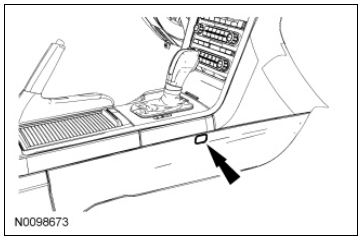


7. Install the selector lever trim ring.

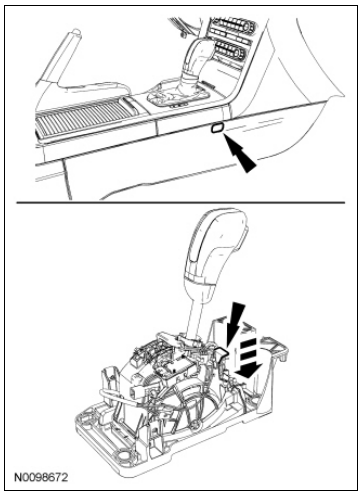


MKZ

8. Remove the access panel.

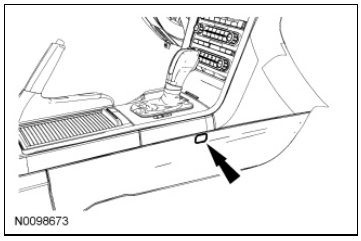


9. Insert a suitable tool into the access hole, depress the brake shift interlock override mechanism on the selector lever, apply the brake, depress the button on the selector lever knob and move the selector lever into NEUTRAL.



10. Start the vehicle.

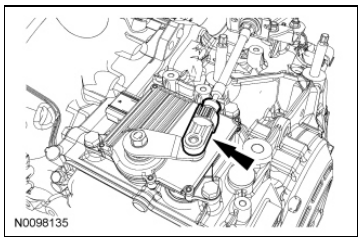
11. Install the access panel.


N0098673

Selector Lever Cable Adjustment - Aisin AW21

1. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12C .

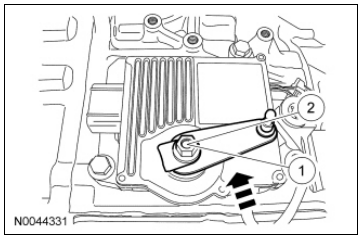
2. Disconnect the selector lever cable end from the manual control lever.



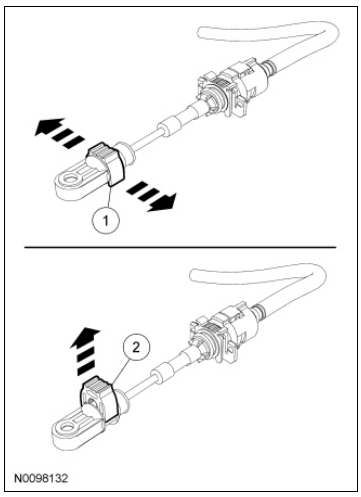
3. Place the selector lever in DRIVE.

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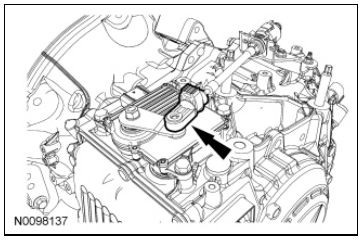
4. Place the manual control lever in DRIVE.
    1. Place the manual control lever in PARK.
    2. Move the manual control lever counterclockwise 3 detents to the DRIVE position.



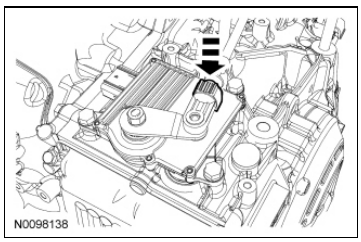
5. Release the selector lever cable adjuster lock.
    1. Pull out on the adjuster lock tabs.
    2. Slide the lock up to unlock the selector lever cable.



6. Align the selector lever cable end to the manual control lever ball stud and install it with the adjuster unlocked.



7. Slide the adjuster tab in place to lock the selector lever cable.

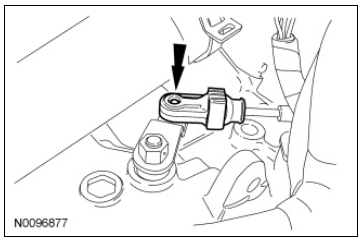


8. Install the ACL assembly. For additional information, refer to Section 303-12C .

9. Verify that the vehicle starts in PARK and NEUTRAL only and that the reverse lamps illuminate in REVERSE.

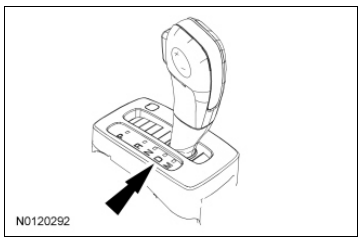
Selector Lever Cable Adjustment - 6F35

1. Disconnect the selector lever cable end from the manual control lever.

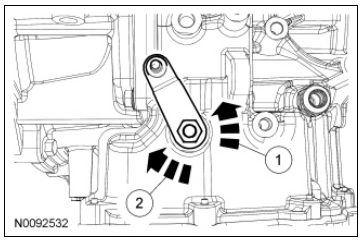


2. **NOTE:** SelectShiftTM shown, Transmission Control Switch (TCS) similar.

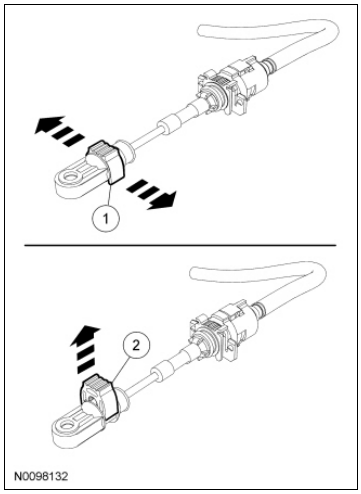
   Place the selector lever in the D position.



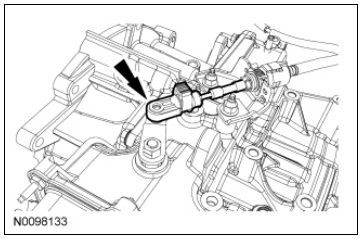
3. Place the manual control lever in the D position.
   1. Rotate the manual control lever counterclockwisPARK position.
   2. Rotate the manual control lever clockwise 3 detents to the D position.



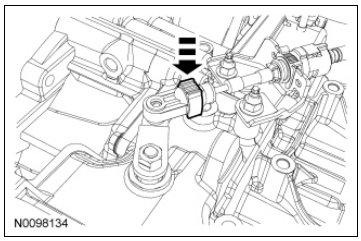
4. Release the selector lever cable adjuster lock.
   1. Pull out on the adjuster lock tabs.
   2. Slide the lock up to unlock the selector lever cable.



5. Align the selector lever cable end to the manual control lever ball stud and install it with the adjuster unlocked.



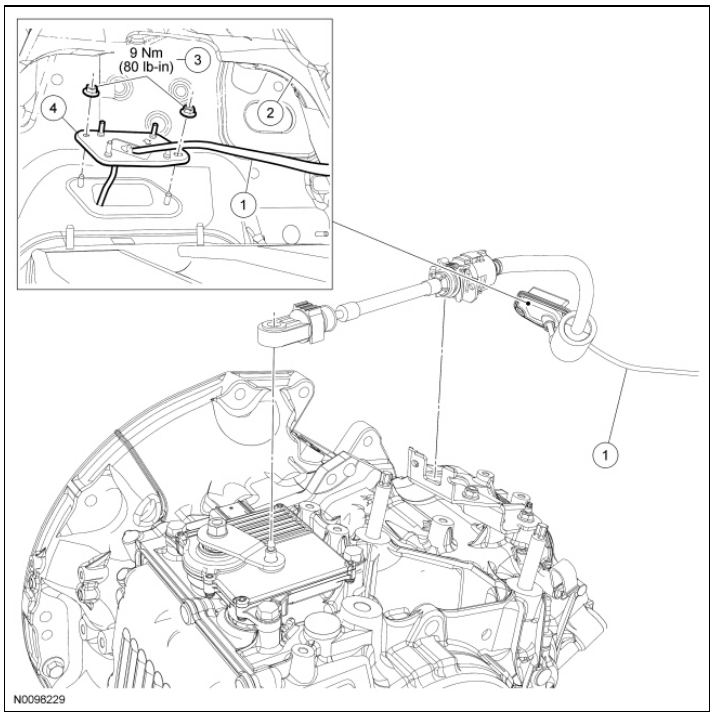
6. Slide the adjuster tab in place to lock the selector lever cable.



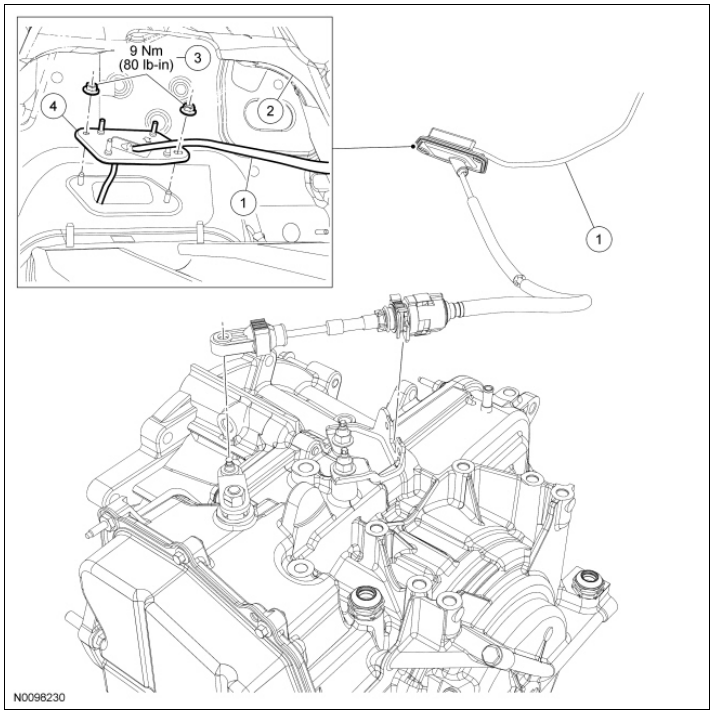
7. Verify that the vehicle starts in PARK and NEUTRAL only and that the reverse lamps illuminate in REVERSE.

Selector Lever Cable

Selector Lever Cable - Aisin AW21



Selector Lever Cable - 6F35 Transaxle

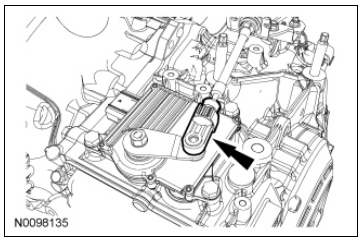


Item	Part Number	Description
1	7E395	Selector lever cable
2	54017A40	
3	W707142	Selector lever cable grommet retaining nuts
4	57809	Selector lever cable grommet

Removal

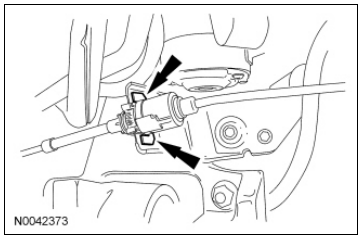
1. Remove the heater core and evaporator core housing. For additional information, refer to Section 412-01 .
2. Remove the Restraints Control Module (RCM). For additional information, refer to Section 501-20B .
3. Remove the battery tray. For additional information, refer to Section 414-01 .
4. **NOTE:** Aisin AW21 shown, 6F35 similar.

   Disconnect the selector lever cable end from the manual control lever.

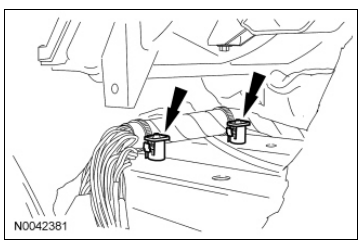


5. **NOTE:** Aisin AW21 shown, 6F35 similar.

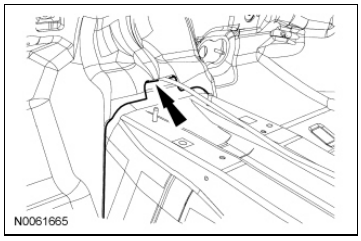
   Release the 2 tabs and remove the selector lever cable from the selector lever cable bracket.



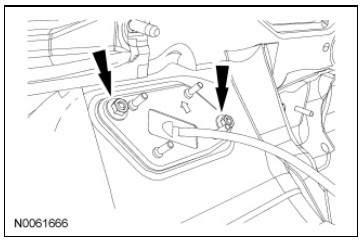
6. Disconnect the 2 wiring harness fasteners and position the RCM wiring harness aside.



7. Position the insulation blanket away from the bulkhead to gain access to the 2 selector lever cable bracket nuts.

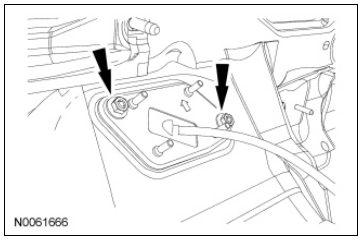


8. Remove the 2 selector lever cable grommet nuts and remove the selector lever cable through the interior of the vehicle.

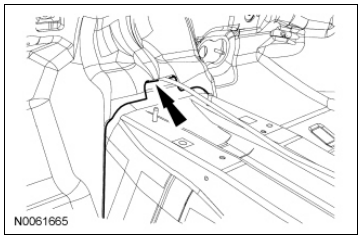


Installation

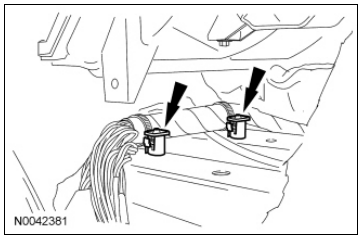
1. Position the selector lever cable in place and install the 2 nuts.
   - Tighten to 9 Nm (80 lb-in).



2. Position the insulation blanket in place over the selector lever cable grommet.



3. Position back the RCM wiring harness and install the fasteners on the studs.

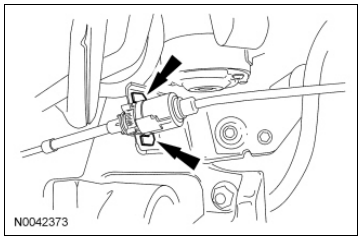


4. **NOTE:** Aisin AW21 shown, 6F35 similar.

   NOTE: When installing the selector lever cable, make sure that the selector lever cable locking tabs are locked in place and the selector lever cable end is snapped onto the ball stud. Press the selector lever cable into the bracket and listen for the selector lever cable to click in place. Pull back on the

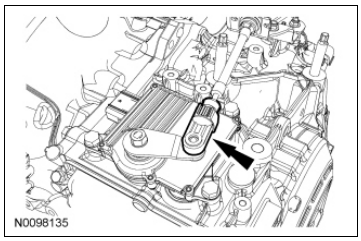
selector lever cable to make sure that it is locked into the selector lever cable bracket. Also make sure that the selector lever cable end is correctly installed onto the ball stud. Pull back on the selector lever cable end to make sure that the selector lever cable end is correctly installed.

Install the selector lever cable in the bracket. Be sure the tabs are locked in place.



5. **NOTE:** Aisin AW21 shown, 6F35 similar.

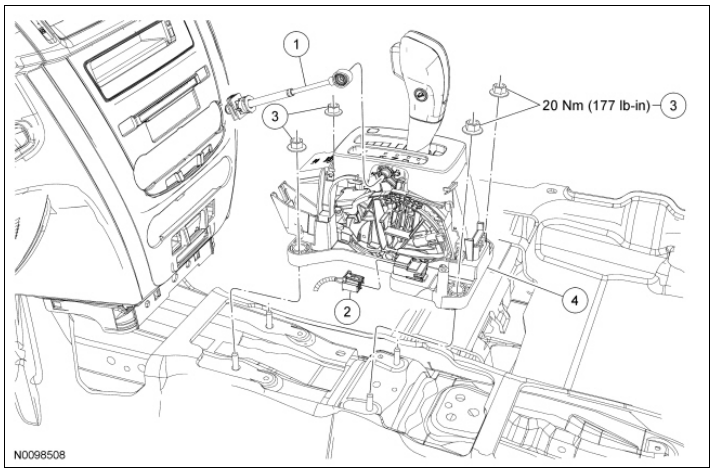
   Connect the selector lever cable end on the manual control lever.



6. Install the battery and battery tray. For additional information, refer to Section 414-01 .
7. Install the RCM . For additional information, refer to Section 501-20B .
8. Install the heater core and evaporator core housing. For additional information, refer to Section 412-01 .
9. Adjust the selector lever cable. For additional information, refer to Selector Lever Cable Adjustment - Aisin AW21 or Selector Lever Cable Adjustment - 6F35 in this section.

Selector Lever - Fusion

NOTE: Transmission Control Switch (TCS) selector lever shown, SelectShiftTM selector lever similar.

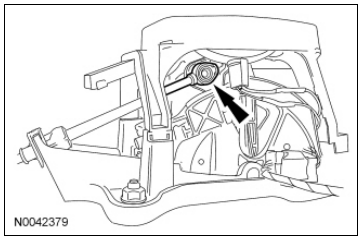


Item	Part Number	Description
1	7E395	Selector lever cable
2	14489	Selector lever electrical connector
3	W714098	Selector lever nuts (4 required)
4	7K004	Selector lever assembly

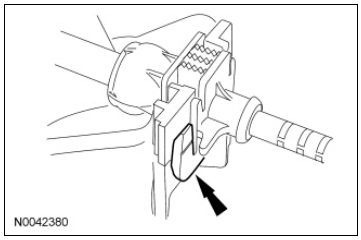
Removal

1. Remove the center console. For additional information, refer to Section 501-12 .

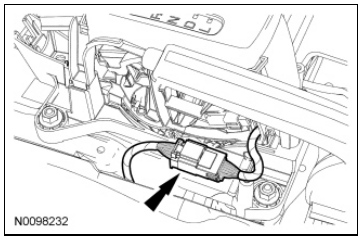
2. Disconnect the selector lever cable end from the selector lever.



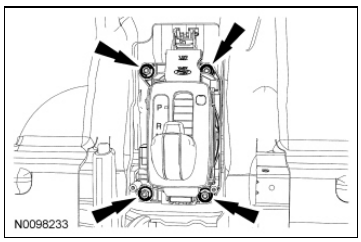
3. Release the tab on the selector lever cable and remove it from the selector lever housing.



4. Disconnect the electrical connector.

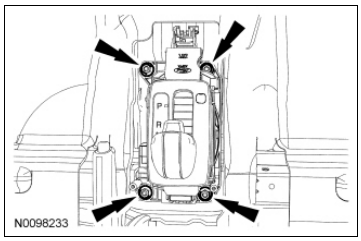


5. Remove the 4 nuts and remove the selector lever.

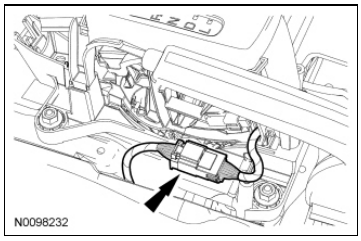


Installation

1. Install the selector lever and the 4 nuts.
   - Tighten to 20 Nm (177 lb-in).

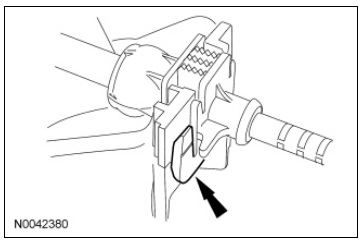


2. Connect the electrical connector.

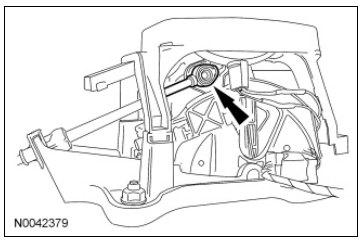


3. **NOTE:** When installing the selector lever cable, make sure that the selector lever cable locking tabs are locked in place and the selector lever cable end is snapped onto the ball stud. Press the selector lever cable into the bracket and listen for the selector lever cable to click in place. Pull back on the selector lever cable to make sure that it is locked into the selector lever cable bracket. Also make sure that the selector lever cable end is correctly installed onto the ball stud. Pull back on the selector lever cable end to make sure that the selector lever cable end is correctly installed.

   Install the selector lever cable in the selector lever housing.



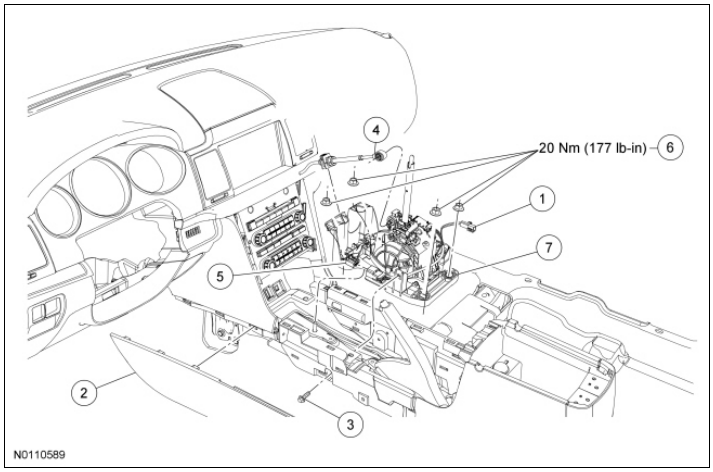
4. Connect the selector lever cable end to the selector lever.



5. Install the center console. For additional information, refer to Section 501-12 .

6. Adjust the selector lever cable. For additional information, refer to Selector Lever Cable Adjustment - Aisin AW21 or Selector Lever Cable Adjustment - 6F35 in this section.

Selector Lever - MKZ

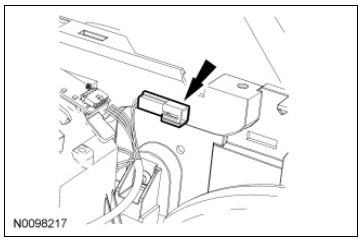


Item	Part Number	Description
1	14A459	Selector lever bezel electrical connector
2	1181081	Floor console lower trim panel
3	W709955	Floor console screw
4	7E395	Selector lever cable
5	14489	Selector lever electrical connector
6	W714098	Selector lever nuts
7 d>7210	Selector lever	

Removal

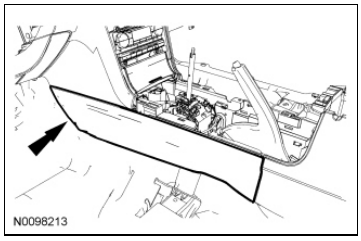
1. Remove the selector lever bezel. For additional information, refer to Selector Lever Bezel - MKZ in this section.

2. Remove the PRNDL electrical connector from the RH side of the center console.



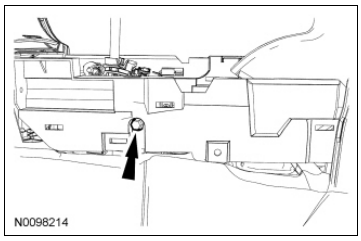
3. **NOTE:** LH shown, RH similar.

   Remove the LH and RH center console trim covers.

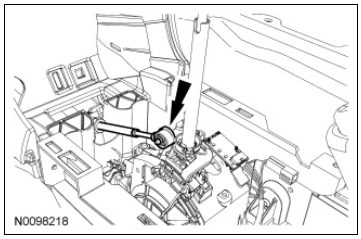


4. **NOTE:** LH shown, RH similar.

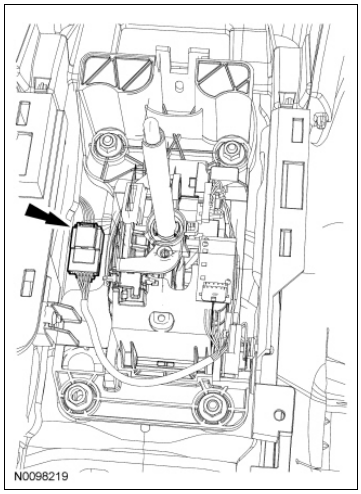
   Remove the LH and RH center console-to-selector lever screws.



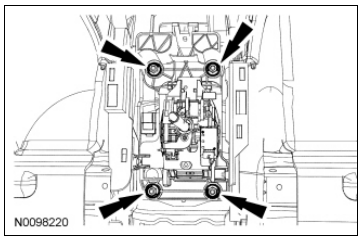
5. Disconnect the selector lever cable end from the selector lever ball stu



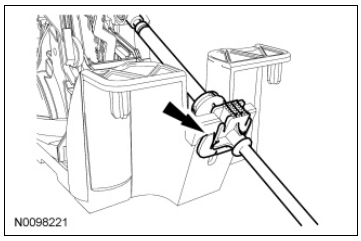
6. Disconnect the selector lever electrical connector.



7. Remove the 4 selector lever nuts.

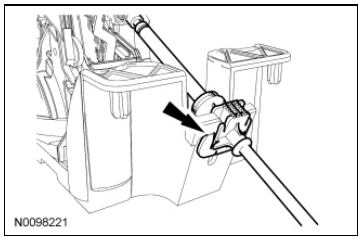


8. Position the selector lever off of the studs, release the tab on the selector lever cable and remove it from the selector lever.

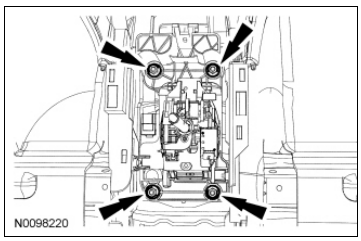


Installation

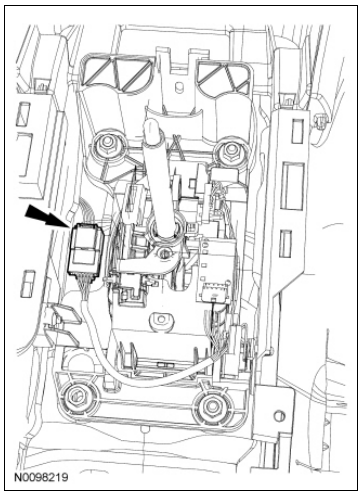
1. Install the selector lever cable in the selector lever and position the selector lever on the studs.



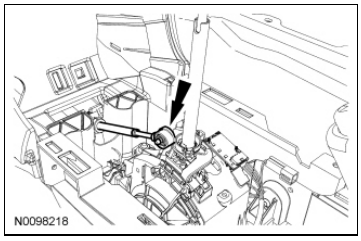
2. Install the 4 selector lever nuts.
   - Tighten to 20 Nm (177 lb-in).



3. Connect the selector lever electrical connector.

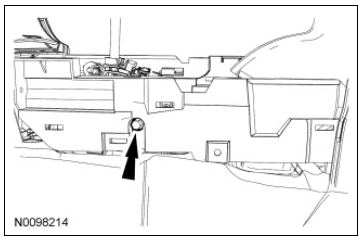


4. Connect the selector lever cable end on the selector lever ball stud.



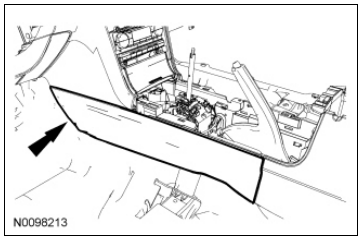
5. **NOTE:** LH shown, RH similar.

   Install the LH and RH center console-to-selector lever screws.

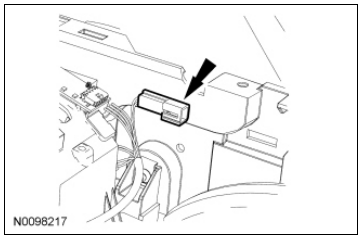


6. **NOTE:** LH shown, RH similar.

   Install the LH and RH center console trim covers.



7. Install the PRNDL electrical connector on the RH side of the center console.



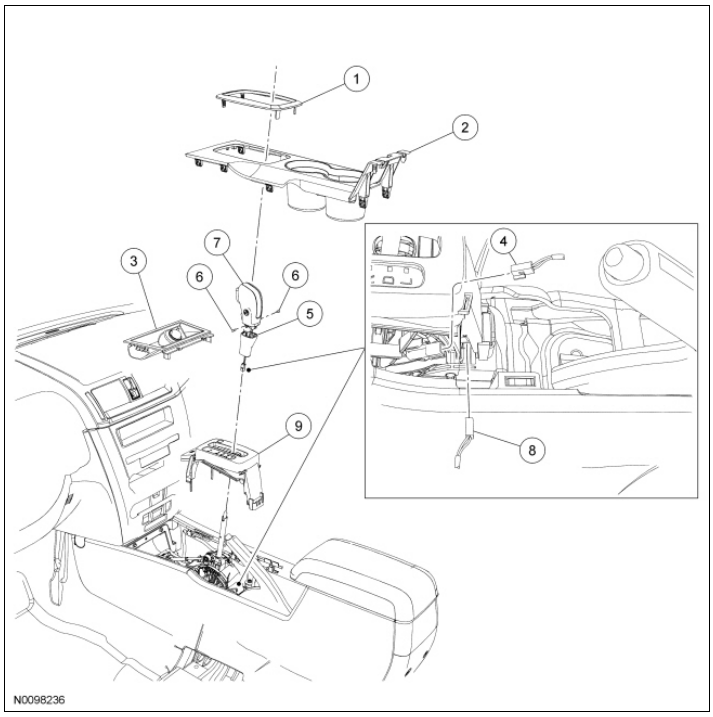
8. Install the selector lever bezel. For additional information, refer to Selector Lever Bezel - MKZ in this section.

9. Check the selector lever cable adjustment. Make sure that the vehicle starts in PARK and NEUTRAL and the reverse lamps illuminate in REVERSE. If an adjustment is necessary, refer to Selector Lever Cable Adjustment - Aisin AW21 in this section.

p;

Selector Lever Bezel - Fusion

NOTE: Transmission Control Switch (TCS) shown, SelectShiftTM switch similar.

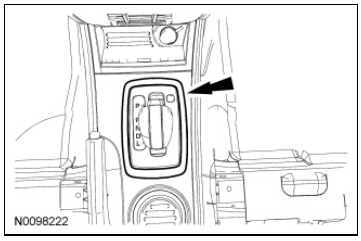


Item	Part Number	Description
1	54061A16	Selector lever trim ring
2	54045A76	Center console trim panel
3	54045A07	Utility tray
4	14A459	Transmission Control Switch (TCS) electrical connector (2.5L engine only)
5	-	Selector lever knob bezel
6	W701894	Selector lever knob screws
7L010	Selector lever knob	
8	14A459	Selector lever bezel electrical connector
9	7E034	Selector lever bezel

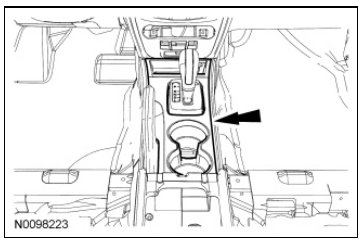
Removal

All vehicles

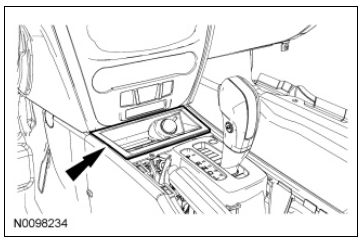
1. Remove the selector lever trim ring.



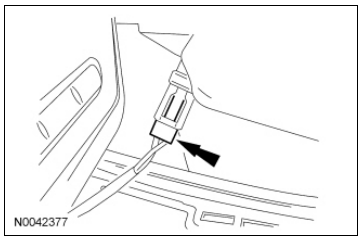
2. Remove the center console trim panel.



3. Remove the utility tray from the center console.

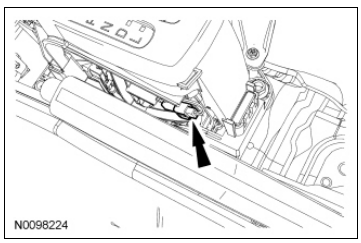


4. Disconnect the electrical connector and remove the utility tray.



Vehicles equipped with a 2.5L or 3.0L (4V) engine

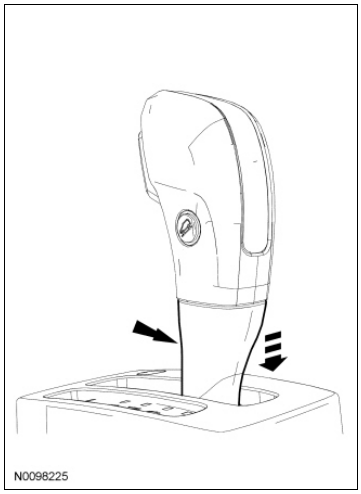
5. Disconnect the Transmission Control Switch (TCS) or SelectShiftTM switch electrical connector.



All vehicles

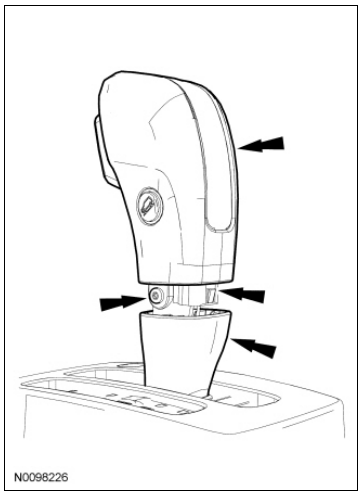
6. **NOTE:** TCS shown, SelectShiftTM switch similar.

Slide the selector lever knob bezel downward to gain access to the 2 selector lever knob screws.



7. *NOTICE:* **It is necessary to route the Transmission Control Switch (TCS) harness or SelectShiftTM switch harness out of the selector lever bezel when removing the selector lever knob.**

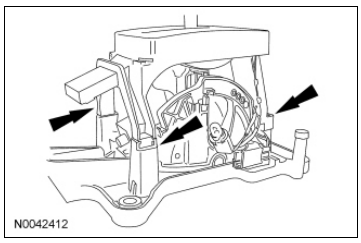
   Remove the 2 screws from the selector lever knob. Remove the selector lever knob and selector lever knob bezel.



8. Disconnect the selector lever bezel electrical connector.

9. **NOTE:** Selector lever removed for clarity.

   Release the 3 tabs and remove the selector lever knob bezel.



Installation

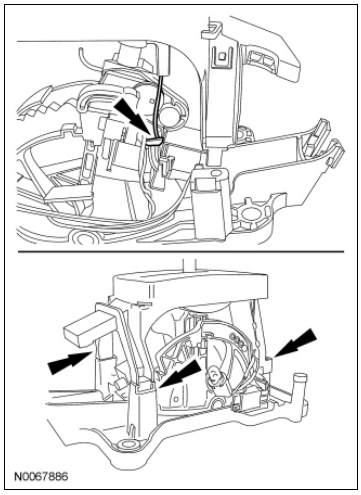
Vehicles equipped with a 2.5L or 3.0L (4V) engine

1. ***NOTICE:*** **Be sure that the override lever is inserted in the override lever guide or the shift interlock override button will not work correctly.**

   NOTE: Selector lever removed for clarity.

   Install the selector lever bezel on the selector lever.

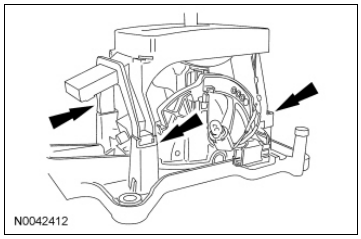
   - Position the override lever in the override lever guide.
   - Make sure that the 3 locking tabs are locked in place.



Vehicles equipped with a 3.5L engine

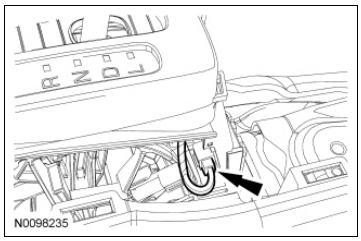
2. **NOTE:** Selector lever removed for clarity.

   Install the selector lever bezel on the selector lever and be sure the 3 tabs are locked in place.



All vehicles

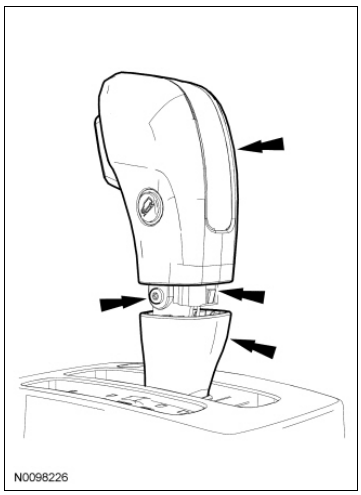
3. Connect the selector lever bezel electrical connector.



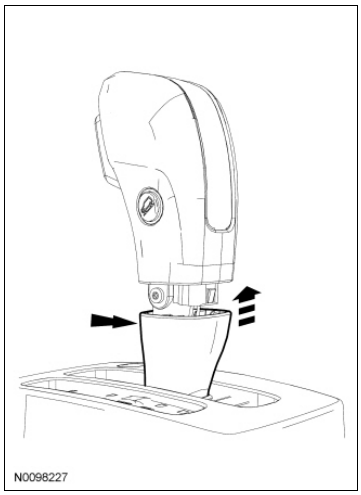
4. ***NOTICE:*** **It is necessary to route the Transmission Control Switch (TCS) harness or SelectShiftTM switch harness out of the selector lever bezel when removing the selector lever knob.**

   NOTE: TCS shown, SelectShiftTM switch similar.

Install the selector lever knob on the selector lever and install the screws.

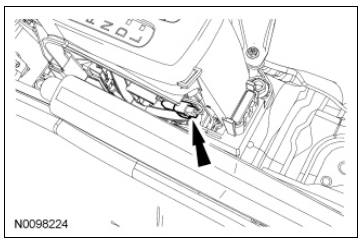


5. Slide the selector lever knob bezel up and install it on the selector lever knob.



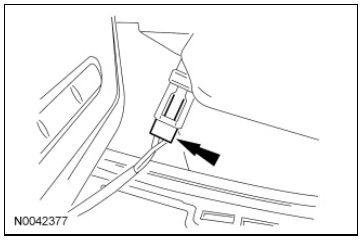
Vehicles equipped with 2.5L or 3.0L (4V) engine

6. Connect the TCS or SelectShiftTM switch electrical connector.

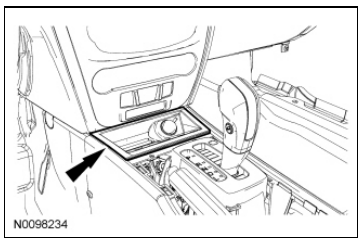


All vehicles

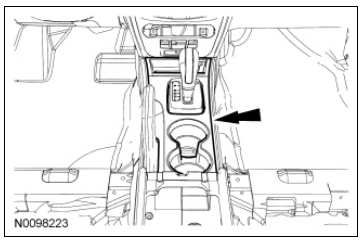
7. Position the utility tray in place and connect the electrical connector.



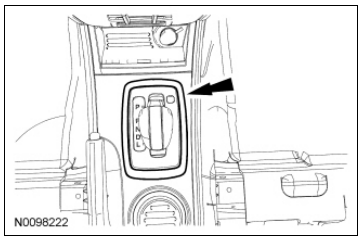
8. Install the utility tray on the center console.



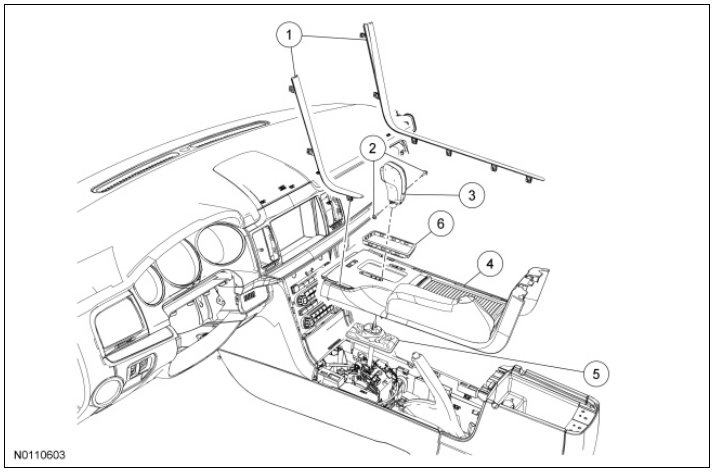
9. Install the center console trim panel.



10. Install the selector lever trim ring.



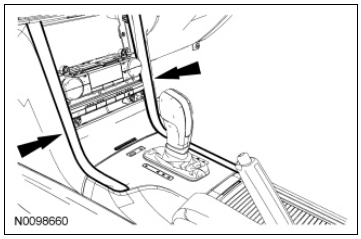
Selector Lever Bezel - MKZ



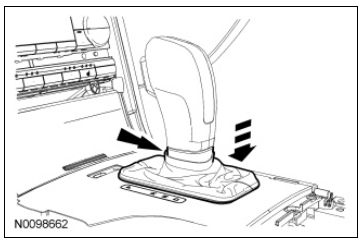
Item	Part Number	Description
1	061A16	Floor console finish moulding
2	W701894	Selector lever knob screws
3	7L010	Selector lever knob
4	7E034	Selector lever bezel
5	7B118	Selector lever boot
6	-	Selector lever trim ring (part of 7B118)

Re>

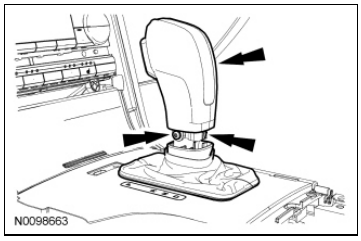
1. Remove the LH and RH console finish moldings.



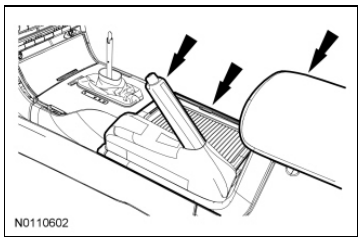
2. Slide the selector lever knob trim ring down to expose the 2 selector lever knob screws.



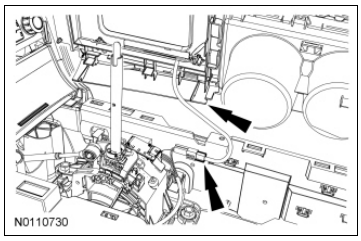
3. Remove the 2 selector lever knob screws and remove the selector lever knob.



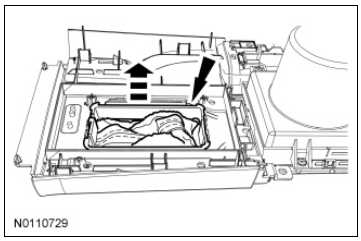
4. Lift the arm rest, apply the emergency brake, pull directly up on the selector lever bezel and remove it from the center console.



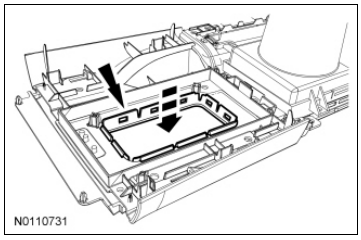
5. Disconnect the selector lever bezel electrical connector and remove the selector lever bezel.



6. Compress the retention tabs on the selector lever boot and remove the boot from the bottom of the selector lever bezel.

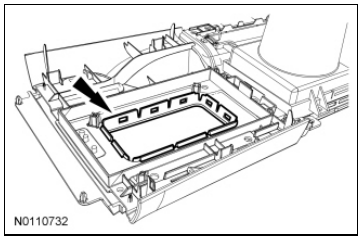


7. Compress the retention tabs on the selector lever trim ring and remove the trim ring through from the top of the selector lever bezel.



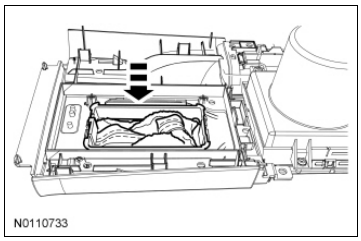
Installation

1. Install the selector lever trim ring in the selector lever bezel.

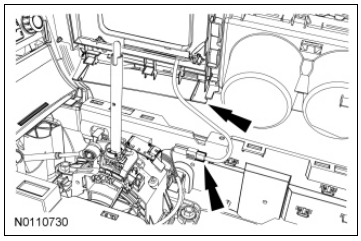


2. ***NOTICE:*** **When installing the selector lever boot, be sure it is in the correct position or the selector lever boot can not be installed on the selector lever knob. If needed, align the selector lever knob to the selector lever boot when installing the boot.**

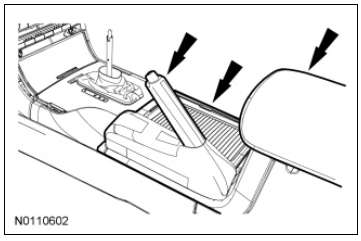
   Install the selector lever boot in the selector lever bezel.



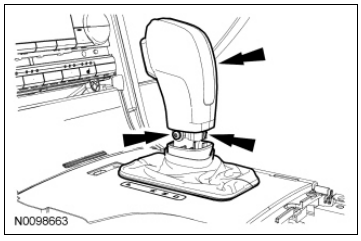
3. Position the selector lever bezel in place and connect the electrical connector.



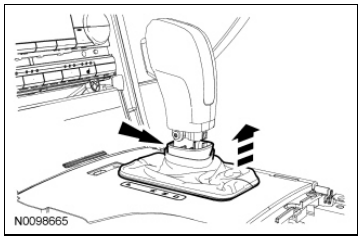
4. Position the selector lever bezel in place and install it onto the center console.



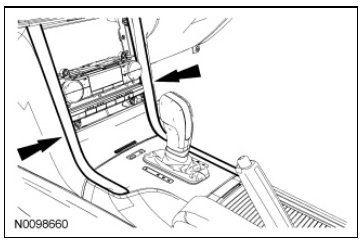
5. Position the selector lever knob onto the selector lever and install the screws.



6. Slide the selector lever knob trim ring up and install it on the selector lever knob.

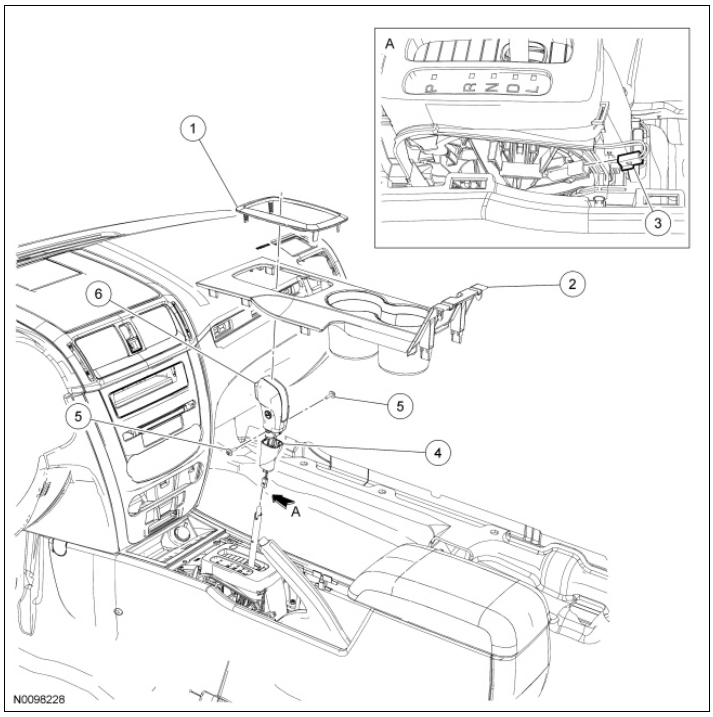


7. Install the LH and RH console finish moldings.



Selector Lever Knob

NOTE: Transmission Control Switch (TCS) shown, select switch similar.

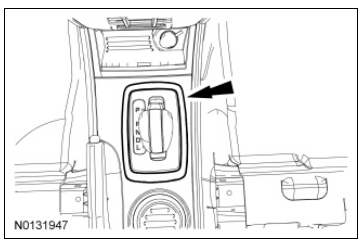


Item	Part Number	Description
1	54061A16	Selector lever trim ring
2	54045A76	Upper console panel
3	14A459	Transmission Control Switch (TCS) electrical connector (2.5L engine only)
4	-	Selector lever knob shroud (part of 7L010)
5	W701894	Selector lever knob screws
6	7L010 td>Selector lever knob	

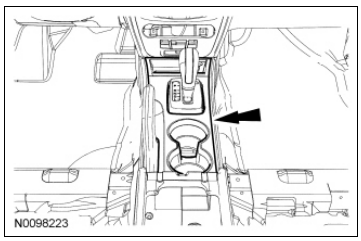
Removal

Vehicles equipped with a 2.5L or 3.0L (4V) engine

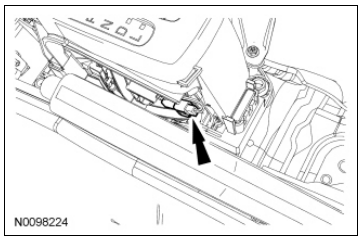
1. Remove the selector lever trim ring.



2. Remove the center console trim panel.



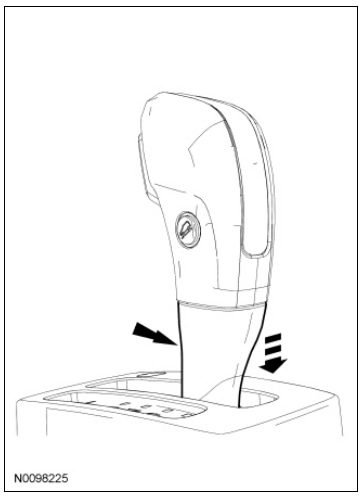
3. Disconnect the Transmission Control Switch (TCS) or select switch electrical connector.



All vehicles

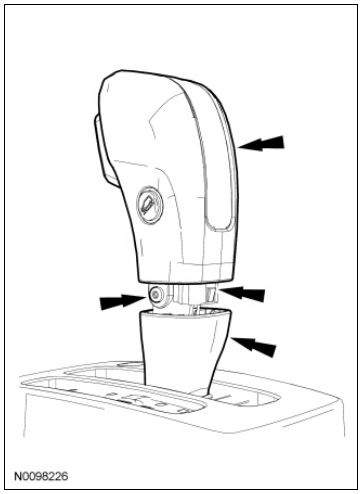
4. **NOTE:** TCS shown, select switch similar.

   Slide the selector lever knob shroud downward to gain access to the 2 selector lever knob screws.



5. ***NOTICE:*** **It is necessary to route the Transmission Control Switch (TCS) harness or select switch harness out of the selector lever shroud when removing the selector lever knob.**

   Remove the 2 screws from the selector lever knob. Remove the selector lever knob and selector lever knob shroud.



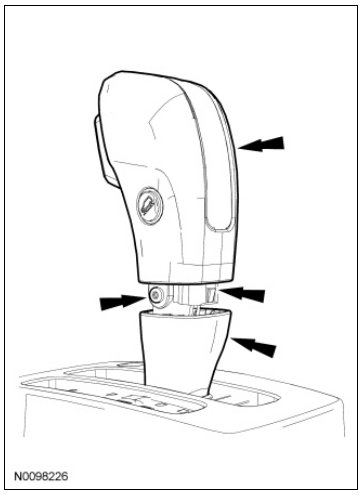
Installation

All vehicles

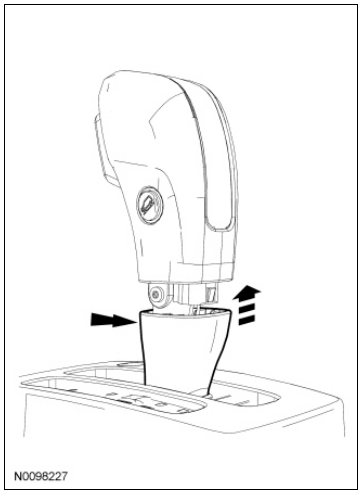
1. ***NOTICE:*** **It is necessary to route the Transmission Control Switch (TCS) harness or select switch harness through the selector lever shroud when installing the selector lever knob.**

   NOTE: TCS shown, select switch similar.

   Install the selector lever knob on the selector lever and install the screws.

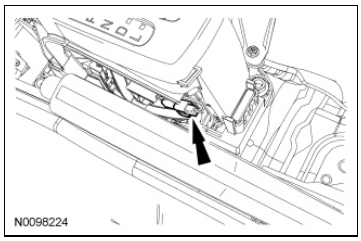


2. Slide the selector lever knob shroud up and install it on the selector lever knob.

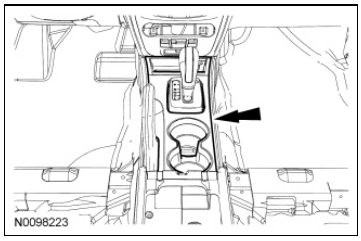


Vehicles equipped with 2.5L or 3.0L (4V) engine

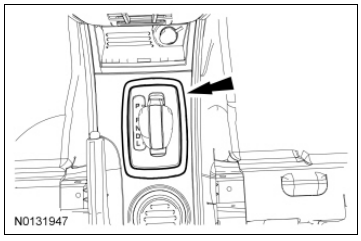
3. Connect the TCS or select switch electrical connector.



4. Install the center console trim panel.



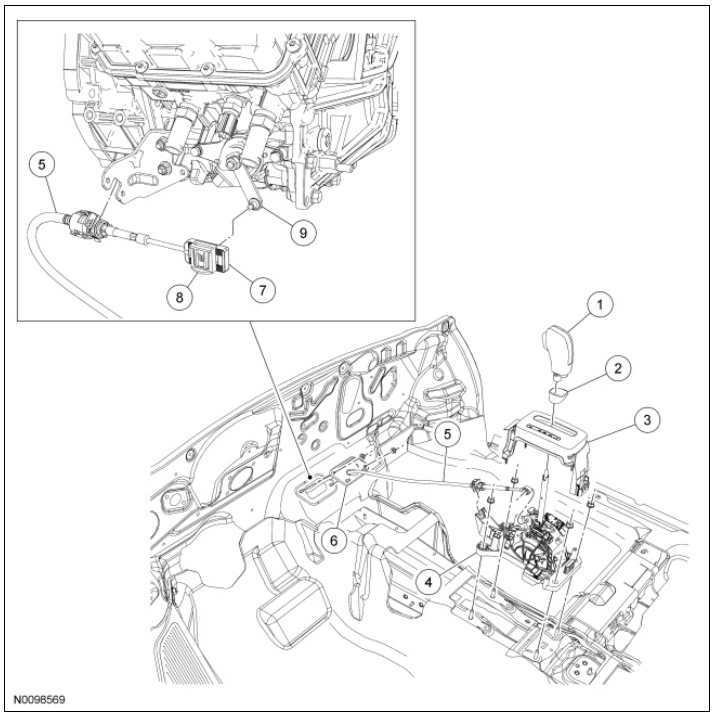
5. Install the selector lever trim ring.



Torque Specifications

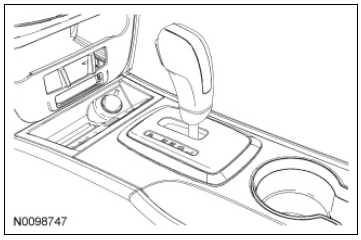
Description	Nm	lb-in
Selector lever cable grommet nuts	9	80
Selector lever nuts	20	177

External Controls



Item	Part Number	Description
1	7L010	Selector lever knob
2	-	Lower selector lever knob bezel (part of 7L010)
3	7E034	Selector lever bezel
4	7K004	Selector lever assembly
5	7E395	Selector lever cable
6	57809	Selector lever cable grommet
7	-	Selector lever cable enof 7E395)
8	-	Selector lever cable adjustment lock tab (part of 7E395)
9	7A257	Manual control lever

Range Selection



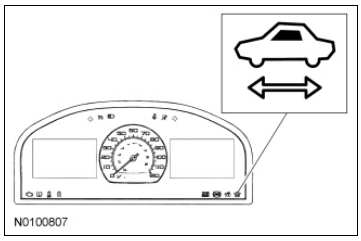
Park

With the range selector in PARK:

- the parking pawl locks the output shaft to the case.
- the ignition key can be removed.
- the ignition switch can be cycled from OFF to START or RUN. The ready indicator light will illuminate on the Instrument Cluster (IC) when the ignition switch is cycled to the START position.

The ready indicator light is located on the lower right hand corner of the IC .

Ready Indicator Light



Reverse

With the range selector in REVERSE:

- the vehicle may be operated in a rearward direction.
- reversing lamps are illuminated.
- if the ready indicator light is not illuminated, which lights when the ignition switch is cycled to the START position, there is no reverse gear engagement.

Neutral

With the range selector in NERAL:

- no power flows through the transmission.
- the output shaft is disengaged from the drive wheels.

Drive

The range selector DRIVE position provides:

- low speed driving.
- acceleration.
- cruise conditions.
- deceleration.
- maximum fuel economy during normal operation.

If the ready indicator light is not illuminated, which lights when the ignition switch is cycled to the START position, there is no forward gear engagement.

Low

The range selector LOW position provides:

- engine braking.
- improved traction on slippery roads.

If the ready indicator light is not illuminated, which lights when the ignition switch is cycled to the START position, there is no forward gear engagement.

Brake Shift Interlock System

The brake shift interlock system prevents a shift out of PARK unless the brake pedal is depressed. The brake shift interlock system has a Brake Shift Interlock Actuator (BSIA) mounted on the selector lever assembly. If the ignition switch is in the RUN position, the BSIA will allow the selector lever to be moved out of PARK only when the brake pedal is pressed.

External Controls

The external control of the Electronically Controlled Continuously Variable Transmission (eCVT) is mechanically controlled by a cable connected to the selector lever and electronically controlled by the TR sensor (located on the transaxle). The selector lever position determines PARK, REVERSE, NEUTRAL, DRIVE and LOW modes. For diagnosis, removal and installation of the TR sensor, refer to Section 307-01C .

External Controls

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, correct the cause before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom. GO to Symptom Chart .

Visual Inspection Chart

Mechanical	Electrical
• Transmission selector lever cable • Manual control lever • Selector lever or selector lever knob	• Smart Junction Box (SJB) fuse 5 (10A) • Connections • Wiring harness • Brake Pedal Position (BPP) switch • Brake Shift Interlock Actuator (BSIA)

DTC Chart

DTC	Component	Description	Condition	Symptom	Action
B2572	Brake Shift Interlock	Brake Shift Interlock Output	The associated circuitry connected to the Smart Junction	Brake shift interlock is inoperative or	GO to Pinpoint

		Circuit Failure	Box (SJB) or fuse, or the SJB itself may have an issue causing a brake shift interlock concern.	does not operate correctly.	Test A .

Symptom Chart - External Controls

Symptom Chart - External Controls

Symptom Chart - NVH

Symptom Chart - NVH

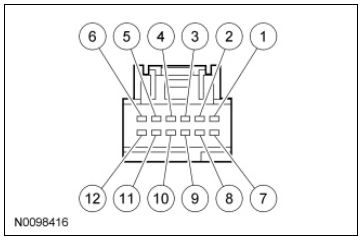
NOTE: NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to Section 100-04 . Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary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

ConditionPossible SourcesAction

- Vibration - a high frequency (20-80 Hz) vibration that is felt through the seat or the selector lever. Changes with engine speed
- Selector lever cable incorrectly routed, grounded out or loose
- REFER to Selector Lever Cable in this section.
- Loose selector lever cable bracket
- CHECK the selector lever cable and bracket for damage and correct assembly. REFER to Selector Lever Cable in this section. REPAIR as necessary.
- Rattle, noise, buzz or other noise
- Selector lever loose
- Noisy selector lever
- TIGHTEN the selector lever nuts.
- INSTALL a new selector lever. REFER to the Selector Lever in this section.

Electrical Connectors

Selector Lever Harness C3233



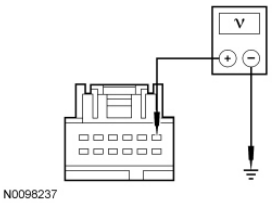
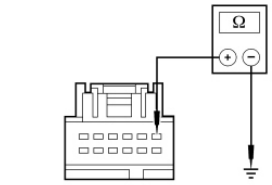
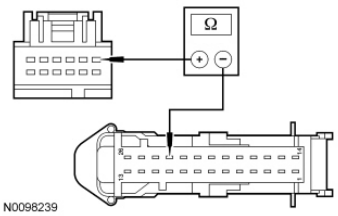
Pin Number	Circuit	Circuit Function
1	CET53 (BU/OG)	Brake Shift Interlock Actuator (BSIA) solenoid power circuit
2	CET22 (GY/BN)	Park position signal to ignition switch
3	CET52 (GN)	Park position signal to Instrument Cluster (IC)
4	VLN04 (VT/GY)	Power to PRNDL LED illumination
5	GD116 (BK/VT)	Ground
6	-	Empty
7	-	Empty
8 D>	-	Empty
9	-	Empty
10	-	Empty
11	-	Empty
12	-	Empty

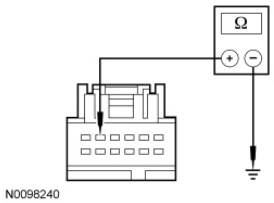
Pinpoint Test

Refer to Wiring Diagrams Cell 37 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Shift Interlock for schematic and connector information.

PINPOINT TEST A: THE BRAKE SHIFT INTERLOCK SYSTEM DOES NOT RELEASE/LOCK CORRECTLY

Test Step	Result / Action to Take
A1 TEST THE BRAKE LIGHTS	
• Apply the brake pedal and view the brake lights. • **Do the brake lights illuminate?**	**Yes** GO to A2 . **No** REFER to Section 417-01 .
A2 TEST SJB FUSE 5 (10A)	
• Check fuse: Smart Junction Box (SJB) 5 (10A). • **Is the resistance less than 5 ohms?**	**Yes** GO to A3 . **No** INSTALL a new fuse. GO to A3 .
A3 TEST BSIA POWER CIRCUIT	
• Disconnect: Selector Lever Electrical C3233. • Ignition ON. • Measure the voltage between selector lever harness C3233-1, circuit CET53 (BU/OG), vehicle harness side and ground, while applying the brake pedal.	**Yes** GO to A6 . **No** GO to A4 .

 N0098237 • **Is the voltage greater than 10 volts?**	
A4 TEST THE BSIA POWER CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280C. • Measure the resistance between selector lever harness C3233-1, circuit CET53 (BU/OG), vehicle harness side and ground.  N0098238 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A5 . **No** REPAIR the circuit. TEST the system for normal operation.
A5 TEST THE BSIA POWER CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between the selector lever harness C3233-1, circuit CET53 (BU/OG), vehicle harness side and SJB C2280C-23, circuit CET53 (BU/OG), vehicle harness side.  N0098239 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new SJB . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
A6 TEST THE BSIA GROUND CIRCUIT	
• Ignition OFF. • Measure the resistance between selector lever harness C3233-5, circuit GD116 (BK/VT), vehicle harness side and ground.	**Yes** INSTALL a new selector lever. REFER to Selector Lever in this section. **No** REPAIR the circuit. TEST the system for normal operation.

 • **Is the resistance less than 5 ohms?**	

Brake Shift Interlock Override

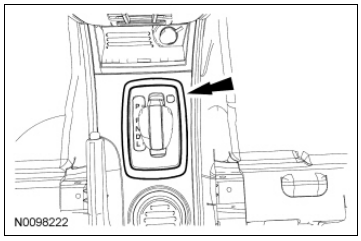
NOTE: If it is necessary to use the override procedure to move the selector lever out of the PARK position, it is possible that a fuse has blown and the brake lights are not operational. Before driving the vehicle, verify that the brake lights are working.

This vehicle is equipped with a brake shift interlock feature that prevents the selector lever from being moved out of PARK when the ignition is in the ON position unless the brake pedal is depressed.

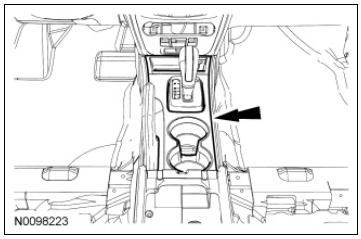
If the selector lever cannot be moved out of the PARK position when the ignition is in the ON position and the brake pedal is depressed, carry out the following procedure:

1. Apply the parking brake.

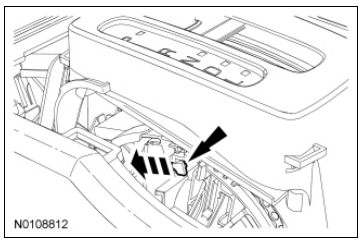
2. Remove the selector lever trim ring.



3. Remove the center console trim panel.

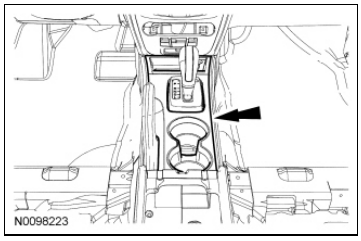


4. Using a suitable tool, push the brake shift interlock override forward, apply the brake, press the selector lever knob button and move the selector lever into NEUTRAL.

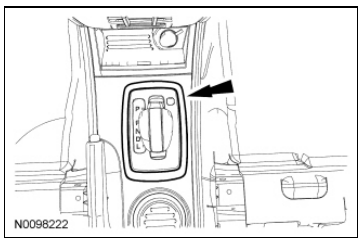


5. Start the vehicle.

6. Install the center console trim panel.



7. Install the selector lever trim ring.

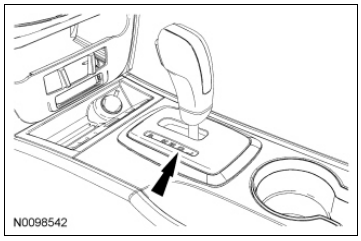


Selector Lever Cable Adjustment

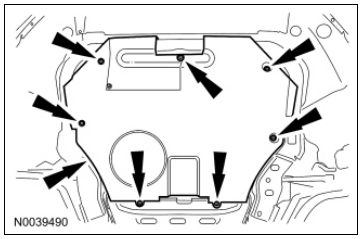
1. ***NOTICE:*** **The ignition must be in the OFF position to make sure that the Electronically Controlled Continuously Variable Transmission (eCVT) and the engine are OFF.**

   With vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

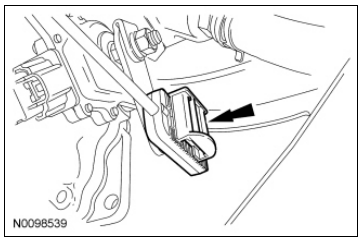
2. Place the selector lever in the D position.



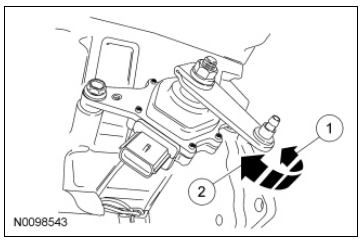
l start="3">
- Remove the bolts and the splash shield.



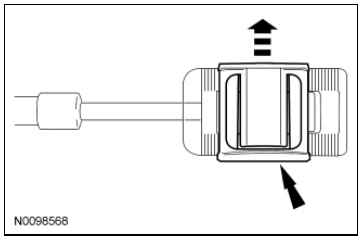
4. Disconnect the selector lever cable end from the manual control lever.



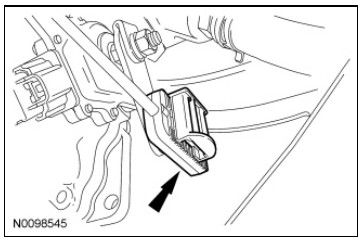
5. Place the manual control lever in the D position.
   1. Rotate the manual control lever counterclockwise to the PARK position.
   2. Rotate the manual control lever clockwise 3 detents to the D position.



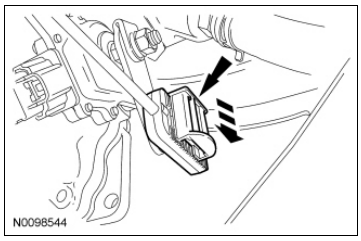
6. Unlock the adjuster by sliding the locking tab over.



7. Align the selector lever cable end to the manual control lever ball stud and install it with the adjuster unlocked.

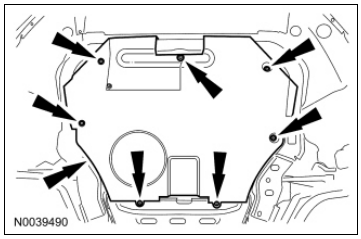


8. Slide the selector lever cable adjuster tab in place to lock the selector lever cable.

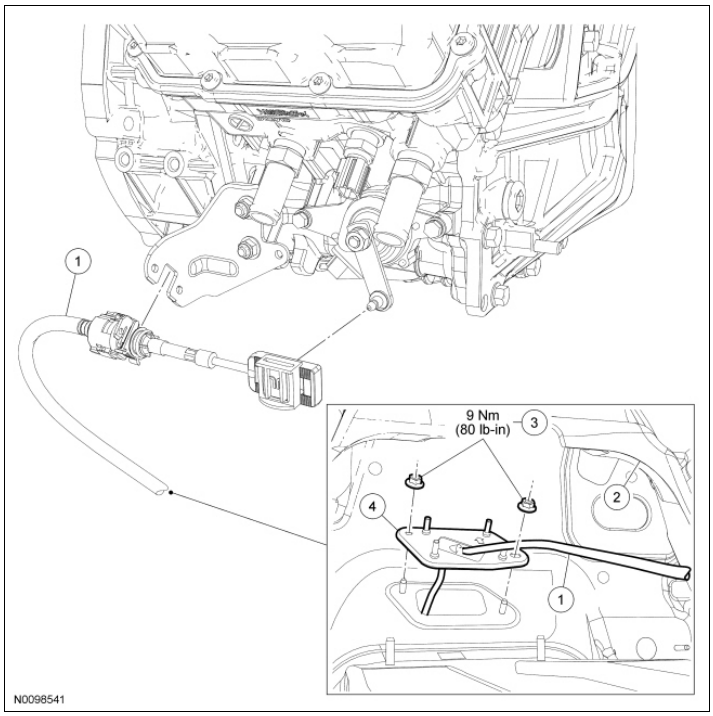


9. Verify that the vehicle starts in PARK and NEUTRAL only and that the reverse lamps illuminate in REVERSE.

10. Install the splash shield and the bolts.



Selector Lever Cable



Item	Part Number	Description
1	7E395	Selector lever cable
2	54017A40	Insulation blanket
3	W707142	Selector lever cable grommet retaining nuts
4	57809	Selector lever cable grommet

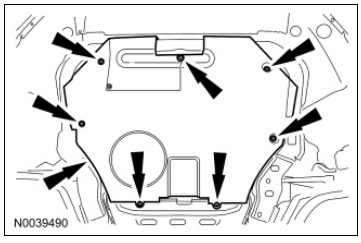
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

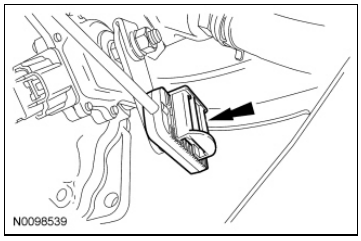
2. Remove the heater core and evaporator core housing. For additional information, refer to Section 412-01 .

3. Remove the Restraints Control Module (RCM). For additional information, refer to Section 501-20B .

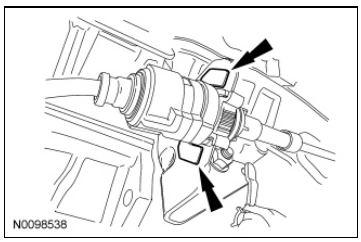
4. Remove the bolts and the splash shield.



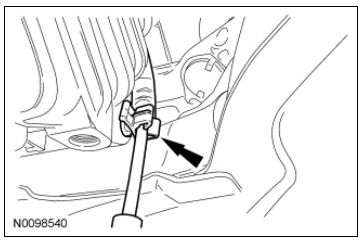
5. Disconnect the selector lever cable end from the manual control lever.



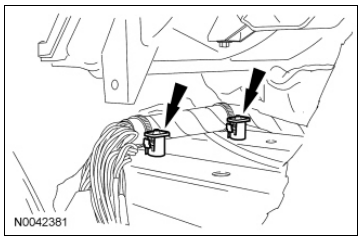
6. Release the 2 tabs and remove the selector lever cable from the selector lever cable bracket.



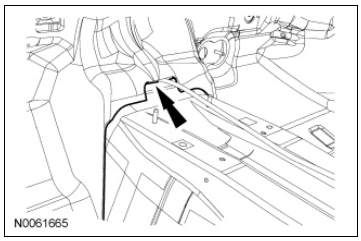
7. Remove the selector lever cable from the retainer.



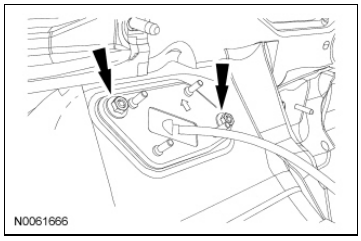
8. Disconnect the 2 wiring harness fasteners and position the RCM wiring harness aside.



9. Position the insulation blanket away from the bulkhead to gain access to the 2 selector lever cable bracket nuts.

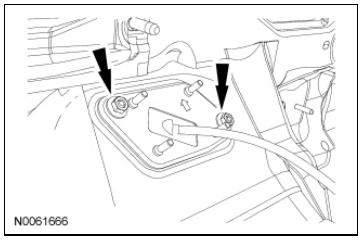


10. Remove the 2 selector lever cable grommet nuts and remove the selector lever cable through the interior of the vehicle.

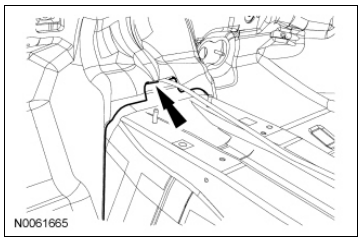


Installation

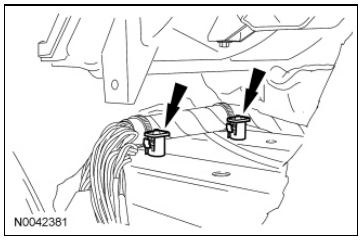
1. Position the selector lever cable in place and install the 2 nuts.
   - Tighten to 9 Nm (80 lb-in).



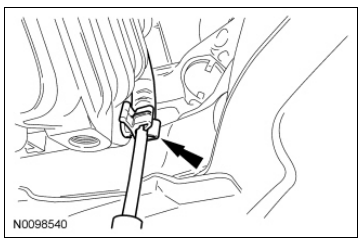
2. Position the insulation blanket in place over the selector lever cable grommet.



3. Position back the RCM wiring harness and install the fasteners on the studs.

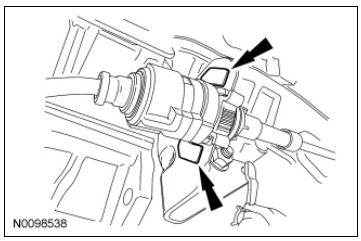


4. Install the selector lever cable in the retainer.

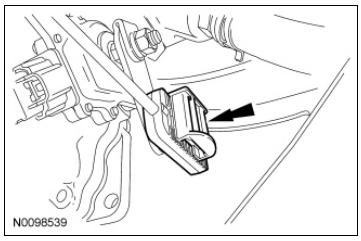


5. **NOTE:** When installing the selector lever cable, make sure that the selector lever cable locking tabs are locked in place and the selector lever cable end is snapped onto the ball stud. Press the selector lever cable into the bracket and listen for the selector lever cable to click in place. Pull back on the selector lever cable to make sure that it is locked into the selector lever cable bracket. Also make sure that the selector lever cable end is correctly installed onto the ball stud. Pull back on the selector lever cable end to make sure that the selector lever cable end is correctly installed.

Install the selector lever cable in the bracket. Be sure the tabs are locked in place.



6. Connect the selector lever cable end on the manual control lever.

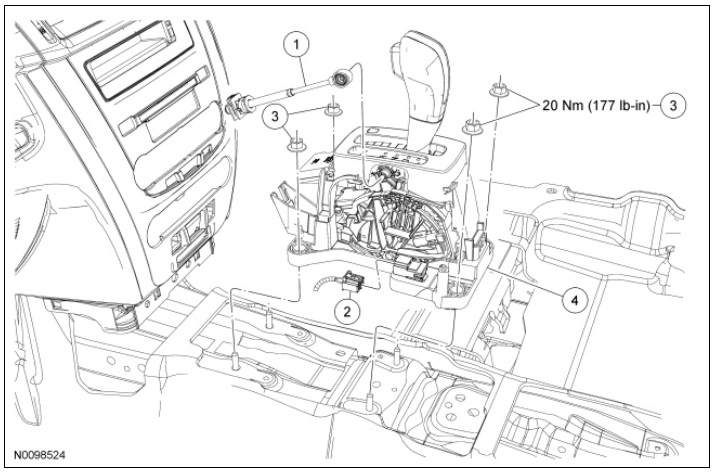


7. Install the RCM . For additional information, refer to Section 501-20B .

8. Install the heater core and evaporator core housing. For additional information, refer to Section 412-01 .

9. Adjust the selector lever cable.

Selector Lever

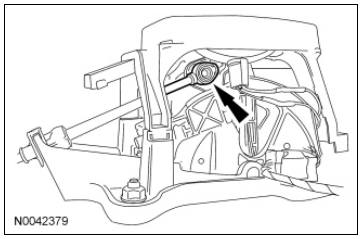


Item	Part Number	Description
1	7E395	Selector lever cable
2	14489	Selector lever electrical connector
3	W714098	Selector lever nuts (4 required)
4	7K004	Selector lever assembly

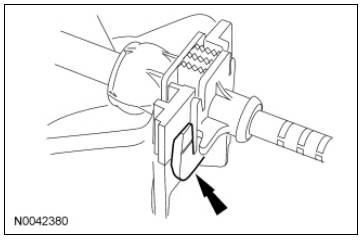
Removal

1. Remove the center console. For additional information, refer to Section 501-12 .

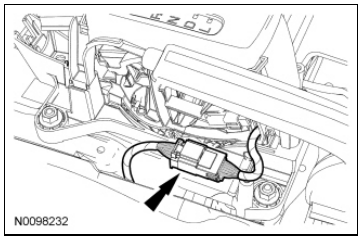
2. Disconnect the selector lever cable end from the selector lever.



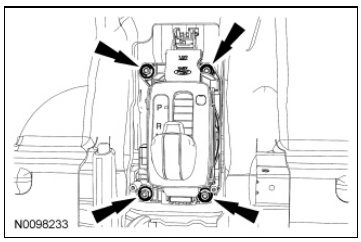
3. Release the tab on the selector lever cable and remove it from the selector lever housing.



4. Disconnect the electrical connector.

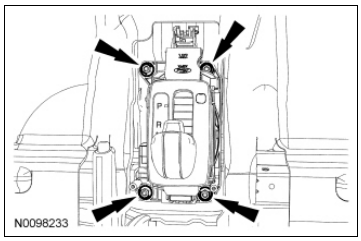


5. Remove the 4 nuts and remove the selector lever.

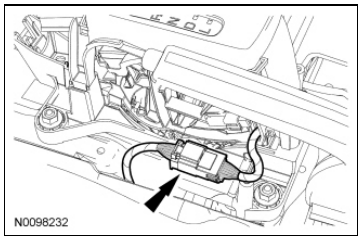


Installation

1. Install the selector lever and the 4 nuts.
   - Tighten to 20 Nm (177 lb-in).

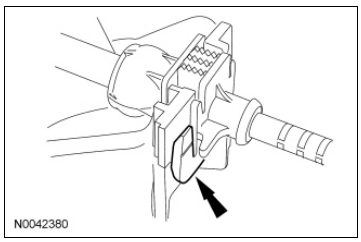


2. Connect the electrical connector.

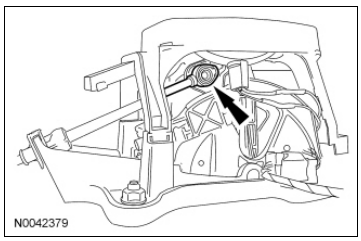


3. **NOTE:** When installing the selector lever cable, make sure that the selector lever cable locking tabs are locked in place and the selector lever cable end is snapped onto the ball stud. Press the selector lever cable into the bracket and listen for the selector lever cable to click in place. Pull back on the selector lever cable to make sure that it is locked into the selector lever cable bracket. Also make sure that the selector lever cable end is correctly installed onto the ball stud. Pull back on the selector lever cable end to make sure that the selector lever cable end is correctly installed.

   Install the selector lever cable in the selector lever housing.



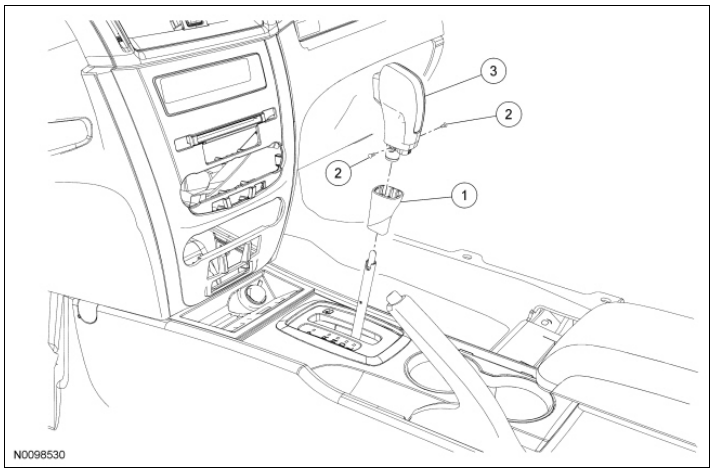
4. Connect the selector lever cable end to the selector lever.



5. Install the center console. For additional information, refer to Section 501-12 .

6. Adjust the selector lever cable. For additional information, refer to Selector Lever Cable Adjustment in this section.

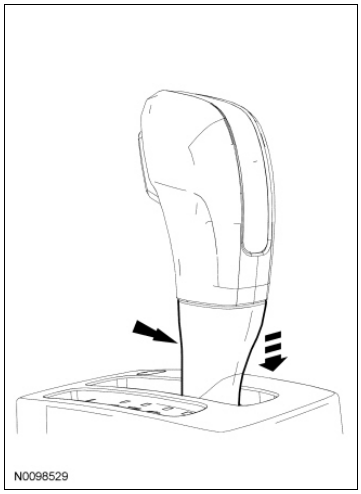
Selector Lever Knob



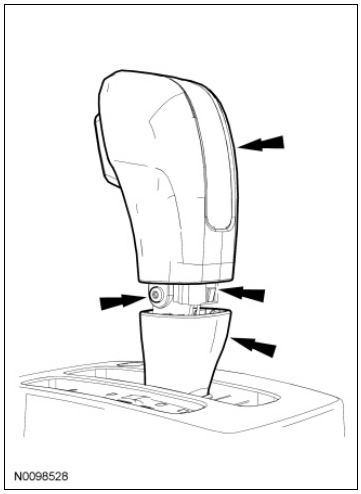
Item	Part Number	Description
1	-	Lower selector lever knob bezel (part of 7L010)
2	W701894	Selector lever knob screws
3	7L010	Selector lever knob

Removal

1. Slide the selector lever knob bezel downward to gain access to the 2 selector lever knob screws.

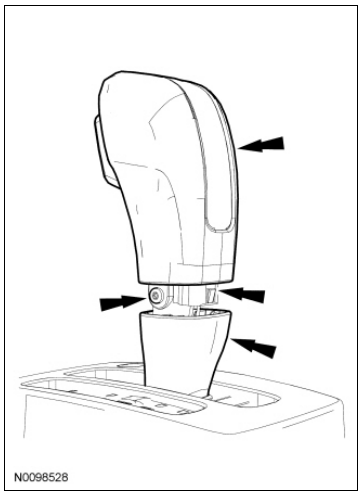


2. Remove the 2 screws from the selector lever knob. Remove the selector lever knob and the selector lever knob bezel.

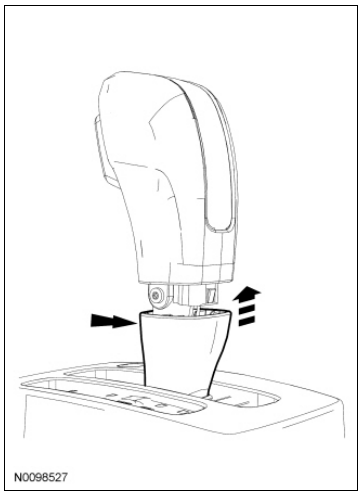


Installation

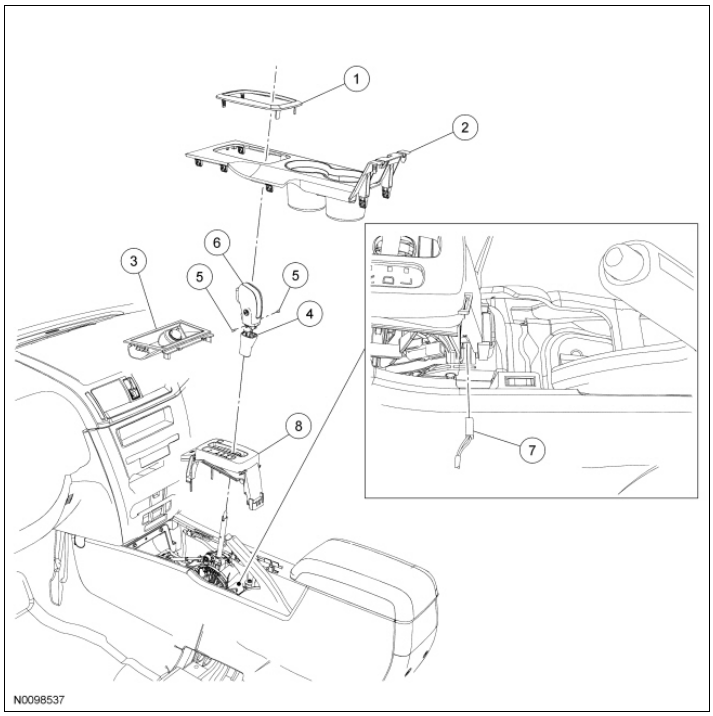
1. Install the selector lever knob on the selector lever and install the screws.



2. Slide the selector lever knob bezel up and install it on the selector lever knob.



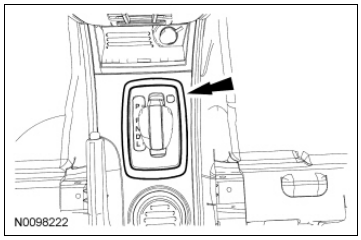
Selector Lever Bezel



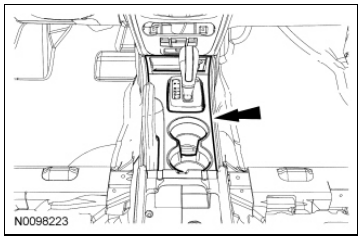
Item	Part Number	Description
1	54061A16	Selector lever trim ring
2	54045A76	Center console trim panel
3	54045A07	Utility tray
4	-	Selector lever knob bezel
5	W701894	Selector lever knob screws
6	7L010	Selector lever knob
7	14A459	Selector lever bezel electricalctor
8	7E034	Selector lever bezel

Removal

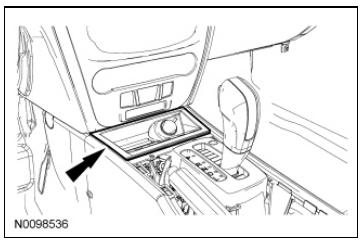
1. Remove the selector lever trim ring.



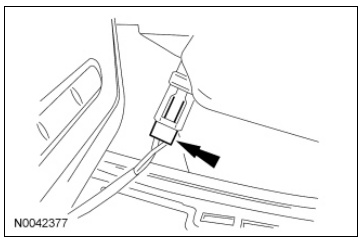
2. Remove the center console trim panel.



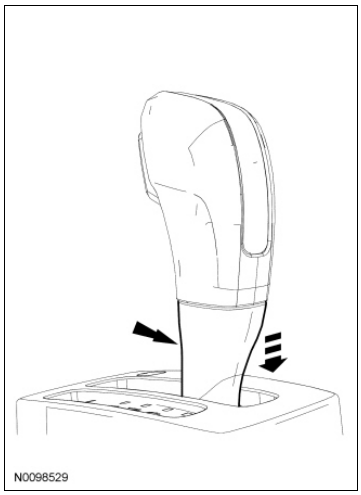
3. Remove the utility tray from the center console.



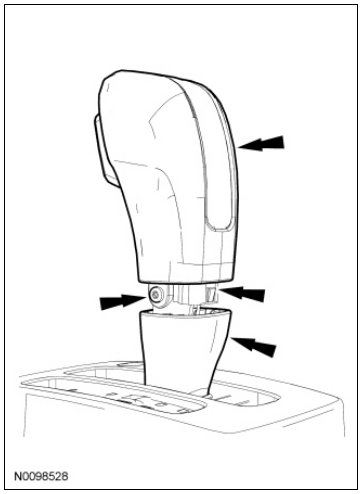
4. Disconnect the electrical connector and remove the utility tray.



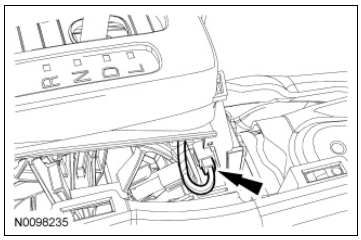
5. Slide the selector lever knob bezel downward to gain access to the 2 selector lever knob screws.



6. Remove the 2 screws from the selector lever knob. Remove the selector lever knob and the selector lever knob bezel.

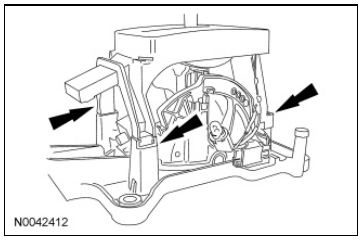


7. Disconnect the selector lever bezel electrical connector.



8. **NOTE:** Selector lever removed for clarity.

   Release the 3 tabs and remove the selector lever knob bezel.



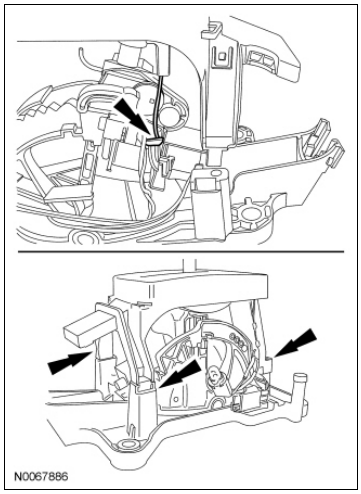
Installation

1. ***NOTICE:*** **Be sure that the override lever is inserted in the override lever guide or the shift interlock override button will not work correctly.**

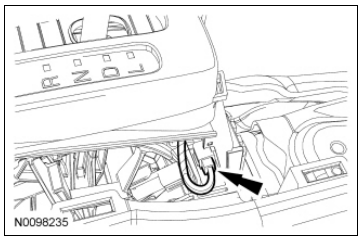
   NOTE: Selector lever removed for clarity.

   Install the selector lever bezel on the selector lever.

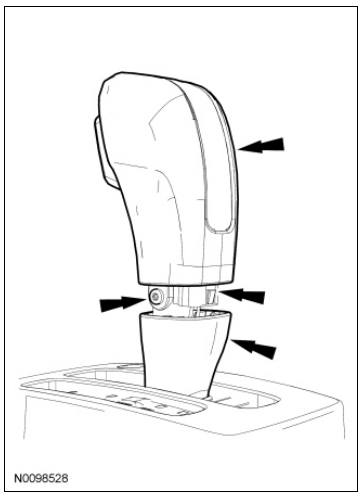
   - Position the override lever in the override lever guide.
   - Make sure that the 3 locking tabs are locked in place.



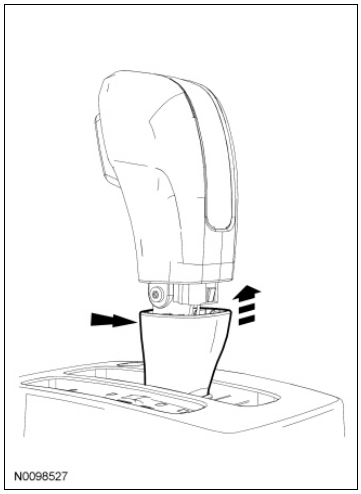
2. Connect selector lever bezel electrical connector.



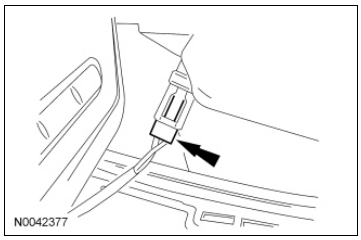
3. Install the selector lever knob on the selector lever and install the screws.



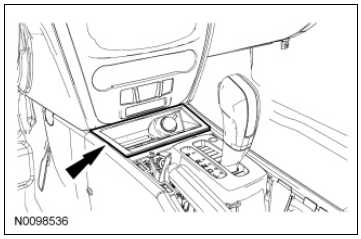
4. Slide the selector lever knob bezel up and install it on the selector lever knob.



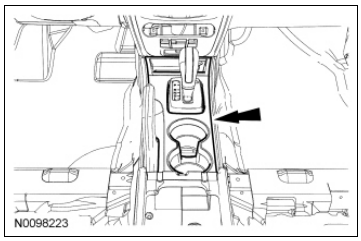
5. Position the utility tray in place and connect the electrical connector.



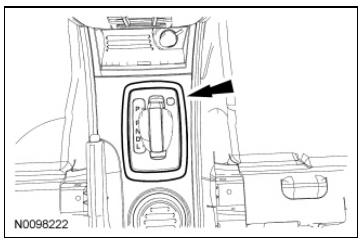
6. Install the utility tray on the center console.



7. Install the center console trim panel.



8. Install the selector lever trim ring.



Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	-
SAE 75W-90 API GL-4 Gear Oil XT-4-QGL	WSS-M2C203-A1	2.84L (3.0 qts.)

General Specifications

Item	Specification
Clutch Disc	
Maximum runout	0.7 mm (0.027 in)
Minimum allowable depth to rivet head	0.3 mm (0.011 in)
Clutch pedal free play	1.0-3.0 mm (0.39-0.118 in)
Clutch Pressure Plate	
Maximum runout	0.5 mm (0.019 in)
Flywheel Runout	
Maximum runout	0.1 mm (0.039 in)
Pressure Plate Diaphragm Spring Fingers	
Maximum clearance	0.3 mm (0.011 in)
Maximum depth	0.6 mm (0.023 in)

Torque Specifications

Description	Nm	lb-in
Bleeder screw	7	62
Clutch pedal locknut	15	133

Manual Transaxle and Clutch

The transaxle and clutch system consist of the following:

- Six-speed manual transaxle
- Clutch disc
- Clutch pressure plate
- Clutch release hub and bearing
- Clutch hydraulic system
- Clutch pedal
- Flywheel
- Pilot bearing
- Shift controls

The function of the transaxle is to move the vehicle from a rest position to motion. The transaxle uses gears to adapt the torque to the demands of load and road conditions. It matches engine power to vehicle needs. This power is delivered from the engine's flywheel to the transaxle. The power is transmitted through a driver-operated clutch, which allows for engagement and disengagement of the engine to the transaxle.

The transaxle input shaft receives the power when the clutch is engaged. The transaxle then uses a system of gears to change the speed and torque relationship between the engine crankshaft and the transaxle differential.

The purpose of the clutch is to connect and dnnect a manually operated transaxle, and the halfshafts, from the engine. This allows starting and stopping the vehicle, shifting and changing vehicle speeds that correspond to the engine speed through gear changes.

The manual transmission has a tag to identify assemblies for repair purposes. Refer to Section 308-03 for the transmission tag information.

Manual Transaxle and Clutch

Material

Item	Specification
SAE 75W-90 API GL-4 Gear Oil XT-4-QGL	WSS-M2C203-A1

Principles of Operation

The function of the transaxle is to move the vehicle from a rest position to motion. The transaxle uses gears to adapt the torque to the demands of load and road conditions. It matches engine power to vehicle needs. This power is delivered from the engine's flywheel to the transaxle. The power is transmitted through a driver-operated clutch, which allows for engagement and disengagement of the engine to the transaxle.

The transaxle input shaft receives the power when the clutch is engaged. The transaxle then uses a system of gears to change the speed and torque relationship between the engine crankshaft and the transaxle differential.

The clutch master cylinder trans hydraulic fluid pressure to the clutch slave cylinder, when the clutch pedal is depressed, which in turn moves the clutch release hub and bearing. The clutch hydraulic system uses brake fluid supplied from the brake master cylinder. The clutch is a single-plate, dry-friction disc with a diaphragm-style spring pressure plate. The clutch disc has frictional material where it contacts the flywheel and the clutch pressure plate. The clutch pressure plate applies pressure to the clutch disc, holding it tightly against the surface of the flywheel.

In the engaged position, the clutch pressure plate diaphragm spring holds the clutch pressure plate against the clutch disc, so that the engine torque is transmitted to the input shaft. When the clutch is depressed, movement is transmitted through the clutch hydraulic system.

Inspection and Verification

NOTICE: **If transaxle noise is reported, first check the manual transmission fluid level. The vehicle should not be driven if the manual transmission fluid level is low or damage can occur.**

NOTE: Before attempting to rectify any concerns, road test the vehicle to ascertain in which system the concern falls.

NOTE: If any evaluation or inspection reveals an obvious concern, repair the vehicle.

The technician should have a thorough knowledge of transaxle/clutch operation and accepted general transaxle/clutch guidelines to detect any problems.

A gear-driven unit will produce a certain amount of noise. Some noise is acceptable and audible at certain speeds or under various driving conditions. Certain conditions, such as road and weather, will amplify normal vehicle noise.

The following overview is a guide to diagnose a transaxle/clutch concern:

- Verify and document the customer concern.
    - ♦ During the customer interview, if a leak was noticed or if a leak is the concern, check the manual transmission fluid. The vehicle should not be driven if the manual transmission fluid level is low.
- Check the manual transmission fluid level and condition.
- Evaluation of the clutch hydraulic system.
- Evaluation of the clutch.
- Inspect gearshift mechanism.
- Road test.
- Find the cause of the problem and correct it.

Verify Customer Concern

1. Verify and document the customer concern.
    1. When was it first noticed?
    2. Did it appear suddenly or gradually?
    3. Did anything unusual occur that would coincide with it or precede it?
    4. Identify when the condition occurs:
        - ♦ Hot or cold vehicle operating conditions
        - ♦ Type of terrain
        - ♦ City/highway driving
        - ♦ Driving at a particular speed
            - ♦ coasting
            - ♦ hard acceleration
        - ♦ Shifting
            - ♦ upshifts
            - ♦ downshifts
            - ♦ in a particular gear
            - ♦ in all gears
        - ♦ Hot or cold ambient temperatures
    5. Has the transaxle/clutch been repaired before or components installed?
        - ♦ Check the vehicle service record. Note any repairs.

Check Manual Transmission Fluid Level and Condition

NOTE: The vehicle should not be driven if the manual transmission fluid level is low.

An incorrect manual transmission fluid level may affect the transaxle operation and can result in transaxle damage. To correctly check and add manual transmission fluid to the transaxle, refer to transaxle draining and filling in Section 308-03 .

A low manual transmission fluid level can result in poor transaxle shifting, engagement or damage. It can also indicate a leak in one of the transaxle seals or gaskets.

1. Check the manual transmission fluid condition.
    - Observe the color and the odor of the manual transmission fluid. Allow the manual transmission fluid to drip onto a white cloth and examine the stain. Check the manual transmission fluid for contamination or metal particles.
        - ♦ Manual transmission fluid should appear nearly clear, similar to clean engine oil.

Evaluation of Clutch Hydraulic System

1. Verify that the brake/clutch hydraulic fluid reservoir is filled to the correct level.
    - If the clutch hydraulic fluid level is correct, proceed to clutch check.

- If the rear chamber hydraulic fluid level is low, add fluid as necessary. Check the clutch hydraulic system for leaks and repair as necessary.

Evaluation of the Clutch

1. Depress and release the clutch pedal slowly to check if the pedal is binding. Make sure the clutch pedal can be fully depressed and is not restricted by the floor mat. Verify that the pedal return spring is present and functions correctly.

2. Measure the clutch reserve. With the engine idling, the parking brake on and the clutch pedal up, gently move the gearshift lever toward reverse gear until gear clash can be heard. Depress the clutch pedal slowly.
    - If the gears cease to clash (full disengage at 25.4 to 38.1 mm (1 to 1.5 in) from the floor), then hold the pedal at the point of disengagement and increase engine to 4,000 rpm. The clutch should remain disengaged, clutch OK.
    - Any concerns indicate a worn or damaged clutch. Repair as necessary.

3. With the engine idling, move the gearshift lever into 4th gear. Increase the rpm to 2,000 and slowly release the clutch pedal.
    - If the engine stalls, the clutch is OK.
    - If the engine does not stall, the clutch is slipping. Repair as necessary.

4. Compare the clutch evaluation results with the following table. The following list of conditions are typical faults into which clutch concerns will fall.

Inspect the Gearshift Mechanism

1. Inspect the cables for:
    - signs of damage.
    - broken locks.
    - binding.
    - cables not fully seated or in hold-down brackets.
    - hold-down bracket nuts are loose.
    - correct routing.
    - correct adjustment.
        - ♦ If the concern is a gear(s) cannot be selected, adjust the cables. Refer to Gearshift Cable Adjustment in this section.

2. Inspect the gearshift for:
    - free play in the gearshift lever (must be no more than 5 mm [0.196 in]). This specification is for an absolute or "no load" free play.
        - ♦ If the gearshift lever free play is too great, check the gearshift cables and repair as necessary.
        - ♦ If the gearshift lever free play is OK, adjust the gearshift linkage.

Evaluation of the Transmission

1. During the road test, use the following driving methods to diagnose the problem.
    - Start the engine.
    - Evaluate the noise in NEUTRAL while the vehicle is parked.
        - ♦ Check whether the noise is present with the clutch fully disengaged (pedal fully depressed). Check to see if the pedal pulsates abnormally (for clutch diaphragm finger run out).
        - ♦ Check whether the noise is present with the gearshift in the NEUTRAL position and

the clutch fully engaged (foot off pedal). With the parking brake engaged, move the gearshift towards the 1st gear position. Apply very slight pressure and note if the gear noise level is reduced. (for gear rollover noise).

- ♦ With the clutch fully engaged (foot off pedal), check whether the noise is present as the engine speed is raised. If the noise reduces, note the engine speed at which this occurs.

- Listen for any change in noise while depressing and releasing the clutch pedal.
- Listen for any change in noise while changing the engine rpm.
- Drive the vehicle and shift through all of the gear ranges, including reverse. Listen for any change in noise in a particular gear.
- Drive the vehicle in the gear in which the noise is most noticeable. Depress the clutch pedal and leave the gear engaged. Listen for any change in noise.
- Drive the vehicle in the gear in which the noise is most noticeable. Depress the clutch pedal and shift the transmission into NEUTRAL. Release the clutch pedal and allow the vehicle to coast.

2. Compare the road test results with the following symptom charts. It is a list of conditions that are typical faults into which the transaxle will fall:

GO to Symptom Chart - Clutch Operation , GO to Symptom Chart - Transaxle or GO to Symptom Chart - NVH in this section.

Symptom Chart - Clutch Operation

Symptom Chart - Clutch Operation

Symptom Chart - Transaxle

Symptom Chart - Transaxle

Symptom Chart - NVH

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

ConditionPossible SourcesAction

- Clutch related vibrations

- Engine component grounding against frame
- Accessory drive belt
- Clutch release bearing
- Flywheel bolts

- Flywheel
- Imbalanced clutch pressure plate

- GO to Pinpoint Test B .

- Excessive noise

- Clutch disc damper damaged
- Transaxle input shaft pilot bearing worn or damaged
- Excessive crankshaft end play
- Clutch release bearing worn or damaged
- Clutch pedal
- Clutch slave cylinder

- GO to Pinpoint Test C . REFER to Section 308-01 . INSPECT the clutch disc for damage. INSPECT the transaxle input shaft and the transaxle input shaft pilot bearing for wear and damage. CHECK the crankshaft endplay. Refer to the appropriate section in Group 303 for the procedure. CHECK the clutch release hub and bearing, and guide tube for wear and damage. REPAIR all components as necessary. TEST the system for normal operation.

- Clutch rattling noise - occurs with clutch engaged, noise changes/disappears with clutch pedal depressed

- Flywheel bolts, clutch housing bolts or clutch pressure plate bolts loe

- CHECK the bolts for damage. TIGHTEN the bolts to specifications. REFER to Section 308-01 .

- Clutch squeaking noise - noise is heard when the clutch is operated. Vehicle moves slowly or creeps when the clutch is disengaged. Can also be difficult to shift into 1st and REVERSE gears

- Pilot bearing seized or damaged

- INSPECT the transaxle pilot bearing for wear or damage. REPAIR as necessary. REFER to Section 308-01 .

- Clutch squeaking noise - occurs with clutch pedal depressed/released

- Worn clutch pedal shaft or bushings

- INSPECT the clutch pedal for wear or damage. REPAIR as necessary. REFER to Section 308-02 .

- Worn, damaged or misaligned clutch release bearing

- INSPECT the clutch release bearing for wear or damage. REPAIR as necessary. REFER to Section 308-01 .

- Clutch grating/grinding noise - occurs when clutch pedal is depressed

- Clutch pressure plate fingers bent or worn

- INSPECT the clutch pressure plate release fingers. INSTALL a new pressure plate as necessary. REFER to Section 308-01 .

- Contact surface of clutch release bearing worn or damaged

- INSPECT the clutch release bearing. REPAIR as necessary. REFER to Section 308-01 .
- Clutchtter - a small amount of noise when clutch pedal is released at initial take off
- Clutch engagement
- Acceptable operating condition.
- Clutch chatter/grabs - in some cases a shudder is felt. Occurs with clutch pedal depressed/released
- Damaged or worn powertrain/driveline mounts
- INSPECT the powertrain/drivetrain mounts. INSTALL new mounts as necessary. Refer to the appropriate section in Group 303 for the procedure.
- Binding or dragging plunger of the clutch master cylinder or slave cylinder
- CHECK the master and slave cylinder operation. INSPECT the components for damage or wear. INSTALL a new master or slave cylinder as necessary. REFER to Section 308-02 .
- Grease or oil on the clutch disc facing
- CHECK the input shaft seal and rear main oil seal. REPAIR as necessary. INSTALL a new clutch disc. REFER to Section 308-01 .
- Clutch disc surface glazed or damaged
- INSPECT the clutch disc surface for a glazed, hardened or damage condition. CARRY OUT a clutch disc check. INSTALL a new clutch disc as necessary. REFER to Section 308-01 .
- Damaged or worn clutch pressure plate
- INSPECT the clutch pressure plate for wear or damage. INSTALL a new clutch pressure plate as necessary. REFER to Section 308-01 .
- Flywheel surface damaged or glazed
- INSPECT the flywheel for damage or wear. CARRY OUT a flywheel runout check. INSTALL a new flywheel as necessary. Refer to the appropriate section in Group 303 for the procedure.
- Clutch chatter noise - noise when clutch pedal is released at initial take off. Clutch is hard to engage and disengage
- Pilot bearing worn, damaged or not correctly aligned in bore
- INSPECT the clutch pressure plate release fingers for uneven wear, clutch components burnt or a seized pilot bearing. INSTALL a new pilot bearing as necessary. REFER to Section 308-01 .
- Transaxle rattling/clattering noise - occurs in NEUTRAL or in gear, at idle
- Incorrect manual transmission fluid level or fluid quality
- CHECK that the transaxle is filled to the correct level and with the specified manual transmission fluid. REFER to Section 308-03 for the manual transmission fluid type.

- Transaxle rattling/clattering noise - noise at idle in NEUTRAL
- Wornugh reverse idler gear
- CHECK the reverse idler gear. REPAIR as necessary. REFER to Section 308-03 .
- Excessive backlash in gears
- CHECK the gear backlash. ADJUST as necessary. REFER to Section 308-03 .
- Worn countershaft gears
- REPAIR as necessary. REFER to Section 308-03 .
- Transaxle whine - a mild whine at extreme speeds or high rpm
- Rotating gears/geartrain
- Acceptable noise.
- Transaxle whine - a high pitched whine, also described as a squeal
- Transaxle gears are worn (hmileage vehicle)
- Result of normal gear wear. REPAIR as necessary. REFER to Section 308-03 .
- Mismatched gear sets
- INSPECT the gear sets for an uneven wear pattern on the face of the gear teeth. REPAIR as necessary. REFER to Section 308-03 .
- Damaged or worn transaxle bearing
- INSPECT the transaxle bearings. INSTALL new bearings as necessary. REFER to Section 308-03 .
- Transaxle growling/humming - noise occurs in the forward gears. The noise is more prominent when the gear is loaded. The problem gear can be located as the noise occurs in a specific gear position
- Gear is cracked, chipped or rough

INSPECT the transaxle gears for damage or wear. INSTALL new gears as necessary. REFER to Section 308-03 .

- Transaxle hissing - noise in NEUTRAL or in forward gears. As bearings wear or break up, the noise changes to a thumping noise
- Damaged or worn bearings
- INSPECT the transaxle bearings. INSTALL new bearings as necessary. REFER to Section 308-03 .
- Transaxle knocking/thudding - noise at low speeds in forward gears
- Bearings with damaged balls or rollers or with pitted and spalled races

- INSPECT the transaxle bearings. INSTALL new bearings as necessary. REFER to Section 308-03 .
- Transaxle rumble/growl - noise at all speeds in forward gears, monounced in a heavy acceleration condition
- Damaged or worn transaxle bearing or gears (high mileage vehicles)
- CHECK manual transmission fluid for excessive metal particles. REPAIR as necessary.

Pinpoint Tests

Pinpoint Test A: Clutch Pedal Pulsation

Normal Operation

Clutch pedal feel should be smooth when disengaging and engaging the clutch. Clutch pedal movement is transmitted by hydraulic fluid pressure, which actuates the clutch release fork and bearing. The clutch release fork and bearing pushes on the spring center towards the flywheel. The diaphragm spring pivots at the fulcrum, relieving the load on the clutch pressure plate. Steel spring straps riveted in the clutch pressure plate cover pull the clutch pressure plate from the clutch disc, disengaging the engine torque from the transmission.

This pinpoint test is intended to diagnose the following:
- Clutch disc
- Clutch pressure plate
- Flywheel

PINPOINT TEST A: CLUTCH PEDAL PULSATION

Test Step	Result / Action to Take
A1 CHECK THE CLUTCH PEDAL PULSATION	
• Start the engine. • With the transmission in NEUTRAL, slowly press the clutch pedal. • **Does the clutch pedal pulsate while being pressed?**	**Yes** GO to A2 . **No** VERIFY customer concern.
A2 INSPECT THE PRESSURE PLATE BOLTS	
• Inspect the pressure plate-to-flywheel bolts. • **Are any of the pressure plate-to-flywheel bolts loose?**	**Yes** TIGHTEN or INSTALL new bolts. REFER to Section 308-01 . TEST the system for normal operation. **No** GO to A3 .
A3 INSPECT THE CLUTCH PRESSURE PLATE	

• Remove the clutch pressure plate. Refer to Section 308-01 . • Inspect the clutch pressure plate for wear or damage. • **Are there any signs of damage present on the clutch pressure plate?**	**Yes** INSTALL a new clutch pressure plate. REFER to Section 308-01 . TEST the system for normal operation. **No** GO to A4 .
A4 INSPECT THE CLUTCH DISC	
• Check the clutch disc for wear or damage. • **Is the clutch disc OK?**	**Yes** GO to A5 . **No** INSTALL a new clutch disc. REFER to Section 308-01 . TEST the system for normal operation.
A5 INSPECT THE FLYWHEEL	
• Inspect the flywheel for wear or damage. • **Is flywheel OK?**	**Yes** VERIFY customer concern. **No** TIGHTEN or INSTALL a new flywheel as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation.

Pinpoint Test B: Clutch Related Vibrations

Normal Operation

The clutch is designed to transfer the power from the engine to the transmission, which may be either stationary (starting) or rotating at a different speed (upshifting or downshifting). The clutch is functioning correctly when both the engine and transmission are rotating at the same speed with the clutch engaged and no vibrations are felt.

This pinpoint test is intended to diagnose the following:

- Engine components
- Accessory drive component
- Clutch release bearing
- Flywheel

PINPOINT TEST B: CLUTCH RELATED VIBRATIONS

Test Step	Result / Action to Take
B1 CHECK FOR ENGINE COMPONENT GROUNDING	
• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02 . • Check the engine mount interlocks for grounding.	**Yes** REPAIR any components as necessary. **No** GO to B2 .

• Check for the exhaust manifold or other engine components grounding on the body or frame. • **Is there evidence of grounding on the body or frame?**	
B2 CHECK FOR ACCESSORY DRIVE VIBRATIONS	
• Ignition OFF. • Remove the accessory drive belt and check for vibration. • Start the engine. • **Does the vibration stop when the accessory drive belts are removed from the engine?**	**Yes** REFER to Section 303-05A to diagnose the accessory drive belt components. **No** INSTALL the accessory drive belt. GO to B3 .
B3 CHECK FOR RELEASE BEARING NOISE	
• Start the engine. • Press and hold the clutch pedal but do not disengage the clutch. • **Is a whirring, grating or grinding noise present only when the pedal is pushed?**	**Yes** INSTALL a new clutch release bearing. REFER to Section 308-01 . **No** GO to B4 .
B4 INSPECT THE FLYWHEEL	
• Remove the clutch disc and pressure plate. Refer to Section 308-01 . • Inspect for loose flywheel bolts. • Check for an excessively burnt or severely cracked contact surface. • Inspect the flywheel runout. Refer to Flywheel Runout Check in this section. • **Is the flywheel OK?**	**Yes** GO to B5 . **No** TIGHTEN or INSTALL a new flywheel. Refer to the appropriate section in Group 303 for the procedure.
B5 CHECK FOR PRESSURE PLATE IMBALANCE	
• ***NOTICE:*** **Failure to support the engine correctly could result in damage to the vehicle.** • Support the engine securely. • Operate the engine with the transaxle removed. • **Is the vibration still present?**	**Yes** REFER to Section 100-04 to diagnose the engine vibration concern. **No** INSTALL a new clutch pressure plate. REFER to Section 308-01 .

Pinpoint Test C: Excessive Noise

Normal Operation

The manual transaxle is controlled by a floor-mounted gearshift lever located in the floor console. Connection between the floor-mounted gearshift lever and the manual transaxle shift control lever assembly is made through 2 gearshift cables.

When the operator moves the floor-mounted gearshift lever, that movement is transmitted through 2 gearshift

cables routed through the body to the transaxle. The 2 gearshift cables are attached to the transaxle at the transaxle shift control lever assembly. The transaxle shift control lever assembly transfers the movement of the gearshift cables to the shift rods and shift forks located inside the transaxle.

The clutch is designed to transfer the power from the engine to the transmission, which may be either stationary (starting) or rotating at a different speed (upshifting or downshifting). The clutch is functioning correctly when both the engine and transmission are rotating at the same speed with the clutch engaged. Clutch pedal movement is transmitted by hydraulic fluid pressure, which actuates the clutch release hub and bearing. The clutch release hub and bearing pushes on the spring center towards the flywheel. The diaphragm spring pivots at the fulcrum, relieving the load on the clutch pressure plate. Steel spring straps riveted in the clutch pressure plate cover pull the clutch pressure plate from the clutch disc, disengaging the engine torque from the transmission.

This pinpoint test is intended to diagnose the following:

- Internal transaxle components
- Clutch pedal
- Clutch slave cylinder
- Clutch pressure plate
- Clutch disc

PINPOINT TEST C: EXCESSIVE NOISE

Test Step	Result / Action to Take
C1 TRANSAXLE NEUTRAL GEAR ROLLOVER TEST	
• Start the engine and let it idle. • **NOTE:** With the clutch pedal fully pressed, the input shaft should stop rotating. • Press the clutch pedal. • **Does the noise stop when the clutch pedal is pressed?**	**Yes** REFER to Section 308-03 for transaxle concerns. **No** GO to C2 .
C2 CHECK THE CLUTCH PEDAL FREE PLAY	
• Press the clutch pedal lightly by hand. • Measure the distance the clutch pedal travels. • **Is the clutch pedal travel within 1-3 mm (0.039-0.118 in)?**	**Yes** GO to C3 . **No** ADJUST clutch pedal freeplay. REFER to Clutch Pedal Freeplay Adjustment in this section.
C3 CHECK THE CLUTCH SLAVE CYLINDER	
• Inspect the clutch slave cylinder for wear or loss of lubrication. • **Are there signs of wear or loss of lubrication?**	**Yes** INSTALL a new clutch slave cylinder. REFER to Section 308-02 . **No** GO to C4 .
C4 CHECK THE CLUTCH PRESSURE PLATE	
• Inspect the clutch pressure plate for damage or	**Yes** INSTALL a new clutch pressure plate.

material between the pressure plate and flywheel. • **Are there signs of damage?**	REFER to Section 308-02 . **No** GO to C5 .
C5 CHECK CLUTCH PEDAL SWITCHES	
• Inspect clutch pedal switches for damage or incorrect installation. • **Are there any signs of damage or incorrect installation?**	**Yes** REPLACE or REINSTALL clutch pedal switches as necessary. **No** REFER to Section 308-03 for transaxle concerns.

Pinpoint Test D: Clutch System Leakage

Normal Operation

Clutch pedal movement is transmitted to the clutch by hydraulic fluid pressure from the master cylinder reservoir through the hydraulic clutch tubes to the slave cylinder. This actuates the clutch release fork and bearing. The clutch release fork and bearing pushes on the spring center towards the flywheel. The diaphragm spring pivots at the fulcrum, relieving the load on the clutch pressure plate. Steel spring straps riveted in the clutch pressure plate cover pull the clutch pressure plate from the clutch disc, disengaging the engine torque from the transmission.

This pinpoint test is intended to diagnose the following:

- Clutch master cylinder
- Clutch slave cylinder
- Hydraulic tubes

PINPOINT TEST D: CLUTCH SYSTEM LEAKAGE

Test Step	Result / Action to Take
D1 INSPECT THE CLUTCH MASTER CYLINDER	
• Inspect clutch master cylinder for leakage. • **Is the clutch master cylinder OK?**	**Yes** GO to D2 . **No** REPAIR or INSTALL a new clutch master cylinder as necessary. REFER to Section 308-02 .
D2 INSPECT THE CLUTCH SLAVE CYLINDER	
• Inspect clutch slave cylinder for leaks. • **Is the clutch slave cylinder OK?**	**Yes** GO to D3 . **No** REPAIR or INSTALL a new clutch slave cylinder as necessary. REFER to Section 308-02 .
D3 INSPECT THE SYSTEM HYDRAULIC TUBES	
	Yes

• Inspect clutch hydraulic tubes for loose or damaged fittings causing leakage. • **Are the clutch hydraulic tubes OK?**	CARRY OUT a road test to VERIFY customer complaint. **No** REPAIR or INSTALL new components as necessary. TEST the clutch system for normal operation.

Component Tests

Clutch Slippage

1. Chock the wheels.

2. Apply the parking brake.

3. Depress and release the clutch pedal slowly to check if the pedal is binding.
   - If the clutch pedal is not binding, proceed to the next step of this procedure.
   - If the clutch pedal is binding, inspect and repair as necessary. Test the system for normal operation. Proceed to the next step in this procedure, if necessary.

4. Depress the clutch pedal.

5. Start the engine.

6. Shift the transmission to 4th gear.

7. Increase engine rpm to 2,000 and slowly release the clutch pedal. If the engine stalls within 5 seconds, the clutch is not slipping.
   - If the clutch is slipping, remove the clutch disc and pressure plate. Refer to Section 308-01 . Inspect the clutch disc and pressure plate for wear or damage. Inspect the flywheel for glazing and damage. Check the clutch release hub and bearing for binding and inspect the guide tube. Inspect the input shaft for wear and damage. Repair all components as necessary.

Clutch Chatter or Shudder

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

2. Inspect the engine and transmission mounts for looseness and damage.
   - If the mounts are OK, proceed to the next step in this procedure.
   - If the mounts are loose or damaged, tighten or install new mounts as necessary. Test the system for normal operation.

3. Check for loose bolts that retain the clutch pressure plate to the flywheel.
   - If the bolts are tightened to specification proceed to the next step in this procedure.
   - If the bolts are loose, tighten the bolts to specification. Refer to Section 308-01 . Test the system for normal operation.

4. Remove the clutch disc and pressure plate. Refer to Section 308-01 . Inspect the clutch disc and pressure plate for wear and damage, and check the clutch disc runout. Refer to Clutch Disc Check in this section. Inspect the flywheel for glazing and damage. Refer to Flywheel Runout Check in this section. Inspect the input shaft for wear, damage and eccentricity. Repair all components as necessary.

Clutch Drag

1. Verify that the clutch hydraulic fluid reservoir is filled to the correct level.
    - If the fluid level is correct, proceed to the next step in this procedure.
    - If the fluid level is low, add fluid as necessary. Inspect the clutch hydraulic system for leaks and repair as necessary. Refer to Section 308-02 . Test the system for normal operation.

2. Depress and release the clutch pedal to check for a spongy pedal.
    - If the pedal feels OK, proceed to the next step in this procedure.
    - If the pedal feels spongy, bleed the clutch hydraulic system. Refer to Clutch System Bleeding in this section. Test the system for normal operation.

3. Remove the clutch disc and pressure plate. Refer to Section 308-01 . Inspect the clutch disc and pressure plate for wear and damage, and check the clutch disc runout. Refer to Clutch Disc Check in this section. Repair all components as necessary.

Hard Shifting

1. Verify that the clutch hydraulic fluid reservoir is filled to the correct level.
    - If the fluid level is correct, proceed to the next step in this procedure.
    - If the fluid level is low, add fluid as necessary. Check the clutch baldric system for leaks, and repair as necessary. Refer to Section 308-02 . Test the system for normal operation.

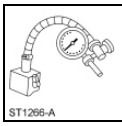
2. Depress and release the clutch pedal to check for a spongy pedal.
    - If the pedal feels OK, proceed to the next step in this procedure.
    - If the pedal feel spongy, bleed the clutch hydraulic system. Refer to Clutch System Bleeding in this section. Test the system for normal operation.

3. Remove the clutch disc and pressure plate. Refer to Section 308-01 . Inspect the clutch disc and pressure plate for wear or damage. Refer to Clutch Disc Check in this section. Check the clutch release hub and bearing for binding and inspect the guide tube. Inspect the input shaft for wear and damage. If all of the components are OK, proceed to the next step in this procedure. Otherwise, repair all components as necessary. Test the system for normal operation.

4. Inspect the transmission housing, shafts, forks and synchronizer assemblies. Refer to Section 308-03 . Repair all components as necessary.

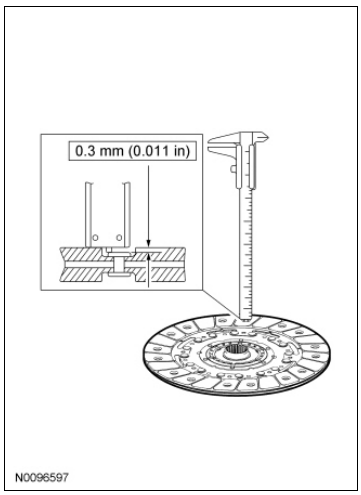
Clutch Disc Check

Special Tool(s)

 ST1266-A	Dial Indicator Gauge with Holding Fixture 100-D002 (D78P-4201-B) or equivalent

1. Check the clutch disc lining surface for hardening, the presence of oil or grease.

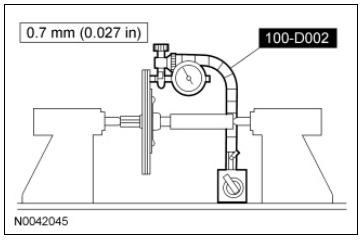
2. Check for a worn clutch disc lining. Measure the minimum allowable depth to the rivet heads with a slide caliper.
   - If the measurement is less than the minimum, install a new clutch disc.



3. Check for loose clutch disc lining rivets.
   - Install a new clutch disc as necessary.

4. Check the clutch disc for cracking, scoring, discoloration or other surface marks.
   - Install a new clutch disc if necessary.

5. Using the Dial Indicator Gauge with Holding Fixture, check the maximum allowable runout of the clutch disc.
   - If the runout exceeds the maximum, install a new clutch disc.

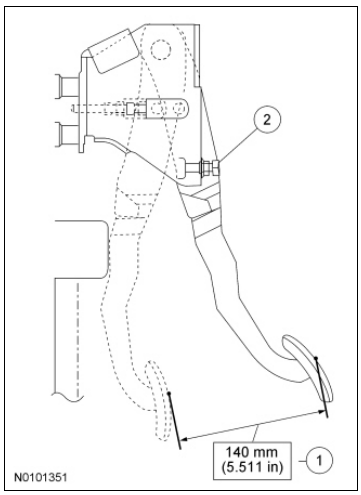


6. Use an emery cloth to remove minor imperfections in the clutch disc lining surface.

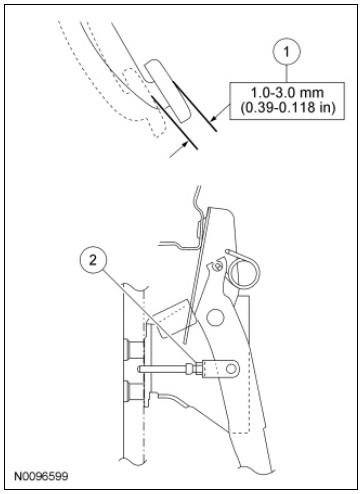
7. Check for wear or rust on the splines. If necessary, clean them with an emery cloth.

Clutch Pedal Freeplay Adjustment

1. Measure the clutch pedal travel.
    1. If the measurement is not within specification, turn the clutch pedal adjustment bolt as necessary.
    2. Tighten the clutch pedal locknut to 15 Nm (133 lb-in).
        - Recheck the measurement.



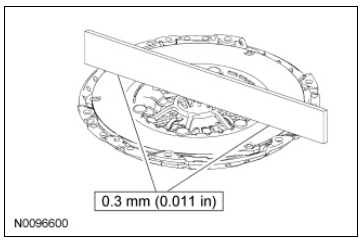
2. Measure clutch pedal free play.
    1. Depress the clutch pedal by hand until the push rod contacts the clutch master cylinder piston.
    2. If the measurement is not within specification, loosen the locknut and turn the push rod as necessary. Tighten the clutch pedal locknut to 15 Nm (133 lb-in).
        - Recheck the measurement.



Clutch Pressure Plate Check

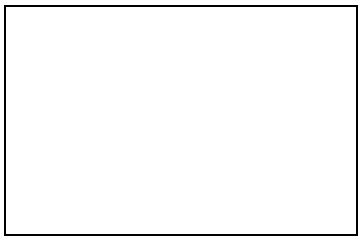
1. Check the clutch pressure plate surface for scoring, cracks or discoloration.
   - Minor scratches or discoloration should be removed with a fine emery cloth.

2. Measure the flatness of the clutch pressure plate surface with a straightedge and a feeler gauge.
   - Install a new pressure plate as necessary.



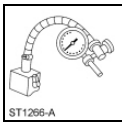
3. Check the diaphragm spring fingers for discoloration, scoring and bent or broken segments.

4. Measure the wear of the diaphragm spring fingers.
   - Install a new pressure plate as necessary.

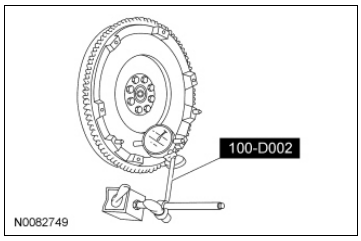


Flywheel Runout Check

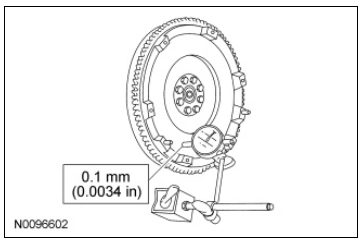
Special Tool(s)

 ST1266-A	Dial Indicator Gauge with Holding Fixture 100-D002 (D78P-4201-B) or equivalent

1. Mount the Dial Indicator Gauge with Holding Fixture so that the Dial Indicator Gauge contact point rides on the clutch disc contact surface.



2. Rotate the flywheel and check the runout.
   - If the runout exceeds the maximum runout 0.076 mm (0.0034 in), install a new flywheel.



Clutch System Bleeding

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

⚠ WARNING: Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTICE: **Brake fluid is harmful to ted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with cold water.**

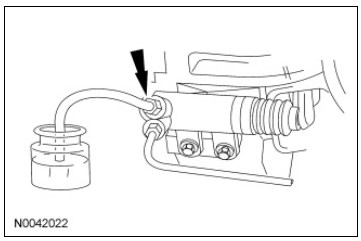
NOTE: When any part of the hydraulic system has been disconnected for repair or new installation, air may get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

1. **NOTE:** Make sure the brake fluid reservoir is to the MAX mark before bleeding the clutch system. Do not allow the fluid level to drop below 6 mm (0.236 in) of the MAX mark.

   Attach a rubber drain hose to the bleeder screw and submerge the free end of the hose in a container partially filled with clean brake fluid.

2. Press the clutch pedal slowly to the floor.

3. With the clutch pedal held to the floor, loosen the bleeder screw until fluid and air are expelled from the system.

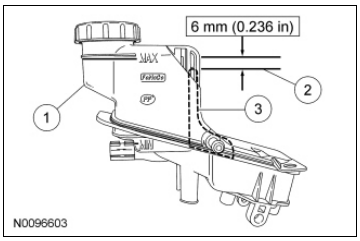


4. With the clutch pedal held to the floor, tighten the bleeder screw.

5. ***NOTICE:*** **The clutch hydraulic system fluid is separated from the brake system fluid by a separate reservoir within the brake reservoir. Do not allow the clutch hydraulic system fluid level in the reservoir to fall more than 6 mm (0.236 in) below the MAX mark during the bleeding operation or fluid supply to the clutch release system will be starved, allowing air to enter the clutch master cylinder. Keep the brake master cylinder reservoir filled with clean,**

specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

Repeat Steps 2 through 4 until no air bubbles appear in the fluid.



Item	Part Number	Description
1	-	Brake fluid reservoir
2	-	Minimum fluid level for clutch reservoir to fill
3	-	Inner clutch fluid reservoir

6. Tighten the bleeder screw.
    - Tighten to 7 Nm (62 lb-in).

7. Fill the brake reservoir.

8. Check system for normal operation.

Gearshift Cable Adjustment

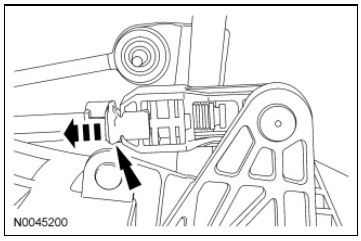
1. Set the parking brake.

2. Place the gearshift in neutral.

3. Remove the gearshift knob and the floor console finish panel.

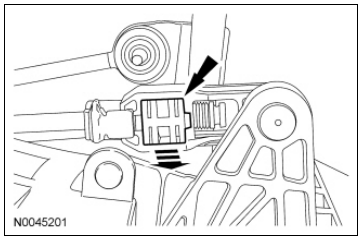
4. **NOTE:** Console removed for clarity.

   Disengage the safety lock by sliding it away from the shifter ball stud.

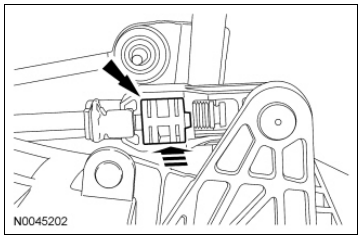


5. **NOTE:** If the cable lock is difficult to slide out, disconnect the shift cable from the stud, push the lock from the rear and reattach the shift cable to the ball stud.

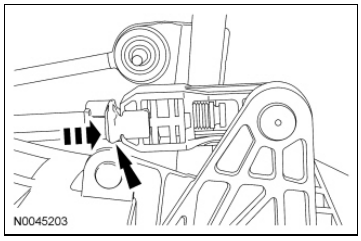
   Disengage the cable lock by sliding it out from the shift cable end fitting.



6. Allow the gearshift lever to center itself. With the shifter and the transmission in NEUTRAL, push the cable lock onto the cable.



7. Engage the safety lock by sliding it over the primary shift cable lock.



8. Check for normal operation.

Material

Item	Specification	Fill Capacity
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	-

General Specifications

Item	Specification
Diaphragm spring finger misalignment	0.6 mm (0.023 in) maximum

Torque Specifications

Description	Nm	lb-ft
Clutch pressure plate bolts [a]	-	-

[a] Refer to the procedure in this section.

Clutch

The clutch system includes the following components:

- Flywheel
- Clutch disc
- Clutch pressure plate
- Clutch release fork
- Clutch release bearing
- Clutch slave cylinder

The clutch is a single-plate, dry-friction disc with a diaphragm-style spring clutch pressure plate. The clutch disc has a hub which is splined to the transmission input shaft. The clutch disc has friction material where it contacts the flywheel and the clutch pressure plate. The clutch pressure plate applies pressure to the clutch disc, holding it tightly against the surface of the flywheel. In the engaged position, the diaphragm spring holds the clutch pressure plate against the clutch disc, so that engine torque is transmitted to the input shaft.

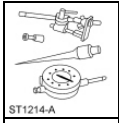
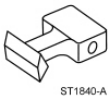
When the clutch pedal is applied, the release bearing pushes the diaphragm spring center of the clutch pressure plate toward the flywheel. The diaphragm spring pivots at the fulcrum, relieving the load on the clutch pressure plate. The clutch slave cylinder assists in the effort it takes to relieve the load on the clutch pressure plate. Steel spring straps riveted to the clutch pressure plate cover pull the clutch pressure plate from the clutch disc, disengaging the engine torque from the transaxle.

Clutch

Refer to Section 308-00 .

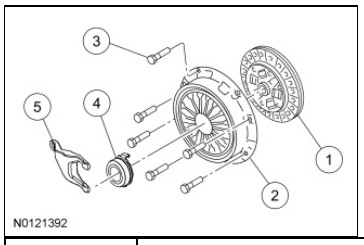
Clutch Disc and Pressure Plate

Special Tool(s)

 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002
 ST1840-A	Flywheel Holding Tool 303-103 (T74P-6375-A)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



Item	Part Number	Description
1	7550	Clutch disc
2	7563	Clutch pressure plate
3	-	Clutch pressure plate bolt (6 required)
4	7548	Clutch release bearing
5	7515	Clutch release fork

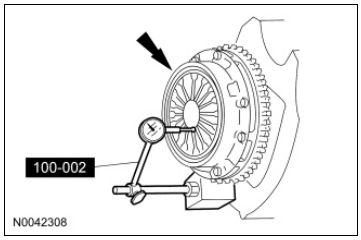
Removal

⚠ WARNING: Do not breathe dust or use compressed air to blow dust from storage containers or friction components. Remove dust using government-approved techniques. Friction component dust may be a cancer and lung disease hazard. Exposure to potentially hazardous components may occur if dusts are created during repair of friction components, such as brake pads and clutch discs. Exposure may also cause irritation to skin, eyes and respiratory tract, and may cause allergic reactions and/or may lead to other chronic health effects. If irritation persists, seek medical attention or advice. Failure to follow these instructions may result in serious personal injury.

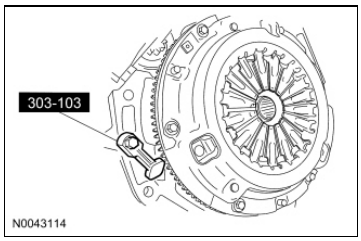
Clutch disc and clutch pressure plate

1. Remove the transaxle. For additional information, refer to Section 308-03 .

2. Inspect the clutch pressure plate.
   - Check the diaphragm spring fingers for discoloration, scoring, bent or broken segments.
   - Using the Dial Indicator Gauge with Holding Fixture, rotate the flywheel and check for sprg ends that are higher or lower than the rest.
     - ♦ The specification is 0.6 mm (0.023 in) maximum.

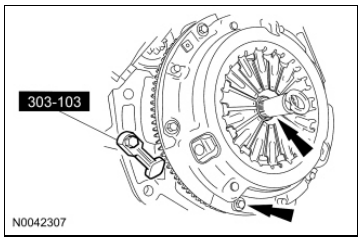


3. Using the Flywheel Holding Tool, lock the flywheel to the engine.



4. **NOTE:** Loosen each bolt, one turn at a time in a star pattern, until spring tension is released.

   Using a suitable clutch disc aligner, remove the bolts, the clutch pressure plate and the clutch disc.



5. **NOTE:** Do not immerse the clutch pressure plate in solvent.

   Using a suitable cleaning solution, clean the clutch pressure plate.

6. Inspect the clutch pressure plate surface for burn marks, scores, flatness, ridges or cracks. For additional information, refer to Section 308-00 .
   - Maximum clearance for flatness check is 0.3 mm (0.011 in).

7. ***NOTICE:*** **If the clutch disc is saturated with oil, inspect the rear engine crankshaft seal or transmission input shaft seal for leakage. If leakage is found, install a new seal prior to clutch disc installation. For additional information, refer to Section 303-01A or Section 308-03 .**

   NOTE: Use an emery cloth to remove minor imperfections in the clutch disc lining surface.

   Inspect the clutch disc for the following:

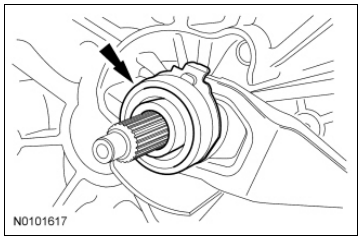
- Oil or grease saturation
- Worn or loose facings
- Warpage or loose rivets at the hub
- Wear or rust on the splines
- Install a new clutch disc if any of these conditions are present.

8. Check the clutch disc runout. For additional information, refer to Clutch Disc Check in Section 308-00 .

9. If necessary, conduct a Flywheel Runout Check. For additional information, refer to Section 308-00 .

Clutch release bearing and clutch release fork

10. Remove the clutch release bearing.

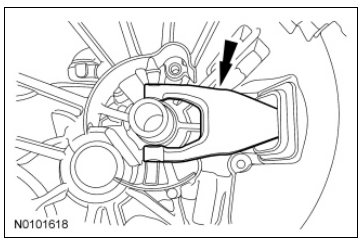


11. Inspect the clutch release bearing for wear or damage.
    - Rotate the bearing while applying pressure in the axial direction. If the bearing feels rough, sticks or has excessive resistance, install a new bearing.



12. Inspect the release bearing guide tube for wear or damage.
    - Slide the release bearing on the guide tube. Check for roughness or sticking.

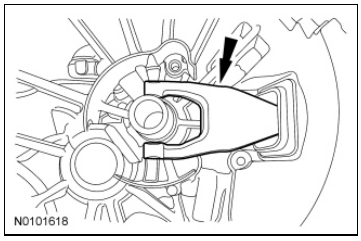
13. Remove the clutch release fork. Inspect the fork for wear or damage.



Installation

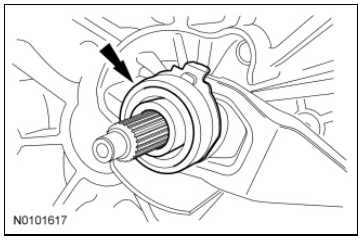
Clutch release bearing and clutch release fork

1. Install the clutch release fork.



2. Check for roughness or sticking. If the bearing feels rough, sticks or has excessive resistance, install a new bearing. Slide the release bearing on the guide tube.

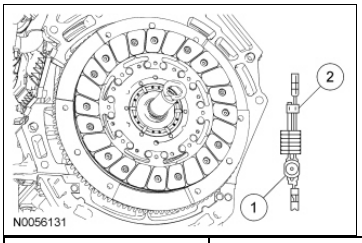
3. Install the clutch release bearing.



Clutch disc and clutch pressure plate

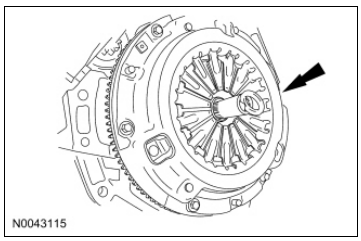
4. Apply a very small amount of grease in the clutch disc hub. Wipe off excess grease to avoid contaminating the clutch disc and affecting clutch function.

5. Using a suitable clutch disc aligner, position the clutch disc on the flywheel.



Item	Part Number	Description
1	-	Transaxle side
2	-	Engine side

6. Position the clutch pressure plate on the flywheel and to the dowels. Install the 6 clutch pressure plate bolts.
    - Tighten the bolts one turn at a time in a star pattern. Tighten to 29 Nm (21 lb-ft).



7. Apply a small amount of grease to:
    - the clutch release fork fingers.
    - the clutch release fork spring.
    - the guide tube.
    - the clutch slave cylinder end that contacts the release fork.

8. **NOTE:** Apply a very small amount of grease to the transmission input shaft end and on the splines.

   Install the transaxle. For additional information, refer to Section 308-03 .

9. If the clutch was replaced, use the scan tool to perfohe Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

Pilot Bearing

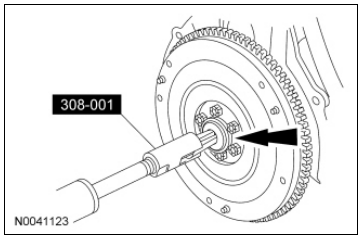
Special Tool(s)

 ST1470-A	Installer, Pilot Bearing 308-105 (T85T-7137-A)
 ST1282-A	Remover, Pilot Bearing 308-001 (T58L-101-B)

Removal

1. Remove the clutch disc and pressure plate. For additional information, refer to Clutch Disc and Pressure Plate in this section.

2. Using the Pilot Bearing Remover, remove the pilot bearing.

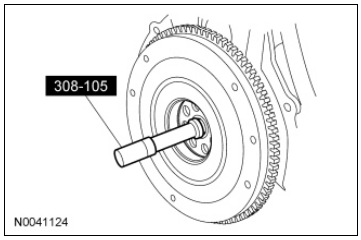


3. Inspect the pilot bearing for:
   - misalignment and looseness in the flywheel.
   - needle rollers for scoring, worn or broken needle rollers, inadequate grease or discoloration.
   - seal leakage.

Installation

1. **NOTE:** The pilot bearing can only be installed with the seal facing the transmission. The pilot bearing is pregreased and does not require additional lubrication. A new pilot bearing must be installed whenever it is removed.

   Using a soft-face hammer and the Pilot Bearing Installer, install the pilot bearing.



2. Install the clutch disc and pressure plate. For additional information, refer to Clutch Disc and Pressure

Plate in this section.

Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	-
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	-

Torque Specifications

Description	Nm	lb-ft	lb-in
Clutch hydraulic tube nut	17	-	150
Clutch master cylinder nuts	21	15	-
Clutch pedal bracket nut	21	15	-
Clutch pedal locknut	10	-	89
Clutch slave cylinder bolts	19	-	168
PCM bolts	10	-	89
PCM bracket nuts	10	-	89

Clutch Controls

The clutch controls system consists of the following components:

- Clutch pedal
- Clutch master cylinder
- Clutch slave cylinder
- Clutch hydraulic fluid tube
- Clutch release fork
- Clutch release bearing

When the clutch pedal is applied, the clutch master cylinder transmits hydraulic fluid pressure to the clutch slave cylinder. The clutch slave cylinder and the clutch release fork transfer the clutch pedal motion to the clutch release bearing. The release bearing presses against the pressure plate diaphragm spring, releasing the clutch disc.

The clutch master cylinder uses brake fluid and shares a common reservoir with the brake master cylinder.

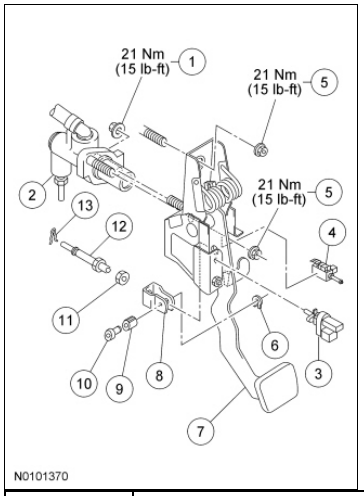
Clutch Controls

For diagnosis and testing of the clutch controls, refer to Section 308-00 .

Clutch Pedal

Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B

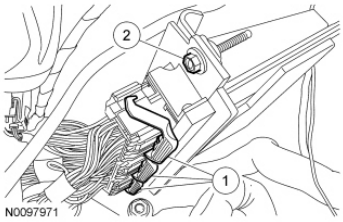


Item	Part Number	Description
1	-	Clutch master cylinder nut (2 required)
2	7A543	Clutch master cylinder
3	-	Clutch switch (cruise control cancel)
4	11A152	Clutch Pedal Position (CPP) switch
5	-	Clutch pedal bracket nuts
6	-	Retaining clip
7	-	Clutch pedal and bracket assembly
8	-	Master cylinder push rod clevis
9	-	Clevis bushing
10	-	Clevis pin
11	-	Clutch pedal locknut
12	-	Master cylinder push rod
13	-	Retaining clip

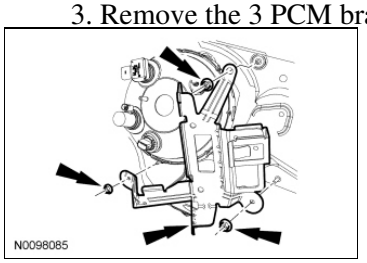
Removal

1. Remove the battery and the battery tray. For additional information, refer to Section 414-01 .
2. Remove the PCM.
    1. Disconnect the electrical connectors.

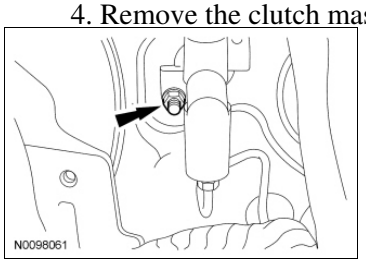
2. Remove the 2 PCM bolts.



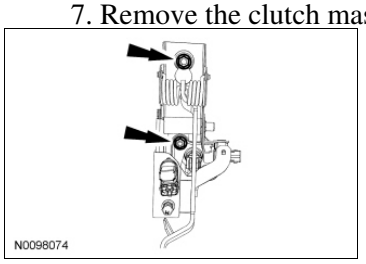
3. Remove the 3 PCM bracket nuts and the bracket.



4. Remove the clutch master cylinder nut.



5. Working under the instrument panel, disconnect the clutch switch (cruise control cancel) electrical connector.
6. Disconnect the Clutch Pedal Position (CPP) electrical connector.
7. Remove the clutch master cylinder nut and the clutch pedal bracket nut.



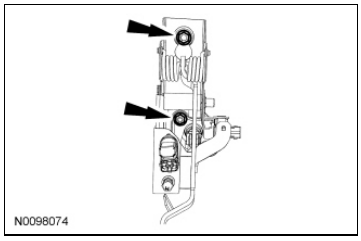
8. Remove the clutch pedal and bracket assembly.

Installation

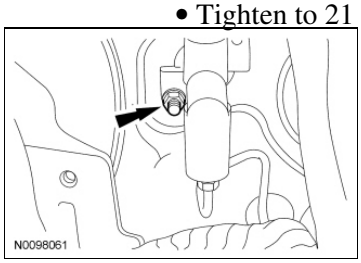
1. **NOTE:** Make sure to align the push rod into the clutch master cylinder piston as the pedal assembly is installed.

   Install the clutch pedal and bracket assembly

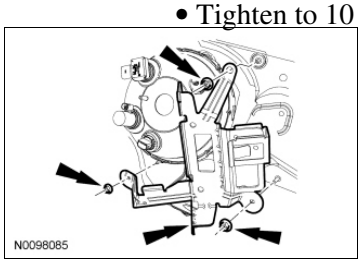
   - Apply a small amount of grease to the:
     - clevis bushing.
     - end of the clutch switch.
     - end of the master cylinder push rod.
2. Working under the instrument panel, connect the clutch switch (cruise control cancel) electrical connector.
3. Install the clutch master cylinder nut and the clutch pedal bracket nut.
   - Tighten to 21 Nm (15 lb-ft).



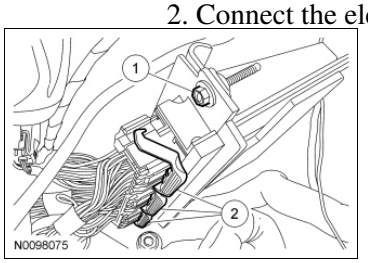
4. Connect the CPP electrical connector.
5. Install the clutch master cylinder nut.
    - Tighten to 21 Nm (15 lb-ft).



6. Install the PCM bracket and the 3 PCM bracket nuts.
    - Tighten to 10 Nm (89 lb-in).



7. Install the PCM.
    1. Install the 2 PCM bolts.
        - Tighten to 10 Nm (89 lb-in).
    2. Connect the electrical connectors.

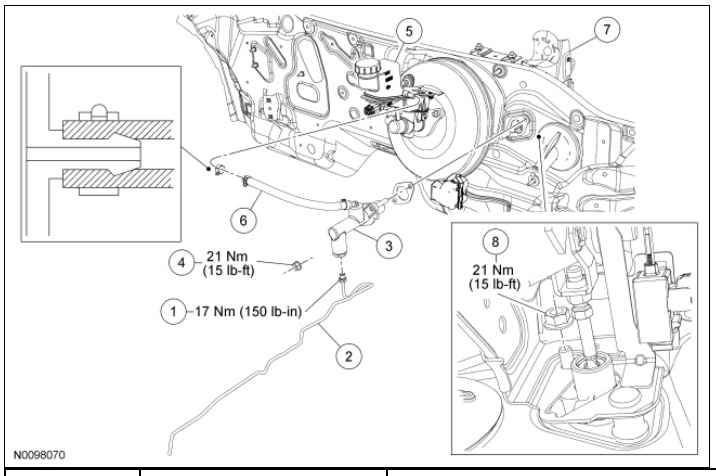


8. Install the battery tray and the battery. For additional information, refer to Section 414-01 .

Clutch Master Cylinder

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



Item	Part Number	Description
1	-	Clutch hydraulic tube nut
2	-	Clutch hydraulic tube
3	7A543	Clutch master cylinder
4	-	Clutch master cylinder nut
5	2K478	Clutch system reservoir
6	-	Clutch master cylinder reservoir hose
7	7519	Clutch pedal and bracket
8	-	Clutch master cylinder nut

Removal

⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

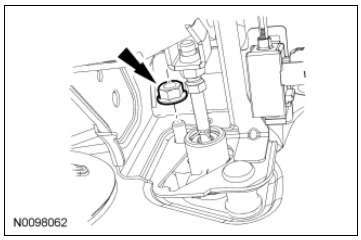
⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.

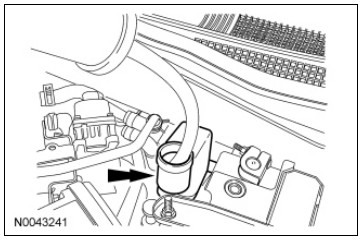
NOTICE: **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: When any part of the hydraulic system has been disconnected for repair or new installation, air may get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

1. Working under the instrument panel, remove the clutch master cylinder nut.

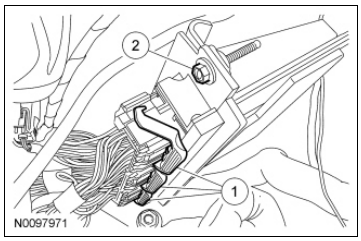


2. Using a suitable suction tool, remove the brake fluid to just below the clutch reservoir hose.

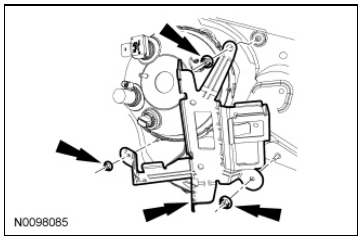


3. Remove the battery tray. For additional information, refer to Section 414-01 .

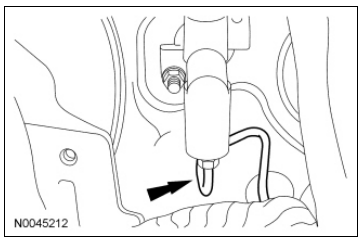
4. Remove the PCM.
    1. Disconnect the electrical connectors.
    2. Remove the 2 PCM bolts.



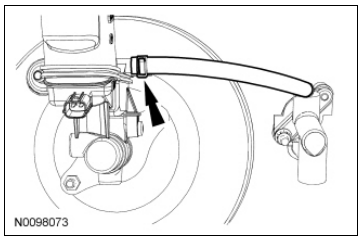
5. Remove 3 PCM bracket nuts and the PCM bracket.



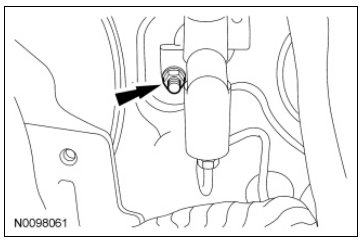
6. Disconnect the clutch master cylinder-to-clutch hydraulic tube.



7. Disconnect the clutch master cylinder reservoir hose.



8. Remove the clutch master cylinder nut.

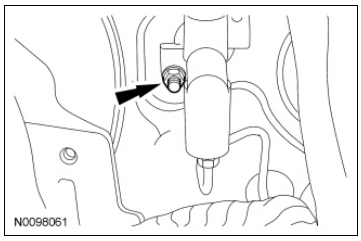


9. Remove the clutch master cylinder assembly.

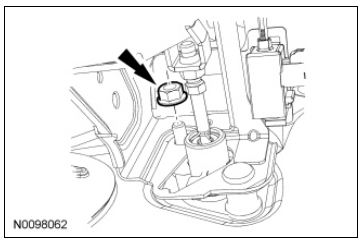
Installation

1. Install the clutch master cylinder assembly.

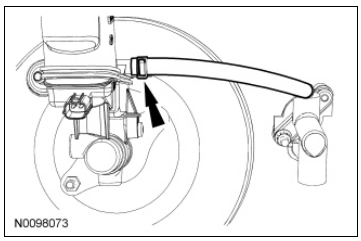
2. Install the clutch master cylinder nut.
   - Tighten to 21 Nm (15 lb-ft).



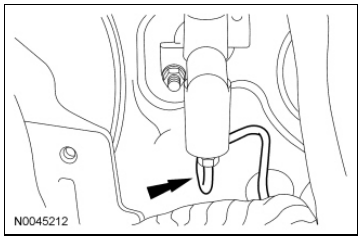
3. Working under the instrument panel, install the clutch master cylinder nut.
   - Tighten to 21 Nm (15 lb-ft).



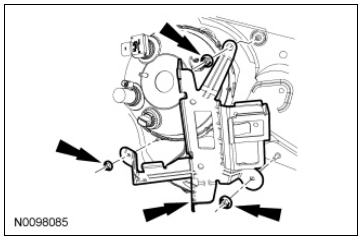
4. Connect the clutch master cylinder reservoir hose.



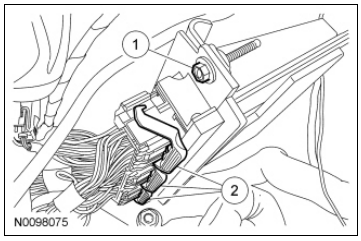
5. Connect the clutch master cylinder-to-clutch hydraulic tube.
    - Tighten the clutch hydraulic tube nut to 17 Nm (150 lb-in).



6. Install the PCM bracket and 3 PCM bracket nuts.
    - Tighten to 10 Nm (89 lb-in).



7. Install the PCM.
    1. Install the 2 PCM bolts.
        - ♦ Tighten to 10 Nm (89 lb-in).
    2. Connect the electrical connectors.



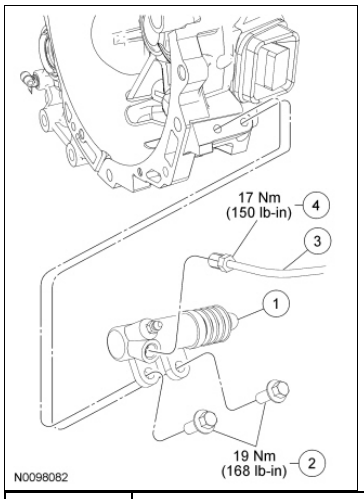
8. Install the battery tray. For additional information, refer to Section 414-01 .

9. Bleed the clutch hydraulic system. For additional information, refer to Section 308-00 .

Clutch Slave Cylinder

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



Item	Part Number	Description
1	7A508	Clutch slave cylinder
2	-	Clutch slave cylinder bolts (2 required)
3	7T504	Clutch hydraulic tube
4	-	Clutch hydraulic tube nut

Removal

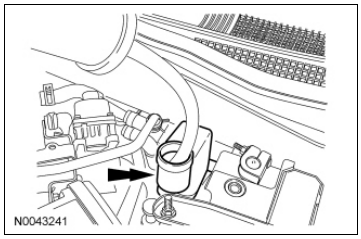
⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

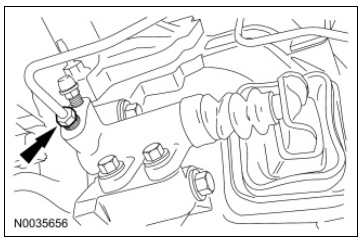
***NOTICE:* Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

NOTE: When any part of the hydraulic system has been disconnected for repair or new installation, air may get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system afte has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

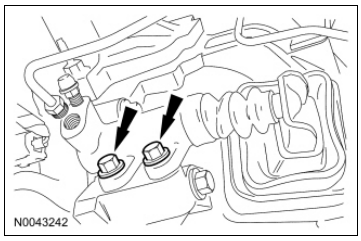
1. Using a suitable suction tool, remove the brake fluid to just below the clutch reservoir hose.



2. Disconnect the clutch hydraulic tube.



3. Remove the 2 clutch slave cylinder bolts and the clutch slave cylinder.

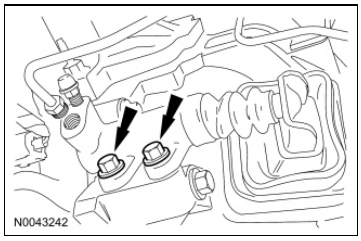


Installation

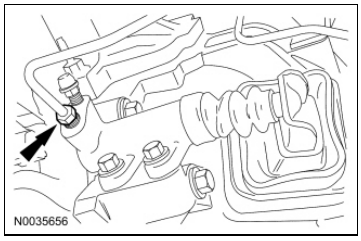
1. **NOTE:** Apply a small amount of grease on the end of the slave cylinder push rod.

   Install the clutch slave cylinder and the 2 clutch slave cylinder bolts.

   - Tighten to 19 Nm (168 lb-in).



2. Connect the clutch hydraulic tube.
   - Tighten to 17 Nm (150 lb-in).



3. ⚠ **WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.**

   Bleed the air from the system. For additional information, refer to Section 308-00 .

Material

Item	Specification	Fill Capacity
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	-
SAE 75W-90 API GL-4 Gear Oil XT-4-QGL	WSS-M2C203-A1	2.84L (3.0 qts.)
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	-
Threadlock and Sealer TA-25	WSK-M2G351-A5	-

General Specifications

Item	Specification
Differential	
Preload	1.4-1.9 Nm (13-17 lb-in)
Secondary shaft gear runout (maximum)	0.015 mm (0.0006 in)
Side gear and pinion gear backlash	0.050-0.150 mm (0.0020-0.059 in)
End Play	
Input shaft	0.00-0.06 mm (0.00-0.0024 in)
Mainshaft	0.00-0.06 mm (0.00-0.0024 in)
Gear Clearance	
1st Gear End Play	
Clearance	0.05-0.28 mm (0.002-0.011 in)
Maximum	0.33 mm (0.012 in)
Clearance	0.018-0.46 mm (0.007-0.018 in)

Maximum	0.51 mm (0.02 in)
3rd Gear Thrust Clearance	
Clearance	0.05-0.20 mm (0.002-0.007 in)
Maximum	0.25 mm (0.009 in)
4th Gear End Play	
Clearance	0.17-0.37 mm (0.007-0.014 in)
Maximum	0.42 mm (0.016 in)
5th Gear Thrust Clearance	
Clearance	0.100-0.220 mm (0.0040-0.0086 in)
Maximum	0.270 mm (0.01 in)
6th Gear Thrust Clearance	
Clearance	0.100-0.220 mm (0.0040-0.0086 in)
Maximum	0.270 mm (0.01 in)
Runout	
Input shaft gear runout (maximum)	0.05 mm (0.001 in)
Reverse idler gear runout (maximum)	0.04-0.14 mm (0.0016-0.0060 in)
Reverse idler gear component dimension	57.0-57.5 mm (2.244-2.263 in)
Shift Fork and Hub Sleeve Clearance	
Reverse Shift Fork and Hub Sleeve	
Maximum	0.90 mm (0.035 in)
Standard	0.10-0.40 mm (0.004-0.015 in)
Clearance Between 1st/2nd Shift Fork and Hub Sleeve	
Maximum	0.95 mm (0.037 in)
Standard	0.10-0.45 mm (0.004-0.017 in)
Clearance Between 3rd/4th Shift Fork and Hub Sleeve	
Maximum	0.90 mm (0.035 in)
Standard	0.10-0.40 mm (0.004-0.015 in)
Clearance Between 5th/6th Shift Fork and Hub Sleeve	
Maximum	0.86 mm (0.033 in)

Standard	0.10-0.36 mm (0.003-0.014 in)
Synchronizer Ring Clearance	
Clearance Between Synchronizer Ring and Flank Surface of Gear	
Maximum	1.50 mm (0.059 in)
Standard	0.80 mm (0.031 in)

Secondary Shaft to Gear Clearance

Gear	Shaft Outer Diameter	Gear Inner Diameter	Clearance
1st	39.445-39.470 mm (1.553-1.554 in)	39.500-39.525 mm (1.555-1.556 in)	0.030-0.080 mm (0.002-0.003 in)
2nd	34.945-34.965 mm (1.376-1.377 in)	35.000-35.025 mm (1.378-1.379 in)	0.05-0.09 mm (0.002-0.003 in)
3rd	35.945-35.970 mm (1.415-1.416 in)	36.000-36.025 mm (1.417-1.418 in)	0.030-0.080 mm (0.002-0.003 in)
4th	30.945-30.970 mm (1.218-1.219 in)	31.000-31.025 mm (1.220-1.221 in)	0.030-0.080 mm (0.001-0.003 in)
5th	33.945-33.970 mm (1.3365-1.3373 in)	34.000-34.025 mm (1.3386-1.3395 in)	0.030-0.080 mm (0.0012-0.0031 in)

Differential Shim Thickness (7067)

mm	Inch
0.1	0.003
0.20	0.007
0.25	0.009
0.30	0.011
0.35	0.013
0.40	0.015
0.45	0.017
0.50	0.019
0.55	0.021
0.60	0.023
0.65	0.025
0.70	0.027

0.75	0.029
0.80	0.031
0.85	0.033
0.90	0.035
0.95	0.037
1.0	0.039
1.05	0.041
1.10	0.043
1.15	0.045
1.20	0.047

Primary Shaft Gear Shim Thickness (7L172)

mm	Inch
0.30	0.011
0.35	0.013
0.40	0.015
0.45	0.017
0.50	0.019
0.55	0.021
0.60	0.023
0.65	0.025
0.70	0.027
0.75	0.029
0.80	0.031
0.85	0.033
0.90	0.035
0.95	0.037
1.0	0.039

Secondary Shaft Gear Shim Thickness (7L172)

mm	Inch
0.20	0.007
0.25	0.009
0.30	0.011
0.35	0.013
0.40	0.015
0.45	0.017
0.50	0.019

0.55	0.021
0.60	0.023
0.65	0.025
0.70	0.027

Reverse Thrust Washer Thickness

mm	Inch
2.04	0.080
2.09	0.082
2.14	0.084
2.19	0.086
2.24	0.088
2.29	0.090
2.34	0.092
2.39	0.094

Torque Specifications

Description	Nm	lb-ft	lb-in
Anchor bolt	10	-	89
Breather cover bolts	10	-	89
Case cover bolts	45	33	-
Clutch housing-to-oil pan bolts	48	35	-
Clutch slave cylinder bolts	20	-	177
Clutch tube hydraulic line bracket bolts	22	16	-
	12	-	106
Drain plug	49	36	-
Electronic Power Assist Steering (EPAS) ground bolt	12	-	106
Fill plug	49	36	-
Oil pan-to-clutch housing bolts	48	35	-
Primary and secondary shaft locknuts	160	118	-
Reverse idler shaft lock bolt	22	16	-
Roll restrictor bracket bolts	90	66	-
Roll restrictor bracket through bolt	90	66	-
Roll restrictor-to-subframe through bolt	90	66	-
Shim selection set bolts	33	-	
Shift control selector plate bolts [a]	-	-	-
Shift detent bolt	18	-	159
Shift gate bolt	13	-	115

Shift lever assembly bolts	22	16	-
Shift rail guide bolt	12	-	106
Splash shield bolts	9	-	80
Stabilizer bar link nuts	40	30	-
Steering shaft pinch bolt	20	-	177
Subframe bracket-to-body bolts	103	76	-
Subframe nuts	150	111	-
	45	33	-
Transaxle rear support insulator bolt and nuts	80	59	-
Transaxle rear support insulator-to-frame bolts (upper and lower) (4 required)	63	46	-
Transaxle-to-engine bolts	48	35	-
Upper transaxle-to-engine bolts	48	35	-
Vehicle Speed Sensor (VSS) bolt	9	-	80

[a] Refer to the procedure in this section.

Manual Transaxle

Manual Transaxle

The G6M 6-speed manual transaxle features the following:

- Fully synchronized 6-speed transaxle
- Synchronized reverse gear
- Six forward speeds and one reverse speed
- An aluminum main case, clutch housing and structural cover

The function of the transmission is to move the vehicle from a rest position to motion. This is done by transferring the engine torque, through the transaxle, to the front wheels. The transmission input shaft receives power when the clutch is engaged. Torque flows through the input shaft to the drive gear. The forward gears are selected by a synchronizer mechanism. The helical-cut forward gears are in constant mesh with the corresponding gears on the opposing shaft. Reverse gears have helical-cut teeth and are engaged through the reverse idler gear.

External Shift Linkage

The manual transaxle is controlled by a floor-mounted gearshift lever located in the floor console. Connection between the floor-mounted gear shift lever and the manual transaxle gear shift control mechanism is made through 2 shift cables. The clutch pedal disengages the clutch allowing the transaxle to be shifted from one gear to another.

Internal Shift Linkage

The G6M manual transaxle is shifted internally by 4 shift forks. The reverse gear shift fork shifts in and out of the reverse gear. The 1st/2nd, 3rd/4th and 5th/6th shift forks control all forward gear shifts.

Reverse Gear

The reverse idler gear is mounted on a reverse idler gear shaft supported at one end in the clutch housing and at the other in the transaxle case by a reverse idler shaft lock bolt.

When the reverse idler gear slides on the reverse idler gear shaft, it engages the reverse drive gear on the input shaft and the reverse gear on the output shaft. The driving gear is part of the input shaft and the reverse gear is machined on the outside diameter of the 1st/2nd synchronizer sleeve.

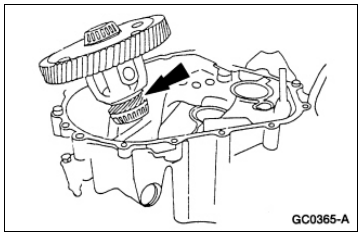
When the reverse idler gear rotates on the reverse idler gear shaft, it reverses the power flow to the output shaft.

To engage the reverse idler gear, the motion of the shift fork is transferred to the reverse gearshift lever through the shift gate. The reverse gearshift lever is mounted on a meshlock plunger that allows it to act as a fulcrum. When the reverse gearshift selector arm moves its end of the shift fork, the opposite end slides the reverse idler gear into engagement with the input shaft and output shaft reverse gears.

Differential

The ends of the differential are supported on tapered roller differential bearings. The cups for these differential bearings are seated in the transaxle case and the flywheel housing. Differential bearing preload is set using a selective differential bearing shim that is installed under the differential bearing cup in the transaxle case.

The differential includes the differential side gears and the shaft mounted differential pinion gears. Direct contact between the gears and the differential case is prevented by the differential side gear thrust washers installed under the gears. The differential pinion shaft is held in position by a differential pinion shaft lock pin that extends through the end of the differential pinion shaft and the differential case.



The speedometer drive gear is also mounted on the differential case. It is located between the tapered roller differential bearing and the differential case. A tab on the speedometer drive gear and a matching slot in the differential case prevent the speedometer drive gear from spinning on the differential case.

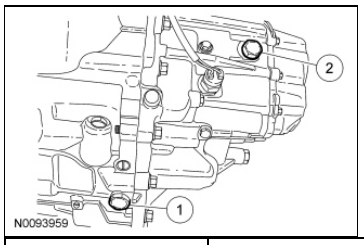
Manual Transaxle

Refer to Section 308-00 .

Transaxle Draining and Filling

Material

Item	Specification
SAE 75W-90 API GL-4 Gear Oil XT-4-QGL	WSS-M2C203-A1



Item	Part Number	Description
1	-	Transaxle drain plug
2	-	Transaxle fill plug

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the drain plug and drain the fluid.

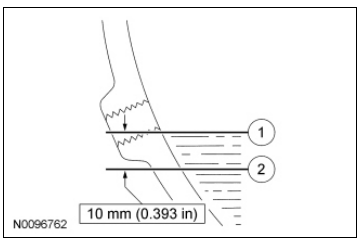
3. Install a new washer and the drain plug.
   - Tighten to 49 Nm (36 lb-ft).

4. **NOTE:** Prior to removal, clean the area of the fill plug.

   Remove the fill plug.

5. **NOTE:** Do not overfill the transaxle. This may result in increased operating temperature or cause transaxle fluid to be forced out of the case.

   Fill the transaxle with the recommended fluid.



Item	Part Number	Description

1	-	Correct level
2	-	Low level

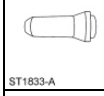
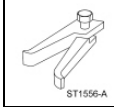
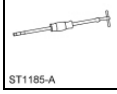
6. Install a new washer and fill plug.
   - Tighten to 49 Nm (36 lb-ft).

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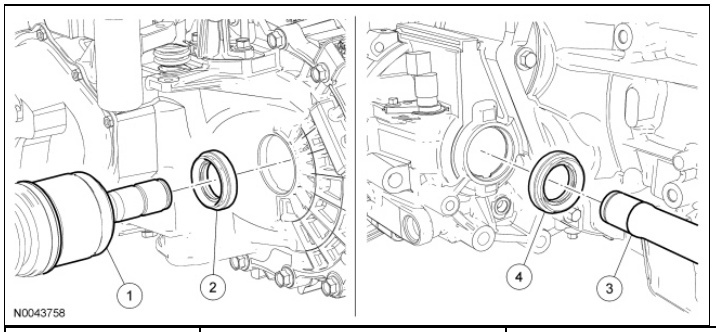
Halfshaft Seal

Special Tool(s)

 ST1833-A	Installer, Halfshaft Oil Seal 308-119 (T87C-77000-H)
 ST1556-A	Remover, Stator Case Bearing 307-163 (T86P-70043-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
SAE 75W-90 API GL-4 Gear Oil XT-4-QGL	WSS-M2C203-A1



Item	Part Number	Description
1	4B436	LH halfshaft assembly
2	7052	Halfshaft oil seal
3	-	RH intermediate shaft
4	7052	Halfshaft oil seal

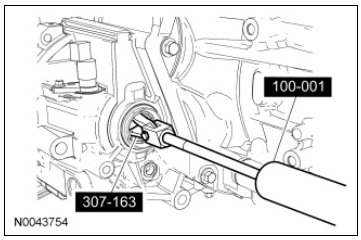
Removal and Installation

NOTICE: **New halfshaft oil seals should be installed any time the halfshafts are removed. Failure to install new halfshafts seals may result in transaxle oil leak(s) and damage to the transmission may occur.**

1. Remove the transaxle drain plug and drain the fluid.

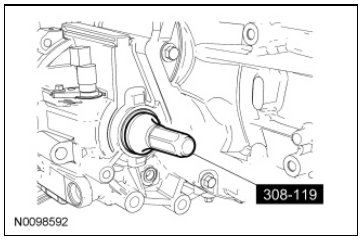
2. Remove the RH intermediate shaft or LH halfshaft. For additional information, refer to Section 205-04 .

3. Using the Slide Hammer with the Stator Case Bearing Remover, remove the RH intermediate shaft oil seal or the LH halfshaft oil seal.



Installation

1. Using the Halfshaft Oil Seal Installer, install the RH intermediate shaft or the LH halfshaft oil seal.



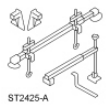
2. **NOTE:** Do not allow t splines on the halfshaft to touch the oil seal.

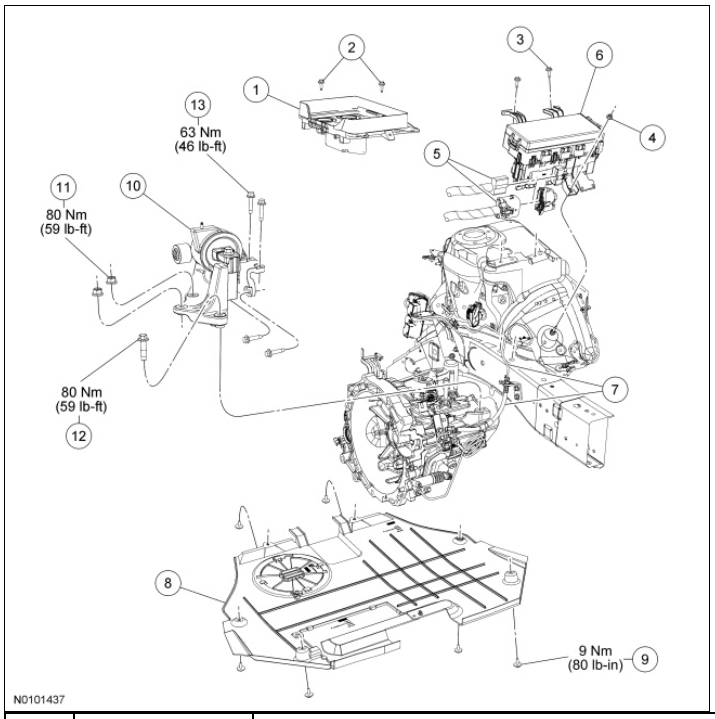
   Install the RH intermediate shaft or LH halfshaft. For additional information, refer to Section 205-04 .

3. Fill the transaxle to specification. For additional information, refer to Transaxle Draining and Filling in this section.

Transaxle Rear Support Insulator

Special Tool(s)

 ST2425-A	Support Bar, Engine 303-F072

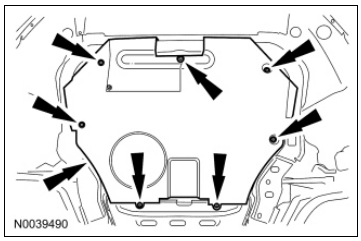


Item	Part Number	Description
1	10723	Battery tray
2	-	Battery tray bolts (2 required)
3	-	Power Distribution Box (PDB) bolt (2 required)
4	-	PDB nut
5	-	PDB electrical connectors
6	14A067	PDB assembly
7	-	Clutch hydraulic tube
8	5410494	Splash shield
9	W707398-S	Splash shield bolt (7 required)
10	6F020	Transaxle rear support insulator
11	W710645-S	Transaxle rear support insulator nut (2 required)
12	W711487-S	Transaxle rear support insulator bolt
13	W709234-S	Transaxle rear support insulator-to-frame bolt (4 required)

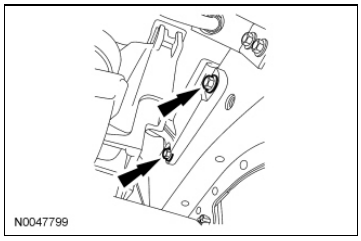
Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

1. Remove the 7 splash shield bolts and the splash shield.

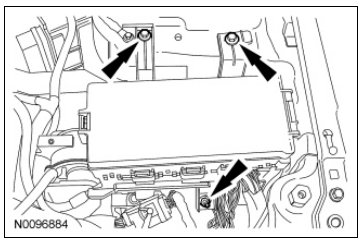


3. Remove the 2 lower transaxle rear support insulator bolts.

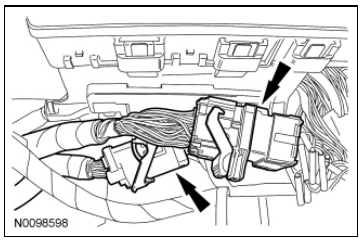


4. Remove the battery tray. For additional information, refer to Section 414-01 .

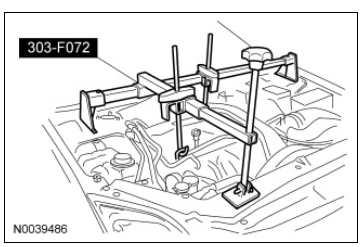
5. Remove the 2 Power Distribution Box (PDB) bolts and the lower nut. Pull the PDB upward to unclip the pushpin.



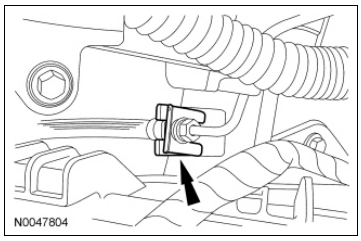
6. Disconnect the 2 electrical connectors.



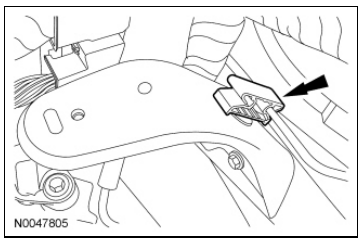
7. Install the Engine Support Bar.



8. Remove the clutch hydraulic tube spring clip. Push downward on the clutch tube to release it from the bracket.



9. Remove the clutch hydraulic tube from the plastic retainer.



10. **NOTE:** If one or both of the mount studs are removed or come out, do not reinstall the old stud(s). Install a new stud(s). Make sure the studs are properly seated in the case, even if they were not replaced.

    Remove the remaining 2 transaxle rear support insulator-to-frame bolts, the 2 transaxle rear support insulator nuts and the transaxle rear support insulator-to-transaxle bolt.

11. Remove the transaxle rear support insulator.

Installation

1. Install the transaxle rear support insulator.

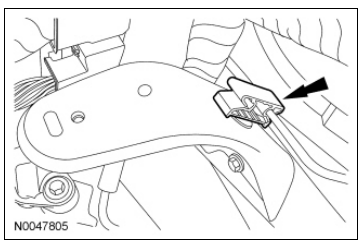
2. **NOTE:** If one or both of the mount studs are removed or come out, do not reinstall the old stud(s). Install a new stud(s). Make sure the studs are properly seated in the case, even if they were not replaced.

   Install the 2 upper transaxle rear support insulator-to-frame bolts.

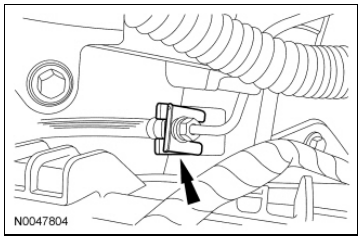
   - Tighten to 63 Nm (46 lb-ft).

3. Install the 2 transaxle rear support insulator nuts and the transaxle rear support insulator bolt.
   - Tighten to 80 Nm (59 lb-ft).

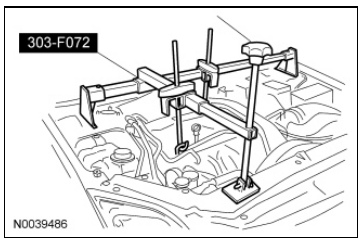
4. Install the clutch hydraulic tube into the plastic retainer.



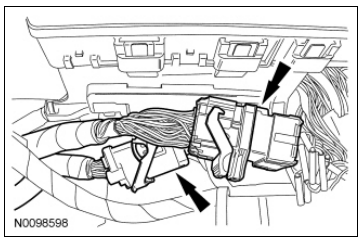
5. Install the clutch hydraulic tube spring clip. Push upward on the clutch tube to attach it to the bracket.



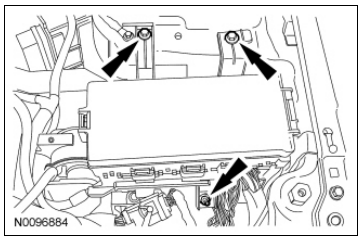
6. Remove the Engine Support Bar.



7. Position the PDB in place. Connect the 2 electrical connectors.

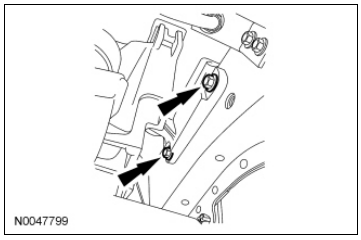


8. Push the PDB downward to clip the pushpin. Install the 2 PDB bolts and the lower nut.

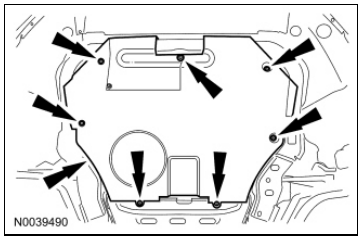


9. Install the battery tray and battery. For additional information, refer to Section 414-01 .

10. Install the 2 lower transaxle rear support insulator-to-frame bolts.
    - Tighten to 63 Nm (46 lb-ft).



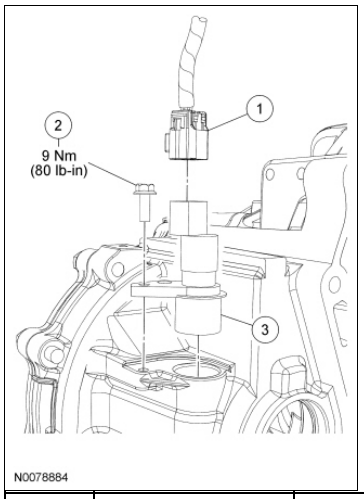
11. Install the splash shield and the 7 splash shield bolts.
    - Tighten to 9 Nm (80 lb-in).


N0039490

Vehicle Speed Sensor (VSS)

Material

Item	Specification
SAE 75W-90 API GL-4 Gear Oil XT-4-QGL	WSS-M2C203-A1

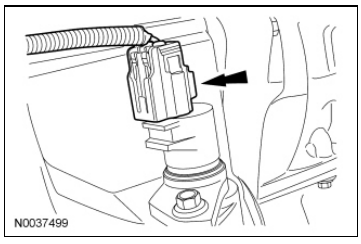


Item	Part Number	Description
1	14487	Vehicle Speed Sensor (VSS) electrical connector
2	-	VSS bolt
3	17271	VSS

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the Vehicle Speed Sensor (VSS) electrical connector.



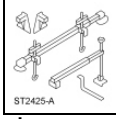
3. Remove the VSS bolt.
   - To install, tighten to 9 Nm (80 lb-in).

4. Remove the VSS .
   - Discard the O-ring.

5. To install, reverse the removal procedure.
    - Apply clean manual transaxle fluid to a new O-ring and install it on the VSS .

Transaxle

Special Tool(s)

 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent
 ST2425-A	Support Bar, Engine 303-F072

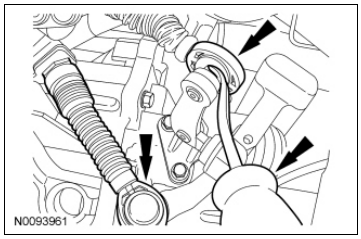
⚠ WARNING: Do not breathe dust or use compressed air to blow dust from storage containers or friction components. Remove dust using government-approved techniques. Friction component dust may be a cancer and lung disease hazard. Exposure to potentially hazardous components may occur if dusts are created during repair of friction components, such as brake pads and clutch discs. Exposure may also cause irritation to skin, eyes and respiratory tract, and may cause allergic reactions and/or may lead to other chronic health effects. If irritation persists, seek medical attention or advice. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the battery tray. For additional information, refer to Section 414-01 .

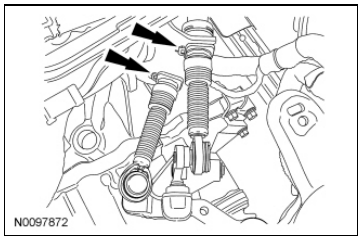
3. Remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A .

4. Disconnect the shift cables from the transaxle shift control lever, using a suitable tool to lightly pry them off the transaxle shift control lever.

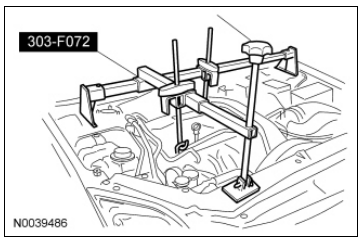

N0093961

5. ***NOTICE:*** **Carefully pry the retainer on the shift cables. Do not damage the shift cable retainers. Using a small screwdriver push from the back.**

   Disconnect the shift cables from the transaxle bracket.


N0097872

6. Install the Engine Support Bar.



7. Detach the wire harness from the transaxle.

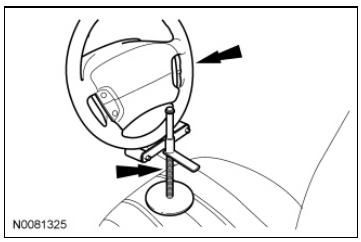
8. Remove the 3 upper transaxle-to-engine bolts.

9. **NOTE:** If one or both of the mount studs are removed or come out, do not reinstall the old stud(s). Install a new stud(s). Make sure the studs are properly seated in the case, even if they were not replaced.

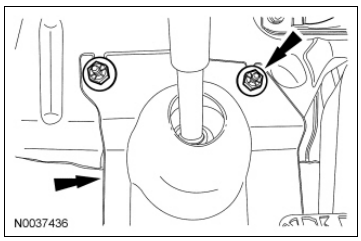
   Remove the transaxle rear support insulator nuts and the transaxle rear support insulator bolt.

10. **NOTE:** Use a steering wheel holding device such as Hunter® 28-75-1 or equivalent, to hold the steering wheel.

    Using a suitable holding device, hold the steering wheel in the straight-ahead position.

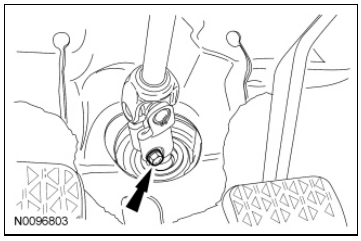


11. Remove the 2 nuts and the steering joint cover.

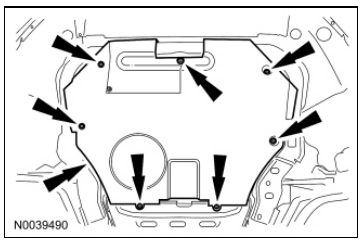


12. ***NOTICE:*** **Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

    Remove and discard the bolt and disconnect the steering column shaft from the steering gear.

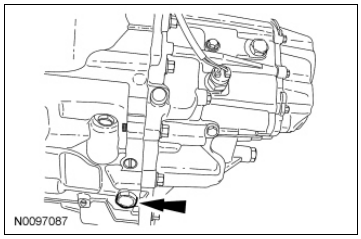


13. If equipped, remove the 7 screws and the underbody cover.



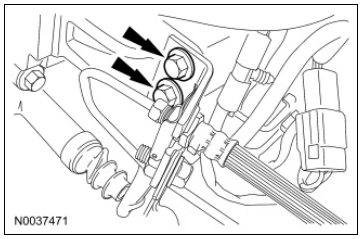
14. **NOTE:** If disassembly of the transaxle is required, remove the drain plug and drain the transaxle.

    Remove the drain plug and drain the transaxle.

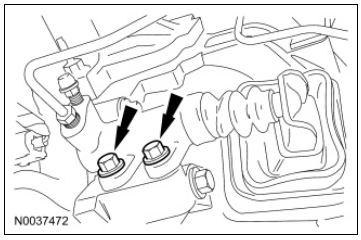


15. Once fluid has drained, install the drain plug.
    - Tighten to 49 Nm (36 lb-ft).

16. Remove the 2 clutch tube hydraulic line bracket bolts.



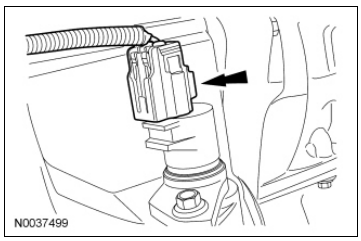
17. Remove the 2 bolts and position the clutch slave cylinder aside.



18. Disconnect the reverse lamp switch electrical connector.

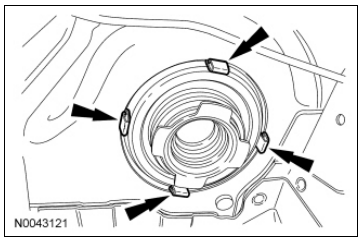
19. Remove the starter motor. For additional information, refer to Section 303-06 .

20. Disconnect the Output Shaft Speed (OSS) electrical connector.



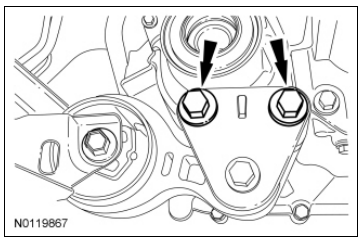
21. ***NOTICE:*** **Remove the steering gear/dash seal or damage to the seal may occur.**

    Release the 4 clips and slide the steering gear/dash seal off of the steering gear.

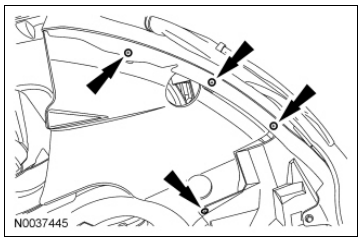


22. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .

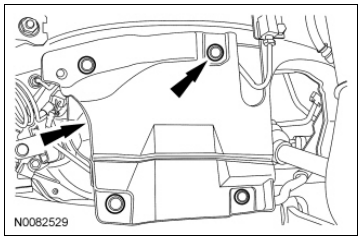
23. Remove the 2 roll restrictor bracket bolts.



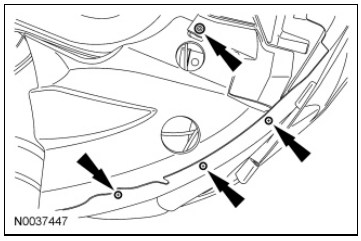
24. Remove the 4 screws and position the RH fender splash shield aside.



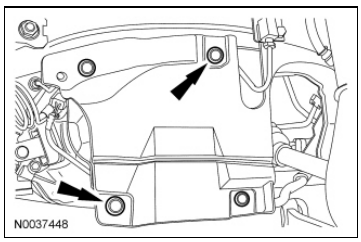
25. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.



26. Remove the 4 screws and position the LH fender splash shield aside.

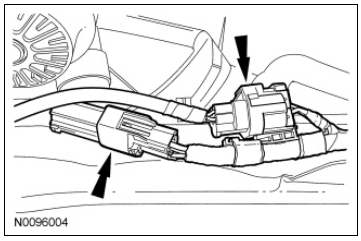


27. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.

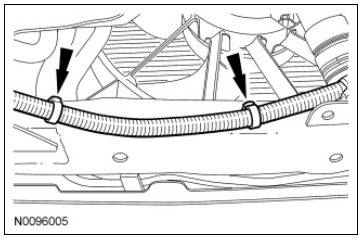


28. Remove the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

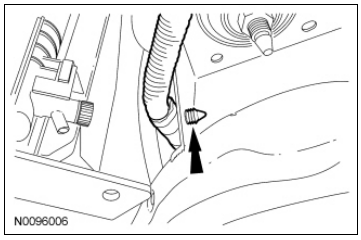
29. Disconnect the 2 in-lineElectronic Power Assist Steering (EPAS) system electrical connectors at the front of the subframe.



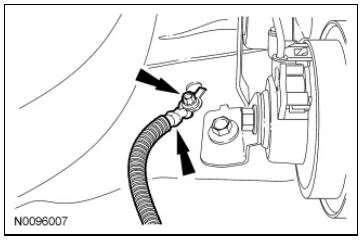
30. Detach the 2 EPAS system wiring harness pin-type retainers from the subframe.



31. Detach the EPAS system wiring harness pin-type retainer from the subframe under the LH fender splash shield.

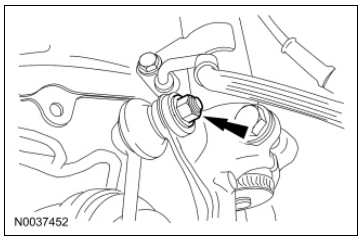


32. Remove the bolt and the EPAS system wiring harness ground from behind the RH splash shield.

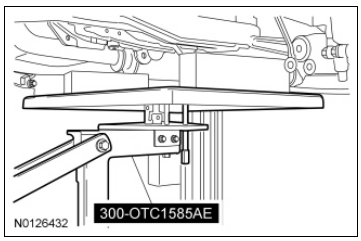


33. **NOTE:** LH shown, RH similar.

    Remove the nuts and separate the stabilizer bar links from the struts.

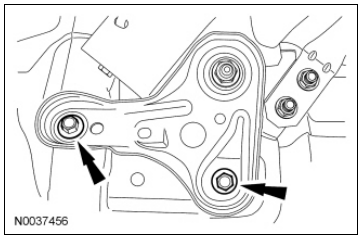


34. Position the Powertrain Lift under the subframe assembly.



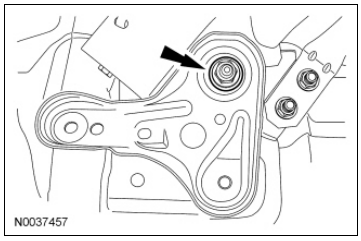
35. **NOTE:** LH shown, RH similar.

    Remove the subframe bracket-to-body bolts.



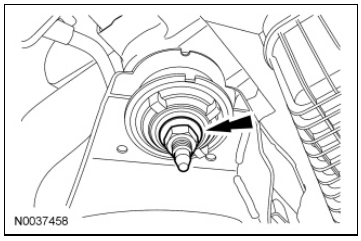
36. **NOTE:** LH shown, RH similar.

    Remove the rear subframe nuts and the subframe brackets.



37. **NOTE:** LH shown, RH similar.

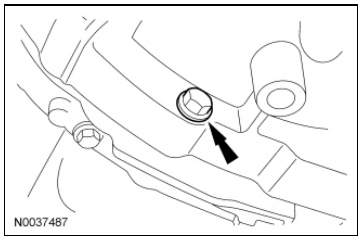
    Remove the front subframe nuts.



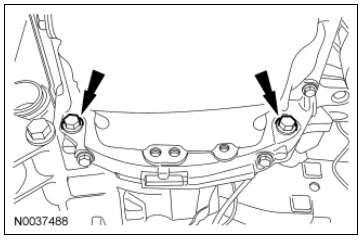
38. Lower the subframe assembly from the vehicle.

39. Support the transaxle with a suitable transmission jack. Secure the transaxle to the transmission jack with a safety strap.

40. Remove the clutch housing-to-oil pan bolt.



41. Remove the 2 oil pan-to-clutch housing bolts.

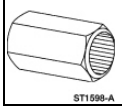


42. Remove the remaining 4 transaxle-to-engine bolts.

43. Move the transaxle away from the engine and lower it from the vehicle.

Transaxle

Special Tool(s)

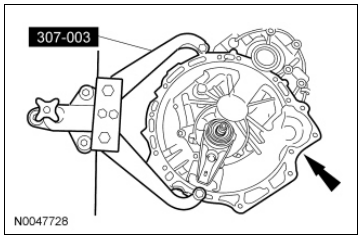
 ST1186-A	Holding Fixture 307-003 (T57L-500-B)
 ST1598-A	Turning Torque Socket, Transmission 308-160 (T88C-7025-GH)

NOTE: Clean the transaxle exterior before disassembly.

NOTE: Clean all removed parts and all sealing surfaces with solvent, and dry with compressed air.

NOTE: Clean out all holes and passages with compressed air and verify that there are no obstructions.

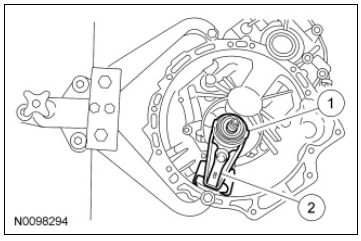
1. Mount the transaxle to the Holding Fixture.



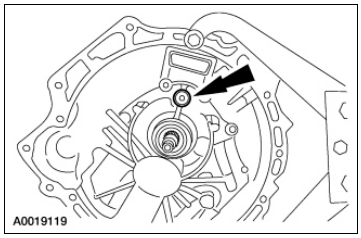
2. Remove the clutch release fork and bearing.

   NOTE: May need to use a screwdriver to pry the clutch release fork off the anchor bolt, if needed.

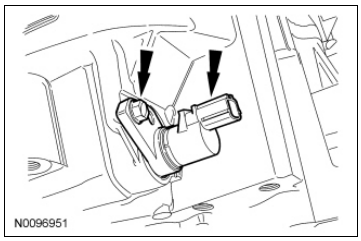
   1. Remove the clutch release bearing.
   2. Remove the clutch release fork and diaphragm.



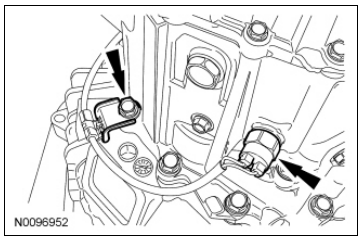
3. If necessary, remove the anchor bolt.



4. Remove the bolt and the Vehicle Speed Sensor (VSS).

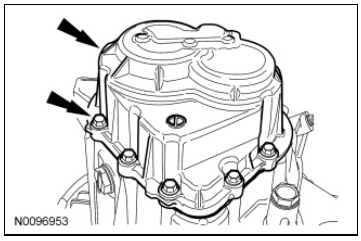


5. Remove the reversing lamp switch wiring harness retainer bolt and reversing lamp switch.

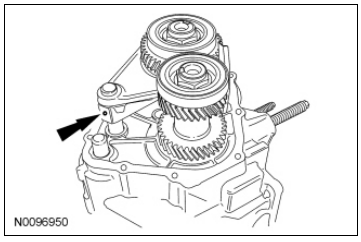


6. Shift the transaxle into the NEUTRAL position.

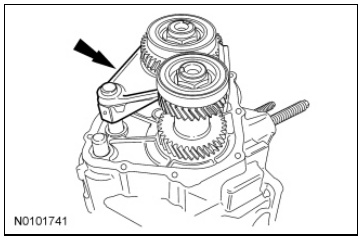
7. Remove the 9 case cover bolts and the case cover.



8. Remove and discard the 5th/6th gear shift fork roll pin.



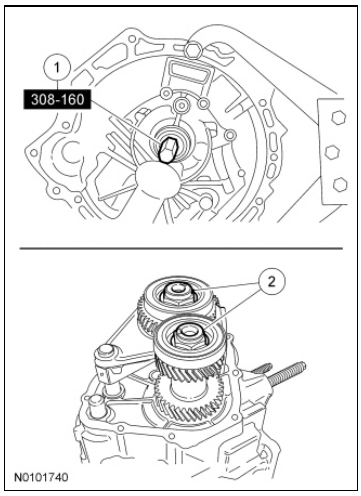
9. Shift the 5th/6th gear shift fork to 5th.



10. **NOTE:** Do not reuse locknuts.

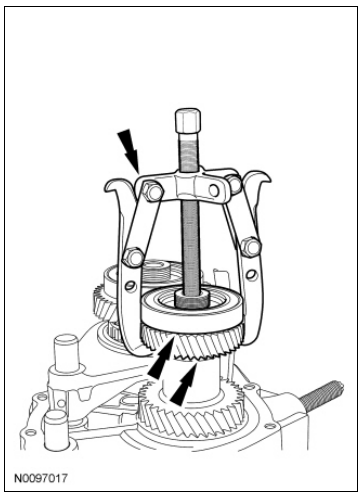
    Remove the primary and secondary shaft locknuts.

    1. Using the Transmission Turning Torque Socket, keep the input shaft from turning.
    2. Using a punch, release the locking tabs from the shafts. Remove and discard the primary and secondary shaft locknuts.



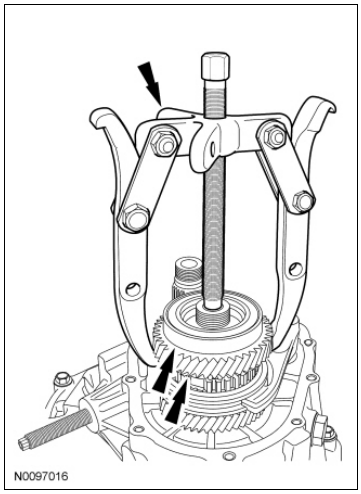
11. ***NOTICE:*** **Make sure the tabs of the suitable tool are securely positioned on the gear or damage to the gear may occur.**

    Using a suitable tool, remove the bearing and 6th gear from the secondary shaft.

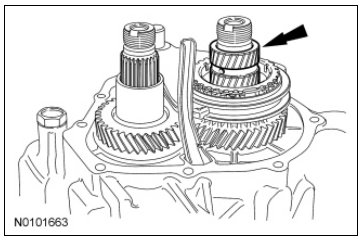


12. ***NOTICE:*** **Make sure the tabs of the suitable tool are securely positioned on the gear or damage to the gear may occur.**

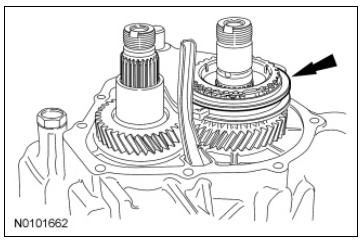
    Using a suitable tool, remove the bearing and 6th gear from the primary shaft.



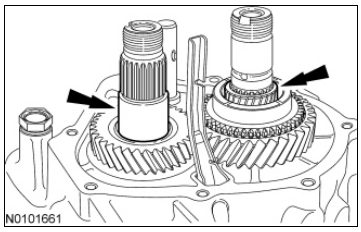
13. Remove the gear sleeve.



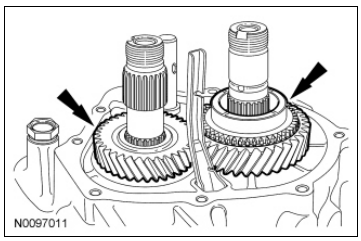
14. Remove the 5th/6th shift fork and synchronizer assembly.



15. Remove the spacer and the gear sleeve.

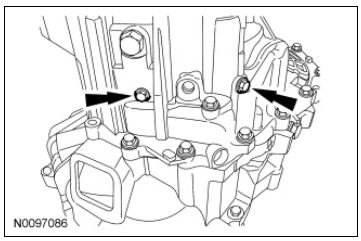


16. Remove the 5th speed primary and secondary gears.

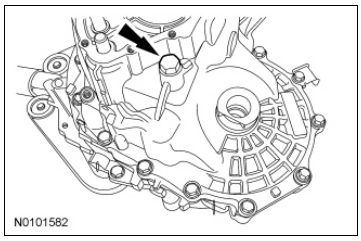


NOTE: Make sure the transaxle is in neutral.

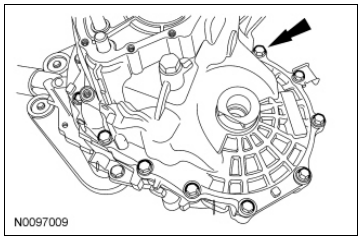
17. Remove the reverse idler shaft lock bolt and shift rail guide bolt.



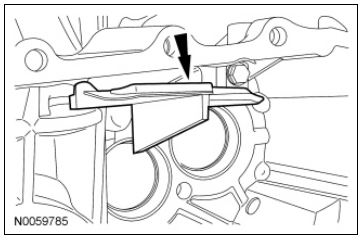
18. Remove the shift detent bolt, spring and ball.



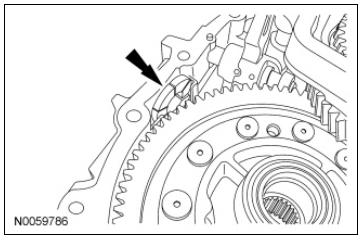
19. Remove the 15 transaxle case bolts and separate the transaxle case.
    - After separating the transaxle cases, position the removed case on its side. Use care not to damage the funnel.



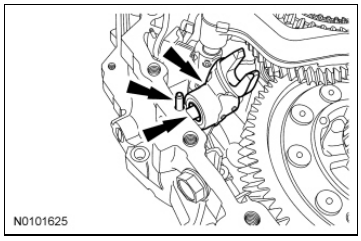
20. Remove the funnel bolt and the funnel.



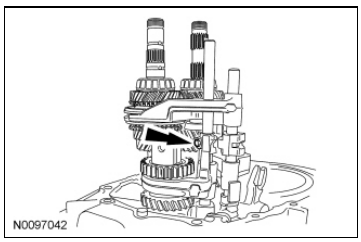
21. Remove the magnet.



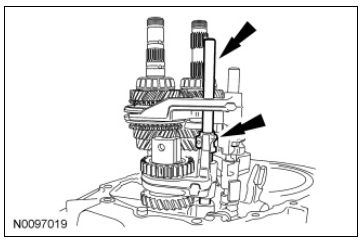
22. Remove the shift lever shaft pin, then remove the shift lever shaft and shift fork selector lever.



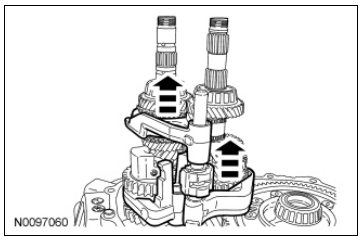
23. Remove the shift gate bolt.



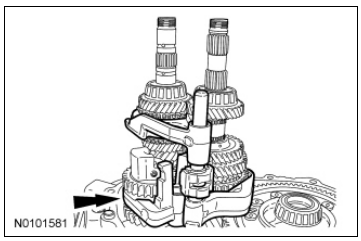
24. Remove the shift control shaft and remove the shift gate.



25. Move the shift forks upward into 2nd and 4th gears.

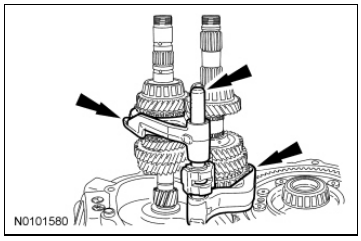


26. Remove the reverse idler gear assembly and shift fork.

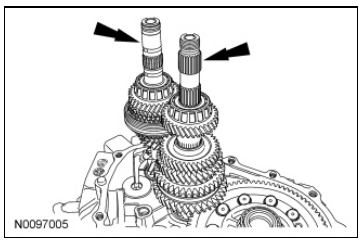


27. Rotate the main shift control shaft clockwise to free the interlock from the 1-2 and 3-4 shift forks.

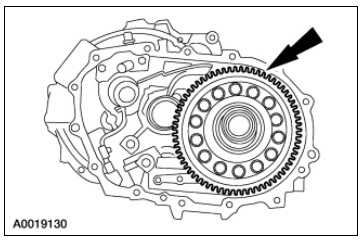
28. Raise the main shift control shaft until it clears the bore in the transaxle case and remove the main shift control shaft assembly, shift forks.



29. Remove the primary and secondary shafts at the same time.



30. Remove the differential.



31. For further disassembly of the transaxle case, refer to Transaxle Case in this section.

5th/6th Gear

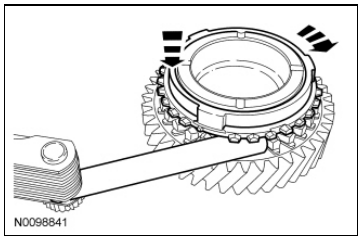
1. Inspect the 5th and 6th gear synchronizer cones, gear teeth and rings for wear or damage. Replace as necessary.

2. **NOTE:** Set the synchronizer ring squarely on the gear and measure around the circumference.

   Using a feeler gauge, while applying pressure and rotating the synchronizer ring, measure the clearance between the 5th gear synchronizer ring and the flank surface of the gear. The measurement should be the same around the entire circumference. Replace the synchronizer ring if less than the minimum specification.

5th Gear Synchronizer Ring Clearance

Standard	Minimum
1.50 mm (0.059 in)	0.80 mm (0.031 in)

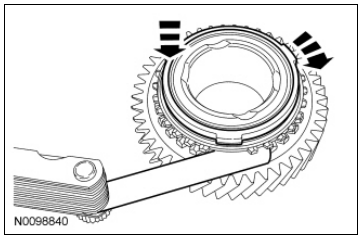


3. **NOTE:** Set the synchronizer ring squarely on the gear and measure around the circumference.

   Using a feeler gauge, while applying pressure and rotating the synchronizer ring, measure the clearance between the 6th gear synchronizer ring and the flank surface of the gear. The measurement should be the same around the entire circumference. Replace the synchronizer ring if less than the minimum specification.

6th Gear Synchronizer Ring Clearance

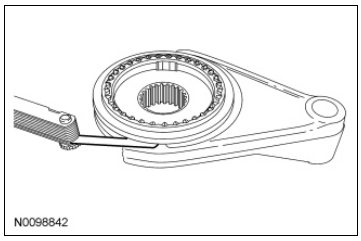
Standard	Minimum
1.50 mm (0.059 in)	0.80 mm (0.031 in)



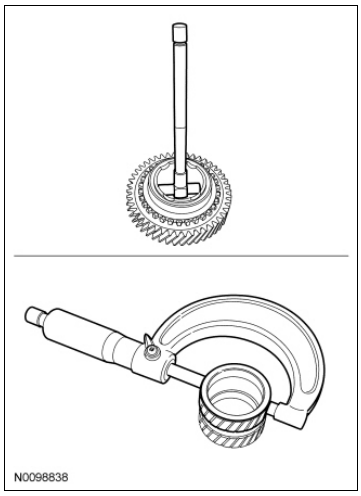
4. Measure the clearance between the clutch hub sleeve and the shift fork. Replace if it exceeds the maximum specification.
    - Inspect the clutch hub sleeve and clutch hub operation. Replace if there is a malfunction.

5th/6th Gear Clutch Hub Sleeve and Shift Fork Clearance

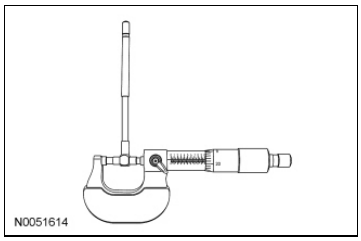
Standard	Maximum
0.10-0.36 mm (0.004-0.014 in)	0.86 mm (0.033 in)



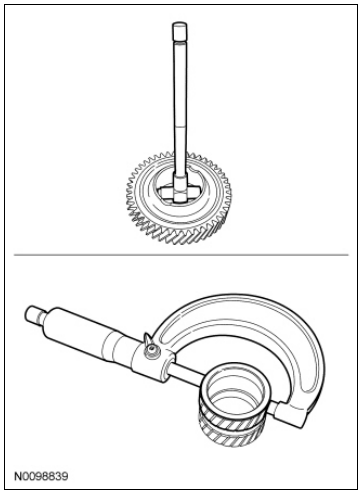
5. Using a telescoping gauge, measure the ID of the 5th gear. Using a micrometer, measure the OD of the gear sleeve.



6. Measure the telescoping gauge to determine if the gear to the gear sleeve clearances are within specifications. If not within specifications, replace as needed.



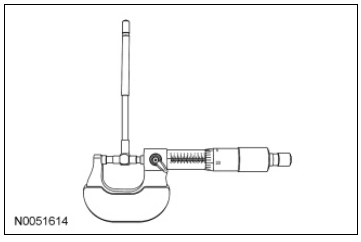
7. Using a telescoping gauge, measure the ID of the 6th gear. Using a micrometer, measure the OD of the gear sleeve.



8. Measure the telescoping gauge to determine if the gear to the gear sleeve clearances are within specifications. If not within specifications, replace as needed.

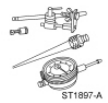
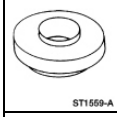
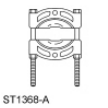
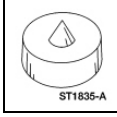
5th and 6th Gear Oil Clearance

Gear	Gear ID	Gear Sleeve OD	Clearance
5th	34.00-34.025 mm (1.3386-1.3395 in)	33.945-33.970 mm (1.3365-1.3373 in)	0.030-0.80 mm (0.001-0.003 in)
6th	34.00-34.025 mm (1.3386-1.3395 in)	33.945-33.970 mm (1.3365-1.3373 in)	0.030-0.80 mm (0.001-0.003 in)



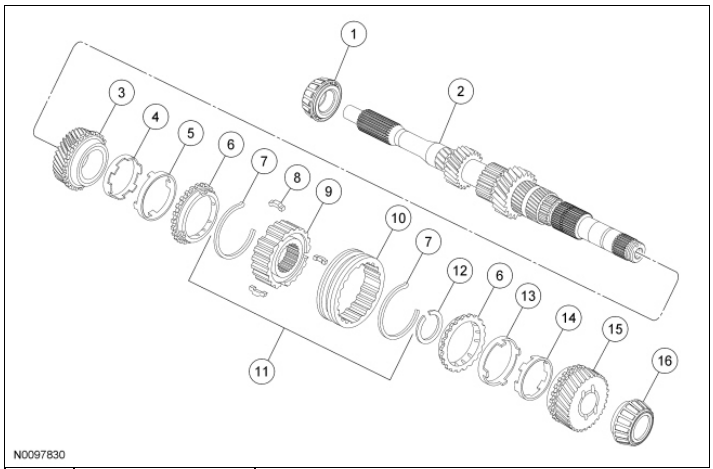
Input Shaft

Special Tool(s)

 ST1897-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-A)
 ST2444-A	Installer, Differential Bearing Cup 308-155 (T88C-7025-DH)
 ST1559-A	Installer, Transaxle Bearing Cone 307-181 (T87C-77000-D)
 ST1254-A	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A) or equivalent
 ST1835-A	Shaft Protector Set 205-DS004 (D80L-625-A) or equivalent

Material

Item	Specification
SAE 75W-90 API GL-4 Gear Oil XT-4-QGL	WSS-M2C203-A1

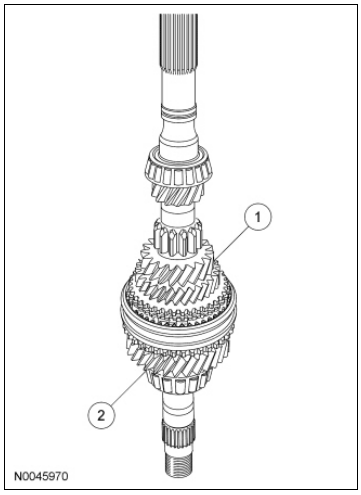


Item	Part Number	Description
1	7025	Bearing

2	7017	Input shaft
3	7101	3rd gear
4	-	Double cone (part of 7Z018)
5	-	Inner cone (part of 7Z018)
6	7Z018	Synchronizer blocking ring (part of blocking ring set)
7	7109	Synchronizer blocking springs (part of 7124)
8	7A044	Synchronizer hub insert (part of 7124)
9	7105	Synchronizer hub (part of 7124)
10	7106	Synchronizer sleeve (part of 7124)
11	7124	Synchronizer hub assembly
12	7064	Snap ring
13	-	Double cone (part of 7Z018)
14	-	Inner cone (part of 7Z018)
15	7110	4th gear
16	7025	Bearing

Disassembly

1. Measure the input shaft clearances.
    1. Measure the clearance between the 3rd and 2nd gears. Third gear thrust clearance is 0.05-0.20 mm (0.001-0.007 in).
    2. Measure the clearance between 4th gear and the bearing cone. Fourth gear endplay is 0.17-0.37 mm (0.006-0.014 in).

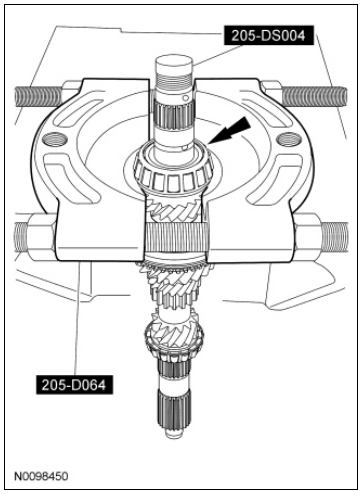


2. **NOTE:** When pressing off components, hold the shaft so it does not fall.

   NOTE: Use the Shaft Protector Set to pamage to the shaft.

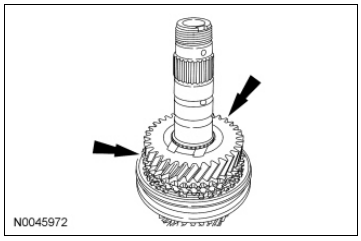
   Using the Bearing Puller and a suitable press, press off the bearing.

   - Discard the bearing.
   - Always install new bearings and cups as a set.

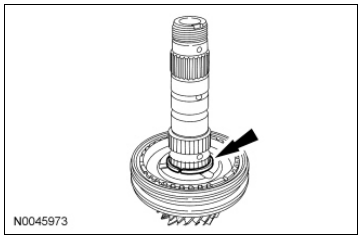


3. **NOTE:** The synchronizer blocking rings are not interchangeable. Make sure to keep them in the order that they were removed.

   Remove 4th gear and the synchronizer blocking ring.



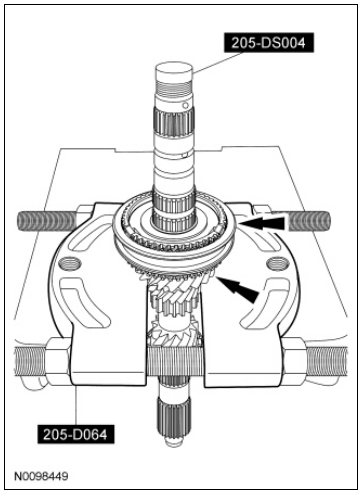
4. Remove and discard the snap ring.



5. ***NOTICE:*** **The synchronizer blocking rings are not interchangeable. Make sure to keep them in the order that they were removed.**

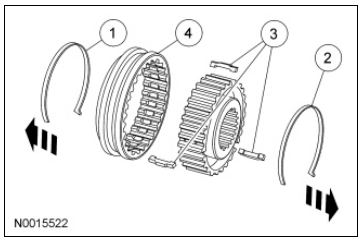
   NOTE: Use the Shaft Protector Set to prevent damage to the shaft.

   Using the Bearing Puller and a suitable press, press off the synchronizer hub assembly, the synchronizer blocking ring and 3rd gear as an assembly.



NOTE: Using a paint pen, mark the hub to sleeve position for reassembly.

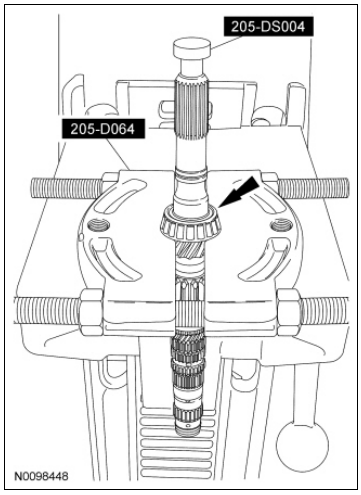
6. Disassemble the synchronizer assembly.
    1. Remove the synchronizer blocking spring.
    2. Remove the opposite synchronize spring.
    3. Remove the synchronizer hub inserts.
    4. Separate the synchronizer hub from the sleeve.
        - ♦ Inspect all synchronizer components for wear and damage. Install a new synchronizer as necessary.



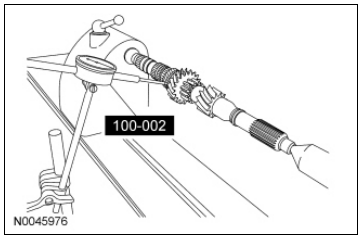
7. **NOTE:** Use the Shaft Protector Set to prevent damage to the shaft.

    Using the Bearing Puller and a suitable press, press off the bearing.

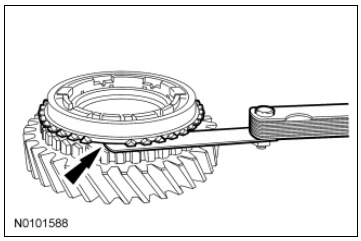
    - Discard the bearing.
    - Always install new bearings and cups as a set.



8. Using the Dial Indicator Gauge with Holding Fixture, measure the input shaft gear runout.
    - Inspect the input shaft for worn or damaged gears. Install a new input shaft as necessary.
    - Input shaft gear maximum runout is 0.05 mm (0.001 in).



9. Set the synchronizer ring set squarely on the gear, then measure around the circumference.
    - Measure the clearance from the side of the gear.
        - ♦ Synchronizer ring clearance is 0.80-1.50 mm (0.031-0.059 in).
    - Inspect for smooth engagement with the gear.
    - Inspect for worn or damaged teeth. Install new components as necessary.



10. Inspect the synchronizer hub.
    - Inspect for worn or damaged splines, synchronizer insert groove or end surface.
    - Inspect for smooth hub sleeve movement when it is installed.

11. Measure the clearance between the 3rd/4th synchronizer hub and its shift fork.
    - Shift fork and hub sleeve clearance is 0.10-0.90 mm (0.003-0.035 in).

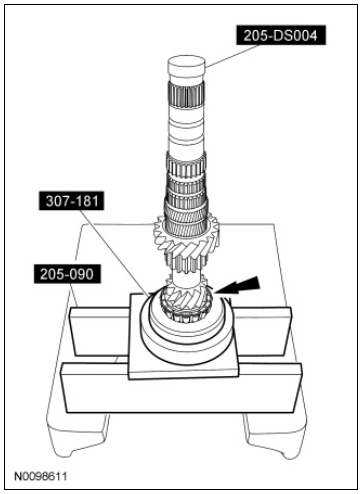
Assembly

NOTE: Do not reassemble the input shaft dry.

1. Lubricate all input shaft components with the recommended transmission lubricant during reassembly.

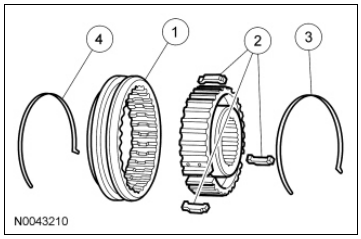
2. **NOTE:** Use the Shaft Protector Set to prevent damage to the shaft.

   Using the Bearing/Oil Seal Plate, Transaxle Bearing Cone Installer and a suitable press, press on the new bearing.



3. Install 3rd gear.

4. Assemble the synchronizer.
    1. Position the synchronizer hub and sleeve together.
    2. Install the synchronizer hub inserts.
    3. Install the synchronizer blocking spring.
    4. Rotate the synchronizer and install the opposite synchronizer blocking spring.



5. Assemble 3rd gear blocking ring set and synchronizer assembly

6. **NOTE:** Use the Shaft Protector Set to prevent damage to the shaft.

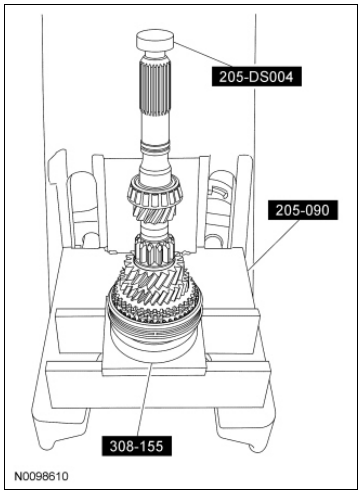
    NOTE: When installing the synchronizer blocking ring, align the synchronizer blocking ring groove and synchronizer hub inserts.

    NOTE: Make sure to have the ridge facing the 3rd gear when installing the synchronizer hub assembly.

    NOTE: Make sure that the 4 grooves in the synchronizer hub are facing the 3rd gear.

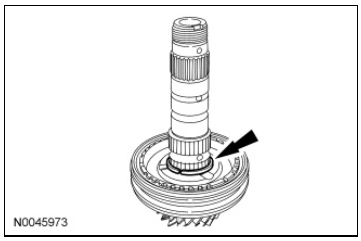
    NOTE: Make sure 3rd gear rotates freely on the shaft.

    Using the Bearing/Oil Seal Plate, Differential Bearing Cup Installer and a suitable press, press the input shaft onto the 3rd gear synchronizer blocking ring and synchronizer assembly.



7. **NOTE:** Invert the input shaft.

   Install a new snap ring.

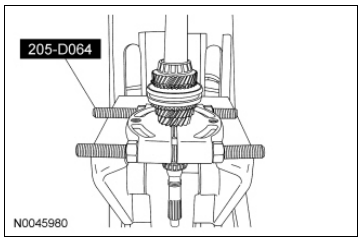


8. Assemble the 4th gear blocking ring set.
9. Assemble the 4th gear synchronizer assembly.
10. Install the 4th gear blocking ring set and synchronizer assembly into the input shaft.
11. ***NOTICE:*** **Press the bearing onto the input shaft by the inner race only. Pressing on the outer race will damage the bearing.**

    NOTE: Make sure 4th gear rotates freely on the shaft.

    NOTE: When installing the synchronizer blocking ring, align the synchronizer blocking ring tab and synchronizer hub inserts.

    Using the Bearing Puller and a suitable press, press on a new bearing.



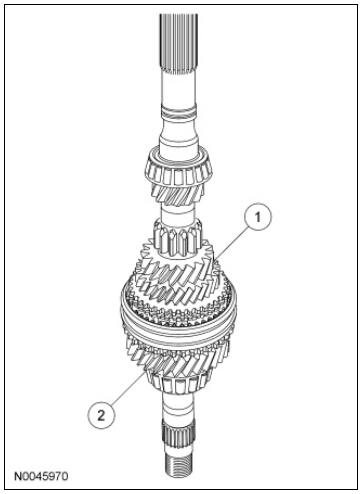
12. **NOTE:** If not within specifications, disassemble and reassemble the input shaft assembly.

    Measure the input shaft clearances.

    1. Measure the clearance between the 3rd and 2nd gears.

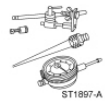
- 2nd gear end play is 0.018-0.46 mm (0.007-0.018 in), maximum end play is 0.51 mm (0.02 in).

2. Measure the clearance between the 4th gear and the bearing cone.
   - 4th gear end play is 0.17-0.37 mm (0.006-0.014 in), maximum end play is 0.42 mm (0.016 in).



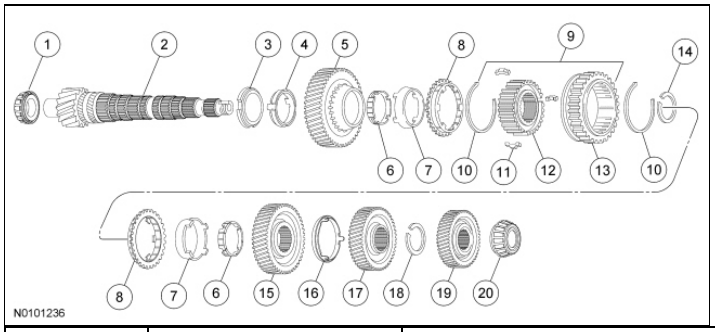
Output Shaft

Special Tool(s)

 ST1368-A	Bearing Puller 205-D064 (D84L-1123-A) or equivalent
 ST1897-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-A)
 ST2444-A	Installer, Differential Bearing Cup 308-155 (T88C-7025-DH)
 ST1559-A	Installer, Transaxle Bearing Cone 307-181 (T87C-77000-D)
 ST1254-A	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)

Material

Item	Specification
SAE 75W-90 API GL-4 Gear Oil XT-4-QGL	WSS-M2C203-A1



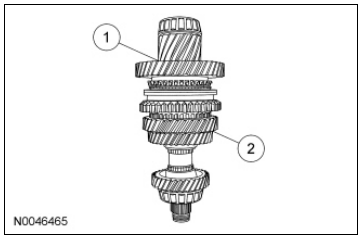
Item	Part Number	Description
1	7F431	Output shaft bearing
2	7061	Output shaft
3	-	Spacer
4	-	Friction dampener
5	7100	1st gear
6	-	Synchronizer inner cones
7	-	Synchronizer outer cones

8	7107	Synchronizer blocking rings
9	-	1st/2nd gear synchronizer assembly
10	-	Synchronizer key springs
11	-	Synchronizer key
12	-	1st/2nd clutch hub
13	-	Clutch hub sleeve (reverse gear)
14	7064	Snap ring
15	7102	2nd gear
16	-	Friction damper cone
17	-	Secondary 3rd gear
18	7064	Snap ring
19	-	Secondary 4th gear
20	7025	Bearing

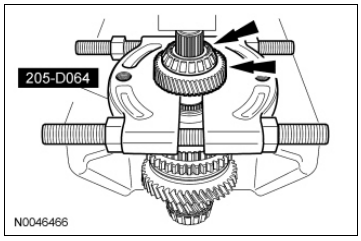
Disassembly

NOTE: When pressing off components, hold the shaft so it does not fall.

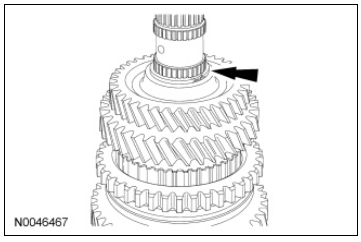
1. Measure the output shaft clearances.
    1. Measure the clearance between 1st gear and the differential drive gear. First gear endplay is 0.05-0.33 mm (0.001-0.012 in).
    2. Measure the clearance between 2nd gear and secondary 3rd gear. Second gear endplay is 0.18-0.51 mm (0.007-0.02 in).



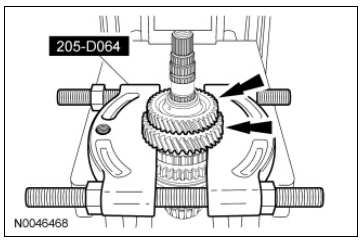
2. Using the Bearing Puller and a suitable press, press off the bearing and 4th gear.
    - Discard the bearing.
    - Always install new bearings and cups as a set.



3. Remove and discard the snap ring.

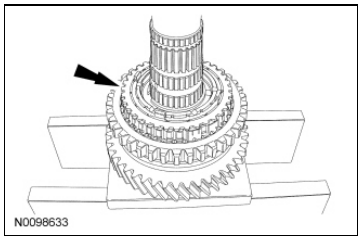


4. Using the Bearing Puller and a suitable press, press off the 3rd gear and 2nd gear.

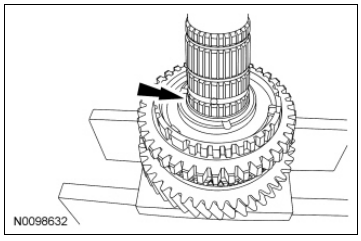


5. **NOTE:** The synchronizer blocking rings are not interchangeable. Be sure to keep them in the order that they were removed.

   Remove the synchronizer blocking ring, the synchronizer inner cone and the synchronizer outer cone.

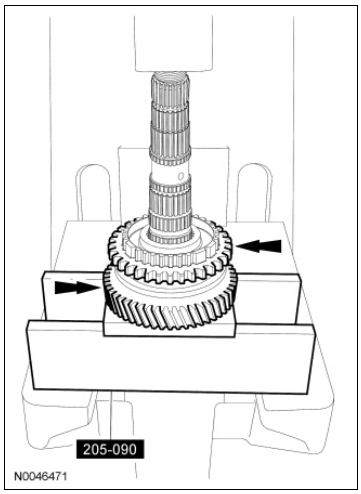


6. Remove and discard the snap ring.



7. **NOTE:** The synchronizer blocking rings are not interchangeable. Make sure to keep them in the order that they were removed.

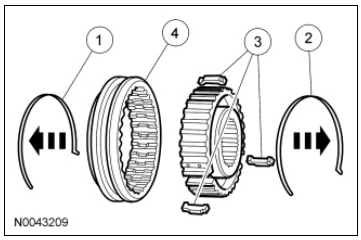
   Using the Bearing/Oil Seal Plate and a suitable press, press off the synchronizer hub, synchronizer blocking ring and 1st gear.



8. **NOTE:** Using a paint pen, mark the hub to sleeve position for reassembly.

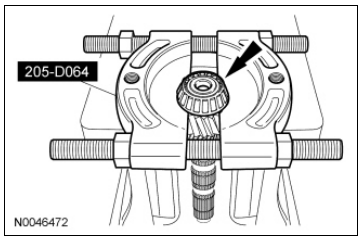
Disassemble the synchronizer assembly.

1. Remove the synchronizer blocking spring.
2. Rotate the synchronizer and remove the opposite spring.
3. Remove the hub inserts.
4. Separate the synchronizer hub from the sleeve.
    - ♦ Inspect all synchronizer components for wear or damage. Install a new synchronizer as necessary.

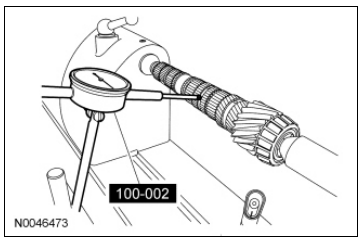


9. **NOTE:** Always install new bearings and cups as a set.

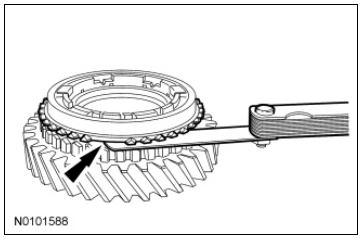
   Using the Bearing Puller and a suitable press, press off the bearing and discard.



10. Using a Dial Indicator Gauge with Holding Fixture, measure the output shaft gear runout.
    - Inspect the output shaft for wear or damage.
    - Inspect the output shaft for a plugged oil passage.
    - Maximum output shaft gear runout is 0.015 mm (0.0006 in).
    - Install a new output shaft as necessary.



11. Set the synchronizer ring squarely in the gear, then measure around the circumference.
    - Measure the clearance from the side of the gear.
        - ♦ Synchronizer ring clearance is 0.80-1.50 mm (0.031-0.059 in).
    - Inspect for smooth engagement with the gear.
    - Inspect for worn or damaged teeth or tapered surface. Install new components as necessary.



12. Inspect the synchronizer hub.
    - Inspect for worn or damaged splines, synchronizer insert groove or end surface.
    - Inspect for smooth hub sleeve movement when it is installed.

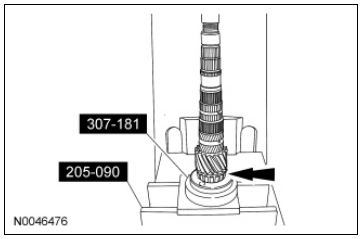
13. Measure the clearance between the 1st/2nd synchronizer hub and its shift fork.
    - Shift fork and hub sleeve clearance is 0.10-0.95 mm (0.003-0.037 in).

Assembly

1. **NOTE:** Do not reassemble the output shaft dry. Apply lubricant throughout the assembly procedure.

   Lubricate all output shaft components with the recommended transmission lubricant during reassemble.

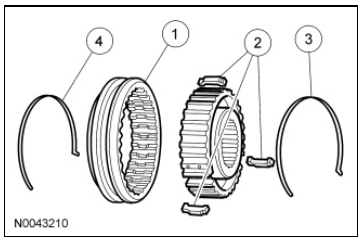
2. Using the Bearing/Oil Seal Plate, Transaxle Bearing Cup Installer and a suitable press, press on a new bearing.



3. If installing a new output shaft, using a suitable press, install the new spacer.

4. Install the friction dampener.

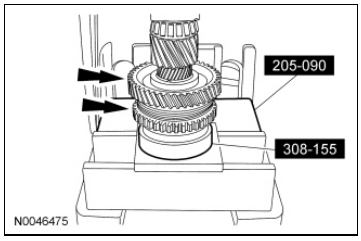
5. Assemble the synchronizer.
    1. Position the synchronizer hub to the sleeve.
    2. Install the hub inserts.
    3. Install the blocking spring.
    4. Rotate the synchronizer and install the opposite blocking spring.



6. Assemble the 1st gear blocking ring set and synchronizer.

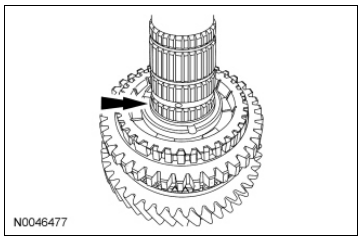
7. **NOTE:** When installing the synchronizer blocking ring, align the synchronizer blocking ring groove and synchronizer hub inserts to prevent damage.

   Using the Bearing/Oil Seal Plate, Differential Bearing Cup Installer and a suitable press, press on the 1st gear, the synchronizer blocking ring and synchronizer assembly.



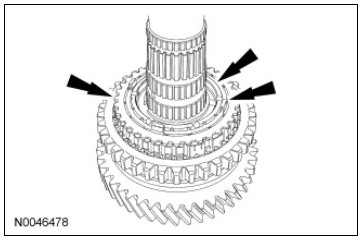
8. Invert the shaft.

9. Install a new snap ring.



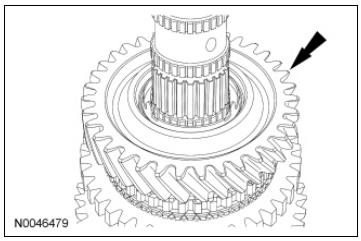
10. **NOTE:** Make sure 1st gear rotates freely.

    Install the synchronizer blocking ring, the synchronizer outer cone and the synchronizer inner cone.

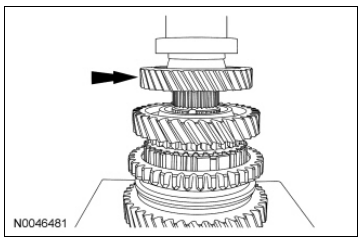


11. Install the friction damper cone onto 2nd gear.

12. Install 2nd gear.

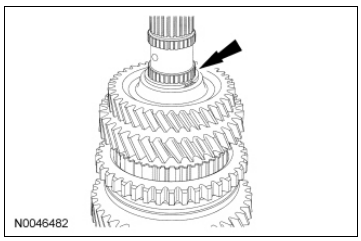


13. Using a suitable tool, press on 3rd gear.
    - Make sure the slots on 3rd gear are aligned with the fingers on the friction damper cone.

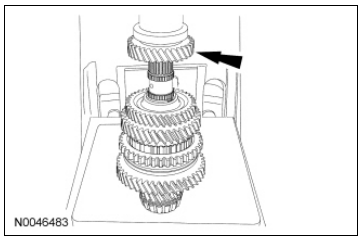


14. **NOTE:** Make sure 2nd gear rotates freely.

Install a new snap ring.



15. Using a suitable tool, press on 4th gear.



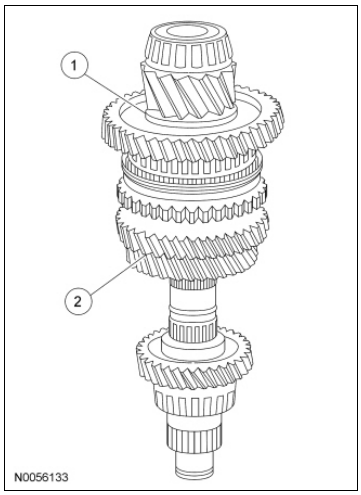
16. ***NOTICE:*** **Only press on the inner race of the bearing or damage may occur to the bearing.**

    Invert the output shaft in the press. Using a suitable tool, install a new bearing.

17. **NOTE:** If not within specifications, disassemble and reassemble the output shaft assembly.

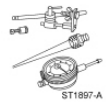
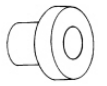
    Measure the output shaft clearances.

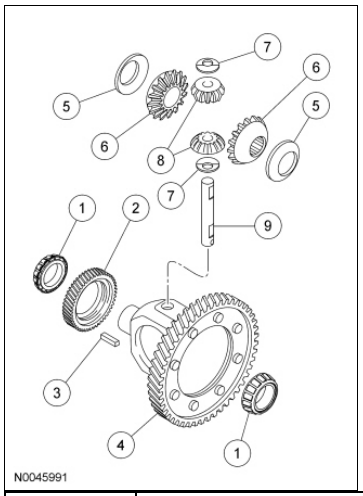
    1. Measure the clearance between 1st gear and the differential drive gear. First gear endplay is 0.05-0.33 mm (0.001-0.012 in).
    2. Measure the clearance between 2nd gear and 3rd gear. Second gear endplay is 0.18-0.51 mm (0.007-0.02 in).



Differential

Special Tool(s)

 ST1369-A	Adapter Set, Step Plate 205-DS011 (D80L-630-A) or equivalent
 ST1368-A	Bearing Puller 205-D064 (D84L-1123-A) or equivalent
 ST1897-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-A)
 ST1583-A	Installer, Differential Bearing Cup 308-162 (T88C-77000-EH)
 ST1596-A	Push/Puller Set 205-DS023 (D80L-927-A) or equivalent



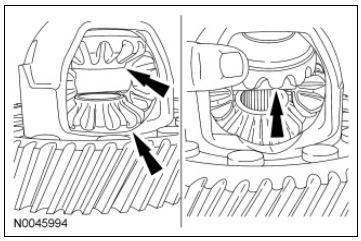
Item	Part Number	Description
1	4221	Differential bearings
2	17285	Speedometer drive gear
3	4241	Differential pinion shaft lock pin
4	4026	Differential
5	4228	Differential side gear thrust washers
6	4236	Differential side gears
7	4230	Differential pinion gear thrust washers
8	4215	Differential pinion gears

9	4211	Differential pinion shaft

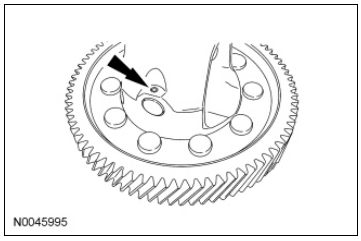
Disassembly

1. Inspect the differential for wear or damage.
    - Inspect for damaged or worn gears.
    - Inspect for worn or damaged differential bearings.
    - Install new components as necessary.

2. Remove the differential side gears and thrust washers.
    - Rotate the differential side gears to remove.

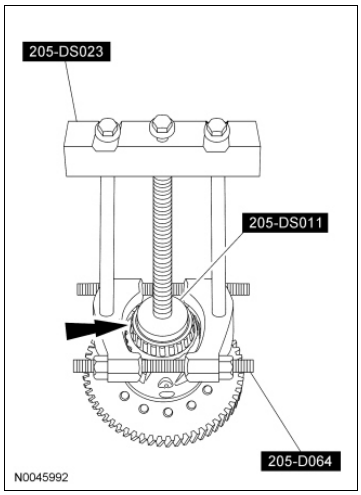


3. Remove and discard the differential pinion shaft lock pin.

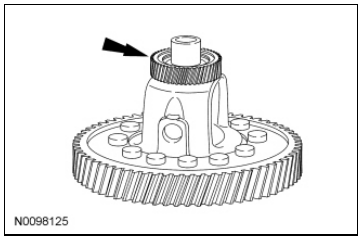


4. Remove the differential pinion shaft, the differential pinon gears and the thrust washers.

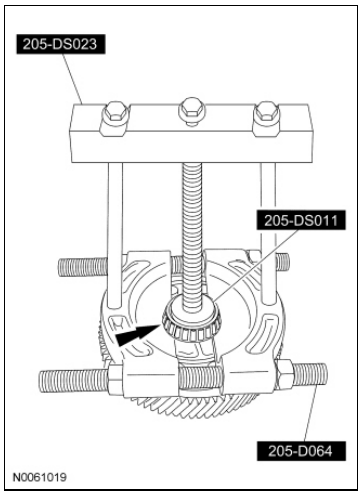
5. Using the Step Plate Adapter Set, Bearing Puller and the Push/Puller Set, remove the differential bearing.
    - Always install new bearings and cups as a set.



6. Remove the speedometer drive gear.

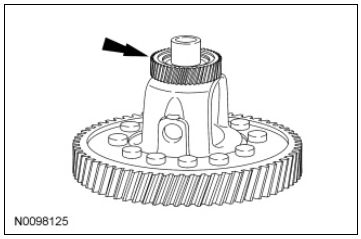


7. Rotate the differential assembly. Using the Step Plate Adapter Set, Bearing Puller and the Push/Puller Set, remove the other differential bearing.
    - Always install new bearings and cups as a set.



Assembly

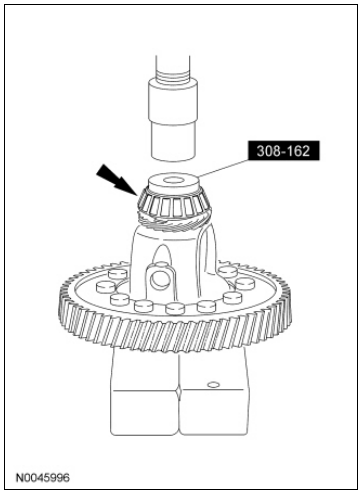
1. Align the locking tabs and install the speedometer drive gear.



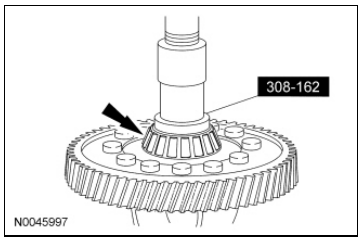
2. ***NOTICE:*** **Press the differential bearings onto the differential case by the inner race only. Pressing on the outer race will damage the bearing.**

   Using the Differential Bearing Cup Installer and a suitable press, press the differential bearing onto the differential case.

    - Always install new bearings and cups as a set.



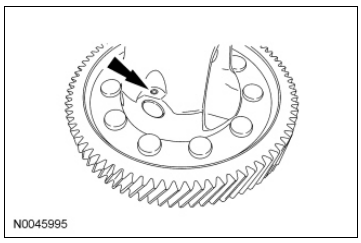
3. Rotate the differential case. Using the Differential Bearing Cup Installer and a suitable press, press on the differential bearing.
    - Always install new bearings and cups as a set.



4. Install the differential pinion gears and thrust washers.

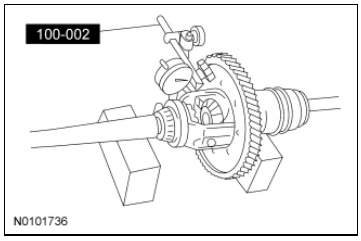
5. Install the differential pinion shaft.

6. Install the new differential pinion shaft lock pin.



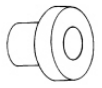
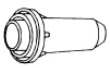
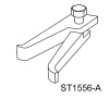
7. Install the differential side gears and thrust washers.

8. Measure the differential backlash using the following steps in the following sequence:
    1. Install the LH and RH halfshafts in the differential.
    2. Support the halfshafts on V-blocks as shown.
    3. Using the Dial Indicator Gauge with Holding Fixture, measure the backlash of both pinion gears.
        - ♦ If not within specification, replace worn and damaged parts.

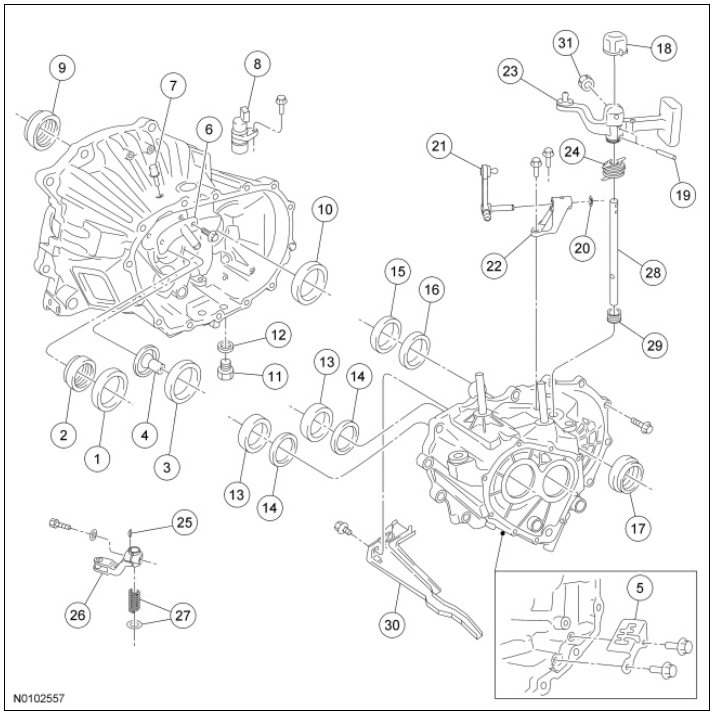

100-002
N0101736

Transaxle Case

Special Tool(s)

 ST1255-A	Handle 205-153 (T80T-4000-W)
 ST1316-A	Installer, Clutch Housing Oil Seal 308-057 (T77J-7025-G)
 ST1563-A	Installer, Differential Bearing Cup 308-162 (T88C-77000-EH)
 ST1560-A	Installer, Halfshaft Oil Seal 308-119 (T87C-77000-H)
 ST1556-A	Remover, Stator Case Bearing 307-163 (T86P-70043-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A

Transaxle Case Exploded View

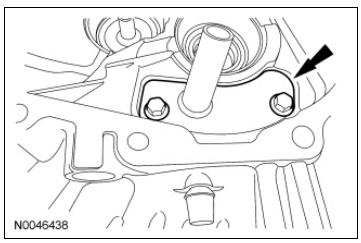


Item	Part Number	Description
1	7025	Bearing race
2	7052	Oil seal
3	7F431	Bearing race
4	7L276	Funnel
5	7479	Shift control selector plate
6	7K470	Vent cover
7	7034	Vent
8	17271	Vehicle Speed Sensor (VSS)
9	7052	Oil seal
10	-	Bearing race
11	7B096	Drain plug
12	99562	Drain plug washer
13	7025	Bearing race
14	-	Selective shim (part of 7L172)
15	7025	Bearing race
16	-	Selective shim (part of 4067)
17	7052	Oil seal
18	7277B	Dust boot (part of 7439)
19	7Z262	Spring pin
20	99576	Snap ring (part of 7439)
21	-	Selector lever (part of 7439)
22	-	Bracket (part of 7439)
23	7202	Shift lever
24	7277A	Dust boot
25	7B220	Key
26	7B125	Control rod end
27	7G046	Spring and washer
28	7358	Shift lever shaft
29	7288	Oil seal
30	7A174	Oil funnel
31	7141	Bushing

Disassembly and Assembly

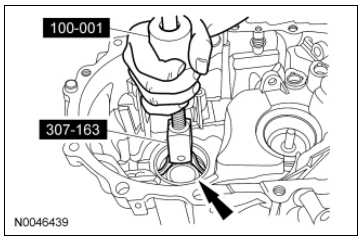
1. Place the transaxle clutch housing on a bench.

2. Remove the 2 vent cover bolts and the vent cover.

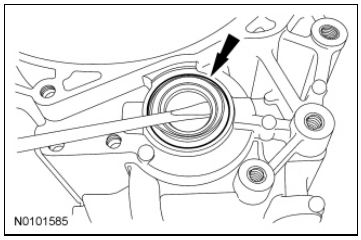


3. Using the Slide Hammer and Stator Case Bearing Remover, remove the differential bearing cup.

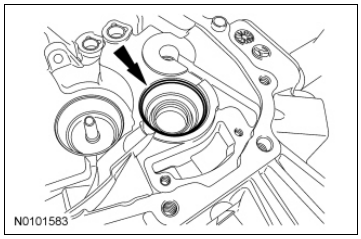
- Inspect the cup for wear or damage. Install a new cup as necessary.
- Always install new bearings and cups as a set.



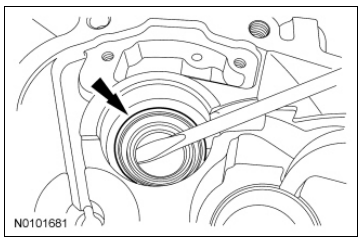
4. Using a screwdriver, remove and discard the differential seal.



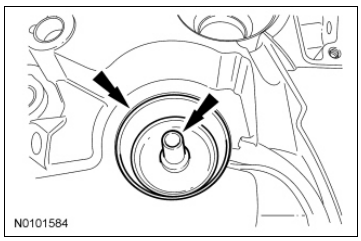
5. Remove the input shaft bearing cup.
    - Inspect the cup for wear or damage. Install a new cup as necessary.
    - Always install new bearings and cups as a set.



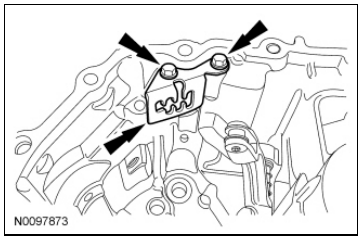
6. Using a screwdriver, remove and discard the input shaft oil seal.



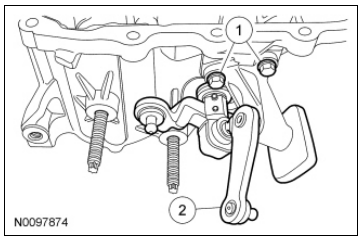
7. Remove the output shaft bearing cup and the funnel.
    - Inspect the cup for wear or damage. Install a new cup as necessary.
    - Always install new bearings and cups as a set.



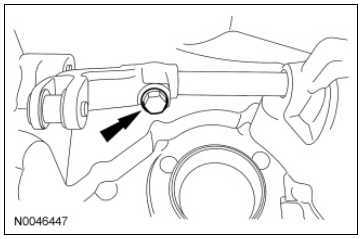
8. Remove the shift control selector plate bolts and the shift control selector plate.



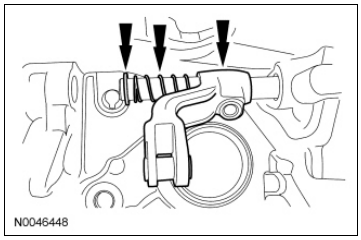
9. Working on the transaxle case:
    1. Remove the 2 shift lever assembly bolts and separate the boot from the case.
    2. Separate the shift arm, boot and bushing from the shift lever assembly.



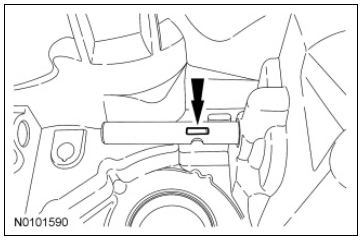
10. Remove the control arm bolt.



11. Pull the shift lever outward, then remove the washer, spring and the control arm.

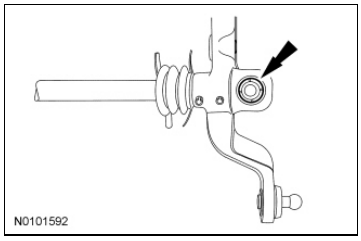


12. Remove the control arm key.

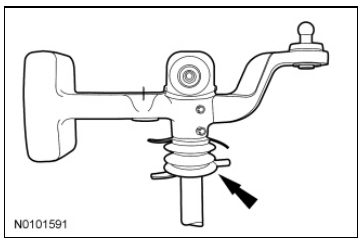


13. Remove the shift lever from the case.
    - Inspect all components for wear or damage. Install new components as necessary.

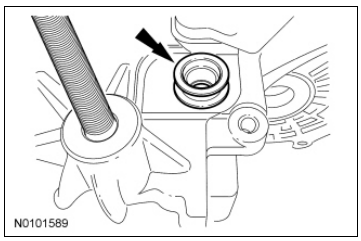
14. Inspect the shift lever bushing and replace if necessary.



15. Remove the shift lever boot.



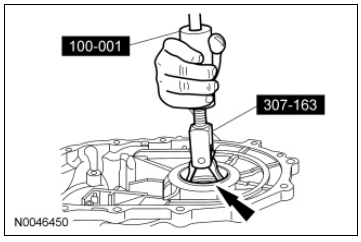
16. Remove the shift lever seal.



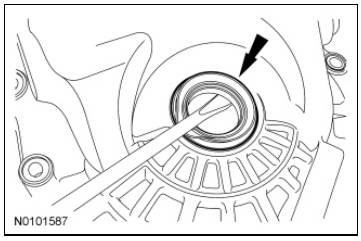
17. Remove the input shaft bearing cup and shims.
    - Inspect the cup for wear or damage. Install a new cup as necessary.
    - Always install new bearings and cups as a set.

18. Remove the output shaft bearing cup and shims.
    - Inspect the cup for wear or damage. Install a new cup as necessary.
    - Always install new bearings and cups as a set.

19. Using the Slide Hammer and Stator Case Bearing Remover, remove the differential bearing cup and shims.
    - Inspect the cup for wear or damage. Install a new cup as necessary.
    - Always install new bearings and cups as a set.



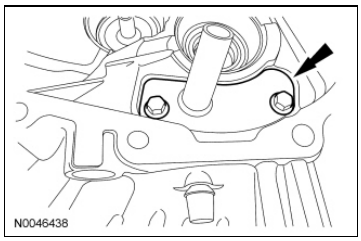
20. Remove and discard the differential oil seal.



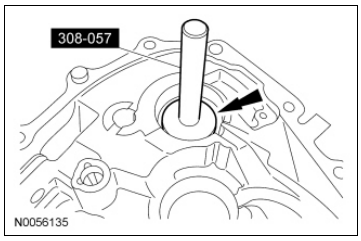
Assembly

1. Do not install the following components into the transaxle case at this time. These components will be installed during final assembly.
    - Input shaft bearing cup and shim
    - Output shaft bearing cup and shim
    - Differential bearing cup and shim
    - Funnel

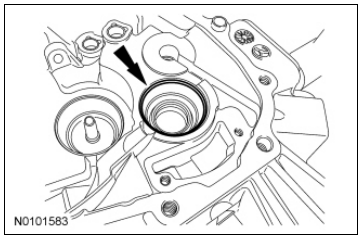
2. Working on the transaxle clutch housing side, install the vent cover and the 2 vent cover bolts.
    - Tighten to 10 Nm (89 lb-in).



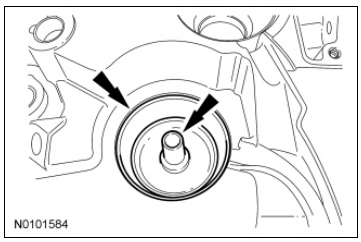
3. Using the Clutch Housing Oil Seal Installer, install a new input shaft seal.



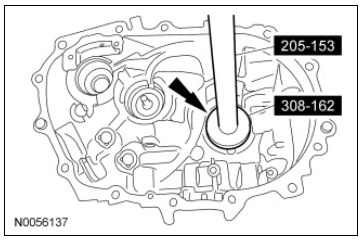
4. Install the input shaft bearing cup into the clutch housing.



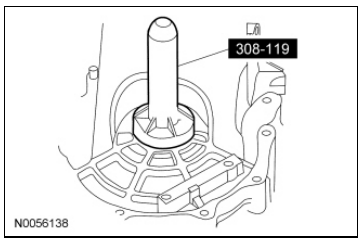
5. Align and install the funnel and the output shaft bearing cup into the clutch housing.



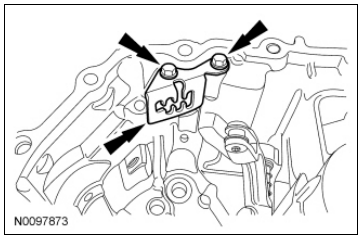
6. Using the Differential Bearing Cup Installer and Handle, install the differential bearing cup into the clutch housing.



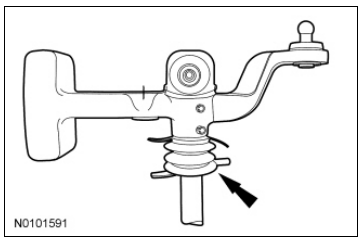
7. Using the Halfshaft Oil Seal Installer, install new halfshaft seals.



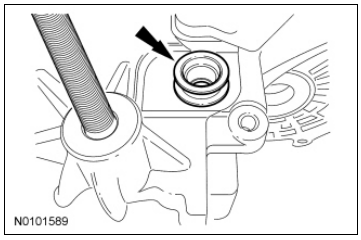
8. Install the shift control selector plate.
    - Tighten the bolt on the left to 10 Nm (89 lb-in).
    - Tighten the bolt on the right to 28 Nm (21 lb-ft).



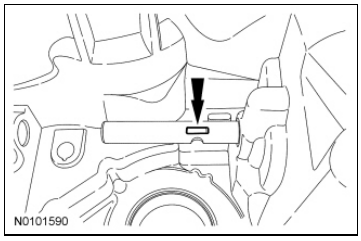
9. Install the shift lever boot.



10. Install shift lever seal into the case.



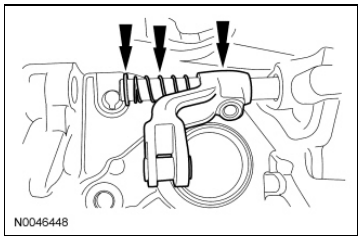
11. Install the shift lever rod into the case. Install the control arm key.



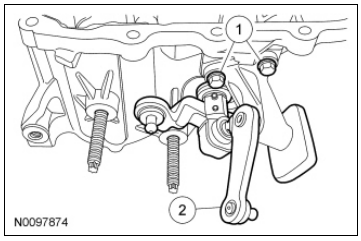
12. **NOTE:** Use care not to let the washer fall off the rod.

    Install the control arm, the spring and the washer. Push the assembly inward. Align the control arm bolt with the notch on the shift lever rod. Install the bolt.

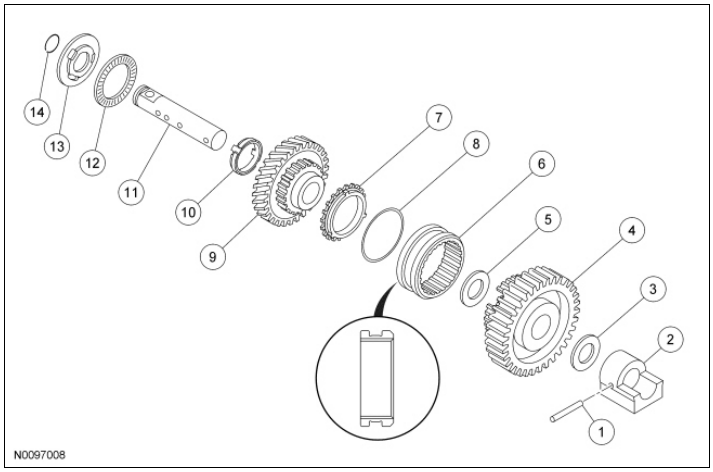
    - Tighten to 12 Nm (106 lb-in).



13. Install the shift lever assembly.
    1. Install the 2 shift lever assembly bolts and attach the boot and bushing to the case.
        - ♦ Tighten to 22 Nm (16 lb-ft).
    2. Attach the shift arm, boot and bushing to the shift assembly.



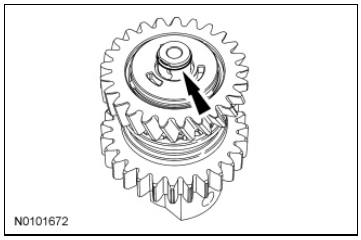
Reverse Idler Gear



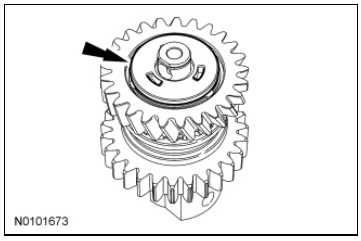
Item	Part Number	Description
1	-	Roll pin
2	-	Reverse idler gear support
3	-	Washer
4	-	Reverse idler gear
5	-	Thrust washer
6	-	Reverse clutch hub sleeve
7	-	Reverse synchronizer ring
8	-	Synchronizer key spring
9	-	Reverse idler gear
10	-	Friction damper
11	-	Reverse idler gear shaft
12	-	Needle bearing
13	-	Thrust washer
14	-	Clip

Disassembly

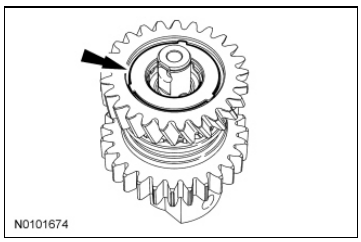
1. Remove the clip.



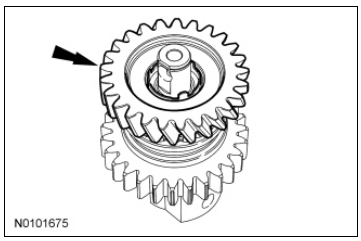
2. Remove the thrust washer.



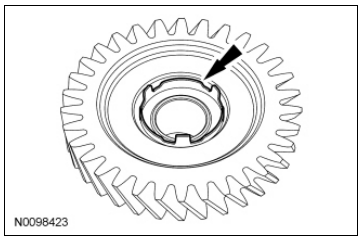
3. Remove the needle bearing.



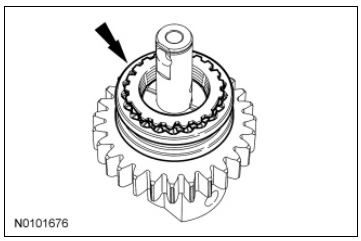
4. Remove the reverse idler gear.



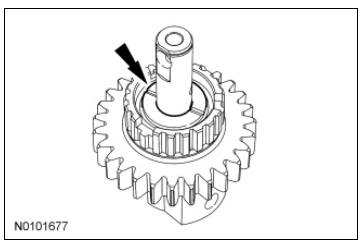
5. Remove the friction damper.



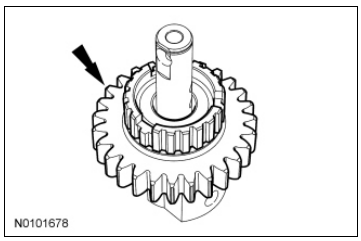
6. Remove the reverse synchronizer assembly.



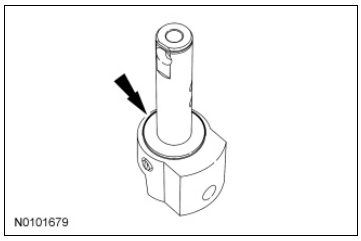
7. Remove the reverse idler gear washer.



8. Remove the reverse idler gear.

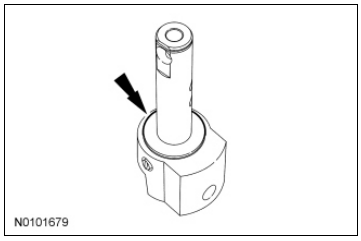


9. Remove the reverse idler gear washer.

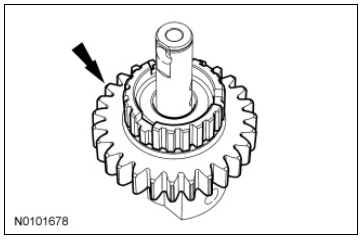


Assembly

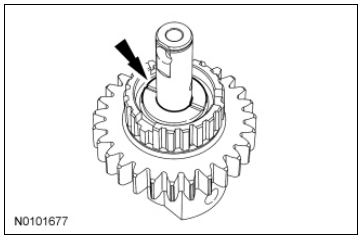
1. Install the reverse idler gear washer.



2. Install the reverse idler gear.



3. Install the reverse idler gear washer.



4. Install the reverse synchronizer assembly.
   - Reverse clutch hub inspection.
     - ♦ Inspect the clutch hub sleeve and hub operation. Install new components as necessary.

- ♦ Inspect the gear teeth for damage, wear, and cracks. Install new components as necessary.
- ♦ Measure the clearance between the hub sleeve and shift forks. If it exceeds the maximum specification replace the hub sleeve and shift fork as a set.

Reverse Clutch Hub Sleeve and Shift Fork Clearance

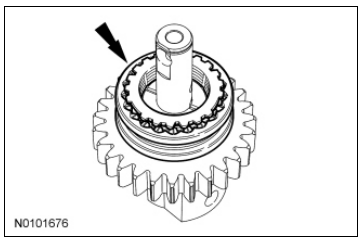
Standard	Maximum
0.10 mm-0.40 mm (0.003-0.015 in)	0.90 mm (0.035 in)

- Reverse synchronizer ring inspection.
  - ♦ Inspect the synchronizer teeth for damage, wear and cracks. Install new components as necessary.
  - ♦ Inspect the tapered surface for wear or cracks. Install new components as necessary.
  - ♦ **NOTE:** Set the synchronizer ring squarely on the gear and measure around the circumference.

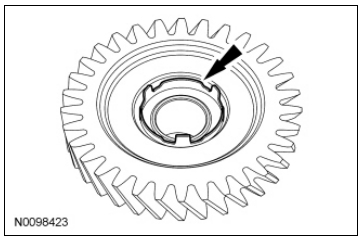
    Measure the clearance between the synchronizer ring and the flank surface on the gear. If it is less than minimum specification, replace the synchronizer ring.

Reverse Synchronizer Ring Clearance

Standard	Minimum
1.50 mm (0.059 in)	0.80 mm (0.031 in)



5. Install the friction damper onto the reverse idler gear.

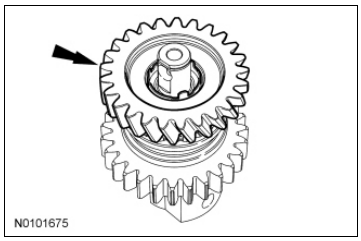


6. **NOTE:** The reverse idler gear is not serviced separately. A kit consisting of the output shaft reverse gear, the countershaft reverse gear and the reverse idler gear is available for service. All 3 gears in the kit must be installed. The replacement gears are not compatible with the existing gears.

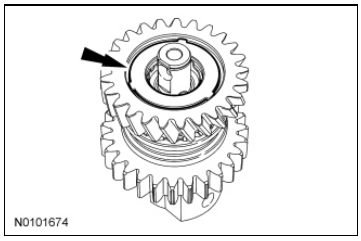
   Install the reverse idler gear.

   - Reverse idler gear inspection.
     - ♦ Inspect the synchronizer cones for wear. Install new components as necessary.

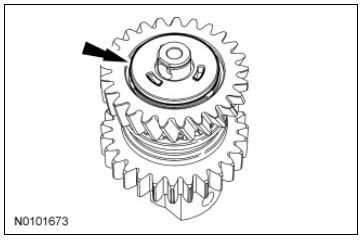
- Inspect the gear teeth for damage, wear and cracks. Install new components as necessary.
- Inspect the synchronizer ring matching teeth for damage or wear. Install new components as necessary.



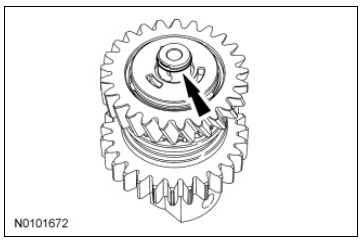
7. Install the needle bearing.



8. Install the thrust washer.



9. Install the clip.



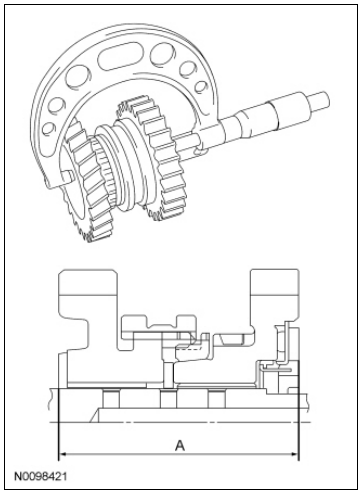
10. Measure the reverse idler gear component dimension.

Reverse Thrust Washer Thickness

mm	Inch
2.04	0.080
2.09	0.082
2.14	0.084
2.19	0.086
2.24	0.088
2.29	0.090

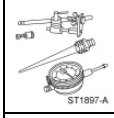
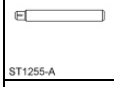
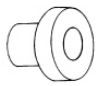
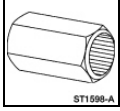
2.34	0.092
2.39	0.094

- If the reverse idler gear component dimension is not within specification, install a thrust washer of the correct thickness.



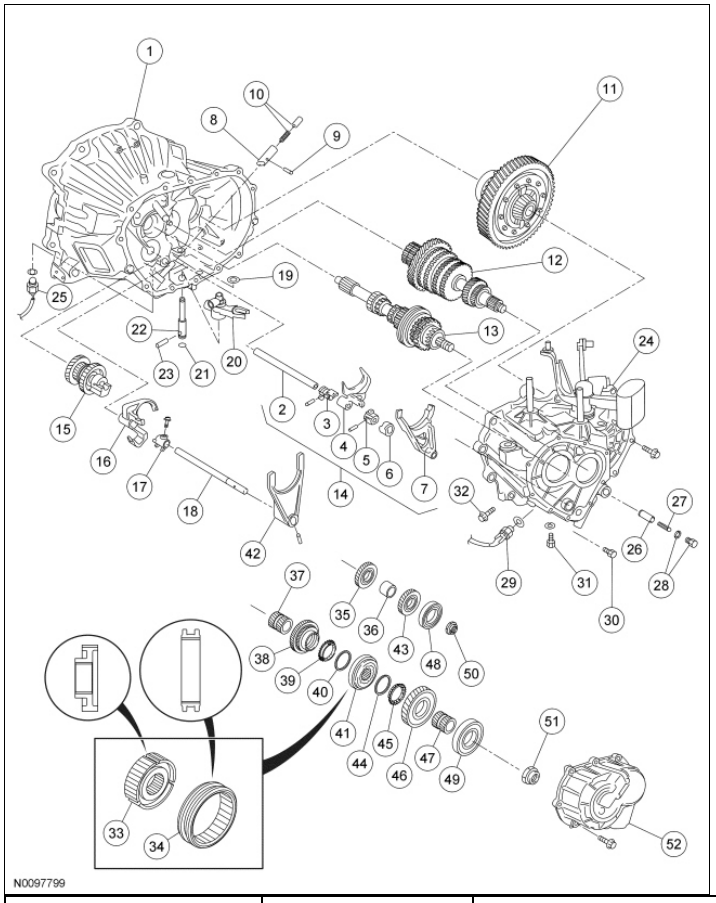
Transaxle

Special Tool(s)

 ST1897-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-A)
 ST1255-A	Handle 205-153 (T80T-4000-W)
 ST1186-A	Holding Fixture 307-003 (T57L-500-B)
 ST1563-A	Installer, Differential Bearing Cup Replacer 308-162 (T88C-77000-EH)
 ST1597-A	Rotator, Differential 308-165 (T88C-77000-L)
 ST1564-A	Shim Selection Set 308-161 (T88C-77000-C)
 ST1562-A	Shim Selection Set 308-164 (T88C-77000-JF)
 ST1598-A	Turning Torque Socket, Transmission 308-160 (T88C-7025-GH)

Material

Item	Specification
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

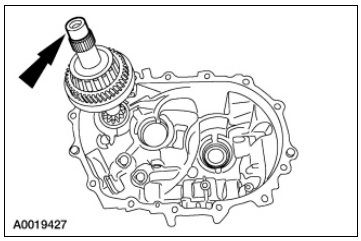


Item	Part Number	Description
1	7505	Clutch housing
2	-	Control rod
3	-	Control end
4	-	1st/2nd shift fork
5	-	Control lever
6	-	Interlock lever
7	-	3rd/4th shift fork
8	-	Inner shift lever
9	-	Spring pin
10	-	Push pin component and spring
11	4026	Differential
12	-	Secondary shaft gear assembly
13	-	Primary shaft gear assembly
14	-	Shift fork and shift rod assembly
15	-	Reverse idler gear
16	-	Reverse shift fork
17	-	5th/reverse shift rod end
18	-	5th/reverse shift rod
19	7L027	Magnet
20	7F116	Crank lever component
21	-	O-ring
22	7C355	Crank lever shaft

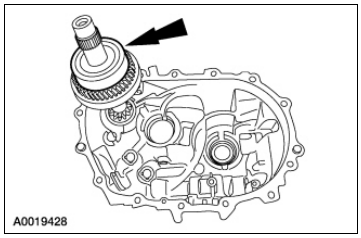
23	-	Pin
24	7005	Transaxle case component
25	7G072	Neutral switch
26	-	Push pin component
27	-	Detent spring
g bolt and washer		
29	15520	Reversing lamp switch
30	-	Lock bolt
31	-	Shift rail guide bolt
32	-	Reverse idler shaft lock bolt
33	-	Clutch hub
34	-	Clutch hub sleeve
35	-	Secondary 5th gear
36	-	Spacer
37	-	Gear sleeve
38	-	5th gear
39	-	5th gear synchronizer
40	-	Synchronizer key spring
41	-	5th/6th clutch hub
42	-	5th/6th shift fork
43	-	Secondary 6th gear
44	-	Synchronizer key spring
45	-	6th gear synchronizer
46	-	6th gear
47	-	Gear sleeve
48	-	Bearing (secondary shaft)
49	-	Bearing (primary shaft)
50	7N170	Locknut (secondary shaft)
51	7N170	Locknut (primary shaft)
52	7222	Rear cover

NOTE: Whenever the transaxle has been disassembled, the bearing preload must be and differential bearing preload can be adjusted by selecting shims to insert between the bearing races and the case.

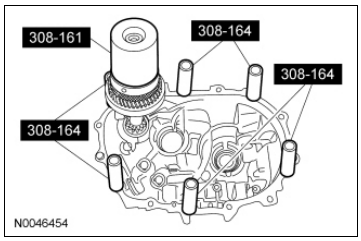
1. Install the input shaft.



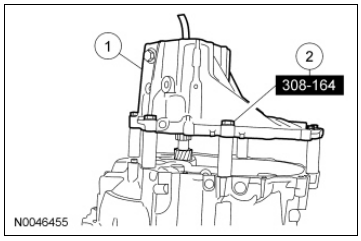
2. Install the bearing cup onto the bearing.



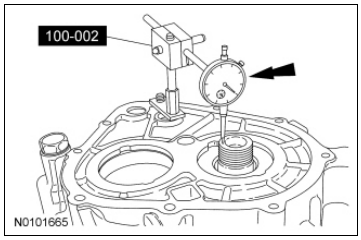
3. Install the Shim Selection Set.



4. Install the transaxle case.
    1. Position the transaxle case in place.
    2. Install the Shim Selection Set bolts.
        - Tighten to 45 Nm (33 lb-ft).



5. Mount the Dial Indicator Gauge with Holding Fixture to the transaxle case.



6. Rotate the input shaft to seat the bearings.

7. Zero the Dial Indicator Gauge with Holding Fixture.

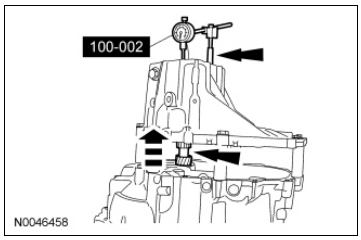
8. **NOTE:** The shaft must be lifted equally on both sides or it may bind on one side, resulting in an incorrect reading.

   Rotate the input shaft until the Dial Indicator Gauge returns to zero, then raise the input shaft and read the end play.

   - Take and record 3 readings within 0.10 mm (0.003 in) of each other. Use the formula below to select the correct shim size.

Average the 3 readings	Example
Reading A	0.019

Reading B	0.014
Reading C	+0.021
	0.054 ÷ 3 = 0.018
Final Shim Size	0.018

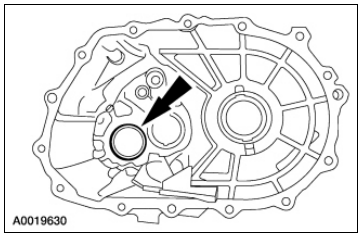


9. **NOTE:** Do not use more than 2 shims.

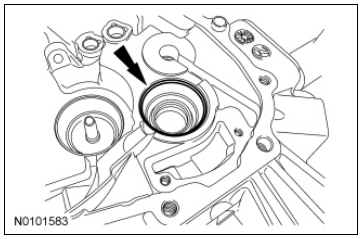
   From the Shim Selection Set, select the shim(s) that is closest to (or slightly thinner than) the final shim size calculated in the previous step.

10. Remove the transaxle case, Shim Selection Set, bearing cup and input shaft.

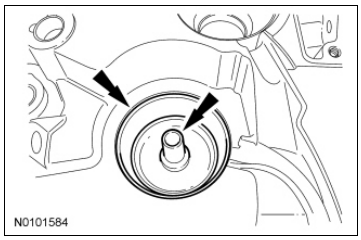
11. Install the input shaft shim(s).



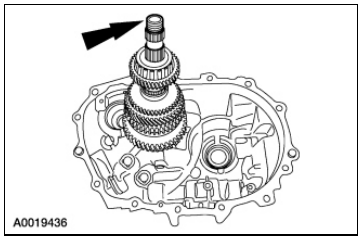
12. Install the input shaft bearing cup.



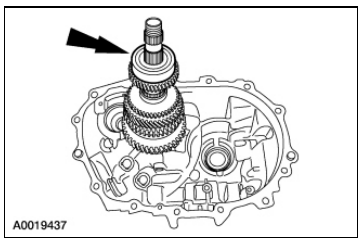
13. Install the funnel and the output shaft bearing cup.



14. Install the output shaft.

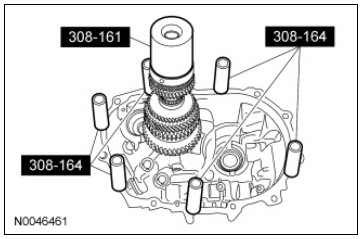


15. Install the bearing cup onto the bearing.

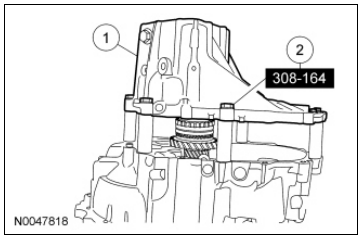


16. **NOTE:** The gauge halves must be turned to eliminate any gap between them.

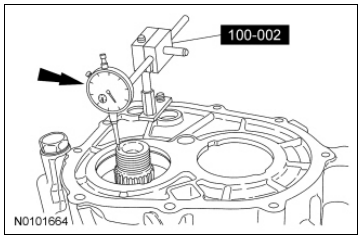
    Install the Shim Selection Set.



17. Install the transaxle case.
    1. Position the transaxle case in place.
    2. Install the Shim Selection Set bolts.
        - Tighten to 45 Nm (33 lb-ft).



18. Mount the Dial Indicator Gauge with Holding Fixture on the transaxle case.



19. Rotate the output shaft to seat the bearings.

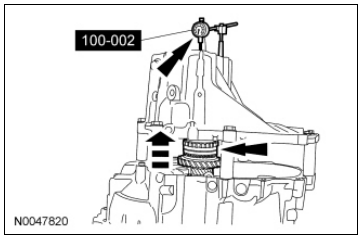
20. Zero the Dial Indicator Gauge.

21. **NOTE:** The shaft must be lifted equally on both sides or it may bind on one side, resulting in an incorrect reading.

    Rotate the output shaft until the Dial Indicator Gauge returns to zero, then raise the output shaft and read the end play.

    - Take and record 3 readings within 0.10 mm (0.003 in) of each other. Use the formula below to select the correct shim size.

Average the 3 readings	Example
Reading A	0.019
Reading B	0.014
Reading C	+0.021
	0.054 ÷ 3 = 0.018
Final Shim Size	0.018

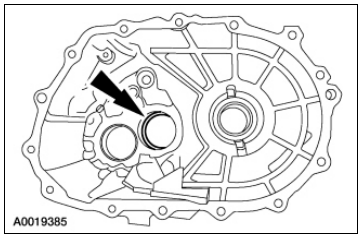


2. **NOTE:** Do not use more than 2 shims.

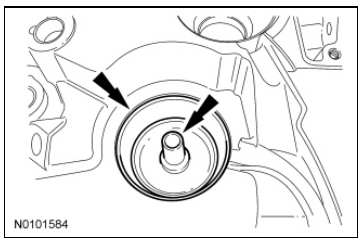
   From the Shim Selection Set, select the shim(s) that is closest to (or slightly thinner than) the final shim size determined in the previous step.

23. Remove the transaxle case, Shim Selection Set, bearing cup and output shaft.

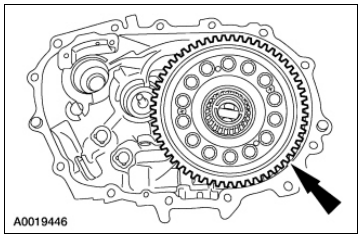
24. Install the shim.



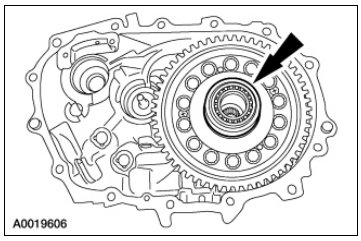
25. Install the funnel and the output shaft bearing cup.



26. Install the differential.

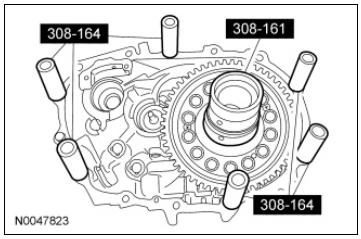


27. Install the bearing cup onto the bearing.

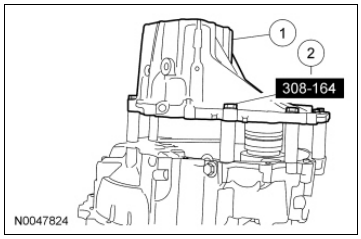


28. **NOTE:** The gauge halves must be turned to eliminate any gap between them.

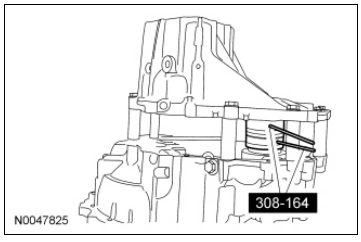
    Install the Shim Selection Set.



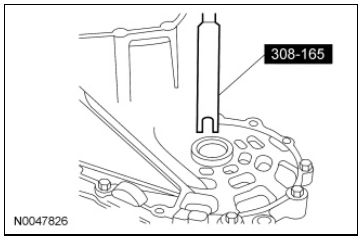
29. Install the transaxle case.
    1. Position the transaxle case in place.
    2. Install the Shim Selection Set bolts.
        - Tighten to 45 Nm (33 lb-ft).



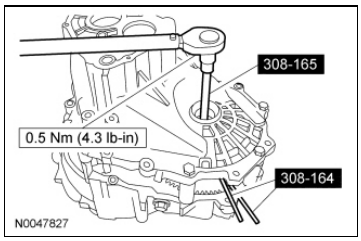
30. Using the Shim Selection Set, adjust gauge until the free play is removed. Turn gauge back together.



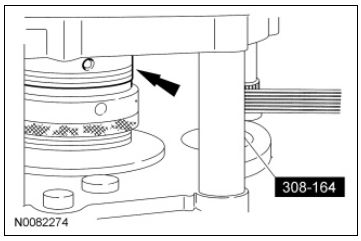
31. Insert the Differential Rotator through the transaxle case and engage the differential pinion shaft.



32. Using the Differential Rotator and Shim Selector Set, adjust gauge until the differential rotation is within specification.



33. Measure the gap in the Shim Selector Set.



34. ***NOTICE:*** **Do not use more than 2 differential shims.**

    Add 0.15 mm (0.005 in) to the measurement to achieve the final clearance.

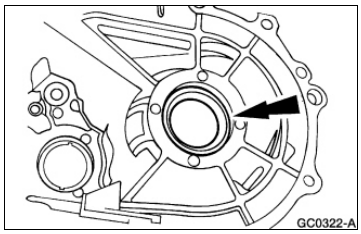
    - Using the following chart, select the differential bearing shims that are closest to (or slightly larger than) the final shim size.

Shim Thickness
0.10 mm (0.003 in)
0.15 mm (0.005 in)
0.20 mm (0.007 in)
0.25 mm (0.009 in)
0.30 mm (0.011 in)
0.35 mm (0.013 in)
0.40 mm (0.015 in)
0.45 mm (0.017 in)
0.50 mm (0.019 in)
0.55 mm (0.021 in)
0.60 mm (0.023 in)
0.65 mm (0.025 in)
0.70 mm (0.027 in)
0.75 mm (0.029 in)
0.80 mm (0.031 in)

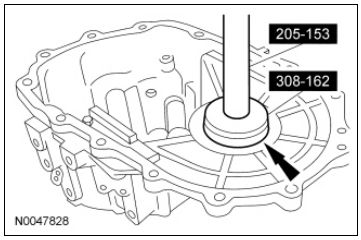
0.85 mm (0.033 in)
0.90 mm (0.035 in)
0.95 mm (0.037 in)
1.00 mm (0.039 in)
1.05 mm (0.041 in)
1.10 mm (0.043 in)
1.15 mm (0.045 in)
1.20 mm (0.047 in)

35. Remove the transaxle case, Shim Selection Set, differential and bearing cup.

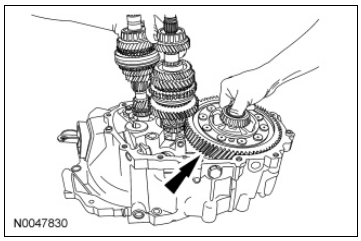
36. Install the differential bearing cup shim(s) into the transaxle case.



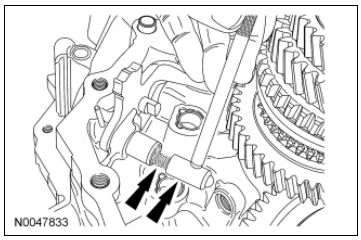
37. Using the Differential Bearing Cup Installer and Handle, install the differential bearing cup into the transaxle case.



38. Install the output shaft, the input shaft and the differential together.

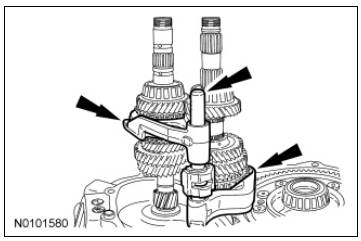


39. Install the spring and the shift detent.



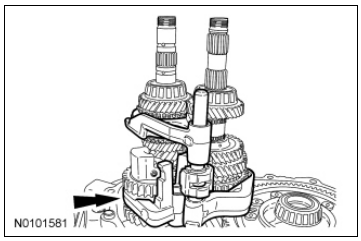
40. Shift the synchronizers into the 2nd and 4th gear positions.

41. Install the main shift control shaft assembly, shift forks.

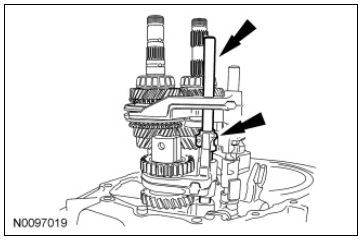


42. **NOTE:** Align the reverse idler shaft anchor bolt hole for installation of the bolt through the case.

    Install the reverse idler gear and shift fork.



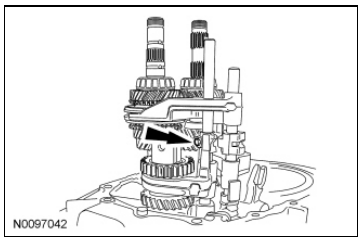
43. Install the shift control shaft and the shift gate.



44. **NOTE:** Make sure to align the shift gate at the bottom and the shift gate with the main shift control.

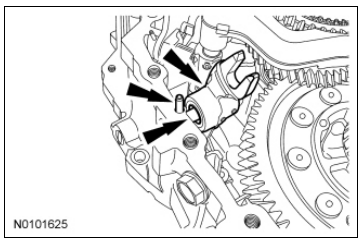
    Install the shift gate bolt.

    - Tighten to 13 Nm (115 lb-in).

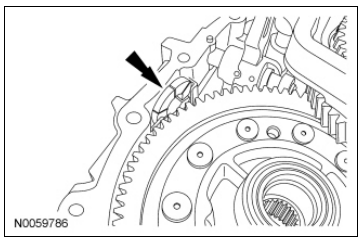


45. **NOTE:** Shift lever shaft uses a solid pin.

    Install the shift lever shaft, shift fork selector lever and shift shaft pin.

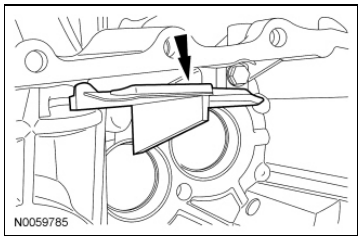


46. Install the magnet.



47. Position the 2nd and 4th gear synchronizers into neutral, then shift the 1st/2nd gear synchronizer into neutral.

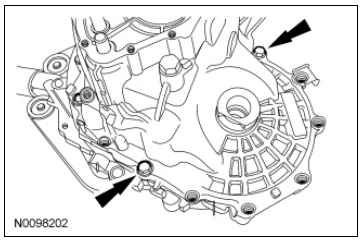
48. Install the oil funnel.



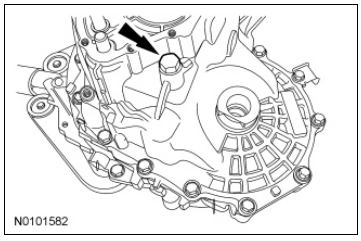
49. **NOTE:** The transaxle case must be installed within 4 minutes after applying silicone gasket and sealant.

    Apply a small bead of silicone gasket and sealant to the transaxle mating surface.
    Install the transaxle case and the 2 transaxle case bolts.

    - Make sure to align the shift lever to the shift lever shaft. Do not move the shaft outward to the stop. The washer can slide off of the shaft into the case.
    - Tighten to 45 Nm (33 lb-ft).



50. Install the shift detent ball, spring and bolt.
    - Tighten to 18 Nm (159 lb-in).

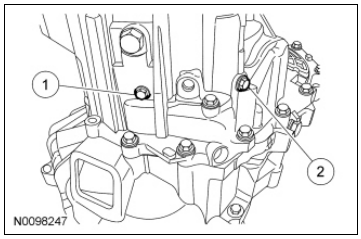


51. **NOTE:** Make sure that the shift rail guide bolt is in the groove of the shift rail.

    NOTE: Do not shift the transaxle until the reverse idler shaft lock bolt and the shift rail guide bolt are installed.

Install the reverse idler shaft lock bolt and the shift rail guide bolt.

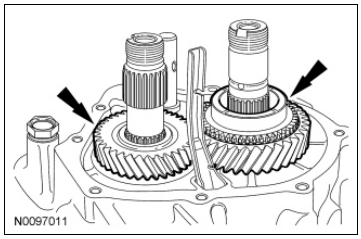
1. Install the reverse idler shaft lock bolt.
   - ♦ Tighten the reverse idler shaft lock bolt to 22 Nm (16 lb-ft).
2. Install the shift rail guide bolt.
   - ♦ Tighten the shift rail guide bolt to 12 Nm (106 lb-in).



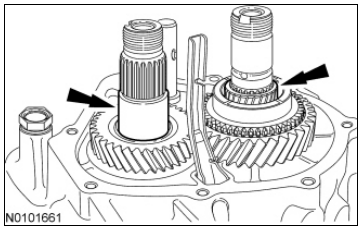
52. Check the shift function.

53. Install the remaining 13 transaxle case bolts.
    - • Tighten to 45 Nm (33 lb-ft).

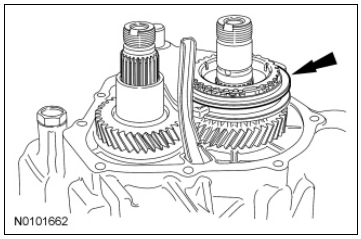
54. Install the primary and secondary 5th gears.



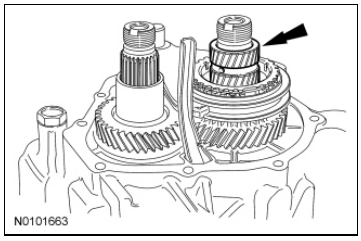
55. Install the spacer and the gear sleeve.



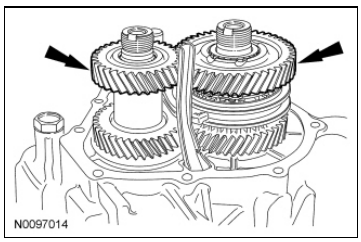
56. Install the 5th/6th shift fork and synchronizer assembly.



57. Install the gear spacer.

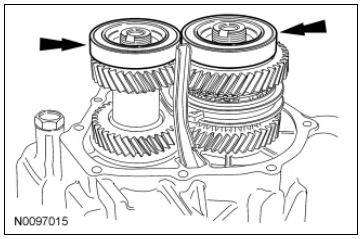


58. Install the primary and secondary 6th gears.

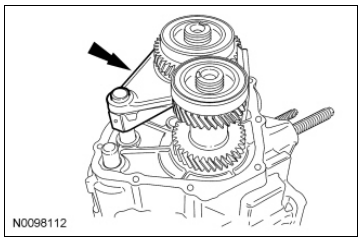


59. **NOTE:** When the locknuts are tightened to specifications they will seat the bearings.

    Install the 6th gear bearings onto the primary and secondary shafts.



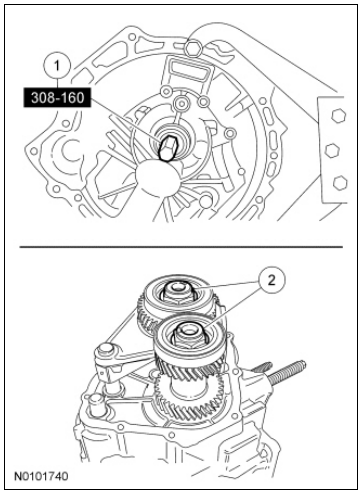
60. Shift the 5th/6th gear shift fork to 5th.



61. **NOTE:** Do not reuse locknuts.

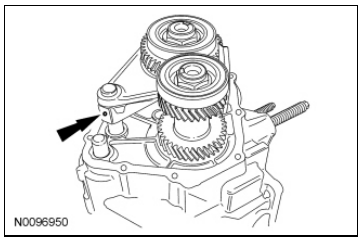
    Install the new primary and secondary shaft locknuts.

    1. Shifting into 5th/6th gears and using the Transmission Turning Torque Socket will keep the primary shaft from turning.
    2. Install the new primary and secondary shaft locknuts. Using a punch, stake the locknuts to the shafts.
        - Tighten to 160 Nm (118 lb-ft).



62. **NOTE:** Shift 5th/6th into neutral.

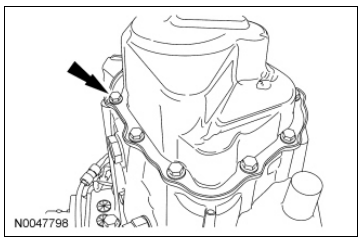
    Install a new 5th/6th shift fork roll pin.



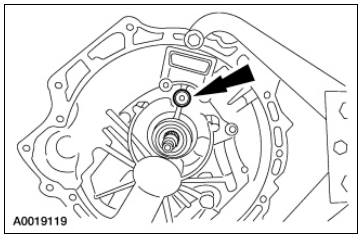
63. **NOTE:** The case cover must be installed within 4 minutes after applying silicone gasket and sealant.

    Apply a small bead of silicone gasket and sealant to the case and case cover mating surface.

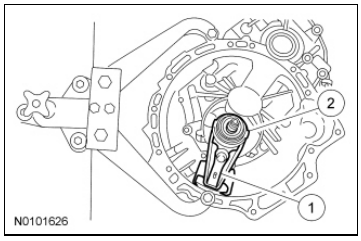
64. Install the case cover and the 9 case cover bolts.
    - Tighten to 45 Nm (33 lb-ft).



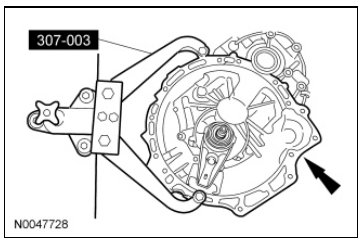
65. If removed, install the anchor bolt.
    - Tighten to 10 Nm (89 lb-in).



66. Install the clutch release fork and bearing.
    1. Install the clutch release fork and diaphragm.
    2. Install the clutch release bearing.

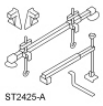


67. Remove the transaxle from the Holding Fixture.



Transaxle

Special Tool(s)

 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent
 ST2425-A	Support Bar, Engine 303-F072 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
SAE 75W-90 API GL-4 Gear Oil XT-4-QGL	WSS-M2C203-A1
Threadlock and Sealer TA-25	WSK-M2G351-A5

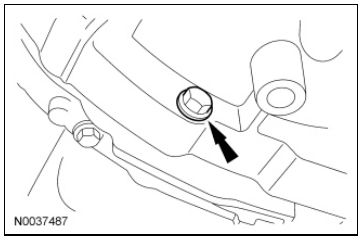
⚠ **WARNING: Do not breathe dust or use compressed air to blow dust from storage containers or friction components. Remove dust using government-approved techniques. Friction component dust may be a cancer and lung disease hazard. Exposure to potentially hazardous components may occur if dusts are created during repair of friction components, such as brake pads and clutch discs. Exposure may also cause irritation to skin, eyes and respiratory tract, and may cause allergic reactions and/or may lead to other chronic health effects. If irritation persists, seek medical attention or advice. Failure to follow these instructions may result in serious personal injury.**

1. **NOTE:** Wipe off excess grease. The splines should have a thin film of grease only. Excess grease can contaminate the clutch facing and affect clutch function.

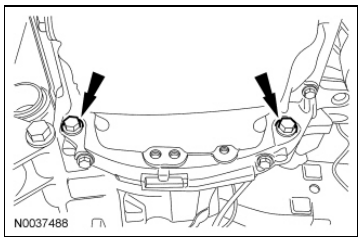
   Apply a very small amount of grease on the input shaft splines.

2. Secure the transaxle to a suitable transmission jack with a safety strap. Raise and position the transaxle behind the engine.

3. Install the clutch housing-to-oil pan bolt.
   - Tighten to 48 Nm (35 lb-ft).



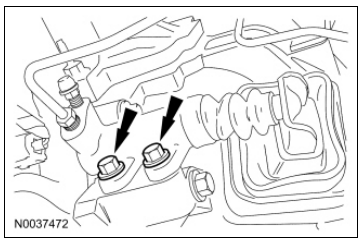
4. Install the 2 oil pan-to-clutch housing bolts.
    - Tighten to 48 Nm (35 lb-ft).



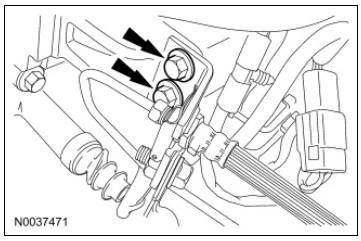
5. Install the 4 lower transaxle-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).

6. Apply threadlock and sealer to the threads and install the 2 transmission lower mount nuts and bolt to the transaxle. Do not tighten the fasteners at this time.

7. Position the clutch slave cylinder to the clutch release arm and install the bolts.
    - Tighten to 20 Nm (177 lb-in).

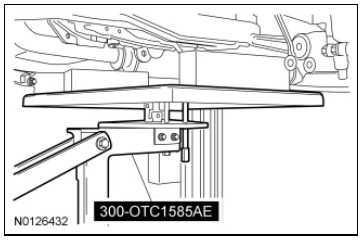


8. Install the clutch tube hydraulic line bracket bolts.
    - Tighten to 22 Nm (16 lb-ft).



9. Install the starter motor. For additional information, refer to Section 303-06 .

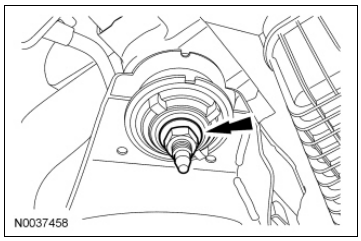
10. Place the subframe assembly on the Powertrain Lift and raise the subframe into the installed position.



11. **NOTE:** LH shown, RH similar.

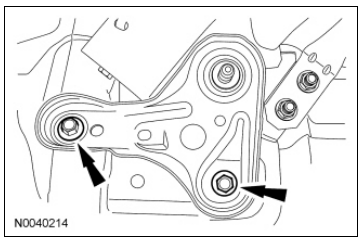
    Install the front subframe nuts.

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



12. **NOTE:** LH shown, RH similar.

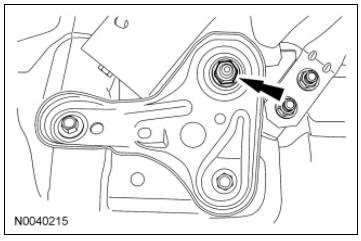
    Position the subframe brackets and install the bolts finger-tight.



13. **NOTE:** LH shown, RH similar.

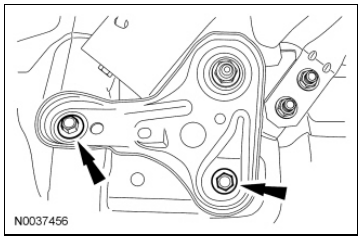
    Install the subframe nuts.

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



14. **NOTE:** LH shown, RH similar.

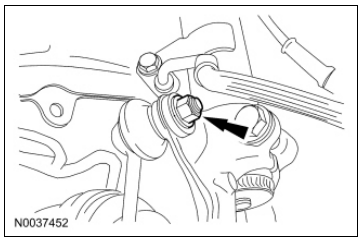
    Tighten the subframe bracket-to-body bolts to 103 Nm (76 lb-ft).



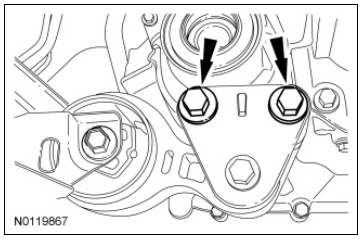
15. **NOTE:** LH shown, RH similar.

    Install the stabilizer bar links and nuts on the struts.

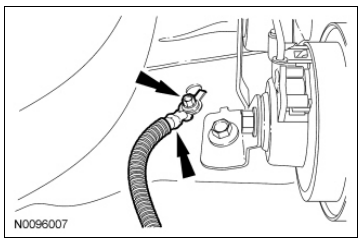
    - Tighten to 40 Nm (30 lb-ft).



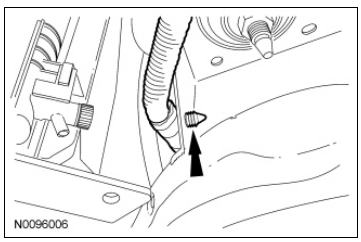
16. Install the 2 roll restrictor bracket bolts.
    - Tighten to 90 Nm (66 lb-ft).



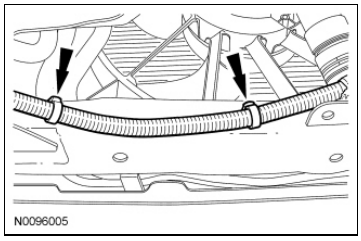
17. Install the Electronic Power Assist Steering (EPAS) system wiring harness ground and the bolt behind the RH splash shield.
    - Tighten to 12 Nm (106 lb-in).



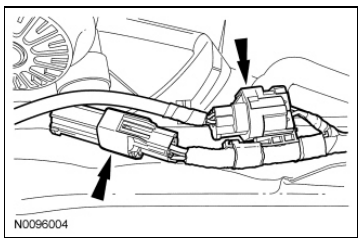
18. Attach the EPAS system wiring harness pin-type retainer to the subframe under the LH fender splash shield.



19. Attach the 2 EPAS system wiring harness pin-type retainers to the subframe.

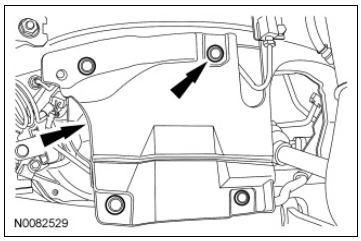


20. Connect the 2 in-line EPAS system electrical connectors at the front of the subframe.

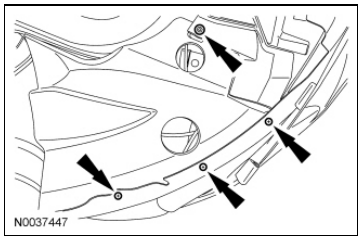


21. Install the LH halfshaft and the intermediate shaft. For additional information, refer to Section 205-04 .

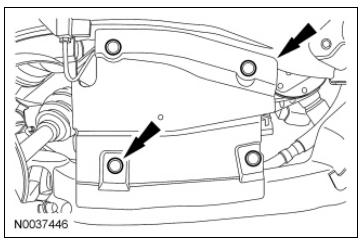
22. Install the LH splash shield and the 6 pin-type retainers (4 shown).



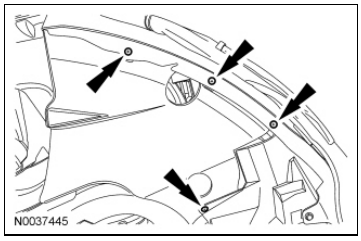
23. Position the LH fender splash shield and install the 4 screws.



24. Install the RH splash shield and the 6 pin-type retainers (4 shown).



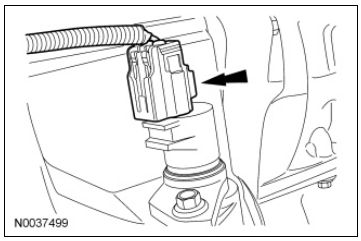
25. Position the RH fender splash shield and install the 4 screws.



26. Install the exhaust flexible pipe. For additional information, refer to Section 309-00 .

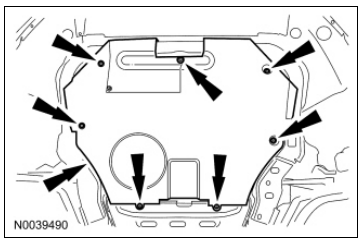
27. Connect the reverse lamp switch electrical connector.

28. Connect the Output Shaft Speed (OSS) sensor electrical connector.



29. Fill the transaxle with clean gear oil. For additional information, refer to Transaxle Draining and Filling in this section.

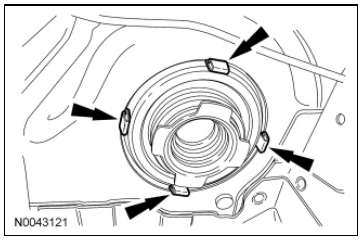
30. Install the splash shield and the 7 bolts.
    - Tighten to 9 Nm (80 lb-in).



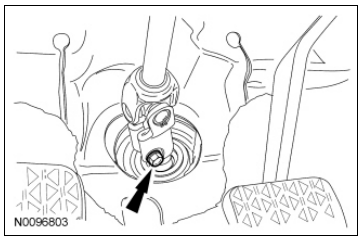
31. ***NOTICE:*** **The steering gear/dash seal must be fully seated in the steering valve tower groove before the retaining clips are fully engaged into the body. If the steering gear/dash seal is not seated to the steering gear valve tower groove and the clips are not fully engaged to the body, water and foreign material may enter the passenger compartment and damage the vehicle interior can occur.**

    Install the steering gear/dash seal.

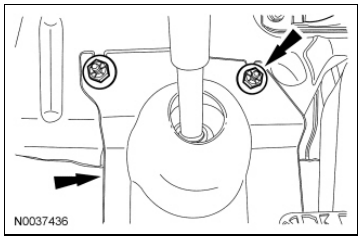
    - Apply hand force to the center of the seal, install the steering gear/dash seal onto the steering gear valve tower until the seal is fully seated in the valve tower groove. Install the steering gear/dash seal until the retaining clips are fully engaged into the body.



32. Install the steering column shaft onto the steering gear and install a new bolt.
    - Tighten to 20 Nm (177 lb-in).



33. Install the steering joint cover and the 2 nuts.



34. **NOTE:** If one or both of the mount studs were removed or came out, do not reinstall the old stud(s). Install a new stud(s). Make sure they are properly seated in the case.

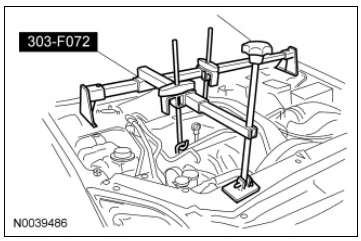
    Tighten the transaxle rear support insulator nuts and bolt to specification.

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

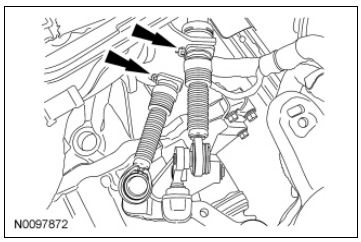
35. Install the 3 upper transaxle-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).

36. Attach the wire harness to the transaxle.

37. Remove the Engine Support Bar.



38. Install the gearshift and shift cables onto the transaxle bracket and gearshift control assembly. Make sure the cables are engaged in the shift bracket and fully installed on the gearshift control assembly.



39. Install the battery tray and battery. For additional information, refer to Section 414-01 .

40. Install the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A .

41. If the input shaft was replaced, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

42. Check the vehicle for normal operation.

Torque Specifications

Description	Nm	lb-ft	lb-in
Gearshift cable grommet nuts	8	-	71
Gearshift lever nuts	23	17	-

External Controls

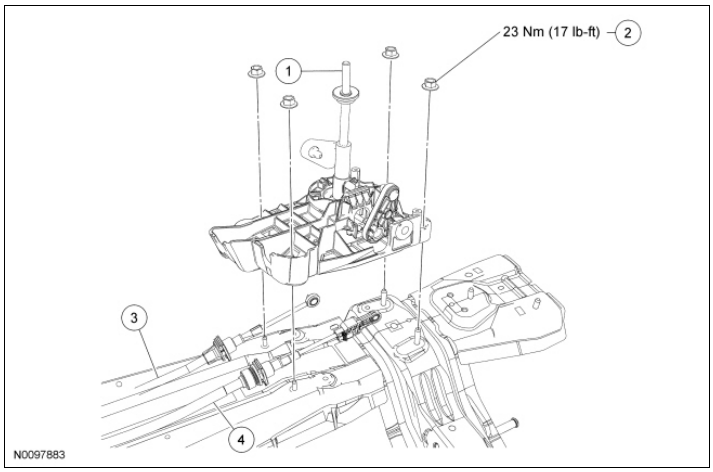
The manual transaxle external controls consist of the following:

- Gearshift lever
- Gearshift lever knob and boot
- Gearshift cables

The manual transaxle is controlled by a floor-mounted gearshift lever located in the floor console. Connection between the floor mounted gearshift lever and the manual transaxle gearshift control assembly is made through 2 gearshift cables.

When the operator moves the floor mounted gearshift lever, that movement is transmitted through 2 gearshift cables routed through the body to the transaxle. The 2 gearshift cables are attached to the transaxle at the gearshift control assembly. The gearshift control assembly transfers the movement of the gearshift cables to the shift rods and shift forks located inside the transaxle. Removal and installation of the gearshift cables requires specific adjustments for correct shifting of the transaxle. For information regarding gearshift cable adjustments, refer to Section 308-00 .

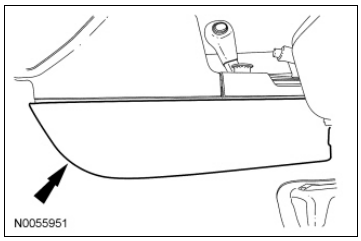
Gearshift Lever



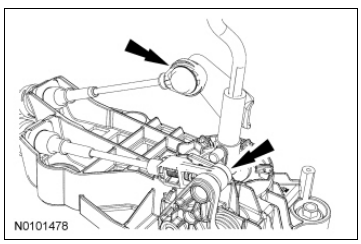
Item	Part Number	Description
1	7210	Gearshift lever assembly
2	-	Gearshift lever nut (4 required)
3	7E395	Shift cable
4	7E395	Select cable

Removal

1. Remove the gearshift knob.
2. Open the storage compartment door.
3. Remove the floor console finish panel. Disconnect the electrical connectors.
4. Remove the LH floor console trim panel. For additional information, refer to Section 501-12 .

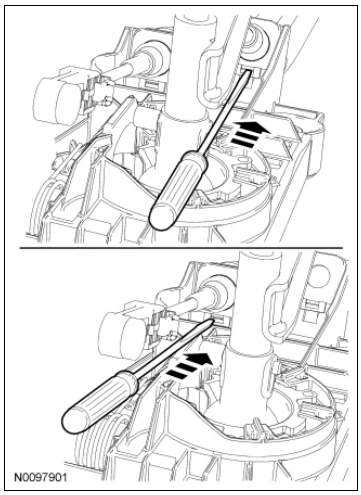


5. Disconnect the shift cable and the select cable from the gearshift lever.

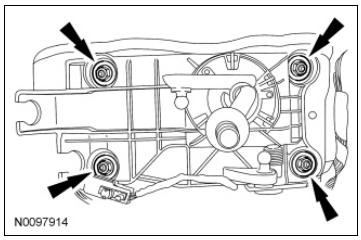


6. ***NOTICE:*** **Carefully disconnect the gearshift cables from the gearshift lever base. Do not damage the gearshift cable retainers.**

   Disconnect the gearshift cables from the gearshift lever base.



7. Remove the 4 gearshift lever nuts.

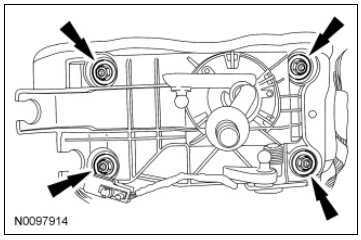


8. Remove the gearshift lever assembly.

Installation

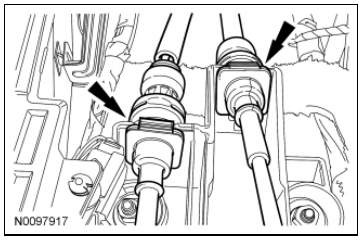
1. Position the gearshift lever assembly in the vehicle.

2. Install the 4 gearshift lever nuts.
   - Tighten to 23 Nm (17 lb-ft).

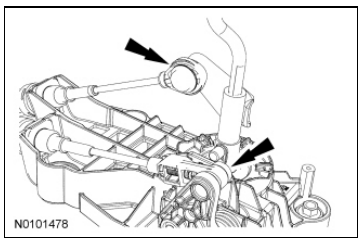


3. ***NOTICE:*** **Make sure the gearshift cables are fully seated into the gearshift lever base or damage may occur.**

   Connect the gearshift cables to the gearshift lever base.

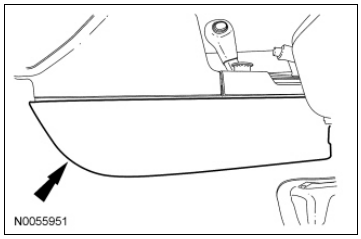


4. Connect the select cable and the shift cable to the gearshift lever.



5. Adjust the gearshift cables. For additional information, refer to Section 308-00 .

6. Install the LH floor console trim panel. For additional information, refer to Section 501-12 .

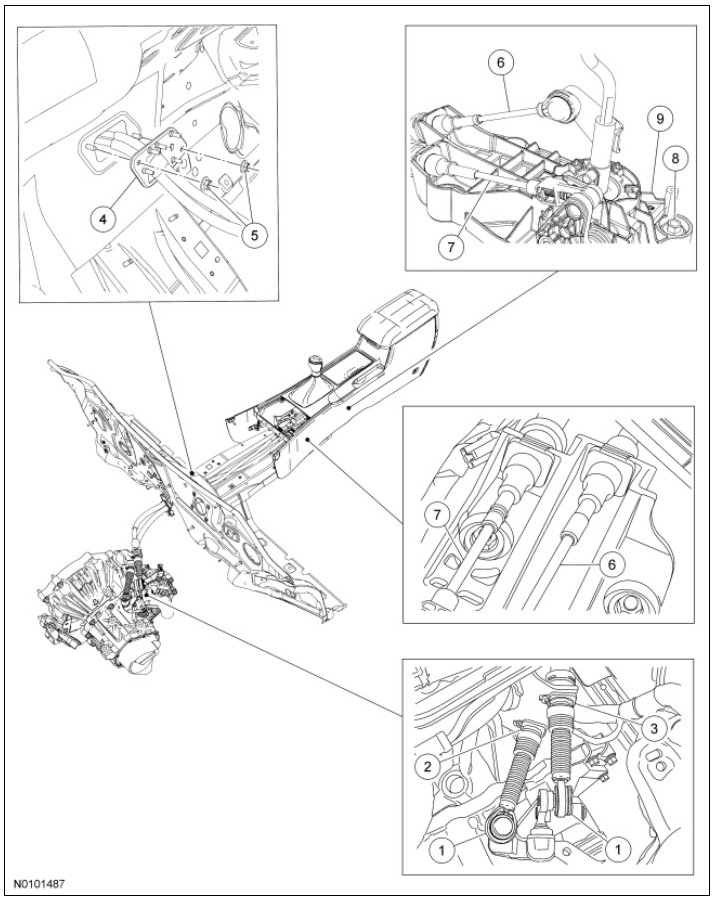


7. Install the floor console finish panel and connect the electrical connectors.

8. Close the storage compartment door.

9. Install the gearshift knob.

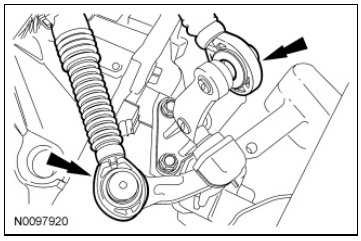
Gearshift Cables



Item	Part Number	Description
1	7K391	Gearshift cable ends
2	7E395	Shift cable
3	7E395	Select cable
4	-	Gearshift cable grommet (part of 7E395)
5	W707142-S439	Gearshift cable grommet nuts
6	7E395	Shift cable
7	7E395	Select cable
8	-	Gearshift lever nut (4 required)
9	7210	Gearshift lever assembly

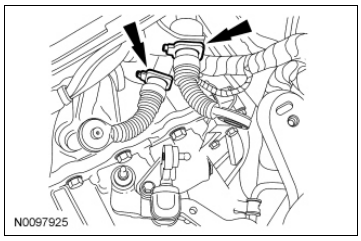
Removal

1. Remove the heater core and evaporator core housing. For additional information, refer to Section 412-01 .
2. Remove the battery tray. For additional information, refer to Section 414-01 .
3. Disconnect the gearshift cables from the transaxle shift control lever.

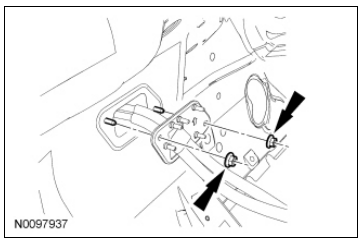


4. **NOTE:** Carefully pry the retainer on the gearshift cables. Do not damage the gearshift cable retainers.

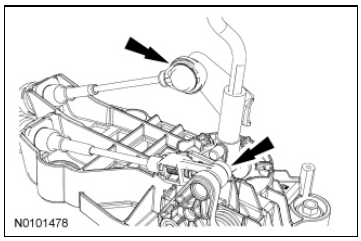
   Disconnect the gearshift cs from the transaxle bracket.



5. Remove the Restraints Control Module (RCM). For additional information, refer to Section 501-20B .
6. Position the insulation blanket aside.
7. Remove the wiring harness from the studs.
8. Remove the 2 gearshift cable grommet nuts and detach the gearshift cables from the floor.

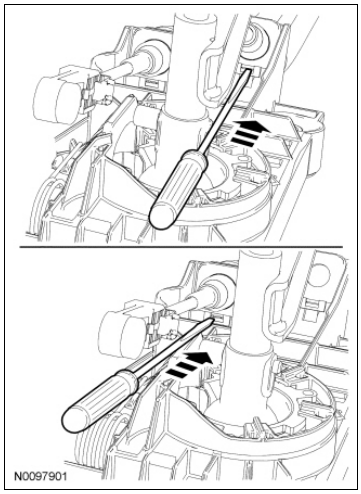


9. Disconnect the shift cable and select cable from the gearshift lever.



10. ***NOTICE:*** **Carefully disconnect the gearshift cables from the gearshift lever base. Do not damage the gearshift cable retainers.**

    Disconnect the gearshift cables from the gearshift lever base.



11. Pull the gearshift cables through the bulkhead into the interior.

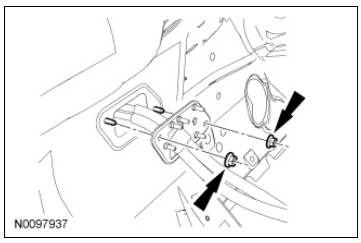
Installation

1. ***NOTICE:*** **When inserting the gearshift cables through the bulkhead, use care and do not damage the heat shielding.**

   NOTE: When inserting the gearshift cables through the bulkhead, make sure the arrow on the grommet is pointing upward.

   Pull the gearshift cables through the bulkhead into the exterior.

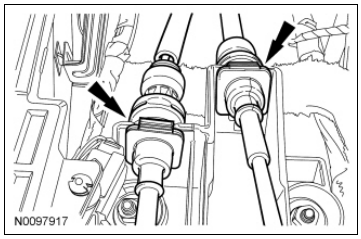
2. Install the 2 gearshift cable grommet nuts and attach the gearshift cables to the floor.
   - Tighten to 8 Nm (71 lb-in).



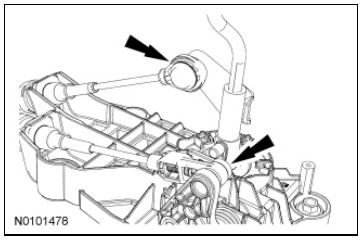
3. Install the wiring harness onto the studs.

4. ***NOTICE:*** **Make sure the gearshift cables are fully seated into the gearshift lever base or damage may occur.**

   Connect the gearshift cables to the gearshift lever base.



5. Connect the select cable and the shift cable to the gearshift lever.



6. Position the insulation blanket into place.

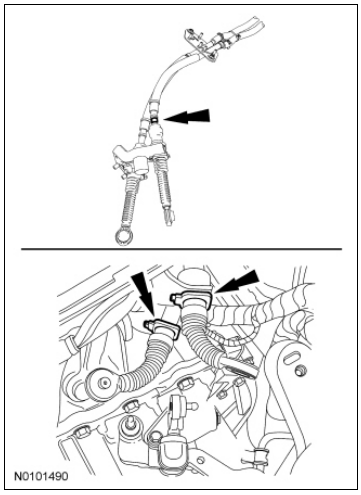
7. Install the RCM . For additional information, refer to Section 501-20B .

8. ***NOTICE:*** **Make sure the gearshift cables are fully seated into the transaxle bracket or damage may occur.**

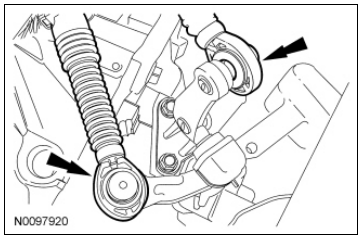
   NOTE: The gearshift cable ends and transaxle bracket slots are unique. They can only be fully seated in the correct slot.

   NOTE: The top cable will have id tape.

   Connect the gearshift cables to the transaxle bracket.



9. Connect the gearshift cables to the transaxle shift control lever.



10. Adjust the gearshift cables. For additional information, refer to Section 308-00 .

11. Install the battery tray. For additional information, refer to Section 414-01 .

12. Install the heater core and evaporator core housing. For additional information, refer to Section 412-01 .

Material

Item	Specification	Fill Capacity
Motorcraft SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A	530 ml (18 oz) [a]
Motorcraft SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A	1.15L (2.43 pt) [b]

[a] Power transfer unit (PTU)
[b] Rear differential unit (RDU)

Torque Specifications

Description	Nm	lb-in
4X4 control module nuts	9	80

Four Wheel Drive (4WD) Systems

The All-Wheel Drive (AWD) system consists of the following:

- Power Transfer Unit (PTU)
- Rear driveshaft
- AWD relay module
- Rear axle with coupling device

Torque from the engine is transferred through the transaxle to the PTU . This torque is transferred from the driveshaft to the rear axle, which drives the rear halfshafts. The AWD system, also referred to as an Active Torque Coupling (ATC) system, is always active and requires no driver input.

The AWD system continuously monitors vehicle conditions and automatically adjusts the torque distribution between the front and rear wheels. During normal operation, most of the torque is delivered to the front wheels. If wheel slip between the front and rear wheels is detected, or if the vehicle is under heavy acceleration, the AWD system increases torque to the rear wheels to prevent or control wheel slip. When the AWD system is functioning properly, there should be no perceived speed difference between the front and rear axles when launching or driving the vehicle on any uniform surface. Traction should be similar to a part time Four-Wheel Drive (4WD) system in 4H (4X4 HIGH), but have no binding in turns.

Serviceable components of the PTU are limited to the output shaft seal and flange, intermediate shaft seal and deflector, and the PTU transaxle compression seal. No internal components are serviced. There should be no need to remove the PTU cover. If any of the internal geared components, bearings, case cover or shafts are worn or damaged, a new PTU must be installed.

Four Wheel Drive (4WD) Systems

Special Tool(s)

 ST2574-A	Flex Probe Kit 105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

The vehicle is equipped with an All-Wheel Drive (AWD) system, also referred to as Active Torque Coupling (ATC), that is always active and requires no driver input. The system has no Mode Select Switch (MSS).

Two transmissions are used with AWD . Vehicles with a 3.0L engine have the 6F35 transmission, controlled by the PCM. Vehicles with the 3.5L engine use the Aisin AW21, which is controlled by a stand-alone Transmission Control Module (TCM).

The system continuously monitors vehicle conditions and automatically adjusts the torque distribution between the front and rear wheels. During normal operation, most of the torque is sent to the front wheels. If wheel slip between the front and rear wheels is detected or if the vehicle is under heavy acceleration (high-throttle position), the AWD system increases torque to the rear wheels to prevent or control wheel slip.

AWD faults may be indicated in the message center by the wrench lamp as well as the CHECK AWD message.

The system consists of a Power Transfer Unit (PTU), 4X4 control module, rear axle and a solenoid actuated ATC device. Based on the amount of current sent to the clutch, the module varies the torque sent to the rear wheels by sending a duty cycle to the ATC device, located inside the rear axle. For concerns with the PTU , refer to Section 308-07B .

The 4X4 control module also provides the brake system with its current clutch duty cycle and determines whether or not the brake system may take command of the clutch duty cycle.

NOTE: The ATC solenoid is not repairable. If a new component is required, the ATC solenoid and rear axle are installed as an assembly. Refer to Section 205-02 .

The active, on-demand AWD system uses data from other systems as inputs to the 4X4 control module. The 4X4 control module uses the inputs to determine the appropriate amount of current to send to the ATC solenoid that delivers the desired torque to the rear wheels. Specific inputs to the 4X4 control module are:

- Accelerator pedal position via the High Speed Controller Area Network (HS-CAN)
- Transaxle range from the TCM or PCM via the HS-CAN
- Brake system status from the ABS module via the HS-CAN
- Wheel speed from all 4 wheels from the ABS module via the HS-CAN

4X4 control module outputs are:

- Solid-state clutch (Pulse-Width Modulation (PWM) signal) to the ATC solenoid
- Percent of torque transfer commanded signal to the ABS module via the HS-CAN
- Torque request available signal to the ABS module via the HS-CAN

Heat Protection Mode

During very extreme off-road operation, the AWD system utilizes a heat protection mode to protect the ATC solenoid (part of rear axle) from damage. If the system detects an overheat condition, it enters a locked mode. If the heat in the system continues to rise once in the locked mode, the 4X4 control module disables the ATC solenoid. Allow the system to cool down at least 10 minutes with the ignition switch in the ON position.

Inspection and Verification

1. Verify the customer concern.

2. Inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Active Torque Coupling (ATC) solenoid (part of rear axle) • Power Transfer Unit (PTU) • Rear Drive Unit (RDU) • Halfshafts and CV joints • Driveshaft and U-joints • Fluid leaks • Wheel/tire size and brand • Matching tire size and brand • Tire pressure	• Smart Junction Box (SJB) fuse(s): ♦ 11 (10A) ♦ 35 (10A) • 4X4 control module • Wiring harness • Connector(s) • Circuitry

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

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

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

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

If the scan tool does not communicate with the VCM :

- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM .
- refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is in the ON position.
   - refer to Section 418-00 to diagnose no response from the PCM.

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

8. Clear the DTCs and carry out the self-test diagnostics for the 4X4 control module.

9. If the DTCs retrieved are related to the concern, go to the 4X4 Control Module DTC Chart. For all other DTCs, refer to Section 419-10 .

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

DTC Chart

4X4 Control Module DTC Chart

DTC	Description	Action
B1317	Battery Voltage High	GO to Pinpoint Test B .
B1318	Battery Voltage Low	GO to Pinpoint Test B .
B1342	Electronic Control Unit (ECU) is Faulted	CLEAR the DTCs. REPEAT the self-test. If DTC B1342 is retrieved again, INSTALL a new 4X4 control module. REFER to 4X4 Control Module in this section.
B2900	Vehicle Identification Number (VIN) Mismatch	CHECK the PCM configuration. REFER to Section 418-01 .
P1635	Tire/Axle Out of Acceptable Range	GO to Pinpoint Test F .
P1824	Four-Wheel Drive (4WD) Clutch Relay Circuit Failure	GO to Pinpoint Test D .
P1825	4WD Clutch Relay Open Circuit	Check for a possible open fuse (B+) . GO to Pinpoint Test D .
U0100	Lost Communication with PCM or Transmission Control Module (TCM) (3.5L only)	REFER to Section 418-00 to diagnose the lost communication with the PCM or TCM (3.5L only).
U0121	Lost Communication with Anti-lock Brake System (ABS) Control Module	REFER to Section 418-00 to diagnose the lost communication with the ABS control module.
U0155	Lost Communication with IC Control Module	REFER to Section 418-00 to diagnose the lost communication with the IC .
U0401	Invalid Data Received From PCM or TCM (3.5L only)	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnose the accelerator position, engine coolant or keep alive memory fault.
U0415		GO to Pinpoint Test C .

	Invalid Data Received From Anti-lock Brake System (ABS) Control Module	
U2050	No Application Present	REPLACE the 4X4 control module. REFER to 4X4 Control Module in this section. REPEAT the self-test.
U2051	One or More Calibration Files Missing/Corrupt	REPLACE the 4X4 control module. REFER to 4X4 Control Module in this section. REPEAT the self-test.

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: All-Wheel Drive (AWD) System Functional Test

Refer to Wiring Diagrams Cell 34 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), All Wheel Drive (AWD) for schematic and connector information.

Normal Operation

The All-Wheel Drive (AWD) system continuously monitors vehicle conditions and automatically adjusts the torque distribution between the front and rear wheels. During normal operation, most of the torque is delivered to the front wheels. If wheel slip between the front and rear wheels is detected, or if the vehicle is under heavy acceleration, the AWD system increases torque to the rear wheels to prevent or control wheel slip.

This pinpoint test is intended to diagnose the following:

- AWD system concern without on-demand or continuous DTCs

PINPOINT TEST A: ALL-WHEEL DRIVE (AWD) SYSTEM FUNCTIONAL TEST

⚠ WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

NOTE: Carry out a thorough inspection and verification as outlined before carrying out this pinpoint test.

Test Step	Result / Action to Take
A1 CHECK FOR WRENCH LIGHT PROVE-OUT	
• Turn the ignition to the ON position and observe the wrench light. • **Does the wrench light illuminate for 3 seconds and then turn OFF?**	**Yes** GO to A2 . **No** REFER to Section 413-01 for further diagnosis of

	the Instrument Cluster (IC).
A2 CHECK FOR ATC SOLENOID (PART OF REAR AXLE) LOCK	
• Drive the vehicle on a dry, hard surface in turns while applying the accelerator pedal. • **Is driveline wind-up present in turns?**	**Yes** With the ignition switch in ON position, allow the Active Torque Coupling (ATC) solenoid to cool down for at least 10 minutes and repeat the test. CHECK for wind-up again. If no wind-up is found, GO to A3 . If still present, GO to Pinpoint Test E . **No** GO to A3 .
A3 CHECK FOR VALID ACCELERATOR PEDAL POSITION MONITORING THE ACCELERATOR PEDAL POSITION (AP) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - 4X4 Control Module . • Monitor the AP PID while pressing the accelerator pedal. • **Does the accelerator pedal position match the AP PID percent value?**	**Yes** GO to A4 . **No** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnose the accelerator pedal position sensor concern.
A4 CHECK 4X4 CONTROL MODULE WHEEL SPEED SENSOR PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger - 4X4 Control Module . • While driving the vehicle at 48 km/h (30 mph), monitor the following wheel speed sensor PIDs: ♦ Left Front Wheel Speed Sensor (LF_WSPD) ♦ Left Rear Wheel Speed Sensor (LR_WSPD) ♦ Right Front Wheel Speed Sensor (RF_WSPD) ♦ Right Rear Wheel Speed Sensor (RR_WSPD) • **Are all 4 wheel speeds within 2 km/h (1.2 mph) of each other?**	**Yes** GO to A5 . **No** GO to Pinpoint Test F .
A5 CHECK VEHICLE ACCELERATION IN A STRAIGHT LINE	
• Carry out 3 accelerations from 0-48 km/h (0-30 mph) in a straight line (one each with low, medium and full accelerator pedal application). • **Does the vehicle pulsate or shudder while accelerating?**	**Yes** GO to Pinpoint Test E . **No** GO to A6 .

A6 CHECK VEHICLE TURNING ABILITY	
• Drive the vehicle in a fully locked turn, on dry pavement, at 8 km/h (5 mph). • **Does the vehicle bind in the turn or resist turning?**	**Yes** GO to Pinpoint Test E . **No** GO to A7 .
A7 CHECK FOR TORQUE AT REAR WHEELS USING PWM OUTPUT CONTROL COMMAND #1 (CLCH_SOL) ACTIVE COMMAND	
• Enter the following diagnostic mode on the scan tool: DataLogger - 4X4 Control Module . • Using the scan tool, command CLCH_ SOL to energize the ATC solenoid to a constant 100% applied. • Drive the vehicle in a fully locked turn, on dry pavement, at 8 km/h (5 mph). • **Does the vehicle bind in the turn or resist turning?**	**Yes** END the active command. The concern cannot be duplicated at this time. RETURN the vehicle to the customer. **No** END the active command. CHECK that the driveshaft rotates when the transaxle is in gear. If yes, GO to Pinpoint Test D . If no, CHECK the Power Transfer Unit (PTU). REFER to Section 308-07B .

npoint Test B: DTCs B1317 and B1318

Refer to Wiring Diagrams Cell 34 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), All Wheel Drive (AWD) for schematic and connector information.

Normal Operation

If the 4X4 control module observes an overpower or underpower voltage condition, DTCs are set and the 4X4 control module may not allow Four-Wheel Drive (4WD) operation.

- DTC B1317 Battery Voltage High - When the 4X4 control module detects battery voltage greater than 16 volts for at least 10 seconds, this DTC is set.
- DTC B1318 Battery Voltage Low - When the 4X4 control module detects battery voltage less than 9 volts for at least 10 seconds, with the engine running at 1,500 rpm or greater, this DTC is set.

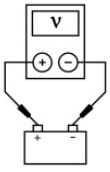
This pinpoint test is intended to diagnose the following:

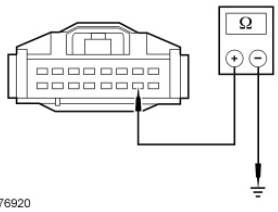
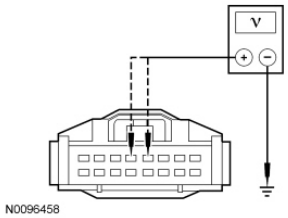
- Fuses
- Vehicle battery
- Charging system
- Wiring, terminals or connectors
- 4X4 control module

PINPOINT TEST B: DTCs B1317 AND B1318

NOTE: DTC B1or B1318 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

Test Step	Result / Action to Take
B1 RETRIEVE ALL CMDTCs IN ALL MODULES	
• Enter the following diagnostic mode on the scan tool: Self Test - All CMDTCs . • **Is DTC B1317 or B1318 present in more than one module AND P0563, P0620, P0625, P0626 or P065B present in the PCM?**	**Yes** REFER to Section 414-00 for diagnosis of the battery and charging system. **No** GO to B2 .
B2 CHECK BATTERY CONDITION	
• Refer to Section 414-01 and carry out the Battery - Condition Test. • **Does the battery pass the condition test?**	**Yes** If the battery passed the condition test but required a recharge, REFER to Section 414-00 to diagnose the charging system. CLEAR all Continuous Memory Diagnostic Trouble Codes (CMDTCs). TEST the system for normal operation. If the battery passed the condition test and did not require a recharge, GO to B3 . **No** INSTALL a new battery. CLEAR all CMDTCs . TEST the system for normal operation.
&sp; **B3 CHECK THE CHARGING SYSTEM VOLTAGE**	
NOTE: Do not allow the engine rpm to increase above 2,000 rpm while performing this step or the generator may self excite and result in default charging system output voltage. If engine rpm has gone above 2,000 rpm, shut the vehicle off and restart the engine before performing this step. • Start the engine. • Measure the voltage of the battery. ♦ For DTC B1317, turn off all accessories and run the engine at 1,500 rpm for a minimum of 2 minutes. ♦ For DTC B1318, turn on headlights and HVAC fan on high and run engine at 1,500 rpm for a minimum of 2 minutes.  AJ0210-A	**Yes** GO to B4 . **No** REFER to Section 414-00 to diagnose the charging system. CLEAR all CMDTCs . TEST the system for normal operation.

• **Is the battery voltage between 13-15.2 volts?**	
B4 CHECK FOR VOLTAGE BY MONITORING THE MODULE SUPPLY VOLTAGE (VBAT_4X4) PID	
• Enter the following diagnostic mode on the scan tool: DataLogger - 4X4 Control Module . • With the engine running, monitor the battery voltage VBAT_4X4 PID. • **Is the battery voltage less than 9 or greater than 15.5 volts?**	**Yes** If voltage is less than 9 volts, GO to B5 . If voltage is greater than 15.5 volts, INSTALL a new 4X4 control module. REFER to 4X4 Control Module in this section. CLEAR all CMDTCs . REPEAT the self-test. **No** GO to B7
B5 CHECK CIRCUIT GD126 (BK/WH) FOR AN OPEN	
• Ignition OFF. • Disconnect: 4X4 Control Module C3253 . • Measure the resistance between 4X4 control module C3253-15, circuit GD126 (BK/WH), harness side and ground. • Repeat this measurement while wiggling the harness.  N0076920 • **Is the resistance less than 5 ohms?**	**Yes** GO to B6 . **No** REPAIR the circuit. CLEAR all CMDTCs . REPEAT the self-test.
B6 CHECK POWER TO 4X4 CONTROL MODULE	
• Ignition ON. • Measure the voltage between 4X4 control module C3253-4, circuit CBP35 (YE/GY), harness side and ground; and between 4X4 control module C3253-5, circuit SBP11 (BU/RD), harness side and ground.  N0096458	**Yes** GO to B7 . **No** VERIFY the Smart Junction Box (SJB) fuse(s) 11 (10A) and 35 (10A) are OK. If fuse(s) are OK, REPAIR the circuit in question. If SJB fuse(s) are not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR all CMDTCs . REPEAT the self-test.

• **Is the voltage greater than 10 volts?**	
B7 CHECK FOR CORRECT 4X4 CONTROL MODULE OPERATION	
• Disconnect the 4X4 control module. • Check the harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the 4X4 control module and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new 4X4 control module. REFER to 4X4 Control Module in this section. CLEAR the CMDTCs . REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all CMDTCs . REPEAT the self-test.

Pinpoint Test C: DTC U0415

Refer to Wiring Diagrams Cell 34 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), All Wheel Drive (AWD) for schematic and connector information.

Normal Operation

The All-Wheel Drive (AWD) system uses data from other systems as inputs to the 4X4 control module. The 4X4 control module uses the inputs to determine the appropriate duty cycle to send to the Active Torque Coupling (ATC) solenoid (part of rear axle) that delivers the desired torque to the rear wheels. Specific inputs to the 4X4 control module are: accelerator pedal position output from the PCM, transmission range from the PCM or Transmission Control Module (TCM) (3.5L only), brake system status and all 4 wheel speeds from the ABS module. Communication between the 4X4 control module and other modules is obtained through the High Speed Controller Area Network (HS-CAN). If the 4X4 control module loses communication with, or receives invalid data from any of the necessary modules, DTCs are set and the 4X4 control module may not allow Four-Wheel Drive (4WD) operation.

- DTC U0415 Invalid Data Received from Anti-lock Brake System (ABS) Control Module - When the 4X4 control module receives invalid HS-CAN bus data or invalid wheel speed(s) from the ABS module for more than 5 seconds, this DTC is set.

This pinpoint test is intended to diagnose the following:

- ABS module

PINPOINT TEST C: DTC U0415

⚠ WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.

NOTE: Carry out a thorough inspection and verification as outlined before carrying out this pinpoint st.

Test Step	Result / Action to Take
C1 CHECK FOR ABS MODULE DTCs	
	Yes

• Ignition ON. • Carry out the ABS module self-test. • Review the results of the ABS module self-test. • **Are any DTCs present?**	REFER to Section 206-09 for further diagnosis of the ABS. **No** GO to C2 .
C2 CHECK WHEEL SPEED SENSORS PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger - 4X4 Control Module . • While driving the vehicle at 48 km/h (30 mph), monitor the following wheel speed sensor PIDs: ♦ Left Front Wheel Speed Sensor (LF_WSPD) ♦ Left Rear Wheel Speed Sensor (LR_WSPD) ♦ Right Front Wheel Speed Sensor (RF_WSPD) ♦ Right Rear Wheel Speed Sensor (RR_WSPD) • **Do the 4 wheel speed sensors match the speedometer and are they within 2 km/h (1.2 mph) of each other?**	**Yes** The system is operating correctly athis time. CLEAR the DTCs. REPEAT the self-test. **No** INSPECT for proper tire size and tire inflation. If no concerns with the tires are found, REFER to Section 206-09 for further diagnosis of the ABS.

Pinpoint Test D: DTCs P1824 and P1825

Refer to Wiring Diagrams Cell 34 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), All Wheel Drive (AWD) for schematic and connector information.

Normal Operation

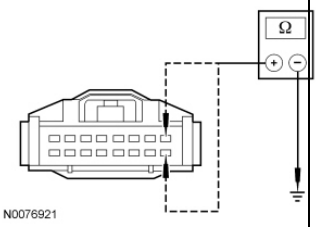
The All-Wheel Drive (AWD) system uses data from other systems as inputs to the 4X4 control module. The 4X4 control module uses the inputs to determine the appropriate duty cycle to send to the Active Torque Coupling (ATC) solenoid (part of rear axle) that delivers the desired torque to the rear wheels. If the 4X4 control module loses communication with, or receives invalid data from any of the necessary modules, DTCs are set and the 4X4 control module may not allow Four-Wheel Drive (4WD) operation.

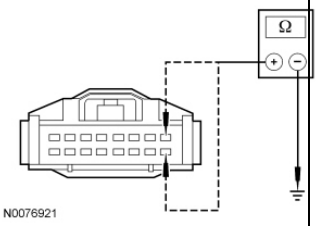
- DTC P1824 4-Wheel Drive Clutch Relay Circuit Failure - When the 4X4 control module detects a short to ground on the ATC solenoid feedback circuit, this DTC is set.
- DTC P1825 4-Wheel Drive Clutch Relay Open Circuit - When the 4X4 control module detects an open or short to ground on the ATC solenoid command or feedback circuit for more than 2 seconds, this DTC is set.

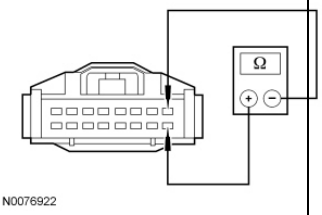
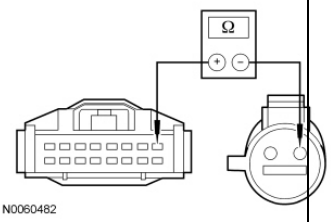
This pinpoint test is intended to diagnose the following:
- Tire/axle out of range
- Wiring, terminals or connectors
- ATC solenoid (part of rear axle)
- 4X4 control module
- Power Transfer Unit (PTU)

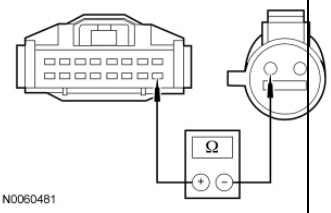
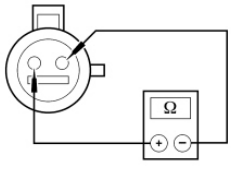
PINPOINT TEST D: DTCs P1824 AND P1825

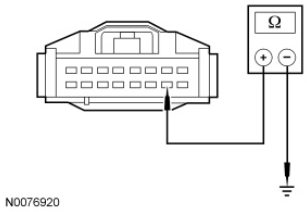
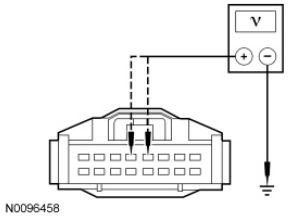
NOTE: Carry out a thorough inspection and verification as outlined before carrying out this pinpoint test.

Test Step	Result / Action to Take
D1 CHECK FOR 4X4 CONTROL MODULE DTCs	
• Ignition ON. • Carry out the 4X4 control module self-test. • **Are any DTCs received?**	**Yes** For DTC P1824 or P1825, GO toa href="SCS~us~en~file=SCS87A03.HTM~gen~ref.HTM#D2" >D2 . For all other DTCs, REFER to the 4X4 Control Module DTC Chart in this section. **No** GO to D2 .
D2 CHECK CIRCUITS CCF21 (VT/WH) AND RCF21 (WH/VT) FOR A SHORT TO GROUND WITH ATC SOLENOID (PART OF REAR AXLE) CONNECTED	
• Ignition OFF. • Disconnect: 4X4 Control Module C3253 . • Measure the resistance between 4X4 control module C3253-8, circuit CCF21 (VT/WH), harness side and ground; and between 4X4 control module C3253-16, circuit RCF21 (WH/VT), harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to D5 . **No** GO to D3 .
D3 CHECK CIRCUITS CCF21 (VT/WH) AND RCF21 (WH/VT) FOR A SHORT TO GROUND WITH C3051 DISCONNECTED	

• Disconnect: ATC Solenoid Jumper Harness C3051 . • Measure the resistance between 4X4 control module C3253-8, circuit CCF21 (VT/WH), harness side and ground; and between 4X4 control module C3253-16, circuit RCF21 (WH/VT), harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to D4 . **No** REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self-test.
D4 CHECKING THE ATC SOLENOID JUMPER HARNESS	
NOTICE: **The Active Torque Coupling (ATC) solenoid jumper harness must be secured to prevent damage to the wiring.** • Disconnect: ATC Solenoid C3254 . • Inspect the ATC solenoid jumper harness for damage. • **Is the ATC solenoid jumper harness damaged?**	**Yes** REPAIR or INSTALL a new ATC solenoid jumper harness. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new rear axle assembly. REFER to Section 205-02 . CLEAR the DTCs. REPEAT the self-test.
D5 CHECK CIRCUITS CCF21 (VT/WH) AND RCF21 (WH/VT) FOR AN OPEN WITH ATC SOLENOID CONNECTED	

• Connect: ATC Solenoid C3254 and ATC Solenoid Jumper Harness C3051 . • Measure the resistance between 4X4 control module C3253-8, circuit CCF21 (VT/WH), harness side and 4X4 control module C3253-16, circuit RCF21 (WH/VT), harness side.  • **Is the resistance less than 10 ohms?**	**Yes** GO to D8 . **No** GO to D6 .
D6 CHECK CIRCUITS CCF21 (VT/WH) AND RCF21 (WH/VT) FOR AN OPEN AT C3051	
• Disconnect: ATC Solenoid Jumper Harness C3051 . • Measure the resistance between 4X4 control module C3253-8, circuit CCF21 (VT/WH), harness side and ATC solenoid jumper harness C3051-1, circuit CCF21 (VT/WH).  • Repeat this measurement while wiggling the harness. • Measure the resistance between 4X4 control module C3253-16, circuit	**Yes** GO to D7 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

RCF21 (WH/VT), harness side and ATC solenoid jumper harness C3051-2, circuit RCF21 (WH/VT), harness side.  N0060481 • Repeat this measurement while wiggling the harness. • **Are the resistances less than 5 ohms?**	
D7 CHECK THE ATC SOLENOID CIRCUIT FOR AN INTERNAL OPEN	
***NOTICE:* The Active Torque Coupling (ATC) solenoid jumper harness must be secured to prevent damage to the wiring.** • Disconnect: ATC Solenoid C3254 . • Measure the resistance between ATC solenoid C3254-1, circuit CCF21 (VT/WH), component side, and ATC solenoid C3254-2, circuit RCF21 (WH/VT), component side.  N0076923 • Repeat this measurement while wiggling the harness.	**Yes** REPAIR or INSTALL a new ATC solenoid jumper harness. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new rear axle assembly. REFER to Section 205-02 . CLEAR the DTCs. REPEAT the self-test.

• **Is the resistance less than 10 ohms?**	
D8 CHECK CIRCUIT GD126 (BK/WH) FOR AN OPEN	
• Measure the resistance between 4X4 control module C3253-15, circuit GD126 (BK/WH), harness side and ground.  • Repeat this measurement while wiggling the harness. • **Is the resistance less than 5 ohms?**	**Yes** GO to D9 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
D9 CHECK THE 4X4 CONTROL MODULE POWER CIRCUITS	
• Ignition ON. • Measure the voltage between 4X4 control module C3253-4, circuit CBP35 (YE/GY), harness side and ground; and between 4X4 control module C3253-5, circuit SBP11 (BU/RD), harness side and ground.  • **Are the voltages greater than 10 volts?**	**Yes** GO to D10 . **No** VERIFY the Smart Junction Box (SJB) fuse(s) 11 (10A) and 35 (10A) are OK. If fuse(s) are OK, REPAIR the circuit in question. If SJB fuse(s) are not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short. CLEAR all Continuous Memory Diagnostic Trouble Codes (CMDTCs). REPEAT the self-test.
D10 CHECK FOR CORRECT 4X4 CONTROL MODULE OPERATION	

• Disconnect: 4X4 Control Module C3253 . • Check the harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Check the ATC solenoid jumper harness between the 4X4 control module and the ATC solenoid, located on the rear subframe. • Connect the 4X4 control module and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new 4X4 control module. REFER to 4X4 Control Module in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test E: Vehicle Binds in a Turn or Resists Turning/Pulsates or Shudders in a Straight Line

Refer to Wiring Diagrams Cell 34 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), All Wheel Drive (AWD) for schematic and connector information.

Normal Operation

The All-Wheel Drive (AWD) system continuously monitors vehicle conditions and automatically adjusts the torque distribution between the front and rear wheels. During normal operation, most of the torque is sent to the front wheels. If wheel slip between the front and rear wheels is detected or the vehicle is under heavy acceleration, the AWD system increases torque to the rear wheels.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Rear axle
- Wheels/tires
- PCM
- ABS module
- 4X4 control module

PINPOINT TEST E: VEHICLE BINDS IN A TURN OR RESISTS TURNING/PULSATES OR SHUDDERS IN A STRAIGHT LINE

NOTE: Carry out a thorough inspection and verification as outlined before carrying out this pinpoint test.

Test Step	Result / Action to Take
E1 CHECK FOR TORQUE AT THE REAR WHEELS	

• Ignition OFF. • Disconnect: Active Torque Coupling (ATC) Solenoid (part of rear axle) C3254 . • Drive the vehicle in a straight line on dry pavement. • **Is a pulsation or shudder still present?**	**Yes** REFER to Section 205-00 for additional axle diagnosis. **No** GO to E2 .
E2 CHECK TO SEE IF THE ATC SOLENOID IS BEING COMMANDED ON MONITORING 4WD CLUTCH PWM STATUS (4WDCPWMST) PID	
• Ignition OFF. • Connect: ATC Solenoid C3254 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - 4X4 Control Module . • Monitor the 4WDCPWMST PID. • Drive the vehicle no faster than 8 km/h (5 mph) in tight turns on dry pavement while monitoring the ATC solenoid duty cycle. • **Is the duty cycle greater than 20%?**	**Yes** GO to E3 . **No** GO to Pinpoint Test F .
E3 CHECK FOR THE CORRECT WHEEL SPEEDS USING THE WHEEL SPEED SENSORS PIDs	
• Enter the following diagnostic mode on the scan tool: DataLogger - 4X4 Control Module . • While driving the vehicle at 48 km/h (30 mph), monitor the following wheel speed sensor PIDs: ♦ Left Front Wheel Speed Sensor (LF_WSPD) ♦ Left Rear Wheel Speed Sensor (LR_WSPD) ♦ Right Front Wheel Speed Sensor (RF_WSPD) ♦ Right Rear Wheel Speed Sensor (RR_WSPD) • **Are all 4 wheel speeds within 2 km/h (1.2 mph) of each other?**	**Yes** GO to E4 . **No** GO to Pinpoint Test F .
E4 CHECK FOR VALID ACCELERATOR PEDAL POSITION MONITORING ACCELERATOR PEDAL POSITION (AP) PID	
• Key ON Engine OF(KOEO). • Enter the following diagnostic mode on the scan tool: DataLogger - 4X4 Control Module . • Monitor AP PID while pressing/releasing the accelerator pedal.	**Yes** GO to E5 . **No** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnose the engine control system.

• **Does the accelerator position match the PID percent value?**	
E5 CHECK FOR CORRECT 4X4 CONTROL MODULE OPERATION	
• Disconnect the 4X4 control module. • Check the harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Check the ATC solenoid jumper harness between the 4X4 control module and the ATC solenoid, located on the rear subframe. • Connect the 4X4 control module and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new 4X4 control module. REFER to 4X4 Control Module in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test F: DTC P1635

Refer to Wiring Diagrams Cell 34 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), All Wheel Drive (AWD) for schematic and connector information.

Normal Operation

The All-Wheel Drive (AWD) system continuously monitors vehicle conditions and automatically adjusts the torque distribution between the front and rear wheels. During normal operation, most of the torque is sent to the front wheels. If wheel slip between the front and rear wheels is detected or the vehicle is under heavy acceleration, the AWD system increases torque to the rear wheels.

- DTC P1635 Tire/Axle Out of Acceptable Range - When the 4X4 control module detects inappropriate mini spare or road wheels/tires (greater than 7% across the front and rear axle or 14% at one wheel) installed, this DTC is set.

This pinpoint test is intended to diagnose the following:
- Wheels/tires
- Wheel speed sensors
- ABS module
- 4X4 control module

PINPOINT TEST F: DTC P1635

⚠ **WARNING: When directed to drive the vehicle as part of this test, drive the vehicle on a hard surface in an area without traffic to prevent a crash. Failure to follow these instructions may result in personal injury.**

NOTE: Carry out a thorough inspection and verification as outlined before carrying out this pinpoint test.

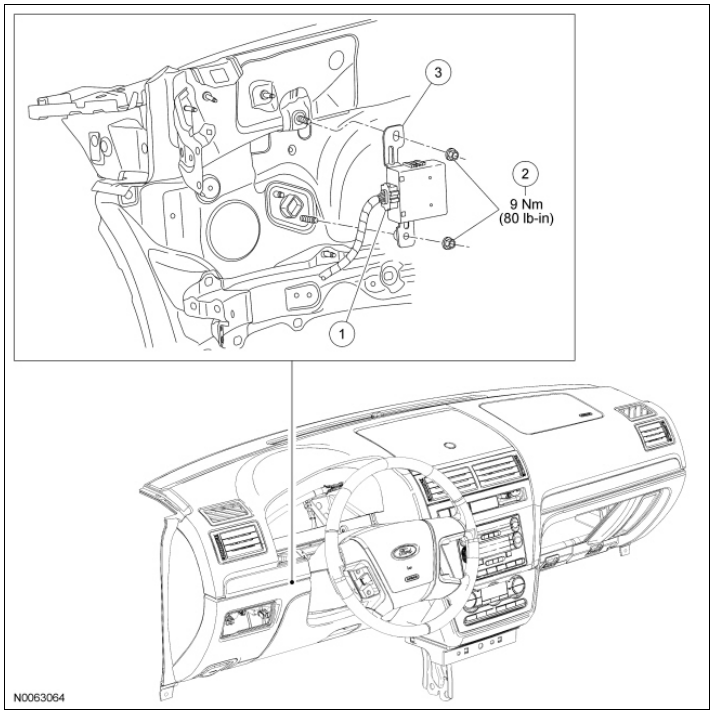
Test Step	Result / Action to Take
F1 CHECK THE RECENT TIRE USAGE	

• Check with customer about recent tire usage or installation. • **Has a tire been installed on the vehicle recently that was not originally supplied with the vehicle?**	**Yes** INFORM the customer to only use tires of the type supplied with the vehicle. CLEAR the DTCs. REPEAT the self-test. **No** GO to F2 .
F2 CHECK TIRE SIZE AND BRAND	
• Check the tire size and the brand of tire. • **Are all 4 tires the same size and brand?**	**Yes** GO to F3 . **No** INSTALL tires that are the same size and brand. INFORM the customer to only use the same size tires and brand. CLEAR the DTCs. REPEAT the self-test.
F3 CHECK TIRE AIR PRESSURES	
• Check the air pressure in all 4 tires. • **Are all 4 tires at the recommended air pressure?**	**Yes** GO to F4 . **No** ADJUST the tire air pressures. CLEAR the DTCs. REPEAT the self-test. INFORM the customer to maintain the correct tire air pressure.
F4 CHECK FOR CORRECT WHEEL SPEEDS	
• Connect the scan tool. • Enter the following diagnostic mode on the scan tool: DataLogger - 4X4 Control Module . • While driving the vehicle at 48 km/h (30 mph), monitor the following wheel speed sensor PIDs: ♦ Left Front Wheel Speed Sensor (LF_WSPD) ♦ Left Rear Wheel Speed Sensor (LR_WSPD) ♦ Right Front Wheel Speed Sensor (RF_WSPD) ♦ Right Rear Wheel Speed Sensor (RR_WSPD) • **Are all 4 wheel speeds within 2 km/h (1.2 mph) of each other?**	**Yes** GO to F5 . **No** The ABS module is sending invalid wheel speed data to the 4X4 control module. REFER to Section 206-09 for additional ABS diagnosis.
F5 CHECK FOR CORRECT 4X4 CONTROL MODULE OPERATION	
• Disconnect: 4X4 Control Module C3253 . • Check for: ♦ corrosion. ♦ pushed-out pins. • Connect the 4X4 control module and make sure it seats correctly.	**Yes** INSTALL a new 4X4 control module. REFER to 4X4 Control Module in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The

• Operate the system and determine if the concern is still present. • **Is the concern still present?**	concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

4X4 Control Module

Removal and Installation



Item	Part Number	Description
1	-	Electrical connector (part of 14A005)
2	W706840	4X4 control module nuts and washers (2 required)
3	7E453	4X4 control module and bracket assembly

1. From below the LH side instrument panel, disconnect the 4X4 control module harness connector.

2. Remove the two 4X4 control module nuts.
   - To install, tighten to 9 Nm (80 lb-in).

3. Remove the 4X4 control module and bracket.

4. To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	-	-
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV	-
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A	-
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5	0.53L (18 oz)
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	-

Torque Specifications

	Nm	lb-ft	lb-in
Driveshaft-to-output flange bolts	70	52	-
Filler plug	20	-	177
Pinion flange nut [a]	-	-	-
Power Transfer Unit (PTU) support bracket bolts	48	35	-
PTU -to-transaxle bolts	90	66	-

[a] Refer to the procedure in this section.

Power Transfer Unit (PTU)

The AWD system consists of the following:

- PTU
- Rear driveshaft
- 4X4 control module
- Rear axle with coupling device

The PTU is a mechanical device attached to the transaxle. It supplies torque to the rear axle through the rear driveshaft. The 4X4 control module is an electronic device which controls the rear axle coupling to apply the torque generated from the PTU to the rear wheels when required.

Power Transfer Unit (PTU)

Principles of Operation

The Power Transfer Unit (PTU) is a gearbox that attaches to the transaxle. Vehicles equipped with the 3.0L engine have the 6F35 transaxle and those with the 3.5L engine have the Aisin AW21 transaxle. The PTU design is similar between the two. The RH intermediate shaft passes through the PTU and engages the differential side gear as in normal Front Wheel Drive (FWD) applications. The PTU directs power to the rear driveshaft through a helical gear spline coupled to the transaxle differential case, a helical gear drop (idler gear) and hypoid/helical riear assembly and pinion set. The PTU is sealed from the transaxle and has its own oil sump.

Serviceable components of the PTU are limited to the output shaft seal and flange, intermediate shaft seal and deflector, cover seal and the PTU -transaxle compression seal. The internal components are not serviced. Do not remove the cover of the PTU . If any of the geared components, bearings, case cover or internal shafts are worn or damaged, a new PTU must be installed.

Heat Protection Mode

During very extreme off-road operation, the All-Wheel Drive (AWD) system utilizes a heat protection mode to protect the Active Torque Coupling (ATC) solenoid (part of rear axle) from damage. If the system detects an overheat condition, it enters a locked mode. If the heat in the system continues to rise once in the locked mode, the 4X4 control module disables the ATC solenoid. Allow the system to cool down at least 10 minutes with the ignition switch in the ON position.

For concerns with the 4X4 control module or ATC , refer to Section 308-07A .

Inspection and Verification

1. Verify the customer concern.
2. Inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• Power Transfer Unit (PTU) • Halfshafts and CV joints • Driveshaft and U-joints • Wheel/tire size and brand

- Matching tire size and brand
- Tire pressure

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

4. If the cause is not visually evident, verify the symptom and GO to Symptom Chart - Power Transfer Unit (PTU) .

Symptom Chart - Power Transfer Unit (PTU)

Symptom Chart - Power Transfer Unit (PTU)

Analysis of Leakage

NOTE: There are 2 different PTU configurations used depending on the transaxle. The repairs made for leakage on these 2 different PTU s may vary depending upon the type and location of the leakage. The specified tools called out in this section will allow seal replacement without causing damage to the PTU case and drive gear.

NOTE: Inspection of the seal's mating journal should be performed every time a seal is replaced. The mating part/journal should be replaced if it has any of the following conditions: Radial wear groove that can be felt by running a finger nail across it where seal lip runs. Scratches, pitting, galling, nicks or other shaft damage under or near where the seal lip runs. Discoloration or coked oil on the shaft where the seal lip runs. Shaft corrosion under or near where the seal lip runs. Sharp edges or burrs on the shaft lead in chamfer. NEVER use emery cloth on journal finishes, replace the part.

The PTU may leak different color fluids, red ATF or tan/brown/black gear lube. The PTU and transaxle seals prevent these types of fluids from leaking. It is important to note which color of fluid is leaking to determine the most appropriate service procedure. The residue of red ATF should be cleaned from the PTU to prevent a inaccurate diagnosis of a red ATF leak following the repair.

PTU Leaks From the RH Side

Vehicles Equipped with Aisin AW21 Transaxle

NOTE: The intermediate shaft seal functions as a dust seal and is not a source of a red ATF leak.

If the leak is red ATF , this indicates the transaxle seal is leaking and needs to be replaced. For additional information, refer to Section 307-01A .

If the leak is tan/brown/black gear lube, the PTU cover seal is leaking and needs to be replaced. This cover seal is located on the PTU cover, behind the deflector. For additional information, refer to Cover Seal procedure in this section.

Vehicles Equipped with 6F35 Transaxle

If the leak is red ATF , this indicates the intermediate shaft seal is leaking and needs to be replaced. For additional information, refer to Intermediate Shaft Seal - 6F35 procedure in this section.

If the leak is tan/brown/black gear lube, the PTU cover seal is leaking and needs to be replaced. The cover seal is located on the PTU cover, behind the deflector. For additional information, refer to Cover Seal procedure in this section.

PTU Leaks From the LH Side

Vehicles Equipped with Aisin AW21 Transaxle

NOTE: The compression seal functions as a dust seal and is not the main source of the red ATF leak.

If the leak is red ATF , this indicates the transaxle seal is leaking and needs to be replaced. For additional information, refer to Section 307-01A .

If the leak is tan/brown/black gear lube and not at the vent, check the non-serviceable PTU inboard seal for leakage. If the PTU inboard seal is leaking, the PTU must be replaced. If the leak is from the vent, the PTU may be overfilled. Determine if the red ATF has entered the PTU . If red ATF has entered the PTU , the transaxle seal and PTU must be replaced. For additional information, refer to Section 307-01A and Power Transfer Unit (PTU) in this section.

Vehicles Equipped with 6F35 Transaxle

If the leak is red ATF , this indicates the transaxle seal is leaking and needs to be replaced. For additional information, refer to Section 307-01B .

If the leak is tan/brown/black gear lube, the PTU may be overfilled and leaking from the vent. If the PTU is overfilled, adjust the level as necessary. If the leak is not at the vent, the non-serviceable PTU inboard seal is leaking and the PTU must be replaced. For additional information, refer to Power Transfer Unit (PTU) in this section.

Power Transfer Unit (PTU) Draining and Filling

Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5

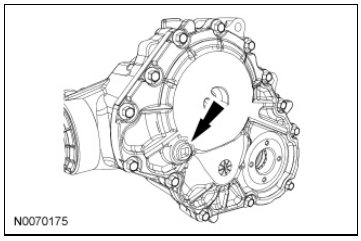
NOTICE: **A new Power Transfer Unit (PTU) must be installed any time the PTU has been submerged in water.**

NOTE: The Power Transfer Unit (PTU) is not to be drained unless contamination is suspected. To drain the PTU fluid, the PTU must be removed from the vehicle. The fluid that is drained may appear black and have a pungent odor. Do not mistake this for contaminated fluid. For additional information, refer to Power Transfer Unit (PTU) in the Removal portion of this section.

NOTE: Fill level checks are done in-vehicle only. Let the vehicle sit 10 minutes after the road test before checking the fluid level.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Clean the area around the filler plug before removing.



3. Remove and discard the filler plug.

4. With the vehicle on a flat, level surface, fill the PTU with lubricant. The fluid must be even with the bottom of the fill opening.
    - Fluid capacity is 0.53L (18 oz).

5. Install a new filler plug.
    - Tighten to 20 Nm (177 lb-in).

Cover Seal

Special Tool(s)

 ST3082-A	Handle, Driver (32 in) 205-907
 ST2572-A	Installer, Halfshaft Oil Seal 308-431td>
 ST1164-A	Installer, Shaft Bearing Cup 308-221 (T94P-7025-BH)
 ST1582-A	Remover, Halfshaft 205-241
 ST1605-A	Slide Hammer 100-01 (T50T-100-A)

Removal

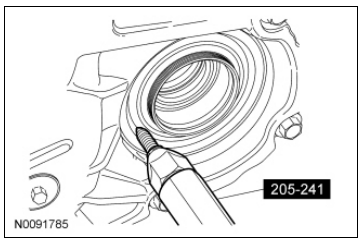
NOTE: The Power Transfer Unit (PTU) may leak different color fluids, red Automatic Transmission Fluid (ATF) and tan/brown/black gear lube for PTU fluid. The PTU seals prevent these types of fluids from leaking. It is important to note which color fluid is leaking to determine the most appropriate service procedure. This procedure will correct a tan/brown/black (gear lube) leak from the RH side of the PTU . For additional information, refer to Analysis of Leakage in this section.

NOTE: This procedure is to be performed through the RH wheel opening. It is not necessary to remove the exhaust components to complete this repair.

1. Remove the intermediate shaft seal deflector. For additional information, refer to Intermediate Shaft Seal Deflector in this section.

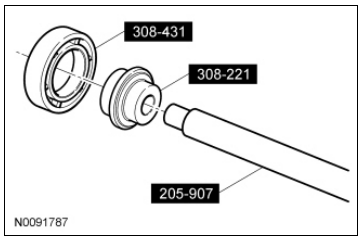
2. **NOTE:** There is a bearing inside the PTU directly behind the cover seal. The bearing is not serviced.

   Remove the cover seal using the Slide Hammer, the extension from the Halfshaft Remover and a suitable seal puller inserted into the groove of the seal.

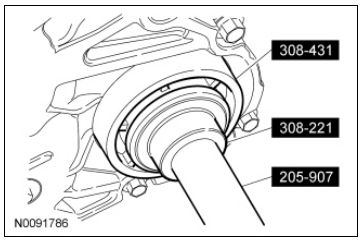


Installation

1. Assemble the Driver Handle, the Halfshaft Oil Seal Installer and the Shaft Bearing Cup Installer as shown.



2. Using the Driver Handle, the Halfshaft Oil Seal Installer and the Shaft Bearing Cup Installer, install the cover seal in the PTU .



3. Install the intermediate shaft seal deflector. For additional information, refer to Intermediate Shaft Seal Deflector in this section.

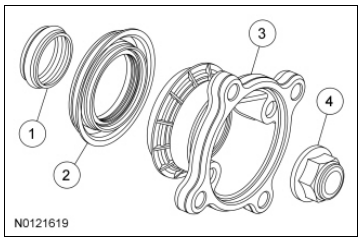
4. Fill the PTU as necessary. For additional information, refer to Power Transfer Unit (PTU) Draining and Filling in this section.

Output Shaft Seal

Special Tool(s)

 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST2571-A	Installer, PTU Drive Gear Outer Oil Seal 308-430
 ST2937A	Remover, Output Flange 307-523

Output Shaft Seal and Flange



Item	Description
1	Collapsible spacer (part of 7275 kit)
2	Output shaft seal (part of 7275 kit)
3	Output pinion flange (part of 7275 kit)
4	Pinion flange nut (part of 7275 kit)

Removal

All vehicles

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

All vehicles except GTDI

2. Remove the 2 exhaust Y-pipe-to-muffler and tail pipe flange nuts.
   - Discard the nuts and gasket.

3. ***NOTICE:*** **The resonator must be supported to prevent damage to the flexible pipe.**

Using a length of mechanic's wire, support the resonator.

GTDI vehicles

4. Remove the 4 LH and RH exhaust flexible pipes-to-underbody catalytic converter nuts.
   - Discard the nuts and gasket.

All vehicles

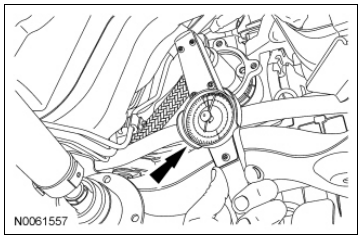
5. **NOTE:** Index-mark both the driveshaft flanges for installation.

   Remove the 4 driveshaft-to- PTU output flange bolts. Disconnect the driveshaft from the PTU and position it aside.

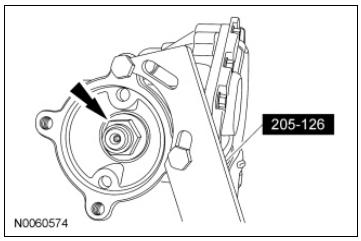
   - Using mechanic's wire, support the driveshaft.

6. **NOTE:** Rotational torque of the PTU rear output shaft flange must be measured and recorded using a Nm (lb-in) torque wrench for correct pinion bearing preload when reassembled. This will be the torque-to-turn measurement.

   Using a suitable torque wrench, measure and record the rotational torque of the PTU output shaft.

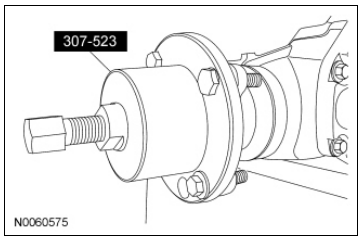


7. Using the Drive Pinion Flange Holding Fixture, hold the output pinion flange. Remove and discard the pinion nut.



8. **NOTE:** Index-mark the output pinion flange to the pinion shaft.

   Using the Output Flange Remover, remove the output pinion flange.



9. Remove and discard the output shaft seal.

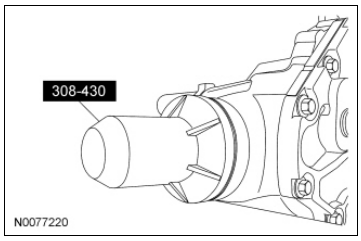
10. Remove the bearing from the output shaft.

11. Remove and discard the collapsible spacer.

Installation

All vehicles

1. Install the new collapsible spacer.
2. Install the bearing onto the output shaft.
3. Using the PTU Drive Gear Outer Oil Seal Installer, install the output shaft seal.

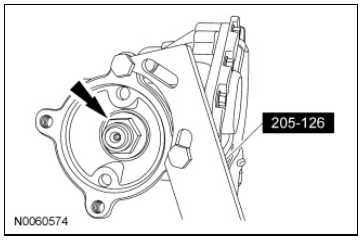


4. **NOTE:** Install the output pinion flange to engage the spline as previously marked.

   Install the output pinion flange.

5. ***NOTICE:*** **Refer to the rotational torque previously recorded with the Nm (lb-in) torque wrench. Tighten the pinion nut in small increments until it is within 0.3 Nm (3 lb-in) of the reference measurement. If 0.3 Nm (3 lb-in) is exceeded, then the collapsible spacer will be damaged and a new collapsible spacer will be required.**

   Using the Drive Pinion Flange Holding Fixture to hold the output pinion flange, install and tighten the new pinion flange nut.



6. Using the index mark, position the driveshaft and install the 4 driveshaft-to- PTU output flange bolts.
   - Tighten to 70 Nm (52 lb-ft).

GTDI vehicles

7. Install the new LH and RH exhaust flexible pipe-to-underbody catalytic converter gaskets and nuts.
   - Tighten to 40 Nm (30 lb-ft).

All vehicles except GTDI

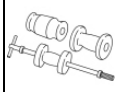
8. Install the new exhaust Y-pipe-to-muffler and tail pipe flange gasket and nuts.
   - Tighten to 40 Nm (30 lb-ft).

All vehicles

9. Fill the PTU as necessary. Refer to Power Transfer Unit (PTU) Draining and Filling .

Intermediate Shaft Seal Deflector

Special Tool(s)

 ST3082-A	Handle, Driver 32 in 205-907
 ST3053-A	
 ST1582-A	Remover, Halfshaft 205-241
 ST3084-A	Remover, Transfer Case Bearing Cup 308-125 (T87P-7120-D)
 ST3248A	Slide Hammer Master Set 100-D112 or equivalent

General Equipment

16 mm (5/8 in) washer (used with 308-125)

Material

Item	Specification
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	-
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada) WSS-M2C924-A	
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

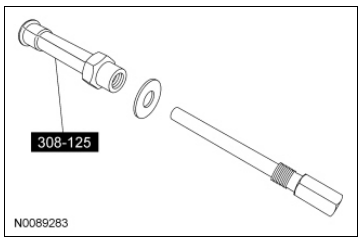
Removal

NOTE: This procedure is to be performed through the RH wheel opening. It is not necessary to remove the exhaust components to complete this repair.

1. Remove the intermediate shaft. For additional information, refer to Section 205-04 .

2. **NOTE:** The following instruction will prevent the Transfer Case Bearing Cup Remover from opening too far which would make removing the intermediate shaft seal deflector difficult.

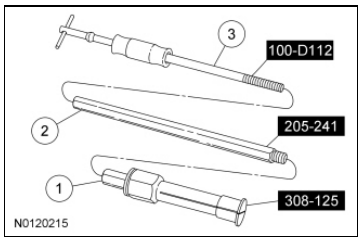
   Place a 16 mm (5/8 in) washer between the components of the Transfer Case Bearing Cup Remover as shown.



NOTICE: **Failure to utilize the recommended tools may result in serious damage to the Power Transfer Unit (PTU).**

3. Assemble the special tools as indicated in the following table and illustration:

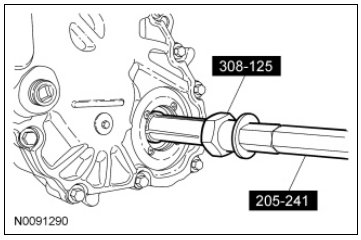
Item	Description
1	308-125
2	Extension from 205-241
3	100-D112 Slide Hammer Master Set



4. **NOTE:** Using a Slide Hammer Master Set eases the removal of the seal deflector.

   Using the Bearing Cup Remover, the extension from the Halfshaft Remover and a suitable slide hammer, remove the seal deflector.

   - The seal deflector will have been damaged during removal. Remove all foreign material from the PTU before continuing with the repair.



Installation

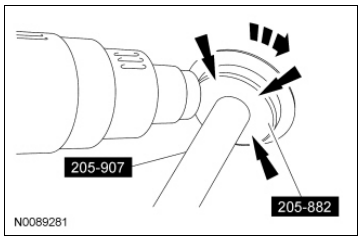
1. ***NOTICE:*** **Do not overheat (melt) the seal deflector. Monitor the temperature of the deflector with a suitable temperature measuring device, such as a digital temperature laser or infrared**

thermometer, while heating. Do not allow the temperature to exceed 100°C (212°F). Overheating will damage the deflector. If the deflector is damaged, a new deflector must be used.

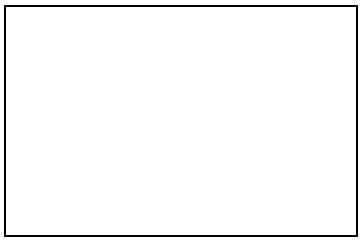
NOTE: Apply a small amount of silicone brake caliper grease and dielectric compound to the inner lip of the deflecr where it installs on the tube inside the PTU before heating. This will ease the installation of the deflector.

Position the deflector on the PTU Linkshaft Seal Dust Shield Installer using silicone brake caliper grease and dielectric compound to retain it to the installer. Using a suitable heat gun, heat the deflector to a minimum of 71°C (160°F) and a maximum of 93°C (200°F) by concentrating the heat across the back of the installer while rotating the tool. Once the optimum temperature is achieved on the tool, move the heat gun to the front of the tool and heat the inside of the deflector where it snaps onto the PTU shaft until the temperature of the deflector is a minimum of 100°C (212°F).

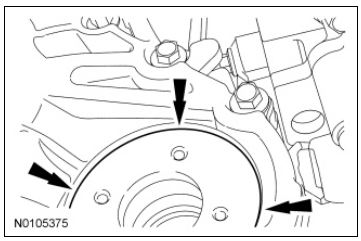
- As an alternative method to heating the seal deflector, place the deflector in boiling water for 3 to 5 minutes. Dry off the deflector and install.



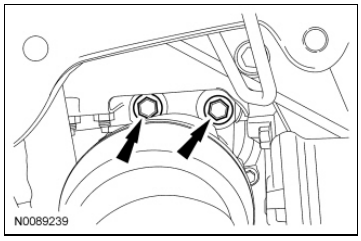
2. Using a 5-pound or larger dead blow hammer, install the seal deflector immediately after heating using the PTU Linkshaft Seal Dust Shield Installer and Driver Handle.



3. Make sure the deflector is completely seated all the way around and there are no cracks on the face. The deflector is correctly installed when the face of the deflector is recessed 3-5 mm (0.12-0.20 in) into the pocket all the way around.



4. Fully install the intermediate and halfshaft assembly and the 2 bolts.
   - Tighten to 40 Nm (30 lb-ft).



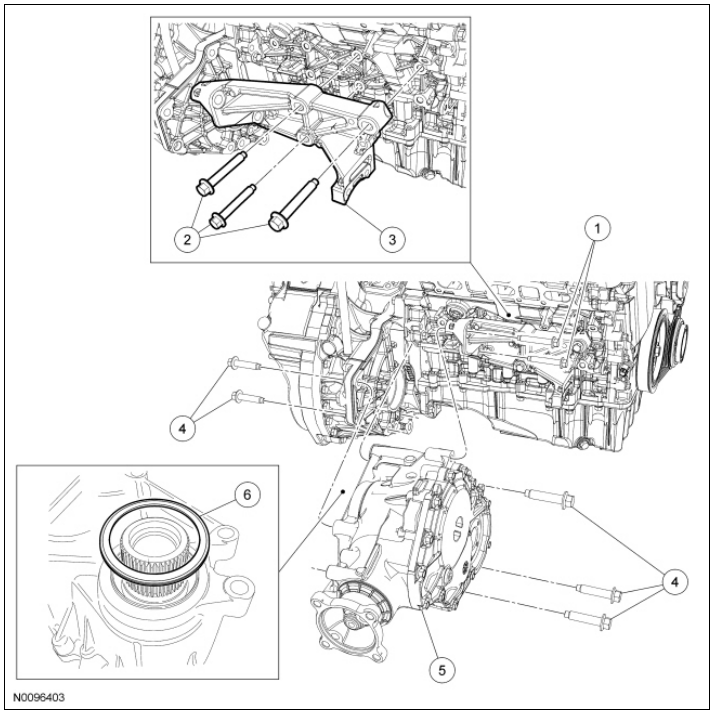
5. **NOTE:** A significant amount of residual fluid will collect between the seal and deflector during this repair. This is a normal condition and should not be misinterpreted as a leak after the repair is complete.

   Using metal brake parts cleaner, thoroughly clean the deflector and intermediate shaft area of any residual fluid that may have accumulated during the repair.

6. Fill the transaxle to the correct fluid level.

Power Transfer Unit (PTU)

NOTE: 3.5L with Aisin AW21 transaxle shown, 3.0L with 6F35 transaxle similar.

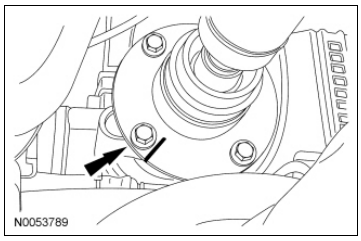


Item	Part Number	Description
1	W500324	Power Transfer Unit (PTU)-to-support bracket bolts (2 required)
2	W500324	PTU support bracket-to-engine block bolts (3 required)
3	7A444	PTU support bracket
4	W500741	PTU -to-transaxle bolts (5 required)
5	7251	PTU
6	7087	Compression seal (vehicles equipped with Aisin AW21 transaxle)

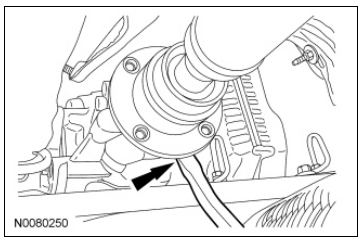
All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove and discard the 4 front driveshaft-to-Power Transfer Unit (PTU) flange bolts.



3. Using a suitable pry bar as shown, separate the driveshaft flange from the PTU flange.



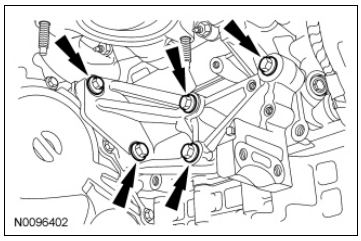
4. Remove the RH catalytic converter. For additional information, refer to Section 309-00 .

3.0L vehicles

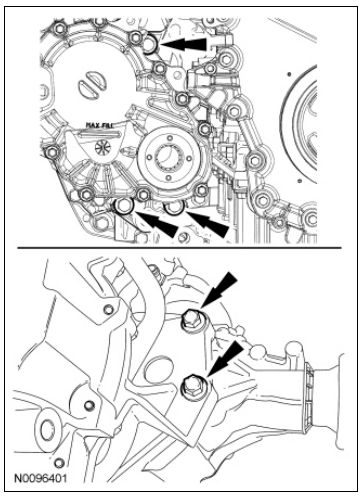
5. Remove the intermediate shaft. For additional information, refer to Section 205-04 .

All vehicles

6. Remove the 2 PTU -to-support bracket bolts, then remove the 3 PTU support bracket bolts and the PTU support bracket.



7. Remove the 5 PTU -to-transaxle bolts.

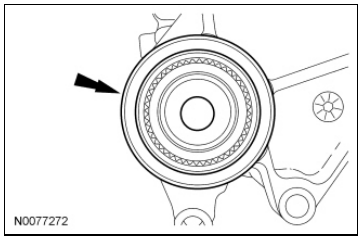


8. Separate the PTU from the transaxle. Remove the PTU from the vehicle.

Vehicles equipped with Aisin AW21 transaxle

9. ***NOTICE:*** **A new compression seal must be installed whenever the PTU is removed from the vehicle. Failure to replace the compression seal may allow debris to enter the area around the transaxle seal and cause the transaxle seal to fail.**

   Using a suitable tool, remove the compression seal and discard.


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Intermediate Shaft Seal - 6F35

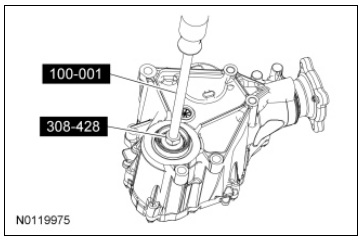
Special Tool(s)

 ST2569-A	Remover, PTO Driven Gear Oil Seal 308-428
 ST1605-A	Slide Hammer 100-001 (T50T-100-A)

1. **NOTE:** Red Automatic Transmission Fluid (ATF) leaking from the RH side of the Power Transfer Unit (PTU) indicates a ntermediate shaft seal. For additional information, refer to Analysis of Leakage in this section.

   Remove the PTU . For additional information, refer to Power Transfer Unit (PTU) in the section.

2. Using the PTO Driven Gear Oil Seal Remover and Slide Hammer, remove the intermediate shaft seal.

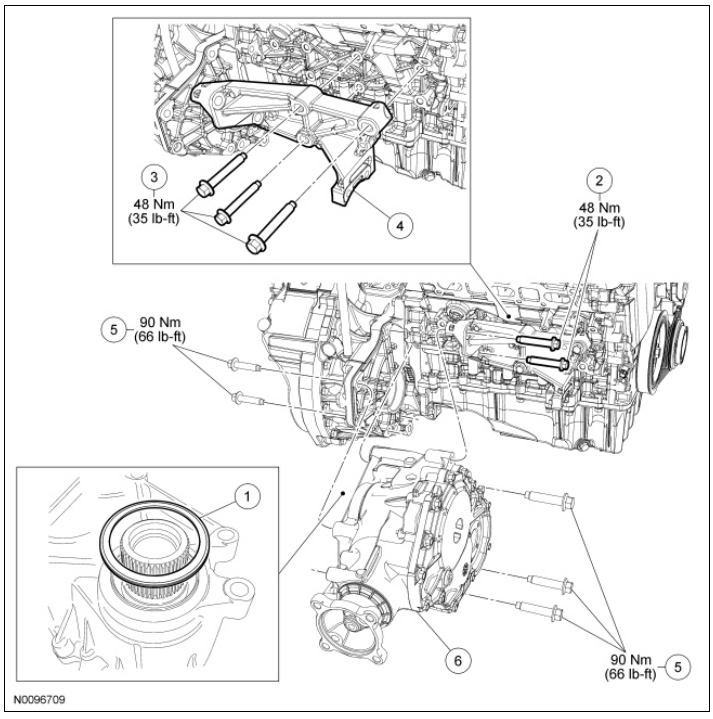


Power Transfer Unit (PTU)

Material

Item	Specification
Motorcraft® MERCON® LV Automatic Transmission Fluid XT-10-QLVC	MERCON® LV
Motorcraft® Premium Automatic Transmission Fluid XT-8-QAW (US); CXT-8-LAW12 (Canada)	WSS-M2C924-A
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5

NOTE: 3.5L with Aisin AW21 transaxle shown, 3.0L with 6F35 transaxle similar.



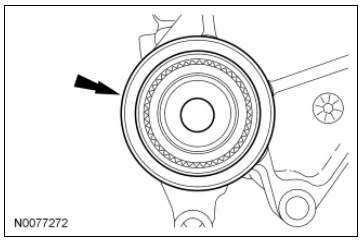
Item	Part Number	Description
1	7087	Compression seal (vehicles with Aisin AW21 transaxle)

2	W500324	Power Transfer Unit (PTU)-to-support bracket bolts (2 required)
3	W500324	PTU support bracket-to-engine block bolts (3 required)
4	7A444	PTU support bracket
5	W500741	PTU -to-transaxle bolts (5 required)
6	7251	PTU

Vehicles equipped with Aisin AW21 transaxle

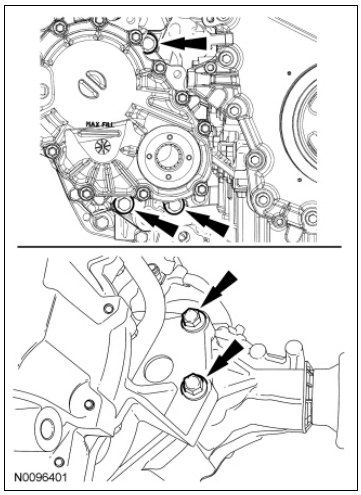
1. ***NOTICE:*** **A new compression seal must be installed whenever the Power Transfer Unit (PTU) is removed from the vehicle. Failure to replace the compression seal may allow debris to enter the area around the transaxle seal and cause the transaxle seal to fail.**

   Using a suitable tool, install the new compression seal.

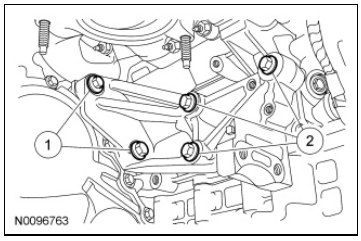


All vehicles

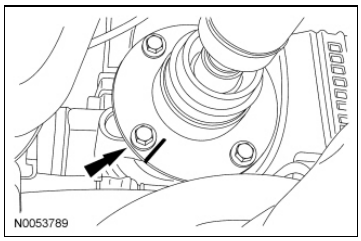
2. Position the Power Transfer Unit (PTU) to the transaxle. Install the 5 PTU -to-transaxle bolts.
   - Tighten to 90 Nm (66 lb-ft).



3. Position the PTU support bracket into place and install the 5 PTU support bracket bolts.
   1. Tighten the bolts to the PTU to 48 Nm (35 lb-ft).
   2. Tighten the bolts to the engine to 48 Nm (35 lb-ft).



4. Position the driveshaft and install 4 new driveshaft-to- PTU flange bolts.
    - Tighten to 70 Nm (52 lb-ft).



3.0L vehicles

5. Install the intermediate shaft. For additional information, refer to Section 205-04 .

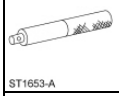
All vehicles

6. Install the RH catalytic converter. For additional information, refer to Section 309-00 .

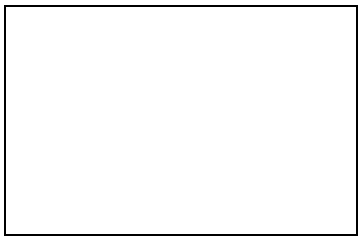
7. Fill the transaxle and/or PTU as necessary.

Intermediate Shaft Seal - 6F35

Special Tool(s)

 ST1653-A	Handle 205-153 (T80T-4000-W)
 ST2570-A	Installer, PTO Driven Gear Oil Seal 308-429

1. Using the Handle and PTO Driven Gear Oil Seal Installer, install the intermediate shaft seal.



2. Install the Power Transfer Unit (PTU). For additional information, refer to Power Transfer Unit (PTU) in this section.

Torque Specifications

Description	Nm	lb-ft	lb-in
Bracket-to-LH catalytic converter bolts (3.5L)	20	-	177
Bracket-to-RH catalytic converter bolts (3.5L)	20	-	177
Catalytic converter manifold bracket nuts and bolts (2.5L, 3.0L)	20	-	177
Catalytic converter manifold nuts (2.5L) [a]	-	-	-
Catalytic converter manifold shield bolts (2.5L, 3.0L)	10	-	89
Catalytic converter manifold shield bracket bolts (2.5L)	20	-	177
Catalytic converter manifold studs (2.5L)	17	-	150
Catalytic converter support bracket-to-engine block nuts (3.5L)	40	30	-
Catalytic converter support bracket-to-transmission bolts (3.5L)	48	35	-
Catalytic converter-to-exhaust flexible pipe nuts (2.5L)	40	30	-
Exhaust flexible pipe-to-catalytic converter nuts (2.5L, 3.0L)	40	30	-
Exhaust manifold nuts (2.5L)	40	30	-
Exhaust manifold studs (2.5L)	25	18	-
Exhaust Y-pipe-to-LH catalytic converter nut (3.5L)	40	30	-
Exhaust Y-pipe-to-RH catalytic converter nut (3.5L)	40	30	-
Exhaust Y-pipe-to-resonator nuts (3.5L)	40	30	-
LH catalytic converter heat shield bolt (3.5L)	10	-	89
LH catalytic converter manifold bracket bolts (3.0L)	20	-	177
LH catalytic converter manifold nuts (3.0L) [a]	-	-	-
LH catalytic converter manifold shield bolts "top" align="center">10	-	89	
LH catalytic converter manifold shield bracket bolts (3.0L)	20	-	177
LH catalytic converter manifold studs (3.0L)	11	-	97
LH catalytic converter-to-exhaust flexible pipe nuts (3.0L)	40	30	-
LH catalytic converter-to-exhaust manifold nuts (3.5L)	40	30	-
LH catalytic converter-to-exhaust manifold studs (3.5L)	25	18	-
Power steering gear shield bolts	15	-	133
RH catalytic converter heat shield bolt (3.5L)	10	-	89
RH catalytic converter manifold shield bracket bolt (3.0L)	20	-	177
RH catalytic converter manifold shield bracket nuts (3.0L)	20		177
RH catalytic converter-to-exhaust flexible pipe bolts (3.0L)	40	30	-
RH catalytic converter-to-exhaust manifold nuts (3.5L)	40	30	-
RH catalytic converter-to-exhaust manifold studs (3.5L)	25	18	-
RH catalytic converter-to-manifold nuts (3.0L)	40	30	-
RH catalytic converter-to-manifold studs (3.0L)	25	18	-
Roll restrictor bolt (3.0L, 3.5L)	90	66	-

Torca® clamp	47	35	-
U-bolt nuts (2.5L)	30	22	-
Worm gear clamp	7	-	62

[a] Refer to the procedure in this section.

&nb

Exhaust System

The 2.5L exhaust system consists of:

- a one-piece catalytic converter manifold (hybrid only).
- an exhaust manifold (except hybrid).
- an exhaust flexible pipe.
- an underbody catalytic converter.
- a Catalyst Monitor Sensor (CMS) mounted to the underbody catalytic converter.
- a production muffler and tail pipe assembly.
- isolators installed on the body and muffler hangers.

The 3.0L exhaust system consists of:

- a one-piece catalytic converter manifold.
- a RH exhaust manifold-mounted catalytic converter.
- an exhaust flexible pipe.
- an underbody catalytic converter.
- a production muffler and tail pipe assembly.
- isolators installed on the body and muffler hangers.

The 3.5L exhaust system consists of:

- two exhaust manifold-mounted catalytic converters.
- an exhaust Y-pipe.
- a resonator and flex assembly.
- a production muffler and tail pipe assembly.
- isolators installed on the body and muffler hangers.

The exhaust system provides an exit for exhaust gases and reduces engine noise by passing exhaust gases through the catalytic converters, a muffler assembly and resonator. Rubber exhaust hanger isolators attach the exhaust system to the hangers welded on the body.

Catalytic Converter

The catalytic converter plays a major role in the emission control system. The catalytic converter operates as a gas reactor. Its catalytic function is to speed the heat-producing chemical reaction of components in the exhaust gases in order to reduce air pollutants.

The catalyst material inside the catalytic converter consists of a ceramic substrate.

The catalytic converter is designed to provide a long life. No maintenance is necessary for the catalytic converter.

Precautions

NOTICE: **Do not use leaded fuel in a vehicle equipped with a catalytic converter. In a vehicle that is continually misfueled, the lead in the fuel will be deposited in the catalytic converter and completely blanket the catalyst. Lead reacts with platinum to "poison" the catalyst. Continuous use of leaded fuel**

can destroy the catalyst and render the catalytic converter useless. The addition of lead to the catalytic converter can also solidify the catalyst, causing excessive back pressure in the exhaust system and possibly causing engine damage.

NOTICE: **Extremely high temperatures of 1,100°C (2,012°F) or above due to misfiring or an over-rich fuel/air mixture will cause the ceramic substrate to sinter or burn, destroying the catalytic converter. Do not continue to operate the vehicle if the engine is misfiring, there is a power loss or other unusual operating conditions, such as engine overheating and backfiring.**

Some exhaust fasteners must be discarded and new ones installed as indicated in the procedures. Also, any damaged or heavily corroded fasteners should be discarded and new ones installed. Some exhaust fasteners are of a prevailing torque design. Use only new fasteners with the same part number as the original. Torque values must be used as specified during reassembly to make sure of correct retention of exhaust components.

Sound Insulators and Shields

Sound insulators and shields, attached to the underbody, protect the vehicle from exhaust system heat and should be inspected at regular intervals to make sure they are not dented or out of position. If a sound insulator and shield is damaged or shows evidence of deterioration, install a new insulator and shield. The sound insulators and shields for the muffler, muffler pipe, resonator and catalytic converter pipe are installed separately.

Exhaust System

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect the components of the exhaust system and related controls that may affect exhaust gas quality or loss of power.
3. Visually inspect for obvious signs of mechanical damage. Refer to the following chart.

Visual Inspection Chart

Mechanical
• Exhaust pipe pinched or crushed • Damaged muffler • Broken or damaged exhaust hanger brackets or isolators • Damaged catalytic converter • Cracked exhaust manifold • Loose or damaged heat shields

4. Verify that the exhaust system is installed correctly, with clamps correctly located and tightened to specification.
5. If the fault is not visually evident, determine the symptom. GO to Symptom Chart - Exhaust System or GO to Symptom Chart - NVH .

Symptom Chart - Exhaust System

Symptom Chart - Exhaust System

Symptom Chart - NVH

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

the symptom, refer back to Section 100-04 for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Rattle, squeaks or buzz type noise - from the bottom of the vehicle	• Loose or damaged heat shield	• INSPECT the exhaust system for loose or missing heat shields or foreign material trapped between the heat shields and the exhaust system components. If any heat shields are loose, INSTALL worm gear clamp 7L5Z-5A231-AA and tighten to 7 Nm (62 lb-in). If the heat shields are missing, INSTALL new heat shields or exhaust system components as necessary. If a rattle, noise or buzz condition persists, INSTALL a new heat shield or component as necessary. TEST the system for normal operation after the repair.
	• Loose or damaged exhaust isolators	• VERIFY that the exhaust isolators are correctly installed. INSPECT the exhaust isolators for wear or damage. INSTALL new isolators as necessary. TEST the system for normal operation after the repair.
	• Damaged exhaust isolator hanger bracket	• INSPECT the exhaust system components for damage or broken hangers. INSTALL new components as necessary. CHECK for loose or damaged exhaust hanger brackets. INSTALL new components as necessary. TEST the system for normal operation after the repair.
	• Loose or damaged catalytic converter or muffler	
	• Exhaust grounded to chassis	• INSPECT for signs of exhaust components-to-body contact. If necessary, CARRY OUT the Exhaust System Alignment in this section.
• Drone or clunk type noise - from the bottom of the vehicle	• Loose or damaged exhaust isolators	• INSPECT the exhaust isolators for wear or damage. INSTALL new isolators as necessary. TEST the system for normal operation after the repair.
	• Exhaust grounded to chassis	• INSPECT for signs of exhaust components-to-body contact. If necessary, CARRY OUT the Exhaust System Alignment in this section.
• Whistles, boom, hum or ticking type noise - noise tends to change as the engine warms. The noises are often accompanied by exhaust fumes	• Exhaust system leak	• INSPECT the entire exhaust system for leaks. CHECK for punctures, loose or damaged clamps/fasteners, gaskets, sensors or broken welds. EXAMINE the chassis for grayish-white or black exhaust soot, which indicates exhaust leakage at that point. To magnify a small leak, have an assistant hold a rag over the tail pipe outlet while listening for a leak. REPAIR or INSTALL new components

as necessary. TEST the system for normal operation after the repair.

- Catalytic converter

- MOVE the exhaust system to simulate the bouncing action of the vehicle, checking for exhaust-to-body contact while moving the exhaust system. Using a rubber mallet, TAP on the exhaust components to duplicate the noise concern. Lightly TAP on the muffler and the catalytic converter. DETERMINE if there are loose or broken baffles in the muffler, or a loose or broken element in the catalytic converter. REPAIR or INSTALL new components as necessary. TEST the system for normal operation after the repair.

- Exhaust muffler/resonator drain hole enlarged due to corrosion

- CONFIRM the drain holes are the noise source. INSTALL new components as necessary. TEST the system for normal operation after the repair.

- Hissing or rushing noise - high frequency sound. Vehicle performance is unaffected

♦ Exhaust system. Exhaust flow through pipes

- CHECK the exhaust system for leaks. Using a rubber mallet, TAP on the exhaust components to duplicate the noise concern. Lightly TAP on the muffler and the catalytic converter. DETERMINE if there are loose or broken baffles in the muffler, or a loose or broken element in the catalytic converter. REPAIR or INSTALL new components as necessary. TEST the system for normal operation after the repair.

- Pinging noise - occurs when exhaust system is hot, engine turned off

- Catalytic converter/exhaust system

- Cool down pinging is a result of the exhaust system expanding and contracting during heating and cooling. This is a normal condition.

- Vibration - occurs at idle and at low speeds. Also accompanied by a clunk or buzz type noise

- Loose or damaged exhaust isolator

- INSPECT the exhaust isolators for wear or damage. INSTALL new isolators as necessary. TEST the system for normal operation after the repair.

- Loose or damaged exhaust isolator hanger brackets

- INSPECT the exhaust isolator hanger brackets for wear or damage. INSTALL or REPAIR as necessary. TEST the system for normal operation after the repair.

- Exhaust system grounded to chassis

- CARRY OUT the Exhaust System Alignment in this section.

- Engine drumming noise - normally accompanied by vibration

- Damaged or misaligned exhaust system

- INSPECT the exhaust system for loose or damaged fasteners, Torca® clamps or isolators. CARRY

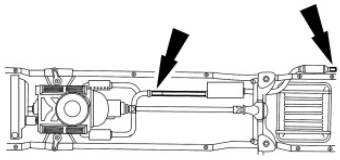
OUT the Exhaust System Alignment in this section.

- Sputter type noise - noise worse when cold, lessens or disappears when the vehicle is at operating temperature
- Damaged or worn exhaust system
- INSPECT the exhaust system for leaks or damage. REPAIR as necessary. TEST the system for normal operation after the repair.
- Thumping noise - from the bottom of the vehicle, worse at acceleration
- Misaligned exhaust system
- CHECK the exhaust system to chassis clearance. CHECK the exhaust system isolators for damage. REPAIR as necessary. TEST the system for normal operation after the repair.
- Loose or damaged body shield
- CHECK the body shield for damaged, loose or missing fasteners. REPAIR or REPLACE as necessary. TEST the system for normal operation after the repair.
- Engine vibration - is felt with increases and decreases in engine rpm
- Strain on exhaust system isolators
- CARRY OUT the Exhaust System Alignment in this section. REPAIR as necessary. TEST the system for normal operation after the repair.
- Drumming noise - occurs inside the vehicle during idle or high idle, hot or cold. Very low-frequency drumming is very rpm dependent
- Exhaust system vibration excites the body resonances inducing interior noise
- GO to Pinpoint Test A .

Pinpoint Test

PINPOINT TEST A: DRUMMING NOISE

Test Step	Result / Action to Take
A1 CHECK THE EXHAUST SYSTEM	
• Start the engine. • Increase the engine rpm until the noise is the loudest. Note the engine rpm. • Ignition OFF. • Add approximately 9 kg (20 lb) of weight to the exhaust system.st place the weight at the tail pipe and test, then at the	**Yes** REFER to Exhaust System Alignment in this section. TEST the system for normal operation. **No** CONDUCT a diagnosis on other

front pipe.  DF1768-A • Start the engine. • Increase the engine rpm and listen for the drumming noise. Note the engine rpm if the noise occurs. • Ignition OFF. • Remove the weight from the exhaust system. • **Is the noise/vibration reduced or eliminated, or does the noise/vibration occur at a different rpm?**	suspect systems. REFER to Section 100-04 .

Exhaust System Alignment

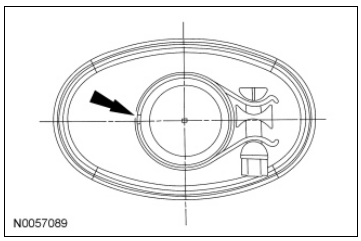
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Loosen all fasteners joining the exhaust system components.
3. Beginning at the front of the vehicle, align the exhaust system to establish the maximum clearance. Make sure all fit pipes are pushed all the way into the preceding pipe and the notches are correctly lined up with the tabs.
4. Beginning at the front of the vehicle, tighten all fasteners and clamps to specification. For additional information, refer to Specifications in this section.
5. Start the engine and check the exhaust system for leaks.

Torca® Clamp

1. Remove the nut from the Torca® clamp.

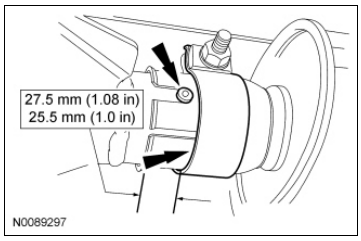
2. Grind the spot weld from the Torca® clamp and remove the clamp.

3. Clean the uneven surface area and position a Torca® clamp.



4. **NOTE:** Make sure the clamp position is no more than 27.5 mm (1.08 in) or less than 25.5 mm (1 in) from the inlet of the resonator pipe.

   Make sure the back of the slot is covered by the clamp and the button is fully seated inside the notch.



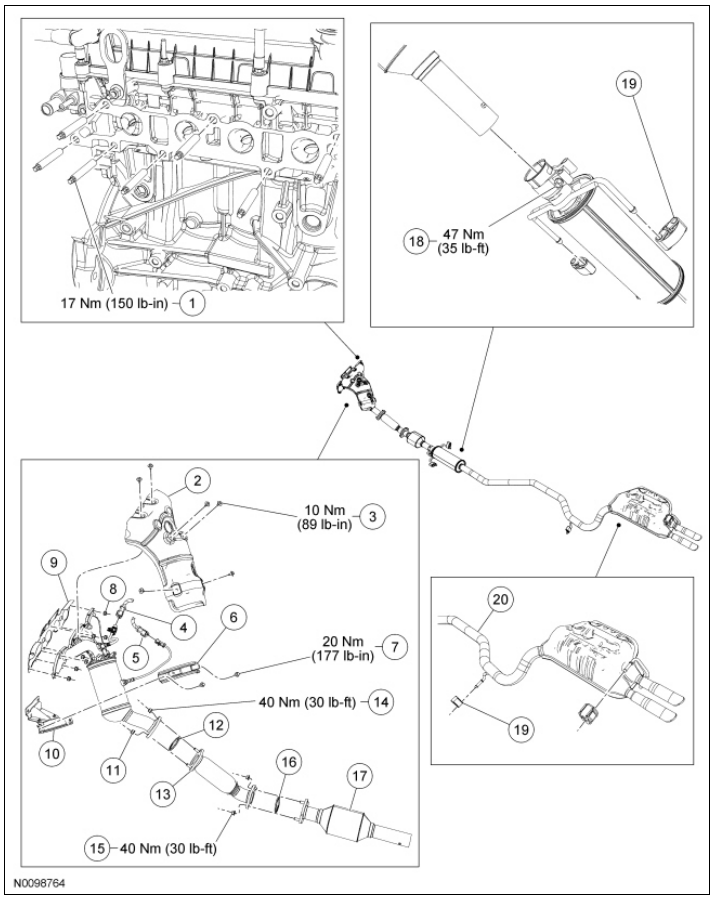
5. **NOTE:** Do not tighten the clamp until the exhaust system has been aligned.

   Tighten the Torca® clamp.

   - Tighten to 47 Nm (35 lb-ft).

Exhaust System - Exploded View

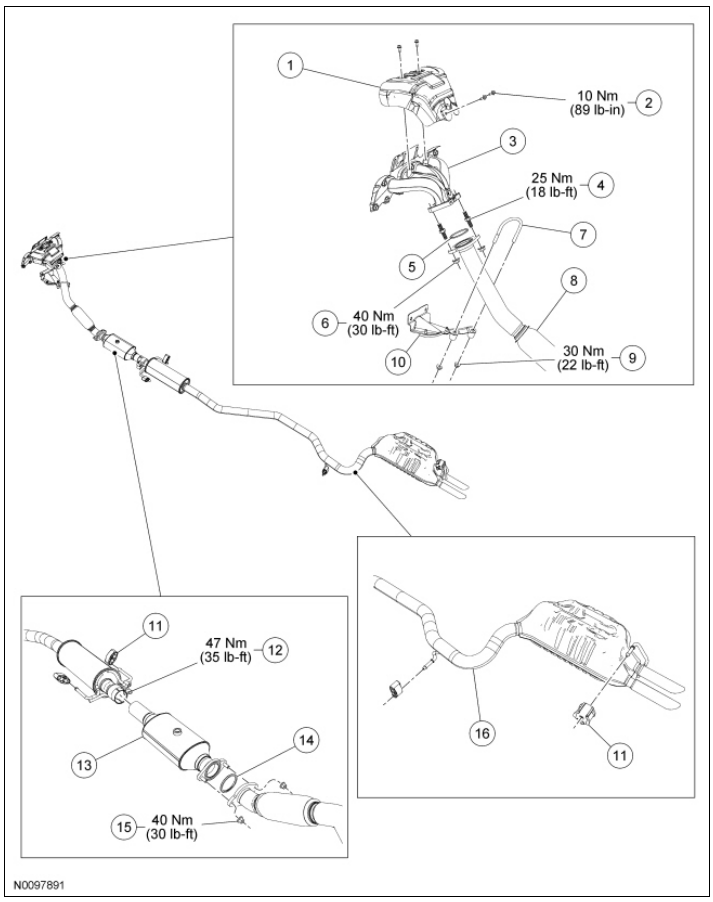
2.5L Hybrid



Item	Part Number	Description
1	W704474	Catalytic converter manifold stud (7 required)
2	5K282	Catalytic converter manifold shield
3	W503921	Catalytic converter manifold shield bolt (6 required)
4	14A464	Heated Oxygen Sensor (HO2S) electrical connector
5	14A464	Catalyst Monitor Sensor (CMS) electrical connector
6	5K291	Catalytic converter manifold shield bracket
7	W500021	Catalytic converter manifold shield bracket bolt (2 required)
8	W708176	Catalytic converter manifold nut (7 required)
9	9448	Catalytic converter manifold gasket
10	-	Catalytic converter manifold bracket
11	5G236	Catalytic converter manifold
12	9451	Gasket

13	5G203	Exhaust flexible pipe
14	W520414	Catalytierter-to-exhaust flexible pipe nut (2 required)
15	W520414	Exhaust flexible pipe-to-catalytic converter nut (2 required)
16	9451	Gasket
17	5E212	Catalytic converter
18	5221	Torca® clamp
19	5F262	Muffler and tail pipe isolator (4 required)
20	5C257	Muffler and tail pipe

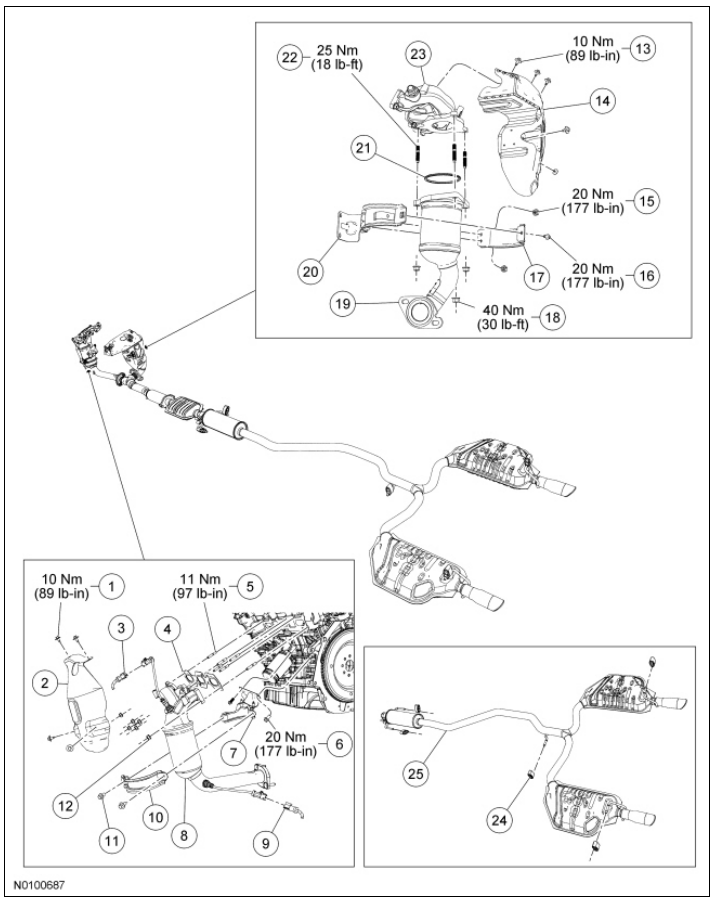
2.5L



Item	Part Number	Description
1	9N454	Catalytic converter manifold shield
2	W503921	Catalytic converter manifold shield bolt (4 required)
3	9430	Exhaust manifold
4	W711133	Exhaust manifold stud (2 required)
5	9451	Gasket
6	W520414	Exhaust manifold nut (2 required)
7	N802137	U-bolt
8	5G203	Exhaust flexible pipe

9	W520414	U-bolt nut (2 required)
10	5K222	Catalytic converter manifold braket
11	5F262	Muffler and tail pipe isolator (4 required)
12	5221	Torca® clamp
13	5E212	Catalytic converter
14	9451	Gasket
15	W520414	Exhaust flexible pipe-to-catalytic converter nut (2 required)
16	5C257	Muffler and tail pipe

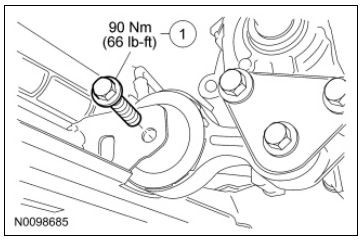
3.0L Front Wheel Drive (FWD) (View 1 of 3)



Item	Part Number	Description
1	W503921	LH catalytic converter manifold shield bolt (4 required)
2	5K282	LH catalytic converter manifold shield
3	14A464	Heated Oxygen Sensor (HO2S) electrical connector
4	9448	LH catalytic converter manifold gasket
5	W701732	LH catalytic converter manifold stud (6 required)
6	W711132	LH catalytic converter manifold bracket bolt (2 required)

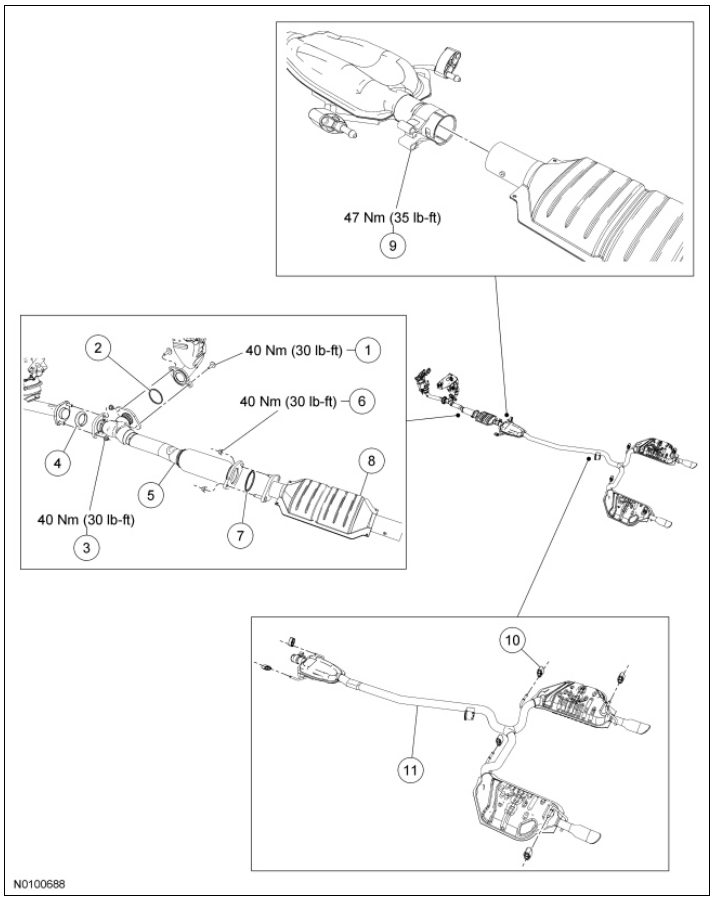
7	5K223	LH catalytic converter manifold bracket
8	5G232	LH catalytic converter manifold
9	14A464	Catalyst Monitor Sensor (CMS) electrical connector
10	5K292	LH catalytic converter manifold shield bracket
11	W500021	LH catalytic converter manifold shield bracket bolt (2 required)
12	W701706	LH catalytic converter manifold nut (6 required)
13	W503921	RH catalytic converter manifold shield bolt (5 required)
14	5K282	RH catalytic converter manifold shield
15	W701706	RH catalytic converter manifold shield bracket nut (2 required)
16	W500021	RH catalytic converter manifold shield bracket bolt
17	5K281	RH catalytic converter manifold shield bracket
18	W520414	RH catalytic converter-to-manifold nut (3 required)
19	5G236	RH catalytic converter manifold
20	5K291	RH catalytic converter manifold bracket
21	5F263	RH catalytic converter manifold gasket
22	W711133	RH catalytic converter-to-manifold stud (3 required)
23	9428	RH exhaust manifold
24	5F262	Muffler and tail pipe isolator (5 required)
25	5G213	Muffler and tail pipe

3.0L, 3.5L (View 2 of 3)



Item	Part Number	Description
1	W711575	Roll restrictor bolt

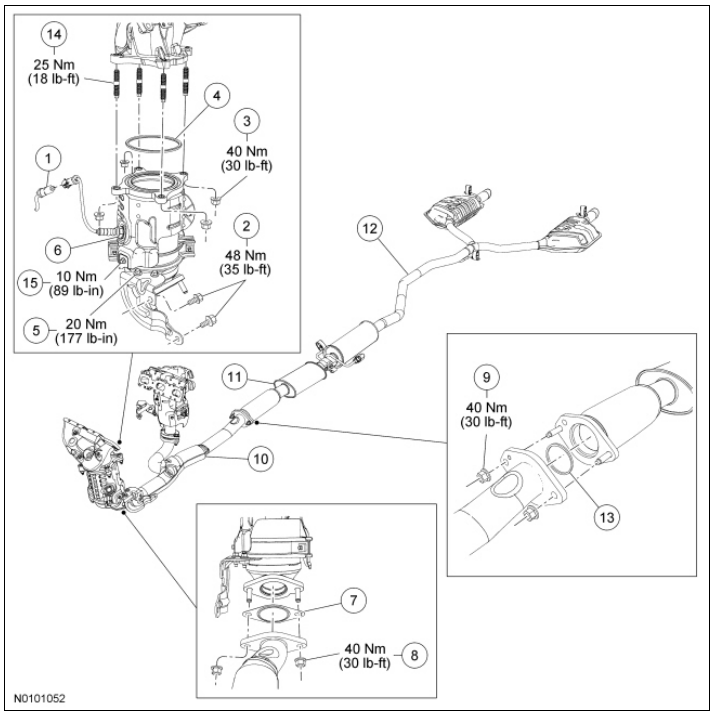
3.0L All-Wheel Drive (AWD) (View 3 of 3)



Item	Part Number	Description
1	W713002	RH catalytic converter-to-exhaust flexible pipe bolt (2 required)
2	9451	Gasket
3	W520414	LH catalytic converter-to-exhaust flexible pipe nut (2 required)
4	5E241	Gasket
5	5G274	Exhaust flexible pipe
6	W520414	Exhaust flexible pipe-to-catalytic converter nut (2 required)
7	9451	Gasket
8	5E212	Catalytic converter
9	5221	Torca® clamp
10	5F262	Muffler and tail pipe isolator (6 required)
11	5G213	Muffler and til pipe

3.5L (View 1 of 3)

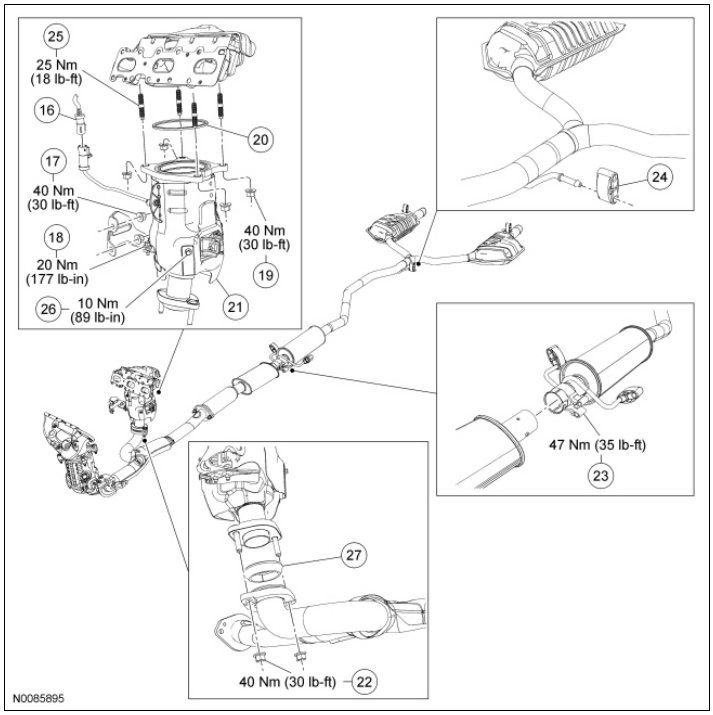
NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.



Item	Part Number	Description
1	14A464	Catalyst Monitor Sensor (CMS) electrical connector
2	-	Catalytic converter support bracket-to-transmission bolts (2 required)
3	W520414	LH catalytic converter-to-exhaust manifold nut (4 required)
4	5F263	Gasket
5	W500222	Bracket-to-LH catalytic converter bolt (2 required)
6	5E213	LH catalytic converter
7	9451	Gasket
8	W520414	Exhaust Y-pipe-to-LH catalytic converter nut (2 required)
9	W520414	Exhaust Y-pipe-to-resonator nut (2 required)
10	5G274	Exhaust Y-pipe
11	5H292	Resonator
12	5G213	Muffler and tail pipe
13	9451	Gasket
14	W712458	LH catalytic converter-to-exhaust manifold stud (4 required)
15	W500211	LH catalytic converter heat shield bolt (3 required)

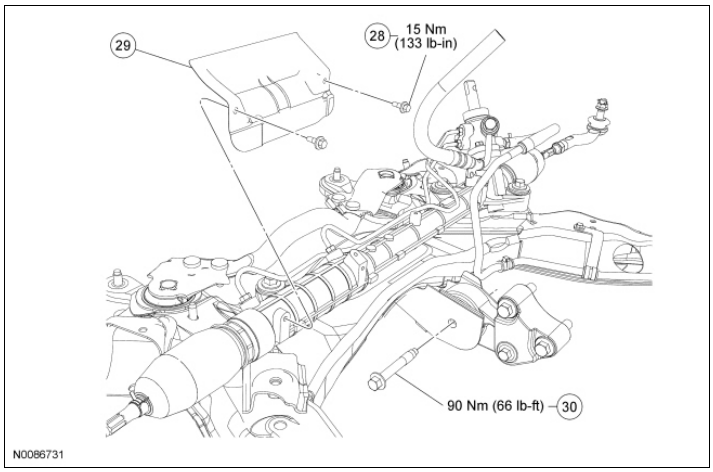
3.5L (View 2 of 3)

NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.



Item	Part Number	Description
16	14A464	RH CMS electrical connector
17	W710512/ W520414	Catalytic converter support bracket-to-engine block nut (2 required)
18	W500222	Bracket-to-RH catalytic converter bolt (2 required)
19	W520414	RH catalytic converter-to-exhaust manifold nut (4 required)
20	5F263	Gasket
21	5E211	RH catalytic converter
22	W520414	Exhaust Y-pipe-to-RH catalytic converter nut (2 required)
23	5221	Torca® clamp
24	5F262	Muffler and tail pipe isolator (5 required)
25	W712458	RH catalytic converter-to-exhaust manifold stud (4 required)
26	W500211	H catalytic converter heat shield bolt (3 required)
27	-	Gasket

3.5L (View 3 of 3)



Item	Part Number	Description
28	W500210	Power steering gear shield bolt (2 required)
29	-	Power steering gear shield
30	W706674	Roll restrictor bolt

1. For additional information, refer to the procedures in this section.

Catalytic Converter - Manifold, Hybrid

Removal

1. **NOTE:** Always install new fasteners and gaskets as indicated. Clean flange faces prior to new gasket installation to make sure of proper sealing.

   With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the Heated Oxygen Sensor (HO2S) and the Catalyst Monitor Sensor (CMS) electrical connectors.

3. Remove the 2 catalytic converter manifold-to-exhaust flexible pipe nuts.
   - Discard the gasket and the 2 nuts.

4. Remove the 6 catalytic converter manifold shield bolts and the heat shield.

5. Remove the 2 catalytic converter manifold shield bracket bolts and the bracket.

6. Loosen the 2 catalytic converter manifold bracket bolts.

7. Remove the 7 catalytic converter manifold nuts and remove the converter from the vehicle.
   - Discard the 7 nuts and the gasket.

8. Remove and discard the 7 catalytic converter manifold studs.

9. Clean and inspect the catalytic converter manifold. For additional information, refer to Section 303-00 .

Installation

1. Install the 7 new catalytic converter manifold studs.
   - Tighten to 17 Nm (150 lb-in).

2. Position a new catalytic converter manifold gasket on the studs.

3. ***NOTICE:*** **Failure to tighten the catalytic converter manifold nuts to specification before installing the converter bracket bolts will cause the converter to develop an exhaust leak.**

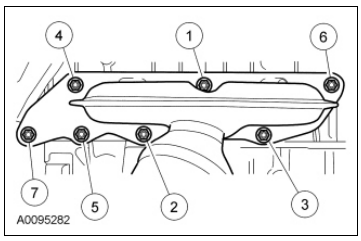
   NOTICE: **Failure to tighten the catalytic converter manifold nuts to specification a second time will cause the converter to develop an exhaust leak.**

   NOTE: Make sure to tighten the nuts in the following sequence in 2 stages.

   Position the catalytic converter manifold and tighten the 7 new nuts in the sequence shown, in 2 stages.

   - Stage 1: Tighten to 55 Nm (41 lb-ft).

- Stage 2: Tighten to 55 Nm (41 lb-ft).



4. Tighten the 2 catalytic converter manifold bracket bolts.
   - Tighten to 20 Nm (177 lb-in).

5. Install the 2 catalytic converter manifold shield bracket bolts and the bracket.
   - Tighten to 20 Nm (177 lb-in).

6. Position the catalytic converter manifold shield and install the 6 heat shield bolts.
   - Tighten to 10 Nm (89 lb-in).

7. Install the exhaust flexible pipe to the catalytic converter.
   - Install a new gasket and nuts.
   - Tighten to 40 Nm (30 lb-ft).

8. Connect the HO2S and the CMS electrical connectors.

Catalytic Converter - 3.0L RH

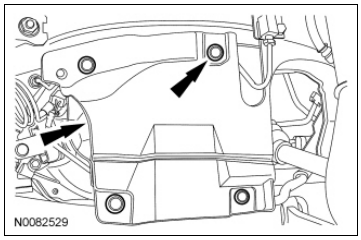
Removal

NOTE: Always install new fasteners and gaskets as indicated. Clean flange faces prior to new gasket installation to make sure of proper sealing.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the RH front wheel and tire. For additional information, refer to Section 204-04 .

3. Remove the pin-type retainers and position the splash shield aside.



4. Remove the exhaust flexible pipe. For additional information, refer to Exhausexible Pipe - 2.5L, 3.0L in this section.

5. Remove the Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor (CMS). For additional information, refer to Section 303-14B.

6. Remove the roll restrictor bolt and rotate the engine forward.

7. Remove the 5 bolts and position aside the catalytic converter manifold shield.

8. Remove the bolt, 2 nuts and the RH catalytic converter manifold brackets.

9. Remove the 3 nuts and the RH catalytic converter.
    - Rotate the RH catalytic converter so the flex-pipe flange opening is facing toward the front of the vehicle to remove.
    - Discard the 3 RH catalytic converter nuts and gasket. Click here to view a video version of this procedure.

Installation

1. **NOTE:** Do not tighten the 3 new RH catalytic converter nuts at this time.

   Install the RH catalytic converter and a new gasket.

    - Loosely install the 3 new nuts.

2. **NOTE:** Do not tighten the catalytic converter manifold brackets bolt and 2 nuts at this time.

Install the RH catalytic converter manifold brackets.

- ♦ Tighten the 3 RH catalytic converter nuts.
  - Tighten to 40 Nm (30 lb-ft).

4. **NOTE:** Do not tighten the 5 catalytic converter manifold shield bolts at this time.

   Install the catalytic converter manifold shield.

   - Loosely install the 5 bolts.

5. Tighten the RH catalytic converter manifold brackets bolt and 2 nuts.
   - Tighten to 20 Nm (177 lb-in).

6. Tighten the catalytic converter manifold shield 5 bolts.
   - Tighten to 10 Nm (89 lb-in).

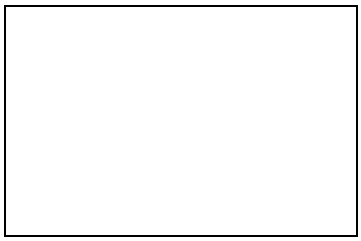
7. Install the roll restrictor bolt.
   - Tighten to 90 Nm (66 lb-ft).

8. ***NOTICE:*** **Prior to installation, inspect the Heated Oxygen Sensor (HO2S) and the Catalyst Monitor Sensor (CMS) wiring harness for damage.**

   Install the HO2S and CMS . For additional information, refer to Section 303-14B.

9. Install the exhaust flexible pipe. For additional information, refer to Exhaust Flexible Pipe - 2.5L, 3.0L in this section.

10. Install the splash shield and the pin-type retainers.



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

Catalytic Converter - 3.0L LH Manifold

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the oil level indicator and tube. For additional information, refer to Section 303-01B .
3. Disconnect the Heated Oxygen Sensor (HO2S) and the Catalyst Monitor Sensor (CMS) electrical connectors.
4. Remove the 2 LH catalytic converter-to-exhaust flexible pipe nuts.
    - Discard the gasket and the 2 nuts.
5. Remove the 4 bolts and the LH catalytic converter manifold shield.
6. Remove the 2 LH catalytic converter manifold shield bracket bolts and the shield bracket.
7. Remove the 2 LH catalytic converter manifold bracket bolts and bracket.
8. Remove the 6 nuts and the LH catalytic converter manifold.
    - Discard the 6 LH catalytic converter manifold nuts and the gasket.
9. Remove and discard the 6 LH catalytic converter manifold studs.
10. Clean and inspect the catalytic crter manifold. For additional information, refer to Section 303-00 .

Installation

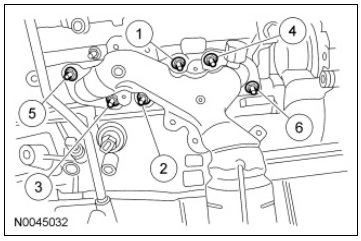
1. Install the 6 new LH catalytic converter manifold studs.
    - Tighten to 11 Nm (97 lb-in).
2. Position a new LH catalytic converter manifold gasket on the studs.
3. Position the LH catalytic converter manifold and finger-tighten the 6 new nuts.
4. Install a new gasket and finger-tighten 2 new nuts at the LH catalytic converter-to-exhaust flexible pipe.
5. ***NOTICE:*** **Failure to tighten the catalytic converter manifold nuts to specification before installing the converter bracket bolts will cause the converter to develop an exhaust leak.**

   NOTICE: **Failure to tighten the catalytic converter manifold nuts to specification a second time will cause the converter to develop an exhaust leak.**

   NOTE: Make sure to tighten the nuts in the sequence shown in 2 stages.

Position the LH catalytic converter manifold and tighten the 6 new nuts in the sequence shown, in 2 stages.

- Stage 1: Tighten to 20 Nm (177 lb-in).
- Stage 2: Tighten to 20 Nm (177 lb-in).



6. Install the shield bracket and the 2 LH catalytic converter manifold shield bracket bolts.
   - Tighten to 20 Nm (177 lb-in).
7. Install the LH catalytic converter manifold bracket and 2 bolts.
   - To install, tighten to 20 Nm (177 lb-in).
8. Position the LH catalytic converter manifold shield and install the 4 bolts.
   - Tighten to 10 Nm (89 lb-in).
9. Tighten the 2 new LH catalytic converter-to-exhaust flexible pipe nuts.
   - Tighten to 40 Nm (30 lb-ft).
10. Connect the HO2S and the CMS electrical connectors.
11. Install the oil level indicator and tube. For additional information, refer to Section 303-01B .

Catalytic Converter - 3.5L RH

Removal and Installation

All vehicles

1. **NOTE:** Always install new fasteners and gaskets as indicated. Clean flange faces prior to new gasket installation to make sure of proper sealing.

   With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

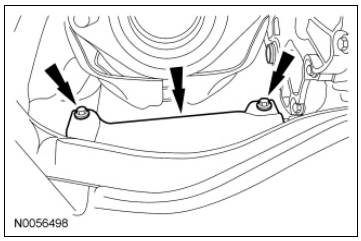
2. Remove the exhaust Y-pipe. For additional information, refer to Exhaust Y-Pipe - 3.5L in this section.

All-Wheel Drive (AWD) vehicles

3. Remove the intermediate shaft. For additional information, refer to Section 205-04 .

All vehicles

4. Remove the 2 bolts and the power steering gear shield.
   - To install, tighten to 15 Nm (133 lb-in).



5. Remove the roll restrictor bolt and rotate the engine forward.
   - To install, tighten to 90 Nm (66 lb-ft).

6. Disconnect the Catalyst Monitor Sensor (CMS) electrical connector.

7. Remove the 2 bracket-to-RH catalytic converter bolts.
   - To install, tighten to 20 Nm (177 lb-in).

8. Remove the 4 nuts and the RH catalytic converter.
   - Discard the 4 RH catalytic converter-to-exhaust manifold nuts and gasket.
   - To install, tighten to 40 Nm (30 lb-ft).

9. ***NOTICE:*** **Prior to Installation, Inspect the CMS wiring harness for damage.**

   To install, reverse the removal procedure.

   - Install a new gasket, nuts and studs as indicated.

Catalytic Converter â 3.5L LH

Removal and Installation

1. **NOTE:** Always install new fasteners and gaskets as indicated. Clean flange faces prior to new gasket installation to make sure of proper sealing.

   With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the Catalyst Monitor Sensor (CMS) electrical connector.

3. Remove the exhaust Y-pipe. For additional information, refer to Exhaust Y-Pipe â 3.5L in this section.

4. Remove the 2 catalytic converter support bracket-to-transmission bolts.
   - To install, tighten to 48 Nm (35 lb-ft).

5. Remove the 4 nuts and the LH catalytic converter.
   - Discard the 4 LH catalytic converter-to-exhaust manifold nuts and gasket.
   - To install, tighten to 40 Nm (30 lb-ft).

6. To install, reverse the removal procedure.
   - Install a new gasket, nuts and studs as indicated.

Exhaust Flexible Pipe - 2.5L, 3.0L

Removal

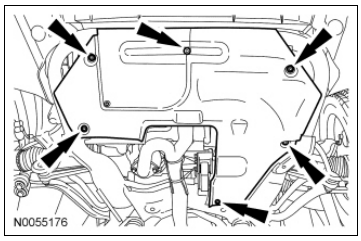
NOTICE: **Do not excessively bend, twist or allow the exhaust to hang from the flexible pipe or damage to the exhaust system may occur.**

All vehicles

1. **NOTE:** Always install new fasteners and gaskets as indicated. Clean flange faces prior to new gasket installation to make sure of proper sealing.

   With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. If equipped, remove the 6 screws and the underbody shield.



3. Remove and discard the 2 exhaust flexible pipe-to-catalytic converter nuts.
   - Discard the gasket.

3.0L vehicles

4. Remove and discard the 2 RH catalytic converter-to-exhaust flexible pipe nuts.
   - Discard the gasket.

5. Remove and discard the 2 LH catalytic converter-to-exhaust flexible pipe nuts and remove the exhaust flexible pipe.
   - Discard the gasket.

2.5L vehicles

6. Remove and discard the 2 catalytic converter manifto-exhaust flexible pipe nuts and remove the exhaust flexible pipe.
   - Discard the gasket.

Installation

2.5L vehicles

1. Using a new gasket, install the exhaust flexible pipe and 2 new catalytic converter manifold-to-exhaust flexible pipe nuts.
   - Tighten to 40 Nm (30 lb-ft).

3.0L vehicles

2. Using a new gasket, install the exhaust flexible pipe and 2 new LH catalytic converter-to-exhaust flexible pipe nuts.
    - Tighten to 40 Nm (30 lb-ft).

3. Using a new gasket, install the 2 new exhaust flexible pipe-to-catalytic converter nuts.
    - Tighten to 40 Nm (30 lb-ft).

All vehicles

4. Using a new gasket, install 2 new exhaust flexible pipe-to-catalytic converter nuts.
    - Tighten to 40 Nm (30 lb-ft).

5. If equipped, install the underbody shield and the 6 screws.

6. Start the engine and check for exhaust leaks.

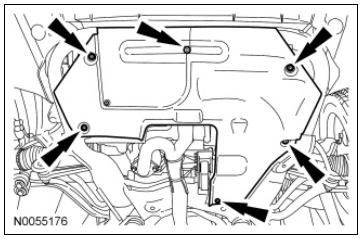
Exhaust Y-Pipe - 3.5L

Removal and Installation

1. **NOTE:** Always install new fasteners and gaskets. Clean flange faces prior to new gasket installation to make sure of proper sealing.

   With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. If equipped, remove the 6 screws and the underbody shield.



3. Remove and discard the 2 exhaust Y-pipe-to-resonator nuts.
   - Discard the gasket.
   - To install, tighten to 40 Nm (30 lb-ft).

4. Remove and discard the 2 RH catalytic converter-to-exhaust Y-pipe nuts.
   - To install, tighten to 40 Nm (30 lb-ft).

5. Remove and discard the 2 exhaust Y-pipe-to-LH catalytic converter nuts and remove the exhaust Y-pipe.
   - Discard the gasket.
   - To install, tighten to 40 Nm (30 lb-ft).

6. To install, reverse the removal procedure.
   - Install new gaskets and nuts.

7. Start the engine and check for exhaust leaks/li>

Catalytic Converter - Underbody

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove and discard the 2 exhaust flexible pipe-to-catalytic converter nuts.
   - Discard the gasket.
   - To install, tighten to 40 Nm (30 lb-ft).

3. Remove the Torca® clamp. For additional information, refer to Torca® Clamp in this section.

4. Separate the catalytic converter from the muffler and tail pipe.
   - Remove the catalytic converter.

5. To install, reverse the removal procedure.
   - Install a new gasket and nuts.

6. Start the engine and check for exhaust leaks.

Resonator - 3.5L

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove and discard the 2 exhaust Y-pipe-to-resonator nuts.
   - Discard the gasket.
   - To install, tighten to 40 Nm (30 lb-ft).

3. Loosen Torca® clamp nut.
   - To install, tighten to 47 Nm (35 lb-ft).

4. Separate the resonator from the muffler and tail pipe and remove the resonator.

5. To install, reverse the removal procedure.
   - Install a new gasket and nuts.

6. Start the engine and check for exhaust leaks.

Muffler and Tailpipe

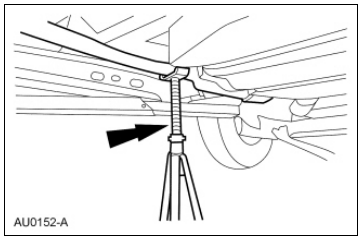
Removal and Installation

NOTICE: **Do not use oil or grease-based lubricants on the isolators. They may cause deterioration of the rubber.**

NOTICE: **Oil or grease-based lubricants on the isolators may cause the exhaust hanger isolator to separate from the exhaust hanger bracket during vehicle operation.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

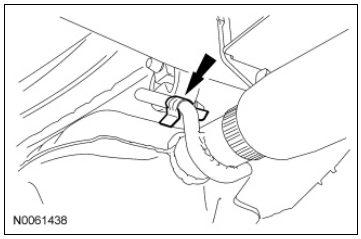
2. Support the muffler and tail pipe with a suitable jackstand.



3. ***NOTICE:*** **Do not excessively bend, twist or allow the exhaust to hang from the flexible pipe or damage to the exhaust system may occur.**

   Support the catalytic converter with a suitable jackstand.

4. Disconnect the ground clip from the exhaust hanger.



5. Loosen Torca® clamp nut.
   - To install, tighten to 47 Nm (35 lb-ft).

6. **NOTE:** Do not damage or tear the isolators during removal.

   Using soapy water, separate the 4 or 5 muffler and tail pipe isolators from the vehicle.

7. Separate the muffler and tail pipe from the catalytic converter and remove the muffler and tail pipe.

8. To install, reverse the removal procedure.
   - Inspect and replace any isolators damaged or torn during the removal process.

9. Start the engine and check for exhaust leaks.

Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-

General Specifications

Item	Specification
Fuel tank capacity (All-Wheel Drive (AWD) vehicles)	62.46L (16.5 gal)
Fuel tank capacity (Front Wheel Drive (FWD) vehicles)	66.24L (17.5 gal)
Fuel Pressure	
2.5L and 3.0L engine running fuel pressure	379-399 kPa (55-58 psi)
3.5L engine running fuel pressure	441-461 kPa (64-67 psi)

Torque Specifications

Description	Nm	lb-in
Fuel tank filler pipe hose clamp	4	35

Fuel System

Fuel System

The fuel system consists of the:

- All-Wheel Drive (AWD) saddle-type or Front Wheel Drive (FWD) L-shaped fuel tank.
- Fuel Pump (FP) module.
- fuel level sensor assembly (saddle-type fuel tank).
- fuel level sender (mounted on the FP module and, if equipped, on the fuel level sensor assembly).
- Easy Fuel ™ (capless) fuel tank filler pipe assembly.
- FP control module on 2.5L and 3.0L vehicles.
- Inertia Fuel Shutoff (IFS) switch on 3.5L vehicles.
- fuel tubes.
- fuel injectors.
- fuel rail.
- Fuel Tank Pressure (FTP) sensor (part of the fuel vapor tube assembly).

The vehicle

- has a single speed Mechanical Retess Fuel System (MRFS) on 3.5L vehicles.
- has a 2-speed MRFS on 2.5L and 3.0L vehicles.
- has either a single container (L-shaped) (FWD) or a dual container (saddle-type) (AWD) fuel tank.
- has a FP module containing:
  - ♦ an electric FP , which provides pressurized fuel to the fuel rail.
  - ♦ a serviceable fuel level sender.
  - ♦ a check valve, which maintains system pressure after the FP is shut off.
  - ♦ a pressure relief valve for overpressure protection in the event of restricted fuel flow.
  - ♦ a lifetime fuel filter providing filtration to protect the fuel injectors from foreign material.
- has an individual fuel level sensor, AWD vehicles only.
- has a fuel rail-mounted Schrader valve on early build 3.0L vehicles.
- has fuel, vapor and brake tubes in an integrated bundle assembly attached to the underside of the vehicle by retaining clips.
- has an Easy Fuel ™ (capless) fuel tank filler pipe assembly, which cannot be modified in any way.
- has a supplemental refueling adapter located in the luggage compartment.
- has a FTP sensor (part of the fuel vapor tube assembly).
- is equipped with a sequential Multi-Port Fuel Injection (MFI) system.
- uses separately controlled fuel injectors for each cylinder. The fuel injectors are mounted to the intake manifold.
- fuel injectors are supplied with pressurized fuel from the FP module to the fuel rail.

Fuel System Shutoff Feature

2.5L and 3.0L vehicles

In event of a moderate to severe collision, the vehicle is equipped with a FP shutoff feature that is initiated by the event notification signal. The event notification signal is provided by the Restraints Control Module (RCM) to the FP control module. Signal communication between the RCM and the FP control module allows

the PCM to shutoff the FP module. Should the vehicle shut off after a collision due to this feature, restart the vehicle by first turning the ignition to the OFF position and then turn the ignition to the ON position. In some instances, the vehicle may not restart the first time and may take an additional attempt.

3.5L vehicles

The FP module is controlled by the PCM. Electrical power to the FP module is provided through the IFS switch that will de-energize the fuel delivery secondary circuit in the event of a moderate to severe collision. The IFS switch is a safety device, located under the RH front door scuff plate. Should the vehicle shutoff after a collision due to this feature, restart the vehicle by first turning the ignition OFF, push the reset button on the IFS switch, then turn the ignition to the ON position.

Fuel System

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

NOTE: The following procedure diagnoses a slow to fill concern only. For all other concerns refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

The fuel tank filler pipe assembly is used to refuel the vehicle. The fuel tank inlet check valve prevents spitback of fuel during and after refueling. The fuel tank stores the fuel. The fuel tank contains a Fuel Pump (FP) module. The FP module consists of a fuel level sensor and a FP . The fuel level sender sends a signal to the fuel gauge informing the driver of how much fuel is in the fuel tank. The FP provides fuel to the fuel tubes which supply the fuel rail.

During refueling, the fuel tank vents to the atmosphere through the vent and filler pipes, on vehicles without On-Board Refueling Vapor Recovery (ORVR) systems. In vehicles equipped with ORVR , the fuel tank and filler pipe are designed so that when the vehicle is being refueled, fuel vapors in the fuel tank travel to the Evaporative Emission (EVAP) canister, which absorbs the fuel vapors and vents the pressure from the fuel tank during refueling.

Inspection and Verification

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Verify the customer's concern by refueling the vehicle and observe the fuel fill rate.

2. Inspect to determine if any of the following mechanical concerns apply.

Visual Inspection Chart

Mechanical

- Bent, kinked or damaged fuel tank filler pipe
- Bent, kinked or damaged fuel tank filler pipe vent tube (if equipped)
- Incorrect routing of the fuel tank filler pipe
- Incorrect routing of the fuel tank filler pipe vent tube (if equipped)
- Incorrect position of fuel tank filler pipe clamps
- Incorrect position of fuel tank filler pipe vent tube clamps (if equipped)
- Fuel tank mounted vapor tubes bent or damaged
- Evaporative Emission (EVAP) system tubes or hoses bent or damaged
- Accident damage to the fuel tank
- Accident damage to the vehicle effecting the fuel tank filler pipe-to-body connection
- Unauthorized modifications and/or alterations to the vehicle
- EVAP system fresh air tube plugged (dirt, spider webbing)

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

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

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

8. Clear the continuous DTCs and carry out the self-test diagnostics for the EVAP system.

9. If the DTCs retrieved are related to the concern, go to Evaporative Emission (EVAP) System DTC Chart. For PCM-related DTCs, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. For all other DTCs, refer to Section 419-10 .

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

DTC Chart

Evaporative Emission (EVAP) System DTC Chart

DTC	Description	Action
P0446	Evaporative Emission System Vent Control Circuit	GO to Pinpoint Test A .
P0451	Evaporative Emission System Pressure Sensor/Switch Range/Performance	GO to Pinpoint Test A .
P0452	Evaporative Emission System Pressure Sensor/Switch Low	GO to Pinpoint Test A .
P0453	Evaporative Emission System Pressure Sensor/Switch High	GO to Pinpoint Test A .
P0454	Evaporative Emission System Pressure Sensor/Switch Intermittent	GO to Pinpoint Test A .
P1450	Unable to Bleed up Fuel Tank Vacuum	GO to Pinpoint Test A .
P1451	Evaporative Emission System Vent Control Circuit	GO to Pinpoint Test A .
P260F	Emission System Monitoring Processor Performance	GO to Pinpoint Test A .

Symptom Chart

Symptom Chart

Pinpoint Test

Pinpoint Test A: Slow to Fill

Normal Operation

Under normal operation, fuel should flow at a steady rate through the fuel tank filler pipe into the fuel tank. As fuel enters the fuel tank, air is vented through the filler pipe or the On-Board Refueling Vapor Recovery (ORVR) system.

This pinpoint test is intended to diagnose the following:

- Fuel tank filler pipe vent tube, if equipped
- Fuel tank filler pipe
- Evaporative Emission (EVAP) system
- Fuel tank inlet check valve (part of the fuel tank)
- Fuel level vent valve (part of the fuel tank)

PINPOINT TEST A: SLOW TO FILL

Test Step	Result / Action to Take
A1 CARRY OUT INSPECTION AND VERIFICATION	
• Carry out inspection and verification. • **Was the cause of the concern found?**	**Yes** REPAIR or INSTALL new components to correct the concern. **No** GO to A2 .
A2 CHECK THE SYSTEM FOR ANY EVAP DTCs	

• Connect the scan tool. • Check the system for any of the following EVAP DTCs: P0446, P0451, P0452, P0453, P0454, P1450, P1451 and P260F. • **Are any of these DTCs present?**	**Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnose the EVAP system. **No** GO to A3 .
A3 MONITOR THE FTP WHILE FILLING THE FUEL TANK	
• Monitor the Fuel Tank Pressure (FTP) reference value while filling the fuel tank. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual. • **Is FTP within specification?**	**Yes** GO to A5 . **No** GO to A4 .
A4 MONITOR THE FTP WHILE FILLING THE FUEL TANK WITH THE EVAP SYSTEM DISCONNECTED	
• Disconnect the fuel tank-to- EVAP canister quick connect coupling at the EVAP canister. Refer to Quick Connect Coupling in this section. • Monitor the FTP reference value while filling the fuel tank. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual. • **Is FTP within specification?**	**Yes** INSPECT the EVAP system for blockage or restrictions. REPAIR the blockage or restriction. If the restriction or blockage cannot be repaired, INSTALL new EVAP system components. **No** GO to A5 .
A5 CHECK THE FUEL TANK FILLER PIPE ASSEMBLY FOR BLOCKAGE OR RESTRICTION	
• Remove the fuel tank filler pipe assembly. Refer to Section 310-01A . • Inspect the fuel tank filler pipe and fuel tank filler pipe vent tube (if equipped) for a blockage or restriction. • **Is the fuel tank filler pipe or fuel tank filler pipe vent tube (if equipped) blocked or restricted?**	**Yes** If possible, REPAIR the blockage or restriction. If the blockage or restriction cannot be repaired, INSTALL a new fuel tank filler pipe or fuel tank filler pipe vent tube. **No** GO to A6 .
A6 CHECK THE FUEL TANK INLET CHECK VALVE	
• Inspect the fuel tank inlet check valve for restriction or sticking. • **Is the fuel tank filler pipe inlet check valve restricted or sticking?**	**Yes** If possible, REPAIR the restriction. If the restriction cannot be repaired, INSTALL a new fuel tank. REFER to Section 310-01A . **No** INSTALL a new fuel tank. REFER to Section 310-01A .

Fuel System Pressure Release

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

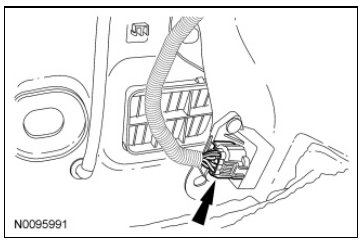
⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammamixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

2.5L and 3.0L vehicles

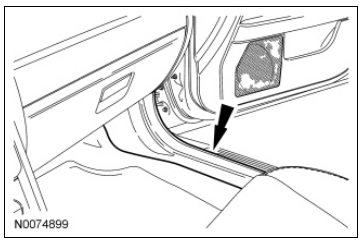
1. Position aside the LR quarter panel luggage compartment trim.

2. Disconnect the Fuel Pump (FP) control module electrical connector.

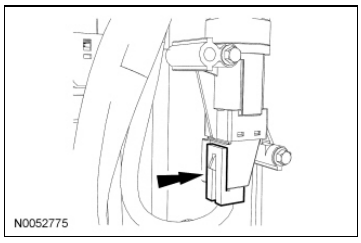


3.5L vehicles

3. Remove the RF door scuff plate.



4. Disconnect the Inertia Fuel Shutoff (IFS) switch.



All vehicles

5. Start the engine and allow it to idle until it stalls.

6. After the engine stalls, crank the engine for approximately 5 seconds to make sure the fuel system pressure has been released.

7. Turn the ignition switch to the OFF position.

2.5L and 3.0L vehicles

8. When fuel system service is complete, reconnect the FP control module electrical connector.

9. Position the LR quarter panel luggage compartment trim.

3.5L vehicles

10. When fuel system service is complete, reconnect the IFS switch electrical connector.

11. Install the RF door scuff plate.

All vehicles

12. **NOTE:** It may take more than one key cycle to pressurize the fuel system.

    Cycle the ignition key and wait 3 seconds to pressurize the fuel system.

13. **NOTE:** Carry out a Key ON Engine OFF (KOEO) visual inspection for fuel leaks prior to starting the engine.

    Start the vehicle and check the fuel system for leaks.

Fuel System Pressure Test

Special Tool(s)

 ST3047-A	Adapter, Fuel Pressure Test 310-180
 ST3038-A	Fuel Pressure Test Kit 310-D009 (D95L-7211A)

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

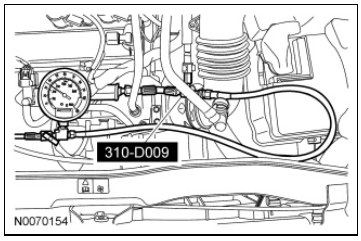
⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

NOTE: Early build 3.0L engines are equipped with a Schrader valve on the fuel rail. Late build 3.0L engines do not have a Schrader valve.

2.5L engine

1. Release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Disconnect the fuel jumper tube-to-fuel rail quick connect coupling. For additional information, refer to Quick Connect Coupling in this section.
4. Install the Fuel Pressure Test Kit between the fuel jumper tube and the fuel rail.



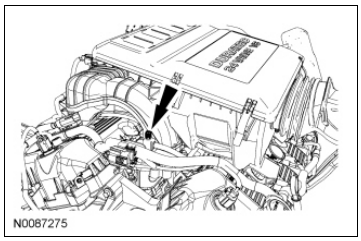
5. **NOTE:** The Fuel Pump (FP) control module was disconnected in the fuel system pressure release.

   Connect the FP control module electrical connector.

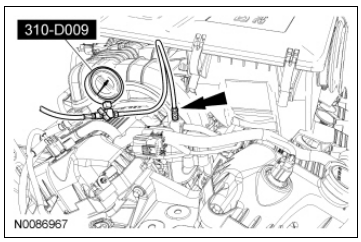
6. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Early build 3.0L engine

7. Remove the fuel rail Schrader valve cap.



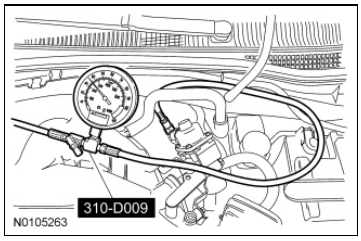
8. Install the Fuel Pressure Test Kit to the fuel rail Schrader valve.



Late build 3.0L engine

9. Disconnect the fuel jumper tube-to-fuel tube quick connect coupling. For additional information, refer to Quick Connect Coupling in this section.

10. Install the Fuel Pressure Test Kit between the fuel jumper tube and the fuel tube.



3.5L engine

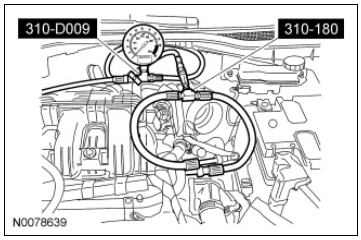
11. Release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

12. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

13. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12C .

14. Disconnect the fuel tube-to-fuel rail spring lock coupling. For additional information, refer to Spring Lock Couplings in this section.

15. Install the Fuel Pressure Test Adapter and Fuel Pressure Test Kit between the fuel tube and the fuel rail.



16. **NOTE:** The ACL outlet pipe must be installed prior to completing the fuel system pressure test.

    Install the ACL outlet pipe. For additional information, refer to Section 303-12C .

17. **NOTE:** The Inertia Fuel Shutoff (IFS) switch was disconnected in the fuel system pressure release.

    Connect the IFS switch electrical connector.

18. Connect the battery ground cable. For additional information, refer to Section 414-01 .

All engines

19. **NOTE:** Carry out a Key ON Engine OFF (KOEO) visual inspection for fuel leaks prior to completing the fuel system pressure test.

    NOTE: After completion of the fuel system pressure test, open the drain valve on the Fuel Pressure Test Kit and release any residual fuel into a suitable container prior to removing the tool.

    Test the fuel system pressure to make sure it is within the specified range. For additional information, refer to Specifications in this section.

Fuel Tank Draining - 2.5L

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent
 ST2803-A	Fuel Tank Sender Unit Wrench 310-123

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: For vehicles with an inaccurate or inoperable fuel gauge, follow the instructions for draining a fuel tank with more than three-fourths of a tank of fuel.

All vehicles

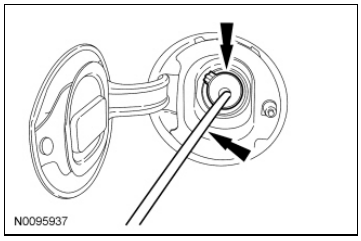
1. Release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

Vehicles with more than three-fourths of a tank of fuel

3. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe until the tube enters the fuel tank.



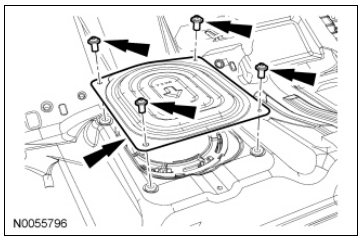
4. **NOTE:** This step will remove approximately one-fourth tank of the fuel from a completely full fuel tank and the majority of any residual fuel in the fuel tank filler pipe, lowering the fuel level below the Fuel Pump (FP) module mounting flange.

   Attach the Fuel Storage Tanker to the fuel drain tube and remove one-fourth (approximately 4 gallons) of fuel from the tank.

All vehicles

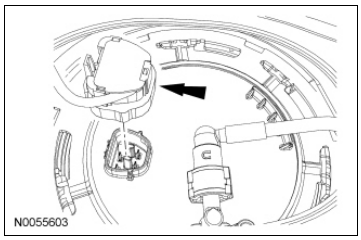
5. Remove the rear seat lower cushion. For additional information, refer to Section 501-10 .

6. Remove the 4 screws and the FP module access cover.



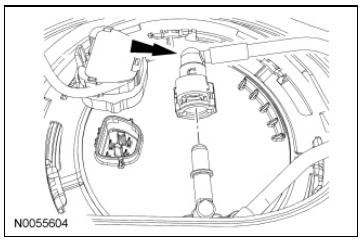
7. **NOTE:** Clean the FP module connections, couplings, flange surfaces and the immediate surrounding area of any dirt or foreign material.

   Disconnect the FP module electrical connector.



8. **NOTE:** Place absorbent toweling in the immediate surrounding area in case of fuel spillage.

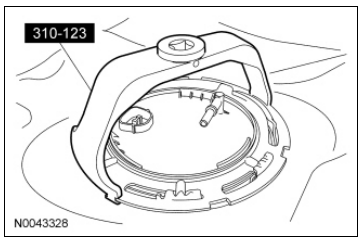
   Disconnect the fuel tube-to- FP module quick connect coupling. For additional information, refer to Section 310-00 .



9. **NOTE:** Make sure to install a new FP module O-ring seal.

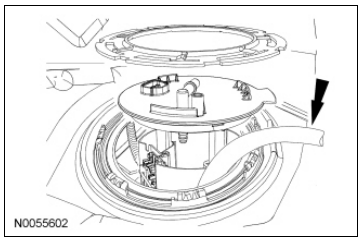
Install the Fuel Tank Sender Unit Wrench, remove the FP module lock ring.

- Discard the FP module O-ring seal.



10. ***NOTICE:*** **The Fuel Pump (FP) module must be handled carefully to avoid damage to the float arm.**

    Position the FP module aside and insert the tube from the Fuel Storage Tanker into the FP module aperture and drain as much fuel from the fuel tank as possible.



Fuel Tank Draining - 3.0L Front Wheel Drive (FWD)

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent
 ST2803-A	Fuel Tank Sender Unit Wrench 310-123

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: For vehicles with an inaccurate or inoperable fuel gauge, follow the instructions for draining a fuel tank with more than three-fourths of a tank of fuel.

All vehicles

1. Release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

Vehicles with more than three-fourths of a tank of fuel

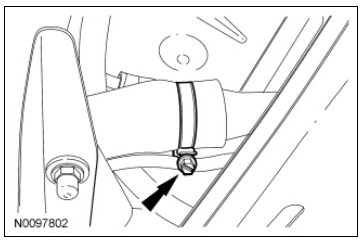
NOTE: The Easy Fuel ™ (capless) fuel tank filler pipe on 3.0L vehicles have an anti-siphon grate that will not allow a fuel drain tube to penetrate the fuel tank and requires the following steps to drain the fuel.

3. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

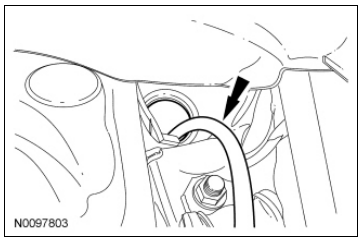
4. **NOTE:** Index-mark the fuel tank filler pipe hose and the clamp prior to removal for correct installation.

Release the clamp and disconnect the hose from the fuel tank filler pipe.

- To install, tighten to 4 Nm (35 lb-in).



5. Insert a semi-rigid fuel drain tube into the fuel tank filler pipe hose until it enters the fuel tank.



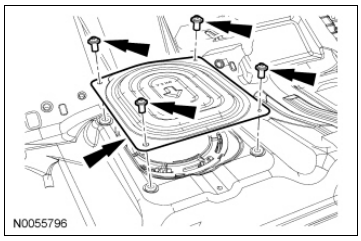
6. **NOTE:** This step is to remove approximately one-fourth tank of the fuel from a completely full fuel tank, lowering the fuel level below the Fuel Pump (FP) module mounting flange.

   Attach the Fuel Storage Tanker to the fuel drain tube and remove one-fourth (approximately 4 gallons) of fuel from the tank.

All vehicles

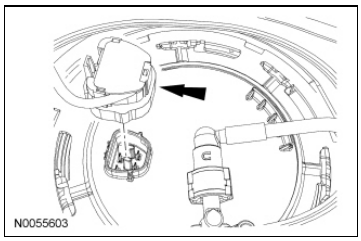
7. Remove the rear seat lower cushion. For additional information, refer to Section 501-10 .

8. Remove the 4 screws and the FP module access cover.



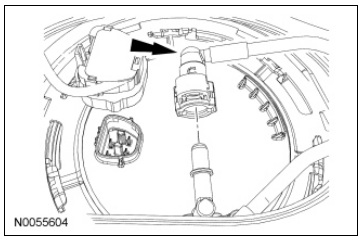
9. **NOTE:** Clean the FP module connections, couplings, flange surfaces and the immediate surrounding area of any dirt or foreign material.

   Disconnect the FP module electrical connector.



10. **NOTE:** Place absorbent toweling in the immediate surrounding area in case of fuel spillage.

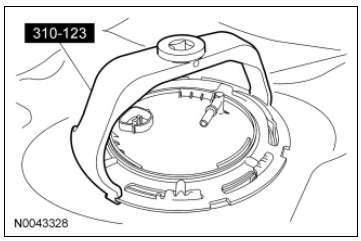
Disconnect the fuel tube-to- FP module quick connect coupling. For additional information, refer to Section 310-00 .



11. **NOTE:** Make sure to install a new FP module O-ring seal.

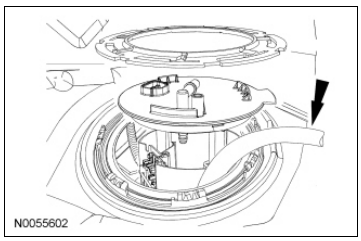
    Install the Fuel Tank Sender Unit Wrench and remove the FP module lock ring.

    - Discard the FP module O-ring seal.



12. ***NOTICE:*** **The Fuel Pump (FP) module must be handled carefully to avoid damage to the float arm.**

    Position the FP module aside and insert the tube from the Fuel Storage Tanker into the FP module aperture and drain as much fuel from the fuel tank as possible.



Fuel Tank Draining - 3.0L All Wheel Drive (AWD)

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent
 ST2803-A	Fuel Tank Sender Unit Wrench 310-123

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: For vehicles with an inaccurate or inoperable fuel gauge, follow the instructions for draining a fuel tank with more than one-half of a tank of fuel.

All vehicles

1. Release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

Vehicles with more than one-half of a tank of fuel

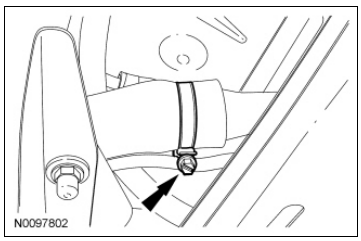
NOTE: The Easy Fuel ™ (capless) fuel tank filler pipe on 3.0L vehicles have an anti-siphon grate that will not allow a fuel drain tube to penetrate the fuel tank and requires the following steps to drain the fuel.

3. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

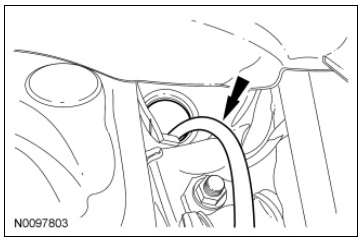
4. **NOTE:** Index-mark the fuel tank filler pipe hose and the clamp prior to removal for correct installation.

Release the clamp and disconnect the hose from the fuel tank filler pipe.

- To install, tighten to 4 Nm (35 lb-in).



5. Insert a semi-rigid fuel drain tube into the fuel tank filler pipe hose until it enters the fuel tank.



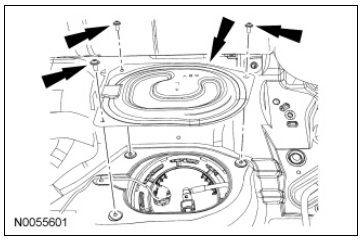
6. **NOTE:** This step is to remove approximately one-half tank of the fuel from a completely full fuel tank, lowering the fuel level below the Fuel Pump (FP) module mounting flange.

   Attach the Fuel Storage Tanker to the fuel drain tube and remove one-half (approximately 9 gallons) of fuel from the tank.

All vehicles

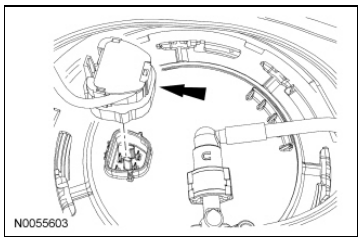
7. Remove the rear seat lower cushion. For additional information, refer to Section 501-10 .

8. Remove the 3 screws and the FP module access cover.



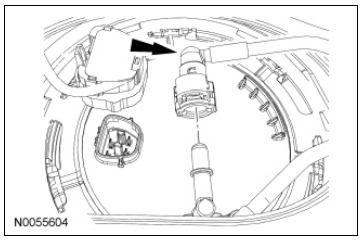
9. **NOTE:** Clean the FP module connections, couplings, flange surfaces and the immediate surrounding area of any dirt or foreign material.

   Disconnect the FP module electrical connector.



10. **NOTE:** Place absorbent toweling in the immediate surrounding area in case of fuel spillage.

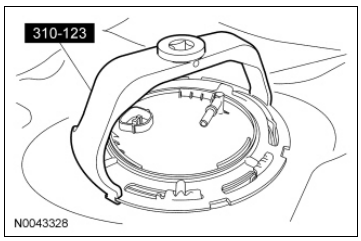
Disconnect the fuel tube-to- FP module quick connect coupling. For additional information, refer to Section 310-00 .



11. **NOTE:** Make sure to install a new FP module O-ring seal.

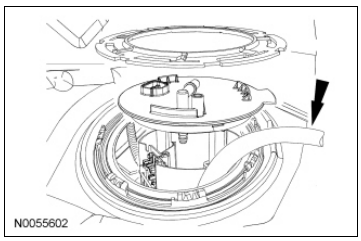
    Install the Fuel Tank Sender Unit Wrench and remove the FP module lock ring.

    - Discard the FP module O-ring seal.

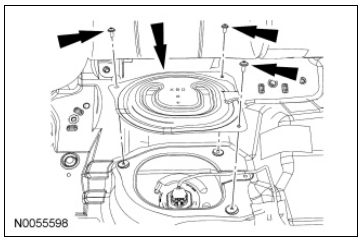


12. ***NOTICE:*** **The Fuel Pump (FP) module must be handled carefully to avoid damage to the float arm.**

    Position the FP module aside and insert the tube from the Fuel Storage Tanker into the FP module aperture and drain as much fuel from the fuel tank as possible.

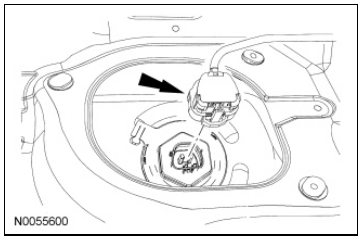


13. Remove the 3 screws and the fuel level sensor access cover.



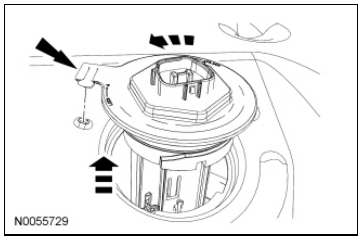
14. **NOTE:** Clean the fuel level sensor electrical connector, flange surface and the immediate surrounding area of any dirt or foreign material.

    Disconnect the fuel level sensor electrical connector.

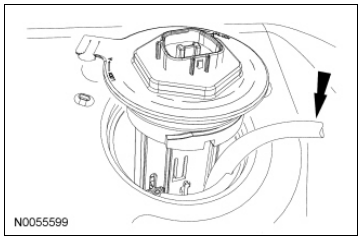


15. **NOTE:** Place absorbent toweling in the immediate surrounding area in case of fuel spillage.

    Release the lock tab and rotate the fuel level sensor counterclockwise approximately one-fourth turn, lift and position aside.



16. Insert the tube from the Fuel Storage Tanker into the fuel level sensor aperture and drain the remainder of the fuel from the fuel tank.



Fuel Tank Draining - 3.5L

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent
 ST2803-A	Fuel Tank Sender Unit Wrench 310-123

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: For (Front Wheel Drive (FWD)) vehicles with an inaccurate or inoperable fuel gauge, follow the instructions for draining a fuel tank with more than three-fourths of a tank of fuel.

NOTE: For (All-Wheel Drive (AWD)) vehicles with an inaccurate or inoperable fuel gauge, follow the instructions for draining a fuel tank with more than one-half of a tank of fuel.

All vehicles

1. Release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

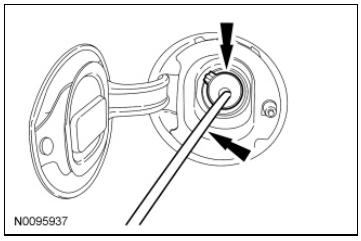
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the rear seat lower cushion. For additional information, refer to Section 501-10 .

Front Wheel Drive (FWD) vehicles with more than three-fourths tank of fuel

4. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe until the tube enters the fuel tank.



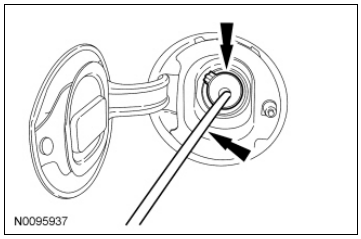
5. **NOTE:** This step will remove approximately one-fourth tank of the fuel from a completely full fuel tank and the majority of any residual fuel in the fuel tank filler pipe, lowering the fuel level below the Fuel Pump (FP) module mounting flange.

   Attach the Fuel Storage Tanker to the fuel drain tube and remove one-fourth (approximately 4 gallons) of fuel from the tank.

All-Wheel Drive (AWD) vehicles with more than one-half tank of fuel

6. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe until the tube enters the fuel tank.

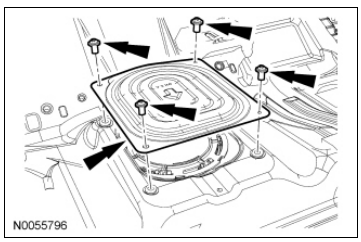


7. **NOTE:** This step is to remove approximately one-half tank of the fuel from a completely full fuel tank, lowering the fuel level below the FP module mounting flange.

   Attach the Fuel Storage Tanker to the fuel drain tube and remove one-half (approximately 9 gallons) of fuel from the tank.

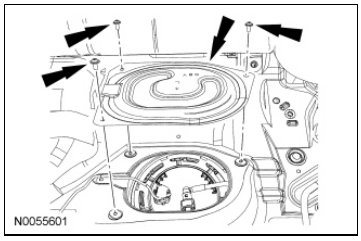
FWD vehicles

8. Remove the 4 screws and the FP module access cover.



AWD vehicles

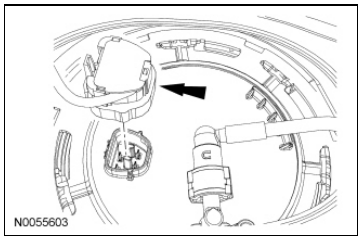
9. Remove the 3 screws and the FP module access cover.



All vehicles

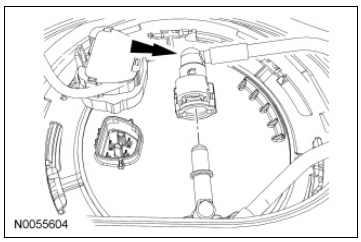
10. **NOTE:** Clean the FP module connections, couplings, flange surfaces and the immediate surrounding area of any dirt or foreign material.

    Disconnect the FP module electrical connector.



11. **NOTE:** Place absorbent toweling in the immediate surrounding area in case of fuel spillage.

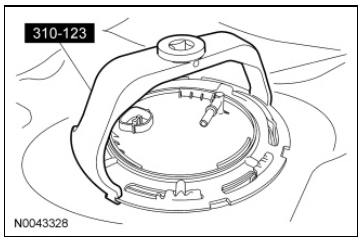
    Disconnect the fuel tube-to- FP module quick connect coupling. For additional information, refer to Section 310-00 .



12. **NOTE:** Make sure to install a new FP module O-ring seal.

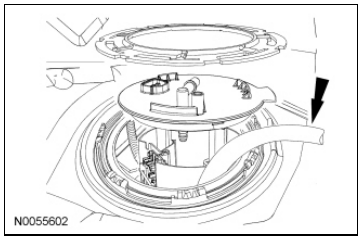
    Install the Fuel Tank Sender Unit Wrench, remove the FP module lock ring.

    - Discard the FP module O-ring seal.



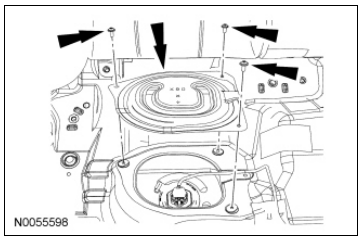
13. ***NOTICE:*** **The Fuel Pump (FP) module must be handled carefully to avoid damage to the float arm.**

    Position the FP module aside and insert the tube from the fuel storage tanker into the FP module aperture and drain as much fuel from the fuel tank as possible.



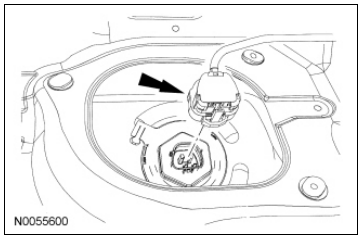
AWD vehicles

14. Remove the 3 screws and the fuel level sensor access cover.



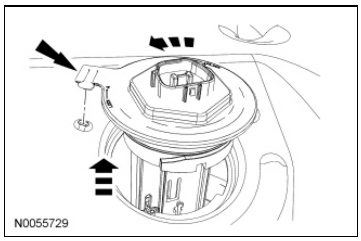
15. **NOTE:** Clean the fuel level sensor electrical connector, flange surface and the immediate surrounding area of any dirt or foreign material.

    Disconnect the fuel level sensor electrical connector.

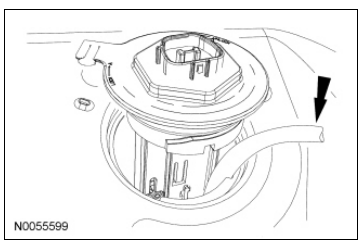


16. **NOTE:** Place absorbent toweling in the immediate surrounding area in case of fuel spillage.

    Release the lock tab and rotate the fuel level sensor counterclockwise approximately one-fourth turn, lift and position aside.



17. Insert the tube from the Fuel Storage Tanker into the fuel level sensor aperture and drain the remainder of the fuel from the fuel tank.



Quick Connect Coupling

Special Tool(s)

 ST2583-A	Disconnect Tool, Fuel Pipe (5/16") 310-040

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Disconnect - Type I

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTICE: **When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip can occur. Apply clean engine oil to the end of the tube before inserting the tube into the connector.**

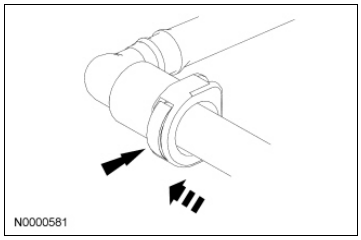
NOTICE: **Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage can occur. Always install plugs to any open orifices or tubes.**

NOTICE: **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

1. If servicing a liquid fuel tube quick connect coupling, release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

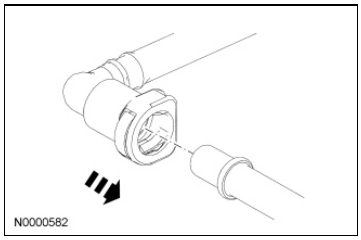
3. Depress the locking tab and release the quick connect coupling from the tube.



Connect - Type I

1. **NOTE:** Make sure the retainer clip is fully seated and locked onto the tube by pulling on the quick connect coupling.

   Install the quick connect coupling onto the tube until it is fully seated.



2. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Disconnect - Type II

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near auel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

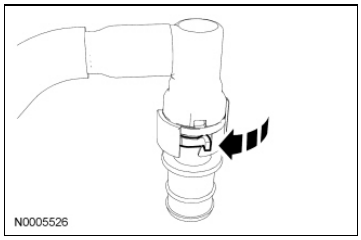
NOTICE: **When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip can occur. Apply clean engine oil to the end of the tube before inserting the tube into the connector.**

NOTICE: **Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage can occur. Always install plugs to any open orifices or tubes.**

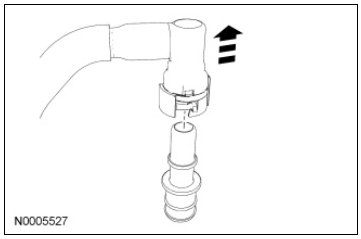
NOTICE: **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Release the lock tab on the quick connect coupling.



3. Separate the quick connect coupling from the fitting.

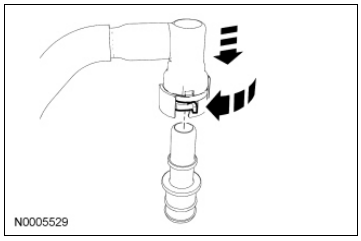


Connect - Type II

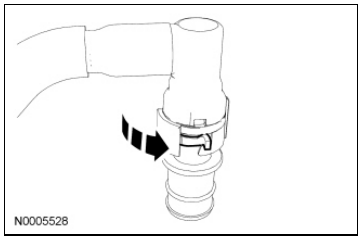
1. **NOTE:** Apply clean engine oil to the O-ring seals.

   NOTE: Make sure the retainer clip is fully seated and locked onto the tube by pulling on the quick connect coupling.

   Release the lock tab and install the quick connect coupling onto the fitting.



2. Apply the lock tab into the latched position.



3. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Disconnect - Type III

⚠

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTICE: **When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip can occur. Apply clean engine oil to the end of the tube before inserting the tube into the connector.**

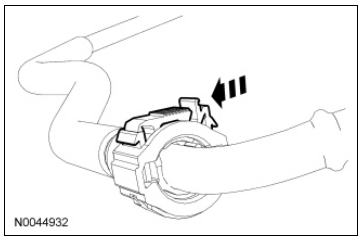
NOTICE: **Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage can occur. Always install plugs to any open orifices or tubes.**

NOTICE: **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

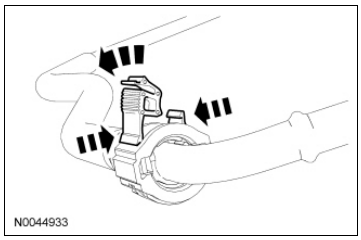
1. If servicing a liquid fuel tube quick connect coupling, release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

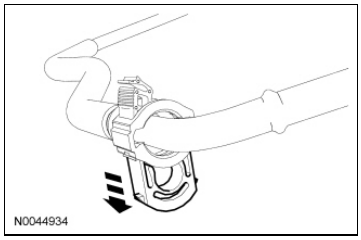
3. Release the quick connect coupling lock tab.



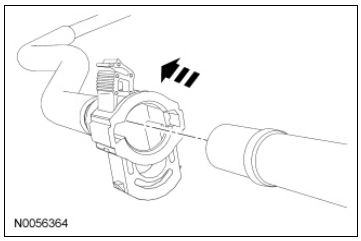
4. Rotate the primary locking tab to the fully opened position and squeeze the secondary locking tabs to release the locking mechanism.



5. Push the locking mechanism outward and release the tube.



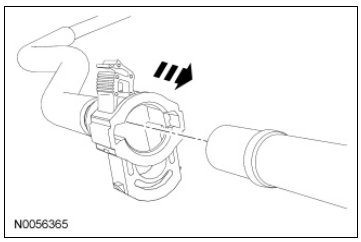
6. Remove the quick connect coupling from the tube.



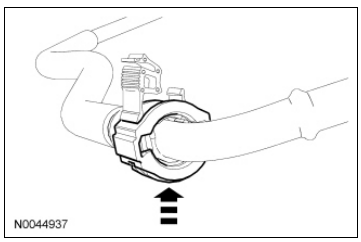
Connect - Type III

1. **NOTE:** Apply clean engine oil to the O-ring seals.

   Install the quick connect coupling onto the tube until it is fully seated.

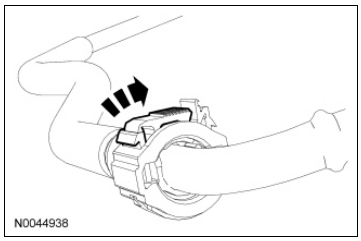


2. Depress the retainer clip until it is flush with the quick connect coupler housing and is fully seated on the tube.



3. **NOTE:** Make sure the retainer clip is fully seated and locked onto the tube by pulling on the quick connect coupling.

   Rotate the primary locking tab on the retainer clip to the closed position.



4. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Disconnect - Type IV

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTICE: **When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip can occur. Apply clean engine oil to the end of the tube before inserting the tube into the connector.**

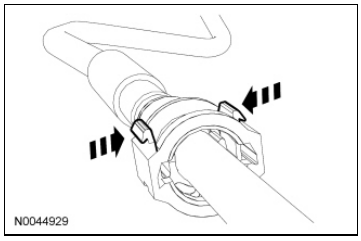
NOTICE: **Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage can occur. Always install plugs to any open orifices or tubes.**

NOTICE: **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

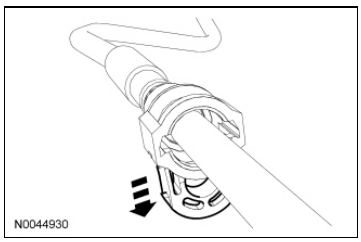
1. If servicing a liquid fuel tube quick connect coupling, release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

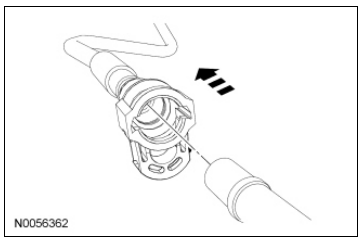
3. Squeeze the quick connect coupling retainer clip tabs to release the locking mechanism.



4. Push the locking mechanism outward to release the tube.



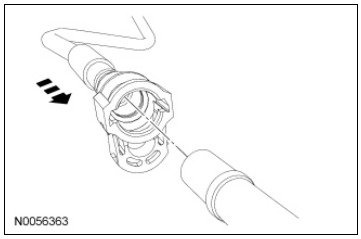
5. Remove the quick connect coupling from the tube.



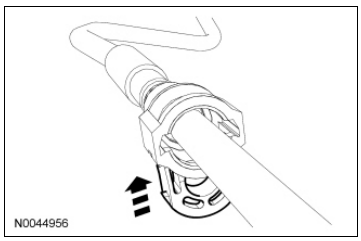
Connect - Type IV

1. **NOTE:** Apply clean engine oil to the O-ring seals.

   Install the quick connect coupling onto the tube.

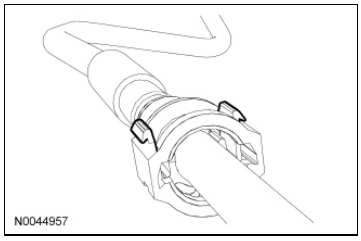


2. Depress the quick connect coupling locking mechanism into the locked position.



3. **NOTE:** Make sure the retainer clip is fully seated and locked onto the tube by pulling on the quick connect coupling.

   Visually inspect and verify that the locking mechanism is flush with the quick connect coupling housing and that the tabs are locked in place.



4. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Disconnect - Type V

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

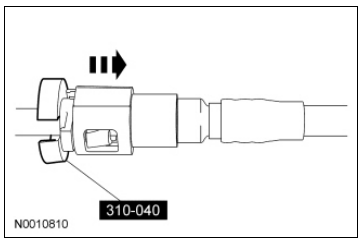
NOTICE: **When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip can occur. Apply clean engine oil to the end of the tube before inserting the tube into the connector.**

NOTICE: **Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage can occur. Always install plugs to any open orifices or tubes.**

1. If servicing a liquid fuel tube quick connect coupling, release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Install the Fuel Pipe Disconnect Tool on the tube and push into the quick connect coupling locking clip to release.



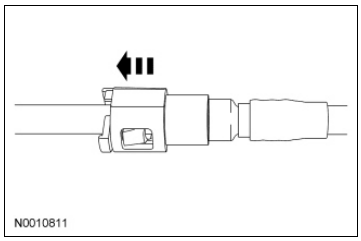
4. Remove the quick connect coupling from the tube.

Connect - Type V

1. **NOTE:** Apply ean engine oil to the O-ring seals.

   NOTE: Make sure the retainer clip is fully seated and locked onto the tube by pulling on the quick connect coupling.

   Install the quick connect coupling onto the tube until it is fully seated.



2. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Disconnect - Type VI

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry persal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTICE: **When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip can occur. Apply clean engine oil to the end of the tube before inserting the tube into the connector.**

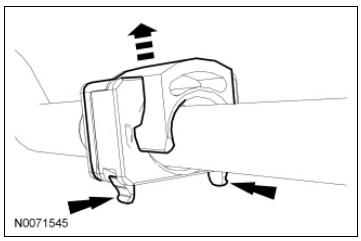
NOTICE: **Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage can occur. Always install plugs to any open orifices or tubes.**

NOTICE: **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

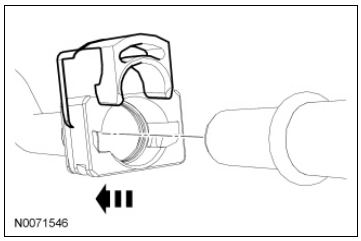
1. If servicing a liquid fuel tube quick connect coupling, release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Depress the legs of the retainer clip and position the clip in an outward position.



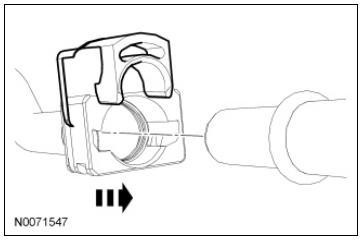
4. Disconnect the quick connect coupling from the tube.



Connect - Type VI

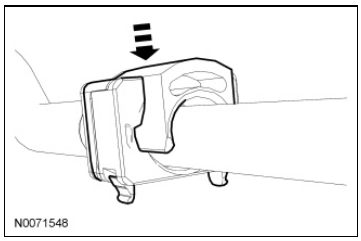
1. **NOTE:** Apply clean engine oil to the end of the tube and quick connect coupling O-ring seals.

   Install the quick connect coupling onto the tube until fully seated.



2. **NOTE:** Make sure the retainer clip is fully seated and locked onto the tube by pulling on the quick connect coupling.

   Press the retainer clip into the quick connect coupling body until flush and the legs are locked in place.



3. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Disconnect - Type VII

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be

ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTICE: **When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip can occur. Apply clean engine oil to the end of the tube before inserting the tube into the connector.**

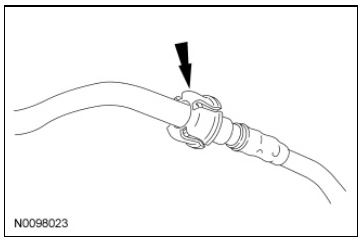
NOTICE: **Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage can occur. Always install plugs to any open orifices or tubes.**

NOTICE: **Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.**

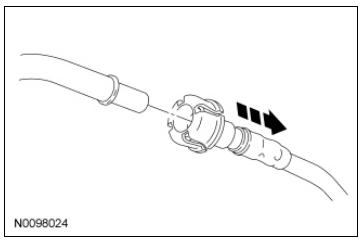
1. If servicing a liquid fuel tube quick connect coupling, release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Push the tube into the quick connect coupling and depress the release mechanism.



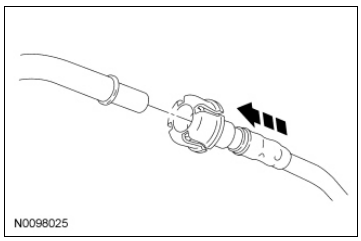
4. Disconnect the quick connect coupling from the tube.



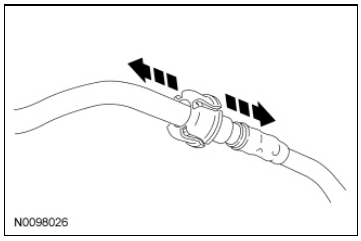
Connect - Type VII

1. **NOTE:** Apply clean engine oil to the end of the tube and quick connect coupling O-ring seals.

   Install the quick connect coupling onto the tube until fully seated.



2. Pull the tube and the coupling in separate directions to ensure the quick connect coupling is secured on the tube.



3. Connect the battery ground cable. For additiol information, refer to Section 414-01 .

Spring Lock Couplings

Special Tool(s)

 ST1399-A	Disconnect Tool, Spring Lock Coupling 310-S039 (T90T-9550-S) or equivalent

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent WSS-M2C930-A	

Disconnect

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

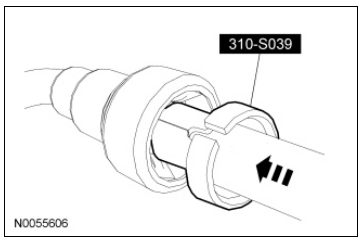
NOTICE: **When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube or damage to the tube or connector retaining clip can occur. Apply clean engine oil to the end of the tube before inserting the tube into the connector.**

NOTICE: **Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components or component damage can occur. Always install plugs to any open orifices or tubes.**

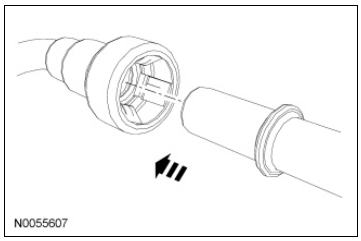
1. Release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Install the Spring Lock Coupling Disconnect Tool on the tube and push into the spring lock coupling to release.



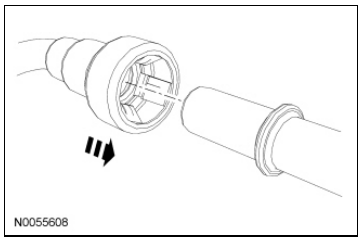
4. Separate the spring lock coupling from the tube.



Connect

1. **NOTE:** Lubricate the fuel tube with clean engine oil.

   Align and push the spring lock coupling onto the tube until a click is heard.



2. Pull on the coupling to make sure it is fully engaged.

3. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	-

General Specifications

Item	Specification
Fuel tank capacity (All-Wheel Drive (AWD) vehicles)	62.46L (16.5 gal)
Fuel tank capacity (Front Wheel Drive (FWD) vehicles)	66.24L (17.5 gal)

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel level sensor access cover screws	2	-	18
Fuel Pump (FP) module access cover screws	2	-	18
Fuel tank filler pipe bracket bolt	7	-	62
Fuel tank filler pipe bracket nut	7	-	62
Fuel tank filler pipe heat shield nuts	9	-	80
Fuel tank filler pipe hose clamp	4	-	35
Fuel tank strap bolts	40	30	-
Inertia Fuel Shutoff (IFS) switch bolt	2	-	18
LR parking brake cable assembly bracket bolts	23	17	-
Lower crossover support brace nuts	76	56	-

Fuel Tank and Lines

Fuel System

The fuel system consists of:

- a single-speed Mechanical Returnless Fuel System (MRFS) (3.5L vehicles).
- a 2-speed MRFS (2.5L and 3.0L vehicles).
- an All-Wheel Drive (AWD) saddle-type or Front Wheel Drive (FWD) L-shaped fuel tank.
- an Easy Fuel ™ (capless) fuel tank filler pipe assembly, which cannot be modified in any way.
- a Fuel Pump (FP) module containing:
    - ♦ an electric FP , which provides pressurized fuel to the fuel rail.
    - ♦ a serviceable fuel level sender.
    - ♦ a check valve, which maintains system pressure after the FP is shut off.
    - ♦ a pressure relief valve for overpressure protection in the event of restricted fuel flow.
    - ♦ a lifetime fuel filter providing filtration to protect the fuel injectors from foreign material.
- fuel, vapor and brake tubes in an integrated bundle assembly attached to the underside of the vehicle by retaining clips.
- has a supplemental refueling adapter located in the luggage compartment.
- an Inertia Fuel Shutoff (IFS) switch (3.5L vehicles).
- a FP control module (2.5L and 3.0L vehicles).
- an individual fuel level sensor, AWD vehicles only.

Fuel System Shutoff Feature

2.5L and 3.0L vehicles

In event of a moderate to severe collision, the vehicle is equipped with a FP shutoff feature that is initiated by the event notification signal. The event notification signal is provided by the Restraints Control Module (RCM) to the FP control module. Signal communication between the RCM and the FP control module allows the PCM to shutoff the FP module. Should the vehicle shut off after a collision due to this feature, restart the vehicle by first turning the ignition to the OFF position and then turn the ignition to the ON position. In some instances, the vehicle may not restart the first time and may take an additional attempt.

3.5L vehicles

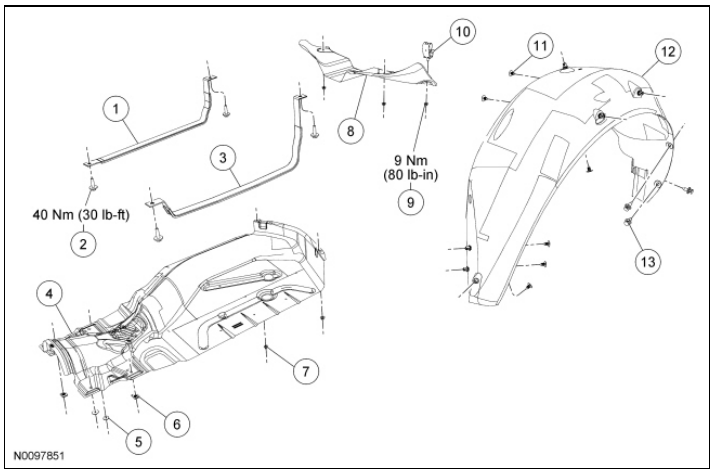
The FP module is controlled by the PCM. Electrical power to the FP module is provided through the IFS switch that will de-energize the fuel delivery secondary circuit in the event of a moderate to severe collision. The IFS switch is a safety device, located under the RH front door scuff plate. Should the vehicle shutoff after a collision due to this feature, restart the vehicle by first turning the ignition OFF, push the reset button on the IFS switch, then turn the ignition to the ON position.

Fuel Tank and Lines

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Fuel Tank and Filler Pipe - Exploded View

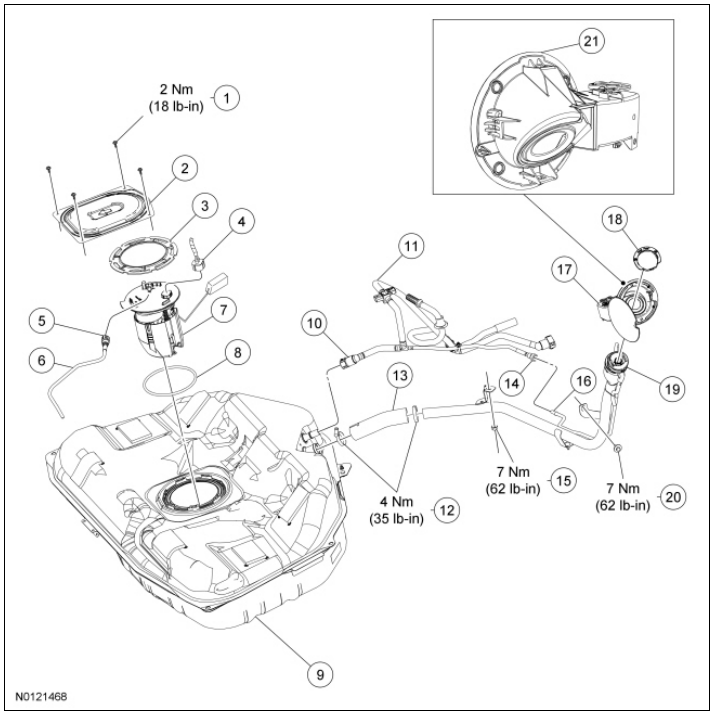
Fuel Tank Supports and Shields (Front Wheel Drive (FWD) Vehicles)



Item	Part Number	Description
1	9092	RH fuel tank strap
2	W505444	Fuel tank strap bolt (4 required)
3	9092	LH fuel tank strap
4	9A031	Fuel tank heat shield
5	W700430	Fuel tank heat shield nut (2 required)
6	9B328	Fuel tank heat shield clip (2 required)
7	W712232	Fuel tank heat shield nut (2 required)
8	5411268	Fuel tank filler pipe heat shield
9	W707142	Fuel tank filler pipe heat shield nut (3 required)
10	529330	Fuel tank filler pipe heat shield bracket
11	W701259	Splash shield pin-type retainer (6 required)
12	5428371	LR splash shield
13	N807379	Splash shield rivet (3 required)

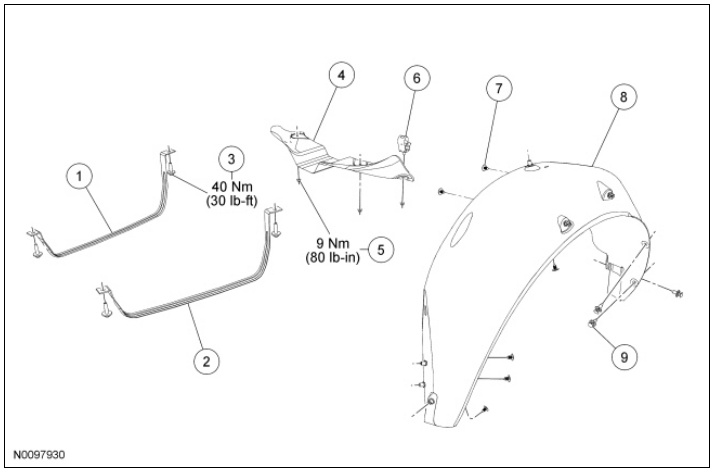
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Fuel Tank and Filler Pipe (FWD Vehicles)



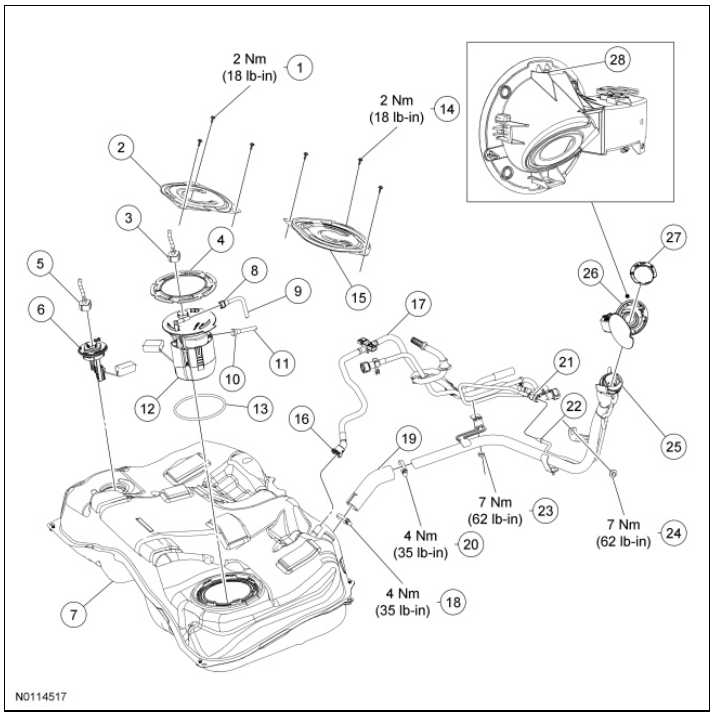
Item	Part Number	Description
1	W807011	Fuel Pump (FP) module access cover screw (4 required)
2	54111	FP module access cover
3	9C385	FP module lock ring
4	14A464	FP module electrical connector
5	-	Fuel tube-to- FP module quick connect coupling (part of 9J279)
6	9J279	Fuel tube
7	9H307	FP module
9	9002	Fuel tank
10	-	Fuel vapor tube assembly-to-fuel tank quick connect coupling (part of 9A228)
11	9A228	Fuel vapor tube assembly
12	W525937	Fuel tank filler pipe hose clamp
13	9047	Fuel tank filler pipe hose
14	-	Fuel vapor tube assembly-to-fuel tank filler pipe recirculation tube quick connect coupling (part of 9A228)
15	N806543	Fuel tank filler pipe bracket nut
16	-	Fuel tank filler pipe recirculation tube (part of 9034)
17	27936	Fuel tank filler pipe housing
18	9K072	Information bezel
19	9B178	Fuel tank filler pipe
20	W707398	Fuel tank filler pipe bracket bolt
21	-	Fuel tank filler pipe housing retainer (3 required) (part of 27936)

Fuel Tank Supports and Shields (All-Wheel Drive (AWD) Vehicles)



Item	Part Number	Description
1	9092	RH fuel tank strap
2	9092	LH fuel tank strap
3	W505444	Fuel tank strap bolt (4 required)
4	5411268	Fuel tank filler pipe heat shield
5	W707142	Fuel tank filler pipe heat shield nut (3 required)
6	529330	Fuel tank filler pipe heat shield bracket
7	W701259	Splash shield pin-type retainer (6 required)
8	5428371	LR splash shield
9	N807379	Splash shield rivet (3 required)

Fuel Tank and Filler Pipe (AWD Vehicles)



Item	Part Number	Description
1	W807011	Fuel level sensor access cover screw (3 required)
2	54111	Fuel level sensor access cover
3	14A464	Fuel Pump (FP) module electrical connector
4	9C385	FP module lock ring
5	14A464	Fuel level sensor electrical connector
6	9275	Fuel level sensor
7	9002	Fuel tank
8	-	Fuel tube-to- FP module quick connect coupling (part of 9J279)
9	9J279	Fuel tube
10	-	Internal crossover fuel tube-to- FP module quick connect coupling (part of 9002)
11	-	Internal crossover fuel tube (part of 9002)
12	9H307	FP module
13	9276	FP module O-ring seal
14	W807011	FP module access cover screw (3 required)
15	54111	span> module access cover
16	-	Fuel vapor tube assembly-to-fuel tank quick connect coupling (part of 9A228)
17	9A228	Fuel vapor tube assembly
18	W525937	Fuel tank filler pipe hose clamp
19	9047	Fuel tank filler pipe hose
20	W525937	Fuel tank filler pipe hose clamp
21	-	Fuel vapor tube assembly-to-fuel tank filler pipe recirculation tube quick connect coupling (part of 9A228)
22	-	Fuel tank filler pipe recirculation tube (part of 9034)
23	N806543	Fuel tank filler pipe bracket nut
24	W707398	Fuel tank filler pipe bracket bolt
25	9B178	Fuel tank filler pipe
26	27936	Fuel tank filler pipe housing
27	9K072	Information bezel
28	-	Fuel tank filler pipe housing retainer (3 required) (part of 27936)

1. For additional information, refer to the procedures in this section.

Fuel Tank - Front Wheel Drive (FWD)

Special Tool(s)

 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Drain the fuel tank. For additional information, refer to Section 310-00 .

3. Remove the muffler and tailpipe. For additional information, refer to Section 309-00 .

4. **NOTE:** Some residual fuel may remain in the fuel tank filler pipe after draining the fuel tank. Carefully drain any remaining fuel into a suitable container.

   Release the clamp and disconnect the fuel tank filler pipe hose from the fuel tank.

   - To install, tighten to 4 Nm (35 lb-in).

5. Disconnect the fuel vapor tube assembly-to-fuel tank quick connect coupling. For additional information, refer to Section 310-00 .

6. Remove the 4 nuts, 2 clips and release the heat shield from the fuel tank.

7. Install the Powertrain Lift under the fuel tank.

8. Remove the 4 bolts and the 2 fuel tank straps.
    - To install, tighten to 40 Nm (30 lb-ft).

9. Carefully lower and remove the fuel tank from the vehicle.

10. To install, reverse the removal procedure.

Fuel Tank - All Wheel Drive (AWD)

Special Tool(s)

 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Drain the fuel tank. For additional information, refer to Section 310-00 .

3. Remove the muffler and tailpipe. For additional information, refer to Section 309-00 .

4. Remove the driveshaft. For additional information, refer to Section 205-01 .

5. Install the Powertrain Lift under the fuel tank.

6. Remove the 4 bolts and the 2 fuel tank straps.
   - To install, tighten to 40 Nm (30 lb-ft).

7. Partially lower the fuel tank enough to access the fuel tank filler pipe hose clamp.

8. **NOTE:** Some residual fuel may remain in the fuel tank filler pipe after draining the fuel tank. Carefully drain any remaining fuel into a suitable container.

   Release the clamp and disconnect the fuel tank filler pipe hose from the fuel tank.

   - To install, tighten to 4 Nm (35 lb-in).

9. Disconnect the fuel vapor tube assembly-to-fuel tank quick connect coupling. For additional information, refer to Section 310-00 .

10. Carefully lower and remove the fuel tank from the vehicle.

11. To install, reverse the removal procedure.

Fuel Tank Filler Pipe - Front Wheel Drive (FWD)

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

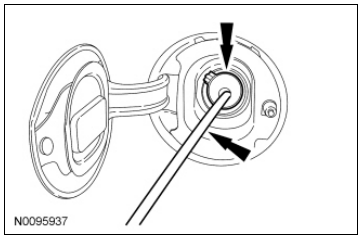
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. If the vehicle is equipped with a dual exhaust system, remove the muffler and tailpipe. For additional information, refer to Section 309-00 .

4. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe.


N0095937

5. Attach the Fuel Storage Tanker to the fuel drain tube and remove any residual fuel in the fuel tank filler pipe.

6. Remove the LR wheel and tire. For additional information, refer to Section 204-04 .

7. Remove the 3 rivets, 6 pin-type retainers and the LR splash shield.

8. Remove the 3 nuts and the fuel tank filler pipe heat shield.
   - To install, tighten to 9 Nm (80 lb-in).

9. Remove the fuel tank filler pipe bolt and nut.
   - To install, tighten to 7 Nm (62 lb-in).

10. Disconnect the fuel vapor tube assembly-to-fuel tank filler pipe recirculation tube quick connect coupling. For additional information, refer to Section 310-00 .

11. Remove the information bezel.

12. Release the 3 retainers and remove the fuel tank filler pipe housing.

13. **NOTE:** Some fuel may remain in the fuel tank filler pipe after the initial drain. Carefully drain any residual fuel into a suitable container.

    Release the clamp and disconnect the fuel tank filler pipe hose from the fuel tank.

    - To install, tighten to 4 Nm (35 lb-in).

14. **NOTE:** The fuel tank filler pipe assembly has to be directed upward and partially out of the fuel door opening, then it can be lowered and removed from the vehicle.

    Remove the fuel tank filler pipe assembly from the vehicle.

15. To install, reverse the removal procedure.

Fuel Tank Filler Pipe - All Wheel Drive (AWD)

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent
 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARN Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

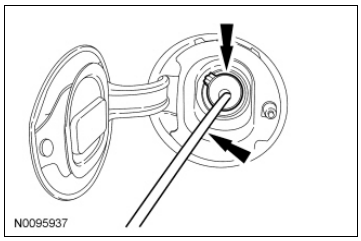
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the muffler and tailpipe. For additional information, refer to Section 309-00 .

4. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe.


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5. Attach the Fuel Storage Tanker to the fuel drain tube and remove any residual fuel in the fuel tank filler pipe.

6. Remove the LR wheel and tire. For additional information, refer to Section 204-04 .

7. Remove the 3 rivets, 6 pin-type retainers and the LR splash shield.

8. Remove the 3 nuts and the fuel tank filler pipe heat shield.
   - To install, tighten to 9 Nm (80 lb-in).

9. Remove the fuel tank filler pipe bolt and nut.
   - To install, tighten to 7 Nm (62 lb-in).

10. Disconnect the fuel vapor tube assembly-to-fuel tank filler pipe recirculation tube quick connect coupling. For additional information, refer to Section 310-00 .

11. Remove the information bezel.

12. Release the 3 retainers and remove the fuel tank filler pipe housing.

13. Install the Powertrain Lift under the fuel tank.

14. Remove the 4 bolts and the 2 fuel tank straps.
   - To install, tighten to 40 Nm (30 lb-ft).

15. Partially lower the fuel tank enough to access the fuel tank filler pipe hose clamp.

16. **NOTE:** Some residual fuel may remain in the fuel tank filler pipe after draining the fuel tank. Carefully drain any remaining fuel into a suitable container.

    Release the clamp and disconnect the fuel tank filler pipe hose from the fuel tank.

    - To install, tighten to 4 Nm (35 lb-in).

17. **NOTE:** The fuel tank filler pipe assembly has to be directed upward and partially out of the fuel door opening, then it can be lowered and removed from the vehicle.

    Remove the fuel tank filler pipe assembly from the vehicle.

18. To install, reverse the removal procedure.

Fuel Pump Module - Front Wheel Drive (FWD)

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent
 ST2803-A	Fuel Tank Sender Unit Wrench 310-123

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow tnstructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: Vehicles with an inaccurate or inoperable fuel gauge, follow the instructions for draining a fuel tank with more than three-fourths of a tank of fuel.

All vehicles

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .

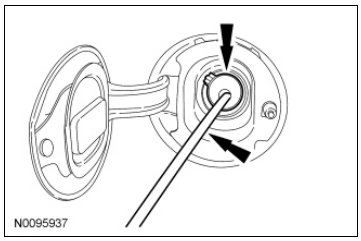
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the rear seat lower cushion. For additional information, refer to Section 501-10 .

2.5L and 3.5L vehicles with more than three-fourths of a tank of fuel

4. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe until the tube enters the fuel tank.



5. **NOTE:** This step is to remove approximately one-fourth tank of the fuel from a completely full fuel tank and the majority of any residual fuel in the fuel tank filler pipe, lowering the fuel level below the Fuel Pump (FP) module mounting flange.

   Attach the Fuel Storage Tanker to the fuel drain tube and remove one-fourth (approximately 4 gallons) of fuel from the tank.

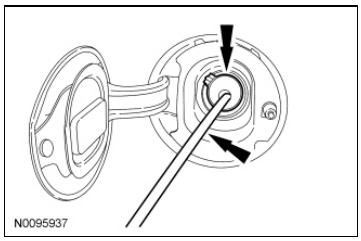
3.0L vehicles with more than three-fourths of a tank of fuel

NOTE: The Easy Fuel ™ (capless) fuel tank filler pipe on 3.0L vehicles have an anti-siphon grate that will not allow a fuel drain tube to penetrate the fuel tank and requires the following steps to drain the fuel.

6. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

7. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe.

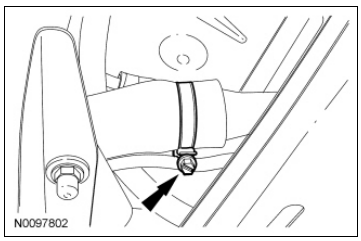


8. Attach the Fuel Storage Tanker to the fuel drain tube and remove any residual fuel in the fuel tank filler pipe.

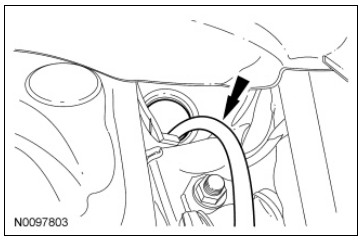
9. **NOTE:** Index-mark the fuel tank filler pipe hose and the clamp prior to removal for correct installation.

   Release the clamp and disconnect the hose from the fuel tank filler pipe.

- To install, tighten to 4 Nm (35 lb-in).



10. Insert a semi-rigid fuel drain tube into the fuel tank filler pipe hose until it enters the fuel tank.



11. **NOTE:** This step is to remove approximately one-fourth tank of the fuel from a completely full fuel tank, lowering the fuel level below the FP module mounting flange.

    Attach the Fuel Storage Tanker to the fuel drain tube and remove one-fourth (approximately 4 gallons) of fuel from the tank.

All vehicles

12. Remove the 4 screws and the FP module access cover.
    - To install, tighten to 2 Nm (18 lb-in).

13. **NOTE:** Clean the FP module connections, couplings, flange surfaces and the immediate surrounding area of any dirt or foreign material.

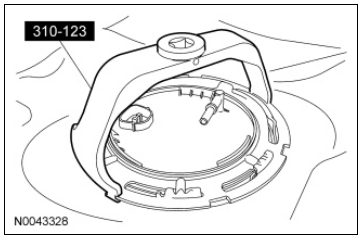
    Disconnect the FP module electrical connector.

14. Disconnect the fuel tube-to- FP module quick connect coupling. For additional information, refer to Section 310-00 .

15. **NOTE:** Place absorbent pads on the floor pan in the immediate area in case of fuel spills. Carefully remove the FP module from the vehicle to avoid fuel spillage inside the vehicle.

    NOTE: Make sure to install a new FP module O-ring seal.

    Install the Fuel Tank Sender Unit Wrench and remove the FP module lock ring.



16. ***NOTICE:*** **The Fuel Pump (FP) module must be handled carefully to avoid damage to the float arm.**

NOTE: The FP module will have residual fuel remaining internally, drain into a suitable container.

Carefully remove the FP module from the fuel tank.

17. ***NOTICE:*** **Inspect the mating surfaces of the Fuel Pump (FP) module flange and the fuel tank O-ring seal contact surfaces. Do not polish or adjust the O-ring seal contact area of the fuel tank flange or the fuel tank. Install a new FP module or fuel tank if the O-ring seal contact area is bent, scratched or corroded.**

    NOTE: To install, apply clean engine oil to the new O-ring seal.

    Remove and discard the FP module O-ring seal.

18. To install, reverse the removal procedure.
    - Make sure the alignment tab on the FP module and the fuel tank meet before tightening the FP module lock ring.

Fuel Pump Module - All Wheel Drive (AWD)

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent
 ST2803-A	Fuel Tank Sender Unit Wrench 310-123

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow theseuctions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: Vehicles with an inaccurate or inoperable fuel gauge, follow the instructions for draining a fuel tank with more than one-half of a tank of fuel.

All vehicles

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .

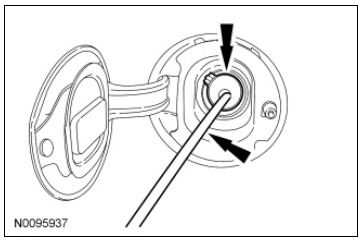
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the rear seat lower cushion. For additional information, refer to Section 501-10 .

2.5L and 3.5L vehicles with more than one-half of a tank of fuel

4. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe until the tube enters the fuel tank.



5. **NOTE:** This step is to remove approximately one-half tank of the fuel from a completely full fuel tank and the majority of any residual fuel in the fuel tank filler pipe, lowering the fuel level below the Fuel Pump (FP) module mounting flange.

   Attach the Fuel Storage Tanker to the fuel drain tube and remove one-half (approximately 8 gallons) of fuel from the tank.

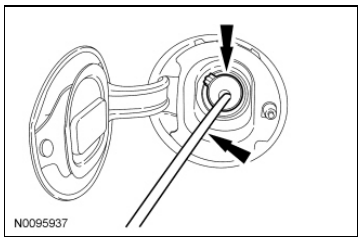
3.0L vehicles with more than one-half of a tank of fuel

NOTE: The Easy Fuel ™ (capless) fuel tank filler pipe on 3.0L vehicles have an anti-siphon grate that will not allow a fuel drain tube to penetrate the fuel tank and requires the following steps to drain the fuel.

6. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

7. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe.

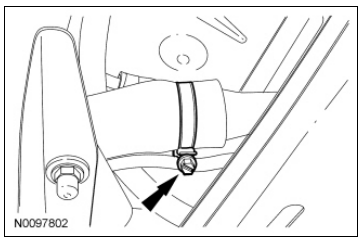


8. Attach the Fuel Storage Tanker to the fuel drain tube and remove any residual fuel in the fuel tank filler pipe.

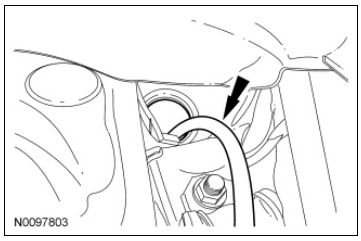
9. **NOTE:** Index-mark the fuel tank filler pipe hose and the clamp prior to removal for correct installation.

   Release the clamp and disconnect the hose from the fuel tank filler pipe.

- To install, tighten to 4 Nm (35 lb-in).



10. Insert a semi-rigid fuel drain tube into the fuel tank filler pipe hose until it enters the fuel tank.



11. **NOTE:** This step is to remove approximately one-half tank of the fuel from a completely full fuel tank, lowering the fuel level below the FP module mounting flange.

    Attach the Fuel Storage Tanker to the fuel drain tube and remove one-half (approximately 8 gallons) of fuel from the tank.

All vehicles

12. Remove the 3 screws and the FP module access cover.
    - To install, tighten to 2 Nm (18 lb-in).

13. **NOTE:** Clean the FP module connections, couplings, flange surfaces and the immediate surrounding area of any dirt or foreign material.

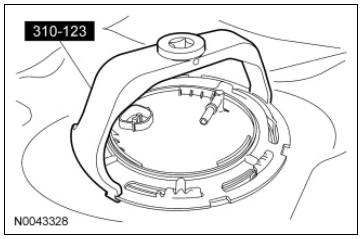
    Disconnect the FP module electrical connector.

14. Disconnect the fuel tube-to- FP module quick connect coupling. For additional information, refer to Section 310-00 .

15. **NOTE:** Place absorbent pads on the floor pan in the immediate area in case of fuel spills. Carefully remove the FP module from the vehicle to avoid fuel spillage inside the vehicle.

    NOTE: Make sure to install a new FP module O-ring seal.

    Install the Fuel Tank Sender Unit Wrench and remove the FP module lock ring.



16. Carefully lift the FP module out of the fuel tank enough to access and release the internal fuel tube-to-FP module quick connect coupling. For additional information, refer to Section 310-00 .

17. ***NOTICE:*** **The Fuel Pump (FP) module must be handled carefully to avoid damage to the float arm.**

    NOTE: The FP module will have residual fuel remaining internally, drain into a suitable container.

    Carefully remove the FP module from the fuel tank.

18. ***NOTICE:*** **Inspect the mating surfaces of the Fuel Pump (FP) module flange and the fuel tank O-ring seal contact surfaces. Do not polish or adjust the O-ring seal contact area of the fuel tank flange or the fuel tank. Install a new FP module or fuel tank if the O-ring seal contact area is bent, scratched or corroded.**

    NOTE: To install, apply clean engine oil to the new O-ring seal.

    Remove and discard the FP module O-ring seal.

19. To install, reverse the removal procedure.
    - Make sure the alignment tab on the FP module and the fuel tank meet before tightening the FP module lock ring.

Fuel Level Sensor

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal inry.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

NOTE: Only All-Wheel Drive (AWD) vehicles are equipped with a fuel level sensor (sub-side module) in the RH side of the saddle-type tank.

All vehicles

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the rear seat lower cushion. For additional information, refer to Section 501-10 .

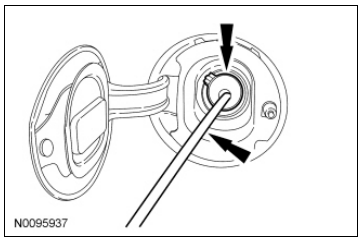
3.0L vehicles with more than one-half of a tank of fuel

NOTE: The Easy Fuel ™ (capless) fuel tank filler pipe on 3.0L vehicles have an anti-siphon grate that will not allow a fuel drain tube to penetrate the fuel tank and requires the following steps to drain the fuel.

3. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

4. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe.

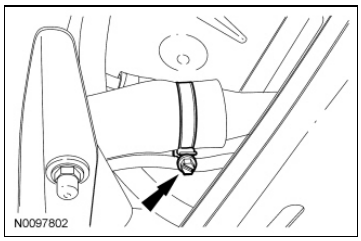


5. Attach the Fuel Storage Tanker to the fuel drain tube and remove any residual fuel in the fuel tank filler pipe.

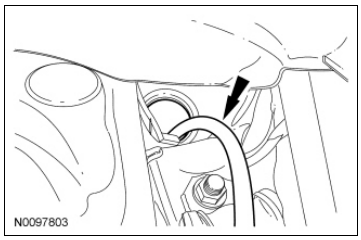
6. **NOTE:** Index-mark the fuel tank filler pipe hose and the clamp prior to removal for correct installation.

   Release the clamp and disconnect the hose from the fuel tank filler pipe.

   - To install, tighten to 4 Nm (35 lb-in).



7. Insert a semi-rigid fuel drain tube into the fuel tank filler pipe hose until it enters the fuel tank.



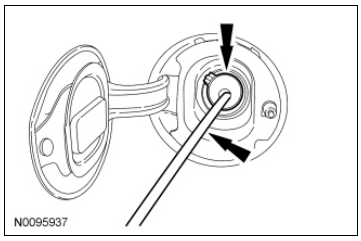
8. **NOTE:** This step is to remove approximately one-half tank of the fuel from a completely full fuel tank, lowering the fuel level below the fuel level sensor mounting flange.

   Attach the Fuel Storage Tanker to the fuel drain tube and remove one-half (approximately 8 gallons) of fuel from the tank.

3.5L vehicles with more than one-half of a tank of fuel

9. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe until the tube enters the fuel tank.



10. **NOTE:** This step is to remove approximately one-half tank of the fuel from a completely full fuel tank, lowering the fuel level below the fuel level sensor mounting flange.

    Attach the Fuel Storage Tanker to the fuel drain tube and remove one-half (approximately 8 gallons) of fuel from the tank.

All vehicles

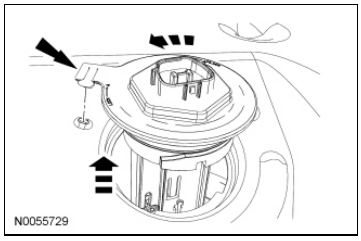
11. Remove the 3 screws and the fuel level sensor access cover.
    - To install, tighten to 2 Nm (18 lb-in).

12. **NOTE:** Clean the fuel level sensor connections, flange surfaces and the immediate surrounding area of any dirt or foreign material.

    Disconnect the fuel level sensor electrical connector.

13. **NOTE:** Place absorbent pads in the general work area in case of fuel spillage.

    Release the lock tab, rotate the fuel level sensor counterclockwise approximately one-fourth turn and lift upward.



14. ***NOTICE:*** **Inspect the mating surfaces of the fuel level sensor flange and the fuel tank O-ring seal contact surfaces. Do not polish or adjust the O-ring seal contact area of the fuel tank flange or the fuel tank. Install a new fuel level sensor or fuel tank if the O-ring seal contact area is bent, scratched or corroded.**

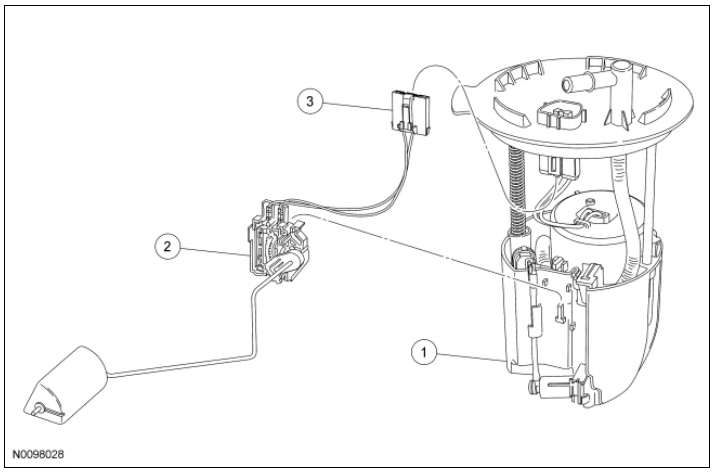
    NOTICE: **The fuel level sensor must be handled carefully to avoid damage to the float arm.**

    NOTE: Carefully remove the fuel level sensor from the fuel tank to avoid fuel spillage inside the vehicle.

    Carefully lift and remove the fuel level sensor from the fuel tank.

15. To install, reverse the removal procedure.
    - Make sure the fuel level sensor locking tab is correctly positioned.

Fuel Level Sender



Item	Part Number	Description
1	9H307	Fuel Pump (FP) module
2	9A299	Fuel level sender
3	-	Fuel level sender electrical connector (part of 9A299)

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

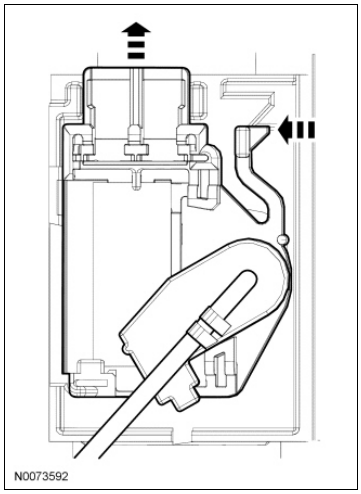
⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: The fuel level sender is serviced as part of a kit (9A299).

1. Remove the Fuel Pump (FP) module. For additional information, refer to Fuel Pump Module - Front Wheel Drive (FWD) or Fuel Pump Module - All Wheel Drive (AWD) in this section.

2. Disconnect the fuel level sender electrical connector.

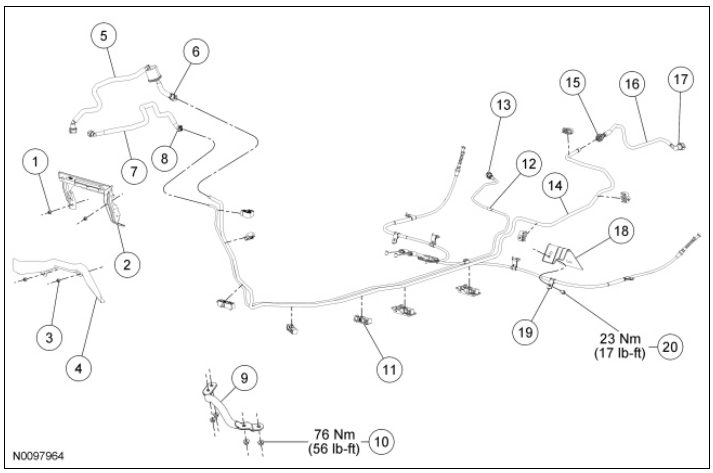
3. Depress the lock tab and slide the fuel level sender upwards and remove.



4. To install, reverse the removal edure.

Fuel Lines - Front Wheel Drive (FWD)

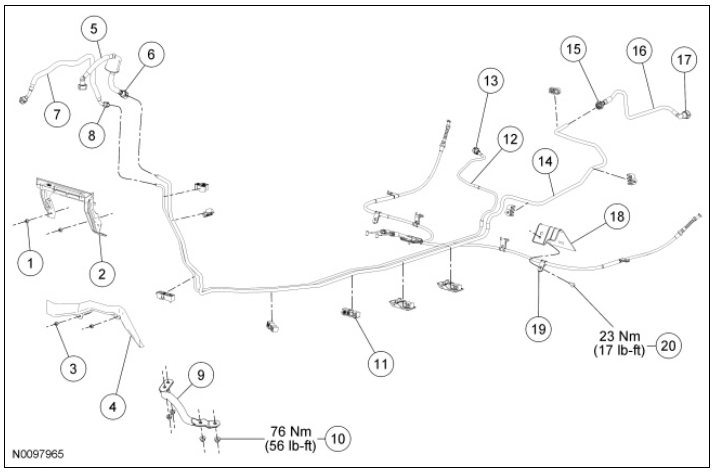
2.5L Vehicles



Item	Part Number	Description
1	W707142	Heat shield nut (2 required)
2	54017	Heat shield
3	W707142	Heat shield nut (2 required)
4	020602	Heat shield
5	9G271	Vapor jumper tube
6	-	Vapor jumper tube-to-vapor tube quick connect coupling (part of 9G271)
7	9J280	Fuel jumper tube
8	-	Fuel jumper tube-to-fuel tube quick connect coupling (part of 9J280)
9	5884	Lower crossover support brace
10	W580415	Lower crossover support brace nut (4 required)
11	-	Fuel tube bundle retaining clip (part of 9J279) (9 required)
12	9J279	Fuel tube
13	-	Fuel tube-to-Fuel Pump (FP) module quick connect coupling (part of 9J279)
14	9J279	Vapor tube
15	-	Vapor jumper tube-to-ck connect coupling (part of 9J279)
16	9J279	Vapor jumper tube
17	-	Vapor jumper tube-to-Evaporative Emission (EVAP) canister quick connect coupling (part of 9J279)
18	-	Stone shield (part of 2A815)
19	2A815	LR parking brake cable assembly

20	W505263	Rear parking brake cable assembly bolt

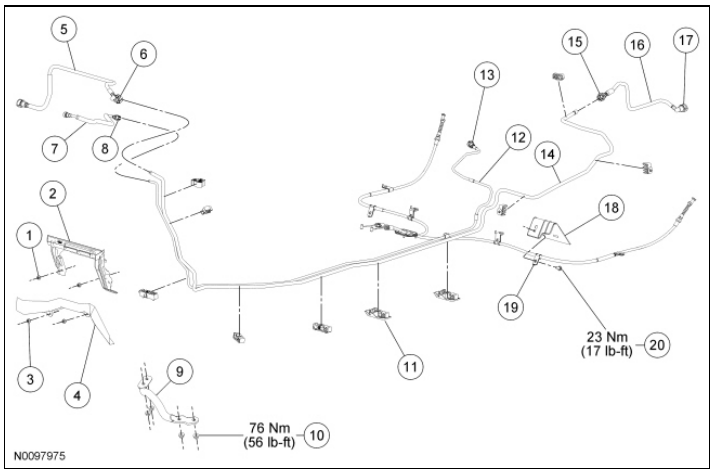
3.0L Vehicles



Item	Part Number	Description
1	W707142	Heat shield nut (2 required)
2	54017	Heat shield
3	W707142	Heat shield nut (2 required)
4	020602	Heat shield
5	9G271	Vapor jumper tube
6	-	Vapor jumper tube-to-vapor tube quick connect coupling (part of 9G271)
7	9J280	Fuel jumper tube
8	-	Fuel jumper tube-to-fuel tube quick connect coupling (part of 9J280)
9	5884	Lower crossover support brace
10	W580415	Lower crossover support brace nut (4 required)
11	-	Fuel tube bundle retaining clip (part of 9J279) (9 required)
12	9J279	Fuel tube
13	-	Fuel tube-to-Fuel Pump (FP) module quick connect coupling (part of 9J279)
14	9J279	Vapor tube
15	-	Vapor jumper tube-to-vapor tube quick connect coupling (part of 9J279)
16	9J279	Vapor jumper tube
17	-	Vapor jumper tube-to-Evaporative Emission (EVAP) canister quick

		connect coupling (part of 9J279)
18	-	Stone shield (part of 2A815)
19	2A815	LR parking brake cable assembly
20	W505263	Rear parking brake cable assembly bolt

3.5L Vehicles



Item	Part Number	Description
1	W707142	Heat shield nut (2 required)
2	54017	Heat shield
3	W707142	Heat shield nut (2 required)
4	020602	Heat shield
5	9G271	Vapor jumper tube
6	-	Vapor jumperor tube quick connect coupling (part of 9G271)
7	9J280	Fuel jumper tube
8	-	Fuel jumper tube-to-fuel tube quick connect coupling (part of 9J280)
9	5884	Lower crossover support brace
10	W580415	Lower crossover support brace nut (4 required)
11	-	Fuel tube bundle retaining clip (part of 9J279) (9 required)
12	9J279	Fuel tube
13	-	Fuel tube-to-Fuel Pump (FP) module quick connect coupling (part of 9J279)
14	9J279	Vapor tube
15	-	Vapor jumper tube-to-vapor tube quick connect coupling (part of 9J279)
16	9J279	Vapor jumper tube
17	-	Vapor jumper tube-to-Evaporative Emission (EVAP) canister quick connect coupling (part of 9J279)

18	-	Stone shield (part of 2A815)
19	2A815	LR parking brake cable assembly
20	W505263	Rear parking brake cable assembly bolt

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Release the fuel system pressure. For additional information, refer to Section 310-00 .

3. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3.5L vehicles

4. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12C .

5. **NOTE:** The lower cowl panel must be removed to access the fuel and vapor tube quick connect couplings.

   Remove the lower cowl panel. For additional information, refer to the Cowl Panel Grille procedure in Section 501-02 .

All vehicles

6. Remove the 4 nuts and the 2 heat shields.

7. **NOTE:** Some residual fuel may remain in the fuel tubes after releasing the fuel system pressure. When disconnecting or removing any fuel tubes, carefully drain any residual fuel into a suitable container.

Disconnect the fuel jumper tube-to-fuel tube quick connect coupling. For additional information, refer to Section 310-00 .

8. Disconnect the vapor jumper tube-to-vapor tube quick connect coupling. For additional information, refer to Section 310-00 .

9. Remove the 4 nuts and the lower crossover support brace.
    - To install, tighten to 76 Nm (56 lb-ft).

10. Remove the fuel tank. For additional information, refer to Fuel Tank - Front Wheel Drive (FWD) in this section.

11. **NOTE:** The LR parking brake cable bolt also retains a stone shield. Position the cable and shield aside.

    Remove the bolt and position the LR parking brake cable assembly aside.

    - To install, tighten to 23 Nm (17 lb-ft).

12. Disconnect the vapor jumper tube-to-vapor tube quick connect coupling. For additional information, refer to Section 310-00 .

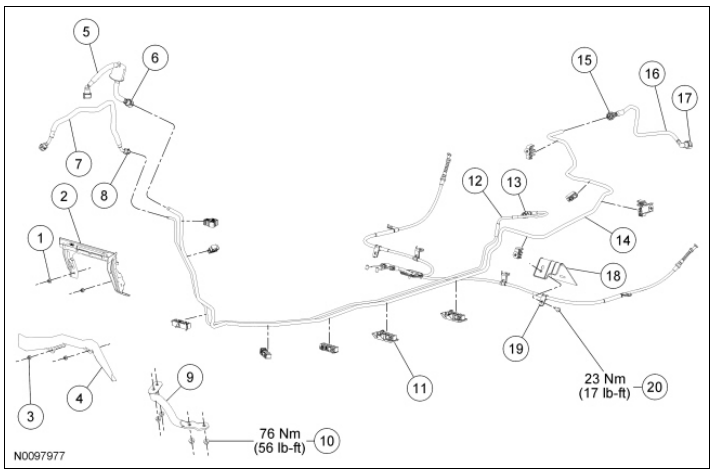
13. Release the 9 fuel tube bundle retaining clips and remove the fuel and vapor tubes.

14. Disconnect the vapor jumper tube-to-Evaporative Emission (EVAP) canister quick connect coupling and remove the vapor jumper tube. For additional information, refer to Section 310-00 .

15. To install, reverse the removal procedure.

Fuel Lines - All Wheel Drive (AWD)

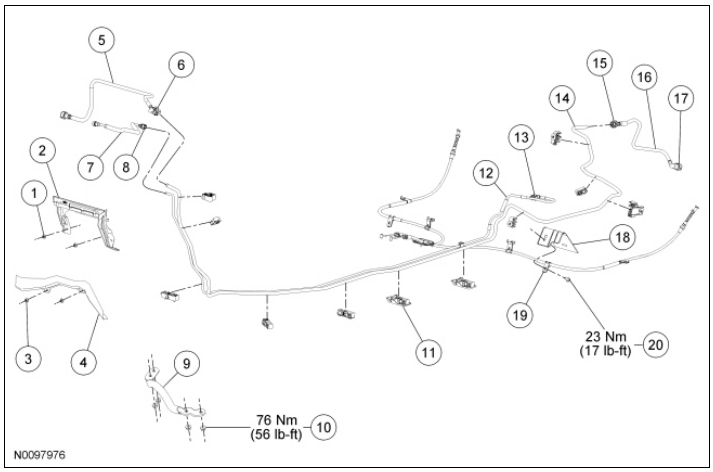
3.0L Vehicles



Item	Part Number	Description
1	W707142	Heat shield nut (2 required)
2	54017	Heat shield
3	W707142	Heat shield nut (2 required)
4	020602	Heat shield
5	9G271	Vapor jumper tube
6	-	Vapor jumper tube-to-vapor tube quick connect coupling (part of 9G271)
7	9J280	Fuel jumper tube
8	-	Fuel jumper tube-to-fuel tube quick connect coupling (part of 9J280)
9	5884	Lower crossover support brace
10	W580415	Lower crossover support brace nut (4 required)
11	-	Fuel tube bundle retaining clip (part of 9J279) (9 required)
12	9J279	Fuel tube
13	-	Fuel tube-to-Fuel Pump (FP) module quick connect coupling (part of 9J279)
14	9J279	Vapor tube
15	-	Vapor jumper tube-to-vapoonnect coupling (part of 9J279)
16	9J279	Vapor jumper tube
17	-	Vapor jumper tube-to-Evaporative Emission (EVAP) canister quick connect coupling (part of 9J279)
18	-	Stone shield (part of 2A815)
19	2A815	LR parking brake cable assembly

20	W505263	Rear parking brake cable assembly bolt

3.5L Vehicles



Item	Part Number	Description
1	W707142	Heat shield nut (2 required)
2	54017	Heat shield
3	W707142	Heat shield nut (2 required)
4	020602	Heat shield
5	9G271	Vapor jumper tube
6	-	Vapor jumper tube-to-vapor tube quick connect coupling (part of 9G271)
7	9J280	Fuel jumper tube
8	-	Fuel jumper tube-to-fuel tube quick connect coupling (part of 9J280)
9	5884	Lower crossover support brace
10	W580415	Lower crossover support brace nut (4 required)
11	-	Fuel tube bundle retaining clip (part of 9J279) (9 required)
12	9J279	Fuel tube
13	-	Fuel tube-to-Fuel Pump (FP) module quick connect coupling (part of 9J279)
14	9J279	Vapor tube
15	-	Vapor jumper tube-to-vapor tube quick connect coupling (part of 9J279)
16	9J279	Vapor jumper tube
17	-	Vapor jumper tube-to-Evaporative Emission (EVAP) canister quick connect coupling (part of 9J279)
18	-	Stone shield (part of 2A815)
19	2A815	LR parking brake cable assembly
20	W505263	Rear parking brake cable assembly bolt

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electres such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Release the fuel system pressure. For additional information, refer to Section 310-00 .

3. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3.5L vehicles

4. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to Section 303-12C .

5. **NOTE:** The lower cowl panel must be removed to access the fuel and vapor tube quick connect couplings.

   Remove the lower cowl panel. For additional information, refer to the Cowl Panel Grille procedure in Section 501-02 .

All vehicles

6. Remove the 4 nuts and the 2 heat shields.

7. **NOTE:** Some residual fuel may remain in the fuel tubes after releasing the fuel system pressure. When disconnecting or removing any fuel tubes, carefully drain any residual fuel into a suitable container.

   Disconnect the fuel jumper tube-to-fuel tube quick connect coupling. For additional information, refer to Section 310-00 .

8. Disconnect the vapor jumper tube-to-vapor tube quick connect coupling. For additional information, refer to Section 310-00 .

9. Remove the 4 nuts and the lower crossover support brace.
    - To install, tighten to 76 Nm (56 lb-ft).

10. Remove the fuel tank. For additional information, refer to Fuel Tank - All Wheel Drive (AWD) in this section.

11. **NOTE:** The LR parking brake cable bolt also retains a stone shield. Position the cable and shield aside.

    Remove the bolt and position the LR parking brake cable assembly aside.

    - To install, tighten to 23 Nm (17 lb-ft).

12. Disconnect the vapor jumper tube-to-vapor tube quick connect coupling. For additional information, refer to Section 310-00 .

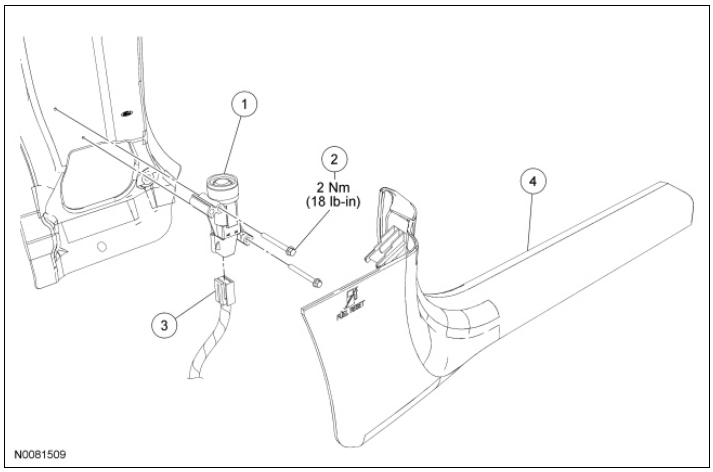
13. Release the 9 fuel tube bundle retaining clips and remove the fuel and vapor tubes.

14. Disconnect the vapor jumper tube-to-Evaporative Emission (EVAP) canister quick connect coupling and remove the vapor jumper tube. For additional information, refer to Section 310-00 .

15. To install, reverse the removal procedure.

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Inertia Fuel Shutoff (IFS) Switch - 3.5L



Item	Part Number	Description
1	9341	Inertia Fuel Shutoff (IFS) switch
2	W504148	IFS bolt (2 required)
3	14489A	IFS switch electrical connector
4	5413200	RH front door scuff plate

Removal and Installation

1. Remove the RH front door scuff plate.
2. Disconnect the Inertia Fuel Shutoff (IFS) switch electrical connector.
3. ***NOTICE:*** **Do not overtighten the fasteners or damage to the switch will occur.**

   Remove the 2 bolts and the IFS switch.

   - To install, tighten to 2 Nm (18 lb-in).
4. To install, reverse the removal procedure.

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Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-

General Specifications

Item	Specification
Fuel tank capacity	66.24L (17.5 gal)

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel Pump (FP) ccess cover screws	2	-	18
Fuel tank filler pipe bracket bolt	7	-	62
Fuel tank filler pipe bracket nut	7	-	62
Fuel tank filler pipe heat shield nut	9	-	80
Fuel tank filler pipe hose clamp	4	-	35
Fuel tank strap bolt	40	30	-
LH rear parking brake cable assembly bracket bolt	23	17	-
Lower crossover support brace nut	76	56	-

Fuel Tank and Lines

Fuel System

The fuel system consists of:

- a 2-speed Mechanical Returnless Fuel System (MRFS).
- a standard L-shaped fuel tank.
- an Easy Fuel ™ (capless) fuel tank filler pipe assembly, which cannot be modified in any way.
- a Fuel Pump (FP) module containing:
  - an electric FP , which provides pressurized fuel to the fuel rail.
  - a serviceable fuel level sender.
  - a check valve, which maintains system pressure after the FP is shut off.
  - a pressure relief valve for overpressure protection in the event of restricted fuel flow.
  - a lifetime fuel filter providing filtration to protect the fuel injectors from foreign material.
- fuel, vapor anake tubes in an integrated bundle assembly attached to the underside of the vehicle by retaining clips.
- has a supplemental refueling adapter located in the luggage compartment.
- a FP control module.

Fuel System Shutoff Feature

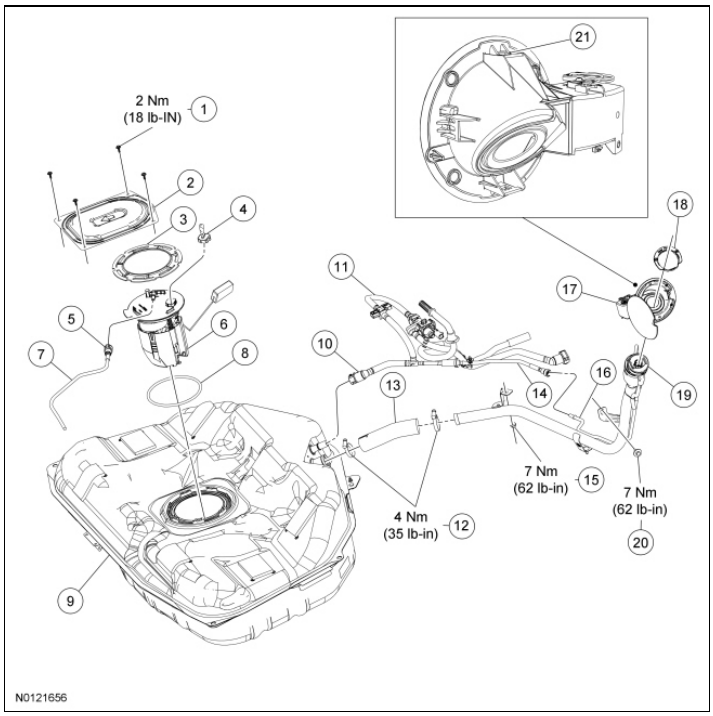
The vehicle is equipped with a FP shutoff feature that is initiated by theRestraints Control Module (RCM). The FP control module receives an event notification signal from the RCM to disable the FP . The event notification signal is sent on a dedicated circuit between the FP control module and the RCM . Should the vehicle shut-off after a collision due to this feature, restart the vehicle by first turning the ignition to the OFF position and then turn the ignition to the ON position. In some instances, the vehicle may not restart the first time and may take an additional attempt.

Fuel Tank and Lines

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Fuel Tank and Filler Pipe - Exploded View

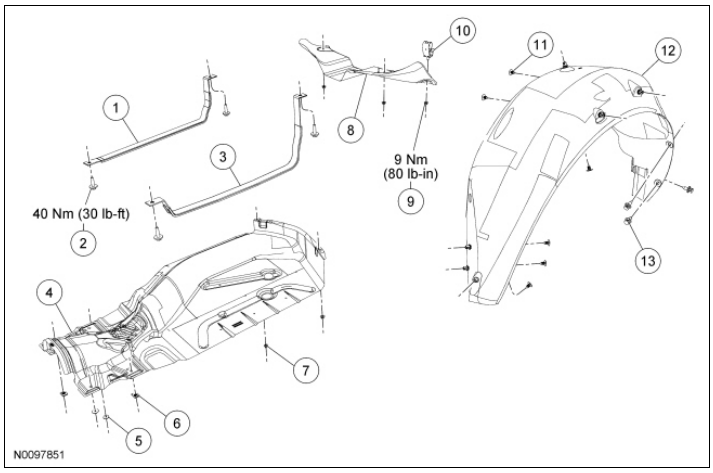
Fuel Tank and Filler Pipe



Item	Part Number	Description
1	W807011	Fuel Pump (FP) module access cover screw (4 required)
2	54111	FP module access cover
3	9C385	FP module lock ring
4	14A464	FP module electrical connector
5	-	Fuel tube-to- FP module quick connect coupling (part of 9J279)
6	9H307	FP module
7	9J279	Fuel tube
8	9276	FP module O-ring seal
9	9002	Fuel tank
10	-	Fuel vapor tube assembly-to-fuel tank quick connect coupling (part of 9A228)
11	9A228	Fuel vapor tube assembly
12	W525937	Fuel tank filler pipe hose clamp
13	9047	Fuel tank filler pipe hose
14	-	Fuel vapor tube assembly-to-fuel tank filler pipe recirculation tube quick connect coupling (part of 9A228)

15	N806543	Fuel tank filler pipe bracket nut
16	-	Fuel tank filler pipe recirculation tube (part of 9034)
17	27936	Fuel tank filler pipe housing
18	9K072 >Information bezel	
19	9B187	Fuel tank filler pipe
20	W707398	Fuel tank filler pipe bracket bolt
21	-	Fuel tank filler pipe housing retainer (3 required) (part of 27936)

Fuel Tank Supports and Shields



Item	Part Number	Description
1	9092	RH fuel tank strap
2	W505444	Fuel tank strap bolt (4 required)
3	9092	LH fuel tank strap
4	9A031	Fuel tank heat shield
5	W700430	Fuel tank heat shield nut (2 required)
6	9B328	Fuel tank heat shield clip (2 required)
7	W712232	Fuel tank heat shield nut (2 required)
8	5411268	Fuel tank filler pipe heat shield
9	W707142	Fuel tank filler pipe heat shield nut (3 required)
10	529330	Fuel tank filler pipe heat shield bracket
11	W701259	Splash shield pin-type retainer (6 required)
12	5428371	LH splash shield
13	N807379	Splash shield rivet (3 required)

1. For additional information, refer to the procedures in this section.

Fuel Tank

Special Tool(s)

 ST1293-A	Powertrain Lift 300-OTC1585AE or equivalent

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result erious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Drain the fuel tank. For additional information, refer to Section 310-00 .

3. Remove the muffler and tailpipe. For additional information, refer to Section 309-00 .

4. **NOTE:** Some residual fuel may remain in the fuel tank filler pipe after draining the fuel tank. Carefully drain any remaining fuel into a suitable container.

   Release the clamp and disconnect the fuel tank filler pipe hose from the fuel tank.

   - To install, tighten to 4 Nm (35 lb-in).

5. Disconnect the fuel vapor tube assembly-to-fuel tank quick connect coupling. For additional information, refer to Section 310-00 .

6. Remove the 4 nuts, 2 clips and release the heat shield from the fuel tank.

7. Install the Powertrain Lift under the fuel tank.

8. Remove the 4 bolts and the 2 fuel tank straps.
    - To install, tighten to 40 Nm (30 lb-ft).

9. Carefully lower and remove the fuel tank from the vehicle.

10. To install, reverse the removal procedure.

Fuel Tank Filler Pipe

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these ructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

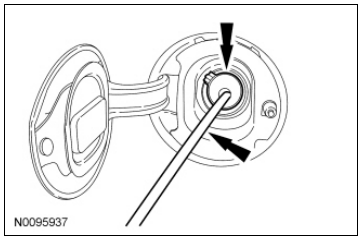
⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

   Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe until the tube enters the fuel tank.


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4. **NOTE:** This step is to remove approximately one-fourth tank of the fuel from a completely full fuel tank and the majority of any residual fuel in the fuel tank filler pipe, lowering the fuel level below the fuel tank inlet.

Attach the Fuel Storage Tanker to the fuel drain tube and remove one-fourth (approximately 4 gallons) of fuel from the tank.

5. Remove the LR wheel and tire. For additional information, refer to Section 204-04 .

6. Remove the 3 rivets, 6 pin-type retainers and the LR wheel splash shield.

7. Remove the 3 nuts and the fuel tank filler pipe heat shield.
   - To install, tighten to 9 Nm (80 lb-in).

8. Remove the fuel tank filler pipe bracket nut.
   - To install, tighten to 7 Nm (62 lb-in).

9. Remove the fuel tank filler pipe bracket bolt.
   - To install, tighten to 7 Nm (62 lb-in).

10. Disconnect the fuel vapor tube assembly-to-fuel tank filler pipe recirculation tube quick connect coupling. For additional information, refer to Section 310-00 .

11. Remove the information bezel.

12. Release the 3 retainers and remove the fuel tank filler pipe housing.

13. **NOTE:** Some fuel may remain in the fuel tank filler pipe after the initial drain. Carefully drain any residual fuel into a suitable container.

    Release the clamp and disconnect the fuel tank filler pipe hose from the fuel tank.

    - To install, tighten to 4 Nm (35 lb-in).

14. Remove the fuel tank filler pipe assembly from the vehicle.

15. To install, reverse the removal procedure.

Fuel Pump Module

Special Tool(s)

 ST1134A	Fuel Storage Tanker 164-R3202 or equivalent
 ST2803-A	Fuel Tank Sender Unit Wrench 310-123

Material

Item	Specification
Motorc® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

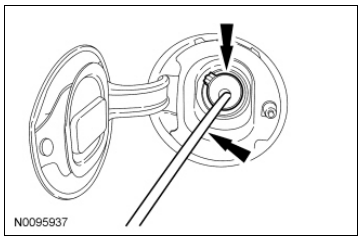
⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when thengine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. **NOTE:** The supplemental refueling adapter is located in the luggage compartment.

Install the supplemental refueling adapter and a length of semi-rigid fuel drain tube into the Easy Fuel ™ (capless) fuel tank filler pipe until the tube enters the fuel tank.



4. **NOTE:** This step is to remove approximately one-fourth tank of the fuel from a completely full fuel tank and the majority of any residual fuel in the fuel tank filler pipe, lowering the fuel level below the Fuel Pump (FP) module flange.

   Attach the Fuel Storage Tanker to the fuel drain tube and remove one-fourth (approximately 4 gallons) of fuel from the tank.

5. Remove the rear seat lower cushion. For additional information, refer to Section 501-10 .

6. Remove the 4 screws and the FP module access cover.
   - To install, tighten to 2 Nm (18 lb-in).

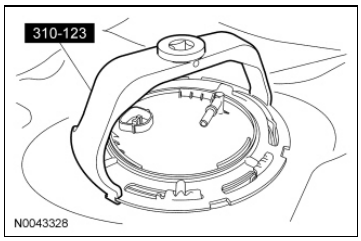
7. Disconnect the FP module electrical connector.

8. Disconnect the fuel tube-to- FP module quick connect coupling. For additional information, refer to Section 310-00 .

9. **NOTE:** Place absorbent pads on the floor pan in the immediate area in case of fuel spills. Carefully remove the FP module from the vehicle to avoid fuel spillage inside the vehicle.

   NOTE: Make sure to install a new FP module O-ring seal.

   Install the Fuel Tank Sender Unit Wrench and remove the FP module lock ring.



10. ***NOTICE:*** **The Fuel Pump (FP) module must be handled carefully to avoid damage to the float arm.**

    NOTE: The FP module will have residual fuel remaining internally, drain into a suitable container.

    Completely remove the FP module from the fuel tank.

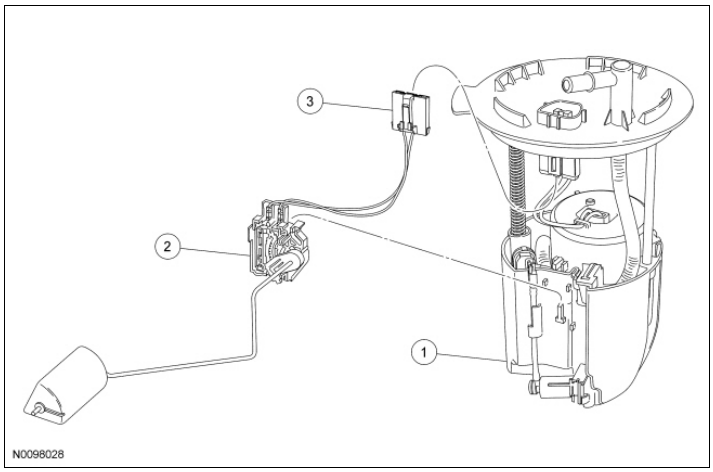
11. ***NOTICE:*** **Inspect the mating surfaces of the Fuel Pump (FP) module flange and the fuel tank O-ring seal contact surfaces. Do not polish or adjust the O-ring seal contact area of the fuel tank flange or the fuel tank. Install a new FP module or fuel tank if the O-ring seal contact area is bent, scratched or corroded.**

NOTE: To install, apply clean engine oil to the new O-ring seal.

Remove and discard the FP module O-ring seal.

12. To install, reverse the removal procedure.
    - Make sure the alignment tab on the FP module and the fuel tank meet before tightening the FP module lock ring.

Fuel Level Sender



Item	Part Number	Description
1	9H307	Fuel Pump (FP) module
2	9A299	Fuel level sender
3	-	Fuel level sender electrical connector (part of 9A299)

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

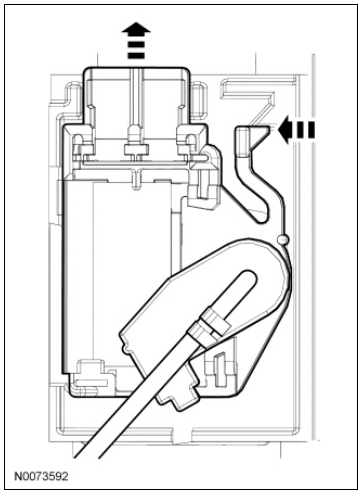
⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

NOTE: The fuel level sender is serviced as part of a kit (9A299).

1. Remove the Fuel Pump (FP) module. For additional information, refer to Fuel Pump Module in this section.

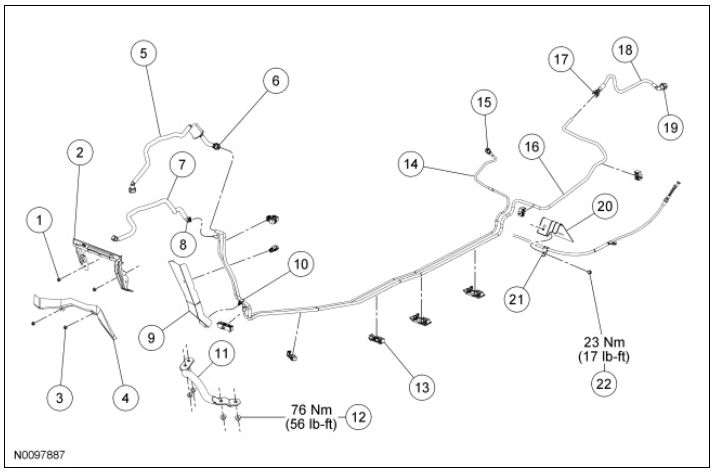
2. Disconnect the fuel level sender electrical connector.

3. Depress the lock tab and slide the fuel level sender upwards and remove.



4. To install, reverse the removal procedure.

Fuel Lines



Item	Part Number	Description
1	W707142	Heat shield nut (2 required)
2	54017	Heat shield
3	W707142	Heat shield nut (2 required)
4	020602	Heat shield
5	9G271	Vapor jumper tube
6	-	Vapor jumper tube-to-vapor tube quick connect coupling (part of 9G271)
7	9J280	Fuel jumper tube
8	Fuel jumper tube-to-fuel tube quick connect coupling (part of 9J280)	
9	-	Hybrid fuel tube bundle shield (part of 9J279)
10	-	Hybrid fuel tube bundle shield pin-type retainer (part of 9J279)
11	5884	Lower crossover support brace
12	W580415	Lower crossover support brace nut (4 required)
13	-	Fuel tube bundle retaining clip (part of 9J279) (9 required)
14	9J279	Fuel tube
15	-	Fuel tube-to-Fuel Pump (FP) module quick connect coupling (part of 9J279)
16	9J279	Vapor tube

17	-	Vapor jumper tube-to-vapor tube quick connect coupling (part of 9J279)
18	9J279	Vapor jumper tube
19	-	Vapor jumper tube-to-Evaporative Emission (EVAP) canister quick connect coupling (part of 9J279)
20	-	Stone shield (part of 2A815)
21	2A815	LR parking brake cable assembly
22	W505263	Rear parking brake cable assembly bolt

Removal and Installation

⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near anymponent. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

⚠ WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

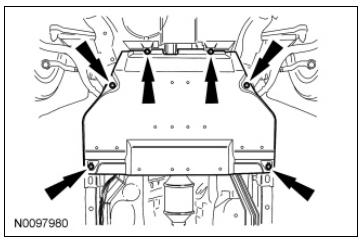
⚠ WARNING: When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Release the fuel system pressure. For additional information, refer to Section 310-00 .
3. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
4. Remove the 4 nuts and 2 heat shields.
5. Release the pin-type retainer and remove the hybrid fuel tube bundle shield.
6. **NOTE:** Some residual fuel may remain in the fuel tubes after releasing the fuel system pressure. When disconnecting or removing any fuel tubes, carefully drain any residual fuel into a suitable container.

Disconnect the fuel jumper tube-to-fuel tube quick connect coupling. For additional information, refer to Section 310-00 .

7. Disconnect the vapor jumper tube-to-vapor tube quick connect coupling. For additional information, refer to Section 310-00 .

8. If equipped, remove the 6 bolts and the underbody shield.



9. Remove the 4 nuts and the lower crossover support brace.
    - To install, tighten to 76 Nm (56 lb-ft).

10. Remove the fuel tank. For additional information, refer to Fuel Tank in this section.

11. **NOTE:** The LR parking brake cable bolt also retains a stone shield. Position the cable and shield aside.

    Remove the bolt, stone shield and position the LR parking brake cable assembly aside.

    - To install, tighten to 23 Nm (17 lb-ft).

12. Disconnect the vapor jumper tube-to-vapor tube quick connect coupling. For additional information, refer to Section 310-00 .

13. Release the 9 fuel tube bundle retaining clips and remove the fuel and vapor tubes.

14. Disconnect the vapor jumper tube-to-Evaporative Emission (EVAP) canister quick connect coupling and remove the vapor jumper tube. For additional information, refer to Section 310-00 .

15. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Accelerator pedal and sensor assembly nuts	10	89

Acceleration Control

The acceleration controls consist of an accelerator pedal and sensor assembly.

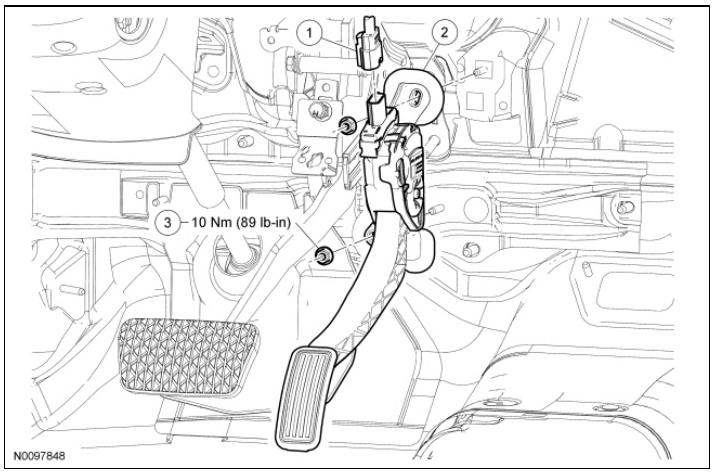
The engine management system electronically operates the accelerator of the engine in response to accelerator pedal movements initiated by the driver. In the event of a system failure, the engine management system provides a "limp home" mode which allows the vehicle to be driven with limited performance.

Acceleration Control

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

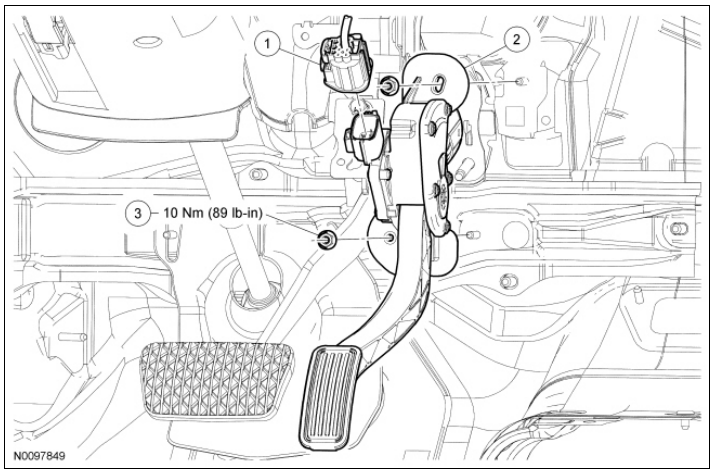
Accelerator Pedal and Bracket

2.5L, 2.5L Hybrid and 3.0L Vehicles



Item	Part Number	Description
1	14A464	Accelerator pedal sensor electrical connector
2	9F836	Accelerator pedal and sensor assembly
3	W706131	Accelerator pedal and sensor assembly nut (2 required)

3.5L Vehicles



Item	Part Number	Description
1	14A464	Accelerator pedal sensor electrical connector
2	9F836	Accelerator pedal and sensor assembly
3	W706131	Accelerator pedal and sensor assembly nut (2 required)

Removal and Installation

NOTE: The sport metallic accelerator pedal pad is not to be re-used. If the sport metallic accelerator pedal pad is removed it should be discarded and replaced with a new sport metallic accelerator pedal pad.

1. Disconnect the accelerator pedal sensor electrical connector.

2. Remove the 2 nuts and the accelerator pedal and sensor assembly.
    - To install, tighten to 10 Nm (89 lb-in).

3. To install, reverse the removal procedure.

Acronyms

2WD - 2-Wheel Drive

4WD - Four-Wheel Drive

A/C - Air Conditioning

ABS - Acrylonitrile Butadiene Styrene

ABS - Anti-Lock Brake System

ACCM - Air Conditioning Compressor Module

ACL - Air Cleaner

ACM - Audio Control Module

ACM - Audio Front Control Module

ALR - Automatic Locking Retractor

APIM - Accessory Protocol Interface Module

APP - Accelerator Pedal Position

ATC - Active Torque Coupling

ATF - Automatic Transmission Fluid

AWD - All-Wheel Drive

BCM - Body Control Module

BCM-HVTB - Battery Control Module - High Voltage Traction Battery

BEC - Bussed Electrical Center

BECM - Battery Energy Control Module

BJB - Battery Junction Box

BLIS® - Blind Spot Information System

BLISTM - Blind Spot Information System

BPP - Brake Pedal Position

BPSM - Battery Pack Sensor Module

BSIA - Brake Shift Interlock Actuator

BTS - Belt Tension Sensor

CAN - Controller Area Network

CAN2 - Controller Area Network 2

CASS - Compressor Anti-Slugging Strategy

CCA - Cold Cranking Amps

CHT - Cylinder Head Temperature

CID - Cubic Inch Displacement

CIP - Consumer Interface Processor

CKP - Crankshaft Position

CMDTC - Continuous Memory Diagnostic Trouble Code

CMDTCs - Continuous Memory Diagnostic Trouble Codes

CMP - Camshaft Position

CMS - Catalyst Monitor Sensor

CPA - Connector Position Assurance

CPP - Clutch Pedal Position

CTA - Cross Traffic Alert

CVT - Continuously Variable Transaxle

D/A - Dual Action

DAMB - Direct Acting Mechanical Buckets

DATC - Dual Automatic Temperature Control

DC/DC - DC to DC Converter Control Module

DCSM - Dual Climate Controlled Seat Module

DDM - Driver Door Module

DERU - Drive Engine Run-Up

DLC - Data Link Connector

DMM - Digital Multimeter

DOHC - Dual Overhead Camshaft

DP - Dual Phase Steel

DRL - Daytime Running Lamps

DRM - Digital Rights Management

DSM - Driver Seat Module

DSO - District Special Order

DSP - Digital Signal Processing

DTC - Diagnostic Trouble Code

DTE - Distance To Empty

EATC - Electronic Automatic Temperature Control

EBD - Electronic Brake Distribution

ECM - Engine Control Module

ECT - Engine Coolant Temperature

ECU - Electronic Control Unit

eCVT - Electronically Controlled Continuously Variable Transmission

EEPROM - Electrically Erasable Programmable Read-Only Memory

EGR - Exhaust Gas Recirculation

EI - Electronic Ignition

ELR - Emergency Locking Retractor

EMTC - Electronic Manual emperature Control

EONV - Engine Off Natural Vacuum

EOP - Engine Oil Pressure

EPAS - Electronic Power Assist Steering

EPC - Electronic Pressure Control

ESC - Electronic Stability Control

ESN - Electronic Serial Number

ETC - Electronic Throttle Control

EVA - Electronic Vibration Analyzer

EVAP - Evaporative Emission

FC - Fan Control

FCIM - Front Controls Interface Module

FDIM - Front Display Interface Module

FEAD - Front End Accessory Drive

FET - Field-Effect Transistor

FF - Flexible Fuel

FP - Fuel Pump

FTP - Fuel Tank Pressure

FWD - Front Wheel Drive

GEM - Generic Electronic Module

GPS - Global Positioning System

GPSM - Global Positioning System Module

GTDI - Gasoline Turbocharged Direct Injection

GVW - Gross Vehicle Weight

GVWR - Gross Vehicle Weight Rating

HCM - Headlamp Control Module

HCM-2 - Headlamp Control Module 2

HCU - Hydraulic Control Unit

HEV - Hybrid Electric Vehicle

HID - High Intensity Discharge

HO2S - Heated Oxygen Sensor

HPAS - Hydraulic Power Assist Steering

HS-CAN - High Speed Controller Area Network

HSLA - High-Strength Low Alloy

HSS - High-Strength Steel

HVAC - Heating Ventilation Air Conditioning

HVTB - High Voltage Traction Battery

IAT - Intake Air Temperature

IC - Instrument Cluster

IDS - Integrated Diagnostic System

IFS - Inertia Fuel Shutoff

IKT - Integrated Keyhead Transmitter

IKTs - Integrated Keyhead Transmitters

ILCM - Interior Lighting Control Module

IPC - Instrument Panel Cluster

IPM-A - Image Processing Module - A

ISC - Idle Speed Control

KAM - Keep Alive Memory

KOEO - Key ON Engine OFF

KOER - Key ON Engine Running

KS - Knock Sensor

LCD - Liquid Crystal Display

LPC - Line Pressure Control

MACS - Mobile Air Conditioning Society

MAF - Mass Air Flow

MAP - Manifold Absolute Pressure

MECS - Motor Electronics Cooling System

MFI - Multi-Port Fuel Injection

MIG - Metal Inert Gas

MIL - Malfunction Indicator Lamp

MRFS - Mechanical Returnless Fuel System

MS-CAN - Medium Speed Controller Area Network

MSS - Mode Select Switch

NERU - Neutral Engine Run-Up

NOx - Nitrogen Oxides

NVM - Non-Volatile Memory

O/D - Overdrive

OASIS - On-Line Automotive Service Information System

OBD - On-Board Diagnostic

OCS - Occupant Classification Sensor

OCS - Occupant Classification System

OCSM - Occupant Classification System Module

OHC - Overhead Camshaft

ORVR - On-Board Refueling Vapor Recovery

OSS - Output Shaft Speed

OTIS - One-Touch Integrated Start

OWC - One-Way Clutch

PAD - Passenger Air Bag Deactivation

PAM - Parking Aid Module

PATS - Passive Anti-Theft System

PC/ED - Powertrain Control/Emissions Diagnosis

PCM - Powertrain Control Module

PDB - Power Distribution Box

PIN - Personal Identification Number

PMI - Programmable Module Installation

PSCM - Power Steering Control Module

PSP - Power Steering Pressure

PTS - Professional Technician Society

PTU - Power Transfer Unit

PVC - Polyvinyl Chloride

PWM - Pulse Width Modulated

PWM - Pulse-Width Modulation

PZEV - Partial Zero Emissions Vehicle

RAM - Random Access Memory

RCM - Restraints Control Module

RCU - Rear Control Unit

RDU - Rear Drive Unit

READ - Rear End Accessory Drive

RFI - Radio Frequency Interference

RKE - Remote Keyless Entry

ROM - Read-Only Memory

ROW - Rest Of World

RSC® - Roll Stability Control

SDARS - Satellite Digital Audio Receiver System

SFI - Sequential Multi-Port Fuel Injection

SJB - Smart Junction Box

SMC - Sheet-Molded Composite

SOD-L - Side Obstacle Detection Control Module - Left

SOD-R - Side Obstacle Detection Control Module - Right

SRS - Supplemental Restraint System

SSA - Shift Solenoid A

SSB - Shift Solenoid B

SSC - Shift Solenoid C

SSD - Shift Solenoid D

SSE - Shift Solenoid E

SSF - Shift Solenoid F

SSPCC - Shift Solenoid Pressure Control C

SSPCD - Shift Solenoid Pressure Control D

SSPCE - Shift Solenoid Pressure Control E

SSPCF - Shift Solenoid Pressure Control F

STRW - Squeeze-Type Resistance Spot Welding

TB - Throttle Body

TCC - Torque Converter Clutch

TCIL - Transmission Control Indicator Lamp

TCM - Transmission Control Module

TCS - Transmission Control Switch

TDC - Top Dead Center

TED - Thermo-Electric Device

TEDs - Thermo-Electric Devices

TFT - Transmission Fluid Temperature

TIC - Transmitter Identification Code

TICs - Transmitter Identification Codes

TP - Throttle Position

TPM - Tire Pressure Monitor

TPMS - Tire Pressure Monitoring System

TPO - Thermoplastic Olefin

TR - Transmission Range

TRIP - Transformation Induced Plasticity Steel

TSB - Technical Service Bulletin

TSBs - Technical Service Bulletins

TSS - Turbine Shaft Speed

TTS - Text-To-Speech

TXV - Thermostatic Expansion Valve

UHSS - Ultra High Strength Steel

USB - Universal Serial Bus

VC - Vehicle Certification

VCM - Vehicle Communication Module

VCT - Variable Camshaft Timing

VFS - Variable Force Solenoid

VID - Vehicle Identification

VIN - Vehicle Identification Number

VIP - Vehicle Interface Processor

VSS - Vehicle Speed Sensor

WMI - World Manufacturer Identifier

WOT - Wide Open Throttle

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Wheel Speed Sensor - Rear, Front Wheel Drive (FWD) (REMOVAL AND INSTALLATION, Anti-Lock Brake System (ABS) and Stability Control)

Wheel Spindle (REMOVAL AND INSTALLATION, Rear Suspension)

Wheel Studs (REMOVAL AND INSTALLATION, Front Suspension)

Wheel Studs (REMOVAL AND INSTALLATION, Rear Suspension)

Wheels And Tires (DESCRIPTION AND OPERATION, Wheels and Tires)

Wheels And Tires (DIAGNOSIS AND TESTING, Wheels and Tires)

Wheels and Tires (Section Table of Contents)

Wheels and Tires (SPECIFICATIONS)

Window Control Switch (REMOVAL AND INSTALLATION, Glass, Frames and Mechanisms)

Window Glass - Front Door (REMOVAL AND INSTALLATION, Glass, Frames and Mechanisms)

Window Glass - Rear (REMOVAL AND INSTALLATION, Glass, Frames and Mechanisms)

Window Glass - Rear Door (REMOVAL AND INSTALLATION, Glass, Frames and Mechanisms)

Window Glass - Rear Door, Fixed (REMOVAL AND INSTALLATION, Glass, Frames and Mechanisms)

Window Grid Wire Repair (GENERAL PROCEDURES, Glass, Frames and Mechanisms)
lass="nospace">Window Motor Initialization (GENERAL PROCEDURES, Glass, Frames and Mechanisms)

Window Regulator and Motor - Front Door (REMOVAL AND INSTALLATION, Glass, Frames and Mechanisms)

Window Regulator and Motor - Rear Door (REMOVAL AND INSTALLATION, Glass, Frames and Mechanisms)

Window Regulator Motor (REMOVAL AND INSTALLATION, Glass, Frames and Mechanisms)

Windshield Glass (REMOVAL AND INSTALLATION, Glass, Frames and Mechanisms)

Wiper and Washer System - Exploded View (REMOVAL AND INSTALLATION, Wipers and Washers)

Wiper Blade and Pivot Arm Adjustment (GENERAL PROCEDURES, Wipers and Washers)

Wiper Motor (REMOVAL AND INSTALLATION, Wipers and Washers)

Wiper Mounting Arm and Pivot Shaft (REMOVAL AND INSTALLATION, Wipers and Washers)

Wiper Pivot Arm (REMOVAL AND INSTALLATION, Wipers and Washers)

Wiper/Washer Module (REMOVAL AND INSTALLATION, Wipers and Washers)

Wipers and Washers (DESCRIPTION AND OPERATION)

Wipers and Washers (DIAGNOSIS AND TESTING)

Wipers and Washers (Section Table of Contents)

Wipers and Washers (SPECIFICATIONS)

Steering System

Electronic Power Assist Steering (EPAS) System

The Electronic Power Assist Steering (EPAS) system consists of the following components:

- Power Steering Control Module (PSCM) - the PSCM controls the functions of the EPAS system and communicates with other modules that are on the High Speed Controller Area Network (HS-CAN) bus. The PSCM is attached to the RH side of the EPAS gear assembly and is not available separately for service.
- Motor - the EPAS gear uses a 12-volt reversible motor to control the steering effort. The motor is connected to the steering rack by a toothed belt and a pulley/bearing assembly. The motor is used by the PSCM to move the rack inside the gear housing. Motor position is used to determine steering wheel angle/position instead of using a separate sensor. The motor is attached to the RH side of the EPAS gear assembly and is not available separately for service.
- Steering shaft torque sensor - the steering shaft torque sensor is used by the PSCM to determine how much force the steering wheel is being turned. The sensor sends out 2 signals, one for left and one for right. When the steering wheel is turned to the left, the left signal increases while the right signal decreases, likewise when the steering wheel is turned to the right, the right signal increases while the left signal decreases. This allows the PSCM EPAS gear assembly and is not available separately for service.
- Inner tie rod - one inner tie rod is located at each end of the EPAS gear assembly and is available separately for service. Refer to Section 211-02 .
- Outer tie rod - one outer tie rod is located at each end of the EPAS gear assembly and is available separately for service. Refer to Section 211-02 .
- EPAS gear bellows boot - one bellows boot is located on each side of the EPAS gear assembly. Each boot is held in place with 2 boot clamps. The boots and clamps are available for service, refer to Section 211-02 .
- EPAS gear isolators - there are several rubber isolators (one at each attaching point) on the EPAS gear assembly. These isolators aid in reducing NVH concerns and not available separately for service.

The EPAS system utilizes a rack-and-pinion type steering gear. Power assist is provided by a motor that is connected to the steering rack by a belt and a pulley and bearing assembly. The steering gear and motor/module are serviced as an assembly. A new steering gear includes inner tie rods, however, the inner and outer tie rods can also be serviced separately. For information on tie-rod end service, refer to Section 211-02 .

P>

Steering System

Special Tool(s)

 ST1138-A	Flex Probe Kit 105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Electronic Power Assist Steering (EPAS) System

The Electronic Power Assist Steering (EPAS) system provides power steering assist to the driver by replacing the conventional hydraulic valve system with an electric motor coupled to the steering rack by a toothed belt. The motor is controlled by the Power Steering Control Module (PSCM) that senses steering effort/use through the use of a torque sensor which is mounted near the input shaft of the steering gear. Steering assist is provided in proportion to the steering input effort and vehicle speed.

The EPAS system requires a 12-volt, hot at all times feed for system operation. The PSCM is activated when power is applied to the hard-wired ignition/run input. After activation, the PSCM monitors the High Speed Controller Area Network (HS-CAN) bus to determine if the vehicle is operating in a manner capable of supporting the EPAS system.

Once this is determined, vehicle speed sent by the PCM over the HS-CAN bus, steering shaft speed and direction sent by the torque sensor and steering wheel angle/position determined by the motor position all provide the necessary information for the PSCM to determine the amount or level of assist provided by the EPAS system.

Assist is primarily based off of vehicle speed. As vehicle speed increases, the amount of assist provided by the system is decreased to improve and enhance road feel at the steering wheel. As vehicle speed decreases, the amount of assist provided by the system is increased to ease vehicle maneuvering. If the vehicle speed is missing or out of range, the PSCM defaults to a safe level of assist for all driving conditions. If the vehicle speed returns to the correct in-range values, the PSCM will adjust the level of assist accordingly. Steering wheel/shaft torque, speed and direction information will allow the PSCM to determine how much assist is needed to turn the wheels right and left.

The PSCM is self-monitoring and has the capability of setting and storing DTCs. Depending on the DTC set, the control module will enter into a "safe mode" of manual steering. In addition, the PSCM may send a request to the Instrument Panel Cluster (IPC) module over the HS-CAN bus to display a message in the

message center to alert the driver of a potential EPAS concern.

Interactive Diagnostics

For diagnosing and testing please refer to the on-line Workshop Manual. If you do not have an on-line subscription, go to www.motorcraftservice.com.

Material

Item	Specification	Fill Capacity
Dye-Lite® ATF/Power Steering Fluid Leak Detection Dye 164-R3701 (Rotunda)	-	-
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V	1.5L (3.2pt)

General Specifications

Item	Specification	
Power Steering Gear		
Turning effort	35 N (7.86 lb)	
Power Steering Pump		
Flow	Minimum capacity	5.3L/min (1.4 gpm) (while turning steering wheel) Fluid @ 74°-80°C (165°-175°F) Pressure 5,171 kPa (750 psi) Engine @ 675 rpm
Pressure	689 kPa (50 psi) Fluid @ 74°-80°C (165°-175°F) Engine @ 2,000 rpm	
Relief pressure	9,720-10,170 kPa (1,409-1,475 psi)	
Power Steering Purge Vacuum		
Air purge vacuum	68-85 kPa (20-25 in-Hg)	

Steering System

The power steering system consists of the following components:

- Power steering pump
- Power steering fluid reservoir
- Steering gear
- Power steering fluid cooler
- Power steering lines
- Steering column
- Steering column shaft

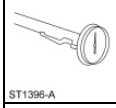
The power steering system transfers driver inputs at the steering wheel to the front wheels of the vehicle. The steering column, hydraulic system and linkages that transfer these driver inputs make up the steering system. Gearing and hydraulic assist are used to significantly reduce steering efforts.

For information on the power steering fluid reservoir, power steering pump, power steering lines and steering gear, refer to Section 211-02 .

For information on the steering wheel, steering column and steering column shaft, refer to Section 211-04 .

Steering System

Special Tool(s)

 ST1300-A	100W/12 Volt DC UV Lamp 164-R0751
 ST1396-A	Dial Thermometer 0-220°F 023-R0007 or equivalent
 ST2670-A	Evacuation Cap, Power Steering 211-265 or equivalent
 ST1176-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Dye-Lite® ATF/Power Steering Fluid Leak Detection Dye 164-R3701 (Rotunda)	-
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V

Principles of Operation

Power Steering

The power steering system uses a vane-type pump to move the fluid from the reservoir to the steering gear and through the rest of the steering hydraulic system. The power steering pump is mounted to the engin driven by the engine accessory drive belt. Power steering fluid flows into the pump from the reservoir. The power steering fluid is then trapped between the pump vanes and moved to the high-pressure side of the pump creating a flow of fluid. The restriction of this flow by the steering gear creates the pressure that provides the steering assist. A combined pressure relief/flow valve is built into the pump to control the maximum pressure and flow provided to the steering system. This action prevents damage to the system and provides the correct level of assist during all engine speeds. While under pressure, the power steering fluid flows through the high-pressure power steering line to the steering gear. The fluid exits the gear and flows through the return line, cooler and finally to the reservoir. The reservoir slows the fluid, allows air to escape and filters the fluid

before returning it to the pump.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• Fluid level • Tire pressure • Tires • Drive belt • Drive belt tensioner • Steering column alignment • Tie-rod ends • Suspension components • Steering column shaft U-joints • Intermediate shaft bolts • Power steering reservoir baffle • Power steering reservoir screen • Power steering pressure lines, fittings or O-rings • Power steering return hoses and clamps • Steering gear • Power steering pump • Power steering pressure switch

3. Inspect the power steering fluid for the following conditions:
   - Aeration or foam: Purge the power steering system. Refer to Power Steering System Purging in this section.
   - Overheating or contamination: Flush the power steering system. Refer to Power Steering System Flushing in this section.

4. **NOTE:** It may be necessary to add power steering fluid to achieve the correct level.

   Check the fluid level and clean the power steering components.
   With the ignition OFF:

   - check the power steering fluid level and add fluid as necessary.
   - wipe off any visible signs of fluid or residue build up.
   - ***NOTICE:*** **Do not hold the steering wheel at the stops for an extended amount of time. Damage to the power steering pump may occur.**

     Start the engine and turn the steering wheel from stop-to-stop several times.

5. Visually inspect the power steering hydraulic line/hose connections for leaks.
    - If a leak is detected at a threaded fitting or clamp plate joint, tighten to specification. If the leak is still evident, visually inspect the O-rings or Teflon® seals. Install new O-rings or Teflon® seals as necessary. Refer to
    - If a leak is detected at a constant tension spring clamp, verify that the hose is not damaged and fully installed on the hose fitting. Make sure that the constant tension spring clamp is positioned 2 mm (0.078 in) from the end of the hose. If the leak remains, install a new constant tension spring clamp.
    - If a leak is detected at a screw clamp joint, verify that the hose is fully installed on the hose fitting and the clamp is positioned 2 mm (0.078 in) from the end of the hose before tightening the screw clamp. If the leak remains, install a new screw clamp. Refer to Section 211-02 .
    - If a leak is detected at the power steering pressure switch, install a new switch. Refer to the appropriate section in Group 303 for the procedure.

6. Visually inspect the power steering components for leaks.
    - If a leak is detected in the power steering pressure line or return hose, install a new hose. Refer to Section 211-02 .
    - If a leak is detected in the power steering pump, install a new power steering pump. Refer to Section 211-02 .
    - **NOTE:** On vehicles with rack-and-pinion steering gear, it may be necessary to remove the bellows boot clamp from the steering gear bellows boot to inspect for internal steering gear leaks.

      If a leak is detected in the steering gear, repair or install a new steering gear. Refer to Section 211-02 .
    - If a leak is detected in the power steering reservoir, install a new reservoir. Refer to Section 211-02 .

7. For information on power steering leak detection, refer to Component Tests in this section.

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

9. If the cause is not visually evident, verify the symptom and GO to Symptom Chart - Steering System or GO to Symptom Chart - NVH .

Steering System Symptom Definitions

Drift/Pull

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

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

- A vehicle-related drift/pull on a flat road can cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect.
- Drift/pull can be induced by conditions external to the vehicle, such as wind or road camber.

Excessive Steering Wheel Play

Excessive steering wheel play is a condition in which there is too much steering wheel movement before the wheels move. A small amount of steering wheel free play is considered normal.

Lack of Assist or Inconsistent Assist

Lack of assist or inconsistent assist is experienced when the steering wheel effort is higher than normal. Hard steering can remain constant through the full turn or occur near the end of a turn. It is important to know the difference between hard steering/lack of assist and poor returnability/sticky steering.

Hard steering or lack of assist can result from either hydraulic or mechanical conditions. It is extremely important to know if this concern occurs during driving or during high-effort parking maneuvers.

Poor Returnability/Sticky Steering

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

Wander

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

Symptom Chart - Steering System

Symptom Chart - Steering System

Symptom Chart - NVH

Power Steering System Flushing

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V

NOTICE: **Do not mix fluid types. Any mixture or any unapproved fluid may lead to seal deterioration and leaks. A leak may ultimately cause loss of fluid, which may result in a loss of power steering assist.**

1. Remove the power steering fluid reservoir cap.

2. Using a sule suction device, remove the power steering fluid from the reservoir.

3. Release the clamp and disconnect the return hose from the reservoir.
   - Remove the clamp from the hose and allow the remaining fluid to drain out of the reservoir.

4. Plug the power steering fluid reservoir inlet port.

5. Attach an extension hose to the return hose.

6. **NOTE:** Do not reuse the power steering fluid that has been flushed from the power steering system.

   Place the open end of the extension hose into a suitable container.

7. If equipped with Hydro-Boost®, apply the brake pedal 4 times.

8. **NOTE:** Do not overfill the reservoir.

   Fill the reservoir as needed with the specified fluid.

9. ***NOTICE:*** **Do not allow the power steering pump to run completely dry of power steering fluid. Damage to the power steering pump may occur.**

   Start the engine while simultaneously turning the steering wheel to lock and then immediately turn the ignition switch to the OFF position.

10. **NOTE:** Avoid turning the steering wheel without the engine running as this may cause air to be pulled into the steering gear.

    NOTE: Do not overfill the reservoir.

    Fill the reservoir as needed with the specified fluid.

11. Repeat Steps 8 and 9, turning the steering wheel in the opposite direction each time, until the fluid exiting the power steering fluid return hose is clean and clear of foreign material.

12. Remove the extension hose from the return hose.

13. Remove the plug from the fluid reservoir inlet port.

14. Install the clamp and connect the power steering return hose to the resevoir.

15. **NOTE:** It is necessary to correctly fill the power steering system to remove any trapped air and completely fill the power steering system components.

    If, after correctly filling the power steering system, there is power steering noise accompanied by evidence of aerated fluid and there are no fluid leaks, it may be necessary to purge the power steering system. For additional information, refer to Power Steering System Purging in this section.

    Fill the power steering system. For additional information, refer to Power Steering System Filling in this section.

Power Steering System Purging

Special Tool(s)

 ST2670-A	Evacuation Cap, Power Steering 211-265
 ST1176-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent

Material**ItemSpecification**MERCON® V Automatic Transmission Fluid
XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)MERCON® V

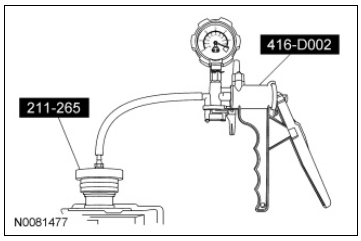
NOTICE: **If the air is not purged from the power steering system correctly, premature power steering pump failure may result. The condition may occur on pre-delivery vehicles with evidence of aerated fluid or on vehicles that have had steering component repairs.**

1. **NOTE:** A whine heard from the power steering pump can be caused by air in the system. The power steering purge procedure must be carried out prior to any component repair for which power steering noise complaints are accompanied by evidence of aerated fluid.

   Remove the power steering reservoir cap. Check the fluid.

2. Raise the front wheels off the floor. Refer to the appropriate section in Group 100 for the procedure.

3. Tightly insert the Power Steering Evacuation Cap into the reservoir and connect the Vacuum Pump Kit.



4. Start the engine.

5. Using the Vacuum Pump Kit, apply vacuum and intain the maximum vacuum of 68-85 kPa (20-25 in-Hg).
   - If the Vacuum Pump Kit does not maintain vacuum, check the power steering system for leaks before proceeding. For additional information, refer to Power Steering Fluid Leak Test in this section.

6. If equipped with Hydro-Boost®, apply the brake pedal 4 times.

7. ***NOTICE:*** **Do not hold the steering wheel against the stops for an extended amount of time. Damage to the power steering pump may occur.**

   Cycle the steering wheel fully from stop-to-stop 10 times.

8. Stop the engine.

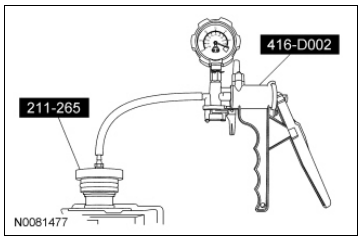
9. Release the vacuum and remove the Vacuum Pump Kit and the Power Steering Evacuation Cap.

10. **NOTE:** Do not overfill the reservoir.

    Fill the reservoir as needed with the specified fluid.

11. Start the engine.

12. Install the Power Steering Evacuation Cap and the Vacuum Pump Kit. Apply and maintain the maximum vacuum of 68-85 kPa (20-25 in-Hg).



13. ***NOTICE:*** **Do not hold the steering wheel against the stops for an extended amount of time. Damage to the power steering pump may occur.**

    Cycle the steering wheel fully from stop-to-stop 10 times.

14. Stop the engine, release the vacuum and remove the Vacuum Pump Kit and the Power Steering Evacuation Cap.

15. **NOTE:** Do not overfill the reservoir.

    Fill the reservoir as needed with the specifie fluid and install the reservoir cap.

16. Visually inspect the power steering system for leaks.

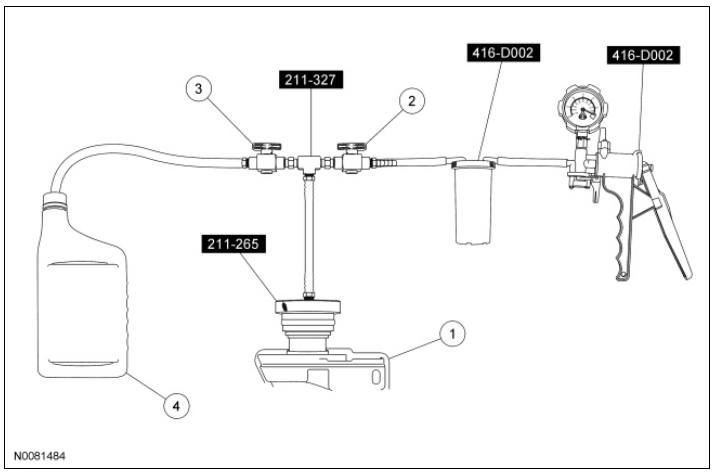
Power Steering System Filling

Special Tool(s)

 ST2670-A	Evacuation Cap, Power Steering 211-265
 ST2826-A	Fill Adapter Manifold, Power Steering 211-327
 ST1176-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V



Item	Description
1	Power steering fluid reservoir
2	Control valve (vacuum side)
3	Control valve (fluid container side)
4	Fluid container

1. ***NOTICE:*** **If the air is not purged from the power steering system correctly, prature power steering pump failure may result. The condition can occur on pre-delivery vehicles with**

evidence of aerated fluid or on vehicles that have had steering component repairs.

Remove the power steering fluid reservoir cap.

2. Install the Power Steering Evacuation Cap, Power Steering Fill Adapter Manifold and Vacuum Pump Kit as shown in the illustration.

3. **NOTE:** The Power Steering Fill Adapter Manifold control valves are in the OPEN position when the points of the handles face the center of the Power Steering Fill Adapter Manifold.

   Close the Power Steering Fill Adapter Manifold control valve (fluid side).

4. Open the Power Steering Fill Adapter Manifold control valve (vacuum side).

5. Using the Vacuum Pump Kit, apply 68-85 kPa (20-25 in-Hg) of vacuum to the power steering system.

6. Observe the Vacuum Pump Kit gauge for 30 seconds.

7. If the Vacuum Pump Kit gauge reading drops more than 3 kPa (0.88 in-Hg), correct any leaks in the power steering system or the Power Steering Evacuation Cap, Power Steering Fill Adapter Manifold and Vacuum Pump Kit before proceeding.

8. **NOTE:** The Vacuum Pump Kit gauge reading will drop slightly during this step.

   Slowly open the Power Steering Fill Adapter Manifold control valve (fluid side) until power steering fluid completely fills the hose and then close the control valve.

9. Using the Vacuum Pump Kit, apply 68-85 kPa (20-25 in-Hg) of vacuum to the power steering system.

10. Close the Power Steering Fill Adapter Manifold control valve (vacuum side).

11. Slowly open the Power Steering Fill Adapter Manifold control valve (fluid side).

12. Once power steering fluid enters the fluid reservoir and reaches the minimum fluid level indicator line on the reservoir, close the Power Steering Fill Adapter Manifold control valve (fluid side).

13. Remove the Power Steering Evacuation Cap, Power Steering Fill Adapter Manifold and Vacuum Pump Kit.

14. Install the reservoir cap.

15. ***NOTICE:*** **Do not hold the steering wheel against the stops for an extended amount of time. Damage to the power steering pump may occur.**

    NOTE: There will be a slight drop in the power steering fluid level in the reservoir when the engine is started.

    Start the engine and turn the steering wheel from stop-to-stop.

16. Turn the ignition switch to the OFF position.

17. **NOTE:** Do not overfill the reservoir.

    Remove the reservoir cap and fill the reservoir with the specified fluid.

18. Install the reservoir cap.

Material

Item	Specification	Fill Capacity
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V	1.4L (2.5) [a]
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	-

[a] Capacities listed are average system capacities and may vary (3.5L only).

Torque Specifications

Description	Nm	lb-ft	lb-in
Catalytic converter-to-exhaust flexible pipe nuts (3.5L)	40	30	-
Damper fork-to-front lower arm bolt	103	76	-
Electronic Power Assist Steering (EPAS) ground wire bolt	10	-	89
Exhaust bracket with U-clamp bolts and nuts (2.5L)	30	22	-
Inner tie rod	103	76	-
Lower stabilizer bar link nuts	42	31	-
Outer tie-rod end nuts	48	35	-
Power steering fluid reservoir bracket bolts (3.5L)	7	-	62
Power steering pump bolts (3.5L)	24	18	-
Pressure line bracket-to-RH valve cover stud nut (3.5L)	9	-	80
Pressure line bracket-to-steering gear bolt (3.5L)	15	-	133
Pressure line-to-power steering pump banjo bolt (3.5L)	48	35	-
Pressure line-to-steering gear banjo bolt (3.5L)	55	41	-
Roll restrictor bolt	90	66	-
Steering column shaft-to-steering gear bolt (2.5L and 3.0L)	20	-	177
Steering column shaft-to-steering gear bolt (3.5L)	25	18	-
Steering gear bolts	107	79	-
Subframe bolts	103	76	-
Subframe nuts	150	111	-
Tie-rod jam nuts	80	59	-
Underbody splash shield bolts-to-subframe	7	-	62

Power Steering

Hydraulic Power Assist Steering (HPAS)

The hydraulic power steering system consists of the following components:

- Power steering pump
- Power steering fluid reservoir
- Power steering pressure and return lines/hoses
- Power steering fluid cooler
- Steering gear
- Inner tie rod
- Outer tie rod

The power steering system uses a vane-type pump to move the fluid from the reservoir to the steering gear and through the rest of the steering hydraulic system. The power steering pump is mounted to the engine and driven by a non-adjustable (stretchy) belt. Power steering fluid flows into the pump from the reservoir. The power steering fluid is then trapped between the pump vanes and moved to the high-pressure side of the pump creating a flow of fluid. The restriction of this flow by the steering gear creates the pressure that provides the steering assist. A combined pressure relief/flow valve is built into the pump to control the maximum pressure and flow provided to the steering system. This action prevents damage to the system and provides the correct level of assist during all engine speeds. While under pressure, the power steering fluid flows through the high-pressure power steering line to the steering gear. The fluid exits the gear and flows through the return line, cooler and finally to the reservoir. The reservoir slows the fluid, allows air to escape and filters the fluid before returning it to the pump.

Electronic Power Assist Steering (EPAS)

The Electronic Power Assist Steering (EPAS) consists of the following components:

- Steering gear
- Outer tie rod
- Inner tie rod

The EPAS system utilizes a rack-and-pinion type steering gear. Power assist is provided by a motor that is connected to the steering rack by a belt and a pulley and bearing assembly. The steering gear and motor/module are serviced as an assembly. A new steering gear includes inner tie rods, however, the inner and outer tie rods can also be serviced separately.

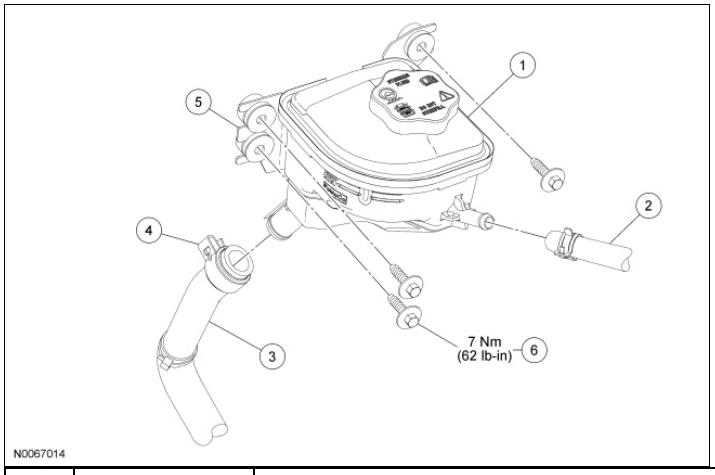
Power Steering

Refer to Section 211-00A or Section 211-00B .

Power Steering Fluid Reservoir - 3.5L

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V



Item	Part Number	Description
1	3A697	Power steering fluid reservoir
2	3A713A	Power steering return hose and clamp
3	3691	Power steering pump supply hose
4	-	Power steering pump supply hose clamp (part of 3691)
5	3490	Power steering fluid reservoir bracket
6	W712963	Power steering fluid reservoir bracket bolt (3 required)

Removal and Installation

NOTICE: **When repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.**

1. Using a suitable suction device, remove the power steering fluid from the fluid reservoir.

2. Release the clamp and disconnect the power steering return hose from the power steering fluid reservoir.
3. Remove the 3 power steering fluid reservoir bracket bolts.
    - To install, tighten to 7 Nm (62 lb-in).

4. Release the power steering pump supply hose clamp and disconnect the supply hose from the reservoir.

5. **NOTE:** If a new power steering fluid reservoir is being installed, a new reservoir mounting bracket must also be installed.

   Remove the power steering fluid reservoir and bracket as an assembly.

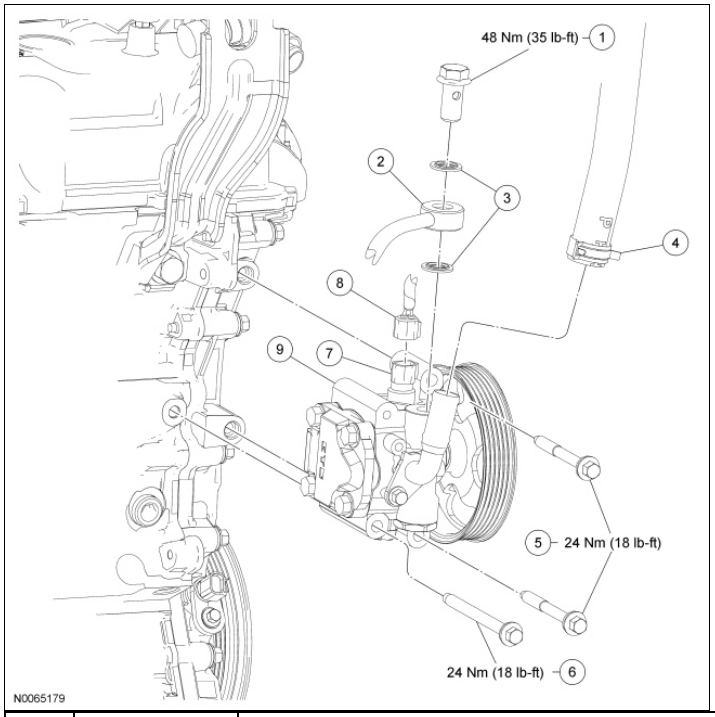
6. To install, reverse removal procedure.

7. Fill the power steering system. For additional information, refer to Section 211-00B .

Power Steering Pump - 3.5L

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V



Item	Part Number	Description
1	-	Pressure line-to-power steering pump banjo bolt (part of 3A705 service kit)
2	-	Power steering pressure line (part of 3A719 service kit)
3	-	Power steering pressure line seals (part of 3A705 service kit)
4	3691	Power steering pump supply hose
5	W701526	Power steering pump bolts (2 required)
6	W701234	Power steering pump bolt
7	-	Power Steering Pressure (PSP) switch electrical connector
8	3N824	PSP switch
9	3A696	Power steering pump

Removal and Installation

NWhen repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.

1. Remove the power steering fluid reservoir. For additional information, refer to Power Steering Fluid Reservoir - 3.5L in this section.

2. Remove the power steering pump belt. For additional information, refer to Section 303-05C .

3. Disconnect the Power Steering Pressure (PSP) switch electrical connector.

4. If equipped, detach the engine block heater electrical harness from the power steering pressure line.

5. Remove the pressure line-to-power steering pump banjo bolt and disconnect the line from the power steering pump.
    - Discard the bolt and 2 seals.
    - To install, tighten the new bolt to 48 Nm (35 lb-ft).

6. Remove the 3 bolts and the power steering pump.
    - To install, tighten to 24 Nm (18 lb-ft).

7. ***NOTICE:*** **A new banjo bolt and new seals must be installed any time the power steering pressure line is disconnected from the power steering pump or a fluid leak may occur.**

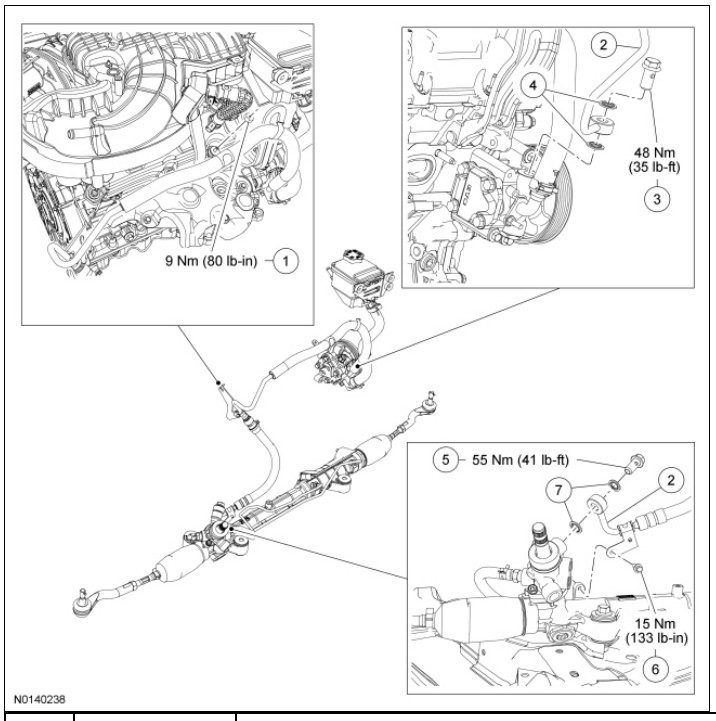
   To install, reverse the removal ocedure.

8. Fill the power steering system. For additional information, refer to Section 211-00B .

Power Steering Pump to Steering Gear Pressure Line

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM (orXT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V



Item	Part Number	Description
1	W703836	Pressure line bracket-to-RH valve cover stud nut
2	-	Power steering pressure line (part of 3A719 service kit)
3	-	Pressure line-to-power steering pump banjo bolt (part of 3A719 service kit)
4	-	Power steering pressure line seals (part of 3A719 service kit)
5	-	Pressure line-to-steering gear banjo bolt (part of 3A719 service kit)
6	W712115	Pressure line bracket-to-steering gear bolt
7	-	Power steering pressure line seals (part of 3A719 service kit)

Removal and Installation

NOTICE: **When repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.**

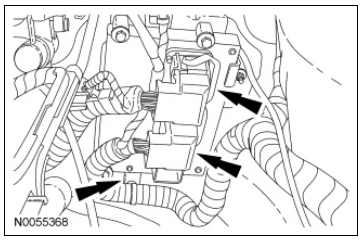
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the battery and battery tray. For additional information, refer to Section 414-01 .

3. **NOTE:** Battery mounting bracket removed for clarity.

   Disconnect the electrical connectors from the PCM.

   - Detach harness retainer from the PCM bracket, and position the harness aside.



4. Remove the lower cowl panel grille. For additional information, refer to Section 501-02 .

5. Remove the pressure line bracket-to-RH valve cover stud nut.
   - Detach the electrical harness retainer from the pressure line bracket.
   - To install, tighten to 9 Nm (80 lb-in).

6. If equipped, detach the engine block heater harness from the power steering pressure line.

7. Remove the pressure line bracket-to-steering gear bolt.
   - To install, tighten to 15 Nm (133 lb-in).

8. Remove the pressure line-to-power steering pump banjo bolt.
   - Discard the bolt and the 2 seals.
   - To install, tighten the new bolt to 48 Nm (35 lb-ft).

9. Remove the pressure line-to-steering gear banjo bolt and remove the power steering pressure line.
   - Discard the bolt and the 2 seals.
   - To install, tighten the new bolt to 55 Nm (41 lb-ft).

10. ***NOTICE:*** **New banjo bolts and new seals must be installed any time the power steering pressure line is disconnected from the power steering pump and/or the power steering gear or a fluid leak may occur.**

    To install, reverse removal procedure.

11. Fill the power steering system. For additional information, refer to Section 211-00B .

Power Steering Fluid Cooler - 3.5L

Removal and Installation

NOTE: The power steering fluid cooler is integral to the A/C condenser core.

For additional information, refer to Section 412-01 .

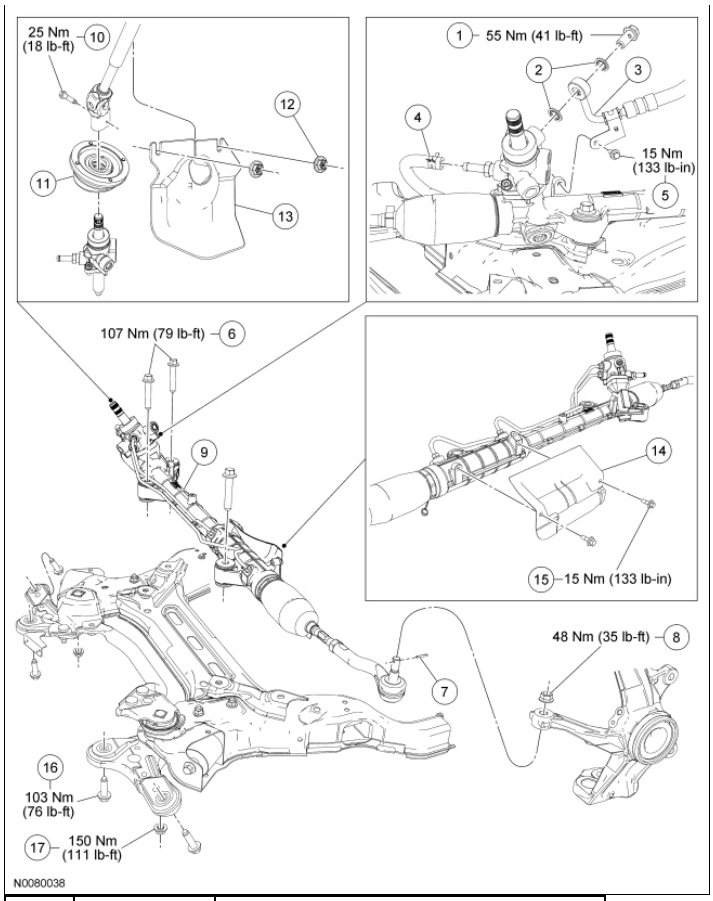
Steering Gear - 3.5L Front Wheel Drive (FWD)

Special Tool(s)

 ST2945-A	Ball Joint Separator 204-592

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V



Item	Part Number	Description
1	-	Pressure line-to-steering gear banjo bolt (part of 3A705 service kit)

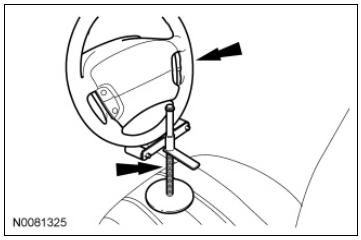
2	-	Power steering pressure line seals (part of 3A705 service kit)			
3	-	Power steering pressure line (part of 3A719 service kit)			
4	3A713	Steering gear-to-fluid cooler return hose			
5	712155	Pressure line bracket-to-steering gear bolt	6	3C497	Steering gear bolts (3 required)
7	99221	Cotter pin (2 required)			
8	6E5C	Outer tie-rod end nut (2 required)			
9	3504	Steering gear			
10	3R827	Steering column shaft-to-steering gear bolt			
11	3611B	Steering gear/dash seal			
12	W704904	Lower steering column shaft joint cover nut (2 required)			
13	3611A	Lower steering column shaft joint cover			
14	391727	Steering gear heat shield			
15	3530B	Steering gear heat shield bolt (2 required)			
16	3C496	Subframe bolt (4 required)			
17	W520416	Subframe nut (2 required)			

Removal

NOTICE: **When repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.**

1. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.

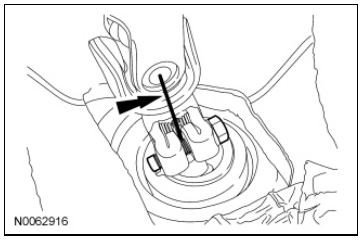


2. Remove the wheels and tires. For additional information, refer to Section 204-04 .

3. Remove the 2 lower steering column shaft joint cover nuts and the cover.

4. ***NOTICE:*** **Make sure to correctly index-mark the steering gear-to-steering column shaft position or unequal right-to-left turns may occur, causing tire contact with the body and/or clockspring damage.**

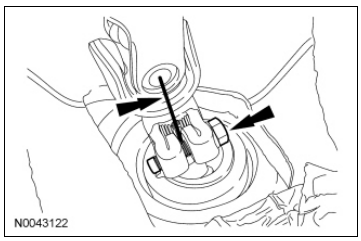
   Index-mark the steering column shaft-to-steering gear position for reference during installation.



5. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected from the steering gear or damage to the clockspring may occur. If there is evidence that the steering column has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   Remove the bolt and disconnect the steering column shaft from the steering gear.

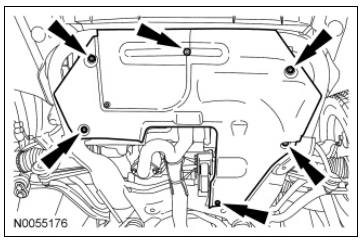
   - Discard the bolt.



6. ***NOTICE:*** **Remove the steering gear/dash seal or damage to the seal may occur.**

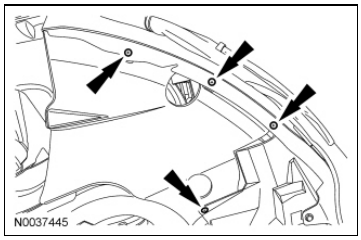
   Pulling upward, remove the steering gear/dash seal.

7. If equipped, remove the 7 screws and the underbody cover.

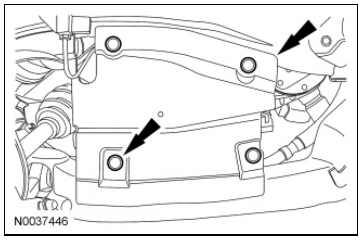


8. **NOTE:** RH side shown, LH side similar.

   Remove the 4 screws from each side and position the RH and LH fender splash shield aside.



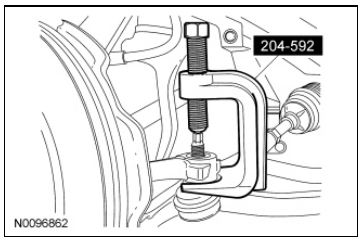
9. Remove the 6 pin-type retainers (4 shown) from the LH and RH splash shield.



10. Remove the 2 outer tie-rod end cotter pins and nuts.
    - Discard the cotter pins.

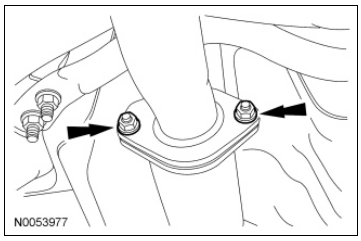
11. ***NOTICE:*** **Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.**

    Using the Ball Joint Separator, separate the outer tie-rod ends from the knuckle.



12. **NOTE:** Always install new fasteners and gaskets. Clean flange faces prior to new gasket installation to make sure of proper sealing.

    Remove and discard the 2 catalytic converter-to-exhaust flexible pipe nuts and separate the exhaust flexible pipe.



13. Remove the 2 bolts and the steering gear heat shield.

14. Remove the pressure line bracket-to-steering gear bolt.

15. Remove the pressure line-to-steering gear banjo bolt.
    - Discard the bolt and 2 seals.

16. Support the rear of the subframe with a suitable jack and remove the 4 rear subframe bolts and 2 rear subframe nuts.

17. Lower the rear of the front subframe 76.2 mm (3 in) with the support of the jack.

18. Release the clamp and disconnect the steering gear-to-fluid cooler return hose.

19. Remove the 3 steering gear bolts.

20. Remove the steering gear from the LH side of the vehicle.

Installation

1. From the LH side of the vehicle, install the steering gear.

2. Install the 3 steering gear bolts.
   - Tighten to 107 Nm (79 lb-ft).

3. Release the clamp and connect the steering gear-to-fluid cooler return hose.

4. Using a suitable jack, raise the rear of the front subframe.

5. Install the subframe support bracket, 4 rear subframe bolts and 2 rear subframe nuts.
   - To install, tighten the bolts and nuts in 2 stages.
     - ♦ Stage 1: Tighten the nuts to 150 Nm (111 lb-ft).
     - ♦ Stage 2: Tighten the bolts to 103 Nm (76 lb-ft).

6. ***NOTICE:*** **New banjo bolts and new seals must be installed any time the power steering pressure line is disconnected from the power steering pump and/or the steering gear or a fluid leak may occur.**

   Install the new pressure line-to-steering gear banjo bolt.

   - Install 2 new seals.
   - Tighten to 55 Nm (41 lb-ft).

7. Install the pressure line bracket-to-steering gear bolt.
   - Tighten to 15 Nm (133 lb-in).

8. Install the steering gear heat shield and the 2 bolts.
   - Tighten to 15 Nm (133 lb-in).

9. **NOTE:** Always install new fasteners and gaskets. Clean flange faces prior to new gasket installation to make sure of proper sealing.

   Position the exhaust flexible pipe and install 2 new catalytic converter-to-exhaust flexible pipe nuts.

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

10. Install the 2 outer tie-rod end nuts.
    - Tighten to 48 Nm (35 lb-ft).
    - Install 2 new cotter pins.

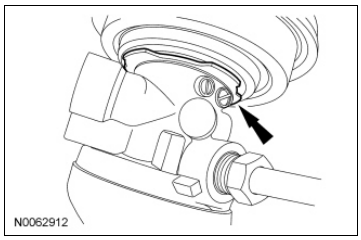
11. Install the LH and RH splash shield and the 6 pin-type retainers.

12. Install the RH and LH fender splash shield and the 4 screws from each side.

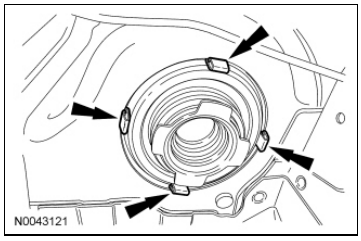
13. If equipped, install the underbody splash shield and the 7 screws.
    - Tighten to 7 Nm (62 lb-in).

14. ***NOTICE:*** **The steering gear/dash seal must be fully seated in the steering gear valve tower groove before the retaining clips are fully engaged into the body. If the steering gear/dash seal is not seated to the steering gear valve tower groove and the clips are not fully engaged to the body, water and foreign material may enter the passenger compartment and damage the vehicle interior.**

Applying hand force to the center of the seal, install the steering gear/dash seal onto the steering gear valve tower until the seal is fully seated in the valve tower groove.



15. Install the steering gear/dash seal until the retaining clips are fully engaged into the body.

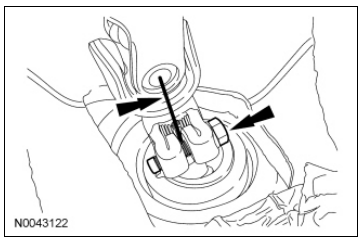


16. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected from the steering gear or damage to the clockspring may occur. If there is evidence that the steering column has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

    NOTICE: **Make sure to correctly align the index marks when installing the steering gear-to-steering column shaft or unequal right-to-left turns may occur, causing tire contact with the body and/or clockspring damage.**

    With the index marks properly aligned, connect the steering column shaft to the steering gear and install the new bolt.

    - Tighten to 25 Nm (18 lb-ft).



17. Install the lower steering column shaft joint cover and the 2 nuts.

18. Fill the power steering system. For additional information, refer to Section 211-00B .

19. Check and, if necessary, adjust the front toe. For additional information, refer to Section 204-00 .

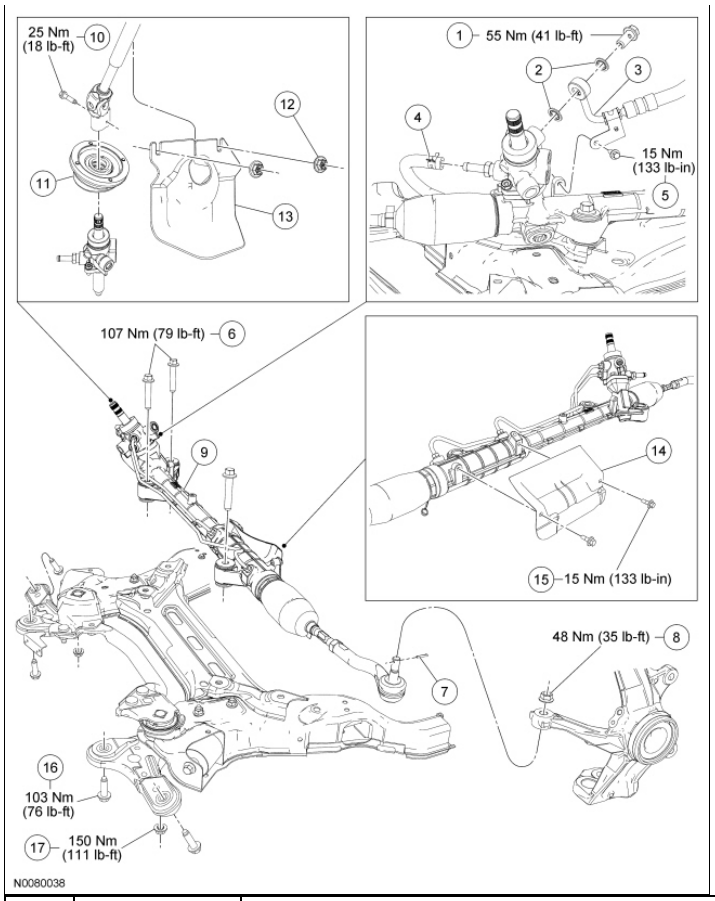
Steering Gear - 3.5L All Wheel Drive (AWD)

Special Tool(s)

 ST2945-A	Ball Joint Separator 204-592

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V



Item	Part Number	Description
1	-	Pressure line-to-steering gear banjo bolt (part of 3A705 service kit)

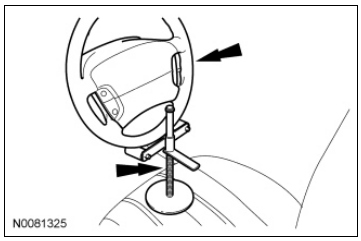
2	-	Power steering pressure line seals (part of 3A705 service kit)
3	-	Power steering pressure line (part of 3A719 service kit)
4	3A713	Steering gear-to-fluid cooler return hose
5	W712155	Pressure line bracket-to-steering gear bolt
6	3C497	Steering gear bolts (3 required)
7	99221	Cotter pin (2 required)
8	6E5C	Outer tie-rod end nut (2 required)
9	3504	Steering gear
10	3R827	Steering column shaft-to-steering gear bolt
11	3611B	Steering gear/dash seal
12	W704904	Lower steering column shaft joint cover nut (2 required)
13	3611A	Lower steering column shaft joint cover
14	391727	Steering gear heat shield
15	3530B	Steering gear heat shield bolt (2 required)
16	3C496	Subframe bolt (4 required)
17	W520416	Subframe nut (2 required)

Removal

NOTICE: **When repairing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.**

1. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.

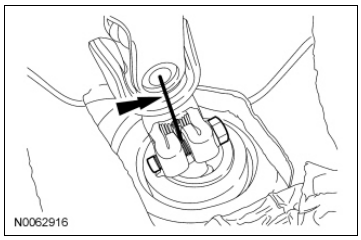


2. Remove the wheels and tires. For additional information, refer to Section 204-04 .

3. Remove the 2 lower steering column shaft joint cover nuts and the cover.

4. ***NOTICE:*** **Make sure to correctly index-mark the steering gear-to-steering column shaft position or unequal right-to-left turns may occur, causing tire contact with the body and/or clockspring damage.**

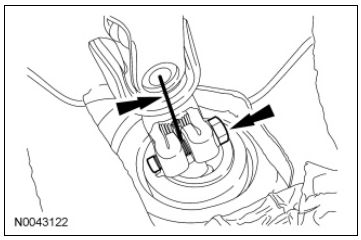
   Index-mark the steering column shaft-to-steering gear position for reference during installation.



5. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected from the steering gear or damage to the clockspring may occur. If there is evidence that the steering column has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   Remove the bolt and disconnect the steering column shaft from the steering gear.

   - Discard the bolt.



6. ***NOTICE:*** **Remove the steering gear/dash seal or damage to the seal may occur.**

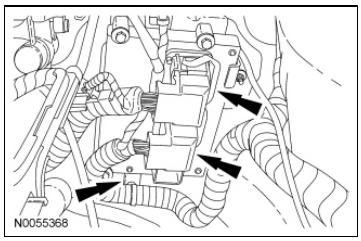
   Pulling upward, remove the steering gear/dash seal.

7. Remove the battery and battery tray. For additional information, refer to Section 414-01 .

8. **NOTE:** Battery mounting bracket removed for clarity.

   Disconnect the electrical connectors from the PCM.

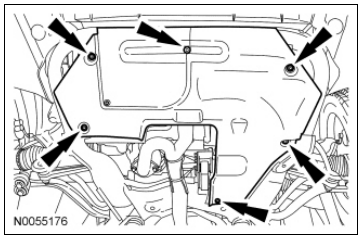
   - Detach the wiring harness retainer from the PCM bracket and position the harness aside.



9. Remove the pressure line-to-steering gear banjo bolt.
   - Discard the bolt and 2 seals.

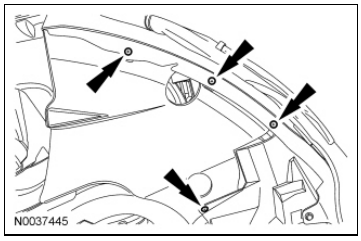
10. Remove the pressure line bracket-to-steering gear bolt.

11. If equipped, remove the 7 screws and the underbody cover.

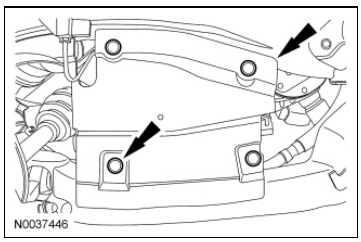


12. **NOTE:** RH side shown, LH side similar.

    Remove the 4 screws from each side and position the RH and LH fender splash shield aside.



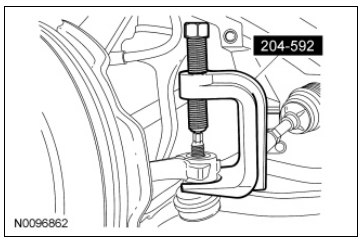
13. Remove the 6 pin-type retainers (4 shown) from the LH and RH splash shield.



14. Remove the 2 outer tie-rod end cotter pins and nuts.
    - Discard the cotter pins.

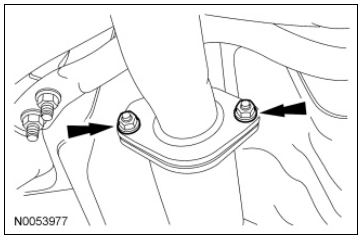
15. ***NOTICE:*** **Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.**

    Using the Ball Joint Separator, separate the outer tie-rod ends from the knuckle.



16. **NOTE:** Always install new fasteners and gaskets. Clean flange faces prior to new gasket installation to make sure of proper sealing.

    Remove and discard the 2 catalytic converter-to-exhaust flexible pipe nuts and separate the exhaust flexible pipe.



17. Remove the 2 bolts and the steering gear heat shield.

18. Support the rear of the subframe with a suitable jack and remove the 4 rear subframe bolts and 2 rear subframe nuts.

19. Lower the rear of the front subframe 76.2 mm (3 in) with the support of the jack.

20. Remove the pressure line bracket-to-steering gear bolt.

21. Release the clamp and disconnect the steering gear-to-fluid cooler return hose.

22. Remove the 3 steering gear bolts.

23. Remove the steering gear from the LH side of the vehicle.

Installation

1. From the LH side of the vehicle, install the steering gear.

2. Install the 3 steering gear bolts.
   - Tighten to 107 Nm (79 lb-ft).

3. Release the clamp and connect the steering gear-to-fluid cooler return hose.

4. Using a suitable jack, raise the rear of the front subframe.

5. Install the subframe support bracket, 4 rear subframe bolts and 2 rear subframe nuts.
   - To install, tighten the bolts and nuts in 2 stages.
     - Stage 1: Tighten the nuts to 150 Nm (111 lb-ft).
     - Stage 2: Tighten the bolts to 103 Nm (76 lb-ft).

6. Install the steering gear heat shield and the 2 bolts.
   - Tighten to 15 Nm (133 lb-in).

7. **NOTE:** Always install new fasteners and gaskets. Clean flange faces prior to new gasket installation to make sure of proper sealing.

   Position the exhaust flexible pipe and install 2 new catalytic converter-to-exhaust flexible pipe nuts.

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

8. Install the 2 outer tie-rod end nuts.
   - Tighten to 48 Nm (35 lb-ft).
   - Install 2 new cotter pins.

9. Install the LH and RH splash shield and the 6 pin-type retainers.

10. Install the RH and LH fender splash shield and the 4 screws from each side.

11. If equipped, install the underbody splash shield and bolts.
    - Tighten to 7 Nm (62 lb-in).

12. Install the pressure line bracket-to-steering gear bolt.
    - Tighten to 15 Nm (133 lb-in).

13. ***NOTICE:*** **New banjo bolts and new seals must be installed any time the power steering pressure line is disconnected from the power steering pump and/or the steering gear or a fluid leak may occur.**

    Install the new pressure line-to-steering gear banjo bolt.

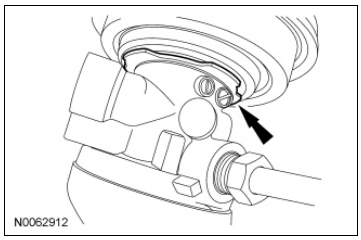
    - Install 2 new seals.
    - Tighten to 55 Nm (41 lb-ft).

14. Connect the electrical connectors to the PCM.
    - Attach the wiring harness retainer to the PCM bracket.

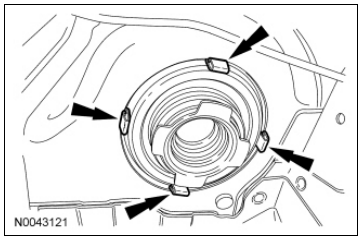
15. Install the battery tray and battery. For additional information, refer to Section 414-01 .

16. ***NOTICE:*** **The steering gear/dash seal must be fully seated in the steering gear valve tower groove before the retaining clips are fully engaged into the body. If the steering gear/dash seal is not seated to the steering gear valve tower groove and the clips are not fully engaged to the body, water and foreign material may enter the passenger compartment and damage the vehicle interior.**

    Applying hand force to the center of the seal, install the steering gear/dash seal onto the steering gear valve tower until the seal is fully seated in the valve tower groove.



17. Install the steering gear/dash seal until the retaining clips are fully engaged into the body.

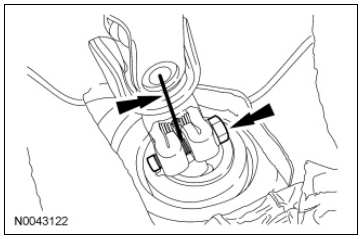


18. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected from the steering gear or damage to the clockspring may occur. If there is evidence that the steering column has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

    NOTICE: **Make sure to correctly align the index marks when installing the steering gear-to-steering column shaft or unequal right-to-left turns may occur, causing tire contact with the body and/or clockspring damage.**

    With the index marks properly aligned, connect the steering column shaft to the steering gear and install the new bolt.

    - Tighten to 25 Nm (18 lb-ft).



19. Install the lower steering column shaft joint cover and the 2 nuts.

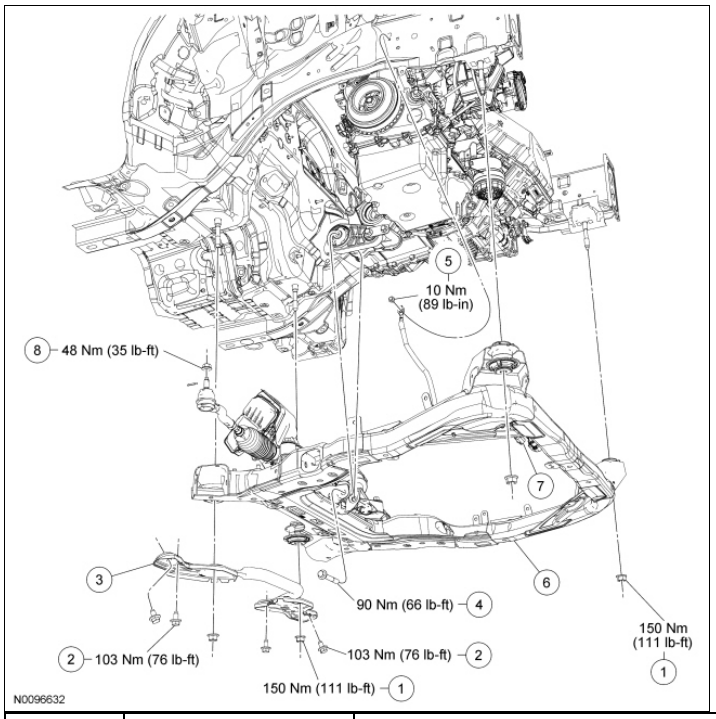
20. Fill the power steering system. For additional information, refer to Section 211-00B .

21. Check and, if necessary, adjust the front toe. For additional information, refer to Section 204-00 .

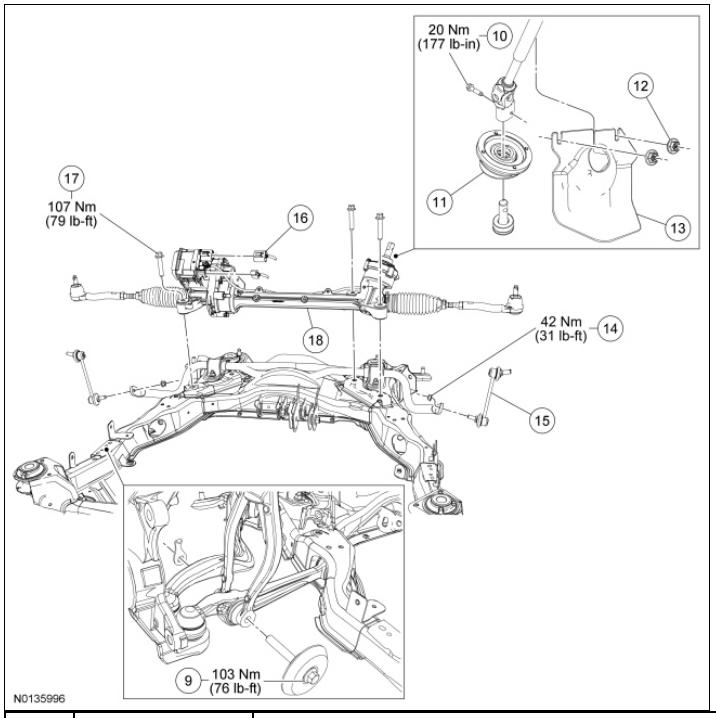
Steering Gear - 2.5L Hybrid and 3.0L All Wheel Drive (AWD)

Special Tool(s)

 ST2945-A	Ball Joint Separator 204-592
 ST1682-A	Powertrain Lift 300-OTC1585AE or equivalent



Item	Part Number	Description
1	W520416	Front subframe nuts (4 required)
2	3C496	Front subframe support bracket bolts (4 required)
3	5884	Subframe support bracket
4	W500545	Roll restrictor bolt
5	W506410	Electronic P Assist Steering (EPAS) ground wire bolt
6	5C145	Front subframe
7	-	EPAS jumper harness connector (2 required)
8	6E5C	Tie-rod end nut (2 required)



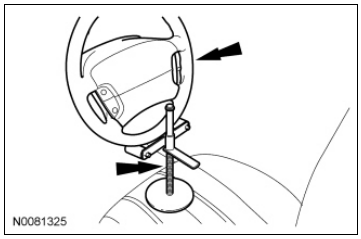
Item	Part Number	Description
9	W500550	Damper fork-to-front lower arm bolt (2 required)
10	3R827	Steering column shaft-to-steering gear bolt
11	3611B	Steering gear/dash seal
12	W704904	Lower steering column shaft joint cover nut (2 required)
13	3611A	Lower steering column shaft joint cover
14	3C494	Lower stabilizer bar link nut (2 required)
15	3053/3052	Stabilizer bar link (2 required)
16	-	EPAS electrical connector (part of 3F720) (2 required)
17	3	Steering gear bolt (3 required)
18	3504	Steering gear

Removal

1. If installing a new steering gear, connect the scan tool and upload the module configuration information from the Power Steering Control Module (PSCM). For additional information, refer to Section 418-01 .

2. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.



3. Remove the 2 lower steering column shaft joint cover nuts and the cover.

4. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected from the steering gear or damage to the clockspring may occur. If there is evidence that the steering column has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   Remove the bolt and disconnect the steering column shaft from the steering gear.

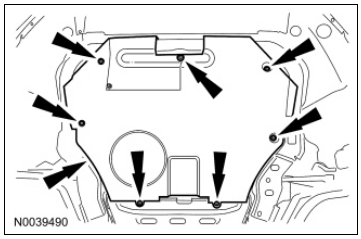
   - Discard the bolt.

5. ***NOTICE:*** **Remove the steering gear/dash seal or damage to the seal may occur.**

   Pulling upward, remove the steering gear/dash seal.

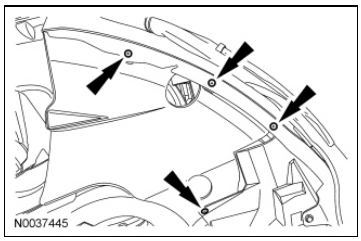
6. Remove the wheels and tires. For additional information, refer to Section 204-04 .

7. If equipped, remove the 7 screws and the underbody cover.

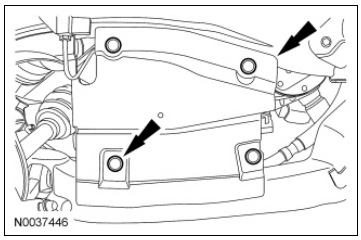


8. **NOTE:** RH side shown, LH side similar.

   Remove the 4 screws from each side and position the RH and LH fender splash shields aside.



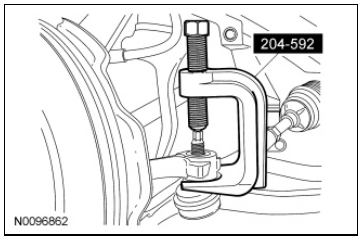
9. Remove the 6 pin-type retainers (4 shown) from the LH and RH splash shield.



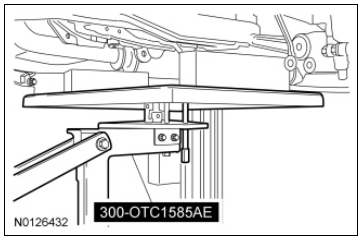
10. Remove the 2 outer tie-rod end cotter pins and nuts.
    - Discard the cotter pins.

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

    Using the Ball Joint Separator, separate the outer tie-rod ends from the wheel knuckles.



12. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .
13. Remove the engine roll restrictor bolt.
14. Disconnect the 2 Electronic Power Assist Steering (EPAS) jumper harness electrical connectors and detach the 3 wiring harness retainers.
15. Remove the bolt and position the ground wire aside.
16. Remove the 2 (one on each side) lower stabilizer bar link nuts and separate the links from the stabilizer bar.
17. Remove the 2 damper fork-to-front lower arm bolts and flagnuts.
18. Position the Powertrain Lift under the subframe.



19. Remove the 2 rear mounting nuts and washers from the front subframe.
20. Remove the 4 bolts and the subframe support bracket.
21. Remove the 2 front mounting nuts and washers from the front subframe.
22. Lower the subframe to gain access to the steering gear.
23. Disconnect the 2 EPAS electrical connectors and the wiring retainer.
24. Remove the 3 bolts and the steering gear.

Installation

1. Position the steering gear and install the 3 bolts.
    - Tighten to 107 Nm (79 lb-ft).
2. Connect the 2 EPAS electrical connectors and the wiring retainer.
3. Raise the subframe.
4. Install the 2 front subframe nuts and washers.
    - Tighten to 150 Nm (111 lb-ft).

5. Install the subframe support bracket, 4 rear subframe bolts and 2 rear subframe nuts.
    - To install, tighten the bolts and nuts in 2 stages.
        - ♦ Stage 1: Tighten the nuts to 150 Nm (111 lb-ft).
        - ♦ Stage 2: Tighten the bolts to 103 Nm (76 lb-ft).

6. Install the 2 damper fork-to-front lower arm bolts and flagnuts.
    - Tighten to 103 Nm (76 lb-ft).

7. Connect the stabilizer bar links and install the 2 nuts.
    - Tighten to 42 Nm (31 lb-ft).

8. Position the ground wire and install the bolt.
    - Tighten to 10 Nm (89 lb-in).

9. Connect the 2 EPAS jumper harness electrical connectors and attach the 3 wiring harness retainers.

10. Install the engine roll restrictor bolt.
    - Tighten to 90 Nm (66 lb-ft).

11. Install the exhaust flexible pipe. For additional information, refer to Section 309-00 .

12. Position the 2 outer tie-rod ends and install the nuts.
    - Tighten to 48 Nm (35 lb-ft).
    - Install 2 new cotter pins.

13. Install the LH and RH splash shield and the 6 pin-type retainers.

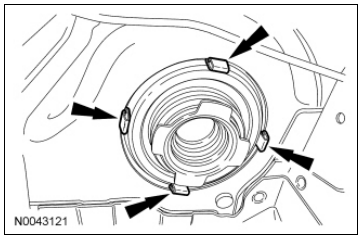
14. Install the RH and LH fender splash shields and the 4 screws from each side.

15. If equipped, install the underbody cover and the 7 screws.

16. ***NOTICE:*** **The steering gear/dash seal must be fully seated in the steering gear valve tower groove before the retaining clips are fully engaged into the body. If the steering gear/dash seal is not seated to the steering gear valve tower groove and the clips are not fully engaged to the body, water and foreign material may enter the passenger compartment, and damage the vehicle interior.**

    Applying hand force to the center of the seal, install the steering gear/dash seal onto the steering gear valve tower until the seal is fully seated in the valve tower groove.

17. Install the steering gear/dash seal until the retaining clips are fully engaged into the body.



18. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected from the steering gear or damage to the clockspring may occur. If there is evidence that the steering column has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

With the locator on the input shaft correctly aligned, connect the steering column shaft to the steering gear and install the new bolt.

- Tighten to 20 Nm (177 lb-in).

19. Install the lower steering column shaft joint cover and the 2 nuts.

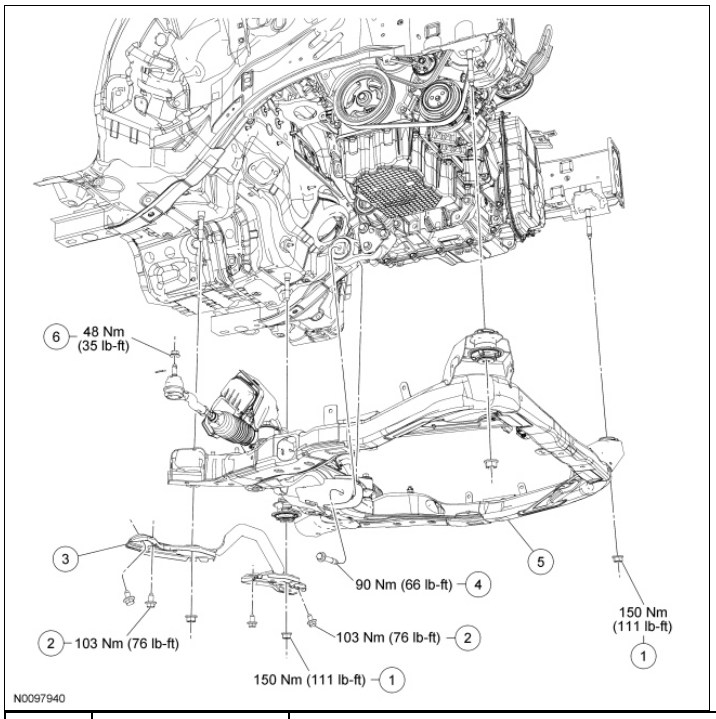
20. When installing a new steering gear, it must be configured (using vehicle as-built data or module configuration information retrieved earlier in this procedure). For additional information on configuration, refer to Programmable Module Installation (PMI) in Section 418-01 .

21. Check, and If necessary, adjust the front toe. Refer to Section 204-00 .

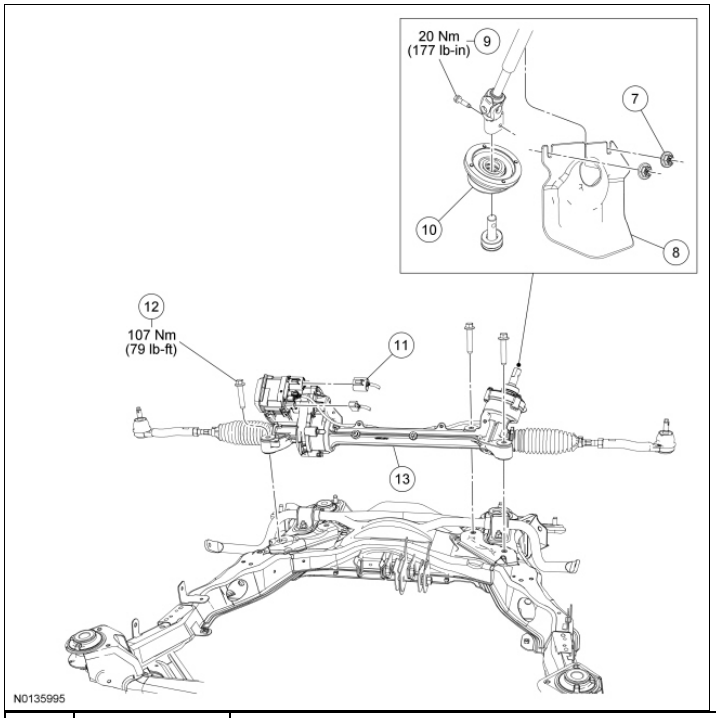
Steering Gear - 2.5L Non-Hybrid and 3.0L Front Wheel Drive (FWD)

Special Tool(s)

 ST2945-A	Ball Joint Separator 204-592



Item	Part Number	Description
1	W520416	Front subframe nuts (4 required)
2	3C496	Front subframe support bracket bolts (4 required)
3	5884	Subframe support bracket
4	W500545	Roll restrictor bolt
5	5C145	Front subframe
6	6E5C	Tie-rod end nut (2 required)



Item	Part Number	Description
7	W704904	Lower steering column shaft joint cover nut (2 required)
8	3611A	Lower steering column shaft joint cover
9	3R827	Steering column shaft-to-steering gear bolt
10	3611B	Steering gear/dash seal
11	-	Electronic Power Assist Steering (EPAS) electrical connector (part of 3F720) (2 required)
12	3C497	Steering gear bolt (3 required)
13	3504	Steering gear

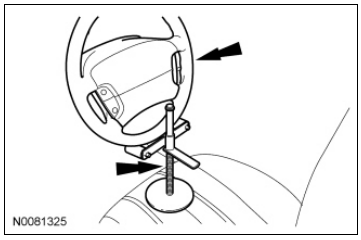
Removal

All vehicles

1. If installing a new steering gear, connect the scan tool and upload the module configuration information from the Power Steering Control Module (PSCM). For additional information, refer to Section 418-01 .

2. **NOTE:** Use a steering wheel holding device (such as Hunter® 28-75-1 or equivalent).

   Using a suitable holding device, hold the steering wheel in the straight-ahead position.



3. Remove the 2 lower steering column shaft joint cover nuts and the cover.

4. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected from the steering gear or damage to the clockspring may occur. If there is evidence that the steering column has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   Remove the bolt and disconnect the steering column shaft from the steering gear.

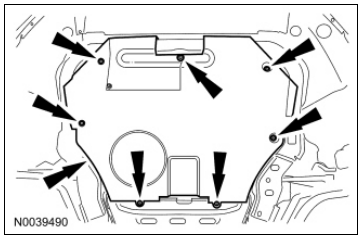
   - Discard the bolt.

5. ***NOTICE:*** **Remove the steering gear/dash seal or damage to the seal may occur.**

   Pulling upward, remove the steering gear/dash seal.

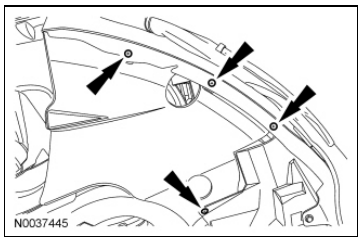
6. Remove the wheels and tires. For additional information, refer to Section 204-04 .

7. If equipped, remove the 7 screws and the underbody cover.

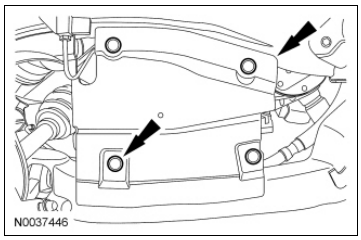


8. **NOTE:** RH side shown, LH side similar.

   Remove the 4 screws from each side and position the RH and LH fender splash shields aside.



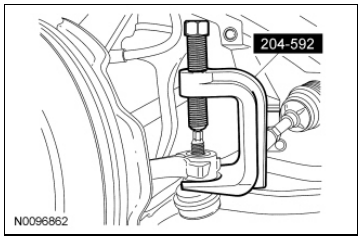
9. Remove the 6 pin-type retainers (4 shown) from the LH and RH splash shields.



10. Remove the 2 outer tie-rod end cotter pins and nuts.
    - Discard the cotter pins.

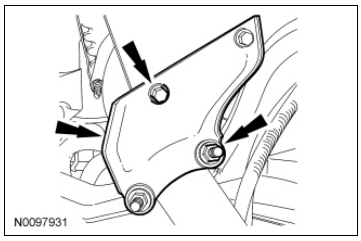
11. ***NOTICE:*** **Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.**

    Using the Ball Joint Separator, separate the outer tie-rod ends from the knuckle.



Vehicles equipped with 2.5L engines

12. Remove the 2 bolts, 2 nuts and the exhaust bracket with U-clamp.



Vehicles equipped with 3.0L engines

13. Remove the exhaust flexible pipe. For additional information, refer to Section 309-00 .

All vehicles

14. Disconnect the 2 EPAS electrical connectors and the wiring retainer.

15. Remove the engine roll restrictor bolt.

16. Support the rear of the subframe with a suitable jack, remove the 4 rear subframe bolts and 2 rear subframe nuts and the subframe support bracket.
    - Loosen the 2 front subframe nuts.

17. Using the jack, lower the rear of the front subframe 76.2 mm (3 in).

18. Remove the 3 steering gear bolts.

19. Remove the steering gear from the vehicle.

Installation

All vehicles

1. Install the steering gear.

2. Install the 3 steering gear bolts.
    - Tighten to 107 Nm (79 lb-ft).

3. Using the jack, raise the rear of the front subframe.

4. Tighten the 2 front subframe nuts.
    - Tighten to 150 Nm (111 lb-ft).

5. Install the subframe support bracket, the 4 rear subframe bolts and the 2 rear subframe nuts.

- To install, tighten the bolts and nuts in 2 stages.
  - ♦ Stage 1: Tighten the nuts to 150 Nm (111 lb-ft).
  - ♦ Stage 2: Tighten the bolts to 103 Nm (76 lb-ft).

6. Install the engine roll restrictor bolt.
   - Tighten to 90 Nm (66 lb-ft).

7. Connect the 2 EPAS electrical connectors and the wiring retainer.

Vehicles equipped with 3.0L engines

8. Install the exhaust flexible pipe. For additional information, refer to Section 309-00 .

Vehicles equipped with 2.5L engines

9. Install the 2 bolts, 2 nuts and the exhaust bracket with U-clamp.
   - Tighten to 30 Nm (22 lb-ft).

All vehicles

10. Position the outer tie-rod ends and install the 2 nuts.
    - Tighten to 48 Nm (35 lb-ft).
    - Install 2 new cotter pins.

11. Install the LH and RH splash shield and the 6 pin-type retainers.

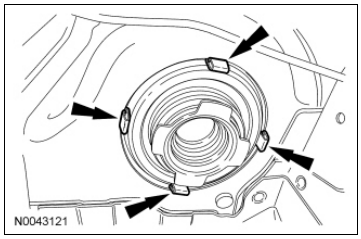
12. Install the RH and LH fender splash shields and the 4 screws from each side.

13. If equipped, install the underbody splash shield and bolts.
    - Tighten to 7 Nm (62 lb-in).

14. ***NOTICE:*** **The steering gear/dash seal must be fully seated in the steering gear valve tower groove before the retaining clips are fully engaged into the body. If the steering gear/dash seal is not seated to the steering gear valve tower groove and the clips are not fully engaged to the body, water and foreign material may enter the passenger compartment and damage the vehicle interior.**

    Applying hand force to the center of the seal, install the steering gear/dash seal onto the steering gear valve tower until the seal is fully seated in the valve tower groove.

15. Install the steering gear/dash seal until the retaining clips are fully engaged into the body.



16. ***NOTICE:*** **Do not allow the steering column to rotate while the steering column shaft is disconnected from the steering gear or damage to the clockspring may occur. If there is evidence that the steering column has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

With the locator on the input shaft properly aligned, connect the steering column shaft to the steering gear and install the new bolt.

- Tighten to 20 Nm (177 lb-in).

17. Install the lower steering column shaft joint cover and the 2 nuts.

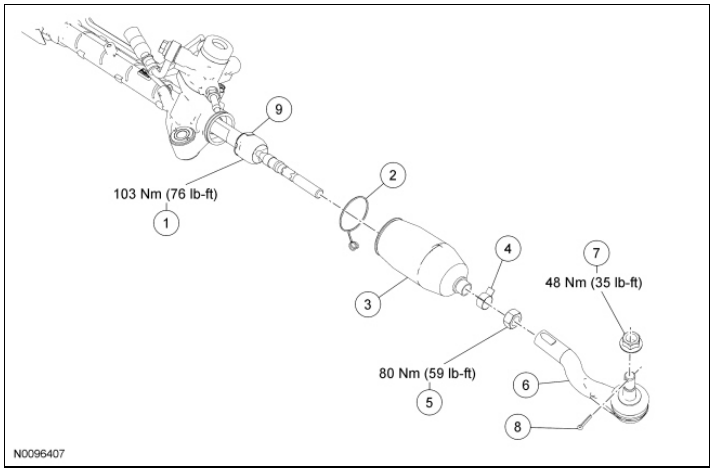
18. When installing a new steering gear, it must be configured (using vehicle as-built data or module configuration information retrieved earlier in this procedure). For additional information on configuration, refer to Programmable Module Installation (PMI) in Section 418-01 .

Tie Rod - Inner

Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B

NOTE: Hydraulic Power Assist Steering (HPAS) shown, Electronic Power Assist Steering (EPAS) similar.



Item	Part Number	Description
1	3280	Hydraulic Power Assist Steering (HPAS) inner tie-rod end (also part of 3332B service kit)
1	-	Electronic Power Assist Steering (EPAS) inner tie-rod end (part of 3280 service kit)
2	3K745	HPAS inner bellows boot clamp (also part of 3332B service kit)
2	-	EPAS inner bellows boot clamp (part of 3280 service kit)
3	3K661	HPAn> bellows boot (also part of 3332B service kit)
3	-	EPAS bellows boot (part of 3280 service kit)
4	3C650	HPAS outer bellows boot clamp (also part of 3332B service kit)
4	-	EPAS outer bellows boot clamp (part of 3280 service kit)
5	W713882	Tie-rod jam nut (all)
6	3A130	Outer tie-rod end (all)
7	W302124	Outer tie-rod end nut (all)

8	W302420	Cotter pin (all)
9	-	Retaining washer (Hydraulic Power Assist Steering (HPAS) only) (part of 3280 and 3332B service kit)

Removal and Installation

NOTICE: **When servicing inner tie rods, a new bellows boot and clamps must be installed or a leak may occur causing steering gear damage.**

1. Remove the steering gear. For additional information, refer to Steering Gear - 3.5L Front Wheel Drive (FWD) , Steering Gear - 3.5L All Wheel Drive (AWD) , Steering Gear - 2.5L Non-Hybrid and 3.0L Front Wheel Drive (FWD) or Steering Gear - 2.5L Hybrid and 3.0L All Wheel Drive (AWD) in this section.

2. ***NOTICE:*** **Position the steering gear in a soft-jaw vise or damage to the steering gear may occur.**

   Loosen the tie-rod jam nut and remove the outer tie-rod end.

   - To install, tighten to 80 Nm (59 lb-ft).

3. **NOTE:** It will be necessary to partially remove the LH bellows boot to hold the rack piston when servicing the RH inner tie rod.

   If servicing the RH inner tie rod, remove the LH inner bellows boot clamp and slide the bellows boot away from the steering gear housing.

   - Discard the clamp.

4. Remove and discard the 2 bellows boot clamps and the bellows boot for the inner tie rod being serviced.

5. On Hydraulic Power Assist Steering (HPAS) steering gears, bend back the crimped edges of the retaining washer.

6. *NOTICE:* The steering gear rack piston must be held while loosening or tightening the inner tie rod or damage to the steering gear may occur.Using a suitable wrench, hold the piston shaft.

7. Using a suitable wrench, remove the inner tie-rod end.
   - To install, tighten to 103 Nm (76 lb-ft).

8. ***NOTICE:*** **When installing the bellows boot(s), grease must be applied to the bellows boot-to-steering gear housing mating surfaces or a leak may occur causing steering gear damage.**

   NOTE: On HPAS steering gears, the inner tie-rod retaining washer must be crimped after the inner tie rod has been tightened.

   To install, reverse the removal procedure.

   - When installing, apply grease to the bellows boot-to-steering gear mating surfaces.
   - Make sure that the steering gear is in the centered position prior to installing the steering gear.

Torque Specifications

Description	Nm	lb-ft	lb-in
Steering column opening trim panel reinforcement bolts	5	-	44
Steering column shaft-to-steering gear bolt	23	-	204
Steering column support bracket nut	21	15	-
Steering wheel nut	35	26	-

Steering Column

The steering column consists of the following:

- Steering wheel
- Steering column
- Upper and lower steering column shafts
- Steering column switches
- Ignition lock cylinder

The steering column is the mechanical linkage between the steering wheel and the steering gear. The steering wheel is mounted to a shaft which passes through the center of the steering column. The shaft is centered by roller ball bearings within the steering column. The steering column shaft then connects the steering column to the steering gear. The upper and lower steering column shaft connections utilize U-joint type couplings. The tilt and telescopic functions of the steering column are controlled by a mechanical lever on the underside of the steering column, which uses a cam to lock and unlock the steering column. When the tilt/telescopic column lever is unlocked, the steering column can then be adjusted to various positions. The steering column switches (multifunction and ignition) are mounted to the steering column. These switches are covered by the upper and lower steering column shrouds.

For steering column switch service information, refer to Section 211-05 .

For ignition lock cylinder service information, refer to Section 501-14 .

Steering Column

For Electronic Power Assist Steering (EPAS), refer to Section 211-00A .

For Hydraulic Power Assist Steering (HPAS), refer to Section 211-00B .

Steering Wheel Wrap Bonding

Material

Item	Specification
Instant Gel Adhesive TA-19	WSK-M2G402-A4

1. **NOTE:** If re-adhering leather to the front side of the steering wheel only, it will not be necessary to remove the steering wheel. Steering wheel removal is necessary only when repairing loose leather on the backside of the steering wheel.

   If necessary remove the steering wheel. For additional information, refer to Steering Wheel in this section.

2. Position the loose leather out of the way.

3. Apply the specificed adhesive evenly over the wheel spoke.

4. Position the loose leather back into the original position.

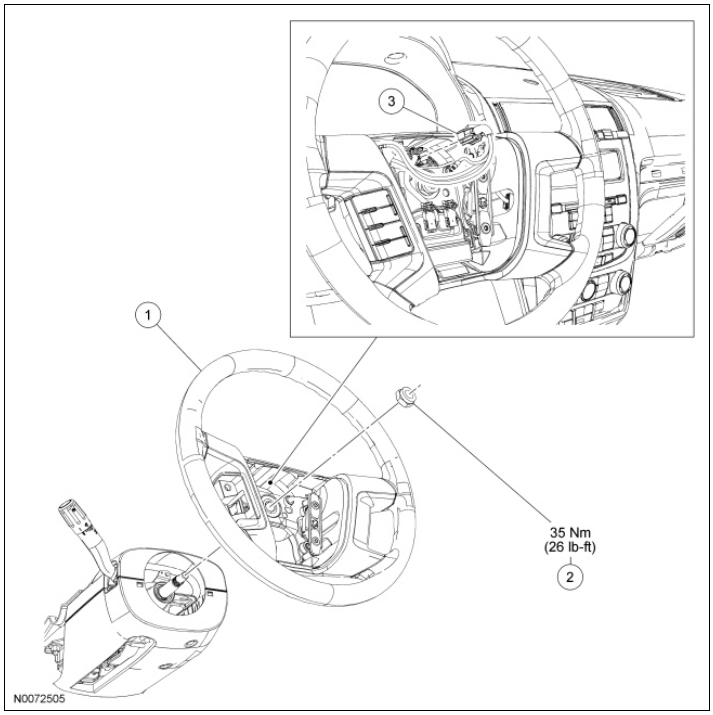
5. **NOTE:** The adhesive should be completely set after 5 minutes. Do not pull on the repair area.

   Smooth the leather and tuck in for neat appearance.

   - Apply pressure (for at least 30 seconds) until the leather is bonded to the wheel spoke.

6. If removed, Install the steering wheel. For additional information, refer to Steering Wheel in this section.

Steering Wheel



Item	Part Number	Description
1	3600/ 3F563	Steering wheel (urethane/leather)
2	W711835	Steering wheel nut
3	-	Steering wheel switches electrical connector (part of 3600/3F563)

Removal and Installation

NOTICE: **Do not allow the clockspring to rotate while the steering wheel is disconnected or damage to the clockspring may result. If there is evidence that the clockspring has rotated, the clockspring must be recentered. For additional information, refer to Section 501-20B .**

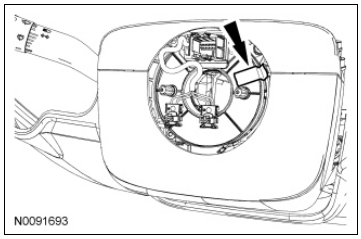
1. Position the steering wheel in the straight-ahead position and turn the ignition switch to the OFF position.
   - Remove the key.
2. Remove the driver air bag module. For additional information, refer to Section 501-20B .
3. **NOTE:** Mark the steering wheel and column shaft for reference during installation.

   Remove the steering wheel nut.
   - To install, tighten to 35 Nm (26 lb-ft).
4. ***NOTICE:*** **Do not remove the steering wheel by hitting the shaft with a hammer. Damage to the column may occur.**

Using a suitable puller, remove the steering wheel.

- Disconnect the steering wheel switches electrical connector from the clockspring.
- Route the 2 driver air bag module electricalonnectors and harness through the steering wheel.

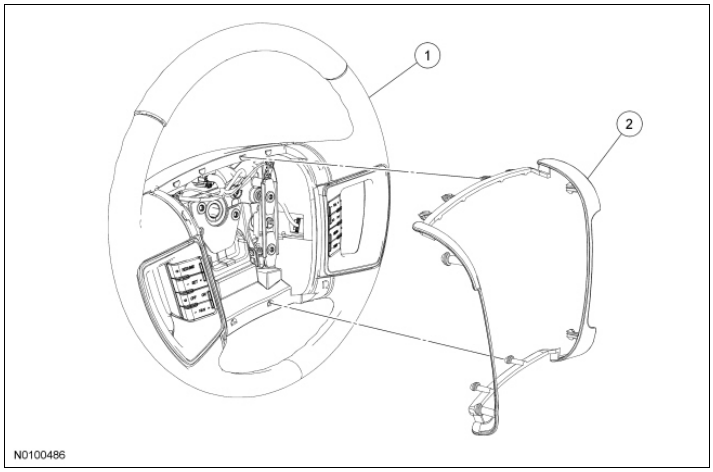
5. Tape the clockspring center rotor to the outer housing to keep it from rotating.



6. To install, reverse the removal procedure.
   - Align the steering wheel using the reference mark.

7. Install the driver air bag module. For additional information, refer to Section 501-20B .

Steering Wheel Bezel



Item	Part Number	Description
1	3600	Steering wheel
2	3F910	Center steering wheel bezel

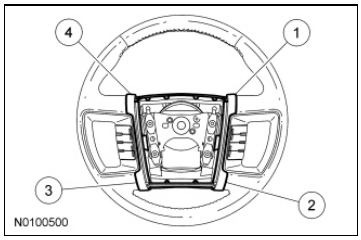
Removal

NOTICE: **The center steering wheel bezel is manufactured using plastic wrapped with aluminium and is very fragile. The removal and installation procedure must be followed exactly as outlined or damage to the bezel can occur.**

NOTICE: **Use a plastic trim removal tool or a plastic-coated tool when removing the bezel to avoid damaging the steering wheel.**

1. Remove the driver air bag module. For additional information, refer to Section 501-20B .

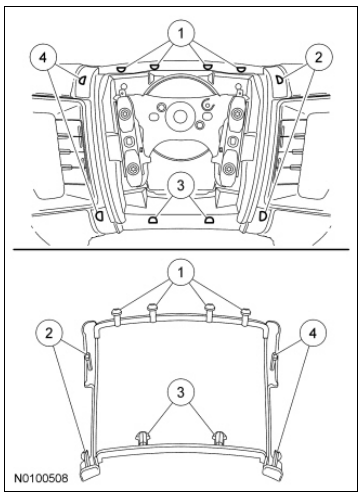
2. Using a plastic trim removal tool, carefully separate the bezel from the steering wheel in the following order:
    1. Upper RH corner
    2. Lower RH corner
    3. Lower LH corner
    4. Upper LH corner



3. **NOTE:** There are a total of 10 pins that secure the bezel to the steering wheel, 4 along the top of the bezel, 2 along the bottom and 2 on each side in the corners.

Using a plastic trim removal tool, carefully remove the bezel from the steering wheel in the following order:

1. Top 4 pins
2. RH side 2 pins
3. Bottom 2 pins
4. LH side 2 pins



Installation

NOTICE: **Carefully install the bezel onto the steering wheel as instructed or damage to the bezel can occur.**

1. Position the bezel onto the steering wheel and align the 10 pins with their respective holes.

2. **NOTE:** The bezel is installed in 2 stages. Stage 1 seats the 10 pins into the steering wheel approximately half-way. Stage 2 fully seats the 10 pins into the steering wheel.

   Beginning with the upper RH corner and continuing in a clockwise direction, push the bezel onto the steering wheel until the pins are seated approximately half-way into the holes.

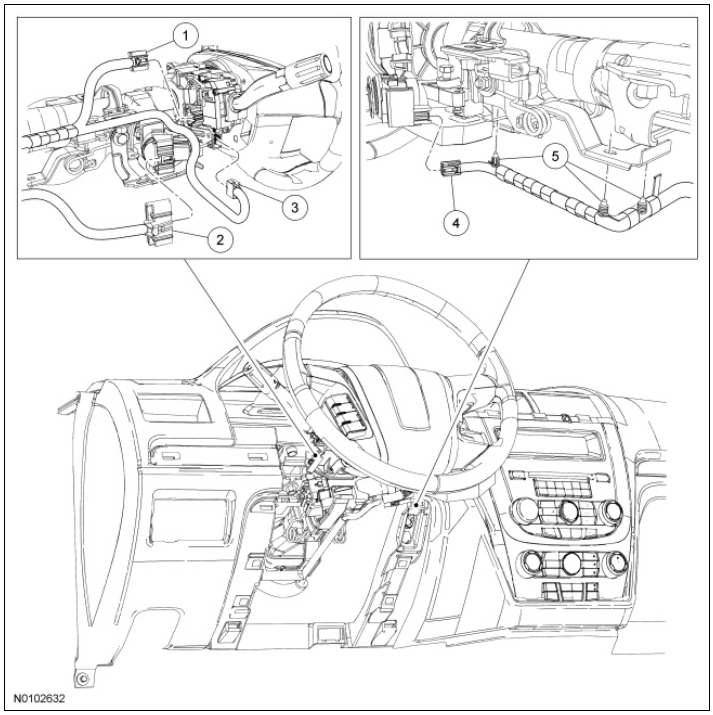
3. Beginning with the upper RH corner and continuing in a clockwise direction, push the bezel onto the steering wheel until the pins are fully seated into the holes.

4. Install the driver air bag module. For additional information, refer to Section 501-20B .

Steering Column

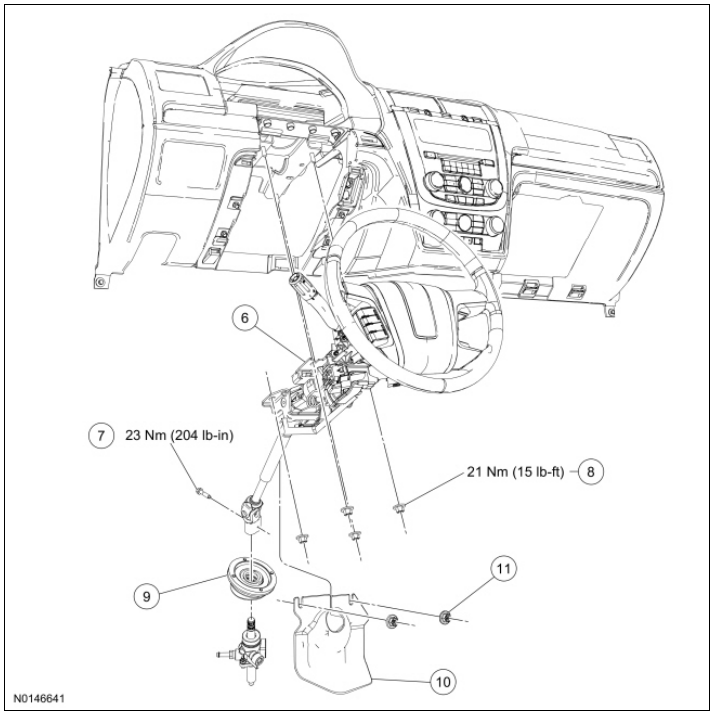
Steering Column Wire Harness

NOTE: 2.5L/3.0L shown, 3.5L similar.



Item	Part Number	Description
1	-	Multifunction switch electrical connector (part of 14401)
2	-	Ignition switch electrical connector (part of 14401)
3	-	Clockspring electrical connector (part of 14401)
4	-	Passive Anti-Theft System (PATS) electrical connector (part of 14401)
5	-	Wiring harness retainers (3 required) (part of 14401)

Steering Column Assembly



Item	Part Number	Description
6	3C529	Steering column
7	3R827	Steering column shaft-to-steering gear bolt
8	N806423	Steering column support bracket nut (4 required)
9	3C611B	Steering gear/dash seal
10	3C611A	Steering column shaft joint cover
11	W704904	Steering column shaft joint cover nut (2 required)

Removal and Installation

All vehicles

1. Remove the steering wheel. For additional information, refer to Steering Wheel in this section.

Hybrid vehicles

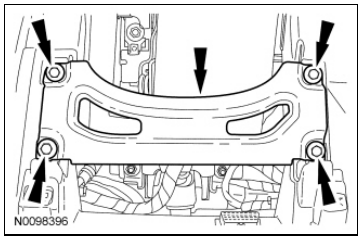
2. Remove the driver knee air bag module. For additional information, refer to Section 501-20B .

Non-Hybrid vehicles

3. Remove the steering column shroud. For additional information, refer to Steering Column Shroud .

All vehicles

4. Remove the 4 steering column opening trim panel reinforcement bolts and the steering column opening trim panel reinforcement.
    - To install, tighten to 5 Nm (44 lb-in).



5. Disconnect the Passive Anti-Theft System (PATS), multifunction switch, ignition switch, clockspring and steering wheel rotation sensor (3.5L only) electrical connectors.

6. Detach the wiring harness pin-type retainers and position the wiring harness aside.

7. Remove the 2 steering column shaft joint cover nuts.

8. Remove the steering column shaft joint cover.

9. Remove and discard the steering column shaft-to-steering gear bolt.
    - To install, tighten the new bolt to 23 Nm (204 lb-in).

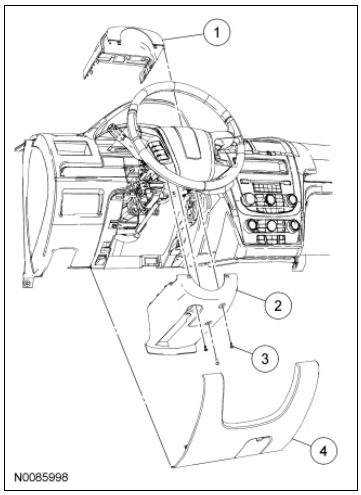
10. Disconnect the steering column shaft from the steering gear.

11. Remove the 4 steering column support bracket nuts and the steering column.
    - Detach the wire harness pin-type retainer.
    - To install, tighten to 21 Nm (15 lb-ft).

12. To install, reverse the removal procedure.
    - If installing a new steering column, transfer parts as necessary.

Steering Column Shroud

NOTE: Non-Hybrid vehicle shown, Hybrid vehicle similar.



Item	Part Number	Description
1	3530	Upper steering column shroud
2	3K512	Lower steering column shroud
3	W707658	Lower steering column shroud screw (3 required)
4	04459	Steering column opening trim panel

Removal and Installation

Hybrid vehicles

1. Remove the 2 steering column opening trim panel screws.

All vehicles

2. **NOTE:** The steering column opening trim panel is held in place by retaining clips that clip into the instrument panel.

   Remove the steering column opening trim panel.

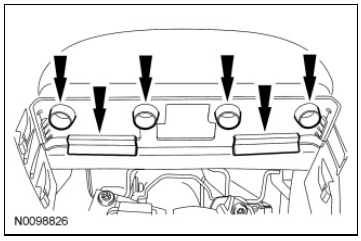
   - Pull the steering column opening trim panel outward to release the retaining clips.

Fusion and Milan only

3. **NOTE:** Release the upper steering column shroud by pressing inward on the sides of the shroud and lifting upwards.

   Remove the upper steering column shroud.

4. From the underside of the upper steering column shroud, detach the upper steering column shroud from the instrument cluster finish panel.



MKZ

5. **NOTE:** Release the upper steering column shroud by pressing inward on the sides of the shroud and lifting upwards.

   Remove the upper steering column shroud.

All vehicles

6. Release the tilt lever, remove the 3 lower steering column shroud screws and then the shroud.

7. To install, reverse the removal procedure.

Steering Column Switches

The steering column switches consist of the following:

- Multifunction switch
- Ignition switch

The steering column switches receive driver inputs and send signals to various components. The multifunction switch controls the windshield wipers, hazard flasher, turn signal, headlamp low/high beam and headlamp dimmer/flash-to-pass. The ignition switch is used in conjunction with the lock cylinder key to start the vehicle. When the lock cylinder key is switched to different positions, it moves linkages which enable the ignition switch to send battery voltage to various components.

Steering Column Switches

Special Tool(s)

 ST2574-A	Flex Probe Kit 105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

NOTE: The Smart Junction Box (SJB) may also be identified as the Generic Electronic Module (GEM).

The steering column switches include the ignition switch and the multifunction switch (high beam/low beam, flash-to-pass, turn signal and windshield wiper).

Ignition Switch

The ignition switch is controlled by the ignition lock cylinder with a key. When the ignition cylinder is turned using the key, a mechanical connection positions the ignition switch to the selected position and allows the ignition switch to send voltage to specific components. The ignition switch is contained in the steering column lock module.

Key Removal Inhibit Solenoid

The key removal inhibit solenoid (also known as the key release interlock actuator) is an electronically controlled solenoid that prevents the ignition lock cylinder from being turned to the OFF position unless the selector lever is in the PARK position. The key removal inhibit solenoid is part of the ignition switch.

Multifunction Switch

The multifunction switch controls the various components electrically. The multifunction switch is hardwired to the SJB and controls a ground signal for the high beam, flash-to-pass and turn signal functions. The multifunction switch is also hardwired to the wiper module and controls a ground signal for the various wiper and washer functions.

For headlamp and turn signal concerns, refer to Section 417-01 . For wiper and washer concerns, refer to Section 501-16 .

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Multifunction switch • Ignition key • Ignition lock cylinder • Ignition switch • Steering column lock module • Steering column shrouds	• Smart Junction Box (SJB) fuse 27 (20A) • Wiring, terminals or connectors • Ignition switch • One-Touch Integrated Start (OTIS) diode • SJB • PCM • Park range switch (part of the selector lever)

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

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

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

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

9. If the DTCs retrieved are related to the concern, go to Smart Junction Box (SJB) DTC Chart. For all other DTCs, refer to Section 419-10 .

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

DTC Chart

Smart Junction Box (SJB) DTC Chart

DTC	Description	Action
B2A20	Ignition stuck in START	GO to Pinpoint Test F .
B2844	Ignition fault	GO to Pinpoint Test G .
U2472	Unexpected Ignition State	GO to Pinpoint Test G .
-	All Other DTCs	REFER to the Master DTC Chart in Section 419-10 .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: No Power in All Ignition Switch Positions

Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

Normal Operation

The ignition switch receives fused battery voltage from Smart Junction Box (SJB) fuse 27 (20A) through circuit SBP27 (BU/RD). The ignition switch then sends voltage to various systems depending on ignition switch position. The ignition switch has 4 possible positions:

- OFF - No power on any circuits
- ACC - Power on circuit CDC33 (VT/GN)
- RUN - Power on circuit CDC34 (WH/OG)
- START - Power on circuit CDC35 (BU/WH)

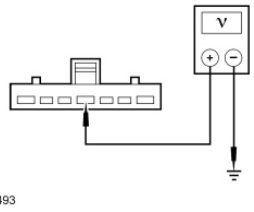
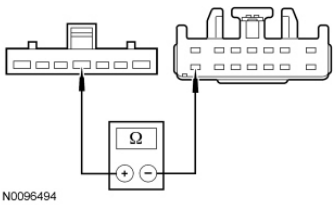
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Ignition switch
- SJB

PINPOINT TEST A: NO POWER IN ALL IGNITION SWITCH POSITIONS

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.**

NOTE: Verify that battery voltage is 10 volts or greater.

Test Step	Result / Action to Take
A1 CHECK AT THE IGNITION SWITCH FOR VOLTAGE	tr>
• Ignition OFF. • Disconnect: Ignition Switch C250. • Measure the voltage between ignition switch C250-4, circuit SBP27 (BU/RD), harness side and ground.  N0096493 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** VERIFY SJB fuse 27 (20A) is OK. If OK, GO to A2 . If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
A2 CHECK THE IGNITION SWITCH INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: SJB C2280A. • Measure the resistance between ignition switch C250-4, circuit SBP27 (BU/RD), harness side and SJB C2280A-14, circuit SBP27 (BU/RD), harness side.  N0096494 • **Is the resistance less than 5 ohms?**	**Yes** GO to A3 . **No** REPAIR circuit SBP27 (BU/RD). TEST the system for normal operation.
A3 CHECK FOR CORRECT SJB OPERATION	
• Disconnect: All SJB connectors. • Check the SJB connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: All SJB connectors and make sure the connectors seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: No Power in ACC

Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

Normal Operation

When the ignition switch is placed in the ACC position, fused ignition voltage is sent to the Smart Junction Box (SJB) through circuit CDC33 (VT/GN).

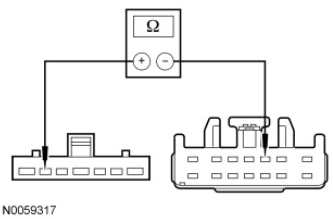
This pinpoint test is intended to diagnose the following:

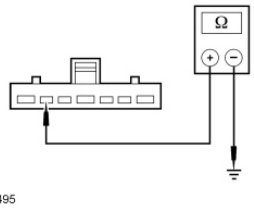
- Wiring, terminals or connectors
- Ignition switch
- SJB

PINPOINT TEST B: NO POWER IN ACC

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.**

NOTE: Verify that battery voltage is 10 volts or greater.

Test Step	Result / Action to Take
B1 CHECK THE IGNITION SWITCH	
• Ignition OFF. • Disconnect: Ignition Switch C250. • Carry out the Ignition Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the ignition switch pass the component test?**	**Yes** GO to B2 . **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation.
B2 CHECK THE IGNITION ACC CIRCUIT FOR AN OPEN	
• Disconnect: SJB C2280A. • Measure the resistance between ignition switch C250-6, circuit CDC33 (VT/GN), harness side and SJB C2280A-3, circuit CDC33 (VT/GN), harness side.  N0059317 • **Is the resistance less than 5 ohms?**	**Yes** GO to B3 . **No** REPAIR circuit CDC33 (VT/GN). TEST the system for normal operation.
B3 CHECK THE IGNITION ACC CIRCUIT FOR A SHORT TO GROUND	

• Measure the resistance between ignition switch C250-6, circuit CDC33 (VT/GN), harness side and ground.  N0096495 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B4 . **No** REPAIR circuit CDC33 (VT/GN). TEST the system for normal operation.
B4 CHECK FOR CORRECT SJB OPERATION	
• Check SJB C2208A for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: SJB C2280A and make sure the connector is seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

Pinpoint Test C: No Power in RUN

Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

Normal Operation

When the ignition switch is placed in the RUN position, fused ignition voltage is sent to the Smart Junction Box (SJB) along circuit CDC34 (WH/OG).

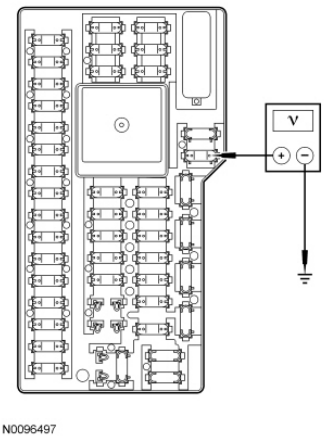
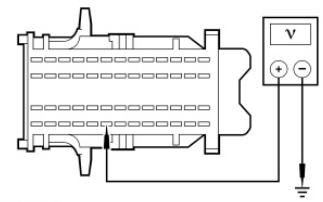
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Ignition switch
- SJB

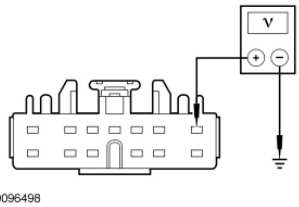
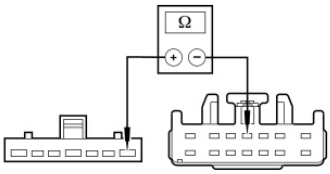
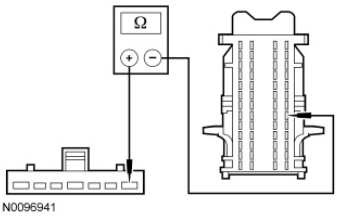
PINPOINT TEST C: NO POWER IN RUN

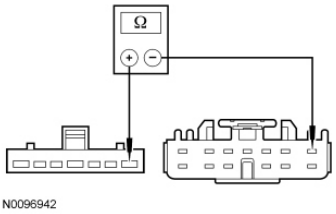
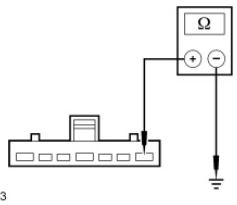
NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.**

NOTE: Verify that battery voltage is greater than 10 volts.

Test Step	Result / Action to Take
C1 CHECK FOR VOLTAGE ON THE IGNITION RUN CIRCUIT	

• Ignition OFF. • Disconnect: SJB Fuse 42 (10A) (if equipped). • Ignition ON. • Measure the voltage between SJB fuse 42 (10A), circuit CDC34 (WH/OG), input side and ground.  N0096497 • **Is the voltage greater than 10 volts?**	**Yes** GO to C2 . **No** GO to C4 .
C2 CHECK FOR VOLTAGE AT THE SJB	
• Ignition OFF. • Disconnect: SJB C2280B. • Ignition ON. • Measure the voltage between SJB C2280B-45, circuit CDC34 (WH/OG), harness side and ground.  N0096496 • **Is the voltage greater than 10 volts?**	**Yes** GO to C3 . **No** GO to C5 .
C3 CHECK THE SJB IGNITION SWITCH INPUT CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280E. • Ignition ON. • Measure the voltage between SJB C2280E-1, circuit CDC34 (WH/OG), harness side and ground.	**Yes** GO to C10 . **No** GO to C6 .

 N0096498 • **Is the voltage greater than 10 volts?**	
C4 CHECK THE SJB IGNITION SWITCH INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: SJB C2280A. • Disconnect: Ignition Switch C250. • Measure the resistance between ignition switch C250-1, circuit CDC34 (WH/OG), harness side and SJB C2280A-4, circuit CDC34 (WH/OG), harness side.  N0096940 • **Is the resistance less than 5 ohms?**	**Yes** GO to C7 . **No** REPAIR circuit CDC34 (WH/OG). TEST the system for normal operation.
C5 CHECK THE IGNITION RUN CIRCUIT FOR AN OPEN	
• Disconnect: Ignition Switch C250. • Measure the resistance between ignition switch C250-1, circuit CDC34 (WH/OG), harness side and SJB C2280B-45, circuit CDC34 (WH/OG), harness side.  N0096941 • **Is the resistance less than 5 ohms?**	**Yes** GO to C9 . **No** REPAIR circuit CDC34 (WH/OG). TEST the system for normal operation.
C6 CHECK THE IGNITION SWITCH OUTPUT CIRCUIT FOR AN OPEN	
• Disconnect: Ignition Switch C250. • Measure the resistance between ignition switch C250-1, circuit CDC34 (WH/OG), harness side and SJB C2280E-1, circuit CDC34 (WH/OG), harness side.	**Yes** GO to C9 . **No** REPAIR circuit CDC34 (WH/OG). TEST the system for normal operation.

 N0096942 • **Is the resistance less than 5 ohms?**	
C7 CHECK THE IGNITION RUN CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: SJB C2280B. • Disconnect: SJB C2280E. • Measure the resistance between ignition switch C250-1, circuit CDC34 (WH/OG), harness side and ground.  N0096943 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C8 . **No** REPAIR circuit CDC34 (WH/OG). TEST the system for normal operation.
C8 CHECK THE IGNITION SWITCH	
• Carry out the Ignition Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the ignition switch pass the component test?**	**Yes** GO to C10 . **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation.
C9 CHECK FOR CORRECT IGNITION SWITCH OPERATION	
• Carry out the Ignition Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the ignition switch pass the component test?**	**Yes** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation.
C10 CHECK FOR CORRECT SJB OPERATION	
• Disconnect: All SJB connectors.	**Yes** INSTALL a new SJB . REFER to

• Check the SJB connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: All SJB connectors and make sure the connectors are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

Pinpoint Test D: No Power in START - Non-Hybrid

Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

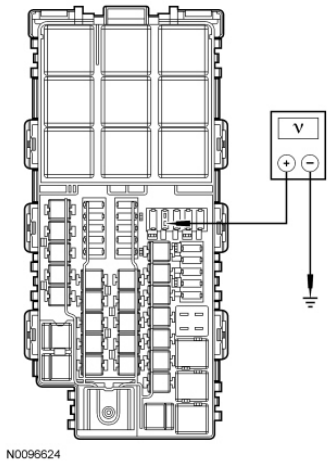
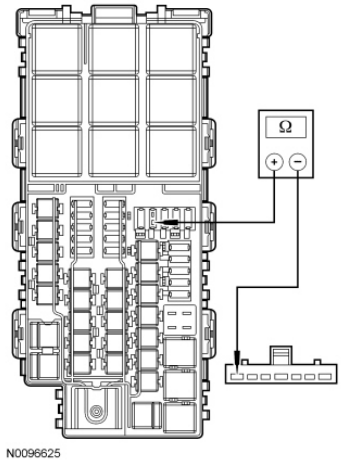
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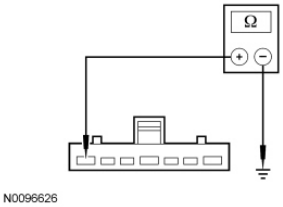
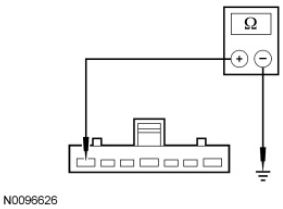
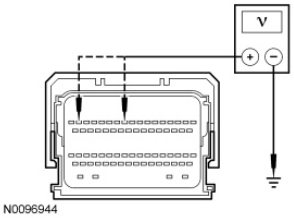
When the ignition switch is placed in the START position, fused ignition voltage is sent to the PCM and the One-Touch Integrated Start (OTIS) diode through circuit CDC35 (BU/WH). The voltage passes through the Battery Junction Box (BJB) OTIS diode and continues to the PCM, starter relay coil and the Smart Junction Box (SJB) through circuit CE336 (GN/WH).

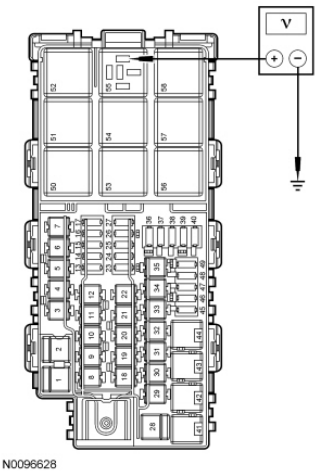
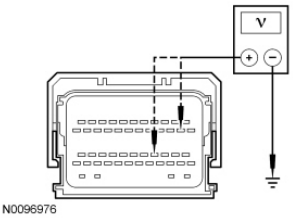
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Ignition switch
- OTIS diode
- SJB
- PCM

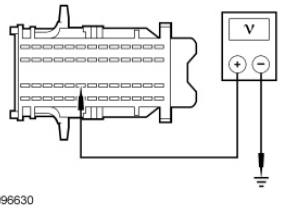
PINPOINT TEST D: NO POWER IN START - NON-HYBRID

Test Step	Result / Action to Take
D1 CHECK FOR VOLTAGE TO THE BJB	
• Disconnect: BJB OTIS Diode. • With the ignition in the START position, measure the voltage between BJB OTIS diode, circuit CDC35 (BU/WH), input side and ground.	**Yes** GO to D5 . **No** GO to D2 .

 N0096624 • **Is the voltage greater than 10 volts?**	
D2 CHECK THE IGNITION START CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Ignition Switch C250. • Measure the resistance between BJB OTIS diode, circuit CDC35 (BU/WH), input side and ignition switch C250-7, circuit CDC35 (BU/WH), harness side.  N0096625 • **Is the resistance less than 5 ohms?**	**Yes** GO to D3 . **No** REPAIR circuit CDC35 (BU/WH). TEST the system for normal operation.
D3 CHECK THE IGNITION START CIRCUIT FOR A SHORT TO GROUND	
• Measure the resistance between ignition switch C250-7, circuit CDC35 (BU/WH), harness side and ground.	**Yes** GO to D10 . **No** GO to D4 .

 N0096626 • **Is the resistance greater than 10,000 ohms?**	
D4 ISOLATE THE PCM FOR A SHORT TO GROUND	
• Disconnect: PCM C175B. • Measure the resistance between ignition switch C250-7, circuit CDC35 (BU/WH), harness side and ground.  N0096626 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D12 . **No** REPAIR circuit CDC35 (BU/WH). TEST the system for normal operation.
D5 CHECK THE OTIS DIODE	
• Test the OTIS diode. • **Is the OTIS diode OK?**	**Yes** GO to D6 . **No** INSTALL a new OTIS diode. TEST the system for normal operation.
D6 CHECK FOR START CIRCUIT VOLTAGE AT THE PCM	
• Ignition OFF. • Connect: BJB OTIS Diode. • Disconnect: PCM C175B. • With the ignition in the START position, measure the voltage between ground and: ♦ **2.5L and 3.0L:** PCM C175B-16, circuit CDC35 (BU/WH), harness side. ♦ **3.5L:** PCM C175B-10, circuit CDC35 (BU/WH), harness side.  N0096944	**Yes** GO to D7 . **No** REPAIR circuit CDC35 (BU/WH). TEST the system for normal operation.

• **Is the voltage greater than 10 volts?**	
D7 CHECK FOR START CIRCUIT VOLTAGE AT THE STARTER RELAY	
• Disconnect: BJB Starter Relay. • With the ignition in the START position, measure the voltage between BJB starter relay socket 86, circuit CE336 (GN/WH), harness side and ground.  N0096628 • **Is the voltage greater than 10 volts?**	**Yes** GO to D8 . **No** REPAIR circuit CE336 (GN/WH). TEST the system for normal operation.
D8 CHECK FOR START CIRCUIT VOLTAGE AT THE PCM	
• With the ignition in the START position, measure the voltage between ground and: ♦ **2.5L and 3.0L:** PCM C175B-37, circuit CE336 (GN/WH), harness side. ♦ **3.5L:** PCM C175B-19, circuit CE336 (GN/WH), harness side.  N0096976 • **Is the voltage greater than 10 volts?**	**Yes** GO to D9 . **No** REPAIR circuit CE336 (GN/WH). TEST the system for normal operation.
D9 CHECK FOR VOLTAGE TO THE SJB	
• Ignition OFF. • Disconnect: SJB C2280B. • With the ignition in the START position, measure the voltage between SJB C2280B-32, circuit CE336 (GN/WH), harness side and ground.	**Yes** GO to D11 . **No** REPAIR circuit CE336 (GN/WH). TEST the system for normal operation.

 • **Is the voltage greater than 10 volts?**	
D10 CHECK THE IGNITION SWITCH	
• Carry out the Ignition Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the ignition switch pass the component test?**	**Yes** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation. **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation.
D11 CHECK FOR CORRECT SJB OPERATION	
• Disconnect: All SJB connectors. • Check all SJB connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: All SJB connectors making sure that all connectors are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.
D12 CHECK FOR CORRECT PCM OPERATION	
• Disconnect: All PCM connectors. • Check all PCM connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: All PCM connectors making sure that all connectors are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

Pinpoint Test E: No Power in START - Hybrid

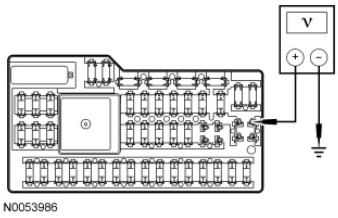
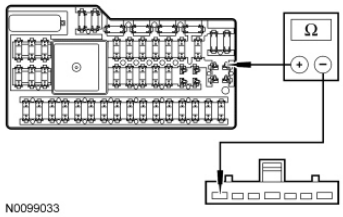
Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

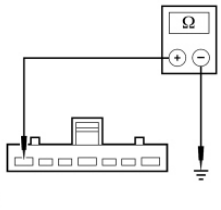
Normal Operation

When the ignition switch is placed in the START position, fused ignition voltage is sent to the Smart Junction Box (SJB) through circuit CDC35 (BU/WH).

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Ignition switch
- SJB

PINPOINT TEST E: NO POWER IN START - HYBRID

Test Step	Result / Action to Take
E1 CHECK FOR VOLTAGE TO SJB FUSE 28 (5A)	
• Disconnect: SJB Fuse 28 (5A). • With the ignition in the START position, measure the voltage between SJB fuse 28 (5A), circuit CDC35 (BU/WH), input side and ground.  N0053986 • **Is the voltage greater than 10 volts?**	**Yes** GO to E4 . **No** GO to E2 .
E2 CHECK THE IGNITION START CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Ignition Switch C250. • Measure the resistance between SJB fuse 28 (5A), circuit CDC35 (BU/WH), input side and ignition switch C250-7, circuit CDC35 (BU/WH), harness side.  N0099033 • **Is the resistance less than 5 ohms?**	**Yes** GO to E3 . **No** REPAIR circuit CDC35 (BU/WH). TEST the system for normal operation.
E3 CHECK THE IGNITION START CIRCUIT FOR A SHORT TO GROUND	

• Measure the resistance between ignition switch C250-7, circuit CDC35 (BU/WH), harness side and ground.  N0096626 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** REPAIR circuit CDC35 (BU/WH). TEST the system for normal operation.
E4 CHECK FOR CORRECT SJB OPERATION	
• Disconnect: All SJB connectors. • Check all SJB connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: All SJB connectors making sure that all connectors are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

Pinpoint Test F: DTC B2A20

Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

Normal Operation

The ignition switch is spring loaded to automatically return to the RUN position after being placed in the START position. A microprocessor in the Smart Junction Box (SJB) monitors the voltage output from the ignition switch while the switch is in the START position. This microprocessor is also connected to the Audio Control Module (ACM) start circuit, so a short to voltage on the ignition switch output circuit or on the ACM start circuit could cause DTC B2A20 to set.

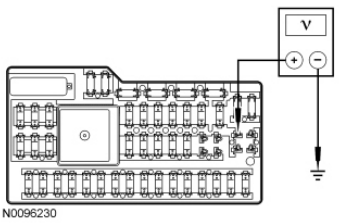
- B2A20 (Ignition Stuck in START) - The SJB continuously monitors the ignition switch state, if the SJB receives a START signal for more than 30 seconds, DTC B2A20 will be set.

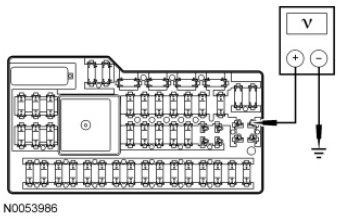
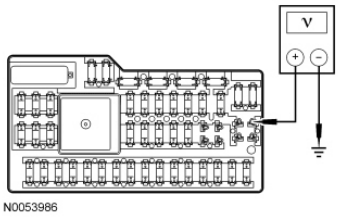
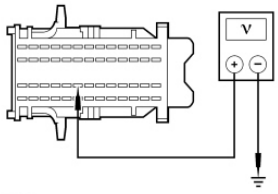
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Ignition switch
- SJB
- PCM
- ACM

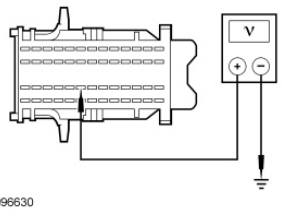
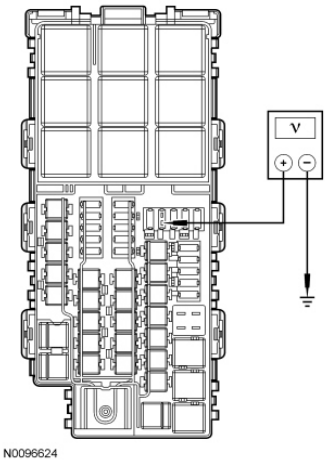
PINPOINT TEST F: DTC B2A20

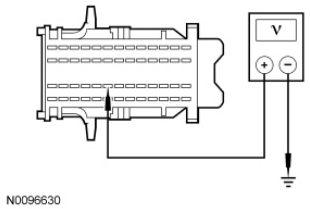
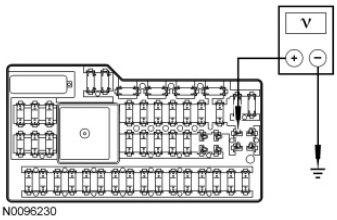
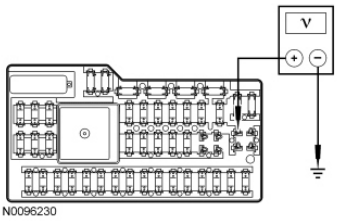
NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.**

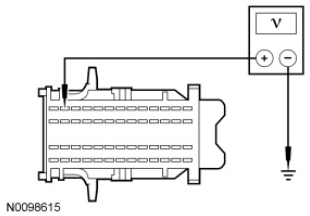
NOTE: Verify that battery voltage is 10 volts or greater.

Test Step	Result / Action to Take
F1 CHECK THE IGNITION SWITCH MECHANICAL FUNCTION	
• Inspect the ignition switch for correct mechanical function. Refer to t Ignition Switch - Mechanical Component Test in this section. • **Did the ignition switch pass the component test?**	**Yes** GO to F2 . **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. CLEAR the DTCs. REPEAT the self-test.
F2 CHECK THE IGNITION SWITCH ELECTRICAL FUNCTION	
• Ignition OFF. • Disconnect: Ignition Switch C250. • Carry out the Ignition Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the ignition switch pass the component test?**	**Yes** GO to F3 . **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. CLEAR the DTCs. REPEAT the self-test.
F3 CHECK THE SJB START POWER OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Connect: Ignition Switch C250. • Disconnect: SJB Fuse 28 (5A). • Ignition ON. • Measure the voltage between SJB fuse 28 (5A), circuit CBP28 (GY/VT), output side and ground.  • **Is any voltage present?**	**Yes** GO to F10 . **No** For **non-hybrid vehicles,** GO to F4 . For **hybrid vehicles,** GO to F9 .
F4 CHECK THE SJB START POWER INPUT CIRCUIT FOR A SHORT TO VOLTAGE	

• Measure the voltage between SJB fuse 28 (5A), circuit CE336 (GN/WH), input side and ground.  N0053986 • **Is any voltage present?**	**Yes** GO to F5 . **No** GO to F13 .
F5 ISOLATE THE SJB START POWER CIRCUIT	
• Ignition OFF. • Disconnect: BJB One-Touch Integrated Start (OTIS) Diode. • Ignition ON. • Measure the voltage between SJB fuse 28 (5A), circuit CE336 (GN/WH), input side and ground.  N0053986 • **Is any voltage present?**	**Yes** GO to F6 . **No** GO to F8 .
F6 CHECK THE PCM IGNITION SWITCH INPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280B. • Ignition ON. • Measure the voltage between SJB C2280B-32, circuit CE336 (GN/WH), harness side and ground.  N0096630 • **Is any voltage present?**	**Yes** GO to F7 . **No** GO to F13 .
F7 CHECK THE PCM FOR A SHORT TO VOLTAGE	

• Ignition OFF. • Disconnect: PCM C175B. • Ignition ON. • Measure the voltage between SJB C2280B-32, circuit CE336 (GN/WH), harness side and ground.  N0096630 • **Is any voltage present?**	**Yes** REPAIR circuit CE336 (GN/WH). CLEAR the DTCs. REPEAT the self-test. **No** GO to F15 .
F8 CHECK THE IGNITION SWITCH START POWER OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PCM C175B. • Ignition ON. • Measure the voltage between BJB OTIS diode, circuit CDC35 (BU/WH), input side and ground.  N0096624 • **Is any voltage present?**	**Yes** REPAIR circuit CDC35 (BU/WH). CLEAR the DTCs. REPEAT the self-test. **No** GO to F15 .
F9 CHECK THE SJB IGNITION SWITCH INPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280B. • Ignition ON. • Measure the voltage between SJB C2280B-32, circuit CDC35 (BU/WH), harness side and ground.	**Yes** REPAIR circuit CDC35 (BU/WH). CLEAR the DTCs. REPEAT the self-test. **No** GO to F13 .

 N0096630 • **Is any voltage present?**	
F10 ISOLATE THE ACM	
• Ignition OFF. • Disconnect: ACM C240A. • Ignition ON. • Measure the voltage between SJB fuse 28 (5A), circuit CBP28 (GY/VT), output side and ground.  N0096230 • **Is any voltage present?**	**Yes** GO to F11 . **No** GO to F14 .
F11 ISOLATE THE PCM	
• Ignition OFF. • Disconnect: PCM C175B. • Ignition ON. • Measure the voltage between SJB fuse 28 (5A), circuit CBP28 (GY/VT), output side and ground.  N0096230 • **Is any voltage present?**	**Yes** GO to F12 . **No** GO to F15 .
F12 ISOLATE THE SJB	
• Ignition OFF. • Disconnect: SJB C2280B. • Ignition ON. • Measure the voltage between SJB C2280B-2, circuit CBP28 (GY/VT), harness side and ground.	**Yes** REPAIR circuit CBP28 (GY/VT). CLEAR the DTCs. REPEAT the self-test. **No** GO to F13 .

 • **Is any voltage present?**	
F13 CHECK FOR CORRECT SJB OPERATION	
• Ignition OFF. • Disconnect: All SJB connectors. • Check the SJB connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: All SJB connectors making sure that they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
F14 CHECK FOR CORRECT ACM OPERATION	
• Disconnect: All ACM connectors. • Check all ACM connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: All ACM connectors making sure that all connectors are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
F15 CHECK FOR CORRECT PCM OPERATION	
• Disconnect: All PCM connectors. • Check all PCM connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: All PCM connectors making sure that all connectors are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B , Section 303-14C or Section 303-14D . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test G: DTCs B2844 and U2472

Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) contains several inputs that monitor the voltage outputs from the ignition switch. The SJB uses these inputs to determine the ignition switch position and then sends that information to various modules over the High Speed Controller Area Network (HS-CAN) bus. The ignition switch is designed so that only one output (ACC, RUN or START) is sent to the SJB at a time.

- DTC B2844 (Ignition Fault) - If the SJB receives an invalid ignition RUN input or cannot receive the ignition RUN input during normal operation, DTC B2844 is set.
- DTC U2472 (Unexpected Ignition State) - If the SJB does not receive the ignition RUN signal or receives conflicting ignition switch signals while performing an on-demand self test, DTC U2472 is set.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Ignition switch
- SJB

PINPOINT TEST G: DTCs B2844 AND U2472

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.**

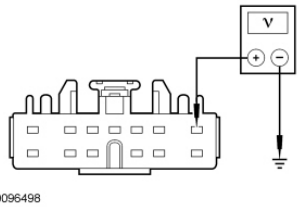
NOTE: Verify that battery voltage is 10 volts or greater.

Test Step	Result / Action to Take
G1 CHECK THE SJB DTCs	
• Use the recorded SJB DTCs from the continuous and on-demand self tests. • **Is DTC B2A20 present?**	**Yes** GO to Pinpoint Test F . **No** GO to G2 .
G2 CHECK THE IGNITION SWITCH PIDs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the following ignition switch PIDs while cycling the ignition switch through each position: ♦ ECU Derived Ignition State-OFF (IGN_O_ECU) ♦ ECU Derived Ignition State-ACC (IGN_A_ECU) ♦ ECU Derived Ignition State-RUN (IGN_R_ECU) ♦ ECU Derived Ignition State-START (IGN_S_ECU) • **Does each PID display YES when the ignition switch is moved into the corresponding position and NO when the**	**Yes** The condition is not present at this time. INSPECT SJB connectors C2280A and C2280B for corrosion, spread terminals and/or pushed-out pins. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. **No** If IGN_A_ECU is displayed YES at all times, **Non-Hybri** GO to G3 . **Hybrid:** GO to G4 . If IGN_R_ECU is displayed YES at all times, GO to G6 . If IGN_S_ECU displayed YES at all times, GO to Pinpoint Test F . If IGN_O_ECU displayed YES at all times, GO to Pinpoint Test A .

switch is moved to another position?	If IGN_A_ECU displayed NO at all times, GO to Pinpoint Test B . If IGN_R_ECU displayed NO at all times, GO to Pinpoint Test C . If IGN_S_ECU displayed NO at all times, **Non-Hybrid:** GO to Pinpoint Test D . **Hybrid:** GO to Pinpoint Test E .
G3 CHECK SJB FUSE 43 (10A) OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB Fuse 43 (10A). • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the ignition switch ACC position PID IGN_A_ECU while cycling the ignition switch through each position. • **Does the PID display YES when the ignition switch is moved through all switch positions?**	**Yes** GO to G4 . **No** REPAIR circuit CBP43 (GY). CLEAR the DTCs. REPEAT the self-test.
G4 CHECK SJB FUSE 45 (5A) OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB Fuse 45 (5A). • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the ignition switch ACC position PID IGN_A_ECU while cycling the ignition switch through each position. • **Does the PID display YES when the ignition switch is moved through all switch positions?**	**Yes** GO to G5 . **No** REPAIR circuit CBP45 (YE). CLEAR the DTCs. REPEAT the self-test.
G5 CHECK THE IGNITION SWITCH	
• Ignition OFF. • Disconnect: Ignition Switch C250. • Carry out the Ignition Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the ignition switch pass the component test?**	**Yes** REPAIR circuit CDC33 (VT/GN). CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. CLEAR the DTCs. REPEAT the self-test.
G6 CHECK SJB FUSE 44 (10A) OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	

• Ignition OFF. • Disconnect: SJB Fuse 44 (10A). • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the ignition switch RUN position PID IGN_R_ECU while cycling the ignition switch through each position. • **Does the PID display YES when the ignition switch is moved through all switch positions?**	**Yes** GO to G7 . **No** REPAIR circuit CBP44 (VT). CLEAR the DTCs. REPEAT the self-test.
G7 CHECK SJB FUSE 42 (10A) OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB Fuse 42 (10A). • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the ignition switch RUN position PID IGN_R_ECU while cycling the ignition switch through each position. • **Does the PID display YES when the ignition switch is moved through all switch positions?**	**Yes** GO to G8 . **No** REPAIR circuit CBP42 (GN). CLEAR the DTCs. REPEAT the self-test.
G8 CHECK SJB FUSE 29 (5A) OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB Fuse 29 (5A). • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the ignition switch RUN position PID IGN_R_ECU while cycling the ignition switch through each position. • **Does the PID display YES when the ignition ch is moved through all switch positions?**	**Yes** GO to G9 . **No** REPAIR circuit CBP29 (WH/VT). CLEAR the DTCs. REPEAT the self-test.
G9 CHECK SJB FUSE 46 (7.5A) OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB Fuse 46 (7.5A). • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the ignition switch RUN position PID IGN_R_ECU while cycling the ignition switch through each position. • **Does the PID display YES when the ignition switch is moved through all switch positions?**	**Yes** GO to G10 . **No** REPAIR circuit CBP46 (WH/BU). CLEAR the DTCs. REPEAT the self-test.

G10 CHECK SJB FUSE 36 (5A) OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB Fuse 36 (5A). • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the ignition switch RUN position PID IGN_R_ECU while cycling the ignition switch through each position. • **Does the PID display YES when the ignition switch is moved through all switch positions?**	**Yes** GO to G11 . **No** REPAIR circuit CBP36 (BU/BN). CLEAR the DTCs. REPEAT the self-test.
G11 CHECK SJB FUSE 35 (10A) OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB Fuse 35 (10A). • Ignition ON. Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the ignition switch RUN position PID IGN_R_ECU while cycling the ignition switch through each position. • **Does the PID display YES when the ignition switch is moved through all switch positions?**	**Yes** GO to G12 . **No** REPAIR circuit CBP35 (YE/GY). CLEAR the DTCs. REPEAT the self-test.
G12 CHECK SJB FUSE 32 (10A) OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB Fuse 32 (10A). • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the ignition switch RUN position PID IGN_R_ECU while cycling the ignition switch through each position. • **Does the PID display YES when the ignition switch is moved through all switch positions?**	**Yes** For **hybrid vehicles,** GO G13 . For **non-hybrid vehicles,** GO to G14 . **No** REPAIR circuit CBP32 (GN/VT). CLEAR the DTCs. REPEAT the self-test.
G13 CHECK SJB FUSE 37 (10A) OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB Fuse 37 (10A) (if equipped). • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - SJB . • Monitor the ignition switch RUN position PID IGN_R_ECU while cycling the ignition switch through each position.	**Yes** GO to G14 . **No** REPAIR circuit SBP37 (WH). CLEAR the DTCs. REPEAT the self-test.

• **Does the PID display YES when the ignition switch is moved through all switch positions?**	
G14 CHECK THE IGNITION SWITCH RUN OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280B. • Disconnect: SJB C2280E. • Ignition ON. • Measure the voltage between SJB C2280E-1, circuit CDC34 (WH/OG), harness side and ground while moving the ignition switch through all switch positions.  N0096498 • **Is voltage present when the ignition switch is moved through all switch positions?**	**Yes** GO to G15 . **No** GO to G16 .
G15 CHECK THE IGNITION SWITCH	
• Ignition OFF. • Disconnect: Ignition Switch C250. • Carry out the Ignition Switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Did the ignition switch pass the component test?**	**Yes** REPAIR circuit CDC34 (WH/OG). CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. CLEAR the DTCs. REPEAT the self-test.
G16 CHECK FOR CORRECT SJB OPERATION	
• Ignition OFF. • Disconnect: All SJB connectors. • Check the SJB connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ spread terminals. • Connect: All SJB connectors making sure that they are seated correctly. • Make sure the connectors are seated correctly, then operate the system and verify the concern is still present.	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CLEAR the DTC. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

• **Is the concern still present?**	

Pinpoint Test H: The Ignition Key Cannot Be Returned to the OFF Position

Refer to Wiring Diagrams Cell 37 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Shift Interlock for schematic and connector information.

Normal Operation

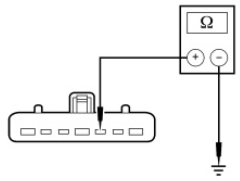
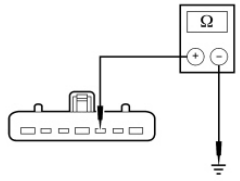
The key removal inhibit solenoid (part of the ignition switch) receives battery voltage from Smart Junction Box (SJB) fuse 27 (20A) through circuit SBP27 (BU/RD). When the selector lever is moved out of the PARK position, the park range switch (part of the selector lever) closes and connects circuit CET22 (GY/BN) to circuit GD116 (BK/VT), providing ground to the key removal inhibit solenoid. The key removal inhibit solenoid activates and prevents the ignition lock cylinder from being turned to the OFF position and the key removed.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Ignition switch
- Ignition lock cylinder
- Selector lever
- Steering column lock module

PINPOINT TEST H: THE IGNITION KEY CANNOT BE RETURNED TO THE OFF POSITION

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
H1 CHECK FOR AN ENERGIZED KEY REMOVAL INHIBIT SOLENOID	
• Remove SJB fuse 27 (20A). • Attempt to turn the ignition lock cylinder to the RUN position and then back to the OFF position and remove the key. • **Does the ignition lock cylinder turn to the OFF position and can the key be removed?**	**Yes** GO to H4 . **No** GO to H2 .
H2 CHECK THE IGNITION SWITCH FOR MECHANICAL DAMAGE	
• Remove the ignition switch. Refer to Ignition Switch in this section. • Attempt to turn the ignition lock cylinder to the OFF position and remove the ignition key. • **Does the ignition lock cylinder turn to the OFF position and can the key be removed?**	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** GO to H3 .
H3 CHECK THE IGNITION LOCK CYLINDER FOR MECHANICAL DAMAGE	

• Remove the ignition lock cylinder. Refer to Section 501-14 . • Rotate the ignition lock cylinder through all positions using the key. • **Does the ignition lock cylinder freely rotate through all positions and can the key be removed from the lock cylinder?**	**Yes** INSTALL a new steering column lock module. REFER to Steering Column Lock Module in this section. TEST the system for normal operation. **No** INSTALL a new ignition lock cylinder. REFER to Section 501-14 . TEST the system for normal operation.
H4 CHECK THE KEY REMOVAL INHIBIT SOLENOID CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Select PARK. • Disconnect: Ignition Switch C250. • Measure the resistance between ignition switch C250-3, circuit CET22 (GY/BN), harness side and ground.  N0065439 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** GO to H5 .
H5 ISOLATE THE SHORT TO GROUND IN THE KEY REMOVAL INHIBIT SOLENOID CIRCUIT	
• Disconnect: Floor Shifter C3233. • Measure the resistance between ignition switch C250-3, circuit CET22 (GY/BN), harness side and ground.  N0065439 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new selector lever. REFER to Section 307-05A or Section 307-05B . TEST the system for normal operation. **No** REPAIR circuit CET22 (GY/BN). TEST the system for normal operation.

Pinpoint Test I: The Ignition Key Can Be Turned to the OFF Position When the Selector Lever is Not in PARK

Refer to Wiring Diagrams Cell 37 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Shift Interlock for schematic and connector information.

Normal Operation

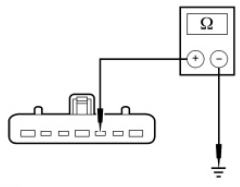
The key removal inhibit solenoid (part of the ignition switch) receives battery voltage from Smart Junction Box (SJB) fuse 27 (20A) through circuit SBP27 (BU/RD). When the selector lever is moved out of the PARK position, the park range switch (part of the selector lever) closes and connects circuit CET22 (GY/BN) to circuit GD116 (BK/VT), providing ground to the key removal inhibit solenoid. The key removal inhibit solenoid activates and prevents the ignition lock cylinder from being turned to the OFF position and the key removed.

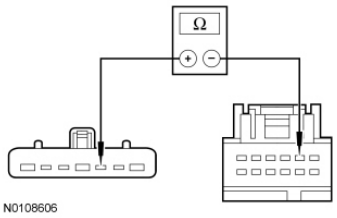
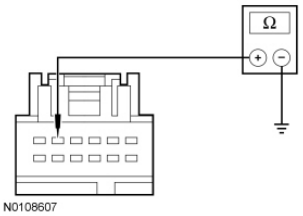
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Ignition switch
- Selector lever

PINPOINT TEST I: THE IGNITION KEY CAN BE TURNED TO THE OFF POSITION WHEN THE SELECTOR LEVER IS NOT IN PARK

NOTICE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

Test Step	Result / Action to Take
I1 CHECK THE KEY REMOVAL INHIBIT SOLENOID CIRCUIT FOR GROUND	
• Select NEUTRAL. • Disconnect: Ignition Switch C250. • Measure the resistance between ignition switch C250-3, circuit CET22 (GY/BN), harness side and ground.  N0065439 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** GO to I2 .
I2 CHECK THE KEY REMOVAL INHIBIT SOLENOID CIRCUIT FOR AN OPEN	
• Disconnect: Floor Shifter C3233. • Measure the resistance between ignition switch C250-3, circuit CET22 (GY/BN), harness side and floor shifter C3233-2, circuit CET22 (GY/BN), harness side.	**Yes** GO to I3 . **No** REPAIR circuit CET22 (GY/BN). TEST the system for normal operation.

 N0108606 • **Is the resistance less than 5 ohms?**	
I3 CHECK THE FLOOR SHIFTER GROUND CIRCUIT FOR AN OPEN	
• Measure the resistance between floor shifter C3233-5, circuit GD116 (BK/VT), harness side and ground.  N0108607 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new selector lever. REFER to Section 307-05A or Section 307-05B . TEST the system for normal operation. **No** REPAIR circuit GD116 (BK/VT). TEST the system for normal operation.

Component Tests

Ignition Switch - Mechanical

The following conditions can cause difficulty in operating the ignition switch and lock cylinder:

- Damaged or incorrectly cut ignition key
- Binding ignition lock cylinder
- Binding ignition switch
- Binding or damaged steering column lock module

Carry out the following test to determine if the ignition key/lock cylinder, ignition switch and the steering column lock module are operating correctly.

1. Inspect the ignition key for any burrs, damage or incorrect cut. Have a new ignition key made as necessary. If the key is OK, continue with Step 2.

2. Remove the ignition lock cylinder. Refer to Section 501-14 .

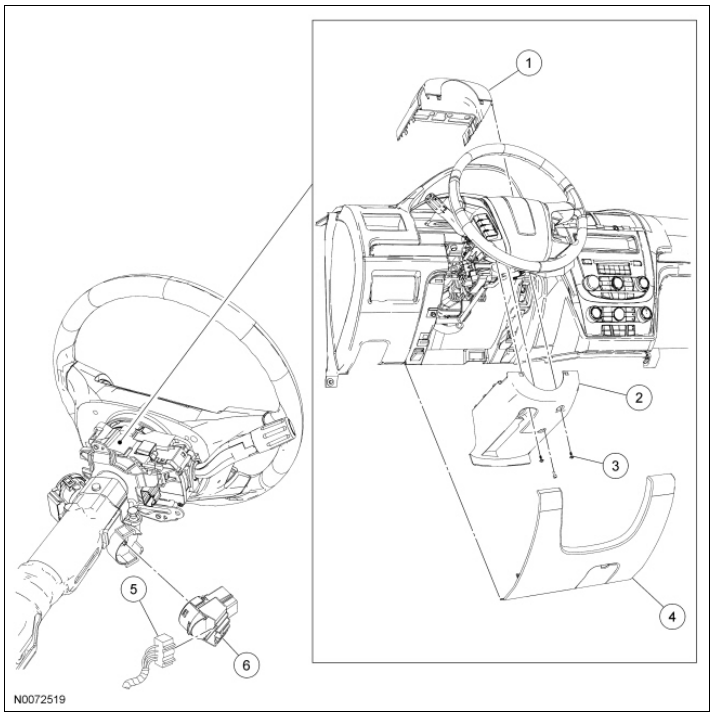
3. Rotate the ignition lock cylinder through all of the switch positions.
   - If the lock cylinder operates correctly, install the lock cylinder and continue with Step 4.
   - If the lock cylinder does not operate correctly, install a new ignition lock cylinder.

4. Remove the ignition switch. Refer to Ignition Switch in this section.

5. Rotate the ignition lock cylinder through all of the switch positions.
   - If the lock cylinder operates correctly, install a new ignition switch.

- If the lock cylinder does not operate correctly, install a new steering column lock module. Refer to Steering Column Lock Module in this section.

Ignition Switch



Item	Part Number	Description
1	3530	Upper steering column shroud
2	3K512	Lower steering column shroud
3	W707658	Lower steering column shroud screw (3 required)
4	5404459	Steering column opening cover
5	-	Ignition switch electrical connector (part of 14401)
6	11572	Ignition switch

Removal and Installation

NOTICE: **Do not remove the ignition lock cylinder and the ignition switch at the same time or damage to the column may result.**

1. Depower the Supplemental Restraint System (SRS). For additional information, refer to Section 501-20B .

2. **NOTE:** The steering column opening cover is held in place by tabs that clip to the instrument panel.

   Remove the steering column opening cover by pulling straight outward.

3. **NOTE:** Release the upper steering column shroud, by pressing inward on the sides of the shroud and lifting upwards.

   Remove the upper steering column shroud.

4. Release the tilt lever, remove the 3 lower steering column shroud screws and then the shroud.

5. **NOTE:** Lower the steering column to the lowest tilt position.

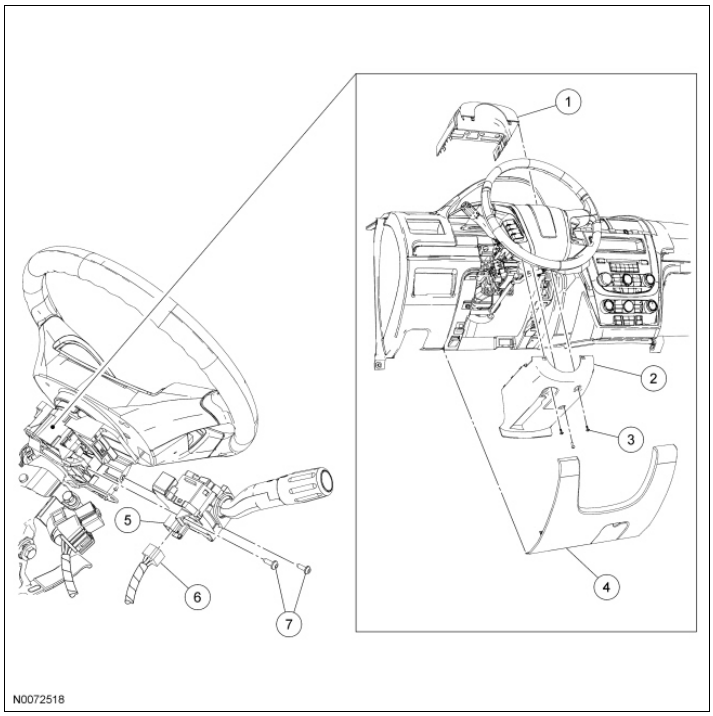
   Disconnect the ignition switch electrical connector.

6. Press the 2 tabs and remove the ignition switch.

7. To install, reverse the removal procedure.

8. Repower the SRS . For additional information, refer to Section 501-20B .

Steering Column Multifunction Switch



Item	Part Number	Description
1	3530	Upper steering column shroud
2	3K512	Lower steering column shroud
3	W707658	Lower steering column shroud screw (3 required)
4	5404459	Steering column opening cover
5	14K147	Multifunction switch
6	-	Multifunction switch electrical connector (part of 14401)
7	W503521	Multifunction switch screws (2 required)

Removal and Installation

1. **NOTE:** The steering column opening cover is held in place by tabs that clip to the instrument panel.

   Remove the steering column opening cover by pulling straight outward.

2. **NOTE:** Release the upper steering column shroud, by pressing inward on the sides of the shroud and lifting upwards.

   Remove the upper steering column shroud.

3. Release the tilt lever, remove the 3 lower steering column shroud screws and then the shroud.

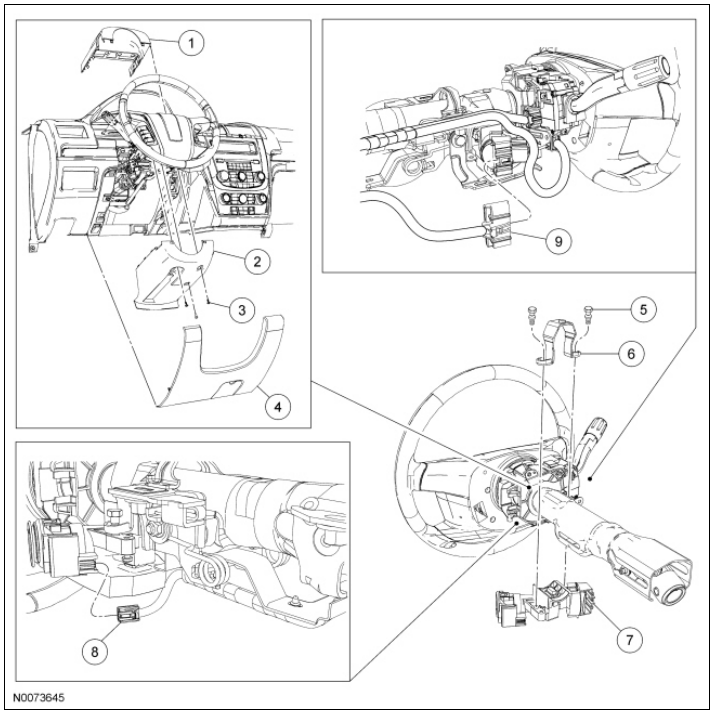
4. Disconnect the multifunction switch electrical connector.

5. Remove the 2 multifunction switch screws and the switch.

6. To install, reverse the removal procedure.

Steering Column Lock Module

Removal and Installation



Item	Part Number	Description
1	3530	Upper steering column shroud
2	3K512	Lower steering column shroud
3	W707658	Lower steering column shroud screw (3 required)
4	5404459	Steering column opening cover
5	12049	Steering column lock module bolt (2 required)
6	-	Steering column lock module clamp (part of 3K772)
7	3K772	Steering column lock module assembly
8	-	Passive Anti-Theft System (PATS) electrical connector (part of 14401)
9	-	Ignition switch electrical connector (part of 14401)

1. **NOTE:** The steering column opening cover is held in place by tabs that clip to the instrument panel.

   Remove the steering column opening cover by pulling straight outward.

2. **NOTE:** Release the upper steering column shroud, by pressing inward on the sides of the shroud and lifting upwards.

   Remove the upper steering column shroud.

3. Release the tilt lever, remove the 3 lower steering column shroud screws and then the shroud.

4. Disconnect the Passive Anti-Theft System (PATS) and ignition switch electrical connectors.

5. Disconnect the multifunction switch electrical connector.

6. **NOTE:** After cutting slots in the lock module bolts, clean all metal shavings and foreign material from the steering column.

   Using a suitable tool, cut slots into the heads of the 2 steering column lock module bolts.

7. **NOTE:** The lock module bolts are designed to sheer off when tightened.

   Remove the 2 steering column lock module bolts using a screwdriver.

   - Discard the bolts.
   - To install, use new steering column lock module bolts and tighten until the heads of the bolts shear off.

8. Remove the steering column lock module clamp and the steering column lock module assembly.

9. **NOTE:** Align the locating tab on the steeriumn lock module with the window of the steering column tube. Verify that the lock module operates correctly.

   To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
A/C Cooling Coil Coating YN-29	-	-
A/C System Flushing Solvent YN-23	-	-
Motorcraft® Electric A/C Compressor Oil YN-32	-	Hybrid vehicles only 130 ml (4.4 fl oz)
PAG Refrigerant Compressor Oil (R-134a Systems) YN-12-D	WSH-M1C231-B	Non-hybrid vehicles only 177 ml (6 fl oz)
R-134a Refrigerant YN-19 (US); CYN-16-P or CYN-16-R (Canada)	WSH-M17B19-A	0.62 kg (22 oz) (1.38 lb)

General Specifications

	Specification
A/C Compressor (Non-Hybrid)	
Type	SP17
A/C Compressor Magnetic Clutch	
Air gap clearance	0.3-0.6 mm (0.012-0.024 in)
A/C Pressure Relief Valve [a]	
Close pressure	3103 kPa (450 psi)
Open pressure	3,792-4,137 kPa (550-600 psi)
Evaporator Discharge Air Temperature Sensor	
OFF temperature	2°C (36°F)
ON temperature	3°C (37°F)
Refrigerant System Dye	
R-134a Leak Detection Dye 164-R6060 or 164-R6081	-

[a] Manifold gauge set pressures may vary slightly depending on the distance between the service gauge port valve and the A/C pressure relief valve, the A/C cycling switch or the pressure cutoff switch location.

Climate Control System

⚠ WARNING: Take the following precautions when repairing an air conditioning system containing R-134a:

- ♦ Always wear safety goggles.
- ♦ Avoid contact with liquid refrigerant R-134a. R-134a vaporizes at approximately -25°C (-13°F) under atmospheric pressure and will freeze skin tissue.
- ♦ Never allow refrigerant R-134a gas to escape in quantity in an occupied space. It will displace the oxygen needed to support life.
- ♦ Never use a torch in an atmosphere containing R-134a gas. R-134a is non-toxic at all normal conditions, but it decomposes when exposed to high temperatures such as a torch flame. During decomposition it releases irritating and toxic gasses (as described in the MSDS sheet from the manufacturer). Decomposition products are hydrofluoric acid, carbon dioxide and water.

Failure to follow theseuctions may result in serious personal injury.

NOTICE: **To avoid damaging the vehicle or Air Conditioning (A/C) components, the following precautions must be observed.**

- The A/C refrigerant of all vehicles must be identified and analyzed prior to refrigerant charging. Failure to do so can contaminate the shop bulk refrigerant and other vehicles.
- Do not add R-12 refrigerant to an A/C system that requires the use of R-134a refrigerant. These 2 types of refrigerant must never be mixed. Doing so can damage the A/C system.
- Charge the A/C system with R-134a refrigerant gas while the engine is running only at the low-pressure side to prevent refrigerant slugging from damaging the A/C compressor.
- Use only R-134a refrigerant. Due to environmental concerns, when the A/C system is drained, the refrigerant must be collected using refrigerant recovery/recycling equipment. Federal, State/Provincial and/or local laws REQUIRE that R-134a be recovered into appropriate recovery equipment and the process be conducted by qualified technicians who have been certified by an approved organization, such as Automotive Service Excellence (ASE) or Mobile Air Conditioning Society (MACS). Use of a recovery machine dedicated to R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns. Refer to the instructions provided by the equipment manufacturer when removing refrigerant from or charging the A/C system.
- Refrigerant R-134a must not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. R-134a is combustible when mixed with high concentrations of air and higher pressures.
- A number of manufacturers are producing refrigerant products that are described as direct substitutes for refrigerant R-134a. The use of any unauthorized substitute refrigerant can severely damage the A/C components. If repair is required, use only new or recycled refrigerant R-134a.

NOTICE: **To avoid contamination of the Air Conditioning (A/C) system, the following precautions must be observed.**

- Never open or loosen a connection before recovering the refrigerant.
- When loosening a connection, if any residual pressure is evident, allow it to leak out before opening the fitting.
- Evacuate a system that has been opened to install a new component or one that has discharged through leakage before charging.
- Seal open fittings with a cap or plug immediately after disconnecting a component from the system.

- Clean the outside of the fittings thoroughly before disconnecting a component from the system.
- Do not remove the sealing caps from a new component until ready to install.
- Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open an oil container until ready to use and install the cap immediately after using. Store the oil in a clean, moisture-free container.
- Install a new O-ring seal before connecting an open fitting. Coat the fitting and O-ring seal with PAG oil before connecting.
- When installing a refrigerant line, avoid sharp bends. Position the line away from the exhaust or any sharp edges that can chafe the line.
- Tighten threaded fittings only to specifications. The steel and aluminum fittings used in the refrigerant system will not tolerate overtightening.
- When disconnecting a fitting, use a wrench on both halves of the fitting to prevent twisting of the refrigerant lines or tubes.
- Do not open a refrigerant system or uncap a new component unless it is as close as possible to room temperature. This will prevent condensation from forming inside a component that is cooler than the surrounding air.

The Electronic Manual Temperature Control (EMTC) system heats or cools the vehicle depending on the HVAC module - control panel selection.

- The control panel selectiondetermine heating or cooling, air distribution and enables blower motor operation.
- The temperature control setting determines the air temperature.
- The blower motor switch varies the blower motor speed.
- During A/C operation, the system also reduces the relative humidity of the air.

The Dual Automatic Temperature Control (DATC) system maintains the selected vehicle interior temperature by heating and/or cooling the air.

- During A/C operation, the system also reduces the relative humidity of the air.
- The driver may override the automatic mode of operation.
- The temperature control setting determines the air temperature.
- The blower motor control override buttons vary the blower motor speed.
- The driver side and passenger side temperature settings can be individually controlled.

The system consists of the following components:

- A/C compressor
- A/C compressor clutch assembly
- A/C condenser core
- A/C evaporator core
- Receiver/drier
- Connecting refrigerant lines
- Thermostatic Expansion Valve (TXV)
- A/C pressure transducer
- Heater core and evaporator core housing
- HVAC module
- Front Controls Interface Module (FCIM) (Fusion with navigation and all MKZ)
- Audio Control Module (ACM) (all vehicles equipped with navigation systems)
- Temperature blend door actuators
- Defrost/panel/floor mode door actuator
- Air inlet mode door actuator
- Blower motor resistor (EMTC systems only)
- Blower motor speed control (DATC systems only)

- Blower motor
- Ambient air temperature sensor
- In-vehicle temperature sensor (DATC systems only)
- Sunload sensor (DATC systems only)
- Evaporator temperature sensor

Electronic Manual Temperature Control (EMTC) System

The EMTC system heats or cools the vehicle depending on the control panel selection.

- The control panel selections determine heating or cooling, air distribution and enables blower motor operation.
- The temperature control setting determines the air temperature.
- The blower motor switch varies the blower motor speed.
- During A/C operation the system also reduces the relative humidity of the air.

The EMTC system operation is determined by the settings on the climate controls. To control the various functions, the EMTC system is composed of the following:

- HVAC module
- Blower motor resistor
- Defrost/panel/floor mode door actuator
- Air inlet mode door actuator
- Temperature blend door actuator
- Evaporator temperature sensor
- Ambient air temperature sensor

The blower motor switch:

- sets the blower motor speed.
- is serviced only with the HVAC module.

The A/C request button:

- can command the A/C compressor ON when the function selector switch is in PANEL, FLOOR/PANEL, FLOOR/DEFROST and FLOOR when the A/C request switch is pressed. Indicator illuminates when A/C request switch is toggled ON.
- indicator illuminates when the function selector switch is in MAX A/C and cannot be toggled.
- is serviced only with the HVAC module.

The function selector:

- selects airflow direction.
- is serviced only with the HVAC module.

The temperature selector:

- selects full warm and full cool as well as blended outlet temperatures.
- is serviced only with the HVAC module.

The air recirculation button:

- selects either recirculated or outside air source.

- recirculates air in any mode except DEFROST, if requested.
- is disabled in MAX A/C or OFF mode where recirculated air only is used.
- is disabled in DEFROST mode where outside air only is used.
- is serviced only with the HVAC module.

Dual Automatic Temperature Control (DATC) System

NOTE: For the passenger side temperature setting on hybrid vehicles equipped with dual-zone Electronic Automatic Temperature Control (EATC) and a Front Controls Interface Module (FCIM) built on or after 04/08/2009 to be functional, a passenger must be seated in the front passenger seat. If the front passenger seat is not occupied, the HVAC module will control the system based only on the driver side temperature setting. The HVAC module receives a Medium Speed Controller Area Network (MS-CAN) signal from the FCIM to indicate if the front passenger seat is occupied.

The DATC system maintains the selected vehicle interior temperature by heating and/or cooling the air.

- During A/C operation, the system also reduces the relative humidity of the air.
- The driver may override the automatic mode of operation.
- The temperature control setting determines the desired air temperature.
- The blower motor control override button varies the blower motor speed.
- The driver side and passenger side temperature settings can be individually controlled.

The DATC system operation is determined by the settings on the climate controls. The HVAC system automatically maintains a selected temperature for vehicle interior comfort. To control the various functions, the DATC system is composed of the following:

- HVAC module
- Front Controls Interface Module (FCIM) (Fusion with navigation and all MKZ)
- Audio Control Module (ACM) (all vehicles equipped with navigation systems)
- Blower motor speed control
- Defrost/panel/floor mode door actuator
- Air inlet mode door actuator
- LH and RH temperature blend door actuators
- In-vehicle temperature sensor
- Ambient air temperature sensor
- Sunload sensor
- Evaporator temperature sensor

When the DATC system is set to AUTO:

- the air distribution direction, blower motor speed and A/C compressor operation are automatically controlled based on the temperature(s) selected.

The DATC system manual override settings:

- allow the air distribution direction to be manually selected.
- allow the blower motor speed to be manually selected.
- allow recirculation mode to be manually selected in all modes except DEFROST. The A/C request can be cancelled by pressing the A/C request switch, turning the indicator OFF.
- allow A/C compressor operation to be manually selected except in DEFROST.

External Temperature Display

While the actual external temperature can vary continuously, the value that is displayed will update at a specific rate depending on whether or not the engine is "hot" and whether or not the vehicle is moving.

When the external temperature is rising, the display will update slowly.

Updates (when the actual external temperature is higher than currently displayed value) will be limited to 0.6°C (1°F) every 20 seconds while the vehicle is moving at greater than 40 km/h (25 mph) for more than 90 seconds or 0.6°C (1°F) every 20 minutes if the vehicle is not moving at this speed. This is to prevent the heat from the engine compartment from affecting the accuracy of the display.

When the external temperature is dropping, the display will update quickly.

Updates (when the actual external temperature is lower than currently displayed value) will only be limited to 0.6°C (1°F) every 2 seconds (regardless of vehicle speed). Consequently the display will essentially follow the drop ienced by the external temperature thermistor.

System Airflow Description - Electronic Manual Temperature Control (EMTC)

Max A/C

When MAX A/C is selected:

- the air inlet mode door actuator closes off outside air and admits only recirculated air.
- the RECIRC button is disabled and the indicator is illuminated.
- the defrost/panel/floor mode door directs airflow to the instrument panel A/C registers.
- blended air temperature is available.
- the A/C request button is illuminated and will be disabled.
- the A/C compressor will operate if the outside temperature is above approximately 6°C (43°F).
- the blower motor is ON.

PANEL

When PANEL is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator ON), the air inlet door actuator closes off outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator OFF), the air inlet mode door actuator admits only outside air into the passenger compartment.
- the defrost/panel/floor mode door directs airflow to the instrument panel A/C registers.
- blended air temperature is available.
- the A/C request button is enabled. The A/C compressor can operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 6°C (43°F).
- the blower motor is ON.

PANEL/FLOOR

When PANEL/FLOOR is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator ON), the air inlet door actuator closes off outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator OFF), the air inlet mode door actuator admits only outside air into the passenger compartment. the defrost/panel/floor mode door directs airflow to the floor duct and the instrument panel A/C registers. A small amount of airflow from the side window demisters

and defrost duct will be present.
- blended air temperature is available.
- the A/C request button is enabled. The A/C compressor can operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 6°C (43°F).
- the blower motor is ON.

OFF

When OFF is selected:

- the air inlet door actuator closes off outside air and admits only recirculated air.
- the blower motor is OFF.

FLOOR

When FLOOR is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator ON), the air inlet door actuator closes off outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator OFF), the air inlet mode door actuator admits only outside air into the passenger compartment.
- the defrost/panel/floor mode door directs airflow to the floor duct. A small amount of airflow from the defroster duct and side window demisters will be present.
- blended air temperature is available.
- the A/C request button is enabled. The A/C compressor can operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 6°C (43°F).
- the blower motor is ON.

FLOOR/DEFROST

When the FLOOR/DEFROST is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator ON), the air inlet mode door actuator closes off outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator OFF), the air inlet mode door actuator admits only outside air into the passenger compartment.
- therost/panel/floor mode door directs airflow to the floor duct, the defroster duct and the side window demisters.
- blended air temperature is available.
- the A/C request button will indicate the last status and the indicator can be toggled. To reduce fogging, the A/C compressor will operate automatically, regardless of indicator status, if the outside temperature is above approximately 6°C (43°F).
- the blower motor is ON.

DEFROST

When DEFROST is selected:

- the air inlet mode door actuator opens, admitting only outside air into the passenger compartment.
- the defrost/panel/floor mode door directs airflow to the defroster duct and side window demisters. A small amount of airflow from the floor duct will be present.
- blended air temperature is available.
- the A/C request button will indicate the last status and the indicator can be toggled. To reduce fogging, the A/C compressor will operate automatically, regardless of indicator status, if the outside

temperature is above approximately 6°C (43°F).
- the blower motor is ON.

System Airflow Description - Dual Automatic Temperature Control (DATC)

AUTO

When AUTO is selected:

- the temperature control setting is manually set to the desired setting.
- the air inlet mode door actuator is automatically controlled by the HVAC module, based on the temperature setting.
- the door actuators are automatically controlled by the HVAC module, based on the temperature setting.
- the A/C compressor is automatically controlled by the HVAC module, based on the temperature setting. The A/C compressor will not operate if the outside temperature is below approximately 6°C (43°F).
- the A/C request button or the RECIRC request button, if pressed, will transfer the system to semi-auto operation.
- the blower motor he blower motor speed is automatically controlled by the HVAC module, based on the temperature setting, but can be manually overridden.

OFF

When OFF is selected:

- the air inlet door actuator closes off outside air and admits only recirculated air.
- the blower motor is OFF.

PANEL

When PANEL is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator ON), the air inlet mode door actuator closes off outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator OFF), the air inlet mode door actuator admits only outside air into the passenger compartment.
- the defrost/panel/floor mode door directs airflow to the instrument panel A/C registers.
- blended air temperature is available. Only when A/C compressor operation has been selected by pressing the A/C request button (indicator ON), can the airflow temperature be cooled below the outside air temperature.
- the A/C request button is enabled. The A/C compressor can operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 6°C (43°F).
- the blower motor is ON.

PANEL/FLOOR

When PANEL/FLOOR is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator ON), the air inlet mode door actuator closes off outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator OFF), the air inlet mode door actuator admits only outside air into the passenger compartment.

- the defrost/panel/floor mode door directs airflow to the floor duct and the instrument panel A/C registers. A small amount of airflow from the side window demisters and defrost duct will be present.
- blended air temperature is available. Only when A/C mpressor operation has been selected by pressing the A/C request button (indicator ON), can the airflow temperature be cooled below the outside air temperature.
- the A/C request button is enabled. The A/C compressor can operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 6°C (43°F).
- the blower motor is ON.

FLOOR

When FLOOR is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator ON), the air inlet mode door actuator closes off outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator OFF), the air inlet mode door actuator admits only outside air into the passenger compartment.
- the defrost/panel/floor mode door directs airflow to the floor duct. A small amount of airflow from the defroster duct and side window demisters will be present.
- blended air temperature is available. Only when A/C compressor operation has been selected by pressing the A/C request button (indicator ON), can the airflow temperature be cooled below the outside air temperature.
- the A/C request button is enabled. The A/C compressor can operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 6°C (43°F).
- the blower motor is ON.

FLOOR/DEFROST

When the FLOOR/DEFROST is selected:

- the RECIRC request button is enabled. If the RECIRC request button is selected (indicator ON), the air inlet mode door actuator closes off outside air from entering the passenger compartment. If the RECIRC request button is not selected (indicator OFF), the air inlet mode door actuator admits only outside air into the passenger compartment.
- the defrost/panel/floor mode door directs airflow to the floor duct, the defroster duct and the side window sters.
- blended air temperature is available.
- the A/C request button is enabled. The A/C compressor will operate automatically and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 6°C (43°F).
- the blower motor is ON.

DEFROST

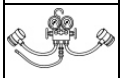
When DEFROST is selected:

- the RECIRC request button and indicator is disabled. Regardless of button and indicator status, the air inlet mode door actuator admits only outside air into the passenger compartment.
- the defrost/panel/floor mode door directs airflow to the defroster duct and side window demisters. A small amount of airflow from the floor duct will be present.
- blended air temperature is available.
- the A/C request button will indicate the last status and the indicator can be toggled. To reduce fogging, the A/C compressor will operate automatically, regardless of indicator status, if the outside temperature is above approximately 6°C (43°F).

- the blower motor is ON.

Climate Control System

Special Tool(s)

 ST2985-A	A/C Flush Adapter Kit 219-00074 or equivalent
 ST2574-A	Flex Probe Kit 105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3072-A	Heated Pentode Halogen Leak Detector 023-00012 or equivalent
 ST1474-A	Pressure Test Kit 014-R1072 or equivalent
 ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent
 ST3094-A	Test Light SGT27000 or equivalent 250-300 mA incandescent bulb test lamp
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

There are 4 main principles involved with the basic theory of operation:

- Heat transfer
- Latent heat of vaporization
- Relative humidity
- Effects of pressure

Heat Transfer

If 2 substances of different temperature are placed near each other, the heat in the warmer substance will transfer to the colder substance.

Latent Heat of Vaporization

When a liquid boils (converts to gas), it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (converts back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

Relative Humidity

The amount of moisture (water vapor content) that the air can hold is directly related to the air temperature. The more heat there is in the air, the more moisture the air can hold. The lower the moisture content in the air, the more comfortable occupants feel. Removing the moisture from the air lowers its relative humidity and improves personal comfort.

Effects of Pressure on Boiling or Condensation

As the pressure is increased on a liquid, the temperature at which the liquid boils (converts to gas) also increases. Conversely, when the pressure on a liquid is reduced, its boiling point is also reduced. When in the gas state, an increase in pressure causes an increase in temperature, while a decrease in pressure will decrease the temperature of the gas.

Compressor Anti-Slugging Strategy (CASS)

Liquid refrigerant may accumulate in the A/C compressor under certain conditions. To alleviate damage to the A/C compressor, Compressor Anti-Slugging Strategy (CASS) is utilized.

CASS is initiated only under specific conditions:

- The ignition is off for more than 8 hours
- The ambient temperature is above -4Â°C (25Â°F)
- Battery voltage is above 8.5 volts during engine cranking

When these conditions are present, the PCM will activate the A/C control relay prior to cranking of the engine. The A/C control relay engages the A/C compressor for approximately 4-15 A/C compressor revolutions or a maximum of 2 seconds (depending upon vehicle application), allowing the liquid refrigerant to be pushed from the A/C compressor. CASS is initiated by the PCM regardless of the system settings.

The Refrigerant Cycle

During stabilized conditions (A/C system shutdown), the refrigerant pressures are equal throughout the system. When the A/C compressor is in operation, it increases pressure on the refrigerant vapor, raising its temperature. The high-pressure and high-temperature vapor is then released into the top of the A/C condenser core.

The A/C condenser, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant by ambient air passing over the fins and tubing. The now liquid refrigerant, still at high pressure, exits from the bottom of the A/C condenser and enters the inlet side of the A/C receiver/drier. The receiver/drier is designed to remove moisture from the refrigerant.

The outlet of the receiver/drier is connected to the Thermostatic Expansion Valve (TXV). The TXV provides the orifice which is the restriction in the refrigerant system and separates the high and low pressure sides of the A/C system. As the liquid refrigerant passes across this restriction, its pressure and boiling point are reduced.

The liquid refrigerant is now at its lowest pressure and temperature. As it passes through the A/C evaporator,

it absorbs heat from the airflow passing over the plate/fin sections of the A/C evaporator. This addition of heat causes the refrigerant to boil (convert to gas). The now cooler air can no longer support the same humidity level of the warmer air and this excess moisture condenses on the exterior of the evaporator coils and fins and drains outside the vehicle.

The refrigerant cycle is now repeated with the A/C compressor again increasing the pressure and temperature of the refrigerant.

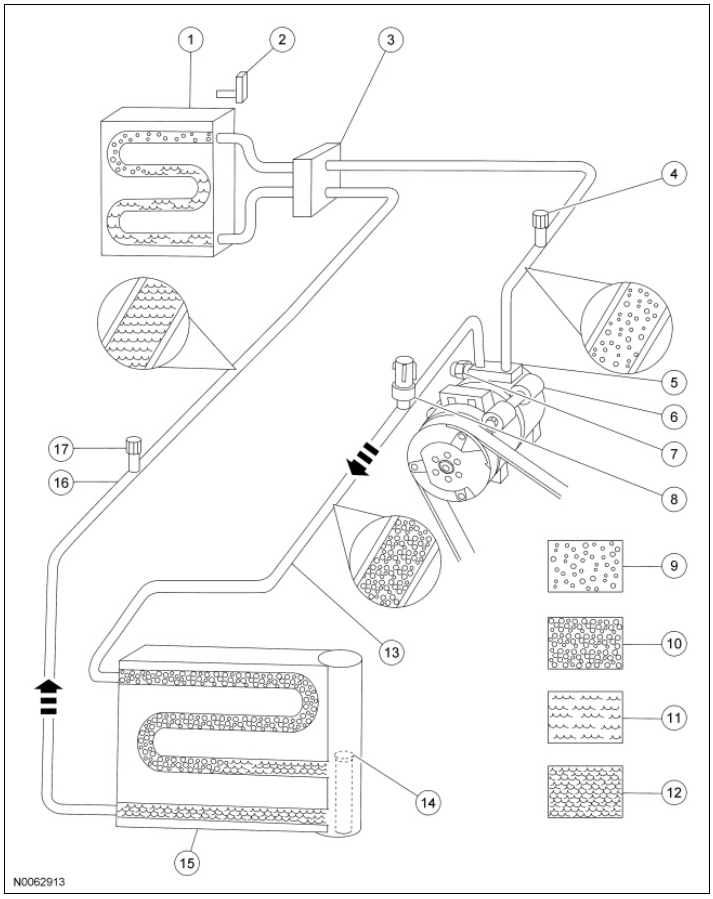
A thermistor which monitors the temperature of the air that has passed through the evaporator core controls A/C clutch cycling. If the temperature of the evaporator core discharge air is low enough to cause the condensed water vapor to freeze, the A/C clutch is disengaged by the vehicle PCM.

The high-side line pressure is also monitored so that A/C compressor operation will be interrupted if the system pressure becomes too high or is determined to be too low (low charge condition).

The A/C compressor thermal protection switch will interrupt compressor operation if the compressor housing exceeds temperature limits.

The A/C compressor relief valve will open and vent refrigerant to relieve unusually high system pressure.

Thermostatic Expansion Valve (TXV) Type Refrigerant System



Item	Description
1	A/C evaporator core
2	A/C evaporator core temperature sensor

3	Thermostatic Expansion Valve (TXV)
4	A/C charge valve port (low side)
5	A/C suction line
6	A/C compressor
7	A/C pressure relief valve
8	A/C pressure transducer
9	Low-pressure vapor
10	High-pressure vapor
11	Low-pressure liquid
12	High-pressure liquid
13	Compressor discharge line
14	A/C desiccant cartridge
15	A/C condenser core with A/C receiver/drier
16	Condenser-to-evaporator line
17	A/C charge valve port (high side)

Inspection and Verification

1. Verify the customer's concern by operating the climate control system to duplicate the condition.
2. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
• Loose, missing or damaged A/C compressor drive belt • Loose or disconnected A/C clutch • Broken or binding door/actuator • Broken or leaking refrigerant lines • Obstructed in-vehicle temperature sensor • Disconnected in-vehicle temperature aspirator hose	• Battery Junction Box (BJB) fuse: ♦ 25 (10A) ♦ 35 (40A) ♦ 47 (10A) • Smart Junction Box (SJB) fuse: ♦ 15 (10A) ♦ 45 (5A) • Blower motor inoperative • A/C compressor inoperative • Circuitry open/shorted • Disconnected electrical connectors • Cooling fan inoperative

3. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.
4. **NOTE:** Make sure to use the latest scan tool software release.

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM, HVAC module.

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

8. Clear the continuous DTCs and carry out the self-test diagnostics from the PCM or HVAC module.

9. **NOTE:** Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

   If the HVAC DTCs retrieved are related to the concern, go to the HVAC Module DTC Chart. If the PCM DTCs retrieved are related to the concern, go to the PCM DTC Chart. For all other DTCs, refer to Section 419-10 .

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Climate Control Systems or GO to Symptom Chart - NVH .

DTC Charts

PCM DTC Chart

DTC	Description	Action to Take
P0532	A/C Pressure Refrigerant Sensor A Circuit Low	GO to Pinpoint Test A .
P0533	A/C Refrigerant Pressure Sensor A Circuit High	GO to Pinpoint Test A .
P0645	Air Conditioning Clutch Relay (A/CCR) Control Circuit	GO to Pinpoint Test B .
P1464	A/C Demand Out Of Self Test Range	If the HVAC selector was not in the OFF position, place it in the OFF position, CLEAR the DTCs and REPEAT the self-test. If the DTC does not return, ignore the DTC and continue diagnostics. If the DTC returns, INSTALL a new HVAC module. CLEAR the DTCs and REPEAT the

		self-test.
All Other DTCs	â	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

HVAC Module DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

NOTE: Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

DTC	Description	Action to Take
B1081:07	Left Temperature Damper Motor: Mechanical Failure	GO to Pinpoint Test P .
B1081:11	Left Temperature Damper Motor: Circuit Short to Ground	GO to Pinpoint Test P .
B1081:12	Left Temperature Damper Motor: Circuit Short to Battery	GO to Pinpoint Test P .
B1081:13	Left Temperature Damper Motor: Circuit Open	GO to Pinpoint Test P .
B1082:07	Right Temperature Damper Motor: Mechanical Failure	GO to Pinpoint Test P .
B1082:11	Right Temperature Damper Motor: Circuit Short to Ground	GO to Pinpoint Test P .
B1082:12	Right Temperature Damper Motor: Circuit Short to Battery	GO to Pinpoint Test P .
B1082:13	Right Temperature Damper Motor: Circuit Open	GO to Pinpoint Test P .
B1083:11	Recirculation Damper Motor: Circuit Short to Ground	GO to Pinpoint Test J .
B1083:12	Recirculation Damper Motor: Circuit Short to Battery	GO to Pinpoint Test J .
B1083:13	Recirculation Damper Motor: Circuit Open	GO to Pinpoint Test J .
B1086:07	Air Distribution Damper Motor: Mechanical Failures	GO to Pinpoint Test K .
B1086:11		GO to Pinpoint Test K .

	Air Distribution Damper Motor: Circuit Short to Ground	
B1086:12	Air Distribution Damper Motor: Circuit Short to Battery	GO to Pinpoint Test K .
B1086:13	Air Distribution Damper Motor: Circuit Open	GO to Pinpoint Test K .
B10AF:12	Blower Fan Relay: Circuit Short to Battery	Electronic Manual Temperature Control (EMTC) systems, GO to Pinpoint Test Q . Dual Automatic Temperature Control (DATC) systems, GO to Pinpoint Test S .
B10AF:14	Blower Fan Relay: Circuit Short to Ground or Open	For EMTC systems, if the blower motor is inoperative, GO to Pinpoint Test Q . For EMTC systems, if the blower motor is always on, GO to Pinpoint Test R . For DATC systems, if the blower motor is inoperative, GO to Pinpoint Test S . For DATC systems, if the blower motor relay is always on, GO to Pinpoint Test T .
B10B8:00	Push Buttons: No Sub Type Information	**Without** navigation, button held too long may set DTC. ATTEMPT to clean buttons. CLEAR the DTCs. REPEAT the self-test. If code returns, INSTALL a new HVAC module. **With** navigation, button held too long may set DTC. ATTEMPT to clean buttons. CLEAR the DTCs. REPEAT the self-test. If code returns, INSTALL a new Front Controls Interface Module (FCIM).
B10B9:12	Blower Control: Circuit Short to Battery	GO to Pinpoint Test S .
B10B9:14	Blower Control: Circuit Short to Ground or Open	If the blower motor is inoperative, GO to Pinpoint Test S . If the blower motor is always on or operates incorrectly, GO to Pinpoint Test T .
B11E5:11	Left HVAC Damper Position Sensor: Circuit Short to Ground	GO to Pinpoint Test P .
B11E5:15	Left HVAC Damper Position Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test P .
B11E6:11	Right HVAC Damper Position Sensor: Circuit Short to Ground	GO to Pinpoint Test P .
B11E6:15	Right HVAC Damper Position Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test P .
B11E7:11		GO to Pinpoint Test K .

	Air Distribution Damper Position Sensor: Circuit Short to Ground	
B11E7:15	Air Distribution Damper Position Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test K .
B1A61:11	Cabin Temperature Sensor: Circuit Short to Ground	GO to Pinpoint Test D .
B1A61:15	Cabin Temperature Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test D .
B1A63:11	Right Solar Sensor: Circuit Short to Ground	GO to Pinpoint Test F .
B1A63:15	Right Solar Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test F .
B1A64:11	Left Solar Sensor: Circuit Short to Ground	GO to Pinpoint Test F .
B1A64:15	Left Solar Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test F .
B1A68:11	Ambient Temperature Sensor: Circuit Short to Ground	GO to Pinpoint Test E .
B1A68:15	Ambient Temperature Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test E .
B1B71:11	Evaporator Temperature Sensor: Circuit Short to Ground	GO to Pinpoint Test G .
B1B71:15	Evaporator Temperature Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test G .
C1B14:11	Sensor Supply Voltage A: Circuit Short to Ground	GO to Pinpoint Test C .
C1B14:12	Sensor Supply Voltage A: Circuit Short to Battery	GO to Pinpoint Test C .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	REFER to Section 418-00 to diagnose lost communication with the Smart Junction Box (SJB).
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Module: No Sub Type Information	REFER to Section 418-00 to diagnose lost communication with the IPC module.
U0163:00	Lost Communication With navigation Control Module: No Sub Type Information	REFER to Section 418-00 to diagnose lost communication with the Audio Control Module (ACM).
U0256:00	Lost Communication With Front Controls Interface Module (FCIM) "A": No Sub Type Information	REFER to Section 418-00 to diagnose lost communication with the FCIM .
U0422:68		

	Invalid Data Received From Body Control Module: Event Information	This DTC can set due to a fault in the SJB or because the SJB is unable to communicate over the Controller Area Network (CAN) bus. CARRY OUT a self-test of the SJB . If the scan tool indicates that the SJB is not responding, REFER to Section 418-00 to diagnose the network communication concern. If SJB DTCs are present, REFER to Section 419-10 .
U0423:68	Invalid Data Received From Instrument Panel Cluster Control Module: Event Information	This DTC can set due to a fault in the IPC or because the IPC is unable to communicate over the CAN bus. CARRY OUT a self-test of the IPC . If the scan tool indicates that the IPC is not responding, REFER to Section 418-00 to diagnose the network communication concern. If IPC DTCs are present, REFER to Section 413-01 to diagnose the IPC system fault
U0557:68	Invalid Data Received From Front Controls Interface Module (FCIM) "A": Event Information	This DTC can set due to a fault in the FCIM or because the FCIM is unable to communicate over the CAN bus. CARRY OUT a self-test of the FCIM . If the scan tool indicates that the FCIM is not responding, REFER to Section 418-00 to diagnose the network communication concern. If FCIM DTCs are present, REFER to Section 415-00 to diagnose the FCIM fault
U1000:00	Solid State Driver Protection Activated-Driver Disabled: No Sub Type Information	INSTALL a new HVAC module. REFER to Section 412-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	INSTALL a new HVAC module. REFER to Section 412-01 .
U3000:41	Control Module: General Checksum Failure	INSTALL a new HVAC module. REFER to Section 412-01 .
U3002:62	Vehicle Identification Number: Signal Compare Failure	INSTALL a new HVAC module. REFER to Section 412-01 .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test H .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test H .
All Other DTCs	â	REFER to the Master DTC Chart in Section 419-10 .

Symptom Chart â Climate Control Systems

Symptom Chart â Climate Control Systems
NOTE: Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

ConditionPossible SourcesAction

- No communication with the HVAC module

- Fuse(s)
- Circuitry open
- HVAC module communication network

- REFER to Section 418-00 .

- Unable to duplicate the customer concern and no DTCs present

- HVAC system and/or related components

- GO to Pinpoint Test I .

- Reduced outlet airflow

- Circuitry short
- A/C compressor clutch air gap
- A/C cycling switch
- A/C clutch relay
- Blower motor
- Blower motor control
- Blower motor resistor
- Blower motor switch
- PCM

- If the A/C compressor does not cycle, GO to Pinpoint Test N .
- For Electronic Manual Temperature Control (EMTC) systems, if the A/C compressor cycles normally, GO to Pinpoint Test R .
- For Dual Automatic Temperature Control (DATC) systems, if the A/C compressor cycles normally, GO to Pinpoint Test T .

- The air inlet door is inoperative

- Circuitry open/shorted
- Door actuator
- Air inlet door binding or stuck
- HVAC module

- GO to Pinpoint Test J .

- Incorrect/erratic direction of airflow from outlets

- Circuitry open/shorted
- Door actuator
- Mode door binding or stuck
- HVAC module

- GO to Pinpoint Test K .

- Insufficient, erratic or no heat

- Low engine coolant level
- Engine overheating
- Plugged or partially plugged heater core
- Temperature blend door is binding or stuck
- Temperature blend door actuator
- Heater hose is kinked or binding

- GO to Pinpoint Test L .

- The air conditioning (A/C) is inoperative

- Fuse(s)
- Circuitry open
- A/C system discharged/low charge
- PCM
- HVAC module
- A/C clutch relay
- A/C compressor clutch air gap
- A/C pressure transducer
- Evaporator discharge temperature sensor
- A/C clutch field coil

- GO to Pinpoint Test M .

- The air conditioning (A/C) is always on â A/C compressor does not cycle

- Circuitry shorted
- PCM
- A/C clutch relay
- A/C compressor clutch air gap
- A/C pressure transducer
- A/C clutch field coil

- GO to Pinpoint Test N .

- The air conditioning (A/C) is always on â A/C mode always commanded ON

- Circuitry shorted
- PCM
- HVAC module

- GO to Pinpoint Test O .

- Temperature control is inoperative/does not operate correctly

- Circuitry open/shorted
- HVAC module
- Temperature blend door is binding or stuck
- Temperature blend door actuator

- GO to Pinpoint Test P .

- The blower motor is inoperative â EMTC

- Fuse(s)
- Circuitry open
- Blower motor relay
- A/C blower motor
- HVAC module â EMTC

- GO to Pinpoint Test Q .

- The blower motor does not operate correctly â EMTC

- Circuitry open/shorted
- A/C blower motor resistor
- HVAC module â EMTC

- GO to Pinpoint Test R .

- The blower motor is inoperative â DATC

- Fuse(s)
- Circuitry short/open
- Blower motor relay
- A/C blower motor
- HVAC module
- A/C blower motor speed control

- GO to Pinpoint Test S .

- The blower motor does not operate correctly â DATC

- Circuitry open/shorted
- A/C blower motor speed control
- HVAC module

- GO to Pinpoint Test T .

- The temperature set point does not repeat after turning the ignition switch OFF

- Fuse
- Circuitry short/open
- HVAC module

- CARRY OUT the HVAC Module Cold Boot Process. If the condition returns, INSTALL a new HVAC module.

- The temperature display will not switch between Celsius and Fahrenheit

- HVAC module

- INSTALL a new HVAC module. REFER to Section 412-01 .

- The dual temperature control is inoperative/does not operate correctly

- Temperature blend door/actuator broken/binding
- HVAC module â Electronic Automatic Temperature Control (EATC)
- Low A/C refrigerant charge

- **NOTE:** For the passenger side temperature setting on hybrid vehicles equipped with dual-zone Electronic Automatic Temperature Control (EATC) and a Front Controls Interface Module (FCIM) built on or after 04/08/2009 to be functional, a passenger must be seated in the front passenger seat. If the front passenger seat is not occupied, the HVAC module will control the system based only on the driver side temperature setting. The HVAC module receives a Medium Speed Controller Area Network (MS-CAN) signal from the FCIM to indicate if the front passenger seat is occupied.

  CHECK that the A/C system pressure is above 290 kPa (42 psi). If the pressure is below 290 kPa (42

psi), REFER to Fluorescent Dye Leak Detection in this section. CHECK the temperature blend doors/actuators for a binding or broken condition. If no condition is found, INSTALL a new HVAC module.

- Inaccurate external temperature display

- HVAC module
- Ambient temperature sensor

- REFER to description and operation of the HVAC module external temperature display. If the external temperature display is not operating as described and no DTC is present, CARRY OUT the Ambient Temperature Sensor component test in this section. If the sensor tests OK, INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.

- A/C pressure relief valve discharging

- High system pressure
- A/C pressure relief valve

- CHECK the high side system pressure. If the pressure is below the A/C pressure relief valve open pressure, REPLACE the A/C pressure relief valve. If the system pressure is above the A/C pressure relief valve open pressure, REPAIR the system for a restriction.

Symptom Chart â NVH

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

ConditionPossible SourcesAction

- Noisy A/C compressor clutch

- A/C compressor clutch air gap out of specification

- CHECK and ADJUST the A/C compressor clutch gap if necessary. REFER to Air Conditioning (A/C) Clutch Air Gap Adjustment in this section. TEST the system for normal operation.
- If the A/C compressor clutch gap is OK, INSTALL an A/C compressor clutch. REFER to Section 412-01 . TEST the system for normal operation.

Pinpoint Tests

Pinpoint Test A: DTC P0532 or P0533

Refer to Wiring Diagrams Cell 23 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Electronic Engine Controls

â 2.3L for schematic and connector information.

Refer to Wiring Diagrams Cell 24 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Electronic Engine Controls
â 3.0L for schematic and connector information.

Refer to Wiring Diagrams Cell 25 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Electronic Engine Controls
â 3.5L for schematic and connector information.

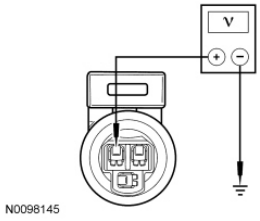
Normal Operation

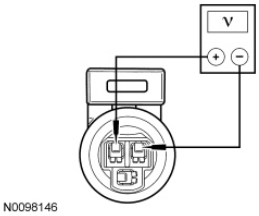
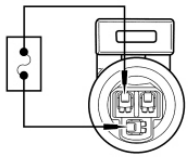
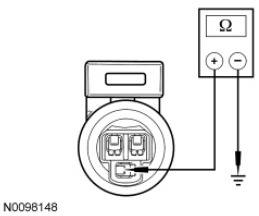
Under normal operation, the A/C pressure transducer receives a ground from the PCM through circuit RE407 (YE/VT). A 5-volt reference voltage is supplied to the A/C pressure transducer from the PCM through circuit LE424 (YE/GN). The A/C pressure transducer sends voltage to the PCM through circuit VH433 (VT/OG) to indicate the A/C pressure.

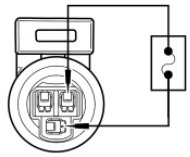
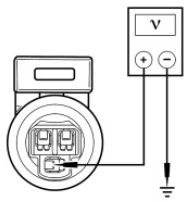
- DTC P0532 (A/C Pressure Refrigerant Sensor A Circuit Low) â The A/C pressure transducer inputs a voltage to the PCM. If the voltage is below the calibrated level, this DTC sets.
- DTC P0533 (A/C Pressure Refrigerant Sensor A Circuit High) â The A/C pressure transducer inputs a voltage to the PCM. If the voltage is above the calibrated level, this DTC sets.

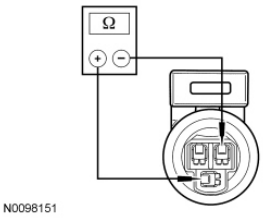
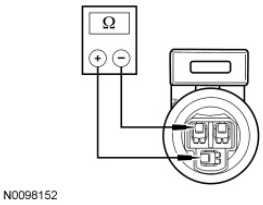
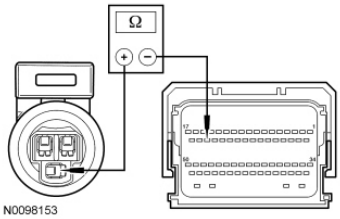
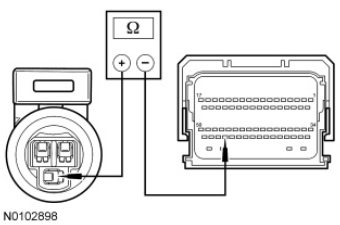
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- A/C pressure transducer
- PCM

PINPOINT TEST A: DTC P0532 OR P0533

Test Step	Result / Action to Take
A1 CHECK THE PCM OUTPUT VOLTAGE	
• Ignition OFF. • Disconnect: A/C Pressure Transducer C1260. • Ignition ON. • Measure the voltage between ground and A/C pressure transducer C1260-2, circuit LE424 (YE/GN), harness side.  N0098145 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** GO to A2 . **No** REPAIR circuit LE424 (YE/GN) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A2 CHECK THE PCM SENSOR GROUND	

• Measure the voltage between A/C pressure transducer C1260-1, circuit RE407 (YE/VT), harness side and A/C pressure transducer C1260-2, circuit LE424 (YE/GN), harness side.  N0098146 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** If diagnosing **DTC P0532** , GO to A3 . If diagnosing **DTC P0533** , GO to A5 . **No** REPAIR circuit RE407 (YE/VT) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A3 CHECK THE A/C PRESSURE TRANSDUCER HIGH	
• Enter the following diagnostic mode on the scan tool: A/C Pressure (ACP_PRESS) PCM PID. • While observing the ACP_PRESS PCM PID, connect a fused jumper between A/C pressure transducer C2160-3, circuit VH433 (VT/OG), harness side and A/C pressure transducer C1260-2, circuit LE424 (YE/GN), harness side.  N0098147 • **Does the ACP_PRESS PCM PID voltage read greater than 4 volts?**	**Yes** INSTALL a new A/C pressure transducer. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A4 .
A4 CHECK CIRCUIT VH433 (VT/OG) FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: PCM C175B. • Measure the resistance between ground and A/C pressure transducer C1260-3, circuit VH433 (VT/OG), harness side.  N0098148	**Yes** GO to A7 . **No** REPAIR circuit VH433 (VT/OG) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• **Is the resistance greater than 10,000 ohms?**	
A5 CHECK THE A/C PRESSURE TRANSDUCER HIGH	
• Enter the following diagnostic mode on the scan tool: A/C Pressure (ACP_PRESS) PCM PID. • While observing the ACP_PRESS PCM PID, connect a fused jumper between A/C pressure transducer C1260-3, circuit VH433 (VT/OG), harness side and A/C pressure transducer C1260-1, circuit RE407 (YE/VT), harness side.  N0098149 • **Does the ACP_PRESS PCM PID voltage read less than 4.9 volts?**	**Yes** INSTALL a new A/C pressure transducer. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A6 .
A6 CHECK CIRCUIT VH433 (VT/OG) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PCM C175B. • Ignition ON. • Measure the voltage between ground and A/C pressure transducer C1260-3, circuit VH433 (VT/OG), harness side.  N0098150 • **Is any voltage present?**	**Yes** REPAIR circuit VH433 (VT/OG) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A7 .
A7 CHECK CIRCUIT VH433 (VT/OG) FOR A SHORT TO CIRCUIT LE424 (YE/GN) OR RE407 (YE/VT)	
• Ignition OFF. • **NOTE: For DTC P0532 only.** • Measure the resistance between A/C pressure transducer C1260-3, circuit VH433 (VT/OG), harness side and A/C pressure transducer C1260-1, circuit RE407 (YE/VT), harness side.	**Yes** GO to A8 . **No** REPAIR circuit VH433 (VT/OG) for a short to circuit LE424 (YE/GN) or RE407 (YE/VT). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0098151 • **NOTE: For DTC P0533 only.** • Measure the resistance between A/C pressure transducer C1260-3, circuit VH433 (VT/OG), harness side and A/C pressure transducer C1260-2, circuit LE424 (YE/GN), harness side.  N0098152 • **Is the resistance greater than 10,000 ohms?**	
A8 CHECK CIRCUIT VH433 (VT/OG) FOR AN OPEN	
• **For 2.5L and 3.0L only** , measure the resistance between A/C pressure transducer C1260-3, circuit VH433 (VT/OG), harness side and PCM C175B-31, circuit VH433 (VT/OG), harness side.  N0098153 • **For 3.5L only** , measure the resistance between A/C pressure transducer C1260-3, circuit VH433 (VT/OG), harness side and PCM C175B-63, circuit VH433 (VT/OG), harness side.  N0102898 • **Is the resistance less than 5 ohms?**	**Yes** GO to A9 . **No** REPAIR circuit VH433 (VT/OG)Â for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

A9 CHECK THE PCM CONNECTION	
• Disconnect all the PCM connectors. • Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the PCM connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: DTC P0645

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

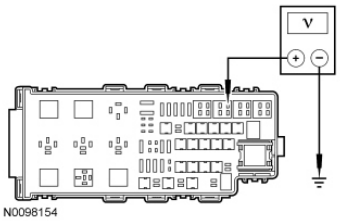
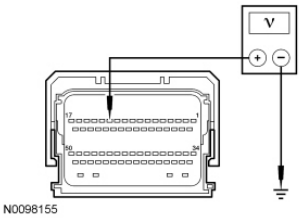
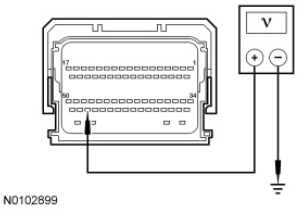
Under normal operation, voltage is provided to the A/C clutch relay coil through circuit CBK03 (GY). When A/C is requested, and A/C line pressures allow, a ground is provided to the A/C clutch relay coil from the PCM through circuit CH302 (WH/BN), energizing the A/C clutch relay.

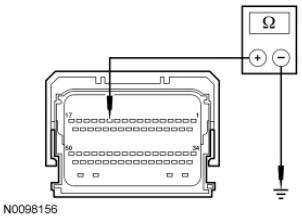
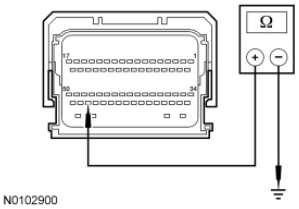
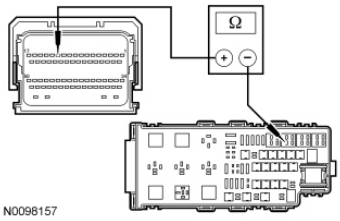
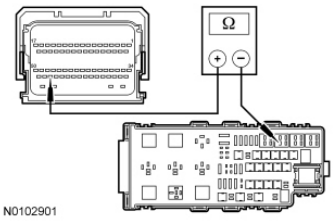
- DTC P0645 (A/C Clutch Relay Control Circuit) â The DTC sets when the PCM grounds the relay circuit and excessive current draw is detected on the relay circuit. The DTC also sets when the relay circuit is OFF and no voltage is detected on the relay circuit. The PCM expects to detect voltage coming through the relay coil to the relay circuit when it is not grounding it.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- A/C clutch relay
- PCM

PINPOINT TEST B: DTC P0645

Test Step	Result / Action to Take
B1 CHECK THE VOLTAGE TO THE A/C CLUTCH RELAY	
• Ignition OFF. • Disconnect: A/C Clutch Relay. • Ignition ON. • Measure the voltage between ground and the A/C clutch relay socket, circuit CBK03 (GY).	**Yes** CARRY OUT the A/C clutch relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing.

 N0098154 • **Is the voltage greater than 10 volts?**	If the relay tests OK, GO to B2 . **No** REPAIR circuit CBK03 (GY) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B2 CHECK CIRCUIT CH302 (WH/BN) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PCM C175B. • Ignition ON. • **For 2.5L and 3.0L only** , measure the voltage between ground and PCM C175B-12, circuit CH302 (WH/BN), harness side.  N0098155 • **For 3.5L only** , measure the voltage between ground and PCM C175B-64, circuit CH302 (WH/BN), harness side.  N0102899 • **Is any voltage present?**	**Yes** REPAIR circuit CH302 (WH/BN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B3 .
B3 CHECK CIRCUIT CH302 (WH/BN) FOR A SHORT TO GROUND	
• Ignition OFF. • **For 2.5L and 3.0L only** , measure the resistance between ground and PCM C175B-12, circuit CH302 (WH/BN), harness side.	**Yes** GO to B4 . **No** REPAIR circuit CH302 (WH/BN) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0098156 • **For 3.5L only** , measure the resistance between ground and PCM C175B-64, circuit CH302 (WH/BN), harness side.  N0102900 • **Is the resistance greater than 10,000 ohms?**	
B4 CHECK CIRCUIT CH302 (WH/BN) FOR AN OPEN	
• **For 2.5L and 3.0L only** , measure the resistance between A/C clutch relay socket, circuit CH302 (WH/BN) and PCM C175B-12, circuit CH302 (WH/BN), harness side.  N0098157 • **For 3.5L only** , measure the resistance between A/C clutch relay socket, circuit CH302 (WH/BN) and PCM C175B-64, circuit CH302 (WH/BN), harness side.  N0102901 • **Is the resistance less than 5 ohms?**	**Yes** GO to B5 . **No** REPAIR circuit CH302 (WH/BN) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B5 CHECK THE PCM CONNECTION	

• Disconnect all the PCM connectors. • Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the PCM connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: DTCs C1B14:11 and 12

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

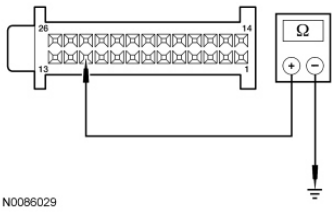
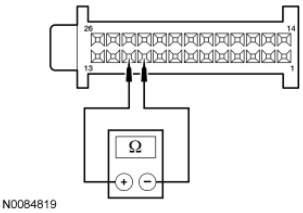
Under normal operation, a 5-volt reference voltage is supplied to the sensors and actuators from the HVAC module through circuit LH111 (BN/WH).

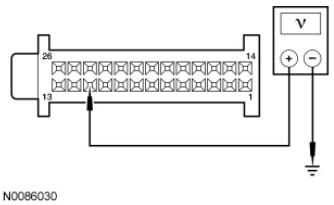
- DTC C1B14:11 (Sensor Supply Voltage A: Circuit Short to Ground) â The module senses less than 0.1 volt on the sensor reference voltage circuit, indicating a short directly to ground.
- DTC C1B14:12 (Sensor Supply Voltage A: Circuit Short to Battery) â The module senses greater than 4.9 volts on the sensor reference voltage circuit, indicating a short directly to voltage.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- HVAC module

PINPOINT TEST C: DTCs C1B14:11 AND 12

Test Step	Result / Action to Take
C1 CHECK THE SENSOR RESISTANCE	
• Check for HVAC DTCs. • **Is DTC C1B14:11 present?**	**Yes** GO to C2 . **No** GO to C4 .
C2 CHECK CIRCUIT LH111 (BN/WH) FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module â Electronic Manual Temperature Control (EMTC) C2357a. • Disconnect: HVAC Module â Dual Automatic Temperature Control (DATC) C2356a.	**Yes** GO to C3 . **No** REPAIR circuit LH111 (BN/WH) for a short to ground. CLEAR the DTCs.

• Disconnect: HVAC Module â DATC C2356b. • Measure the resistance between ground and HVAC module â EMTC C2357a-11 or HVAC module â DATC C2356a-11, circuit LH111 (BN/WH), harness side.  N0086029 • **Is the resistance greater than 10,000 ohms?**	REPEAT the self-test. TEST the system for normal operation.
C3 CHECK CIRCUITS LH111 (BN/WH) AND RH111 (GY/BU) FOR A SHORT TOGETHER	
• Measure the resistance between HVAC module â EMTC C2357a-11 or HVAC module â DATC C2356a-11, circuit LH111 (BN/WH), harness side and HVAC module â EMTC C2357a-10 or HVAC module C2356a-10, circuit RH111 (GY/BU), harness side.  N0084819 • **Is the resistance greater than 200 ohms?**	**Yes** GO to C5 . **No** REPAIR circuits LH111 (BN/WH) and RH111 (GY/BU) for a short together. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C4 CHECK CIRCUIT LH111 (BN/WH) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Ignition ON. • Measure the voltage between ground and HVAC module â EMTC C2357a-11 or HVAC module â DATC C2356a-11, circuit LH111 (BN/WH), harness side.	**Yes** REPAIR circuit LH111 (BN/WH) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to C5 .

 • **Is any voltage present?**	
C5 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test D: DTCs B1A61:11 and 15

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

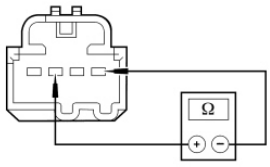
Under normal operation, the in-vehicle air temperature sensor receives a ground from the HVAC module through circuit RH111 (GY/BU). A 5-volt reference voltage is supplied to the in-vehicle air temperature sensor from the HVAC module through circuit VH414 (GN/BU).

- DTC B1A61:11 (Cabin Temperature Sensor: Circuit Short to Ground) â The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
- DTC B1A61:15 (Cabin Temperature Sensor: Circuit Short to Battery or Open) â The module senses no voltage drop on the sensor reference voltage circuit, indicating a short directly to voltage or an open circuit.

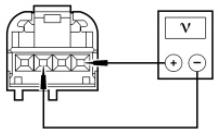
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- In-vehicle air temperature sensor
- HVAC module

PINPOINT TEST D: DTCs B1A61:11 AND 15

Test Step	Result / Action to Take
D1 CHECK THE SENSOR RESISTANCE	

<table>
<tr>
<td>
• Ignition OFF.
• Disconnect: In-Vehicle Temperature Sensor C233.
• Measure the resistance between the in-vehicle temperature sensor C233 terminals and compare to the table below.
<table>
<tr><th>Ambient Temperature</th><th>Resistance</th></tr>
<tr><td>-40Â°C (-40Â°F)</td><td>869,073-1,061,986 ohms</td></tr>
<tr><td>-15Â°C (5Â°F)</td><td>196,465-231,213 ohms</td></tr>
<tr><td>0Â°C (32Â°F)</td><td>89,982-102,514 ohms</td></tr>
<tr><td>15Â°C (59Â°F)</td><td>44,261-49,503 ohms</td></tr>
<tr><td>25Â°C (77Â°F)</td><td>28,500-31,500 ohms</td></tr>
<tr><td>35Â°C (95Â°F)</td><td>18,563-20,751 ohms</td></tr>
<tr><td>60Â°C (140Â°F)</td><td>6,971-8,001 ohms</td></tr>
<tr><td>85Â°C (185Â°F)</td><td>2,959-3,474 ohms</td></tr>
</table>


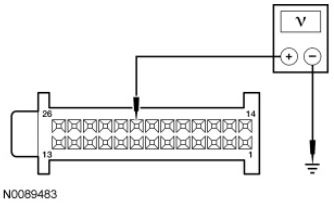
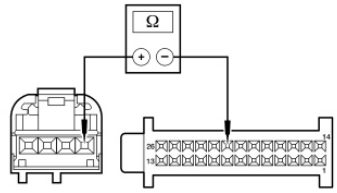
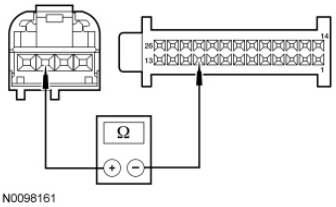
N0098158
• Is the resistance within the specified values for the temperatures?
</td>
<td>Yes
GO to D2 .

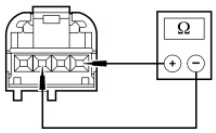
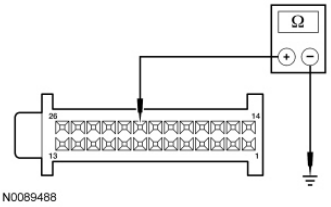
No
INSTALL a new in-vehicle temperature sensor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</td>
</tr>
<tr>
<td>D2 CHECK THE SENSOR OUTPUT VOLTAGE</td>
<td></td>
</tr>
<tr>
<td>
• Ignition ON.
• Measure the voltage between in-vehicle temperature sensor C233-1, circuit VH414 (GN/BU), harness side and C233-3, circuit RH111 (GY/BU), harness side.


N0098159
• Is the voltage between 4.7 and 5.1 volts?
</td>
<td>Yes
INSTALL a new in-vehicle sensor. CLEAR the DTCs. REPEAT the self-test. If code returns, GO to D8 .

No
For DTC B1A68:15 , GO to D3 .

For DTC B1A68:11 , GO to D6 .</td>
</tr>
<tr>
<td>D3 CHECK CIRCUIT VH414 (GN/BU) FOR A SHORT TO VOLTAGE</td>
<td></td>
</tr>
</table>

• Ignition OFF. • Disconnect: HVAC Module â Dual Automatic Temperature Control (DATC) C2356a. • Disconnect: HVAC Module â DATC C2356b. • Ignition ON. • Measure the voltage between ground and HVAC module â DATC C2356b-21, circuit VH414 (GN/BU), harness side.  N0089483 • **Is any voltage present?**	**Yes** REPAIR circuit VH414 (GN/BU) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to D4 .
D4 CHECK CIRCUIT VH414 (GN/BU) FOR AN OPEN	
• Ignition OFF. • Measure the resistance between HVAC module â DATC C2356b-21, circuit VH414 (GN/BU), harness side and in-vehicle temperature sensor C233-1, circuit VH414 (GN/BU), harness side.  N0098160 • **Is the resistance less than 5 ohms?**	**Yes** GO to D5 . **No** REPAIR circuit VH414 (GN/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D5 CHECK CIRCUIT RH111 (GY/BU) FOR AN OPEN	
• Measure the resistance between HVAC module C2356a-10, circuit RH111 (GY/BU), harness side and in-vehicle temperature sensor C233-3, circuit RH111 (GY/BU), harness side.  N0098161	**Yes** GO to D8 . **No** REPAIR circuit RH111 (GY/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• **Is the resistance less than 5 ohms?**	
D6 CHECK CIRCUIT VH414 (GN/BU) FOR A SHORT TO CIRCUIT RH111 (GY/BU)	
• Ignition OFF. • Disconnect: HVAC Module â DATC C2356b. • Measure the resistance between in-vehicle temperature sensor C233-1, circuit VH414 (GN/BU), harness side and C233-3, circuit RH111 (GY/BU), harness side.  N0098162 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D7 . **No** REPAIR circuit VH414 (GN/BU) for a short to circuit RH111 (GY/BU). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D7 CHECK CIRCUIT VH414 (GN/BU) FOR A SHORT TO GROUND	
• Measure the resistance between HVAC module â DATC C2356b-21, circuit VH414 (GN/BU), harness side and ground.  N0089488 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D8 . **No** REPAIR circuit VH414 (GN/BU) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D8 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test E: DTCs B1A68:11 and 15

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, the ambient air temperature sensor receives a ground from the HVAC module through circuit RH111 (GY/BU). A 5-volt reference voltage is supplied to the ambient air temperature sensor from the HVAC module through circuit VH407 (YE/GN).

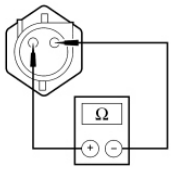
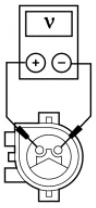
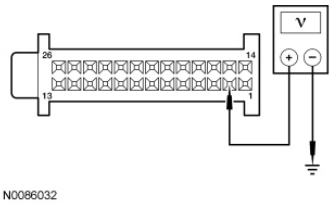
- DTC B1A68:11 (Ambient Temperature Sensor: Circuit Short to Ground) â The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
- DTC B1A68:15 (Ambient Temperature Sensor: Circuit Short to Battery or Open) â The module senses no voltage drop on the sensor reference voltage circuit, indicating a short directly to voltage or an open circuit.

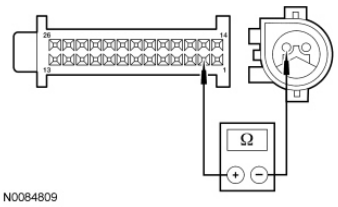
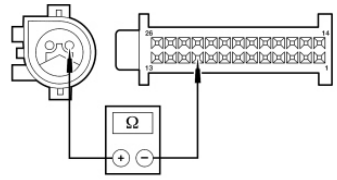
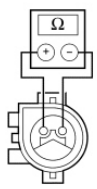
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Ambient air temperature sensor
- HVAC module

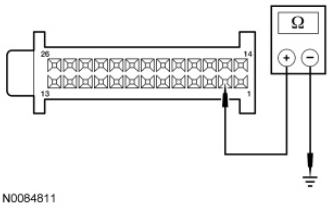
PINPOINT TEST E: DTCs B1A68:11 AND 15

Test Step	Result / Action to Take
E1 CHECK THE SENSOR RESISTANCE	
• Ignition OFF. • Disconnect: Ambient Air Temperature Sensor C132. • Measure the resistance between the ambient air temperature sensor C132 terminals and compare to the table below.	**Yes** GO to E2 . **No** INSTALL a new ambient air temperature sensor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Ambient Temperature	Resistance
-40Â°C (-40Â°F)	832,519-1,017,523 ohms
-15Â°C (5Â°F)	199,325-220,307 ohms
0Â°C (32Â°F)	91,058-100,644 ohms
15Â°C (59Â°F)	44,435-49,113 ohms
25Â°C (77Â°F)	28,500-31,500 ohms
35Â°C (95Â°F)	18,730-20,701 ohms
60Â°C (140Â°F)	7,171-7,925 ohms
85Â°C (185Â°F)	3,110-3,438 ohms

 A0013640 • **Is the resistance within the specified values for the temperatures?**	
E2 CHECK THE SENSOR OUTPUT VOLTAGE	
• Ignition ON. • Measure the voltage between ambient air temperature sensor C132-1, circuit VH407 (YE/GN), harness side and C132-2, circuit RH111 (GY/BU), harness side.  A0002818 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** INSTALL a new ambient air temperature sensor. CLEAR the DTCs. REPEAT the self-test. If code returns, GO to E8 . **No** **For DTC B1A61:15** , GO to E3 . **For DTC B1A61:11** , GO to E6 .
E3 CHECK CIRCUIT VH407 (YE/GN) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module â Electronic Manual Temperature Control (EMTC) C2357a. • Disconnect: HVAC Module â Dual Automatic Temperature Control (DATC) C2356a. • Ignition ON. • Measure the voltage between HVAC module â DATC C2356a-2, circuit VH407 (YE/GN), harness side and ground.  N0086032 • **Is any voltage present?**	**Yes** REPAIR circuit VH407 (YE/GN) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to E4 .
E4 CHECK CIRCUIT VH407 (YE/GN) FOR AN OPEN	

• Ignition OFF. • Measure the resistance between HVAC module â DATC C2356a-2, circuit VH407 (YE/GN), harness side and ambient air temperature sensor C132-1, circuit VH407 (YE/GN), harness side.  N0084809 • **Is the resistance less than 5 ohms?**	**Yes** GO to E5 . **No** REPAIR circuit VH407 (YE/GN) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E5 CHECK CIRCUIT RH111 (GY/BU) FOR AN OPEN	
• Measure the resistance between HVAC module â DATC C2356a-10, circuit RH111 (GY/BU), harness side and ambient air temperature sensor C132-2, circuit RH111 (GY/BU), harness side.  N0084810 • **Is the resistance less than 5 ohms?**	**Yes** GO to E8 . **No** REPAIR circuit RH111 (GY/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E6 CHECK CIRCUIT VH407 (YE/GN) FOR A SHORT TO CIRCUIT RH111 (GY/BU)	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Measure the resistance between ambient air temperature sensor C132-1, circuit VH407 (YE/GN), harness side and C132-2, circuit RH111 (GY/BU), harness side.  A0038068 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to E7 . **No** REPAIR circuit VH407 (YE/GN) for a short to circuit RH111 (GY/BU). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E7 CHECK CIRCUIT VH407 (YE/GN) FOR A SHORT TO GROUND	

• Measure the resistance between HVAC module â DATC C2356a-2, circuit VH407 (YE/GN), harness side and ground.  N0084811 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to E8 . **No** REPAIR circuit VH407 (YE/GN) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E8 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test F: DTCs B1A63:11 and 15 or DTCs B1A64:11 and 15

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

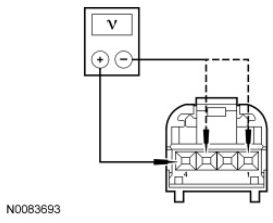
Under normal operation, the sunload sensor receives a ground from the HVAC module through circuit GD116 (BK/VT). A 5-volt reference voltage is supplied to the sunload sensor from the HVAC module through circuit VH417 (YE/OG) (RH) and circuit VH416 (VT/GY) (LH).

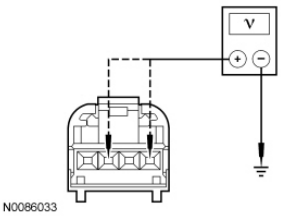
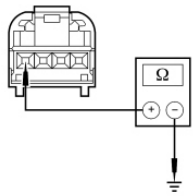
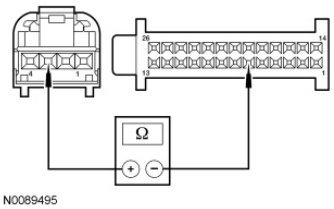
DTC Description	Fault Trigger Conditions
• B1A63:11 â Right Solar Sensor: Circuit Short to Ground	The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
• B1A63:15 â Right Solar Sensor: Circuit Short to Battery or Open	The module senses no voltage drop on the sensor reference voltage circuit, indicating a short directly to voltage or an open circuit.
	The module senses excessive voltage drop on the sensor reference

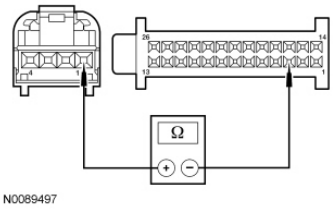
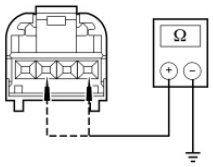
• B1A64:11 â Left Solar Sensor: Circuit Short to Ground	voltage circuit, indicating a short directly to ground.
• B1A64:15 â Left Solar Sensor: Circuit Short to Battery or Open	The module senses no voltage drop on the sensor reference voltage circuit, indicating a short directly to voltage or an open circuit.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Sunload sensor
- HVAC module

PINPOINT TEST F: DTCs B1A63:11 AND 15 OR DTCs B1A64:11 AND 15

Test Step	Result / Action to Take
F1 CHECK THE SUNLOAD SENSOR REFERENCE VOLTAGE	
• Ignition OFF. • Disconnect: Sunload Sensor C286. • Ignition ON. • Press the AUTO button. • Measure the voltage between sunload sensor C266-4, circuit GD116 (BK/VT), harness side and sunload sensor: ♦ **For DTC B1A63** , C286-1, circuit VH417 (YE/OG), harness side. ♦ **For DTC B1A64** , C286-3, circuit VH416 (VT/GY), harness side.  N0083693 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** INSTALL a new sunload sensor. CLEAR the DTCs. REPEAT the self-test. If the code returns, GO to F6 . **No** If diagnosing **DTC B1A63:15** or **DTC B1A64:15** , GO to F2 . If diagnosing **DTC B1A63:11** or **DTC B1A64:11** , GO to F5 .
F2 CHECK CIRCUIT VH416 (VT/GY) AND VH417 (YE/OG) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module â Dual Automatic Temperature Control (DATC) C2356a. • Disconnect: HVAC Module â DATC C2356b. • Ignition ON. • Measure the voltage between ground and	**Yes** REPAIR circuit VH416 (VT/GY) or VH417 (YE/OG) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to F3 .

sunload sensor: ♦ **For DTC B1A64:11** , C286-3, circuit VH416 (VT/GY), harness side. ♦ **For DTC B1A63:11** , C286-1, circuit VH417 (YE/OG), harness side.  N0086033 • **Is any voltage present?**	
F3 CHECK CIRCUIT GD116 (BK/VT) FOR AN OPEN	
• Ignition OFF. • Measure the resistance between ground and sunload sensor C286-4, circuit GD116 (BK/VT), harness side.  N0065587 • **Is the resistance less than 5 ohms?**	**Yes** GO to F4 . **No** REPAIR circuit GD116 (BK/VT) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
F4 CHECK CIRCUITS VH417 (YE/OG) AND VH416 (VT/GY) FOR AN OPEN	
• Measure the resistance between HVAC module â DATC C2356b-6, circuit VH416 (VT/GY), harness side and sunload sensor C286-3, circuit VH416 (VT/GY), harness side.  N0089495 • Measure the resistance between HVAC module â DATC C2356b-3, circuit VH417 (YE/OG), harness side and sunload sensor C286-1, circuit VH417 (YE/OG), harness side.	**Yes** GO to F6 . **No** REPAIR circuit VH416 (VT/GY) or circuit VH417 (YE/OG) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0089497 • **Is the resistance less than 5 ohms?**	
F5 CHECK CIRCUIT VH417 (YE/OG) OR CIRCUIT VH416 (VT/GY) FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Measure the resistance between ground and sunload sensor: ♦ **For DTC B1A64:11** , C286-3, circuit VH416 (VT/GY), harness side. ♦ **For DTC B1A63:11** , C286-1, circuit VH417 (YE/OG), harness side.  N0041881 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to F6 . **No** REPAIR circuits VH417 (YE/OG) or VH416 (VT/GY) for a short to circuit RH111 (GY/BU). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
F6 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test G: DTCs B1B71:11 and 15

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

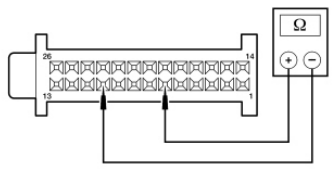
Normal Operation

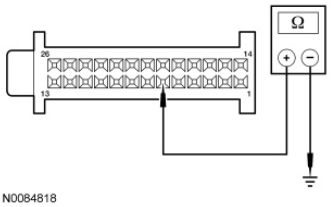
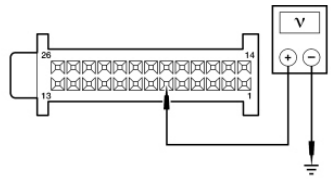
Under normal operation, the evaporator discharge air temperature sensor receives a ground from the HVAC module through circuit RH111 (GY/BU). A 5-volt reference voltage is supplied to the evaporator discharge air temperature sensor from the HVAC module through circuit VH406 (VT/BN).

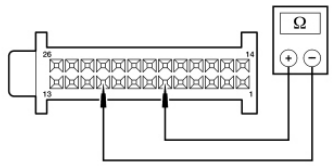
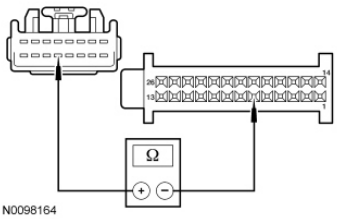
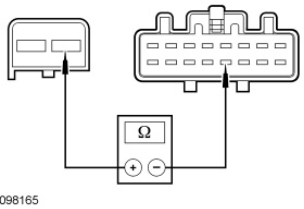
- DTC B1B71:11 (Evaporator Temperature Sensor: Circuit Short to Ground) â The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
- DTC B1B71:15 (Evaporator Temperature Sensor: Circuit Short to Battery or Open) â The module senses no voltage drop on the sensor reference voltage circuit, indicating a short directly to voltage or an open circuit.

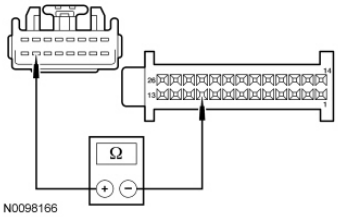
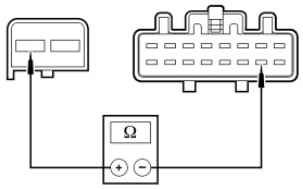
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Evaporator discharge air temperature sensor
- HVAC module

PINPOINT TEST G: DTCs B1B71:11 AND 15

Test Step	Result / Action to Take
G1 CHECK THE SENSOR RESISTANCE	
• Ignition OFF. • Disconnect: HVAC Module â Electronic Manual Temperature Control (EMTC) C2357a. • Disconnect: HVAC Module â Dual Automatic Temperature Control (DATC) C2356a. • Measure the resistance between HVAC module â EMTC C2357a-6 or HVAC module â DATC C2356a-6, circuit VH406 (VT/BN), harness side and HVAC module â EMTC C2357a-10 or HVAC module â DATC C2356a-10, circuit RH111 (GY/BU), harness side .  N0098163 • Compare the measurement to the chart and table of the Evaporator Discharge Air Temperature Sensor component test in this section. • **Is the resistance within the specified values for the temperatures?**	**Yes** **For DTC B1B71:11** , GO to G2 . **For DTC B1B71:15** , GO to G3 . **No** **For DTC B1B71:11** , GO to G4 . **For DTC B1B71:15** , GO to G5 .
G2 CHECK CIRCUIT VH406 (VT/BN) FOR A SHORT TO GROUND	

• Measure the resistance between HVAC module â EMTC C2357a-6 or HVAC module â DATC C2356a-6, circuit VH406 (VT/BN), harness side and ground.  N0084818 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G7 . **No** REPAIR circuit VH406 (VT/BN) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
G3 CHECK CIRCUIT VH406 (VT/BN) FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between ground and HVAC module â EMTC C2357a-6 or HVAC module â DATC C2356a-6, circuit VH406 (VT/BN), harness side and ground.  N0086034 • **Is any voltage present?**	**Yes** REPAIR circuit VH406 (VT/BN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to G7 .
G4 CHECK CIRCUIT VH406 (VT/BN) FOR A SHORT TO CIRCUIT RH111 (GY/BU)	
NOTE: Instrument panel removal is required to disconnect the sensor. Before carrying out this test step, visually inspect the wiring between the HVAC module and sensor for shorts. If no damage is visually evident, proceed with the test. • Ignition OFF. • Disconnect: Evaporator Discharge Air Temperature Sensor C2295. • Measure the resistance between HVAC module â EMTC C2357a-6 or HVAC module â DATC C2356a-6, circuit VH406 (VT/BN), harness side and HVAC module â EMTC C2357a-10 or HVAC module â DATC C2356a-10, circuit RH111 (GY/BU), harness side.	**Yes** INSTALL a new evaporator discharge air temperature sensor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR circuit VH406 (VT/BN) for a short to circuit RH111 (GY/BU). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0098163 • **Is the resistance greater than 10,000 ohms?**	
G5 CHECK CIRCUITS VH406 (VT/BN) FOR AN OPEN	
NOTE: Instrument panel removal is required to disconnect the sensor. Before carrying out this test step, visually inspect the wiring between the HVAC module and sensor for opens. If no damage is visually evident, proceed with the test. • Ignition OFF. • Disconnect: Evaporator Discharge Air Temperature Sensor C2295. • Measure the resistance between HVAC module â EMTC C2357a-6 or HVAC module â DATC C2356a-6, circuit VH406 (VT/BN), harness side and inline (EMTC) C211-13 or (DATC) inline C213-13, circuit VH406 (VT/BN), instrument panel harness side.  N0098164 • Measure the resistance between inline (EMTC) C211-13 or (DATC) inline C213-13, circuit VH406 (VT/BN), HVAC case harness side and evaporator discharge air temperature sensor C2295-1, circuit VH406 (VT/BN), harness side.  N0098165 • **Is the resistance less than 5 ohms?**	**Yes** GO to G6 . **No** REPAIR circuit VH406 (VT/BN) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
G6 CHECK CIRCUITS RH111 (GY/BU) FOR AN OPEN	

• Measure the resistance between HVAC module â EMTC C2357a-10 or HVAC module â DATC C2356a-10, circuit RH111 (GY/BU), harness side and inline (EMTC) C211-15 or (DATC) inline C213-15, circuit RH111 (GY/BU), instrument panel harness side.  N0098166 • Measure the resistance between inline (EMTC) C211-15 or (DATC) inline C213-15, circuit RH111 (GY/BU), HVAC case harness side and evaporator discharge air temperature sensor C2295-2, circuit RH111 (GY/BU), harness side.  N0098167 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new evaporator discharge air temperature sensor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR circuit RH111 (GY/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
G7 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test H: DTCs U3003:16 and 17

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

NOTE: DTC U3003 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

NOTE: Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

Normal Operation

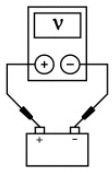
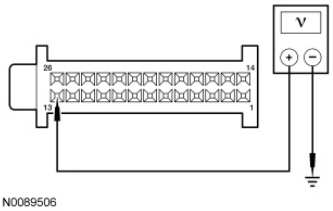
Under normal operation, the HVAC module receives a ground through circuit GD116 (BK/VT). The HVAC module is supplied constant battery voltage through circuit SBP15 (WH/RD).

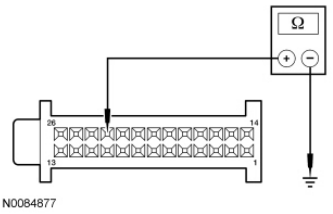
- DTC U3003:16 (Control Module Input Power "A": Circuit Voltage Below Threshold) â The module senses when battery voltage is greater than 16 volts.
- DTC U3003:17 (Control Module Input Power "A": Circuit Voltage Above Threshold) â The module senses when battery voltage is less than 9 volts.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- HVAC module

PINPOINT TEST H: DTCs U3003:16 AND 17

Test Step	Result / Action to Take
H1 RETRIEVE ALL CMDTCs IN ALL MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test â All CMDTCs . • **Is DTC B1317, B1318 or B1676 present in one or more modules and DTC P0563, P0620, P0625, P0626 or P065B present in the PCM?**	**Yes** REFER to Section 414-00 for diagnosis of the battery and charging system. **No** GO to H2 .
H2 CHECK BATTERY CONDITION	
• Ignition OFF. • Refer to Section 414-01 and carry out the Battery â Condition Test • **Does the battery pass the condition test?**	**Yes** If the battery passed the condition test but required a recharge, REFER to Section 414-00 to diagnose the charging system. CLEAR all Continuous Memory Diagnostic Trouble Codes (CMDTCs). TEST the system for normal operation. If the battery passed the condition test and did not require a recharge, GO to H3 . **No** INSTALL a new battery. CLEAR all CMDTCs . TEST the system for normal operation.
H3 CHECK THE CHARGING SYSTEM VOLTAGE	

NOTE: Do not allow the engine rpm to increase above 2,000 rpm while performing this step or the generator may self excite and result in default charging system output voltage. If engine rpm has gone above 2,000 rpm, shut the vehicle OFF and restart the engine before performing this step. • Start the engine. • Measure the voltage of the battery: ♦ **For DTC U3003:17** , turn off all accessories and run the engine at 1,500 rpm for a minimum of 2 minutes. ♦ **For DTC U3003:16** , turn on headlights and HVAC fan on high and run engine at 1,500 rpm for a minimum of 2 minutes.  AJ0210-A • **Is the battery voltage between 13-15.2 volts?**	**Yes** **For DTC U3003:17** , GO to H4 . **For DTC U3003:16** , INSTALL a new HVAC module. REFER to Section 412-01 . CLEAR all CMDTCs . REPEAT the self-test. **No** REFER to Section 414-00 to diagnose the charging system. CLEAR all CMDTCs . TEST the system for normal operation.
H4 CHECK CIRCUITS SBP15 (WH/RD) FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module â Electronic Manual Temperature Control (EMTC) C2357a. • Disconnect: HVAC Module â Dual Automatic Temperature Control (DATC) C2356a. • Ignition ON. • With the engine running, measure the voltage between HVAC module â EMTC C2357a-13 or HVAC module â DATC C2356a-13, circuit SBP15 (WH/RD), harness side and ground.  N0089506 • **Is the voltage greater than 10 volts?**	**Yes** GO to H5 . **No** VERIFY Smart Junction Box (SJB) fuse 15 (10A) is OK. If OK, REPAIR circuit SBP15 (WH/RD) for an open. CLEAR all CMDTCs . REPEAT the self-test. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
H5 CHECK CIRCUIT GD133 (BK) FOR AN OPEN	

• Ignition OFF. • Measure the resistance between HVAC module â EMTC C2357a-23 or HVAC module â DATC C2356a-23, circuit GD116 (BK/VT), harness side and ground. ♦ Repeat this measurement while wiggling the harness.  N0084877 • **Is the resistance less than 5 ohms?**	**Yes** GO to H6 . **No** REPAIR circuit GD116 (BK/VT) for an open. TEST the system for normal operation.
H6 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test I: Unable to Duplicate the Customer Concern and No DTCs Present

This pinpoint test is intended to diagnose the following:
- Incorrect functioning of the HVAC system

PINPOINT TEST I: UNABLE TO DUPLICATE CUSTOMER CONCERN AND NO DTCs PRESENT

NOTE: Diagnose any HVAC module DTCs before carrying out the following pinpoint test.

NOTE: Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to PCM DTC Chart.

Test Step	Result / Action to Take
I1 CHECK THE BLOWER MOTOR OPERATION	
• Ignition ON. • Select PANEL mode. • Observe blower motor operation and select each blower motor speed.	**Yes** GO to I2 . **No** For Electronic Manual Temperature Control (EMTC) systems, if the blower motor does not

• **Does the blower motor operate in all selections and change speed in each?**	operate in any setting, GO to Pinpoint Test Q . For Dual Automatic Temperature Control (DATC) systems, if the blower motor does not operate in any setting, GO to Pinpoint Test S . For EMTC systems if the blower motor does not properly change speeds or shut OFF, GO to Pinpoint Test R . For DATC systems if the blower motor does not properly change speeds or shut OFF, GO to Pinpoint Test T .
I2 CHECK AIRFLOW OPERATION	
• Select the highest blower motor setting. • **NOTE:** Refer to Description and Operation in this section for proper airflow descriptions. • While observing the airflow, select each of the airflow positions (PANEL, PANEL/FLOOR, FLOOR, FLOOR/DEFROST, DEFROST). • **Is the airflow directed to the proper outlets?**	**Yes** GO to I3 . **No** GO to Pinpoint Test K .
I3 VERIFY TEMPERATURE CONTROL OPERATION	
• Start the vehicle and allow it to reach normal operating temperature. • With the A/C OFF, select PANEL mode. • Change the temperature setting from the coldest to the warmest and back to the coldest. • **Does the temperature change between very warm to cool?**	**Yes** GO to I4 . **No** If the temperature does not get very warm, GO to Pinpoint Test L . If the temperature does not change at all, GO to Pinpoint Test P .
I4 VERIFY THE A/C CLUTCH DOES NOT ENGAGE WITH A/C OFF	
• With the A/C OFF, select PANEL mode. • Select the coldest temperature setting. • **Is the outlet temperature close to ambient temperature?**	**Yes** GO to I5 . **No** If the temperature is warmer than ambient temperature, GO to Pinpoint Test P and diagnose for inoperative blend door. If the outlet temperature is significantly colder than ambient temperature and the A/C compressor clutch cycles normally, GO to Pinpoint Test O . If the outlet temperature is significantly colder than ambient temperature and the A/C compressor clutch does not cycle, GO to Pinpoint Test N .

I5 VERIFY A/C CLUTCH ENGAGEMENT IN THE A/C MODE	
• Make sure the ambient air temperature is above 2Â°C (35Â°F). • Select PANEL mode. • Press the A/C button (indicator ON). • **Does the A/C clutch engage when the PANEL and A/C button (indicator ON) is pressed?**	**Yes** GO to I6 . **No** GO to Pinpoint Test M .
I6 CHECK THE RECIRC OPERATION	
• Press the RECIRC button (indicator OFF). • Select PANEL mode. • Select the highest blower motor setting. • Observe airflow noise. • Press the RECIRC button (indicator ON). • **Does the airflow noise increase when the RECIRC mode is selected (indicator ON)?**	**Yes** The system is operating normally. **No** GO to Pinpoint Test J .

Pinpoint Test J: The Air Inlet Door is Inoperative

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

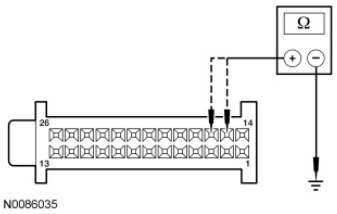
Under normal operation, to rotate the air inlet mode door actuator, the HVAC module supplies voltage or ground to the air inlet mode door actuator through the circuit CH207 (BU/GY), and supplies ground or voltage through circuit CH208 (GN/OG) depending on desired rotation direction.

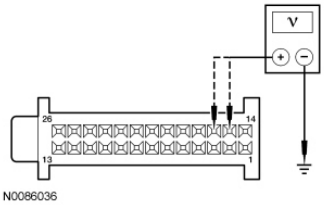
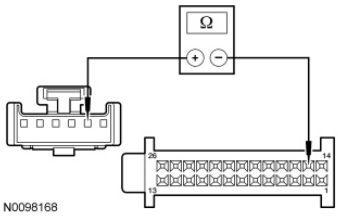
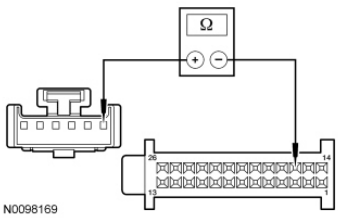
- DTC B1083:11 (Recirculation Damper Motor: Circuit Short to Ground) â The module senses excessive voltage drop on the actuator motor circuit, indicating a short directly to ground.
- DTC B1083:12 (Recirculation Damper Motor: Circuit Short to Battery) â The module senses no voltage drop on the actuator motor circuit, indicating a short directly to voltage.
- DTC B1083:13 (Recirculation Damper Motor: Circuit Open) â The module senses no voltage drop on the actuator motor circuit, indicating an open.

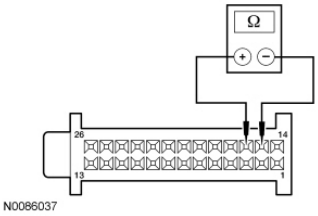
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Air inlet mode door actuator
- HVAC module
- Stuck or bound linkage or door

PINPOINT TEST J: THE AIR INLET DOOR IS INOPERATIVE

Test Step	Result / Action to Take

J1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition OFF. • Disconnect: HVAC Module â Electronic Manual Temperature Control (EMTC) C2357a. • Disconnect: HVAC Module â Dual Automatic Temperature Control (DATC) C2356a. • Disconnect: HVAC Module â DATC C2356b. • Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** **For DTC B1083:11** , GO to J2 . **For DTC B1083:12** , GO to J3 . **For DTC B1083:13** , GO to J4 . **No** INSPECT for broken/binding linkage or door. REPAIR as necessary. If no condition is found, GO to J6 .
J2 CHECK CIRCUITS CH207 (BU/GY) AND CH208 (GN/OG) FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Measure the resistance between ground and: ♦ HVAC module â EMTC C2357a-16 or HVAC module â DATC C2356a-16, circuit CH208 (GN/OG), harness side. ♦ HVAC module â EMTC C2357a-15 or HVAC module â DATC C2356a-15, circuit CH207 (BU/GY), harness side.  N0086035 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to J5 . **No** REPAIR circuit CH207 (BU/GY) or circuit CH208 (GN/OG) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
J3 CHECK CIRCUITS CH207 (BU/GY) AND CH208 (GN/OG) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Ignition ON. • Measure the voltage between ground and: ♦ HVAC module â EMTC C2357a-16 or HVAC module â DATC C2356a-16, circuit CH208 (GN/OG), harness side. ♦ HVAC module â EMTC C2357a-15 or HVAC module â DATC C2356a-15, circuit CH207 (BU/GY), harness side.	**Yes** REPAIR circuit CH207 (BU/GY) or circuit CH208 (GN/OG) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to J5 .

 N0086036 • **Is any voltage present?**	
J4 CHECK THE ACTUATOR MOTOR DRIVE CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Disconnect: Air Inlet Mode Door Actuator C289. • Measure the resistance between HVAC module â EMTC C2357a-15 or HVAC module â DATC C2356a-15, circuit CH207 (BU/GY), harness side and air inlet mode door actuator C289-6, circuit CH207 (BU/GY), harness side.  N0098168 • Measure the resistance between HVAC module â EMTC C2357a-16 or HVAC module â DATC C2356a-16, circuit CH208 (GN/OG), harness side and air inlet mode door actuator C289-5, circuit CH208 (GN/OG), harness side.  N0098169 • **Are the resistances less than 5 ohms?**	**Yes** GO to J6 . **No** REPAIR the circuit(s) for an open. TEST the system for normal operation.
J5 CHECK CIRCUIT CH207 (BU/GY) FOR A SHORT TO CIRCUIT CH208 (GN/OG)	

• Ignition OFF. • Measure the resistance between HVAC module â EMTC C2357a-15 or HVAC module â DATC C2356a-15, circuit CH207 (BU/GY), harness side and HVAC module â EMTC C2357a-16 or HVAC module â DATC C2356a-16, circuit CH208 (GN/OG), harness side.  N0086037 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to J6 . **No** REPAIR circuit CH208 (GN/OG) for a short to circuit CH207 (BU/GY). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
J6 CHECK THE ACTUATOR CONNECTION	
• Disconnect the actuator connector. • Check for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat the actuator connector. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** CARRY OUT the Air Inlet Mode Door Actuator component test in this section. If the actuator tests OK, GO to J7 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.
J7 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test K: Incorrect/Erratic Direction of Airflow From Outlets

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, to rotate the mode door actuator, the HVAC module supplies voltage or ground to the DEFROST/PANEL/FLOOR mode door actuator motor through circuit CH228 (YE/GY), and supplies ground or voltage through circuit CH229 (WH/BU) depending on desired rotation direction.

The mode door actuator feedback resistor is supplied a ground from the HVAC module through circuit RH111 (GY/BU) and a 5-volt reference voltage on circuit LH111 (BN/WH). The HVAC module reads the voltage on the mode door actuator feedback circuit VH436 (YE/VT) to determine the mode door actuator position by the position of the actuator feedback resistor wiper arm.

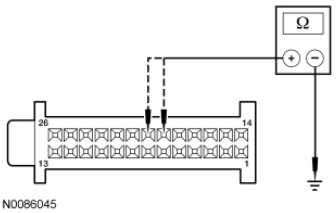
DTC Description	Fault Trigger Conditions
• B1086:07 â Air Distribution Damper Motor: Mechanical Failures	The module senses no changes in the feedback circuit when motor movement is commanded and no motor DTCs are present.
• B1086:11 â Air Distribution Damper Motor: Circuit Short to Ground	The module senses excessive voltage drop on the actuator motor circuit, indicating a short directly to ground.
• B1086:12 â Air Distribution Damper Motor: Circuit Short to Battery	The module senses no voltage drop on the actuator motor circuit, indicating a short directly to voltage.
• B1086:13 â Air Distribution Damper Motor: Circuit Open	The module senses no voltage drop on the actuator motor circuit, indicating an open.
• B11E7:11 â Air Distribution Damper Position Sensor: Circuit Short to Ground	The module senses excessive voltage drop on the actuator feedback circuit, indicating a short directly to ground.
• B11E7:15 â Air Distribution Damper Position Sensor: Circuit Short to Battery or Open	The module senses no voltage drop on the actuator feedback circuit, indicating an open circuit or a short directly to voltage.

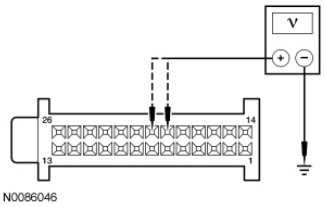
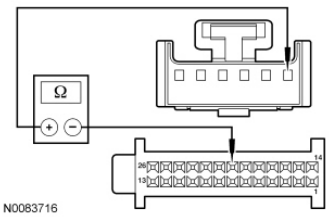
This pinpoint test is intended to diagnose the following:

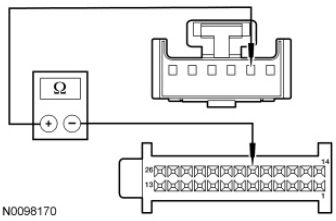
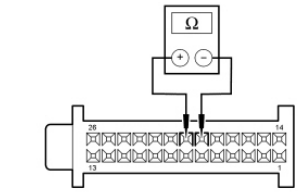
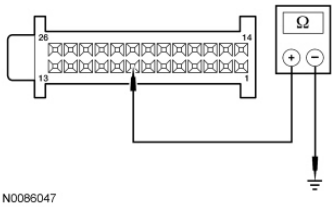
- Wiring, terminals or connectors
- Defrost/panel/floor mode door actuator
- HVAC module
- Stuck or bound linkage or door

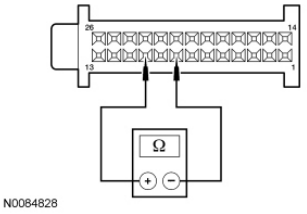
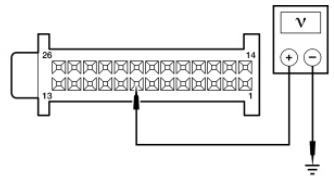
PINPOINT TEST K: INCORRECT/ERRATIC DIRECTION OF AIRFLOW FROM OUTLETS

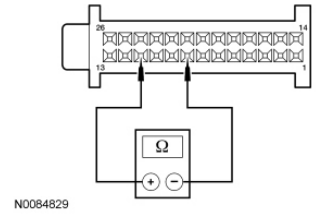
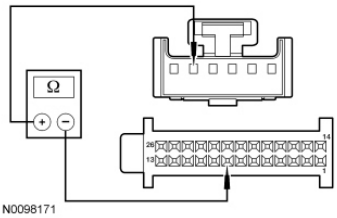
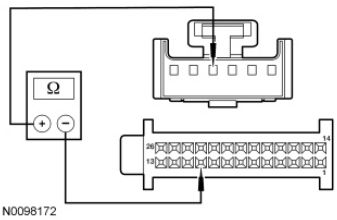
Test Step	Result / Action to Take
K1 CHECK THE HVAC MODULE FOR DTCs	
	Yes

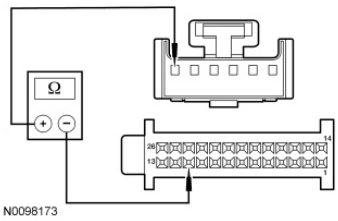
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**For DTC B1086:07** , INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, INSTALL a new defrost/panel/floor door actuator. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For DTC B1086:11** , GO to K2 . **For DTC B1086:12** , GO to K3 . **For DTC B1086:13** , GO to K4 . **For DTC B11E7:11** , GO to K6 . **For DTC B11E7:15** , GO to K8 . **No** INSPECT for broken linkage or door. REPAIR as necessary. If no condition is found, GO to K13 .
K2 CHECK THE ACTUATOR MOTOR DRIVE CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module â Electronic Manual Temperature Control (EMTC) C2357a. • Disconnect: HVAC Module â Dual Automatic Temperature Control (DATC) C2356a. • Disconnect: HVAC Module â DATC C2356b. • Disconnect: Defrost/Panel/Floor Mode Door Actuator C2278. • Measure the resistance between ground and: ♦ HVAC module â EMTC C2357a-19 or HVAC module â DATC C2356a-19, circuit CH229 (WH/BU), harness side. ♦ HVAC module â EMTC C2357a-20 or HVAC module â DATC C2356a-20, circuit CH228 (YE/GY), harness side.  N0086045 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to K5 . **No** REPAIR the circuit CH228 (YE/GY) or CH229 (WH/BU) for a short to ground. TEST the system for normal operation.
K3 CHECK THE ACTUATOR MOTOR DRIVE CIRCUITS FOR A SHORT TO VOLTAGE	

• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Disconnect: Defrost/Panel/Floor Mode Door Actuator C2278. • Ignition ON. • Measure the voltage between ground and: ♦ HVAC module â EMTC C2357a-19 or HVAC module â DATC C2356a-19, circuit CH229 (WH/BU), harness side. ♦ HVAC module â EMTC C2357a-20 or HVAC module â DATC C2356a-20, circuit CH228 (YE/GY), harness side.  N0086046 • **Is any voltage present?**	**Yes** REPAIR the circuit CH228 (YE/GY) or CH229 (WH/BU) for a short to voltage. TEST the system for normal operation. **No** GO to K5 .
K4 CHECK THE ACTUATOR MOTOR DRIVE CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Disconnect: Defrost/Panel/Floor Mode Door Actuator C2278. • Measure the resistance between defrost/panel/floor door actuator C2278-5, circuit CH228 (YE/GY), harness side and HVAC module â EMTC C2357a-20 or HVAC module â DATC C2356a-20, circuit CH228 (YE/GY), harness side.  N0083716 • Measure the resistance between defrost/panel/floor door actuator C2278-6, circuit CH229 (WH/BU), harness side and HVAC module â EMTC C2357a-19 or HVAC module â DATC C2356a-19, circuit CH229 (WH/BU), harness side.	**Yes** GO to K13 . **No** REPAIR the circuit CH228 (YE/GY) or CH229 (WH/BU) for an open. TEST the system for normal operation.

 N0098170 • **Are the resistances less than 5 ohms?**	
K5 CHECK THE ACTUATOR MOTOR DRIVE CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Measure the resistance between HVAC module â EMTC C2357a-20 or HVAC module â DATC C2356a-20, circuit CH228 (YE/GY), harness side and HVAC module â EMTC C2357a-19 or HVAC module â DATC C2356a-19, circuit CH229 (WH/BU), harness side.  A0072918 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K13 . **No** REPAIR circuits CH228 (YE/GY) and CH229 (WH/BU) for a short together. TEST the system for normal operation.
K6 CHECK CIRCUIT VH436 (YE/VT) FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Measure the resistance between ground and HVAC module â EMTC C2357a-8 or HVAC module â DATC C2356a-8, circuit VH436 (YE/VT), harness side.  N0086047 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K7 . **No** REPAIR circuit VH436 (YE/VT) for a short to ground. TEST the system for normal operation.
K7 CHECK CIRCUIT RH111 (GY/BU) FOR A SHORT TO CIRCUIT VH436 (YE/VT)	

• Disconnect: Defrost/Panel/Floor Mode Door Actuator C2278. • Measure the resistance between HVAC module â EMTC C2357a-10 or HVAC module â DATC C2356a-10, circuit RH111 (GY/BU), harness side and HVAC module â EMTC C2357a-8 or HVAC module â DATC C2356a-8, circuit VH436 (YE/VT), harness side.  N0084828 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K13 . **No** REPAIR circuits RH111 (GY/BU) and VH436 (YE/VT) for a short together. TEST the system for normal operation.
K8 CHECK CIRCUIT VH436 (YE/VT) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Ignition ON. • Measure the voltage between ground and HVAC module â EMTC C2357a-8 or HVAC module â DATC C2356a-8, circuit VH436 (YE/VT), harness side.  N0086048 • **Is any voltage present?**	**Yes** REPAIR circuit VH436 (YE/VT) for a short to voltage. TEST the system for normal operation. **No** GO to K9 .
K9 CHECK CIRCUIT LH111 (BN/WH) FOR A SHORT TO CIRCUIT VH436 (YE/VT)	
• Ignition OFF. • Disconnect: Defrost/Panel/Floor Mode Door Actuator C2278. • Measure the resistance between HVAC module â EMTC C2357a-11 or HVAC module â DATC C2356a-11, circuit LH111 (BN/WH), harness side and HVAC module â EMTC C2357a-8 or HVAC module â DATC C2356a-8, circuit VH436 (YE/VT), harness side.	**Yes** GO to K10 . **No** REPAIR circuits LH111 (BN/WH) and VH436 (YE/VT) for a short together. TEST the system for normal operation.

 N0084829 • **Is the resistance greater than 10,000 ohms?**	
K10 CHECK CIRCUIT VH436 (YE/VT) FOR AN OPEN	
• Measure the resistance between HVAC module â EMTC C2357a-8 or HVAC module â DATC C2356a-8, circuit VH436 (YE/VT), harness side and defrost/panel/floor mode door actuator C2278-9, circuit VH436 (YE/VT), harness side.  N0098171 • **Is the resistance less than 5 ohms?**	**Yes** GO to K11 . **No** REPAIR circuit VH436 (YE/VT) for an open. TEST the system for normal operation.
K11 CHECK THE ACTUATOR RETURN CIRCUIT RH111 (GY/BU) FOR AN OPEN	
• Measure the resistance between HVAC module â EMTC C2357a-10 or HVAC module â DATC C2356a-10, circuit RH111 (GY/BU), harness side and defrost/panel/floor mode door actuator C2278-8, circuit RH111 (GY/BU), harness side.  N0098172 • **Is the resistance less than 5 ohms?**	**Yes** GO to K12 . **No** REPAIR circuit RH111 (GY/BU) for an open. TEST the system for normal operation.
K12 CHECK CIRCUIT LH111 (BN/WH) FOR AN OPEN	
• Measure the resistance between HVAC module â EMTC C2357a-11 or HVAC module â DATC C2356a-11, circuit LH111 (BN/WH), harness side and defrost/panel/floor mode door actuator C2278-10, circuit LH111 (BN/WH), harness side.	**Yes** GO to K13 . **No** REPAIR circuit LH111 (BN/WH) for an open. TEST the system for normal

 • **Is the resistance less than 5 ohms?**	operation.
K13 CHECK THE ACTUATOR CONNECTION	
• Inspect the connector for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat the actuator connector. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** CARRY OUT the Defrost/Panel/Floor Mode Door Actuator component test in this section. If the actuator tests OK, GO to K14 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.
K14 MODULE ACTUATOR POSITION CALIBRATION	
NOTE: The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below. • Ignition OFF. • Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Ignition ON. • Clear the DTCs. • Select any position except OFF. • **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators will take approximately 30 seconds. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects.

Pinpoint Test L: Insufficient, Erratic or No Heat

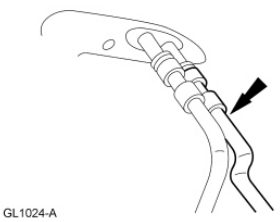
Normal Operation

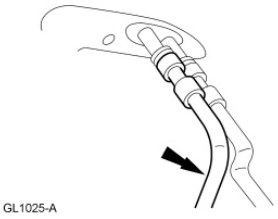
Under normal operation, warm coolant flows from the engine through the heater core and back to the engine.

This pinpoint test is intended to diagnose the following:

- Plugged heater core
- Coolant level
- Temperature blend door

PINPOINT TEST L: INSUFFICIENT, ERRATIC OR NO HEAT

Test Step	Result / Action to Take
L1 CHECK FOR CORRECT ENGINE COOLANT LEVEL	
• Ignition OFF. • Check the engine coolant level when hot and cold. • **Is the engine coolant at the correct level (hot/cold) as indicated on the engine coolant recovery reservoir?**	**Yes** GO to L3 . **No** GO to L2 .
L2 CHECK THE ENGINE COOLING SYSTEM FOR LEAKS	
• Pressure test the cooling system for leaks. Refer to Section 303-03A or Section 303-03B . • **Does the engine cooling system leak?**	**Yes** REPAIR the engine coolant leak. TEST the system for normal operation. **No** GO to L3 .
L3 CHECK FOR COOLANT FLOW TO THE HEATER CORE	
• Run the engine until it reaches normal operation temperature. Select the FLOOR position on the control assembly. Set the temperature control to full warm and the blower to the lowest setting. • Using a suitable temperature measuring device, check the heater core inlet hose to see if it is hot.  GL1024-A • **Is the heater core inlet hose hot?**	**Yes** GO to L4 . **No** REFER to Section 303-03A or Section 303-03B to check cooling system function.
L4 CHECK FOR A PLUGGED OR RESTRICTED HEATER CORE	

• Using a suitable temperature measuring device, measure the heater core outlet hose temperature.  GL1025-A • **Is the heater core outlet hose temperature similar to the inlet hose temperature (within approximately 6-17Â°C [10-30Â°F])?**	**Yes** For EMTC systems, GO to Pinpoint Test P and diagnose for a temperature blend door actuator. For DATC systems, GO to Pinpoint Test Q and diagnose for a temperature blend door actuator. **No** INSTALL a new heater core. TEST the system for normal operation.

Pinpoint Test M: The Air Conditioning (A/C) is Inoperative

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, for **Fusion equipped with navigation** and **all MKZ** vehicles, when A/C button is pressed, a message is sent from the Front Controls Interface Module (FCIM) over the Medium Speed Controller Area Network (MS-CAN) bus to the HVAC module. The HVAC module then sends an A/C request message over the MS-CAN bus to the Instrument Cluster (IC), then from the IC through the High Speed Controller Area Network (HS-CAN) bus to the PCM.

For **all vehicles equipped with navigation** , when MAX A/C is selected on the touch screen, the Audio Control Module (ACM) sends a message over the MS-CAN bus to the HVAC module that MAX A/C has been selected.

For **Fusion not equipped with navigation** , when A/C is requested, a message is sent over the MS-CAN bus to the IC , then from the IC through the HS-CAN bus to the PCM.

Ignition voltage is provided to the A/C clutch relay switch through circuit SBB25 (RD). When the PCM energizes the relay, ignition voltage is supplied to the A/C clutch through circuit CH401 (VT/WH). Ground is supplied for the A/C clutch through circuit GD121 (BK/YE).

When an A/C request is received by the PCM, the A/C compressor clutch will only be engaged through the A/C clutch relay if all of the following conditions are met:

- The PCM does not detect excessively high or low refrigerant pressure from the A/C pressure transducer.
- The PCM does not detect excessively high engine coolant temperature.
- The PCM does not detect an ambient air temperature below -1Â°C (30Â°F).
- The PCM has not detected a Wide Open Throttle (WOT) condition.
- The HVAC module does not detect an evaporator discharge air temperature below 2Â°C (36Â°F).

This pinpoint test is intended to diagnose the following:

- Fuse(s)
- Wiring, terminals or connectors
- PCM
- HVAC module
- FCIM
- ACM
- A/C evaporator discharge temperature sensor
- A/C pressure transducer
- A/C compressor clutch field coil
- A/C control relay
- A/C clutch air gap

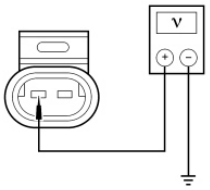
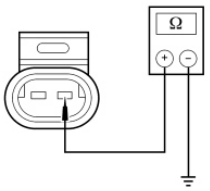
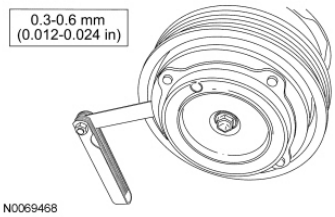
PINPOINT TEST M: THE AIR CONDITIONING (A/C) IS INOPERATIVE

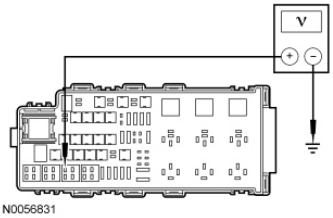
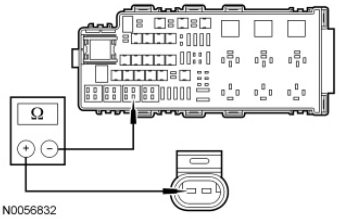
NOTE: Before carrying out the following test, diagnose any HVAC, PCM or Instrument Cluster (IC) DTCs.

NOTE: Before carrying out the following test, check that the A/C system pressure is above 290 kPa (42 psi). If the pressure is below 290 kPa (42 psi), refer to Fluorescent Dye Leak Detection in this section.

Test Step	Result / Action to Take
M1 CHECK THE A/C PRESSURE SENSOR (ACP_PRESS) PCM PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: ACP_PRESS PCM PID. • With the manifold gauge set connected, compare the pressure readings of the manifold gauge set and the ACP_PRESS PID. • **Are the pressure values of the manifold gauge set and the ACP_PRESS PID similar?**	**Yes** GO to M2 . **No** INSTALL a new A/C pressure transducer. TEST the system for normal operation.
M2 CHECK THE A/C EVAPORATOR TEMPERATURE (EVAP_TEMP) HVAC PID	
• Allow the vehicle exterior and interior to stabilize to an ambient temperature above 16Â°C (60Â°F). • Enter the following diagnostic mode on the scan tool: EVAP_TEMP HVAC PID. • **Does the EVAP_TEMP HVAC PID read similar to the ambient temperature?**	**Yes** For **Fusion equipped with navigation** and **all MKZ** vehicles, GO to M4 . For **Fusion not equipped with navigation** , GO to M3 . **No** INSTALL a new A/C evaporator discharge temperature sensor. TEST the system for normal operation.
M3 CHECK THE (A/C) SWITCH (CC_SW_AC) HVAC PID WITH THE A/C ON	
• Enter the following diagnostic mode on the scan tool: CC_SW_AC HVAC PID.	**Yes** GO to M6 . **No**

• Select PANEL press the A/C button (indicator on) on the HVAC module. • **Does the CC_SW_AC HVAC PID read Active?**	GO to M12 .
M4 CHECK THE A/C INDICATOR WITH THE A/C ON	
NOTE: Before carrying out this test step, be sure all other FCIM button functions are operational. If all other buttons operate correctly, continue with this test step. If multiple buttons are inoperative and DTC U0256:00 is not present, install a new FCIM . Test the system for normal operation. If DTC U0256:00 is present, diagnose the DTC first. • Select PANEL press the A/C button on the HVAC module. • **Does the A/C indicator illuminate when the A/C button is pressed?**	**Yes** GO to M6 . **No** GO to M5 .
M5 CHECK THE MAX A/C OPERATION	
NOTE: Before carrying out this test step, be sure all other ACM touch screen functions are operational. If all other touch screen functions operate correctly, continue with this test step. If multiple touch screen functions are inoperative and DTC U0163:00 is not present, install a new ACM . Test the system for normal operation. If DTC U0163:00 is present, diagnose the DTC first. • Select MAX A/C on the next generation navigation screen. • **Does the A/C operate when MAX A/C is selected?**	**Yes** INSTALL a new FCIM . TEST the system for normal operation. **No** GO to M12 .
M6 CHECK THE AIR CONDITIONING COMPRESSOR COMMANDED STATE (ACC_CMD) PCM PID WITH THE A/C ON	
• Enter the following diagnostic mode on the scan tool: ACC_CMD PCM PID. • **Does the ACC_CMD PCM PID read ON?**	**Yes** GO to M7 . **No** GO to M13 .
M7 CHECK THE VOLTAGE AT THE A/C COMPRESSOR CLUTCH FIELD COIL	
• Ignition OFF. • Disconnect: A/C Compressor Clutch Field Coil C100. • Ignition ON. • Select PANEL and A/C on the HVAC module. • Measure the voltage between A/C compressor clutch field coil C100-B, circuit CH401 (VT/WH), harness side and ground.	**Yes** GO to M8 . **No** GO to M10 .

 N0041898 • **Is the voltage greater than 10 volts?**	
M8 CHECK THE GROUND AT THE A/C COMPRESSOR CLUTCH FIELD COIL	
• Ignition OFF. • Measure the resistance between A/C compressor clutch field coil C100-A, circuit GD121 (BK/YE), harness side and ground.  N0041899 • **Is the resistance less than 5 ohms?**	**Yes** GO to M9 . **No** REPAIR circuit GD121 (BK/YE) for an open. TEST the system for normal operation.
M9 CHECK THE A/C COMPRESSOR CLUTCH AIR GAP	
• Measure the A/C compressor clutch air gap at 3 equally spaced locations between the clutch hub and the A/C compressor clutch pulley.  N0069468 • **Is the A/C compressor clutch air gap greater than 0.6 mm (0.024 in)?**	**Yes** ADJUST the A/C compressor clutch gap. REFER to Air Conditioning (A/C) Clutch Air Gap Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new A/C compressor clutch field coil. TEST the system for normal operation.
M10 CHECK THE A/C CLUTCH RELAY FOR VOLTAGE	
• Ignition OFF. • Disconnect: A/C Clutch Relay. • Ignition ON. • Measure the voltage between A/C clutch relay socket, circuit SBB25 (RD) and ground.	**Yes** GO to M11 . **No** VERIFY Battery Junction Box (BJB) fuse 25 (10A) is OK. If OK, REPAIR circuit SBB25 (RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify

 • **Is the voltage greater than 10 volts?**	the possible causes of the circuit short.
M11 CHECK CIRCUIT CH401 (VT/WH) FOR AN OPEN	
• Ignition OFF. • Measure the resistance between A/C clutch relay socket, circuit CH401 (VT/WH) and A/C compressor clutch field coil C100-B, circuit CH401 (VT/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** CARRY OUT the A/C clutch relay component test. If the relay tests OK, GO to M13 . **No** REPAIR circuit CH401 (VT/WH) for an open. TEST the system for normal operation.
M12 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
M13 CHECK THE PCM CONNECTION	
• Disconnect all the PCM connectors. • Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the PCM connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test N: The Air Conditioning (A/C) is Always On â A/C Compressor Does Not Cycle

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, for **Fusion equipped with navigation** and **all MKZ** vehicles, when A/C button is pressed, a message is sent from the Front Controls Interface Module (FCIM) over the Medium Speed Controller Area Network (MS-CAN) bus to the HVAC module. The HVAC module then sends an A/C request message over the MS-CAN bus to the Instrument Cluster (IC), then from the IC through the High Speed Controller Area Network (HS-CAN) bus to the PCM.

For **all vehicles equipped with navigation** , when MAX A/C is selected on the touch screen, the Audio Control Module (ACM) sends a message over the MS-CAN bus to the HVAC module that MAX A/C has been selected.

For **Fusion not equipped with navigation** , when A/C is requested, a message is sent over the MS-CAN bus to the IC , then from the IC through the HS-CAN bus to the PCM.

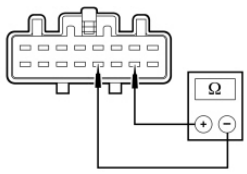
Ignition voltage is provided to the A/C clutch relay switch through circuit SBB25 (RD). When the PCM energizes the relay, ignition voltage is supplied to the A/C clutch through circuit CH401 (VT/WH). Ground is supplied for the A/C clutch through circuit GD121 (BK/YE).

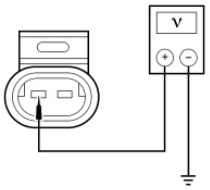
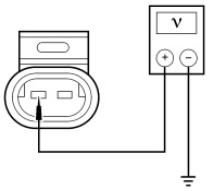
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- PCM
- evaporator discharge air temperature sensor
- A/C control relay
- A/C clutch air gap
- Evaporator core seals

PINPOINT TEST N: THE AIR CONDITIONING (A/C) IS ALWAYS ON â A/C COMPRESSOR DOES NOT CYCLE

Test Step	Result / Action to Take
N1 CHECK THE A/C EVAPORATOR TEMPERATURE (EVAP_TEMP) HVAC PID	
NOTE: Before carrying out the following test, diagnose any HVAC, PCM or Instrument Cluster (IC) DTCs. **NOTE:** CHECK On-Line Automotive Service Information System (OASIS) for any applicable Technical Service Bulletins (TSBs). If a Technical Service Bulletin (TSB) exists for this concern, discontinue this test and follow the TSB instructions. If no TSBs address this concern, continue with this test. • Ignition ON.	**Yes** GO to N3 . **No** GO to N2 .

• Allow the vehicle exterior and interior to stabilize to an ambient temperature between 15Â°C (60Â°F) and 32Â°C (90Â°F). • Enter the following diagnostic mode on the scan tool: EVAP_TEMP HVAC PID. • **Does the EVAP_TEMP HVAC PID read similar to the ambient temperature?**	
N2 CHECK THE EVAPORATOR DISCHARGE AIR TEMPERATURE SENSOR RESISTANCE	
• Ignition OFF. • Disconnect: For Electronic Manual Temperature Control (EMTC) Systems, Inline C211. • Disconnect: For Dual Automatic Temperature Control (DATC) Systems, Inline C213. • Measure the resistance between: ♦ For EMTC Systems, inline C211-13, circuit VH406 (VT/BN), HVAC case harness side and inline C211-15, circuit RH111 (GY/BU), HVAC case harness side. ♦ For DATC Systems, inline C213-13, circuit VH406 (VT/BN), HVAC case harness side and inline C213-15, circuit RH111 (GY/BU), HVAC case harness side.  N0122725 • Compare the measurement to the chart and table of the Evaporator Discharge Air Temperature Sensor component test in this section. • **Is the resistance within the specified values for the temperatures?**	**Yes** GO to N9 . **No** INSTALL a new evaporator discharge air temperature sensor. TEST the system for normal operation.
N3 CHECK THE AIR CONDITIONING COMPRESSOR COMMANDED STATE (ACC_CMD) PCM PID WITH THE A/C OFF	
• Enter the following diagnostic mode on the scan tool: ACC_CMD PCM PID. • **Does the ACC_CMD PCM PID read ON?**	**Yes** GO to N8 . **No** GO to N4 .
N4 CHECK FOR VOLTAGE TO THE A/C COMPRESSOR CLUTCH FIELD COIL	

• Ignition OFF. • Disconnect: A/C Compressor Clutch Field Coil C100. • Ignition ON. • Select the OFF position on the HVAC module. • Measure the voltage between A/C compressor clutch field coil C100-B, circuit CH401 (VT/WH), harness side and ground.  N0041898 • **Is the voltage greater than 10 volts?**	**Yes** GO to N5 . **No** ADJUST the A/C compressor clutch gap. REFER to Air Conditioning (A/C) Clutch Air Gap Adjustment in this section. TEST the system for normal operation.
N5 CHECK CIRCUIT CH401 (VT/WH) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: A/C Clutch Relay. • Ignition ON. • Measure the voltage between A/C compressor clutch field coil C100-B, circuit CH401 (VT/WH), harness side and ground.  N0041898 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit CH401 (VT/WH) for a short to voltage. TEST the system for normal operation. **No** INSTALL a new A/C clutch relay. TEST the system for normal operation. If the concern is still present, GO to N6 .
N6 CHECK THE EVAPORATOR DISCHARGE AIR TEMPERATURE SENSOR MOUNTING	
• Remove the instrument panel. For additional information, refer to Section 501-12 . • Inspect the evaporator discharge air temperature sensor for: ♦ damage. ♦ correct mounting. ♦ damaged mounting tabs. • **Is the sensor and mounting correct and free of damage?**	**Yes** GO to N7 . **No** INSTALL a new evaporator discharge air temperature sensor. TEST the system for normal operation.
N7 CHECK THE EVAPORATOR CORE SEALS	
• Remove the heater core and evaporator core housing. For additional information, refer to Section 412-01 . • Remove the evaporator core. For additional information, refer to Section 412-01 .	**Yes** GO to N9 . **No** CORRECT the evaporator core

• Inspect the evaporator core seals for: ♦ misalignment. ♦ damage. ♦ loose fit. • **Is the evaporator seal mounting tight, correct and free of damage?**	seal alignment or INSTALL a new evaporator core. REFER to Section 412-01 . TEST the system for normal operation.
N8 CHECK THE PCM CONNECTION	
• Disconnect all the PCM connectors. • Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the PCM connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
N9 CHECK THE HVAC MODULE CONNECTION	
• Inspect the HVACmodule connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test O: The Air Conditioning (A/C) is Always On â A/C Mode Always Commanded ON

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, for **Fusion equipped with navigation** and **all MKZ** vehicles, when A/C button is pressed, a message is sent from the Front Controls Interface Module (FCIM) over the Medium Speed Controller Area Network (MS-CAN) bus to the HVAC module. The HVAC module then sends an A/C request message over the MS-CAN bus to the Instrument Cluster (IC), then from the IC through the High Speed Controller Area Network (HS-CAN) bus to the PCM.

For **all vehicles equipped with navigation** , when MAX A/C is selected on the touch screen, the Audio Control Module (ACM) sends a message over the MS-CAN bus to the HVAC module that MAX A/C has been selected.

For **Fusion not equipped with navigation** , when A/C is requested, a message is sent over the MS-CAN bus to the IC , then from the IC through the HS-CAN bus to the PCM.

Ignition voltage is provided to the A/C clutch relay switch through circuit SBB25 (RD). When the PCM energizes the relay, ignition voltage is supplied to the A/C clutch through circuit CH401 (VT/WH). Ground is supplied for the A/C clutch through circuit GD121 (BK/YE).

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- PCM
- HVAC module

PINPOINT TEST O: THE AIR CONDITIONING (A/C) IS ALWAYS ON â A/C MODE ALWAYS COMMANDED ON

NOTE: Before carrying out the following test, diagnose any HVAC, PCM or Instrument Cluster (IC) DTCs.

Test Step	Result / Action to Take
O1 CHECK THE AIR CONDITIONING REQUEST SIGNAL (AC_REQ) PCM PID WITH THE A/C OFF	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: AC_REQ PCM PID. • Select PANEL press the A/C button (indicator off) on the HVAC module. • **Does the AC_REQ PCM PID read YES?**	**Yes** If the vehicle **is** equipped with navigation, GO to O3 . If the vehicle **is not** equipped with navigation, GO to O2 . **No** GO to O6 .
O2 CHECK THE AIR CONDITIONING SWITCH STATUS (CC_SW_AC) HVAC PID WITH THE A/C OFF	
• Enter the following diagnostic mode on the scan tool: CC_SW_AC HVAC PID. • Select PANEL press the A/C button (indicator off) on the HVAC module. • **Does the CC_SW_AC HVAC PID read Inactive?**	**Yes** GO to O6 . **No** GO to O5 .
O3 CHECK THE A/C INDICATOR WITH THE A/C OFF	
NOTE: Before carrying out this test step, be sure all other FCIM button functions are operational. If all other buttons operate correctly, continue with this test step. If multiple buttons are inoperative and DTC U0256:00 is not present, install a new FCIM . Test the system for normal operation. If DTC U0256:00 is present, diagnose the DTC first. • Select PANEL press the A/C button (indicator off) on the HVAC module. • **Does the A/C indicator turn off when the A/C button is pressed?**	**Yes** GO to O5 . **No** GO to O4 .
O4 CHECK THE MAX A/C OPERATION	
NOTE: Before carrying out this test step, be sure all other ACM touch screen functions are operational. If all other touch screen	**Yes** INSTALL a new FCIM . TEST the system for normal

functions operate correctly, continue with this test step. If multiple touch screen functions are inoperative and DTC U0163:00 is not present, install a new ACM . Test the system for normal operation. If DTC U0163:00 is present, diagnose the DTC first. • Select MAX A/C on the next generation navigation screen. • **Does the A/C turn off when MAX A/C is selected?**	operation. **No** GO to O5 .
O5 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
O6 CHECK THE PCM CONNECTION	
• Disconnect all the PCM connectors. • Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the PCM connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test P: Temperature Control is Inoperative/Does Not Operate Correctly

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, to rotate the temperature blend door actuator clockwise, the HVAC module supplies voltage to the temperature blend door actuators through the door actuator feed A circuits, and supplies ground through the door actuator feed B circuits. To rotate the temperature blend door actuator counterclockwise, the HVAC module reverses the voltage and ground circuits.

The temperature blend door actuator feedback resistors are supplied a ground from the HVAC module by the temperature blend door actuator return circuits and a 5-volt reference voltage on the temperature blend door actuator reference circuits. The HVAC module reads the voltage on the temperature blend door actuator

feedback circuits to determine the temperature blend door actuator position by the position of the actuator feedback resistor wiper arm.

NOTE: For the passenger side temperature setting on hybrid vehicles equipped with dual-zone Electronic Automatic Temperature Control (EATC) and a Front Controls Interface Module (FCIM) built on or after 04/08/2009 to be functional, a passenger must be seated in the front passenger seat. If the front passenger seat is not occupied, the HVAC module will control the system based only on the driver side temperature setting. The HVAC module receives a Medium Speed Controller Area Network (MS-CAN) signal from the FCIM to indicate if the front passenger seat is occupied.

Door actuator feed A circuits
- LH blend â CH238 (YE/OG)
- RH blend â CH212 (BU/OG)

Door actuator feed B circuits
- LH blend â CH239 (BU/WH)
- RH blend â CH213 (BN/GN)

Door actuator return circuits
- LH blend â RH111 (GY/BU)
- RH blend â RH111 (GY/BU)

Door actuator reference circuits
- LH blend â LH111 (BN/WH)
- RH blend â LH111 (BN/WH)

Door actuator feedback circuits
- LH blend â VH440 (BU/BN)
- RH blend â VH411 (VT/GN)

DTC Description	Fault Trigger Conditions
• B1081:07 â Left Temperature Damper Motor: Mechanical Failures	The module senses no changes in the feedback circuit when motor movement is commanded and no motor DTCs are present.
• B1081:11 â Left Temperature Damper Motor: Circuit Short to Ground	The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
• B1081:12 â Left Temperature Damper Motor: Circuit Short to Battery	The module senses no voltage drop on the sensor reference voltage circuit, indicating an open circuit.
• B1081:13 â Left Temperature Damper Motor: Circuit Open	The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
• B1082:07 â Right Temperature Damper Motor: Mechanical Failures	The module senses no changes in the feedback circuit when motor movement is commanded and no motor DTCs are present.
• B1082:11 â Right Temperature Damper Motor: Circuit Short to Ground	The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.

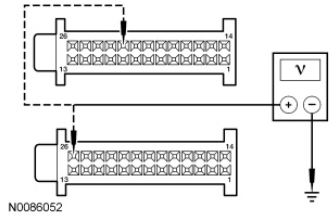
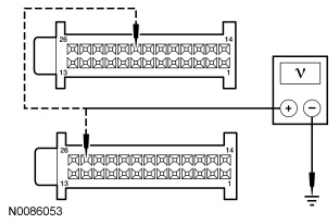
• B1082:12 â Right Temperature Damper Motor: Circuit Short to Battery	The module senses no voltage drop on the sensor reference voltage circuit, indicating an open circuit.
• B1082:13 â Right Temperature Damper Motor: Circuit Open	The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
• B11E5:11 â Left HVAC Damper Position Sensor: Circuit Short to Ground	The module senses no voltage drop on the sensor reference voltage circuit, indicating an open circuit.
• B11E5:15 â Left HVAC Damper Position Sensor: Circuit Short to Battery or Open	The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
• B11E6:11 â Right HVAC Damper Position Sensor: Circuit Short to Ground	The module senses no voltage drop on the sensor reference voltage circuit, indicating an open circuit.
• B11E6:15 â Right HVAC Damper Position Sensor: Circuit Short to Battery or Open	The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.

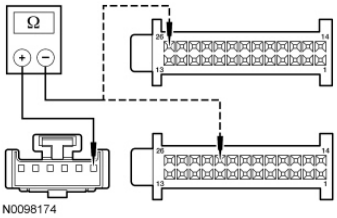
This pinpoint test is intended to diagnose the following:

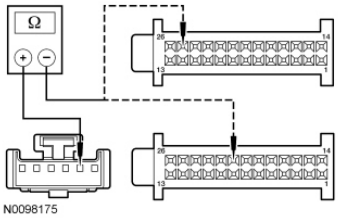
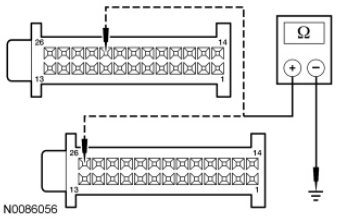
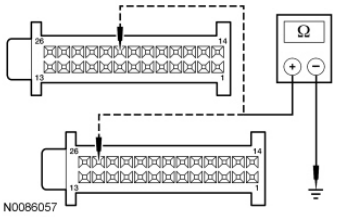
- Wiring, terminals or connectors
- Temperature blend door actuator
- HVAC module
- Stuck or bound linkage or door

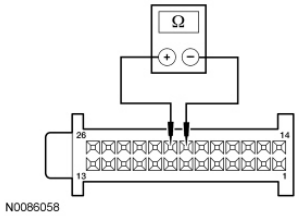
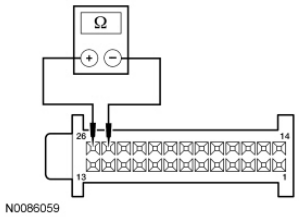
PINPOINT TEST P: TEMPERATURE CONTROL IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

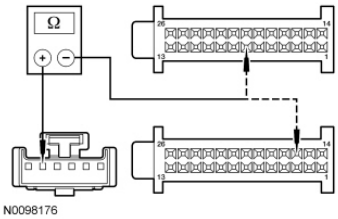
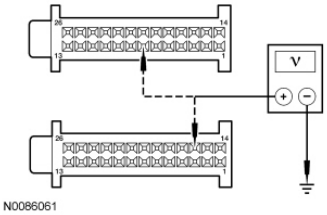
Test Step	Result / Action to Take
P1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** **For DTC B1081:07 or B1082:07** , INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, INSTALL a new door actuator. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For DTC B1081:12 or B1082:12** , GO to P2 . **For DTC B1081:13 or B1082:13** , GO to P3 . **For DTC B1081:11 or B1082:11** , GO to P4 . **For DTC B11E5:15 or B11E6:15** , GO to P6 .

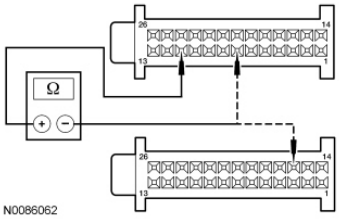
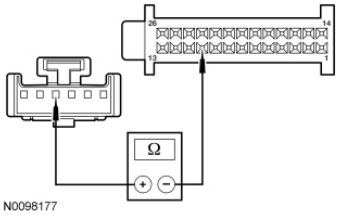
	For DTC B11E5:11 or B11E6:11 , GO to P10 . **No** INSPECT for broken linkage or door. REPAIR as necessary. If no condition is found, GO to P13 .
P2 CHECK THE ACTUATOR MOTOR DRIVE CIRCUITS FOR A SHORT TO POWER	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â Dual Automatic Temperature Control (DATC) C2356a. • Disconnect: HVAC Module â DATC C2356b. • Ignition ON. • Measure the voltage between ground and: ♦ **For DTC B1081:12** , HVAC module â EMTC C2357a-22 or HVAC module â DATC C2356a-22, circuit CH238 (YE/OG), harness side. ♦ **For DTC B1082:12** , HVAC module â DATC C2356b-26, circuit CH212 (BU/OG), harness side.  N0086052 • Measure the voltage between ground and: ♦ **For DTC B1081:12** , HVAC module â EMTC C2357a-21 or HVAC module â DATC C2356a-21, circuit CH239 (BU/WH), harness side. ♦ **For DTC B1082:12** , HVAC module â DATC C2356b-25, circuit CH213 (BN/GN), harness side.  N0086053 • **Are any voltages present?**	**Yes** REPAIR the circuit(s) for a short to power. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to P5 .
P3 CHECK THE ACTUATOR MOTOR DRIVE CIRCUITS FOR AN OPEN	

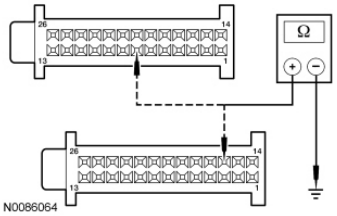
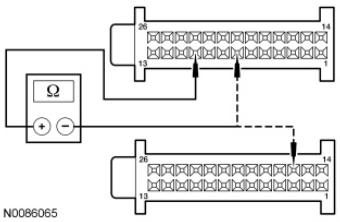
NOTE: Due to limited connector accessibility, before carrying out this test step, visually inspect the wiring between the HVAC module and actuator for opens or shorts. If no damage is visually evident, proceed with the test. • Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Disconnect: **For DTC B1081:00** , LH Temperature Blend Door Actuator C2091. • Disconnect: **For DTC B1082:00** , RH Temperature Blend Door Actuator C2092 . • Measure the resistance between: ♦ **For DTC B1081:00** , HVAC module â EMTC C2357a-22 or HVAC module â DATC C2356a-22, circuit CH238 (YE/OG), harness side and LH temperature blend door actuator C2091-5, circuit CH238 (YE/OG), harness side. ♦ **For DTC B1082:00** , HVAC module â DATC C2356b-26, circuit CH212 (BU/OG), harness side and RH temperature blend door actuator C2092-5, circuit CH212 (BU/OG), harness side.  N0098174 • Measure the resistance between: ♦ **For DTC B1081:00** , HVAC module â EMTC C2357a-21 or HVAC module â DATC C2356a-21, circuit CH239 (BU/WH), harness side and LH temperature blend door actuator C2091-6, circuit CH239 (BU/WH), harness side. ♦ **For DTC B1082:00** , HVAC module â DATC C2356b-25, circuit CH213 (BN/GN), harness side and RH temperature blend door actuator C2092-6, circuit CH213 (BN/GN), harness side.	**Yes** GO to <u>P13</u> . **No** REPAIR the circuit(s) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

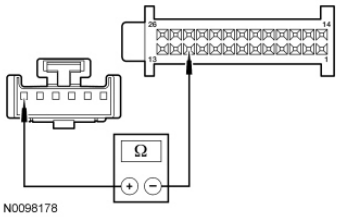
 N0098175 • **Are the resistances less than 5 ohms?**	
P4 CHECK THE ACTUATOR MOTOR DRIVE CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Measure the resistance between ground and: ♦ **For DTC B1081:11** , HVAC module â EMTC C2357a-22 or HVAC module â DATC C2356a-22, circuit CH238 (YE/OG), harness side. ♦ **For DTC B1082:11** , HVAC module â DATC C2356b-26, circuit CH212 (BU/OG), harness side.  N0086056 • Measure the resistance between ground and: ♦ **For DTC B1081:11** , HVAC module â EMTC C2357a-21 or HVAC module â DATC C2356a-21, circuit CH239 (BU/WH), harness side. ♦ **For DTC B1082:11** , HVAC module â DATC C2356b-25, circuit CH213 (BN/GN), harness side.  N0086057 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to P5 . **No** REPAIR the circuit(s) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P5 CHECK THE ACTUATOR MOTOR DRIVE CIRCUITS FOR A SHORT TOGETHER	

NOTE: Due to limited connector accessibility, before carrying out this test step, visually inspect the wiring between the HVAC module and actuator for opens or shorts. If no damage is visually evident, proceed with the test. • Ignition OFF. • Disconnect: **For DTC B1081:11** , LH Temperature Blend Door Actuator C2091. • Disconnect: **For DTC B1082:11** , RH Temperature Blend Door Actuator C2092 . **For DTC B1081:11.**  N0086058 • **NOTE: For DTC B1081:11** . • Measure the resistance between HVAC module â EMTC C2357a-21 or HVAC module â DATC C2356a-21, circuit CH239 (BU/WH), harness side and HVAC module â EMTC C2357a-22 or HVAC module â DATC C2356a-22, circuit CH238 (YE/OG), harness side. **For DTC B1082:11.**  N0086059 • **NOTE: For DTC B1082:11** . • Measure the resistance between HVAC module â DATC C2356b-25, circuit CH213 (BN/GN), harness side and HVAC module â DATC C2356b-26, circuit CH212 (BU/OG), harness side. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P13 . **No** REPAIR circuit(s) for a short together. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P6 CHECK CIRCUIT VH441 (WH/BN) OR VH440 (BU/BN) FOR AN OPEN	
NOTE: Due to limited connector accessibility, before carrying out this test step, visually inspect the wiring between the HVAC module and actuator for opens or shorts. If no damage is visually evident, proceed with the test. • Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a.	**Yes** GO to P7 . **No** REPAIR circuit VH441 (WH/BN) or VH440 (BU/BN) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Disconnect: **For DTC B11E5:15** , LH Temperature Blend Door Actuator C2091. • Disconnect: **For DTC B11E6:15** , RH Temperature Blend Door Actuator C2092 . • Measure the resistance between the following: ♦ **For DTC B11E5:15** , HVAC module â EMTC C2357a-7 or HVAC module â DATC C2356a-7, circuit VH440 (BU/BN), harness side and LH temperature blend door actuator C2091-9, circuit VH440 (BU/BN), harness side. ♦ **For DTC B11E6:15** , HVAC module â DATC C2356b-16, circuit VH441 (WH/BN), harness side and RH temperature blend door actuator C2092-9, circuit VH441 (WH/BN), harness side.  N0098176 • **Is the resistance less than 5 ohms?**	
P7 CHECK CIRCUIT VH440 (BU/BN) OR VH441 (WH/BN) FOR A SHORT TO POWER	
• Ignition ON. • Measure the voltage between ground and the following: ♦ **For DTC B11E5:15** , HVAC module â EMTC C2357a-7 or HVAC module â DATC C2356a-7, circuit VH440 (BU/BN), harness side. ♦ **For DTC B11E6:15** , HVAC module â DATC C2356b-16, circuit VH441 (WH/BN), harness side.  N0086061 • **Is any voltage present?**	**Yes** REPAIR circuits VH441 (WH/BN) or VH440 (BU/BN) for a short to power. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to P8 .
P8 CHECK CIRCUIT LH111 (BN/WH) FOR A SHORT TO CIRCUIT VH441 (WH/BN) OR VH440 (BU/BN)	

• Ignition OFF. • Measure the resistance between HVAC module â EMTC C2357a-11 or HVAC module â DATC C2356a-11, circuit LH111 (BN/WH) and the following: ♦ **For DTC B11E5:15** , HVAC module â EMTC C2357a-7 or HVAC module â DATC C2356a-7, circuit VH440 (BU/BN), harness side. ♦ **For DTC B11E6:15** , HVAC module â DATC C2356b-16, circuit VH441 (WH/BN), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P9 . **No** REPAIR circuits LH111 (BN/WH) and VH441 (WH/BN) or VH440 (BU/BN) for a short together. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P9 CHECK THE ACTUATOR RETURN CIRCUIT RH111 (GY/BU) FOR AN OPEN	
• Measure the resistance between HVAC module â EMTC C2357a-10 or HVAC module â DATC C2356a-10, circuit RH111 (GY/BU) and the following: ♦ **For DTC B11E5:15** , LH temperature blend door actuator C2091-8, circuit RH111 (GY/BU), harness side. ♦ **For DTC B11E6:15** , RH temperature blend door actuator C2092-8, circuit RH111 (GY/BU), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to P13 . **No** REPAIR circuit RH111 (GY/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P10 CHECK CIRCUIT VH440 (BU/BN) OR VH441 (WH/BN) FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357a. • Disconnect: HVAC Module â DATC C2356a. • Disconnect: HVAC Module â DATC C2356b. • Measure the resistance between ground and the following:	**Yes** GO to P11 . **No** REPAIR circuit VH441 (WH/BN) or VH440 (BU/BN) for a short to ground. CLEAR the DTCs. REPEAT the self-test.

♦ **For DTC B11E5:11** , HVAC module â EMTC C2357a-7 or HVAC module â DATC C2356a-7, circuit VH440 (BU/BN), harness side. ♦ **For DTC B11E6:11** , HVAC module â DATC C2356b-16, circuit VH441 (WH/BN), harness side.  • **Are the resistances greater than 10,000 ohms?**	TEST the system for normal operation.
P11 CHECK CIRCUIT RH111 (GY/BU) FOR A SHORT TO CIRCUIT VH441 (WH/BN) OR VH440 (BU/BN)	
NOTE: Due to limited connector accessibility, before carrying out this test step, visually inspect the wiring between the HVAC module and actuator for opens or shorts. If no damage is visually evident, proceed with the test. • Disconnect: **For DTC B11E5:11** , LH Temperature Blend Door Actuator C2091. • Disconnect: **For DTC B11E6:11** , RH Temperature Blend Door Actuator C2092 . • Measure the resistance between HVAC module â EMTC C2357a-10 or HVAC module â DATC C2356a-10, circuit RH111 (GY/BU) and the following: ♦ **For DTC B11E5:11** , HVAC module â EMTC C2357a-7 or HVAC module â DATC C2356a-7, circuit VH440 (BU/BN), harness side. ♦ **For DTC B11E6:11** , HVAC module â DATC C2356b-16, circuit VH441 (WH/BN), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P12 . **No** REPAIR circuits RH111 (GY/BU) and VH441 (WH/BN) or VH440 (BU/BN) for a short together. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P12 CHECK CIRCUIT LH111 (BN/WH) FOR AN OPEN	

• Measure the resistance between HVAC module â EMTC C2357a-11 or HVAC module â DATC C2356a-11, circuit LH111 (BN/WH) and the following: ♦ **For DTC B11E5:11** , LH temperature blend door actuator C2091-10, circuit LH111 (BN/WH), harness side. ♦ **For DTC B11E6:11** , RH temperature blend door actuator C2092-10, circuit LH111 (BN/WH), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** GO to P13 . **No** REPAIR circuit LH111 (BN/WH) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P13 CHECK THE ACTUATOR CONNECTION	
• Disconnect the actuator connector. • Check for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat the actuator connector. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** CARRY OUT the Temperature Blend Door Actuator component test in this section. If the actuator tests OK, GO to P14 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.
P14 MODULE ACTUATOR POSITION CALIBRATION	
NOTE: The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below. • Ignition OFF. • Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Ignition ON. • Clear the DTCs. • Select any position except OFF. • **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators will take approximately 30 seconds.	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects.

• Operate the system and verify the concern is still present. • **Is the concern still present?**	

Pinpoint Test Q: The Blower Motor is Inoperative â EMTC

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Normal Operation

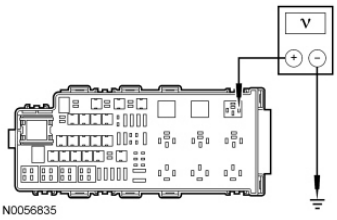
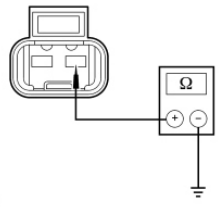
Under normal operation, the blower motor relay coil receives ignition voltage through circuit CBP45 (YE). The coil receives ground from the HVAC module â Electronic Manual Temperature Control (EMTC) through circuit CH123 (VT/GN) if any function selector position but OFF is selected. Voltage is supplied to the relay switch contact through circuit SBB06 (BN/RD). When the relay coil is energized, voltage is delivered to the blower motor through circuit CH402 (YE/GN). Ground for the blower motor is provided through circuit CH426 (YE/OG) from the blower resistor or the blower switch (HI). The blower resistor and blower switch is grounded through circuit GD115 (BK/GY).

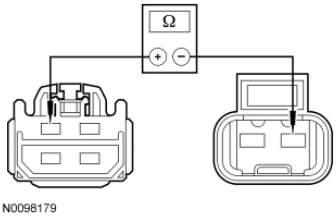
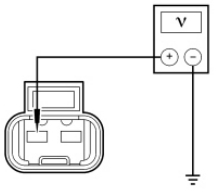
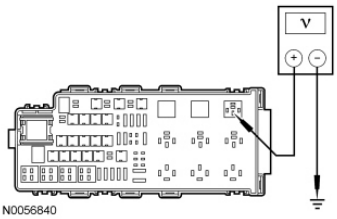
- DTC B10AF:12 (Blower Fan Relay: Circuit Short to Battery) â The module senses excessive voltage on the relay coil ground circuit, indicating a short directly to voltage.
- DTC B10AF:14 (Blower Fan Relay: Circuit Short to Ground or Open) â The module senses no voltage on the relay coil ground circuit, indicating an open or a short directly to ground.

This pinpoint test is intended to diagnose the following:
- Fuse(s)
- Wiring, terminals or connectors
- Blower motor
- Blower motor relay
- HVAC module â EMTC

PINPOINT TEST Q: THE BLOWER MOTOR IS INOPERATIVE â EMTC

Test Step	Result / Action to Take
Q1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** **For B10AF:12** , REPAIR circuit CH123 (VT/GN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For B10AF:14** , CARRY OUT the blower motor relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. If the relay tests OK, GO to Q2 . **No**

	GO to Q3 .
Q2 CHECK THE RELAY COIL SUPPLY VOLTAGE	
• Ignition OFF. • Disconnect: Blower Motor Relay. • Ignition ON. • Measure the voltage between blower motor relay socket pin 86, circuit CBP45 (YE) and ground.  • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit CH123 (VT/GN) for an open. TEST the system for normal operation. **No** VERIFY Smart Junction Box (SJB) fuse 45 (5A) is OK. If OK, REPAIR circuit CBP45 (YE) for an open. TEST the system for normal operation.
Q3 CHECK CIRCUIT CH426 (YE/OG) FOR GROUND	
• Ignition OFF. • Disconnect: Blower Motor C288. • Turn the function selector switch to the PANEL position. • Turn the blower motor switch to the HI position. • Measure the resistance between blower motor connector C288-B, circuit CH426 (YE/OG), harness side and ground.  • **Is the resistance less than 5 ohms?**	**Yes** GO to Q5 . **No** GO to Q4 .
Q4 CHECK CIRCUIT CH426 (YE/OG) FOR AN OPEN	
• Disconnect: HVAC Module â EMTC C2357b. • Measure the resistance between HVAC module â EMTC C2357b-2, circuit CH426 (YE/OG), harness side and blower motor C288-B, circuit CH426 (YE/OG), harness side.	**Yes** REPAIR circuit GD115 (BK/GY) for an open. TEST the system for normal operation. **No** REPAIR circuit CH426 (YE/OG) for an open. TEST the system for normal operation.

 N0098179 • **Is the resistance less than 5 ohms?**	
Q5 CHECK BLOWER MOTOR CIRCUIT CH402 (YE/GN) FOR VOLTAGE	
• Ignition ON. • Measure the voltage between blower motor C288-A, circuit CH402 (YE/GN), harness side and ground.  N0041907 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new blower motor. REFER to Section 412-01 . TEST the system for normal operation. **No** GO to Q6 .
Q6 CHECK CIRCUIT SBB35 (BU/RD) FOR VOLTAGE	
• Ignition OFF. • Disconnect: Blower Motor Relay. • Ignition ON. • Measure the voltage between blower motor relay socket pin 30, circuit SBB35 (BU/RD) and ground.  N0056840 • **Is the voltage greater than 10 volts?**	**Yes** CARRY OUT the blower motor relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. If the relay tests OK, REPAIR circuit CH402 (YE/GN) for an open. TEST the system for normal operation. **No** VERIFY Battery Junction Box (BJB) fuse 35 (40A) is OK. If OK, REPAIR circuit SBB35 (BU/RD) for an open. TEST the system for normal operation.

Pinpoint Test R: The Blower Motor Does Not Operate Correctly â EMTC

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control System for schematic and connector information.

Normal Operation

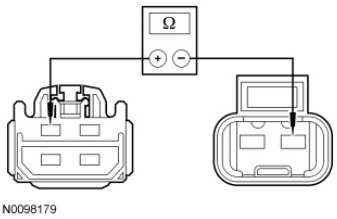
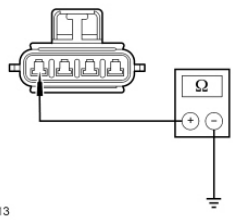
Under normal operation, the blower motor is provided ground from the blower resistor through circuit CH426 (YE/OG). The resistor gets a ground from circuit GD115 (BK/GY) in the lowest blower setting. In MED-LO and MED-HI the resistor gets ground from the blower motor switch through circuit CH428 (GN/WH) or CH429 (GY/BN), depending on selected speed. In HI, the blower motor is grounded directly through the blower motor switch from circuit CH426 (YE/OG) to circuit GD115 (BK/GY). The blower switch receives its ground from circuit GD115 (BK/GY).

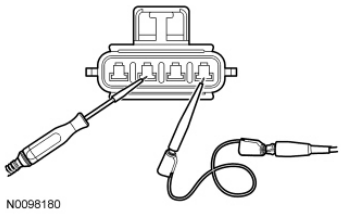
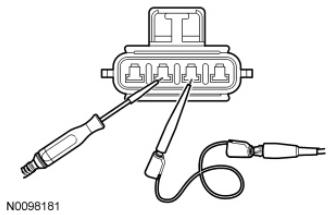
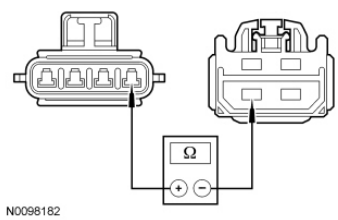
- DTC B10AF:14 (Blower Fan Relay: Circuit Short to Ground or Open) â The module senses no voltage on the relay coil ground circuit, indicating an open or a short directly to ground.

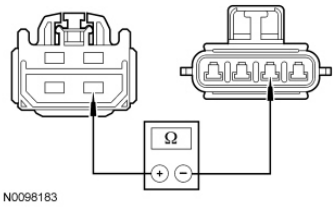
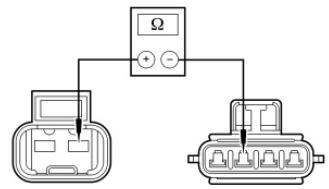
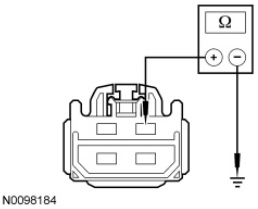
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Blower motor resistor
- HVAC module â Electronic Manual Temperature Control (EMTC)

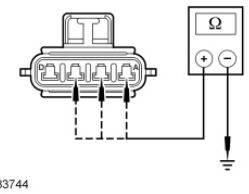
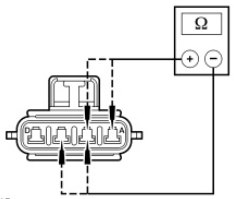
PINPOINT TEST R: THE BLOWER MOTOR DOES NOT OPERATE CORRECTLY â EMTC

Test Step	Result / Action to Take
R1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Is DTC B10AF:14 present?**	**Yes** REPAIR circuit CH123 (VT/GN) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to R2 .
R2 CHECK THE BLOWER MOTOR OPERATION	
• Ignition ON. • Turn the function selector switch to the FLOOR position. • Select all blower speed positions. • **Does the blower motor operate in any position?**	**Yes** If the blower motor does not operate in HI setting only, GO to R3 . If the blower motor does not operate in LO setting only, GO to R4 . If the blower motor does not operate in MED-LO or MED-HI setting only, GO to R5 . If the blower motor

	operates in HI setting only, GO to R7 . If the blower motor operates in LO setting only, GO to R8 . For all other symptoms, GO to R9 . **No** GO to Pinpoint Test Q .
R3 CHECK CIRCUIT CH426 (YE/OG) FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357b. • Disconnect: Blower Motor C288. • Measure the resistance between HVAC module â EMTC C2357b-2, circuit CH426 (YE/OG), harness side and blower motor C288-B, circuit CH426 (YE/OG), harness side.  N0098179 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new HVAC module. TEST the system for normal operation. **No** REPAIR circuit CH426 (YE/OG) for an open. TEST the system for normal operation.
R4 CHECK BLOWER MOTOR RESISTOR GROUND CIRCUIT GD115 (BK/GY) FOR AN OPEN	
• Ignition OFF. • Disconnect: Blower Motor Resistor C1228. • Measure the resistance between blower motor resistor C1228-D, circuit GD115 (BK/GY), harness side and ground.  N0041913 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor resistor. REFER to Section 412-01 . TEST the system for normal operation. **No** REPAIR circuit GD115 (BK/GY) for an open. TEST the system for normal operation.
R5 CHECK CIRCUIT CH428 (GN/WH) OR CH429 (GY/BN) FOR GROUND	

NOTICE: **The following step uses a test light to stimulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section or equivalent. To avoid connector terminal damage, use the Flex Probe kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Ignition OFF. • Disconnect: Blower Motor Resistor C1228. • Ignition ON. **For MED-LO inoperative.**  N0098180 • **For MED-LO inoperative** : With the blower motor switch in the MED-LO speed position, connect a 12-volt test lamp between blower motor resistor C1228-C, circuit CH426 (YE/OG), harness side and blower motor resistor C1228-A, circuit CH428 (GN/WH), harness side. **For MED-HI inoperative.**  N0098181 • **For MED-HI inoperative** : With the blower motor switch in the MED-HI speed position, connect a 12-volt test lamp between blower motor resistor C1228-C, circuit CH426 (YE/OG), harness side and blower motor resistor C1228-B, circuit CH429 (GY/BN), harness side. • **Does the test lamp illuminate?**	**Yes** INSTALL a new blower motor resistor. TEST the system for normal operation. **No** GO to R6 .
R6 CHECK CIRCUIT CH428 (GN/WH) OR CH429 (GY/BN) FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module â EMTC C2357b. **For MED-LO inoperative.**  N0098182 • **For MED-LO inoperative** , measure the resistance between HVAC module â EMTC C2357b-4, circuit CH428 (GN/WH), harness side	**Yes** CARRY OUT the Blower Motor Resistor component test in this section. If the resistor tests OK, INSTALL a new blower motor switch. TEST the system for normal operation. **No** REPAIR circuit CH428 (GN/WH) or

and blower motor resistor C1228-A, circuit CH428 (GN/WH), harness side. **For MED-HI inoperative.**  N0098183 • **For MED-HI inoperative** , measure the resistance between HVAC module â EMTC C2357b-3, circuit CH429 (GY/BN), harness side and blower motor resistor C1228-B, circuit CH429 (GY/BN), harness side. • **Is the resistance less than 5 ohms?**	CH429 (GY/BN) for an open. TEST the system for normal operation.
R7 CHECK CIRCUIT CH426 (YE/OG) FOR AN OPEN	
• Ignition OFF. • Disconnect: Blower Motor Resistor C1228. • Disconnect: Blower Motor C288. • Measure the resistance between blower motor resister C1228-C, circuit CH426 (YE/OG), harness side and blower motor C288-B, circuit CH426 (YE/OG), harness side.  N0041914 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor resistor. TEST the system for normal operation. **No** REPAIR circuit CH426 (YE/OG) for an open. TEST the system for normal operation.
R8 CHECK THE BLOWER MOTOR SWITCH CIRCUIT GD115 (BK/GY) FOR AN OPEN	
• Measure the resistance between HVAC Module â EMTC C2357b-1, circuit GD115 (BK/GY), harness side and ground.  N0098184 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new HVAC module. TEST the system for normal operation. **No** REPAIR circuit GD115 (BK/GY) for an open. TEST the system for normal operation.
R9 CHECK CIRCUITS CH426 (YE/OG), CH428 (GN/WH) AND CH429 (GY/BN) FOR A SHORT TO GROUND	

• Ignition OFF. • Disconnect: Blower Motor C288. • Disconnect: Blower Motor Resistor C1228. • Disconnect: HVAC Module â EMTC C2357b. • Measure the resistance between ground and blower motor resistor: ♦ C1228-A, circuit CH428 (GN/WH), harness side. ♦ C1228-C, circuit CH426 (YE/OG), harness side. ♦ C1228-B, circuit CH429 (GY/BN), harness side.  N0083744 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to R10 . **No** REPAIR the affected circuit for a short to ground. TEST the system for normal operation.
R10 CHECK THE BLOWER MOTOR CIRCUITS FOR SHORTS TOGETHER	
• Measure the resistance between blower motor resistor: ♦ C1228-A, circuit CH428 (GN/WH), harness side and C1228-C, circuit CH426 (YE/OG), harness side. ♦ C1228-A, circuit CH428 (GN/WH), harness side and C1228-B, circuit CH429 (GY/BN), harness side. ♦ C1228-C, circuit CH426 (YE/OG), harness side and C1228-B, circuit CH429 (GY/BN), harness side.  N0083745 • **Are the resistances greater than 10,000 ohms?**	**Yes** CARRY OUT the Blower Motor Resistor component test in this section. If the resistor tests OK, INSTALL a new HVAC module. TEST the system for normal operation. **No** REPAIR the affected circuits. TEST the system for normal operation.

Pinpoint Test S: The Blower Motor is Inoperative â DATC

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, the blower motor relay coil receives a ground from the HVAC module through circuit CH123 (VT/GN). The coil receives ignition voltage through circuit CBP45 (YE). Voltage is supplied to the relay switch contact through circuit SBB06 (BN/RD). When the relay coil is energized, voltage is delivered to the blower motor speed control through circuit CH402 (YE/GN). Ground for the blower motor speed control is provided by circuit GD115 (BK/GY). Voltage for the motor is provided through circuit VH301 (YE/BU) from the blower motor speed control. Ground for the motor is provided through circuit VH219 (GY) from the blower motor speed control. The HVAC module sends a Pulse-Width Modulation (PWM) signal to the blower motor speed control through circuit VH101 (WH/VT) to control the blower

speed.

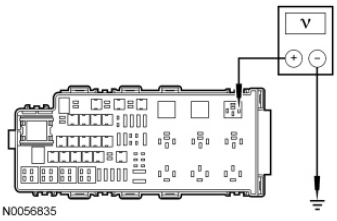
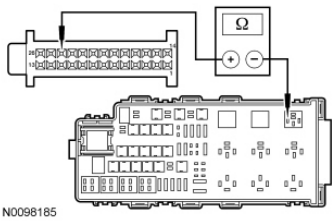
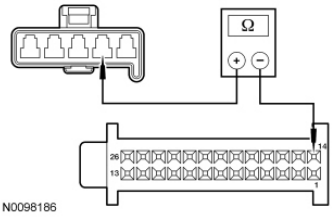
- DTC B10AF:12 (Blower Fan Relay: Circuit Short to Battery) â The module senses excessive voltage on the relay coil ground circuit, indicating a short directly to voltage.
- DTC B10AF:14 (Blower Fan Relay: Circuit Short to Ground or Open) â The module senses no voltage on the relay coil ground circuit, indicating an open or a short directly to ground.
- DTC B10B9:12 (Blower Control: Circuit Short to Battery) â The module senses excessive voltage on the blower motor control PWM circuit, indicating a short directly to voltage.
- DTC B10B9:14 (Blower Control: Circuit Short to Ground or Open) â The module senses no voltage on the blower motor control PWM circuit, indicating an open or a short directly to ground.

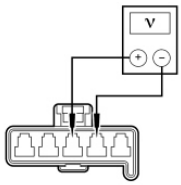
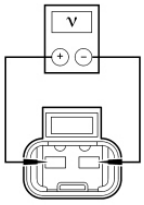
This pinpoint test is intended to diagnose the following:

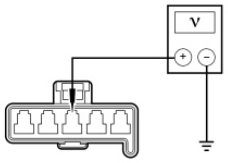
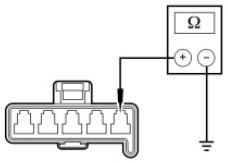
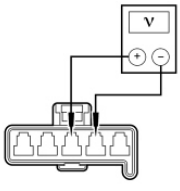
- Fuse(s)
- Wiring, terminals or connectors
- Blower motor relay
- Blower motor speed control
- HVAC module â Dual Automatic Temperature Control (DATC)
- Blower motor

PINPOINT TEST S: THE BLOWER MOTOR IS INOPERATIVE â DATC

Test Step	Result / Action to Take
S1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** **For DTC B10AF:12** , REPAIR circuit CH123 (VT/GN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For DTC B10AF:14** , CARRY OUT the Blower Motor Relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. If the relay tests OK, GO to S2 . **For DTC B10B9:14** , GO to S4 . **No** GO to S6 .
S2 CHECK THE RELAY COIL SUPPLY VOLTAGE	
• Ignition OFF. • Disconnect: Blower Motor Relay. • Ignition ON. • Measure the voltage between blower motor relay socket pin 86, circuit CBP45 (YE) and ground.	**Yes** GO to S3 . **No** VERIFY Smart Junction Box (SJB) fuse 45 (5A) is OK. If OK, REPAIR

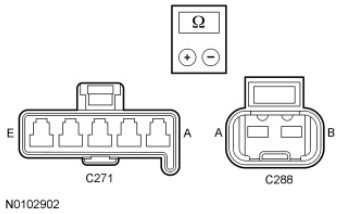
 N0056835 • **Is the voltage greater than 10 volts?**	circuit CBP45 (YE) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
S3 CHECK CIRCUIT CH123 (VT/GN) FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module â DATC C2356a. • Measure the resistance between blower motor relay socket pin 85, circuit CH123 (VT/GN) and HVAC module â DATC C2356a-24, circuit CH123 (VT/GN), harness side.  N0098185 • **Is the resistance less than 5 ohms?**	**Yes** GO to S17 . **No** REPAIR circuit CH123 (VT/GN) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
S4 CHECK CIRCUIT VH101 (WH/VT) FOR AN OPEN	
• Ignition OFF. • Disconnect: Blower Motor Speed Control C271. • Disconnect: HVAC Module â DATC C2356a. • Measure the resistance between blower motor control C271-B, circuit VH101 (WH/VT), harness side and HVAC module â DATC C2356a-14, circuit VH101 (WH/VT), harness side.  N0098186 • **Is the resistance less than 5 ohms?**	**Yes** GO to S5 . **No** REPAIR circuit VH101 (WH/VT) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
S5 CHECK CIRCUIT VH101 (WH/VT) FOR GROUND SIGNAL	

• Connect: HVAC Module â DATC C2356a. • Ignition ON. • Press the PANEL button on the HVAC module. Adjust the blower motor setting to HI. • Measure the voltage between blower motor speed control C271-B, circuit VH101 (WH/VT), harness side and blower motor speed control C271-C, circuit CH402 (YE/GN), harness side.  N0042577 • **Is the voltage greater than 10 volts?**	**Yes** GO to S16 . **No** GO to S17 .
S6 CHECK FOR VOLTAGE TO THE BLOWER MOTOR	
• Ignition OFF. • Disconnect: Blower Motor C288. • Ignition ON. • Measure the voltage between blower motor C288-A, circuit VH219 (GY), harness side and blower motor C288-B, circuit VH301 (YE/BU), harness side.  N0042576 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new blower motor. TEST the system for normal operation. **No** GO to S7 .
S7 CHECK FOR VOLTAGE TO THE BLOWER MOTOR CONTROLLER	
• Ignition OFF. • Disconnect: Blower Motor Speed Control C271. • Ignition ON. • Press the PANEL button on the HVAC module. • Measure the voltage between blower motor speed control C271-C, circuit CH402 (YE/GN), harness side and ground.	**Yes** GO to S8 . **No** GO to S14 .

 N0041919 • **Is the voltage greater than 10 volts?**	
S8 CHECK CIRCUIT GD115 (BK/GY) FOR AN OPEN	
• Ignition OFF. • Measure the resistance between blower motor speed control C271-A, circuit GD115 (BK/GY), harness side and ground.  N0041918 • **Is the resistance less than 5 ohms?**	**Yes** GO to S9 . **No** REPAIR circuit GD115 (BK/GY) for an open. TEST the system for normal operation.
S9 CHECK CIRCUIT VH101 (WH/VT) FOR GROUND SIGNAL	
• Ignition ON. • Press the PANEL button on the HVAC module. Adjust the blower motor setting to HI. • Measure the voltage between blower motor speed control C271-2, circuit VH101 (WH/VT), harness side and blower motor speed control C271-3, circuit CH402 (YE/GN), harness side.  N0042577 • **Is the voltage greater than 10 volts?**	**Yes** GO to S10 . **No** GO to S17 .
S10 CHECK CIRCUITS VH219 (GY) AND VH301 (YE/BU) FOR AN OPEN	
• Measure the resistance between the blower motor connector, harness side and blower motor speed control, harness side using the following chart.	**Yes** GO to S11 . **No** REPAIR circuit VH219 (GY) or VH301 (YE/BU) for an open. TEST

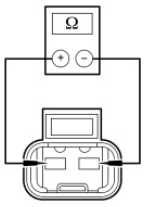
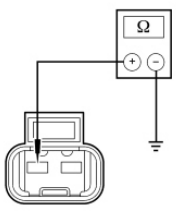
	the system for normal operation.

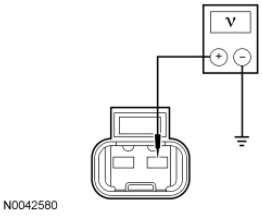
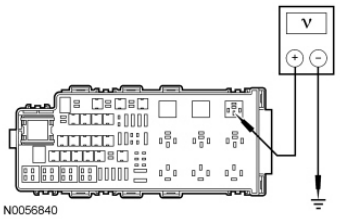
Blower Motor Connector	Circuit	Blower Motor Speed Control Connector
C288-A	VH219 (GY)	C271-E
C288-B	VH301 (YE/BU)	C271-D

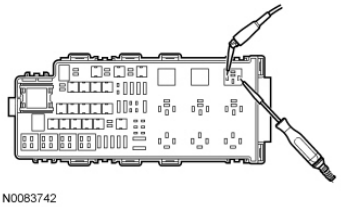


N0102902

- **Are the resistances less than 5 ohms?**

S11 CHECK CIRCUITS VH219 (GY) AND VH301 (YE/BU) FOR A SHORT TOGETHER	
• Measure the resistance between blower motor C288-A, circuit VH219 (GY), harness side and blower motor C288-B, circuit VH301 (YE/BU), harness side.  N0042578 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to S12 . **No** REPAIR circuits VH219 (GY) and VH301 (YE/BU) for a short together. TEST the system for normal operation.
S12 CHECK CIRCUIT VH219 (GY) FOR A SHORT TO GROUND	
• Measure the resistance between ground and blower motor C288-A, circuit VH219 (GY), harness side.  N0042579 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to S13 . **No** REPAIR circuit VH219 (GY) for a short to ground. TEST the system for normal operation.

S13 CHECK CIRCUIT VH301 (YE/BU) FOR A SHORT TO VOLTAGE	
• Ignition ON. • Measure the voltage between ground and blower motor C288-B, circuit VH301 (YE/BU), harness side.  • **Is any voltage present?**	**Yes** REPAIR circuit VH301 (YE/BU) for a short to voltage. TEST the system for normal operation. **No** GO to S16 .
S14 CHECK THE RELAY SWITCH POWER CIRCUIT FOR AN OPEN	
• Measure the voltage between blower motor relay socket pin 30, circuit SBB35 (BU/RD) and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to S15 . **No** VERIFY Battery Junction Box (BJB) fuse 35 (40A) is OK. If OK, REPAIR circuit SBB35 (BU/RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
S15 CHECK THE MODULE OUTPUT	
NOTICE: **The following step use a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section or equivalent. To avoid connector terminal damage, use the Flex Probe kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** • Ignition ON. • With the engine running, connect a 12-volt test lamp between blower motor relay socket pin 85, circuit CH123 (VT/GN) and socket pin 86, circuit CBP45 (YE).	**Yes** INSTALL a new blower motor relay. TEST the system for normal operation. **No** GO to S17 .

 N0083742 • **Does the test lamp illuminate?**	
S16 CHECK THE BLOWER MOTOR SPEED CONTROL CONNECTION	
• Clear the DTCs. • Disconnect the blower motor speed control connector. • Check for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat the connector. • Carry out the HVAC On-Demand Self Test. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new blower motor speed control. REFER to Section 412-01 . CLEAR the DTCs. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.
S17 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test T: The Blower Motor Does Not Operate Correctly â DATC

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, the blower motor relay coil receives a ground from the HVAC module through circuit CH123 (VT/GN). The coil receives ignition voltage through circuit CBP45 (YE). Voltage is supplied to the relay switch contact through circuit SBB06 (BN/RD). When the relay coil is energized, voltage is delivered to the blower motor speed control through circuit CH402 (YE/GN). Ground for the blower motor speed control is provided by circuit GD115 (BK/GY). Voltage for the motor is provided through circuit VH301 (YE/BU) from the blower motor speed control. Ground for the motor is provided through circuit VH219 (GY) from the blower motor speed control. The HVAC module sends a Pulse-Width Modulation (PWM) signal to the blower motor speed control through circuit VH101 (WH/VT) to control the blower speed.

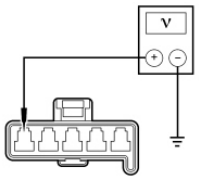
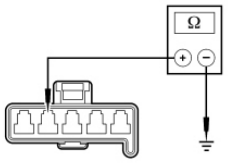
- DTC B10AF:14 (Blower Fan Relay: Circuit Short to Ground or Open) â The module senses no voltage on the relay coil ground circuit, indicating an open or a short directly to ground.
- DTC B10B9:14 (Blower Control: Circuit Short to Ground or Open) â The module senses no voltage on the blower motor control PWM circuit, indicating an open or a short directly to ground.

This pinpoint test is intended to diagnose the following:

- Fuse(s)
- Wiring, terminals or connectors
- Blower motor speed control
- HVAC module â Dual Automatic Temperature Control (DATC)

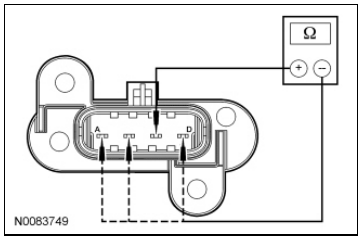
PINPOINT TEST T: THE BLOWER MOTOR DOES NOT OPERATE CORRECTLY â DATC

Test Step	Result / Action to Take
T1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** **For DTC B10AF:14** , REPAIR circuit CH123 (VT/GN) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For DTC B10B9:14** , REPAIR circuit VH101 (WH/VT) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to T2 .
T2 VERIFY THE BLOWER MOTOR OPERATION	
• Ignition ON. • Press the panel button on the HVAC module. Adjust the blower motor setting to LO and then to HI. • **Does the blower motor operate at any setting?**	**Yes** If the blower motor operates always in HI, GO to T3 . If the blower motor is always ON, CARRY OUT the blower motor relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. If the relay tests OK, GO to T5 . **No** GO to Pinpoint Test S .
T3 CHECK CIRCUIT VH301 (YE/BU) FOR A SHORT TO VOLTAGE	

• Ignition OFF. • Disconnect: Blower Motor Speed Control C271. • Disconnect: Blower Motor C288. • Ignition ON. • Measure the voltage between ground and blower motor speed control C271-E, circuit VH301 (YE/BU), harness side.  N0042582 • **Is any voltage present?**	**Yes** REPAIR circuit VH301 (YE/BU) for a short to voltage. TEST the system for normal operation. **No** GO to T4 .
T4 CHECK CIRCUIT VH219 (GY) FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between ground and blower motor speed control C271-D, circuit VH219 (GY), harness side.  N0098188 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new blower control. TEST the system for normal operation. If the condition returns, GO to T5 . **No** REPAIR circuit VH219 (GY) for a short to voltage. TEST the system for normal operation.
T5 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

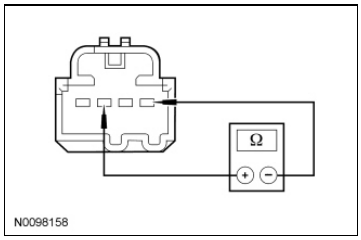
Component Tests

Blower Motor Resistor



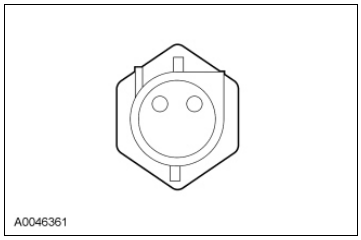
Blower Motor Resistor Pins	Approx. Resistance
C and B	1.27 ohms
C and A	2.45 ohms
C and D	4.5 ohms

Temperature Sensor â In-Vehicle



Ambient Temperature	Resistance
-40Â°C (-40Â°F)	869,073-1,061,986 ohms
-15Â°C (5Â°F)	196,465-231,213 ohms
0Â°C (32Â°F)	89,982-102,514 ohms
15Â°C (59Â°F)	44,261-49,503 ohms
25Â°C (77Â°F)	28,500-31,500 ohms
35Â°C (95Â°F)	18,563-20,751 ohms
60Â°C (140Â°F)	6,971-8,001 ohms
85Â°C (185Â°F)	2,959-3,474 ohms

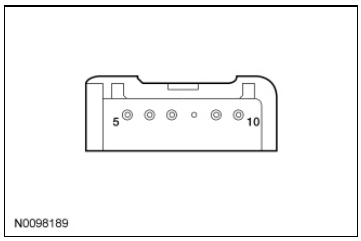
Temperature Sensor â Ambient



Ambient Temperature	Resistance
-40Â°C (-40Â°F)	832,519-1,017,523 ohms
-15Â°C (5Â°F)	199,325-220,307 ohms
0Â°C (32Â°F)	91,058-100,644 ohms

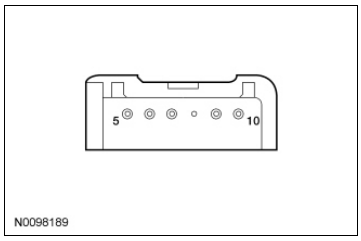
15Â°C (59Â°F)	44,435-49,113 ohms
25Â°C (77Â°F)	28,500-31,500 ohms
35Â°C (95Â°F)	18,730-20,701 ohms
60Â°C (140Â°F)	7,171-7,925 ohms
85Â°C (185Â°F)	3,110-3,438 ohms

Air Inlet Mode Door Actuator



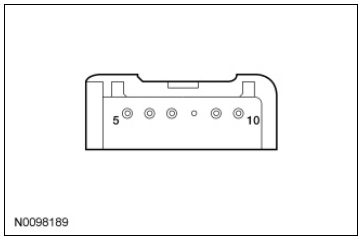
Actuator Pins	Approx. Resistance
51 and 6	71-85 ohms

Defrost/Panel/Floor Door Actuator



Actuator Pins	Approx. Resistance
8 and 10	8,000-12,000 ohms
8 and 9	1-10,000 ohms
9 and 10	1-10,000 ohms
5 and 6	38-48 ohms

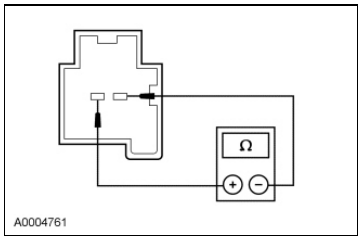
Temperature Blend Door Actuator

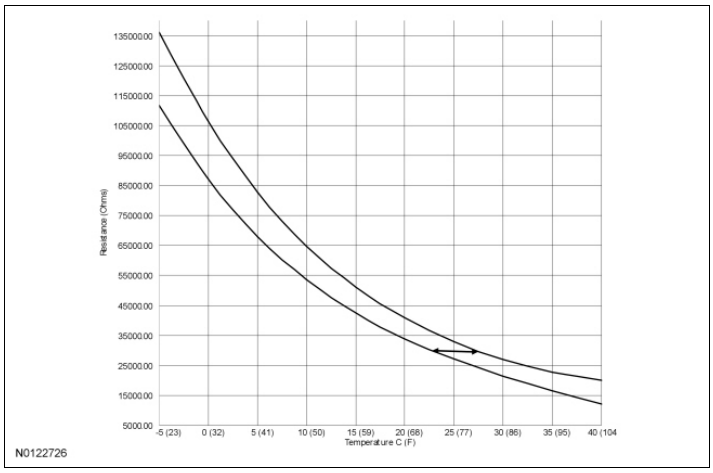


Actuator Pins	Approx. Resistance

8 and 10	8,000-12,000 ohms
8 and 9	1-10,000 ohms
9 and 10	1-10,000 ohms
5 and 6	59-73 ohms

Evaporator Discharge Air Temperature Sensor





Ambient Temperature	Resistance
-5Â°C (23Â°F)	111,677-136,089 ohms
0Â°C (32Â°F)	87,028-106,252 ohms
5Â°C (41Â°F)	67,969-82,801 ohms
10Â°C (50Â°F)	53,505-64,741 ohms
15Â°C (59Â°F)	42,389-51,206 ohms
20Â°C (68Â°F)	33,860-40,844 ohms
25Â°C (77Â°F)	27,058-32,942 ohms
30Â°C (86Â°F)	21,443-27,036 ohms
35Â°C (95Â°F)	16,583-22,808 ohms
40Â°C (104Â°F)	12,177-20,007 ohms

Heater Core

1. **NOTE:** If a heater core leak is suspected, the heater core must be tested by following the Plugged Heater Core Component Test before the heater core pressure test. Carry out a system inspection by checking the heater system thoroughly as follows:

Inspect for evidence of coolant leakage at the heater hose to heater core attachments. A coolant leak in the heater hose could follow the heater core tube to the heater core and appear as a leak in the heater core.

2. **NOTE:** Spring-type clamps are installed as original equipment. Installation and overtightening of non-specified clamps can cause leakage at the heater hose connection and damage the heater core.

   Check the integrity of the heater hose clamps.

Heater Core â Plugged

1. Check to see that the engine coolant is at the correct level.

2. Start the engine and turn on the heater.

3. When the engine coolant reaches operating temperature, using a suitable temperature measuring device, check the core inlet and outlet hoses to see if they are hot.

4. If the outlet only is not hot:
   - the heater core may have an air pocket.
   - the heater core may be plugged.

5. If the inlet only is not hot:
   - the thermostat may not be working correctly.

Heater Core â Pressure Test

⚠ **WARNING: Before disconnecting any heater water hoses, shut OFF the engine and wait until engine is fully cool. Failure to comply with this warning may result in serious injury or burns from hot liquid escaping from the engine cooling system.**

Use the Pressure Test Kit to carry out the pressure test.

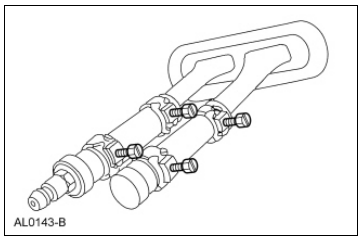
1. **NOTE:** Due to space limitations, a bench test may be necessary for pressure testing.

   Drain the coolant from the cooling system.

2. Disconnect the heater hoses from the heater core.

3. Install a short piece of heater hose, approximately 101 mm (4 in) long on each heater core tube.

4. Fill the heater core and heater hoses with water and install the plug BT-7422-B and the adapter BT-7422-A from the Pressure Test Kit. Secure the heater hoses, plug and adapter with hose clamps.



5. Attach the pump and gauge assembly from the Pressure Test Kit to the adapter.

6. Close the bleed valve at the base of the gauge. Pump 138 kPa (20 psi) of air pressure into the heater core.

7. Observe the pressure gauge for a minimum of 3 minutes.

8. If the pressure drops, check the heater hose connections to the core tubes for leaks. If the heater hoses do not leak, remove the heater core from the vehicle and carry out the bench test.

Heater Core â Bench Test

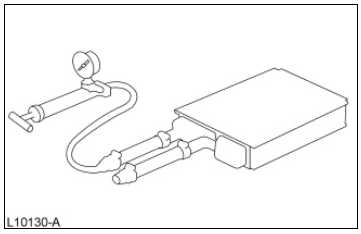
1. Remove the heater core from the vehicle.

2. Drain all of the coolant from the heater core.

3. Connect the 101 mm (4 in) test heater hoses with plug and adapter to the core tubes. Then connect the Pressure Test Kit to the adapter.

4. Apply 138 kPa (20 psi) of air pressure to the heater core. Submerge the heater core in water.

5. If a leak is observed, install a new heater core.



Evaporator/Condenser Core â On-Vehicle Leak Test

1. Discharge and recover the refrigerant. Refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

2. Disconnect the suspect evaporator core or condenser core from the A/C system.

3. Clean the manifold fittings.

4. Connect the appropriate test fittings from the A/C Flush Adapter Kit to the condenser or evaporator core tube connections.

5. **NOTE:** The automatic shut-off valves on some gauge set hoses do not open when connected to the test fittings. If available, use hoses without shut-off valves. If hoses with shut-off valves are used, make sure the valve opens when attached to the test fittings or install an adapter that will activate the valve. The test is not valid if the shut-off valve does not open.

   Connect the red and blue hoses from the R-134a Manifold Gauge Set to the test fittings on the evaporator core or condenser core. Connect the yellow hose to a known good vacuum pump.

6. Open both gauge set valves and start the vacuum pump. Allow the vacuum pump to operate for a minimum of 45 minutes after the gauge set low-pressure gauge indicates 101 kPa (30 in-Hg). The 45-minute evacuation is necessary to remove any refrigerant from oil left in the evaporator core or condenser core. If the refrigerant is not completely removed from the oil, outgassing will degrade the

vacuum and appear as a refrigerant leak.

7. If the low-pressure gauge reading will not drop to 101 kPa (30 in-Hg) when the valves on the gauge and manifold set are open and the vacuum pump is operating, close the gauge set valves and observe the low pressure gauge. If the pressure rises rapidly to zero, a large leak is indicated. Recheck the test fitting connections and gauge set connections before installing a new evaporator core or condenser core.

8. After evacuating for 45 minutes, close the gauge set valves and stop the vacuum pump. Observe the low-pressure gauge; it should remain at the 101 kPa (30 in-Hg) mark.
    - If the low-pressure gauge reading rises 34 or more kPa (10 or more in-Hg) of vacuum from the 101 kPa (30 in-Hg) position in 10 minutes, a leak is indicated.
    - If a very small leak is suspected, wait 30 minutes and observe the vacuum gauge.
    - If a small amount of vacuum is lost, operate the vacuum pump with gauge valves open for an additional 30 minutes to remove any remaining refrigerant from the oil in the evaporator core or condenser core. Then recheck for loss of vacuum.
    - If a very small leak is suspected, allow the system to sit overnight with vacuum applied and check for vacuum loss.

9. If the evaporator core or condenser core does leak, as verified by the above procedure, install a new evaporator core or condenser core.

A/C Compressor â External Leak Test

1. Install the appropriate adapter from the A/C Flush Adapter Kit on the port of the A/C compressor, using the existing manifold retaining bolt.

2. Connect the high- and low-pressure lines of a manifold gauge set or a refrigerant recovery/recycling station to the corresponding fittings on the adapter.

3. Attach the center hose of a manifold gauge set to a refrigerant container standing in an upright position.

4. Open the low-pressure gauge valve, the high-pressure gauge valve and the valve on the refrigerant container to allow the refrigerant vapor to flow into the A/C compressor.

5. Using the Refrigerant Leak Detector, check for leaks at the compressor shaft.

6. If a shaft seal leak is found, install a new compressor shaft seal. If an external leak is found, install a new A/C compressor.

7. When the leak test is complete, recover the refrigerant from the compressor.

Refrigerant System Tests

Special Tool(s)

 ST1928-A	R-134a Manifold Gauge Set 023-00047 or equivalent
 ST3079A	R-134a Refrigerant Management Machine (SAE J2788 Compliant) 023-00181 or equivalent
 ST3081-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 199-00067 or equivalent
 ST3080-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 265-00012 or equivalent

Procedure 1 - Ambient Temperature at or Below 38°C (100°F)

NOTE: The system performance can be evaluated and diagnosed by analysis of the compressor suction and discharge pressures. The following procedure is used to determine if the system is operating at normal pressures.

NOTE: The procedure varies depending on the ambient (shop) temperature. If the ambient temperature is 38°C (100°F) or lower, follow Procedure 1. If the ambient temperature is over 38°C (100°F), follow Procedure 2.

NOTE: If the A/C compressor cycles at any time during this test, refer to the diagnostic table.

1. Drive the vehicle or run the engine until it reaches normal operating temperature.

2. Connect a R-134a Manifold Gauge Set or R-134a Refrigerant Management Machine with high-pressure and low-pressure gauges to the refrigerant system.

3. Set the climate controls.
   - If equipped with manual climate control, set the A/C controls for normal A/C-PANEL mode, full COOL temperature,ir, HI blower. If the vehicle has a fresh air/recirc button, set it to FRESH. If the vehicle has an A/C switch or compressor on switch, set it to A/C ON.
   - If equipped with Electronic Automatic Temperature Control (EATC) or Dual Automatic Temperature Control (DATC), set temperature to 15°C (60°F) (lowest possible temp setting) with the dual function disabled (if equipped). Manually set blower on HI. If the vehicle has a fresh air/recirc button, set it to FRESH. If the vehicle has an A/C switch or compressor on switch, set it to A/C ON.

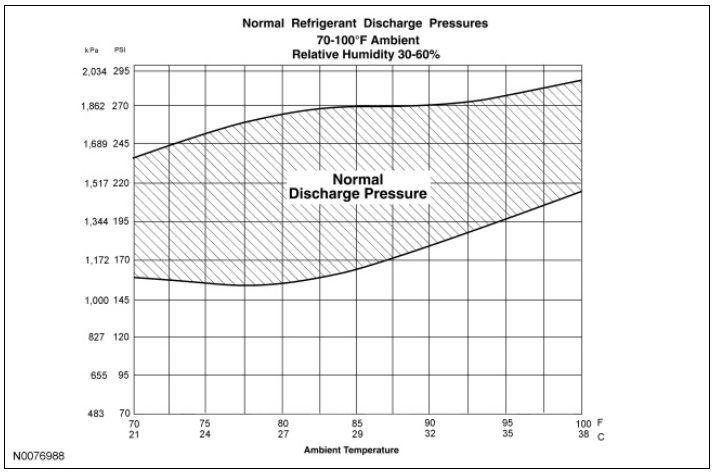
4. Open all vehicle windows and leave the hood open for the test. Open the rear doors.

5. Confirm the compressor clutch is engaged and the engine cooling fan(s) are operating or engaged. Allow the vehicle to idle until the suction (low-side) and discharge (high-side) pressures are stable or fluctuate in a range that repeats.

6. Record the ambient (shop) temperature.

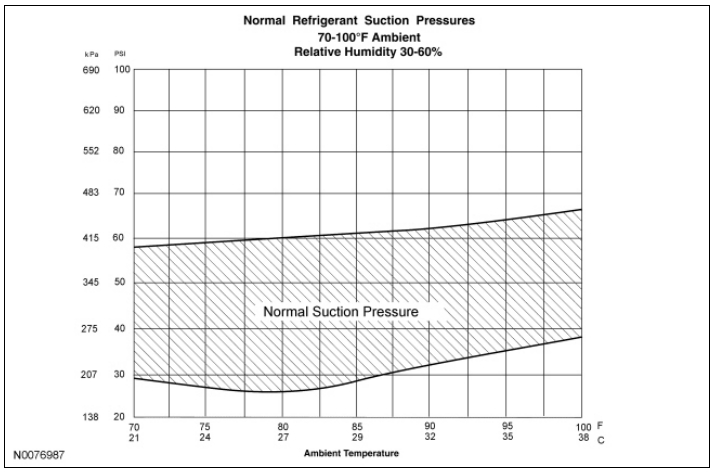
7. Record the discharge pressure. If the pressure is fluctuating, record the average value.

8. Determine if the discharge pressure falls within the normal operating limits using the Normal Refrigerant Discharge Pressures chart.



9. Record the suction pressure. If the pressure is fluctuating, record the average value.

10. Determine if the suction pressure falls between normal operating limits using the Normal Refrigerant Suction Pressures chart.



11. Proceed to the Diagnostic Table.

Procedure 2 - Ambient Temperature Above 38°C (100°F)

NOTE: The system performance can be evaluated and diagnosed by analysis of the compressor suction and discharge pressures. The following procedure is used to determine if the system is operating at normal pressures.

NOTE: The procedure varies depending on the ambient (shop) temperature. If the ambient temperature is 38°C (100°F) or lower, follow Procedure 1. If the ambient temperature is over 38°C (100°F), follow Procedure 2.

1. Drive the vehicle or run the engine until it reaches normal operating temperature.

2. Connect a R-134a Manifold Gauge Set or R-134a Refrigerant Management Machine with high-pressure and low-pressure gauges to the refrigerant system.

3. Set the climate controls.
   - If equipped with manual climate control, set the A/C controls for normal A/C-PANEL mode, full COOL temperature, FRESH air, MED-LO blower. If the vehicle has a fresh air/recirc button, set it to FRESH. If the vehicle has an A/C switch or compressor on switch, set it to A/C ON.
   - If equipped with Electronic Automatic Temperature Control (EATC) or Dual Automatic Temperature Control (DATC), set temperature to 15°C (60°F) (lowest possible temp setting). Manually set blower to MED-LO (3 to 4 bars). If the vehicle has a fresh air/recirc button, set it to FRESH. If the vehicle has an A/C switch or compressor on switch, set it to A/C ON.

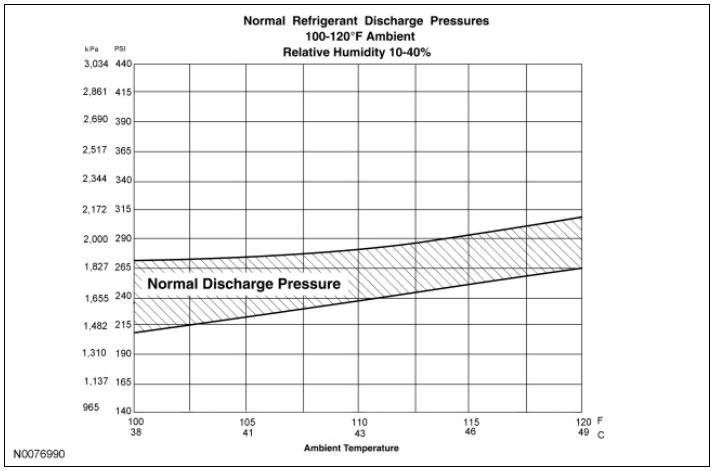
4. Open all vehicle windows the hood open for the test. Open the rear hatch and/or rear doors (if equipped).

5. Confirm the compressor clutch is engaged and the engine cooling fan(s) are operating or engaged. Allow the vehicle to idle until the suction (low-side) and discharge (high-side) pressures are stable or fluctuate in a range that repeats.

6. Record the ambient (shop) temperature.

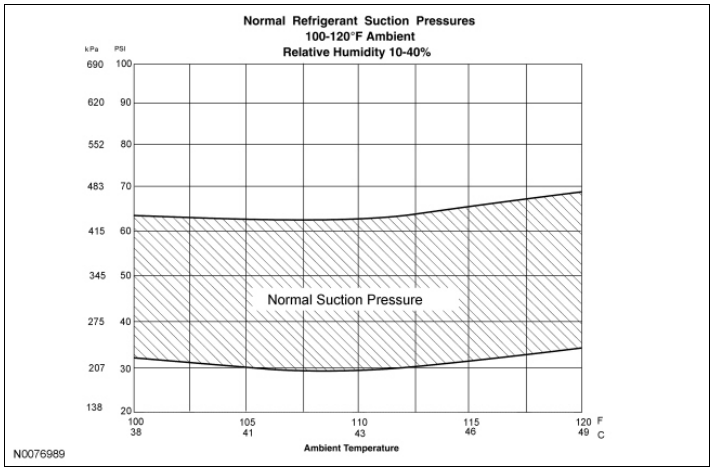
7. Record the discharge pressure. If the pressure is fluctuating, record the average value.

8. Determine if the discharge pressure falls within the normal operating limits using the Normal Refrigerant Discharge Pressures chart.



9. Record the suction pressure. If the pressure is fluctuating, record the average value.

10. Determine if the suction pressure falls between normal operating limits using the Normal Refrigerant Suction Pressures chart.



11. Proceed to the Diagnostic Table.

Diagnostic Table

1. **NOTE:** The following table is used to guide diagnosis of the refrigerant system if operating pressures are outside normal limits.

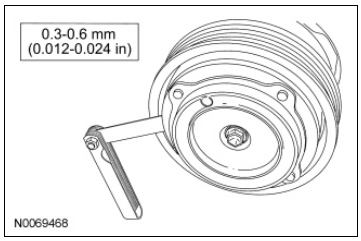
   Refer to the chart below.

High (Discharge) Pressure	Low (Suction) Pressure	Component - Causes
High or Clutch Cycling	High	Condenser - inadequate airflow.
High	Normal to High	Engine - overheating.
Normal to High	Normal	Refrigerant overcharge - air in refrigerant.
Normal to Low	Normal to High	A/C suction line - partially restricted or plugged. [a]
Normal to Low	Low or Clutch Cycling	Low refrigerant charge, A/C suction line - partially restricted or plugged A/C evaporator discharge air temperature sensor - reading erratic or low (if equipped). [b]
Erratic Operation or Compressor Not Running		A/C evaporator discharge air temperature sensor - poor connection at A/C clutch connector or A/C evaporator discharge air temperature sensor connector. A/C electrical circuit erratic - see A/C Electrical Circuit Wiring Diagram.
Normal to Low	High	Compressor - low performance.
Additional Possible Cause Components Associated With Inadequate Compressor Operation		
Additional Possible Cause Components Associated With a Damaged Compressor		
• Incorrect Clutch Air-gap • Refrigerant Leaks		

[a] Low pressure reading will be normal to high if restriction is downstream of service access valve.
[b] Low pressure reading will be low if pressure is taken near the compressor and restriction is upstream of service access valve.

Air Conditioning (A/C) Clutch Air Gap Adjustment

1. Check the A/C clutch air gap at 3 equally spaced places between the clutch plate and the A/C clutch pulley.



2. If the A/C clutch air gap is out of range, remove the clutch plate. Add or remove spacers between the clutch plate hub and the compressor shaft until the clearance is within specification.

Fluorescent Dye Leak Detection

Special Tool(s)

 ST3073-A	Cordless/Rechargable True UV LED Light ES 023-00182 or equivalent
 ST2650-A	R-134a Leak Detection Dye 164-R6060
 ST2649-A	R-134a Loop/Add On Injector Kit-Set 219-00069 or equivalent
 ST1928-A	R-134a Manifold Gauge Set 023-00047 or equivalent
 ST3079A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 023-00181 or equivalent
 ST3081-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 199-00067 or equivalent
 ST3080-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 265-00012 or equivalent

Fluorescent Dye Injection - Using an R-134a Refrigerant Management Center and Dye/Lubricant Injector (Non-Hybrid Only)

NOTICE: **Do not add liquid-based R-134a Leak Detection Dye to the refrigerant system on hybrid vehicles equipped with an electric Air Conditioning (A/C) compressor. Liquid-based dyes are mixed with PAG oil, and will contaminate and damage the hybrid refrigerant system. Dye can only be added to hybrid vehicles by installing a new received/drier desiccant cartridge which includes a fluorescent dye "wafer" which will dissolve after approximately 30 minutes of continued A/C operation.**

NOTE: Fluorescent refrigerant system dye is added to the refrigerant system at the factory to assist in refrigerant system leak diagnosis using a Rotunda-approved UV blacklight. It is not necessary to add additional dye to the refrigerant system before diagnosing leaks, even if a significant amount of refrigerant has been removed from the system. Replacement receiver/drier desiccant cartridges are shipped with a fluorescent dye "wafer" included in the desiccant bag which will dissolve after approximately 30 minutes of continued A/C operation. It is not necessary to add dye after flushing or filtering the refrigerant system because a new receiver/drier desiccant cartridge is installed as part of the flushing or filtering procedure. Additional refrigerant system dye should only be added if more than 50% of the refrigerant system lubricant capacity has been lost due to a fitting separation, hose rupture or other damage.

NOTE: This method of fluorescent dye injection requires the addition of R-134a from a R-134a Refrigerant

Management Machine or R-134a Manifold Gauge Set hooked to an external tank to charge the dye into the refrigerant system. If adding fluorescent dye to a refrigert system that is already fully charged, the R-134a Loop/Add On Injector Kit-Set method should be used.

NOTE: Before using the R-134a Loop/Add On Injector Kit-Set for the first time, refer to the manufacturer's instructions on evacuation of any non-condensable gases from the hoses.

NOTE: Only connect the dye/lubricant injector from the R-134a Loop/Add On Injector Kit-Set when fluorescent dye is to be injected. The dye/lubricant injector has a one-way check valve that will prevent refrigerant system recovery and evacuation.

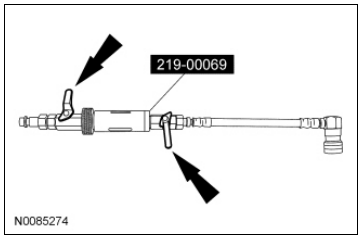
NOTE: Refrigerant system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off.

1. **NOTE:** If no R-134a pressure is present in the refrigerant system, the system should be evacuated before carrying out the injection procedure. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

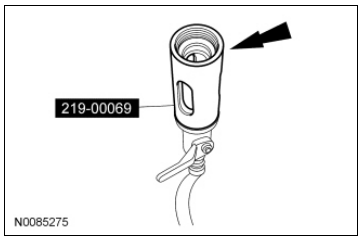
   Connect a R-134a Refrigerant Center or a R-134a Manifold Gauge Set to the refrigerant system service port valves.

2. **NOTE:** The dye/lubricant injector is included as part of the 219-00069 R-134a Loop/Add On Injector Kit-Set.

   Verify that the valves on the dye/lubricant injector are closed.



3. Fill the fluorescent e injector reservoir with 7 ml (0.25 oz) of fluorescent dye.



4. Install the dye/lubricant injector between the low-pressure service gauge port valve and the R-134a Refrigerant Center or R-134a Manifold Gauge Set.

5. Open all valves and inject the fluorescent dye into the refrigerant system.

6. When fluorescent dye injection is complete, close all valves.

7. Recover the refrigerant from the dye/lubricant injector.

8. Remove the dye/lubricant injector from the low-pressure service gauge port valve and the R-134a Refrigerant Center or R-134a Manifold Gauge Set.

Fluorescent Dye Injection - Using an R-134a Loop/Add On Injector Kit-Set (Non-Hybrid Only)

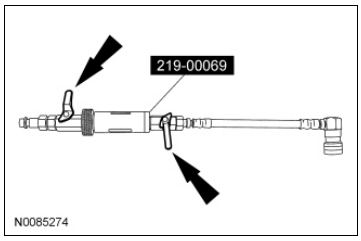
NOTICE: **Do not add liquid-based R-134a Leak Detection Dye to the refrigerant system on hybrid vehicles equipped with an electric Air Conditioning (A/C) compressor. Liquid-based dyes are mixed with PAG oil, and will contaminate and damage the hybrid refrigerant system. Dye can only be added to hybrid vehicles by installing a new received/drier desiccant cartridge which includes a fluorescent dye "wafer" which will dissolve after approximately 30 minutes of continued A/C operation.**

NOTE: Fluorescent refrigerant system dye is added to the refrigerant system at the factory to assist in refrigerant system leak diagnosis using a Rotunda-approved UV blacklight. It is not necessary to add additional dye to the refrigerant system before diagnosing leaks, even if a signicant amount of refrigerant has been removed from the system. Replacement receiver/drier desiccant cartridges are shipped with a fluorescent dye "wafer" included in the desiccant bag which will dissolve after approximately 30 minutes of continued A/C operation. It is not necessary to add dye after flushing or filtering the refrigerant system because a new receiver/drier desiccant cartridge is installed as part of the flushing or filtering procedure. Additional refrigerant system dye should only be added if more than 50% of the refrigerant system lubricant capacity has been lost due to a fitting separation, hose rupture or other damage.

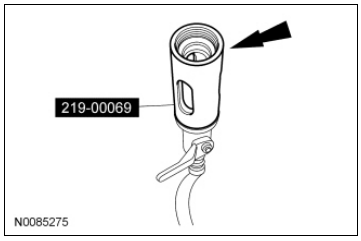
NOTE: Before using the R-134a Loop/Add On Injector Kit-Set for the first time, refer to the equipment manufacturer's instructions on evacuation of non-condensable gases from the hoses.

NOTE: Refrigerant system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off and cool.

1. Verify that the valves on the deluxe injector loop kit are closed.



2. Fill the R-134a Loop/Add On Injector Kit-Set reservoir with 7 ml (0.25 oz) of fluorescent dye.



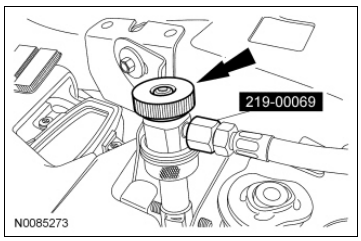
3. Install the R-134a Loop/Add On Injector Kit-Set between the high-pressure and low-pressure service gauge po valves.

4. ***NOTICE:*** **Make sure all tools and hoses are clear of the engine cooling fan and drive belt before starting the engine.**

   Start the engine.

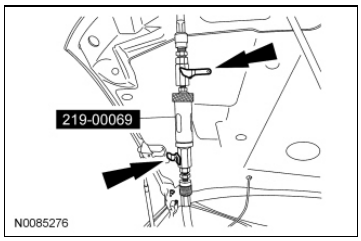
5. Set the A/C to the ON position.

6. Open the high-pressure service valve.

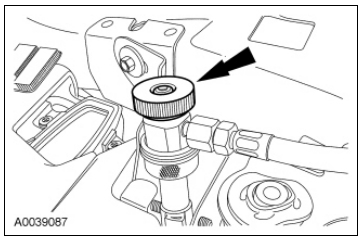


7. **NOTE:** To prevent pressure spike/liquid slug, crack the R-134a Loop/Add On Injector Kit-Set valves and slowly open to inject the fluorescent dye into the refrigerant system.

   Open the R-134a Loop/Add On Injector Kit-Set valves and inject the fluorescent dye into the refrigerant system.

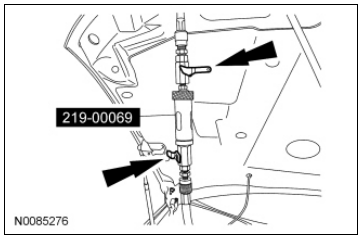


8. Close the high-pressure service valve to allow the pressure inside the R-134a Loop/Add On Injector Kit-Set to equalize with the suction side of the refrigerant system.



9. **NOTE:** Close the valves on the R-134a Loop/Add On Injector Kit-Set while the A/C compressor is operating.

   Close the valves on the R-134a Loop/Add On Injector Kit-Set.



10. **NOTE:** Leave all valves on the R-134a Loop/Add On Injector Kit-Set closed when not in use.

    Disconnect the high-pressure and low-pressure service valves and remove the R-134a Loop/Add On Injector Kit-Set from the vehicle.

Fluorescent Dye Detection

NOTE: Ford Motor Company vehicles are produced with R-134a fluorescent dye installed in the refrigerant system from the factory. The location of leaks can be pinpointed by the bright yellow-green glow of the fluorescent dye under a UV lamp. Since more than one leak can exist, make sure to inspect each component, line and fitting in the refrigerant system for a leak.

1. Check for leaks using a Rotunda-approved UV lamp.
    - Inspect all components, lines and fittings of the refrigerant system.

2. If a leak is found, recover the refrigerant. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

3. Repair the refrigerant system leak(s).

4. Evacuate and charge the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

5. After the leak(s) is repaired, remove any traces of fluorescent dye with a general purpose oil solvent.

6. Verify the repair by running the vehicle for a short period of time and rechecking the area of the leak with a Rotunda-approved UV lamp.

Electronic Leak Detection

Special Tool(s)

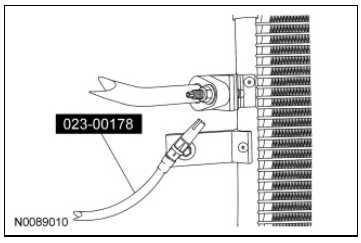
	Heated Pentode Halogen Leak Detector 023-00178 or equivalent

NOTE: Good ventilation is necessary in the area where electronic A/C leak testing is to be carried out. If the surrounding air is contaminated with refrigerant gas, the Heated Pentode Halogen Leak Detector will indicate this gas all the time. Odors from other chemicals such as antifreeze, diesel fuel, disc brake cleaner or other cleaning solvents can cause the same problem. Using a fan to ventilate the area to be tested before proceeding with the leak detection procedure is helpful in removing small traces of contamination from the air, but the fan should be turned off during actual testing.

NOTE: R-134a is heavier than air, and will tend to move downward from the source of the leak if present. It is possible that a leak may not be detected if the leak detector tip is held above the leaking fitting, line or component. Always be sure to thoroughly leak test below the fitting, line or component for the presence of R-134a as well as leak testing above and around.

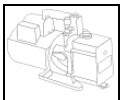
1. **NOTE:** The system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off and cool. The pressure reading may be higher if the engine is hot.

   Leak test the refrigerant system using the Heated Pentode Halogen Leak Detector. Follow the instructions included with the Heated Pentode Halogen Leak Detector for handling and operation techniques.



Air Conditioning (A/C) System Recovery, Evacuation and Charging

Special Tool(s)

 ST1686-A	6.0 CFM Vacuum Pump 300-R0B15600E or equivalent
 ST2742-A	Automatic Refrigerant Charging Meter 023-00155 or equivalent
 ST1928-A	R-134a Manifold Gauge Set 023-00047 or equivalent
 ST3079A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 300-R0B34788-PROE or equivalent
 ST3081-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 199-00067 or equivalent
 ST3080-A	R-134a Refrigerant Management Machine (SAE J-2788 Compliant) 265-00012 or equivalent

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-
PAG Refrigerant Compressor Oil (R-134a Systems) YN-12-D	WSH-M1C231-B
R-134a Refrigerant YN-19 (US); CYN-16-P or CYN-16-R (Canada)	WSH-M17B19-A

Refrigerant System Recovery

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. For additinal information, refer to Refrigerant Oil Adding in this section.**

NOTICE: **Do not use the R-134a Refrigerant Management Machine built-in oil injection system to inject Motorcraft Electric A/C Compressor Oil to the refrigerant system on hybrid vehicles equipped**

with an electric Air Conditioning (A/C) compressor if it has been previously used to inject PAG oil. For hybrid vehicles, use only clean manual injection tools. Injection of Motorcraft Electric A/C Compressor Oil into a hybrid vehicle with equipment previously used with PAG oil will contaminate and damage the hybrid A/C system.

NOTICE: **An Air Conditioning (A/C) refrigerant analyzer must be used before the recovery of any vehicle's A/C refrigerant. Failure to do so puts the shop's refrigerant at risk of contamination. If the vehicle's A/C refrigerant is contaminated, refer the customer to the service facility that carried out the last A/C service. If the customer wishes to pay the additional cost, use the A/C recovery equipment that is designated for recovering contaminated A/C refrigerant. All contaminated A/C refrigerant must be disposed of as hazardous waste. For all equipment, follow the equipment manufacturer procedures and instructions.**

NOTE: Ford Motor Company recommends the use of R-134a refrigerant management equipment that meets the requirements of the SAE J2788 standard.

NOTE: Ford Motor Company recommends use of a R-134a Refrigerant Management Machine to carry out recovery. If a R-134a Refrigerant Management Machine is not available, refrigerant system recovery may be accomplished using a separate recovery station.

NOTE: Leaks in refrigerant system service equipment, hoses or gauges can cause a leak in vacuum that may be misinterpreted as a problem with the vehicle's refrigerant system. It is necessary to leak-test all refrigerant system service equipment, hoses and gauges on a weekly basis to verify that no leaks are present.

1. Prior to recovering, the purity of the refrigerant must be verified. For additional information, refer to Refrigerant Identification Testing in this section.

2. Connect a R-134a Refrigerant Management Machine to the low- and high-pressure service gauge port valves following the operating instructions provided by the equipment manufacturer.

3. Recover the refrigerant from the system following the operating instructions provided by the equipment manufacturer. Note the amount of oil removed during the refrigerant recovery (if any). Add that same amount back into the system once repairs are complete.

4. Once the R-134a Refrigerant Management Machine has recovered the refrigerant, switch OFF the power supply.

5. Allow the system to set for about 2 minutes, and observe the system vacuum reading. If the vacuum is not lost, disconnect the recovery equipment.

6. If the system does lose vacuum, repeat Steps 3 through 5 until the vacuum level remains stable for 2 minutes.

7. Carry out the required repairs.

Refrigerant System Evacuation Using a R-134a Refrigerant Management Machine

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. For additional information, refer to Refrigerant Oil Adding in this section.**

NOTICE: **Do not use the R-134a Refrigerant Management Machine built-in oil injection system to inject Motorcraft Electric A/C Compressor Oil to the refrigerant system on hybrid vehicles equipped with an electric Air Conditioning (A/C) compressor if it has been previously used to inject PAG oil. For hybrid vehicles, use only clean manual injection tools. Injection of Motorcraft Electric A/C Compressor Oiinto a hybrid vehicle with equipment previously used with PAG oil will contaminate and damage the hybrid A/C system.**

NOTE: Ford Motor Company recommends use of a R-134a Refrigerant Management Machine to carry out recovery, evacuation and charging of the refrigerant system. If a R-134a Refrigerant Management Machine is not available, evacuation may be accomplished using a separate Vacuum Pump and R-134a Manifold Gauge Set.

NOTE: Leaks in refrigerant system service equipment, hoses or gauges can cause a leak in vacuum that may be misinterpreted as a problem with the vehicle's refrigerant system. It is necessary to leak-test all refrigerant system service equipment, hoses and gauges on a weekly basis to verify that no leaks are present.

1. Connect a R-134a Refrigerant Management Machine to the low- and high-pressure service gauge port valves following the operating instructions provided by the equipment manufacturer.

2. Evacuate the system until the low-pressure gauge reads at least 99.4 kPa (29.5 in-Hg) of vacuum and as close to 101.1 kPa (30 in-Hg) as possible. Continue to operate the Vacuum Pump for a minimum of 45 minutes.

3. Turn OFF the Vacuum Pump. Observe the low-pressure gauge for 5 minutes to make sure that the system vacuum is held. If vacuum is not held for 5 minutes, leak test the system, repair the leak and evacuate the system again.

Refrigerant System Evacuation Using a R-134a Manifold Gauge Set and Vacuum Pump

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. For additional information, refer to Refrigerant Oil Adding in this section.**

NOTE: Ford Motor Company recommends use of a R-134a Refrigerant Management Machine to carry out evacuation of the refrigerant system. If a R-134a Refrigerant Management Machine is not available, refrigerant system evacuation may be accomplished using a separate Vacuum Pump and R-134a Manifold Gauge Set.

NOTE: Leaks in refrigerant system service equipment, hoses or gauges can cause a leak in vacuum that may be misinterpreted as a problem with the vehicle's refrigerant system. It is necessary to leak-test all refrigerant system service equipment, hoses and gauges on a weekly basis to verify that no leaks are present.

1. Connect the R-134a Manifold Gauge Set to the low-side and high-side service gauge port valves.

2. Connect the center (yellow) hose from the R-134a Manifold Gauge Set to the suction port on the Vacuum Pump.

3. Open all valves on the R-134a Manifold Gauge Set and both service gauge port valves.

4. Turn on the Vacuum Pump and evacuate the system until the low-pressure gauge reads at least 99.4 kPa (29.5 in-Hg) of vacuum and as close to 101.1 kPa (30 in-Hg) as possible. Continue to operate the

Vacuum Pump for a minimum of 45 minutes.

5. Close the high-side and low-side valves on the R-134a Manifold Gauge Set (not the service gauge port valves) and turn OFF the Vacuum Pump.

6. Observe the low-pressure gauge for 5 minutes to make sure that the system vacuum is held. If vacuum is not held for 5 minutes, leak test the system, repair the leak and evacuate the system again.

Refrigerant System Charging Using a R-134a Refrigerant Management Machine

NOTE: Ford Motor Company recommends use of a R-134a Refrigerant Management Machine to carry out charging of the refrigerant system. If a R-134a Refrigerant Management Machine is not available, refrigerant system charging may be accomplished using a separate Automatic Refrigerant Charging Meter and R-134a Manifold Gauge Set.

NOTE: Leaks in refrigerant system service equipment, hoses or gauges can cause a leak that may be misinterpreted as a problem with the vehicle's refrigerant system. It is necessary to leak-test all refrigerant system service equipment, hoses and gauges on a weekly basis to verify that no leaks are present.

1. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. For additional information, refer to Refrigerant Oil Adding in this section.**

   NOTICE: **Do not use the R-134a Refrigerant Management Machine built-in oil injection system to inject Motorcraft Electric A/C Compressor Oil to the refrigerant system on hybrid vehicles equipped with an electric Air Conditioning (A/C) compressor if it has been previously used to inject PAG oil. For hybrid vehicles, use only clean manual injection tools. Injection of Motorcraft Electric A/C Compressor Oil into a hybrid hicle with equipment previously used with PAG oil will contaminate and damage the hybrid A/C system.**

   Lubricate the refrigerant system with the correct amount of clean PAG oil (non-hybrid vehicles) or electric A/C compressor oil (hybrid vehicles). For additional information, refer to Refrigerant Oil Adding in this section.

2. Connect a R-134a Refrigerant Management Machine to the low-side and high-side service gauge port valves following the operating instructions provided by the equipment manufacturer.

3. Set the refrigerant charge amount, and charge the refrigerant system following the instructions provided by the equipment manufacturer.

Refrigerant System Charging Using a R-134a Manifold Gauge Set and Automatic Refrigerant Charging Meter

NOTE: Ford Motor Company recommends use of a R-134a Refrigerant Management Machine to carry out charging of the refrigerant system. If a R-134a Refrigerant Management Machine is not available, refrigerant system charging may be accomplished using a separate Automatic Refrigerant Charging Meter and R-134a Manifold Gauge Set.

NOTE: Leaks in refrigerant system service equipment, hoses or gauges can cause a leak that may be misinterpreted as a problem with the vehicle's refrigerant system. It is necessary to leak-test all refrigerant

system service equipment, hoses and gauges on a weekly basis to verify that no leaks are present.

1. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition o any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. For additional information, refer to Refrigerant Oil Adding in this section.**

   Lubricate the refrigerant system with the correct amount of clean PAG oil (non-hybrid vehicles) or electric A/C compressor oil (hybrid vehicles). For additional information, refer to Refrigerant Oil Adding in this section.

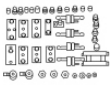
2. Assemble the R-134a Manifold Gauge Set, Automatic Refrigerant Charging Meter and R-134a supply tank following the Automatic Refrigerant Charging Meter operating instructions.

3. Charge the refrigerant system following the Automatic Refrigerant Charging Meter operating instructions.

4. If the refrigerant flow stops before the refrigerant charge is complete, start the engine, select MAX A/C operation and allow the refrigerant charge to complete.

Air Conditioning (A/C) System Flushing

Special Tool(s)

 ST2985-A	A/C Flush Adapter Kit 219-00074 or equivalent
 ST2469-A	A/C Flush and Purge Fitting Kit 219-00024 or equivalent
 ST2466-A	A/C Flush and Purge Machine 219-00022 (part of 219-00023) or equivalent

Material

Item	Specification
A/C System Flushing Solvent YN-23	-
Motorcraft® Electric A/C Compressor Oil YN-32	-
PAG Refrigerant Compressor Oil (R-134a Systems) YN-12-D	WSH-M1C231-B

⚠ WARNING: Take the following precautions when repairing an air conditioning system containing R-134a:

- Always wear safety goggles.
- Avoid contact with liquid refrigerant R-134a. R-134a vaporizes at approximately -25°C (-13°F) under atmospheric pressure and will freeze skin tissue.
- Never allow refrigerant R-134a gas to escape in quantity in an occupied space. It will displace the oxygen needed to support life.
- Never use a torch in an atmosphere containing R-134a gas. R-134a is non-toxic at all normal conditions, but it decomposes when exposed to high temperatures such as a torch flame. During decomposition it releases irritating and toxic gasses (as described in the MSDS sheet from the manufacturer). Decomposition products are hydrofluoric acid, carbon dioxide and water. ul>Failure to follow these instructions may result in serious personal injury.

  NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to Refrigerant Oil Adding in this section.**

NOTICE: **An Air Conditioning (A/C) refrigerant analyzer must be used before the recovery of any vehicle's A/C refrigerant. Failure to do so puts the shop's bulk refrigerant at risk of contamination. If the vehicle's A/C refrigerant is contaminated, refer the customer to the service facility that carried out the last A/C service. If the customer wishes to pay the additional cost, use the A/C recovery equipment that is designated for recovering contaminated A/C refrigerant. All contaminated A/C refrigerant must be disposed of as hazardous waste. For all equipment, follow the equipment manufacturer procedures and instructions.**

NOTICE: **Receiver/drier cartridge, Thermostatic Expansion Valve (TXV), and hoses with mufflers should be removed when flushing the Air Conditioning (A/C) system. Internal plumbing of these devices makes it impossible to correctly remove any residual-flushing agent. These components are typically discarded after A/C system contamination. Hoses without mufflers can normally be reused unless they are clogged with foreign material. The 3.785L (1 gal) of A/C System Flushing Solvent YN-23 and FL1-A filter used in A/C Flush and Purge Machine 219-00022 are intended fouse on one vehicle only. They may be used to flush both the A/C condenser core and the A/C evaporator core on an individual vehicle, but under no circumstances should they be used on more than one vehicle.**

NOTICE: **Only the A/C Flush and Purge Machine 219-00022 and A/C Systems Flushing Solvent, is approved for use on Ford vehicles. No other flushing device or solvent is approved for flushing heat exchangers (Air Conditioning [A/C] condenser, A/C evaporator). Use of any other flusher or solvent may cause damage to the A/C system and the flushing unit.**

NOTE: Prior to using the A/C Flush and Purge Machine 219-00022 for the first time, review the operating instructions.

NOTE: Ford Motor Company has approved a procedure to provide technicians with a non-CFC method of flushing contaminated A/C system heat exchangers. The procedure allows the specific components to be cleaned and flushed while installed in their normal in-vehicle location. The types of contamination flushed include particle matter that results from A/C compressor or desiccant failure and gummy residue that can form when refrigerant oil is overheated during A/C compressor seizure. The flushing process is a 2-step procedure that involves the use of an A/C Flush and Purge Machine 219-00022 to:

- circulate the flushing solvent through the heat exchanger in the reverse direction of normal refrigerant flow (back-flushing). Particulate matter picked up during flushing is filtered from the returning solvent before the solvent is returned to the reservoir for continued circulation.
- remove the flushing solvent from the heat exchanger. In this step of the procedure, pressurized air 621-862 kPa (90-125 psi) is used to push and evaporate any remaining flush solvent from the heat exchanger.

1. Remove the receiver/drier cartridge. For additional information, refer to Section 412-01 .
2. **NOTE:** The condenser core must be flushed with the receiver/drier cartridge removed. Do not install a new receiver/drier cartridge at this time.

   With the receiver/drier cartridge removed, reinstall the receiver/drier plug and snap ring into the condenser core.
3. Remove the condenser inlet and outlet fitting nuts and disconnect the fittings.
4. Connect the A/C Flush and Purge Machine to the condenser inlet and outlet fittings using the correct adapters from the A/C Flush Adapter Kit.
5. Flush the condenser core for a minimum of 30 minutes.
6. Turn the A/C Flush and Purge machine to the PURGE mode and run for a minimum of 20 minutes.
7. Disconnect the A/C Flush and Purge machine and adapters from the condenser core.
8. Install new gasket seals and connect the A/C condenser inlet and outlet fittings.

9. Remove the snap ring and receiver/drier plug.
10. **NOTE:** Do not charge the refrigerant system after the condenser core is installed.

    Install a new receiver/drier cartridge. For additional information, refer to Section 412-01 .
11. Remove the Thermostatic Expansion Valve (TXV). For additional information, refer to Section 412-00A .
12. Connect the A/C Flush and Purge Machine to the evaporator core fitting using the correct adapter from the A/C Flush and Purge Fitting Kit.
13. Flush the evaporator core for a minimum of 20 minutes.
14. Turn the A/C Flush and Purge Machine to the PURGE mode and run for a minimum of 20 minutes.
15. Disconnect the A/C Flush and Purge Machine and adapter from the evaporator core fitting.
16. Install a new front TXV . For additional information, refer to Section 412-01 .
17. **NOTE:** It is necessary to evacuate the refrigerant system for a minimum of one hour to evaporate any traces of flush solvent that may remain in the system.

    Evacuate the refrigerant system for one hour. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.
18. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to Refrigerant Oil Adding in this section.**

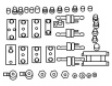
    If a new A/C compressor is not to be installed, lubricate the refrigerant system with the correct amount of clean PAG oil (non-hybrid vehicles) or electric A/C compressor oil (hybrid vehicles). For additional information, refer to Refrigerant Oil Adding in this section.
19. If a new A/C compressor is not to be installed, evacuate, leak test and charge the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

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Refrigerant System Filtering Following Air Conditioning (A/C) Compressor Installation

Special Tool(s)

 ST2985-A	A/C Flush Adapter Kit 219-00074 or equivalent
 ST2469-A	A/C Flush and Purge Fitting Kit 219-00024 or equent

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-
PAG Refrigerant Compressor Oil (R-134a Systems) YN-12-D	WSH-M1C231-B

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to Refrigerant Oil Adding in this section.**

NOTICE: **On vehicles being serviced for an internal compressor or desiccant failure, a new Thermostatic Expansion Valve (TXV) and any hoses containing mufflers must be installed prior to filtering the Air Conditioning (A/C) system. Internal plumbing of these devices makes it impossible to correctly remove any foreign material/debris. These components are typically discarded after A/C system contamination. Hoses without mufflers can normally be reused unless they are clogged with foreign material. The F8VZ-19E773-AB filter is intended for use on one vehicle only.**

All vehicles

1. Remove the receiver/drier cartridge. For additional information, refer to Section 412-01 .

2. **NOTE:** The refrigerant system must be filtered with the receiver/drier cartridge removed. Do not install a new receiver/drier cartridge at this time.

   With the receiver/drier cartridge removed, reinstall the receiver/drier plug and snap ring into the condenser core.

3. Remove the condenser outlet fitting nut and disconnect the fitting.
   - Discard the gasket seal.

4. ***NOTICE:*** **The flexible extension adapters included in the A/C Flush Adapter Kit (219-00074) are designed for low-pressure flushing and are not designed for use with a charged refrigerant**

system. Do not make the condenser fitting connections using the flexible extension adapters or damage to the adapters and loss of refrigerant will occur.

NOTE: Use flexible refrigerant hose of 17,238 kPa (2,500 psi) burst rating.

Using the correct adapters and service hoses, install the pancake filter between the condenser and the condenser outlet fitting.

5. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to Refrigerant Oil Adding in this section.**

   Lubricate the refrigerant systemith the correct amount of clean PAG oil (non-hybrid vehicles) or electric A/C compressor oil (hybrid vehicles). For additional information, refer to Refrigerant Oil Adding in this section.

6. Evacuate and charge the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

Non-hybrid vehicles

7. Provide adequate airflow to the front of the vehicle (with a fan, if necessary). Start the engine and allow it to idle briefly. Select A/C operation and set the blower speed to HI. Verify that the A/C is operating correctly.

8. Gradually bring the engine up to 1,200 rpm by running it at lower rpms for short periods (first at 800 rpm, then at 1,000 rpm). Set the engine at 1,200 rpm and run it for one hour with the A/C system operating.

9. Stop the engine.

Hybrid vehicles

10. Start the vehicle and select A/C operation. Verify that the A/C is operating correctly.

11. Run the A/C system for one hour.

All vehicles

12. Recover the refrigerant. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

13. Remove the pancake filter, hoses and adapters from the vehicle.

14. Install a new gasket seal and connect the condenser outlet fitting.

15. Remove and discard the receiver/drier plug snap ring and the receiver/drier plug.

16. Install a new receiver/drier cartridge. For additional information, refer to Section 412-01 .

17. Evacuate, leak test and charge the refrigerant system. For additional information refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

Refrigerant Oil Adding

Special Tool(s)

 ST3057-A	R-134a Loop/Add On Injector Kit-Set 219-00069 or equivalent

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-
PAG Refrigerant Compressor Oil (R-134a Systems) YN-12-D	WSH-M1C231-B

Refrigerant Oil Adding

NOTICE: **Motorcraft® Electric A/C Compressor Oil only used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system.**

NOTICE: **Do not use the R-134a Refrigerant Management Machine built-in oil injection system to inject Motorcraft Electric A/C Compressor Oil to the refrigerant system on hybrid vehicles equipped with an electric Air Conditioning (A/C) compressor if it has been previously used to inject PAG oil. For hybrid vehicles, use only clean manual injection tools. Injection of Motorcraft Electric A/C Compressor Oil into a hybrid vehicle with equipment previously used with PAG oil will contaminate and damage the hybrid A/C system.**

NOTICE: **During normal Air Conditioning (A/C) operation, oil is circulated through the system with the refrigerant, and a small amount is retained in each component. If certain components of the system are removed, some of the refrigerant oil will go with the component. To maintain the original total oil charge, it is necessary to compensate for the oil lost by adding oil to the system with the new part.**

1. Refer to the chart below for refrigerant oil adding amounts and methods of installation.

Component	Oil Amount	Method of Adding
A/C Compressor - Non-Hybrid	Refer to Adding Refrigerant Oil After A/C Compressor Replacement - Non-Hybrid	Add directly to A/C compressor before installation
Electric A/C Compressor - Hybrid	Refer to Adding Refrigerant Oil After A/C Compressocement - Hybrid	Inject to low-side service port during system charging
Receiver/Drier Desiccant Cartridge	60 ml (2 fl oz) added to the amount collected during refrigerant recovery	Inject to low-side service port during system charging

Evaporator Core	45 ml (1.5 fl oz) added to the amount collected during refrigerant recovery	Add directly to evaporator core inlet tube or inject to low-side service port during system charging
Condenser Core	60 ml (2 fl oz) added to the amount collected during refrigerant recovery	Add directly to condenser core inlet or inject to low-side service port during system charging
Thermostatic Expansion Valve (TXV)	The amount collected during refrigerant recovery	Inject to low-side service port during system charging
A/C Pressure Relief Valve	60 ml (2 fl oz) added to the amount collected during refrigerant recovery	Inject to low-side service port during system charging
Refrigerant Hose/Line	60 ml (2 fl oz) added to the amount collected during refrigerant recovery [a]	Inject to low-side service port during system charging
O-ring Leak Repair	60 ml (2 fl oz) added to the amount collected during refrigerant recovery [b]	Inject to lowide service port during system charging
Service Port Leak Repair	60 ml (2 fl oz) added to the amount collected during refrigerant recovery	Inject to low-side service port during system charging

[a] If an excessive amount of refrigerant oil is lost due to a hose rupture/separation or other damage, the total system refrigerant oil capacity must be added.
[b] The amount specified may be used for one or multiple O-ring leak repairs. Do not multiply the refrigerant oil amount by the number of O-ring leaks being repaired.

Adding Refrigerant Oil After A/C Compressor Replacement - Non-Hybrid

NOTE: Service A/C compressors are shipped without refrigerant oil.

1. Rotate the old A/C compressor shaft 8 to 10 full rotations (clockwise) while collecting the PAG oil in a clean measuring cup.
    - Add the same amount plus the amount collected during refrigerant recovery.

Adding Refrigerant Oil After Electric A/C Compressor Replacement - Hybrid

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system.**

NOTICE: **Do not use the R-134a Refrigerant Management Machine built-in oil injection system to inject Motorcraft Electric A/C Compressor Oil to the refrigerant system on hybrid vehicles equipped with an electric Air Conditioning (A/C) compressor if it has been previously used to inject PAG oil. For hybrid vehicles, us clean manual injection tools. Injection of Motorcraft Electric A/C Compressor Oil into a hybrid vehicle with equipment previously used with PAG oil will contaminate and damage the hybrid A/C system.**

NOTE: Service electric A/C compressors are shipped with 60 ml (2 fl oz) of electric A/C compressor oil already installed.

1. Drain the oil from the old electric compressor into a clean measuring cup.
    - If the amount of oil drained is less than or equal to 60 ml (2 fl oz), add the amount of oil collected by the R-134a Refrigerant Management Machine during refrigerant recovery to the low-side service port after the new electric A/C compressor is installed and the system has

been evacuated.

- If the amount of oil drained is greater than 60 ml (2 fl oz), add the difference between the amount collected and 60 ml (2 fl oz), plus the amount collected by the R-134a Refrigerant Management Machine during refrigerant recovery, to the low-side service port after the new electric A/C compressor is installed and the system has been evacuated.

Oil Injection Using a Dye/Lubricant Injector

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system.**

NOTICE: **Do not add liquid based R-134a Leak Detection Dye to the refrigerant system on hybrid vehicles equipped with an electric A/C compressor. Liquid based dyes are mixed with PAG oil, and will contaminate and damage the hybrid refrigerant system. Dye can only be added to hybrid vehicles by installing a new received/drier desiccant cartridge which includes a fluorescent dye "wafer" which ll dissolve after approximately 30 minutes of continued A/C operation.**

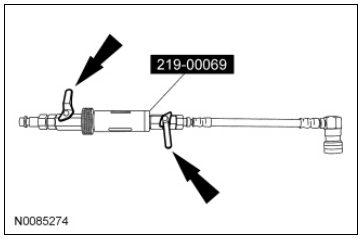
NOTE: The dye/lubricant injector is included as part of the 219-00069 R-134a Loop/Add On Injector Kit-Set.

NOTE: If fluorescent leak detection dye is also to be added during A/C charging, the dye may be added to the dye/lubricant injector along with the refrigerant oil.

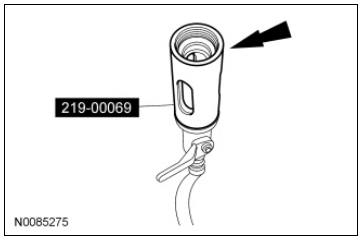
1. Evacuate the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

2. Assemble the dye/lubricant injector using the correct adapters to match the amount of refrigerant compressor oil to be injected.

3. Verify that all the valves on the dye/lubricant injector are closed.



4. Fill the dye/lubricant injector with the correct amount of new refrigerant compressor oil.



5. Install the dye/lubricant injector between the low-side service gauge port valve and the refrigerant service station or manifold gauge set.

6. Open all valves and charge the refrigerant system. For additional information, refer to Air

Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

Air Conditioning (A/C) Odor Treatment

Special Tool(s)

 ST2940-A	Flexible Applicator Tool 258-00005

Material

Item	Specification
Motorcraft® A/C Cooling Coil Coating YN-29	-

⚠ **WARNING: Carry out this procedure in a well-ventilated area with all vehicle windows and doors opened. Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION, seek medical advice. On Ford/Motorcraft products in the USA or Canada call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS), if available. Failure to follow these instructions may result in serious personal injury.**

NOTE: There are typically 4 types of objectionable odors found in a vehicle:

- Chemical odors
- Environmental odors
- Human and other interior-generated odors
- Microbiological odors

Before determining that A/C odor treatment is required, the sourcnd the circumstances under which the odor occurs must be determined.

NOTE: Chemical odors are usually constant regardless of the climate control system setting although they may be enhanced by A/C operation. Most chemical odors are caused by fluid leaks or incorrectly cured adhesives. Chemical odors can be eliminated by repairing the leaking component and removing any residue.

NOTE: Environmental odors usually occur for a short time and diminish after the vehicle passes through the affected area. These odors are typically only detected when the vehicle windows are open, or when the climate control system is operating in a mode that allows for fresh air. Environmental odors cannot be eliminated because they are external in source, but they may be minimized by switching to a climate control setting that uses recirculated air.

NOTE: Human and other interior-generated odors occur while the source is present and may linger for a short time after. These odors may be more noticeable during A/C operation. Human odors may be eliminated by removing the source and cleaning the affected area.

NOTE: Microbiological odors, if in the A/C system, usually last for about 30 seconds after the system is turned on. They will be detected while the A/C is turned on and using either outside or recirculated air. Microbiological odors that occur in areas other than the A/C system (for example, water in doors or wet carpeting) may last indefinitely and will be more intense when recirculated air is used. Microbiological odors

will not be present at temperatures at or below 10°C (50°F).

Microbiological odors can be eliminated by removing the source and treating the affected area. Standing water must be allowed to drain and dry out. A/C systems may be treated by using A/C cooling coil coating as described in the service procedure below.

Microbiological odors result from microbial growth supported by warm temperatures and moisture. Microbiolocal odors are described as musty/mildew type smells and may occur on/in:

- foam seals
- rubber seals
- adhesives
- standing water
- water soaked carpet/trim

1. Identify the type of odor present in the vehicle. Do not proceed with A/C odor treatment if the odor source is found to be outside of the A/C system. Refer to the following chart for examples.

Odor Source	Odor Description
Chemical Odors	
Coolant	Sweet smell
Fuel	Gasoline or diesel fuel smell
Oil	Oil type or burning smell
Power Steering Fluid	Oil type or burning smell
Transmission Fluid	Oil type or burning smell
Washer Fluid	Alcohol type smell
Gear Lube	Garlic/sulfur smell
Refrigerant Oil	Ether type smell
Carpet/trim Adhesives	Fishy, urine or sweet smell
Evaporator Core Coating	Wet cement type smell
Environmental Odors	
Exhaust	Exhaust, fuel or burning type smell
Industrial Pollutants	Various smells
Dust	Musty, mildew or wet cement type smell
Pollen	Sweet smell
Tobacco	Burning, tar smell
Human and Other Interior Generated Odors	
Body Secretions	Body odor
Perfuming Agents	Sweet or fragrance smell
Clothing	Musty, mildew or body odors
Food/Beverage	Sweet, musty, mildew or fishy smell
Microbiological Odors	
Microbiological Odors Occurring Inside of A/C System	Musty, mildew smell lasting about 30 seconds after A/C is turned on
Microbiological Odors Occurring Outside of A/C System	Musty, mildew smell lasting indefinitely and possibly more pronounced when using recirculated air

2. Identify the source of the odor.
    - Check the evaporator core drain tube for restriction.
    - Check the passenger and driver side carpet for moisture. If moisture is found, A/C odor treatment is not necessary. Diagnose for a water leak as needed.
    - Check the blower motor and blower motor cover (if equipped) for moisture resulting from water bypassing the cowl baffling system. If moisture is found, A/C odor treatment is not necessary. Diagnose for a water leak as needed.
    - Check the cowl top panel and air inlet screen for standing water or foreign material. If possible, remove any standing water and clean the air inlet screen using a wet/dry vacuum.

3. Open all vehicle windows and doors.

4. Make sure that the A/C is off.

5. Set the following.
    - Select PANEL mode (A/C off).
    - Adjust the temperature setting to full warm.
    - Adjust the blower motor speed to HI.

6. Run the engine for 25 minutes to dry out the A/C system.

7. Turn the ignition OFF.

8. Remove the blower motor.

9. **NOTE:** Blower motor speed controls that are mounted outside of the evaporator core housing and not exposed to the blower motor airflow do not need to be removed.

   Remove the blower motor resistor (if equipped) or blower motor speed control (if equipped and exposed to the inside of the evaporator core housing).

10. ***NOTICE:*** **To avoid damage to the vehicle interior, do not spill or spray this product on any interior surface.**

    Add one full bottle of A/C cooling coil coating to the Flexible Applicator Tool.

11. Insert the nozzle into the evaporator housing and direct the spray toward the evaporator core face. Spray the entire evaporator core face until empty.

12. Install the blower motor and blower motor resistor (if equipped) or blower motor speed control (if equipped).

13. Repeat Steps 4 through 6 to cure the evaporator core coating.

General Specifications

Item	Specification
A/C Compressor Oil	
NOTICE: Use of any Air Conditioning (A/C) compressor oil other than what is specified for the specific vehicle configuration will damage the A/C compressor and contaminate the refrigerant system. For non-hybrid vehicles with a pulley driven (conventional) A/C compressor, PAG Refrigerant Compressor Oil only must be used. For hybrid vehicles with an electric A/C compressor, Motorcraft® Electric A/C Compressor Oil must be used.	
A/C Pressure Relief Valve [a]	
Close pressure	3,103 kPa (450 psi)
Open pressure 3,792-4,137 kPa (550-600 psi)	

[a] Manifold gauge set pressures may vary slightly depending on the distance between the service gauge port valve and the A/C pressure relief valve, the A/C cycling switch or the pressure cutoff switch location.

NOTE: The specifications apply to hybrid vehicles only. For non-hybrid specifications, refer to Section 412-00A .

Material

Item	Specification	Fill Capacity
Motorcraft® Electric A/C Compressor Oil YN-32	-	Hybrid vehicles only 130 ml (4.4 fl oz)
Motorcraft® R-134a Refrigerant YN-19 (US); CYN-16-R (Canada)	WSH-M17B19-A	0.62 kg (22 oz) (1.38 lb)

Climate Control System

The system consists of the following components:

- Air Conditioning Compressor Module (ACCM)
- A/C condenser core
- A/C evaporator core
- Receiver/drier
- Connecting refrigerant lines
- Thermostatic Expansion Valve (TXV)
- A/C pressure transducer
- Heater core and evaporator core housing
- HVAC module
- Front Controls Interface Module (FCIM) (all vehicles equipped with navigation systems)
- Audio Control Module (ACM) (all vehicles equipped with navigation systems)
- Temperature blend door actuators
- Defrost/panel/floor mode door actuator
- Air inlet mode door actuator
- Blower motor speed control
- Blower motor
- Ambient air temperature sensor
- In-vehicle temperature/humidity sensor
- Sunload sensor
- Evaporator temperature sensor

Humidity Sensor

The humidity sensed by the HVAC module to optimize the Air Conditioning Compressor Module (ACCM) operation for reduced electrical system load while maintaining passenger comfort.

When the relative humidity inside the vehicle is low, passengers are comfortable at a higher air temperature. The ACCM can decrease the compressor rpm before the commanded temperature is reached to reduce compressor electrical load while maintaining passenger comfort.

Hybrid Climate Control System Operation

NOTE: For the passenger side temperature setting on hybrid vehicles equipped with dual-zone Electronic Automatic Temperature Control (EATC) and a Front Controls Interface Module (FCIM) built on or after 4/08/2009 to be functional, a passenger must be seated in the front passenger seat. If the front passenger seat is not occupied, the HVAC module will control the system based only on the driver side temperature setting. The HVAC module receives a Medium Speed Controller Area Network (MS-CAN) signal from the FCIM to indicate if the front passenger seat is occupied.

When an A/C request is made by the HVAC module, a message is sent from the HVAC module over the Medium Speed Controller Area Network (MS-CAN) bus to the Instrument Cluster (IC), then from the IC through the High Speed Controller Area Network (HS-CAN) bus to the PCM.

When an A/C request is received from the HVAC module, an A/C demand message is sent from the PCM over the HS-CAN bus to the Air Conditioning Compressor Module (ACCM) if all of the following conditions are met:

- The PCM does not detect excessively high or low refrigerant pressure from the A/C pressure transducer.
- The PCM does not detect excessively high engine coolant temperature.
- The PCM does not detect an ambient air temperature below -1°C (30°F).
- The PCM has not detected a Wide Open Throttle (WOT) condition.
- The HVAC module does not detect an evaporator discharge air temperature below 2°C (36°F).

When the ACCM receives the A/C demand message, it will engage. Instead of cycling ON and OFF like a traditional A/C compressor, the PCM monitors the evaporator discharge temperature from the HVAC module to raise or lower the electric A/C compressor speed as required. When the HVAC module is OFF or not requiring A/C operation, the electric A/C compressor will be OFF.

Auxiliary Coolant Flow Pump

An auxiliary coolant flow pump is used only on hybrid vehicles to improve engine coolant circulation, for heater operation, at low engine speeds or when the engine is OFF.

For a complete explanation of the auxiliary coolant flow pump refer to heating and ventilation in the Description and Operation portion of Section 412-01 .

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Climate Control System

Special Tool(s)

 ST2574-A	Flex Probe Kit 105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3094-A	Test Light SGT27000 or equivalent 250-300 mA incandescent bulb test lamp
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

The Refrigerant Cycle

During stabilized conditions (A/C system shutdown), the refrigerant pressures are equal throughout the system. When the electric A/C compressor is in operation, it increases pressure on the refrigerant vapor, raising its temperature. The high-pressure and high-temperature vapor is then released into the top of the A/C condenser core.

The A/C condenser, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant by ambient air passing over the fins and tubing. The now liquid refrigerant, still at high pressure, exits from the bottom of the A/C condenser and enters the inlet side of the A/C receiver/drier. The receiver/drier is designed to remove moisture from the refrigerant.

The outlet of the receiver/drier is connected to the Thermostatic Expansion Valve (TXV). The TXV provides the orifice which is the restriction in the refrigerant system and separates the high and low pressure sides of the A/C system. As the liquid refrigerant passes across this restriction, its pressure and boiling point are reduced.

The liquid refrigerant is now at its lowest pressure and temperature. As it passes through the A/C evaporator, it absorbs heat from the airflow passing over the plate/fin sections of the A/C evaporator. This addition of heat causes the refrigerant to boil (convert to gas). The now cooler air can no longer support the same humidity level of the warmer air and this excess moisture condenses on the exterior of the evaporator coils and fins and drains outside the vehicle.

The refrigerant cycle is now repeated with the electric A/C compressor again increasing the pressure and temperature of the refrigerant.

A thermistor which monitors the temperature of the air that has passed through the evaporator core controls electric A/C compressor speed. If the temperature of the evaporator core discharge air is low enough to cause the condensed water vapor to freeze, the electric A/C compressor reduces it speed.

The high-side line pressure is also monitored so that electric A/C compressor operation will be interrupted if the system pressure becomes too high or is determined to be too low (low charge condition).

The electric A/C compressor thermal protection switch will interrupt compressor operation if the compressor housing exceeds temperature limits.

The electric A/C compressor relief valve will open and vent refrigerant to relieve unusually high system pressure.

Inspection and Verification

NOTE: Verify the service disconnect plug is correctly inserted and locked into the LOCK position.

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• A/C compressor	• Battery Junction Box (BJB) fuse: ♦ 13 (15A) ♦ 35 (40A) ♦ 47 (10A) • Smart Junction Box (SJB) fuse: ♦ 15 (10A) ♦ 37 (10A) ♦ 45 (5A) • Circuitry

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

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

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

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

   If the scan tool does not communication with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the VCM .

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.

- refer to Section 418-00 to diagnose no response from the HVAC module, Air Conditioning Compressor Module (ACCM), Instrument Panel Cluster (IPC) or PCM.

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

8. Clear the CMDTCs and carry out the self-test diagnostics for the HVAC, ACCM , IPC or PCM.

9. If the HVAC DTCs retrieved are related to the concern, go to the HVAC Module DTC Chart. If the ACCM DTCs retrieved are related to the concern, go to the Air Conditioning Compressor Module (ACCM) DTC Chart. If the PCM DTCs retrieved are related to the concern, go to the PCM DTC Chart. For all other DTCs, refer to Section 419-10 .

NOTE: If no DTCs are present, GO to Symptom Chart - Climate Control Systems for the appropriate diagnostic action.

HVAC Module and A/C Compressor Self-Test

During the self-test, the HVAC module will do the following:

- command airflow to PANEL vents
- command temperature blend door actuator to full cold
- set blower speed to level 4 and the 4th level will be displayed on the display
- illuminate the POWER, A/C and RECIRC button indicators
- flash the DEFROST, AUTO and rear window defrost button indicators
- command the A/C compressor to between 1,900 and 2,000 rpm

1. Start the engine.

2. Observe the Electric A/C Compressor Speed (ACCM_ECS) Air Conditioning Compressor Module (ACCM) PID.

3. At the same time, press and release the POWER and DEFROST buttons then, within 2 seconds, press the RECIRC button.

4. Observe the HVAC module actions and A/C compressor speed.

5. To exit the self-test, press any climate control button or turn the ignition OFF.
   - If the airflow is incorrect, refer to Section 412-00A .
   - If the panel outlet temperature is incorrect, refer to Section 412-00A .
   - If the blower is inoperative, GO to Pinpoint Test K .
   - If the blower speed is incorrect, GO to Pinpoint Test L .
   - If one or more indicators do not illuminate but the HVAC and A/C compressor operate correctly, INSTALL a new Front Controls Interface Module (FCIM). Refer to Section 415-00 .
   - If the ACCM_ECS PID reads 0 RPM, GO to Pinpoint Test I .
   - If the ACCM_ECS PID reads between 1 and 1,899 rpm or greater than 2,000 rpm, INSTALL a new electric A/C compressor. REFER to Section 412-01 . TEST the system for normal operation.
   - If all modes in the self-test are achieved, GO to Pinpoint Test E .

DTC Charts

PCM DTC Chart

DTC	Description	Action to Take
P0532	A/C Pressure Refrigerant Sensor A Circuit Low	REFER to Section 412-00A .
P0533	A/C Refrigerant Pressure Sensor A Circuit High	REFER to Section 412-00A .
P2600	Coolant Pump A Control Circuit / Open	GO to Pinpoint Test A .
All Other DTCs	-	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Air Conditioning Compressor Module (ACCM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

NOTE: Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

DTC	Description	Action to Take
P0AFA:16	Hybrid Battery System Voltage Low: Circuit Voltage Below Threshold	GO to Pinpoint Test D .
P0AFB:17	Hybridattery System Voltage High: Circuit Voltage Above Threshold	GO to Pinpoint Test D .
B11EE:19	A/C Compressor: Current Above Threshold	INSTALL a new electric A/C compressor. REFER to Section 412-01 . TEST the system for normal operation.
B11EE:49	A/C Compressor: Internal Electronic Failure	INSTALL a new electric A/C compressor. REFER to Section 412-01 . TEST the system for normal operation.
B11EE:4B	A/C Compressor: Over Temperature	VERIFY the refrigerant charge level. REFER to Specifications in this section. If the charge level is low, RECHARGE the system, CLEAR the DTCs and REPEAT the self-test. TEST the system for normal operation. If the DTC returns, INSTALL a new electric A/C compressor. REFER to Section 412-01 . TEST the system for normal operation.
U0100:00	Lost Communication With ECM/PCM "A": No Sub Type Information	REFER to Section 418-00 to diagnose lost communication with the ECM/PCM "A".
U0155:00		

	Lost Communication With Instrument Panel Cluster (IPC) Module: No Sub Type Information	REFER to Section 418-00 to diagnose lost communication with the IPC module.
U0401:68	Invalid Data Received From ECM/PCM "A": Event Information	This DTC can set due to a fault in the PCM or because the PCM is unable to communicate over the Controller Area Network (CAN) bus. CARRY OUT a self-test of the PCM. If the scan tool indicates that the PCM is not responding, REFER to Section 418-00 to diagnose the network communication concern. If PCM DTCs are present, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U0423:68	Invalid Data Received From Instrument Panel Cluster Control Module: Event Information	This DTC can set due to a fault in the Instrument Panel Cluster (IPC) or because the IPC is unable to communicate over the CAN bus. CARRY OUT a self-test of the IPC . If the scan tool indicates that the IPC is not responding, REFER to Section 418-00 to diagnose the network communication concern. If IPC DTCs are present, REFER to Section 413-01 to diagnose the IPC system fault.
U3000:49	Control Module: Internal Electronic Failure	INSTALL a new electric A/C compressor. REFER to Section 412-01 . TEST the system for normal operation.

HVAC Module DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

NOTE: Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

DTC	Description	Action to Take
B1081:07	Left Temperature Damper Motor: Mechanical Failure	REFER to Section 412-00A .
B1081:11	Left Temperature Damper Motor: Circuit Short to Ground	REFER to Section 412-00A .
B1081:12	Left Temperature Damper Motor: Circuit Short to Battery	REFER to Section 412-00A .
B1081:13	Left Temperature Damper Motor: Circuit Open	REFER to Section 412-00A .
B1082:07	Right Temperature Damper Motor: Mechanical Failure	REFER to Section 412-00A .
B1082:11	Right Temperature Damper Motor: Circuit Short to Ground	REFER to Section 412-00A .
B1082:12	Right Temperature Damper Motor: Circuit Short to Battery	REFER to Section 412-00A .

B1082:13	Right Temperature Damper Motor: Circuit Open	REFER to Section 412-00A .
B1083:07	Recirculation Damper Motor: Mechanical Failure	GO to Pinpoint Test G .
B1083:11	Recirculation Damper Motor: Circuit Short to Ground	GO to Pinpoint Test G .
B1083:12	Recirculation Damper Motor: Circuit Short to Battery	GO to Pinpoint Test G .
B1083:13	Recirculation Damper Motor: Circuit Open	GO to Pinpoint Test G .
B1086:07	Air Distribution Damper Motor: Mechanical Failures	REFER to Section 412-00A .
B1086:11	Air Distribution Damper Motor: Circuit Short to Ground	REFER to Section 412-00A .
B1086:12	Air Distribution Damper Motor: Circuit Short to Battery	REFER to Section 412-00A .
B1086:13	Air Distribution Damper Motor: Circuit Open	REFER to Section 412-00A .
B10AF:12	Blower Fan Relay: Circuit Short to Battery	GO to Pinpoint Test K .
B10AF:14	Blower Fan Relay: Circuit Short to Ground or Open	If the blower motor is inoperative, GO to Pinpoint Test K . If the blower motor relay is always on, GO to Pinpoint Test L .
B10B8:00	Push Buttons: No Sub Type Information	Button held too long may set DTC. ATTEMPT to clean buttons. CLEAR the DTCs. REPEAT the self-test. If code returns, INSTALL a new Front Controls Interface Module (FCIM).
B10B9:12	Blower Control: Circuit Short to Battery	GO to Pinpoint Test K .
B10B9:14	Blower Control: Circuit Short to Ground or Open	If the blower motor is inoperative, GO to Pinpoint Test K . If the blower motor is always on or operates incorrectly, GO to Pinpoint Test L .
B11E5:11	Left HVAC Damper Position Sensor: Circuit Short to Ground	REFER to Section 412-00A .
B11E5:15	Left HVAC Damper Position Sensor: Circuit Short to Battery or Open	REFER to Section 412-00A .
B11E6:11	Right HVAC Damper Position Sensor: Circuit Short to Ground	REFER to Section 412-00A .
B11E6:15	Right HVAC Damper Position Sensor: Circuit Short to Battery or Open	REFER to Section 412-00A .
B11E7:11	Air Distribution Damper Position Sensor: Circuit	REFER to Section 412-00A .

	Short to Ground	
B11E7:15	Air Distribution Damper Position Sensor: Circuit Short to Battery or Open	REFER to Section 412-00A .
B11F0:11	Air Intake Damper Position Sensor: Circuit Short to Ground	GO to Pinpoint Test G .
B11F0:15	Air Intake Damper Position Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test G .
B1A61:11	Cabin Temperature Sensor: Circuit Short to Ground	GO to Pinpoint Test B .
B1A61:15	Cabin Temperature Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test B .
B1A63:11	Right Solar Sensor: Circuit Short to Ground	REFER to Section 412-00A .
B1A63:15	Right Solar Sensor: Circuit Short to Battery or Open	REFER to Section 412-00A .
B1A64:11	Left Solar Sensor: Circuit Short to Ground	REFER to Section 412-00A .
B1A64:15	Left Solar Sensor: Circuit Short to Battery or Open	REFER to Section 412-00A .
B1A68:11	Ambient Temperature Sensor: Circuit Short to Ground	REFER to Section 412-00A .
B1A68:15	Ambient Temperature Sensor: Circuit Short to Battery or Open	REFER to Section 412-00A .
B1A69:11	Humidity Sensor: Circuit Short to Ground	GO to Pinpoint Test C .
B1A69:15	Humidity Sensor: Circuit Short to Battery or Open	GO to Pinpoint Test C .
B1B71:11	Evaporator Temperature Sensor: Circuit Short to Ground	REFER to Section 412-00A .
B1B71:15	Evaporator Temperature Sensor: Circuit Short to Battery or Open	REFER to Section 412-00A .
C1B14:11	Sensor Supply Voltage A: Circuit Short to Ground	REFER to Section 412-00A .
C1B14:12	Sensor Supply Voltage A: Circuit Short to Battery	REFER to Section 412-00A .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	REFER to Section 418-00 to diagnose lost communication with the Smart Junction Box (SJB).
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Module: No Sub Type Information	REFER to Section 418-00 to diagnose lost communication with the IPC module.

U0163:00	Lost Communication With navigation Control Module: No Sub Type Information	REFER to Section 418-00 to diagnose lost communication with the Audio Control Module (ACM).
U0256:00	Lost Communication With Front Controls Interface Module (FCIM) "A": No Sub Type Information	REFER to Section 418-00 to diagnose lost communication with the FCIM .
U0422:68	Invalid Data Received From Body Control Module: Event Information	This DTC can set due to a fault in the SJB or because the SJB is unable to communicate over the Controller Area Network (CAN) bus. CARRY OUT a self-test of the SJB . If the scan tool indicates that the SJB is not responding, REFER to Section 418-00 to diagnose the network communication concern. If SJB DTCs are present, REFER to Section 419-10 .
U0423:68	Invalid Data Received From Instrument Panel Cluster Control Module: Event Information	This DTC can set due to a fault in the IPC or because the IPC is unable to communicate over the CAN bus. CARRY OUT a self-test of the IPC . If the scan tool indicates that the IPC is not responding, REFER to Section 418-00 to diagnose the network communication concern. If IPC DTCs are present, REFER to Section 413-01 to diagnose the IPC system fault.
U0464:68	Invalid Data Received From Navigation Control Module: Event Information	This DTC can set due to a fault in the Audio Control Module (ACM) or because the ACM is unable to communicate over the CAN bus. CARRY OUT a self-test of the ACM . If the scan tool indicates that the ACM is not responding, REFER to Section 418-00 to diagnose the network communication concern. If ACM DTCs are present, REFER to Section 415-00 to diagnose the ACM system fault
U0557:68	Invalid Data Received From Front Controls Interface Module (FCIM) "A": Event Information	This DTC can set due to a fault in the FCIM or because the FCIM is unable to communicate over the CAN bus. CARRY OUT a self-test of the FCIM . If the scan tool indicates that the FCIM is not responding, REFER to Section 418-00 to diagnose the network communication concern. If FCIM DTCs are present, REFER to Section 415-00 to diagnose the FCIM fault.
U1000:00	Solid State Driver Protection Activated-Driver Disabled: No Sub Type Information	INSTALL a new HVAC module. REFER to Section 412-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	INSTALL a new HVAC module. REFER to Section 412-01 .
U3000:41	Control Module: General Checksum Failure	INSTALL a new HVAC module. REFER to Section 412-01 .
U3000:49	Control Module: Internal Electronic Failure	INSTALL a new HVAC module. REFER to Section 412-01 .
U3002:62	Vehicle Identification Number: Signal Compare Failure	INSTALL a new HVAC module. REFER to Section 412-01 .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	REFER to Section 412-00A .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	REFER to Section 412-00A .
	-	REFER to the Master DTC Chart in Section 419-10 .

All Other DTCs		

Symptom Chart - Climate Control Systems

Symptom Chart - Climate Control Systems
NOTE: Some PCM DTCs may inhibit A/C operation. If any PCM DTCs are retrieved, diagnose those first. Refer to the PCM DTC Chart.

ConditionPossible SourcesAction

- No communication with the HVAC module

- Fuse(s)
- Circuitry open
- HVAC module communication network

- REFER to Section 418-00 .

- Unable to duplicate the customer concern and no DTCs present

- HVAC system and/or related components

- GO to Pinpoint Test E .

- Incorrect/erratic function in AUTO mode

- Circuitry open/shorted
- In-vehicle temperature/humidity sensor
- HVAC module

- GO to Pinpoint Test F .

- Reduced outlet airflow

- Cabin air filter
- Air Conditioning Compressor Module (ACCM)
- Evaporator discharge air temperature sensor
- Blower motor
- Blower motor control
- PCM

- If the airflow is reduced only when in AUTO, A/C, MAX A/C, defrost or defrost/floor modes, GO to Pinpoint Test J .
- If the airflow is reduced in all modes, INSPECT the cabin air filter. If the cabin air filter is clean and free of damage and debris, GO to Pinpoint Test L .

- The air inlet door is inoperative

- Circuitry open/shorted
- Door actuator

- Air inlet door binding or stuck
- HVAC module

- GO to Pinpoint Test G .

- Incorrect/erratic direction of airflow from outlets

- Circuitry open/shorted
- Door actuator
- Mode door binding or stuck
- HVAC module

- REFER to Section 412-00A .

- Insufficient, erratic or no heat

- Low engine coolant level
- Engine overheating
- Plugged or partially plugged heater core
- Temperature blend door is binding or stuck
- Temperature blend door actuator
- Heater hose is kinked or binding

- GO to Pinpoint Test H .

- The air conditioning (A/C) is inoperative

- A/C pressure transducer
- Evaporator discharge temperature sensor
- HVAC module
- PCM
- FCIM
- ACM
- ACCM

- GO to Pinpoint Test I .

- The air conditioning (A/C) is always on

- Evaporator discharge temperature sensor
- HVAC module
- PCM
- FCIM
- ACM
- ACCM

- GO to Pinpoint Test J .

- Temperature control is inoperative/does not operate correctly

- Circuitry open/shorted
- HVAC module
- Temperature blend door is binding or stuck
- Temperature blend door actuator

- REFER to Section 412-00A .

- The blower motor is inoperative

- Fuse(s)
- Circuitry short/open
- Blower motor relay
- A/C blower motor
- HVAC module
- A/C blower motor speed control

- GO to Pinpoint Test K .

- The blower motor does not operate correctly

- Circuitry open/shorted
- A/C blower motor speed control
- HVAC module

- GO to Pinpoint Test L .

- The dual temperature control is inoperative/does not operate correctly

- Temperature blend door/actuator broken/binding
- HVAC module - Electronic Automatic Temperature Control (EATC)
- Low A/C refrigerant charge

- **NOTE:** For the passenger side temperature setting on hybrid vehicles equipped with dual-zone Electronic Automatic Temperature Control (EATC) and a Front Controls Interface Module (FCIM) built on or after 4/08/2009 to be functional, a passenger must be seated in the front passenger seat. If the front passenger seat is not occupied, the HVAC module will control the system based only on the driver side temperature setting. The HVAC module receives a Medium Speed Controller Area Network (MS-CAN) signal from the FCIM to indicate if the front passenger seat is occupied.

  CHECK that the A/C system pressure is above 290 kPa (42 psi). If the pressure is below 290 kPa (42 psi), REFER to Section 412-00A . CHECK the temperature blend doors/actuators for a binding or broken condition. If no condition is found, INSTALL a new HVAC dule.

- The temperature display will not switch between Celsius and Fahrenheit

- HVAC module

- INSTALL a new HVAC module. REFER to Section 412-01 .

- Inaccurate external temperature display

- HVAC module
- Ambient temperature sensor

- REFER to Section 412-00A .

Pinpoint Tests

Pinpoint Test A: DTC P2600

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, voltage is provided to the auxiliary coolant flow pump relay coil through circuit CBK03 (GY). When the HVAC module is ON, a message is sent over the Controller Area Network (CAN) to the PCM. When the PCM receives the message, a ground is provided to the auxiliary coolant flow pump relay coil from the PCM through circuit CH307 (GY/BU), energizing the auxiliary coolant flow pump relay.

An auxiliary coolant flow pump is used only on hybrid vehicles to improve engine coolant circulation at low engine speeds or when the engine is OFF.

The auxiliary coolant flow pump will be disabled when any of the following conditions are present:

- The climate control module is set to the OFF position.
- The ambient temperature is above 32°C (90°F).
- The coolant temperature is less than -10°C (14°F).
- The engine speed is above 4,000 rpm.

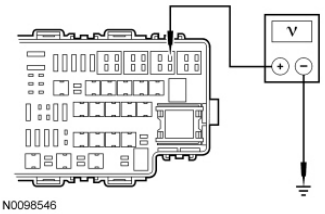
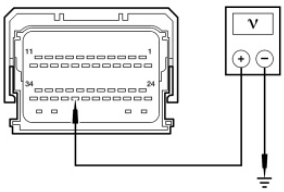
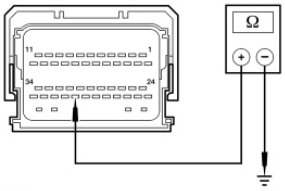
For a complete explanation of the auxiliary coolant flow pump refer to heating and ventilation in the Description and Operation portion of Section 412-01 .

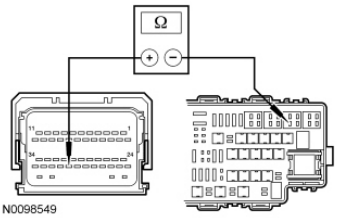
- DTC P2600 (Coolant Pump A Control Circuit / Open) - The DTC sets when the PCM grounds the relay circd excessive current draw is detected on the relay circuit. The DTC also sets when the relay circuit is OFF and no voltage is detected on the relay control circuit. The PCM expects to detect voltage coming through the relay coil to the relay circuit when it is not grounding it.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Heater pump relay
- PCM

PINPOINT TEST A: DTC P2600

Test Step	Result / Action to Take
A1 CHECK THE VOLTAGE TO THE RELAY	
• Ignition OFF. • Disconnect: Auxiliary Coolant Flow Pump Relay. • Ignition ON. • Measure the voltage between ground and the auxiliary coolant flow pump relay socket, circuit CBK03 (GY).	**Yes** CARRY OUT the auxiliary coolant flow pump relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. If the relay tests OK, GO to A2 . **No**

 N0098546 • **Is the voltage greater than 10 volts?**	REPAIR circuit CBK03 (GY) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A2 CHECK CIRCUIT CH307 (GY/BU) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PCM C175t. • Ignition ON. • Measure the voltage between ground and PCM C175t-42, circuit CH307 (GY/BU), harness side.  N0098547 • **Is any voltage present?**	**Yes** REPAIR circuit CH307 (GY/BU) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A3 .
A3 CHECK CIRCUIT CH307 (GY/BU) FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between ground and PCM C175t-42, circuit CH307 (GY/BU), harness side.  N0098548 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A4 . **No** REPAIR circuit CH307 (GY/BU) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A4 CHECK CIRCUIT CH307 (GY/BU) FOR AN OPEN	
• Measure the resistance between auxiliary coolant flow pump relay socket, circuit CH307 (GY/BU) and PCM C175t-42, circuit CH307 (GY/BU), harness side.	**Yes** GO to A5 . **No** REPAIR circuit CH307 (GY/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 • **Is the resistance less than 5 ohms?**	
A5 CHECK THE PCM CONNECTION	
• Clear the DTCs. • Disconnect all the PCM connectors. • Inspect the module connectors for: ♦ corrosion. ♦ pushed-out pins. ♦ incorrectly seated connector. • Connect and correctly seat all the PCM connectors. • Operate the system. • **Does the concern return?**	**Yes** INSTALL a new PCM. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: DTC B1A61:11 and 15

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, the in-vehicle air temperature sensor receives a ground from the HVAC module through circuit RH111 (GY/BU). A 5-volt reference voltage is supplied to the in-vehicle air temperature sensor from the HVAC module through circuit VH414 (GN/BU).

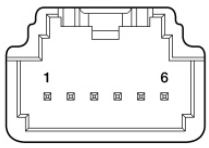
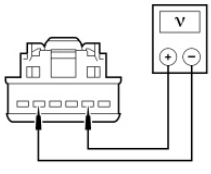
- DTC B1A61:11 (Cabin Temperature Sensor: Circuit Short to Ground) - The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
- DTC B1A61:15 (Cabin Temperature Sensor: Circuit Short to Battery or Open) - The module senses no voltage drop on the sensor reference voltage circuit, indicating a short directly to voltage or an open circuit.

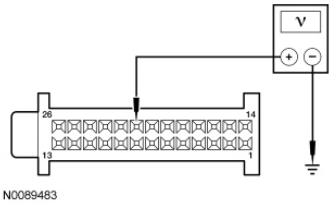
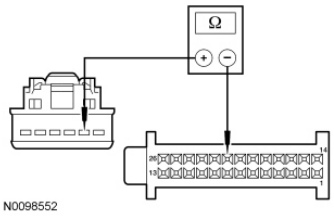
This pinpoint test is intended to diagnose the following:

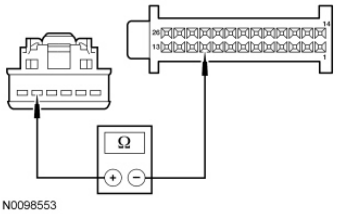
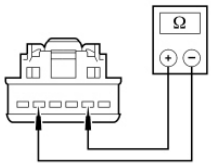
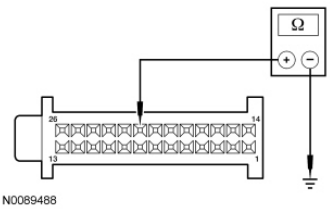
- Wiring, terminals or connectors
- In-vehicle air temperature sensor
- HVAC module

PINPOINT TEST B: DTC B1A61:11 AND 15

Test Step	Result / Action to Take
B1 CHECK THE SENSOR RESISTANCE	

• Ignition OFF. • Disconnect: In-Vehicle Temperature/Humidity Sensor C2247. • Measure the resistance ben the in-vehicle temperature/humidity sensor C2247-2, component side and C2247-5, component side and compare to the table below. **Ambient Temperature** / **Resistance** -40°C (-40°F) — 862,600-942,000 ohms -15°C (5°F) — 202,400-214,700 ohms 0°C (32°F) — 93,510-97,640 ohms 15°C (59°F) — 46,060-47,430 ohms 25°C (77°F) — 29,700-30,300 ohms 35°C (95°F) — 19,400-20,000 ohms 60°C (140°F) — 7,414-7,774 ohms 85°C (185°F) — 3,182-3,393 ohms  N0098550 • **Is the resistance within the specified values for the temperatures?**	**Yes** GO to B2 . **No** INSTALL a new in-vehicle temperature/humidity sensor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B2 CHECK THE SENSOR OUTPUT VOLTAGE	
• Ignition ON. • Measure the voltage between in-vehicle temperature/humidity sensor C2247-2, circuit VH414 (GN/BU), harness side and C2247-5, circuit RH111 (GY/BU), harness side.  N0098551 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** INSTALL a new in-vehicle temperature/humidity sensor. CLEAR the DTCs. REPEAT the self-test. If code returns, GO to B8 . **No** **For DTC B1A68:15** , GO to B3 . **For DTC B1A68:11** , GO to B6 .

B3 CHECK CIRCUIT VH414 (GN/BU) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module - Dual Automatic Temperature Control (DATC) C2356a. • Disconnect: HVAC Module - DATC C2356b. • Ignition ON. • Measure the voltage between ground and HVAC module - DATC C2356b-21, circuit VH414 (GN/BU), harness side.  N0089483 • **Is any voltage present?**	**Yes** REPAIR circuit VH414 (GN/BU) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B4 .
B4 CHECK CIRCUIT VH414 (GN/BU) FOR AN OPEN	
• Ignition OFF. • Measure the resi between HVAC module - DATC C2356b-21, circuit VH414 (GN/BU), harness side and in-vehicle temperature/humidity sensor C2247-2, circuit VH414 (GN/BU), harness side.  N0098552 • **Is the resistance less than 5 ohms?**	**Yes** GO to B5 . **No** REPAIR circuit VH414 (GN/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B5 CHECK CIRCUIT RH111 (GY/BU) FOR AN OPEN	
• Measure the resistance between HVAC module C2356a-10, circuit RH111 (GY/BU), harness side and in-vehicle temperature/humidity sensor C2247-5, circuit RH111 (GY/BU), harness side.	**s** GO to B8 . **No** REPAIR circuit RH111 (GY/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0098553 • **Is the resistance less than 5 ohms?**	
B6 CHECK CIRCUIT VH414 (GN/BU) FOR A SHORT TO CIRCUIT RH111 (GY/BU)	
• Ignition OFF. • Disconnect: HVAC Module - DATC C2356b. • Measure the resistance between in-vehicle temperature/humidity sensor C2247-2, circuit VH414 (GN/BU), harness side and C2247-5, circuit RH111 (GY/BU), harness side.  N0098554 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B7 . **No** REPAIR circuit VH414 (GN/BU) for a short to circuit RH111 (GY/BU). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
• Measure the resistance between HVAC module - DATC C2356b-21, circuit VH414 (GN/BU), harness side and ground.  N0089488 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B8 . **No** REPAIR circuit VH414 (GN/BU) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B8 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs.	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs.

• Operate the system and verify the concern is still present. • **Is the concern still present?**	REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test C: DTC B1A69:11 or 15

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

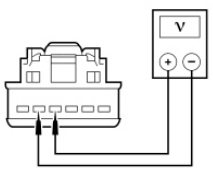
Normal Operation

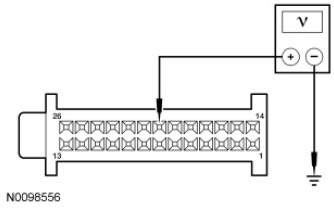
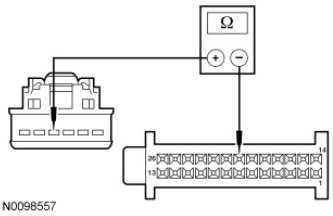
Under normal operation, the in-vehicle temperature/humidity sensor is grounded through circuit RH111 (GY/BU). A 5-volt reference voltage is supplied to the in-vehicle temperature/humidity sensor from the HVAC module through circuit LH111 (BN/WH). The HVAC module receives the humidity value through circuit VH413 (WH/BU).

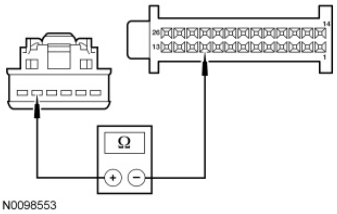
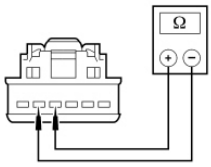
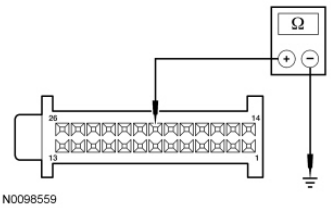
- DTC B1A61:11 (Humidity Sensor: Circuit Short to Ground) - The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
- DTC B1A61:15 (Humidity Sensor: Circuit Short to Battery or Open) - The module senses no voltage drop on the sensor reference voltage circuit, indicating a short directly to voltage or an open circuit.

This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- In-vehicle temperature/humidity sensor
- HVAC module

PINPOINT TEST C: DTC B1A69:11 OR 15

Test Step	Result / Action to Take
C1 CHECK THE SENSOR OUTPUT VOLTAGE	
• Ignition OFF. • Disconnect: In-Vehicle Temperature/Humidity Sensor C2247. • Ignition ON. • Measure the voltage between in-vehicle temperature/humidity sensor C2247-4, circuit VH413 (WH/BU), harness side and C2247-5, circuit RH111 (GY/BU), harness side.  N0098555 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** INSTALL a new in-vehicle temperature/humidity sensor. CLEAR the DTCs. REPEAT the self-test. If code returns, GO to C7 . **No** **For DTC B1A69:15** , GO to C2 . **For DTC B1A69:11** , GO to C5 .

C2 CHECK CIRCUIT VH413 (WH/BU) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module - Dual Automatic Temperature Control (DATC) C2356a. • Disconnect: HVAC Module - DATC C2356b. • Ignition ON. • Measure the voltage between ground and HVAC module - DATC C2356b-20, circuit VH413 (WH/BU), harness side.  N0098556 **Yes** REPAIR circuit VH413 (WH/BU) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to C3 .	
C3 CHECK CIRCUIT VH413 (WH/BU) FOR AN OPEN	
• Ignition OFF. • Measure the resistance between HVAC module - DATC C2356b-20, circuit VH413 (WH/BU), harness side and in-vehicle temperature/humidity sensor C2247-4, circuit VH413 (WH/BU), harness side.  N0098557 • **Is the resistance less than 5 ohms?**	**Yes** GO to C4 . **No** REPAIR circuit VH413 (WH/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C4 CHECK CIRCUIT RH111 (GY/BU) FOR AN OPEN	
• Measure the resistance between HVAC module C2356a-10, circuit RH111 (GY/BU), harness side and in-vehicle temperature/humidity sensor C2247-5, circuit RH111 (GY/BU), harness side.	**Yes** GO to C7 . **No** REPAIR circuit RH111 (GY/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0098553 • **Is the resistance less than 5 ohms?**	
C5 CHECK CIRCUIT VH413 (WH/BU) FOR A SHORT TO CIRCUIT RH111 (GY/BU)	
• Ignition OFF. • Disconnect: HVAC Module - DATC C2356b. • Measure the resistance between in-vehicle temperature/humidity sensor C2247-4, circuit VH413 (WH/BU), harness side and C2247-5, circuit RH111 (GY/BU), harness side.  N0098558 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C6 . **No** REPAIR circuit VH413 (WH/BU) for a short to circuit RH111 (GY/BU). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C6 CHECK CIRCUIT VH413 (WH/BU) FOR A SHORT TO GROUND	
• Measure the resistance between HVAC module - DATC C2356b-20, circuit VH413 (WH/BU), harness side and ground.  N0098559 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C7 . **No** RAIR circuit VH413 (WH/BU) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C7 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs.	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have

• Operate the system and verify the concern is still present. • **Is the concern still present?**	been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test D: DTC P0AFA:16 or P0AFB:17

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

The Air Conditioning Compressor Module (ACCM) receives hybrid battery system voltage through circuit HYT03 (OG/WH). The ACCM is grounded through circuit HYT04 (OG/BK).

- DTC P0AFA:16 (Hybrid Battery System Voltage Low: Circuit Voltage Below Threshold) - The module senses when hybrid battery system voltage is less than 165 volts.
- DTC P0AFB:17 (Hybrid Battery System Voltage High: Circuit Voltage Above Threshold) - The module senses when hybrid battery system voltage is greater than 450 volts.

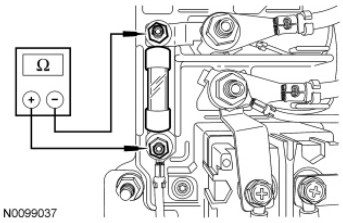
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- ACCM

PINPOINT TEST D: DTC P0AFA:16 OR P0AFB:17

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service ructions, including instructions to depower the system. The high-voltage hybrid system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

NOTE: Before carrying out the following test, diagnose any PCM or Battery Energy Control Module (BECM) DTCs.

Test Step	Result / Action to Take
D1 CHECK THE DTCs FROM THE SELF-TEST	
• Review the DTCs retrieved and recorded during Inspection and Verification. • **Are there any other Battery Energy Control Module (BECM), PCM or Transmission Control Module (TCM) DTCs present along with BECM DTCs P0AFA:16 and P0AFB:17?**	**Yes** DIAGNOSE all other BECM , PCM or TCM DTCs before diagnosing BECM DTCs P0AFA:16 and P0AFB:17. For BECM DTCs, REFER to Section 414-03 . For PCM DTCs, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. For TCM DTCs, REFER to Section 307-01A

	or Section 307-01B . **No** GO to D2 .
D2 CHECK THE HIGH-VOLTAGE BEC HIGH-VOLTAGE LOW-CURRENT FUSE	
⚠ WARNING: Never install the service disconnect plug with the high-voltage bussed electrical center (BEC) cover removed. Always install the cover prior to connecting the service disconnect plug. The high-voltage BEC cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB . Refer to Section 414-03 . • Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the High-Voltage Low-Current Fuse procedure in Section 414-03 . • Inspect and measure the resistance of the high-voltage low-current fuse.  • **Is the fuse undamaged and the resistance less than 5 ohms?**	**Yes** GO to D3 . **No** INSTALL a new high-voltage, low-current fuse. INSPECT the high-voltage BEC for signs of an obvious short condition. INSTALL a new high-voltage BEC as needed. If an obvious short condition is not identified, CARRY OUT self-test of the Battery Energy Control Module (BECM). REFER to Section 414-03 to diagnose BECM DTCs. CLEAR the DTCs from all modules. REPEAT self-test.
D3 COMPARE THE ACCM HIGH VOLTAGE PID WITH THE BECM HIGH VOLTAGE PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Hybrid Battery Pack Voltage (BATPACKVOLT) Battery Energy Control Module (BECM) PID. • Enter the following diagnostic mode on the scan tool: Electric A/C Compressor High Voltage Supply (ACCM_CHVS) Air Conditioning Compressor Module (ACCM) PID. • Compare the BATPACKVOLT BECM PID voltage with the ACCM_CHVS ACCM PID voltage. • **Are both voltages approximately the same?**	**Yes** CLEAR the DTCs from all modules. REPEAT the self-test. TEST the system for normal operation. If the **DTCs return** , INSTALL a new ACCM . REFER to Section 412-01 . TEST the system for normal operation. If the **DTCs do not return** , the system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. **No** INSPECT the ACCM for loose or corroded connections. If OK, INSTALL a new ACCM . REFER to Section 412-01 . TEST the

	system for normal operation.

Pinpoint Test E: Unable to Duplicate Customer Concern and No DTCs Present

This pinpoint test is intended to diagnose the following:

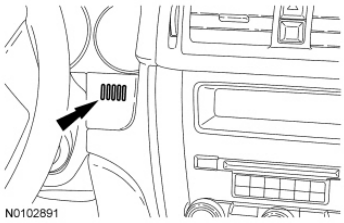
- Incorrect functioning of the HVAC system

PINPOINT TEST E: UNABLE TO DUPLICATE CUSTOMER CONCERN AND NO DTCs PRESENT

NOTE: Diagnose any PCM, HVAC module or Air Conditioning Compressor Module (ACCM) DTCs before carrying out the following pinpoint test.

Test Step	Result / Action to Take
E1 HVAC MODULE AND A/C COMPRESSOR SELF-TEST	
NOTE: If sent to this pinpoint test from the HVAC Module and A/C Compressor Self-Test, **GO to step E2** . • Carry out the HVAC Module and A/C Compressor Self-Test in this section. • **Were all modes in the self-test achieved?**	**Yes** GO to E2 . **No** Follow the actions within the HVAC Module and A/C Compressor Self-Test.
E2 CHECK THE BLOWER MOTOR OPERATION	
• Ignition ON. • Select PANEL mode. • Observe blower motor operation and select each blower motor speed. • **Does the blower motor operate in all selections and change speed in each?**	**Yes** GO to E3 . **No** If the blower motor does not operate in any setting, GO to Pinpoint Test K . If the blower motor does not properly change speeds or shut OFF, GO to Pinpoint Test L .
E3 CHECK AIRFLOW OPERATION	
• Select the highest blower motor setting. • **NOTE:** Refer to Description and Operation in this section for proper airflow descriptions. • While observing the airflow, select each of the airflow positions (PANEL, PANEL/FLOOR, FLOOR, FLOOR/DEFROST, DEFROST). • **Is the airflow directed to the proper outlets?**	**Yes** GO to E4 . **No** REFER to Section 412-00A and DIAGNOSE for incorrect/erratic direction of airflow from outlets.
E4 VERIFY TEMPERATURE CONTROL OPERATION	

• Start the vehicle and allow it to reach normal operating temperature. • With the A/C OFF, select PANEL mode. • Change the temperature setting from the coldest to the warmest and back to the coldest. • **Does the temperature change between very warm to cool?**	**Yes** GO to E5 . **No** If the temperature does not get very warm or heat is erratic, GO to Pinpoint Test H . If the temperature does not change at all, REFER to Section 412-00A and DIAGNOSE for temperature control is inoperative/does not operate correctly.
E5 VERIFY NO A/C COMPRESSOR OPERATION WITH A/C OFF	
• With the A/C OFF, select PANEL mode. • Select the coldest temperature setting. • **Is the outlet temperature close to ambient temperature?**	**Yes** GO to E6 . **No** If the temperature is warmer than ambient temperature, REFER to Section 412-00A and DIAGNOSE for temperature control is inoperative/does not operate correctly. If the outlet temperature is significantly colder than ambient temperature, GO to Pinpoint Test J .
E6 VERIFY A/C OPERATION IN THE A/C MODE	
• Make sure the ambient air temperature is above 2°C (35°F). • Select PANEL mode. • Press the A/C button (indicator ON). • **Does the A/C operate when the PANEL and A/C button (indicator ON) is pressed?**	**Yes** GO to E7 . **No** GO to Pinpoint Test I .
E7 CHECK THE RECIRC OPERATION	
• Press the RECIRC button (indicator OFF). • Select PANEL mode. • Select the highest blower motor setting. • Observe airflow noise. • **Does the airflow noise increase when the RECIRC mode is selected (indicator ON)?**	**Yes** GO to E8 . **No** GO to Pinpoint Test G .
E8 CHECK IN-VEHICLE TEMPERATURE/HUMIDITY SENSOR FAN OPERATION	

• Make sure the ambient air temperature is above 2°C (35°F). • Select PANEL mode. • Press the A/C button (indicator ON). • Place a piece of tissue within 25 mm (1 in) of the in-vehicle temperature/humidity sensor opening.  N0102891 • **Is the tissue drawn to the sensor opening?**	**Yes** GO to E9 . **No** GO to Pinpoint Test F .
E9 CHECK AUXILIARY COOLANT FLOW PUMP OPERATION	
• Allow the vehicle to cool to ambient temperature. • Start the engine and let the engine idle until it shuts down automatically, • Select FLOOR mode. • Set the temperature to the warmest setting. • Select the highest blower motor setting. • **Does the discharge air temperature closely maintain its warm temperature for an extended period of time?**	**Yes** The system is operating normally. If sent here for reduced airflow, CHECK the cabin air filter. If the cabin air filter is dirty, INSTALL a new cabin air filter. TEST the system for normal operation. If reduced airflow is still observed or the cabin air filter is clean, GO to Pinpoint Test L . **No** GO to Pinpoint Test H .

Pinpoint Test F: Incorrect/Erratic Function in AUTO Mode

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

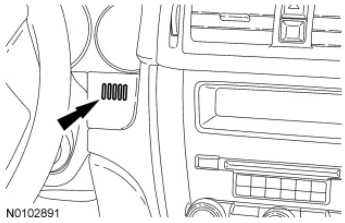
Normal Operation

Under normal operation, the in-vehicle air temperature sensor receives a ground from the HVAC module through circuit RH111 (GY/BU). A 5-volt reference voltage is supplied to the in-vehicle air temperature sensor from the HVAC module through circuit VH414 (GN/BU). To accurately monitor the cabin air temperature, the in-vehicle air temperature sensor uses an integral fan to draw cabin air to the sensor, inside the instrument panel. The fan is supplied voltage through circuit CBP37 (WH) and ground from circuit GD116 (BK/VT)

This pinpoint test is intended to diagnose the following:

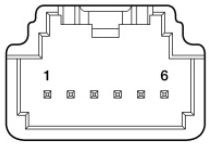
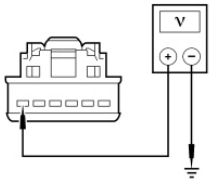
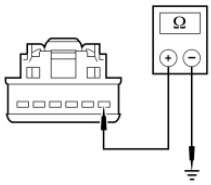
- Wiring, terminals or connectors
- In-vehicle temperature/humidity sensor
- HVAC module

PINPOINT TEST F: INCORRECT/ERRATIC FUNCTION IN AUTO MODE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>F1 CHECK IN-VEHICLE TEMPERATURE/HUMIDITY SENSOR FAN OPERATION</td><td></td></tr>
<tr><td>• Ignition ON.
• Make sure the ambient air temperature is above 2°C (35°F).
• Select PANEL mode.
• Press the A/C button (indicator ON).
• Place a piece of tissue within 25 mm (1 in) of the in-vehicle temperature/humidity sensor opening.
 
N0102891
• Is the tissue drawn to the sensor opening?</td><td>Yes
GO to F2 .

No
GO to F3 .</td></tr>
<tr><td>F2 CHECK THE SENSOR RESISTANCE</td><td></td></tr>
<tr><td>• Ignition OFF.
• Disconnect: In-Vehicle Temperature/Humidity Sensor C2247.
• Measure the resistance between the in-vehicle temperature/humidity seor C2247-2, component side and C2247-5, component side and compare to the table below.

<table><tr><th>Ambient Temperature</th><th>Resistance</th></tr><tr><td>-40°C (-40°F)</td><td>862,600-942,000 ohms</td></tr><tr><td>-15°C (5°F)</td><td>202,400-214,700 ohms</td></tr><tr><td>0°C (32°F)</td><td>93,510-97,640 ohms</td></tr><tr><td>15°C (59°F)</td><td>46,060-47,430 ohms</td></tr><tr><td>25°C (77°F)</td><td>29,700-30,300 ohms</td></tr><tr><td>35°C (95°F)</td><td>19,400-20,000 ohms</td></tr><tr><td>60°C (140°F)</td><td>7,414-7,774 ohms</td></tr><tr><td>85°C (185°F)</td><td>3,182-3,393 ohms</td></tr></table></td><td>Yes
GO to F5 .</td></tr>
</table>

 N0098550 • **Is the resistance within the specified values for the temperatures?**	
F3 CHECK CIRCUIT SBP37 (WH) FOR VOLTAGE	
• Ignition ON. • Measure the voltage between in-vehicle temperature/humidity sensor C2247-6, circuit SBP37 (WH), harness side and ground.  N0098560 • **Is the voltage greater than 10 volts?**	**Yes** GO to F4 . **No** VERIFY Smart Junction Box (SJB) fuse 37 (10A) is OK. If OK, REPAIR circuit SBP37 (WH) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
F4 CHECK CIRCUIT GD116 (BK/VT) FOR GROUND	
• Ignition OFF. • Measure the resistance between in-vehicle temperature/humidity sensor C2247-1, circuit GD116 (BK/VT), harness side and ground.  N0098561 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new in-vehicle temperature/humidity sensor. TEST the system for normal operation. **No** REPAIR circuit GD116 (BK/VT) for an open. TEST the system for normal operation.
F5 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present.	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the

• **Is the concern still present?**	self-test. TEST the system for normal operation.

Pinpoint Test G: The Air Inlet Door is Inoperative

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

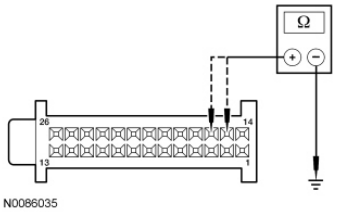
Under normal operation, to rotate the air inlet door actuator, the HVAC module - Dual Automatic Temperature Control (DATC) supplies voltage to the air inlet door actuator motor through the circuit CH207 (BU/GY) or through circuit CH208 (GN/OG). To rotate the air inlet door actuator in the reverse direction, the HVAC module - DATC reverses the voltage and ground circuits.

The air inlet door actuator feedback resistor is supplied a ground from the HVAC module - DATC through circuit RH111 (GY/BU) and a 5-volt reference voltage on circuit LH111 (BN/WH). The HVAC module - DATC reads the voltage on the air inlet door actuator feedback circuit VH438 (GN/VT) to determine the air inlet door actuator position by the position of the actedback resistor wiper arm.

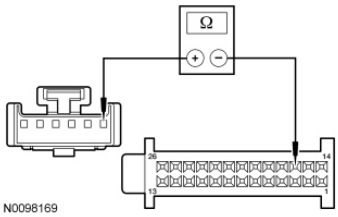
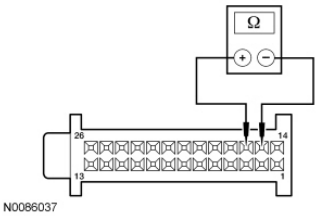
DTC Description	Fault Trigger Conditions
• B1083:07 - Recirculation Damper Motor: Mechanical Failures	The module senses no changes in the feedback circuit when motor movement is commanded and no motor DTCs are present.
• B1083:11 - Recirculation Damper Motor: Circuit Short to Ground	The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
• B1083:12 - Recirculation Damper Motor: Circuit Short to Battery	The module senses no voltage drop on the sensor reference voltage circuit, indicating an open circuit.
• B1083:13 - Recirculation Damper Motor: Circuit Open	The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.
• B11F0:11 - Air Intake Damper Position Sensor: Circuit Short to Ground	The module senses no voltage drop on the sensor reference voltage circuit, indicating an open circuit.
• B11F0:15 - Air Intake Damper Position Sensor: Circuit Short to Battery or Open	The module senses excessive voltage drop on the sensor reference voltage circuit, indicating a short directly to ground.

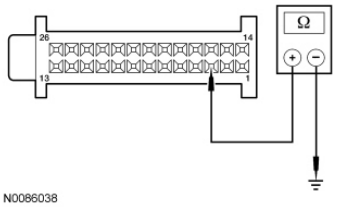
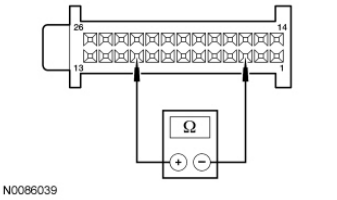
This pinpoint test is intended to diagnose t:
- Wiring, terminals or connectors
- Air inlet door actuator motor
- HVAC module
- Stuck or bound linkage or door

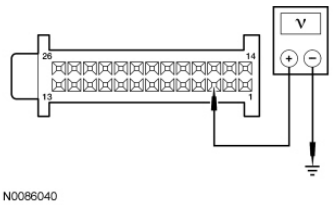
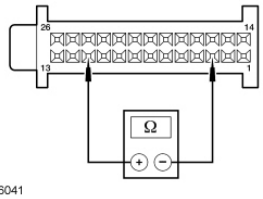
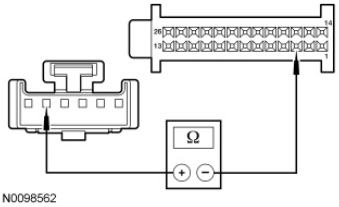
PINPOINT TEST G: THE AIR INLET DOOR IS INOPERATIVE

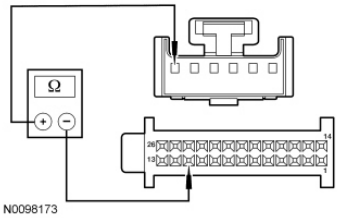
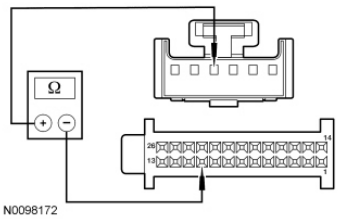
Test Step	Result / Action to Take
G1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are DTCs present?**	**Yes** **For DTC B1083:07** , INSPECT for binding/damaged linkage or door. REPAIR as necessary. If no condition is found, INSTALL a new door actuator. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For DTC B1083:11** , GO to G2 . **For DTC B1083:12** , GO to G3 . **For DTC B1083:13** , GO to G4 . **For DTC B11F0:11** , GO to G6 . **For DTC B11F0:15** , GO to G8 . **No** INSPECT for broken/binding linkage or door. REPAIR as necessary. If no condition is found, GO to G13 .
G2 CHECK CIRCUITS CH207 (BU/GY) AND CH208 (GN/OG) FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module - DATC C2356a. • Measure the resistance between ground and: ♦ HVAC module - DATC C2356a-16, circuit CH208 (GN/OG), harness side. ♦ HVAC module - DATC C2356a-1cuit CH207 (BU/GY), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G5 . **No** REPAIR circuit CH207 (BU/GY) or CH208 (GN/OG) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

G3 CHECK CIRCUITS CH207 (BU/GY) AND CH208 (GN/OG) FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HVAC Module - DATC C2356a. • Ignition ON. • Measure the voltage between ground and: ♦ HVAC module - DATC C2356a-16, circuit CH208 (GN/OG), harness side. ♦ HVAC module - DATC C2356a-15, circuit CH207 (BU/GY), harness side. • **Is any voltage present?**	**Yes** REPAIR circuit CH207 (BU/GY) or CH208 (GN/OG) for a short to power. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to G5 .
G4 CHECK THE ACTUATOR MOTOR DRIVE CIRCUITS FOR AN OPEN	
NOTE: Due to limited connector accessibility, before carrying out this test step, visually inspect the wiring between the HVAC module and actuator for opens or shorts. If no damage is visually evident, proceed with the test. • Ignition OFF. • Disconnect: HVAC Module - DATC C2356a. • Disconnect: Air Inlet Door Actuator C289. • Measure the resistance between HVAC module - DATC C2356a-15, circuit CH207 (BU/GY), harness side and air inlet mode door actuator C289-6, circuit CH207 (BU/GY), harness side.	**Yes** GO to G13 . **No** REPAIR the circuit(s) for an open. TEST the system for normal operation.

• Measure the resistance between HVAC module - DATC C2356a-16, circuit CH208 (GN/OG), harness side and air inlet mode door actuator C289-5, circuit CH208 (GN/OG), harness side.  N0098169 • **Are the resistances less than 5 ohms?**	
G5 CHECK CIRCUIT CH207 (BU/GY) FOR A SHORT TO CIRCUIT CH208 (GN/OG)	
• Ignition OFF. • Disconnect: Air Inlet Door Actuator C289. • Measure the resistance between HVAC module - DATC C2356a-15, circuit CH207 (BU/GY), harness sidd HVAC module - DATC C2356a-16, circuit CH208 (GN/OG), harness side.  N0086037 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G13 . **No** REPAIR circuit CH208 (GN/OG) for a short to circuit CH207 (BU/GY). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
G6 CHECK CIRCUIT VH438 (GN/VT) FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: HVAC Module - DATC C2356a. • Measure the resistance between ground and HVAC module - DATC C2356a-3, circuit VH438 (GN/VT), harness side.	**Yes** GO to G7 . **No** REPAIR circuit VH438 (GN/VT) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0086038 • **Is the resistance greater than 10,000 ohms?**	
G7 CHECK CIRCUITS RH111 (GY/BU) AND VH438 (GN/VT) FOR A SHORT TOGETHER	
NOTE: Due to limited connector accessibility, before carrying out this test step, visually inspect the wiring between the HVAC module and actuator for opens or shorts. If no damage is visually evident, proceed with the test. • Disconnect: Air Inlet Door Actuator C289. • Measure the resistance between HVAC module - DATC C2356a-10, circuit RH111 (GY/BU), harness side and HVAC module C2356a-3, circuit VH438 (GN/VT), harness side.  N0086039 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G13 . **No** REPAIR circuits VH438 (GN/VT) and RH111 (GY/BU) for a short together. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
G8 CHECK CIRCUIT VH438 (GN/VT) FOR A SHORT TO POWER	
• Ignition OFF. • Disconnect: HVAC Module - DATC C2356a. • Ignition ON. • Measure the voltage between ground and HVAC module - DATC C2356a-3, circuit VH438 (GN/VT), harness side.	**Yes** REPAIR circuit VH438 (GN/VT) for a short to power. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to G9 .

 N0086040 • **Is any voltage present?**	
G9 CHECK CIRCUITS LH111 (BN/WH) AND VH438 (GN/VT) FOR A SHORT TOGETHER	
NOTE: Due to limited connector accessibility, before carrying out this test step, visually inspect the wiring between the HVAC module and actuator for opens or shorts. If no damage is visually evident, proceed with the test. • Disconnect: Air Inlet Door Actuator C289. • Measure the resistance between HVAC module - DATC C2356a-11, circuit LH111 (BN/WH), harness side and HVAC module - DATC C2356a-3, circuit VH438 (GN/VT), harness side.  N0086041 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G10 . **No** REPAIR circuits VH438 (GN/VT) and LH111 (BN/WH) for a short together. CLEAR the DTCs. REPEAT the self-test. TEST thetem for normal operation.
G10 CHECK CIRCUIT VH438 (GN/VT) FOR AN OPEN	
• Measure the resistance between HVAC module - DATC C2356a-3, circuit VH438 (GN/VT), harness side and air inlet door actuator C289-9, circuit VH438 (GN/VT), harness side.  N0098562	**Yes** GO to G11 . **No** REPAIR circuit VH438 (GN/VT) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• **Is the resistance less than 5 ohms?**	
G11 CHECK CIRCUIT LH111 (BN/WH) FOR AN OPEN	
• Measure the resistance between HVAC module - DATC C2356a-11, circuit LH111 (BN/WH), harness side and air inlet door actuator C289-10, circuit LH111 (BN/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to G12 . **No** REPAIR circuit LH111 (BN/WH) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
G12 CHECK THE ACTUATOR RETURN CIRCUIT RH111 (GY/BU) FOR AN OPEN	
• Measure the resistance between HVAC module - DATC C2356a-10, circuit RH111 (GY/BU), harness side and air inlet door actuator C289-8, circuit RH111 (GY/BU), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to G13 . **No** REPAIR circuit RH111 (GY/BU) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
G13 CHECK THE ACTUATOR CONNECTION	
• Inspect the connector for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat the actuator connector. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** CARRY OUT the Air Inlet Mode Door Actuator component test in this section. If the actuator tests OK, GO to G14 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.
G14 MODULE ACTUATOR POSITION CALIBRATION	

NOTE: The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out the calibration, follow the steps below. • Ignition OFF. • Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Ignition ON. • Clear the DTCs. • Select any position except OFF • **NOTE:** The HVAC module will now initialize and calibrate the actuators. Calibration of the actuators will take approximately 30 seconds. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is now operating correctly at this time. The concern may have been caused by a foreign object in the HVAC case or temporary binding that restricted actuator door travel. CHECK any actuator external linkage. If condition recurs, INSPECT actuator linkage and door for binding and CHECK HVAC case for foreign objects.

Pinpoint Test H: Insufficient, Erratic or No Heat

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, warm coolant flows from the engine through the auxiliary coolant flow pump to the heater core and back to the engine. The auxiliary coolant flow pump relay (switch side) is supplied voltage through circuit SBB13 (GY/RD). When the relay is energized by the PCM, the voltage is sent from the relay to the auxiliary coolant flow pump through circuit CHC01 (BN/YE). The auxiliary coolant flow pump is grounded through circuit GD112 (BK/YE). When the HVAC module is ON, a message is sent over the Controller Area Network (CAN) to the PCM. When the PCM receives the message, the PCM energizes the auxiliary coolant flow pump relay.

An auxiliary coolant flow pump is used only on hybrid vehicles to improve engine coolant circulation for heater operation at low engine speeds or when the engine is OFF.

The auxiliary coolant flow pump will be disabled when any of the following conditions are present:

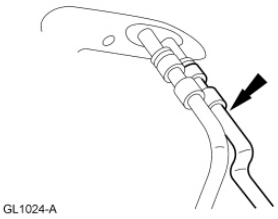
- The climate control module is set to the OFF position.
- The ambient temperature is above 32°C (90°F).
- The coolant temperature is less than -10°C (14°F).
- The engine speed is above 4,000 rpm.

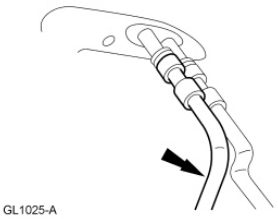
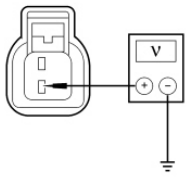
For a complete explanation of the auxiliary coolant flow pump, refer to heating and ventilation in the Description and Operation portion of Section 412-01 .

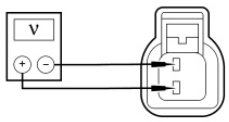
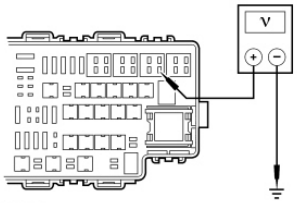
This pinpoint test is intended to diagnose the following:

- Plugged heater core
- Coolant level
- Temperature blend door
- Auxiliary coolant flow pump
- PCM
- HVAC module

PINPOINT TEST H: INSUFFICIENT, ERRATIC OR NO HEAT

Test Step	Result / Action to Take
H1 CHECK FOR CORRECT ENGINE COOLANT LEVEL	
• Ignition OFF. • Check the engine coolant level when hot and cold. • **Is the engine coolant at the correct level (hot/cold) as indicated on the engine coolant recovery reservoir?**	**Yes** GO to H3 . **No** GO to H2 .
H2 CHECK THE ENGINE COOLING SYSTEM FOR LEAKS	
• Pressure test the cooling system for leaks. Refer to Section 303-03A . • **Does the engine cooling system leak?**	**Yes** REPAIR the engine coolant leak. TEST the system for normal operation. **No** FILL and BLEED the cooling system. REFER to Section 303-03A . After filling and bleeding the cooling system, GO to H3 .
H3 CHECK FOR COOLANT FLOW TO THE HEATER CORE	
• Start the engine and let the engine idle until it shuts down automatically, • Select FLOOR mode. • Set the temperature to the warmest setting. • Select the lowest blower motor setting. • Using a suitable temperature measuring device, check the heater core inlet hose to see if it is hot.  GL1024-A • **Is the heater core inlet hose hot?**	**Yes** GO to H4 . **No** GO to H5 .

H4 CHECK FOR A PLUGGED OR RESTRICTED HEATER CORE	
• Using a suitable temperature measuring device, measure the heater core outlet hose temperature.  GL1025-A • **Is the heater core outlet hose temperature similar to the inlet hose temperature (within approximately 6-17°C [10-30°F])?**	**Yes** REFER to Section 412-00A and diagnose for temperature control is inoperative/does not operate correctly. **No** INSTALL a new heater core. TEST the system forormal operation.
H5 CHECK FOR COOLANT FLOW TO THE AUXILIARY COOLANT FLOW PUMP	
• Using a suitable temperature measuring device, check the auxiliary coolant flow pump inlet hose to see if it is hot. • **Is the auxiliary coolant flow pump inlet hose hot?**	**Yes** GO to H6 . **No** REFER to Section 303-03B to check cooling system function.
H6 CHECK CIRCUIT CHC01 (BN/YE) FOR VOLTAGE	
• Ignition OFF. • Disconnect: Auxiliary Coolant Flow Pump C1450. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - PCM. • Toggle the Heater Pump Commanded (HPUMP) output command ON. • Measure the voltage between auxiliary coolant flow pump C1450-2, circuit CHC01 (BN/YE), harness side and ground.  A0034114 • **Is the voltage greater than 10 volts?**	**Yes** GO to H7 . **No** CARRY OUT the auxiliary coolant flow pump relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. If the relay tests OK, GO to H8 .
H7 CHECK CIRCUIT GD121 (BK/YE) FOR GROUND	

• Ignition OFF. • Measure the voltage between auxiliary coolant flow pump C1450-1, circuit GD121 (BK/YE), harness side and auxiliary coolant flow pump C1450-2, circuit CHC01 (BN/YE), harness side.  A0034113 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new auxiliary coolant flow pump. REFER to Section 412-01 . TEST the system for normal operation. **No** REPAIR circuit GD121 (BK/YE) for an open. TEST the system for normal operation.
H8 CHECK THE AUXILIARY COOLANT FLOW PUMP RELAY VOLTAGE SUPPLY	
• Ignition OFF. • Disconnect: Auxiliary Coolant Flow Pump Relay. • Ignition ON. • Measure the voltage between ground and auxiliary coolant flow pump relay socket, circuit SBB13 (GY/RD).  N0098563 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit CHC01 (BN/YE) for an open. TEST the system for normal operation. **No** VERIFY Battery Junction Box (BJB) fuse 13 (15A) is OK. If OK, REPAIR circuit SBB13 (GY/RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

Pinpoint Test I: The Air Conditioning (A/C) is Inoperative

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, for vehicles **equipped** with navigation, when the A/C button is pressed, a message is sent from the Front Controls Interface Module (FCIM) over the Medium Speed Controller Area Network (MS-CAN) bus to the HVAC module. The HVAC module then sends an A/C request message over the MS-CAN bus to the Instrument Cluster (IC), then from the IC through the High Speed Controller Area Network (HS-CAN) bus to the PCM.

For vehicles **equipped** with navigation, when MAX A/C is selected on the touch screen, the Audio Control Module (ACM) sends a message over the MS-CAN bus to the HVAC module that MAX A/C has been

selected.

For vehicles **not equipped** with navigation, when A/C is requested, a message is sent from the HVAC module over the MS-CAN bus to the IC , then from the IC through the HS-CAN bus to the PCM.

When an A/C request is received from the HVAC module, an A/C demand message is sent from the PCM over the HS-CAN bus to the Air Conditioning Compressor Module (ACCM) if all of the following conditions are met:

- The PCM does not detect excessively high or low refrigerant pressure from the A/C pressure transducer.
- The PCM does not detect excessively high engine coolant temperature.
- The PCM does not detect an ambient air temperature below -1°C (30°F).
- The PCM has not detected a Wide Open Throttle (WOT) condition.
- The HVAC module does not detect an evaporator discharge air temperature below 2°C (36°F).

When the ACCM receives the A/C demand message, it will engage. Instead of cycling ON and OFF like a traditional A/C compressor, the PCM monitors the evaporator discharge temperature from the HVAC module to raise or lower the electric A/C compressor speed as required.

This pinpoint test is intended to diagnose the following:

- HVAC module
- PCM
- FCIM
- ACM
- Electric A/C compressor
- A/C evaporator discharge temperature sensor
- A/C pressure transducer

PINPOINT TEST I: THE AIR CONDITIONING (A/C) IS INOPERATIVE

NOTE: Diagnose any PCM, HVAC module or ACCM DTCs before carrying out the following pinpoint test.

NOTE: Before carrying out the following test, check that the A/C system pressure is above 290 kPa (42 psi). If the pressure is below 290 kPa (42 psi), refer to Section 412-00A in this section.

Test Step	Result / Action to Take
I1 CHECK THE A/C PRESSURE SENSOR (ACP_PRESS) PCM PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: ACP_PRESS PCM PID. • With the manifold gauge set connected, compare the pressure readings of the manifold gauge set and the ACP_PRESS PID. • **Are the pressure values of the manifold gauge set and the ACP_PRESS PID similar?**	**Yes** GO to I2 . **No** INSTALL a new A/C pressure transducer. TEST the system for normal operation.
I2 CHECK THE A/C EVAPORATOR TEMPERATURE (EVAP_TEMP) HVAC PID	
• Allow the vehicle exterior and interior to stabilize to an	**Yes** For vehicles **not equipped** with

ambient temperature. • Enter the following diagnostic mode on the scan tool: EVAP_TEMP HVAC PID. • **Does the EVAP_TEMP HVAC PID read similar to the ambient temperature?**	navigation, GO to I3 . For vehicles **equipped** with navigation, GO to I4 . **No** INSTALL a new A/C evaporator discharge temperature sensor. TEST the system for normal operation.
I3 CHECK THE (A/C) SWITCH (CC_SW_AC) HVAC PID WITH THE A/C ON	
• Start the engine. • Enter the following diagnostic mode on the scan tool: CC_SW_AC HVAC PID. • Select PANEL and press the A/C button (indicator OFF). • **Does the CC_SW_AC HVAC PID read Active?**	**Yes** GO to I5 . **No** GO to I6 .
I4 CHECK THE (A/C) SWITCH (CC_SW_AC) FCIM PID WITH THE A/C ON	
NOTE: Before carrying out this test step, be sure all other FCIM button functions are operational. If all other buttons operate correctly, continue with this test step. If multiple buttons are inoperative and DTC U0256:00 is not present, install a new FCIM . Test the system for normal operation. If DTC U0256:00 is present, diagnose the DTC first. • Start the engine. • Enter the following diagnostic mode on the scan tool: CC_SW_AC FCIM PID. • Select PANEL and press the A/C button (indicator on). • **Does the CC_SW_AC FCIM PID read Active?**	**Yes** GO to I5 . **No** INSTALL a new FCIM . REFER to Section 415-00 . TEST the system for normal operation.
I5 CHECK THE AIR CONDITIONING COMPRESSOR COMMANDED STATE (ACC_CMD) PCM PID WITH THE A/C ON	
• Enter the following diagnostic mode on the scan tool: ACC_CMD PCM PID. • **Does the ACC_CMD PCM PID read ON?**	**Yes** GO to I8 . **No** GO to I7 .
I6 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused

	by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
I7 CHECK THE PCM CONNECTION	
• Clear the DTCs. • Disconnect all of the PCM connectors. • Check for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all of the PCM connectors. • Operate the system. • **Does the concern return?**	**Yes** INSTALL a new PCM. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
I8 CHECK ACCM OPERATING CONDITIONS	
• Make sure the following conditions are met: ♦ The PCM does not detect excessively high or low refrigerant pressure from the A/C pressure transducer. ♦ The PCM does not detect excessively high engine coolant temperature. ♦ The PCM does not detect an ambient air temperature below -1°C (30°F). ♦ The PCM has not detected a Wide Open Throttle (WOT) condition. ♦ The HVAC module does not detect an evaporator discharge air temperature below 2°C (36°F). • Start the engine. • Select PANEL and press the A/C button (indicator on). • **Does the A/C operate?**	**Yes** The system is operating correctly at this time. The concern may have been caused by attempting to operate the A/C outside of operating conditions. **No** INSTALL a new electric A/C compressor. REFER to Section 412-01 . TEST the system for normal operation.

Pinpoint Test J: The Air Conditioning (A/C) is Always On

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, for vehicles **equipped** with navigation, when the A/C button is pressed, a message is sent from the Front Controls Interface Module (FCIM) over the Medium Speed Controller Area Network (MS-CAN) bus to the HVAC module. The HVAC module then sends an A/C request message over the MS-CAN bus to the Instrument Cluster (IC), then from the IC through the High Speed Controller Area Network (HS-CAN) bus to the PCM.

For vehicles **equipped** with navigation, when MAX A/C is selected on the touch screen, the Audio Control Module (ACM) sends a message over the MS-CAN bus to the HVAC module that MAX A/C has been selected.

For vehicles **not equipped** with navigation, when A/C is requested, a message is sent from the HVAC module

over the MS-CAN bus to the IC , then from the IC through the HS-CAN bus to the PCM.

When an A/C request is received from the HVAC module, an A/C demand message is sent from the PCM over the HS-CAN bus to the Air Conditioning Compressor Module (ACCM) if all of the following conditions are met:

- The PCM does not detect excessively high or low refrigerant pressure from the A/C pressure transducer.
- The PCM does not detect excessively high engine coolant temperature.
- The PCM does not detect an ambient air temperature below -1°C (30°F).
- The PCM has not detected a Wide Open Throttle (WOT) condition.
- The HVAC module does not detect an evaporator discharge air temperature below 2°C (36°F).

When the ACCM receives the A/C demand message, it will engage. Instead of cycling ON and OFF like a traditional A/C compressor, the PCM monitors the evaporator discharge temperature from the HVAC module to raise or lower the electric A/C compressor speed as required.

This pinpoint test is intended to diagnose the following:

- HVAC module
- FCIM
- ACM
- Electric A/C compressor
- A/C evaporator discharge temperature sensor
- A/C pressure transducer

PINPOINT TEST J: THE AIR CONDITIONING (A/C) IS ALWAYS ON

NOTE: Diagnose any PCM, HVAC module or ACCM DTCs before carrying out the following pinpoint test.

Test Step	Result / Action to Take
J1 CHECK THE A/C EVAPORATOR TEMPERATURE (EVAP_TEMP) HVAC PID	
• Allow the vehicle exterior and interior to stabilize to an ambient temperature. • Ignition ON. • Enter the following diagnostic mode on the scan tool: EVAP_TEMP HVAC PID. • **Does the EVAP_TEMP HVAC PID read similar to the ambient temperature?**	**Yes** For vehicles **not equipped** with navigation, GO to J2 . For vehicles **equipped** with navigation, GO to J3 . **No** INSTALL a new A/C evaporator discharge temperature sensor. TEST the system for normal operation.
J2 CHECK THE (A/C) SWITCH (CC_SW_AC) HVAC PID WITH THE A/C OFF	
• Start the engine. • Enter the following diagnostic mode on the scan tool: CC_SW_AC HVAC PID. • Select PANEL and make sure the A/C indicator is OFF.	**Yes** GO to J4 . **No** INSTALL a new HVAC

• **Does the CC_SW_AC HVAC PID read Inactive?**	module. REFER to Section 412-01 . TEST the system for normal operation.
J3 CHECK THE (A/C) SWITCH (CC_SW_AC) FCIM PID WITH THE A/C OFF	
NOTE: Before carrying out this test step, be sure all other FCIM button functions are functioning correctly. If all other buttons operate correctly, continue with this test step. If multiple buttons are incorrectly functioning and DTC U0256:00 is not present, install a new FCIM . Test the system for normal operation. If DTC U0256:00 is present, diagnose the DTC first. • Start the engine. • Enter the following diagnostic mode on the scan tool: CC_SW_AC FCIM PID. • Select PANEL and make sure the A/C indicator is OFF. • **Does the CC_SW_AC FCIM PID read Inactive?**	**Yes** GO to J4 . **No** INSTALL a new FCIM . REFER to Section 415-00 . TEST the system for normal operation.
J4 CHECK THE AIR CONDITIONING COMPRESSOR COMMANDED STATE (ACC_CMD) PCM PID WITH THE A/C OFF	
• Enter the following diagnostic mode on the scan tool: ACC_CMD PCM PID. • Select PANEL and make sure the A/C indicator is OFF. • **Does the ACC_CMD PCM PID read OFF?**	**Yes** INSTALL a new electric A/C compressor. REFER to Section 412-01 . TEST the system for normal operation. **No** INSTALL a new PCM. TEST the system for normal operation.

Pinpoint Test K: The Blower Motor is Inoperative

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, the blower motor relay coil receives a ground from the HVAC module through circuit CH123 (VT/GN). The coil receives ignition voltage through circuit CBP45 (YE). Voltage is supplied to the relay switch contact through circuit SBB35 (BU/RD). When the relay coil is energized, voltage is delivered to the blower motor speed control through circuit CH402 (YE/GN). Ground for the blower motor speed control is provided by circuit GD115 (BK/GY). Voltage for the motor is provided through circuit VH301 (YE/BU) from the blower motor speed control. Ground for the motor is provided through circuit VH219 (GY) from the blower motor speed control. The HVAC module sends a Pulse-Width Modulation (PWM) signal to the blower motor speed control through circuit VH101 (WH/VT) to control the blower speed.

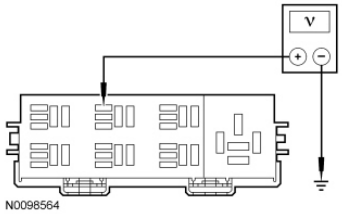
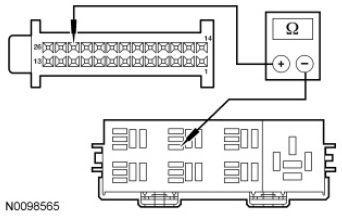
DTC Description	Fault Trigger Conditions
• B10AF:12 - Blower Fan Relay: Circuit Short to Battery	The module senses excessive voltage on the relay coil ground circuit, indicating a short directly to voltage.
• B10AF:14 - Blower Fan Relay: Circuit Short to Ground or Open	The module senses no voltage on the relay coil ground circuit, indicating an open or a short directly to ground.
• B10B9:12 - Blower Control: Circuit Short to Battery	The module senses excessive voltage on the blower motor control PWM circuit, indicating a short directly to voltage.
• B10B9:14 - Blower Control: Circuit Short to Ground or Open	The module senses no voltage on the blower motor control PWM circuit, indicating an open or a short directly to ground.

This pinpoint test is intended to diagnose the following:

- Fuse(s)
- Wiring, terminals or connectors
- Blower motor relay
- Blower motor speed control
- HVAC module - Dual Automatic Temperature Control (DATC)
- Blower motor

PINPOINT TEST K: THE BLOWER MOTOR IS INOPERATIVE

Test Step	Result / Action to Take
K1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** **For DTC B10AF:12** , REPAIR circuit CH123 (VT/GN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For DTC B10AF:14** , CARRY OUT the Blower Motor Relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. If the relay tests OK, GO to K2 . **For DTC B10B9:14** , GO to K4 . **For DTC B10B9:12,** REPAIR circuit VH101 (VT/WH) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

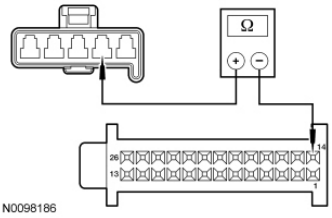
	No GO to K6 .
K2 CHECK THE RELAY COIL SUPPLY VOLTAGE	
• Ignition OFF. • Disconnect: Blower Motor Relay. • Ignition ON. • Measure the voltage between blower motor relay socket pin 1, circuit CBP45 (YE) and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to K3 . **No** VERIFY Smart Junction Box (SJB) fuse 45 (5A) is OK. If OK, REPAIR circuit CBP45 (YE) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
K3 CHECK CIRCUIT CH123 (VT/GN) FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module - DATC C2356a. • Measure the resistance between blower motor relay socket pin 2, circuit CH123 (VT/GN) and HVAC module - DATC C2356a-24, circuit CH123 (VT/GN), harness side.  • **Is the resistance less than 5 ohms?**	**Yes K17**

.

No
REPAIR circuit CH123 (VT/GN) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **K4 CHECK CIRCUIT VH101 (WH/VT) FOR AN OPEN**

- Ignition OFF.
- Disconnect: Blower Motor Speed Control C271.
- Disconnect: HVAC Module - DATC C2356a.

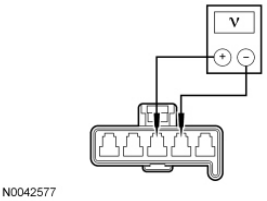
- Measure the resistance between blower motor control C271-B, circuit VH101 (WH/VT), harness side and HVAC module - DATC C2356a-14, circuit VH101 (WH/VT), harness side.



- **Is the resistance less than 5 ohms?**

Yes
GO to K5 .
No
REPAIR circuit VH101 (WH/VT) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **K5 CHECK CIRCUIT VH101 (WH/VT) FOR GROUND SIGNAL**

- Connect: HVAC Module - DATC C2356a.
- Ignition ON.
- Press the PANEL button on the HVAC module. Adjust the blower motor setting to HI.
- Measure the voltage between blower motor speed control C271-B, circuit VH101 (WH/VT), harness side and blower motor speed control C271-C, circuit CH402 (YE/GN), harness side.

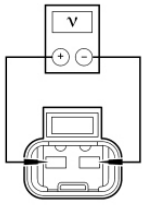


- **Is the voltage greater than 10 volts?**

Yes
GO to K16 .

No
GO to K17 . **K6 CHECK FOR VOLTAGE TO THE BLOWER MOTOR**

- Ignition OFF.
- Disconnect: Blower Motor C288.
- Ignition ON.
- Measure the voltage between blower motor C288-A, circuit VH219 (GY), harness side and blower motor C288-B, circuit VH301 (YE/BU), harness side.



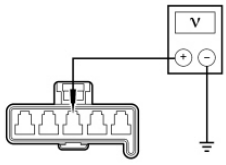
N0042576

- **Is the voltage greater than 10 volts?**

Yes
INSTALL a new blower motor. TEST the system for normal operation.

No
GO to K7 . **K7 CHECK FOR VOLTAGE TO THE BLOWER MOTOR CONTROLLER**

- Ignition OFF.
- Disconnect: Blower Motor Speed Control C271.
- Ignition ON.
- Press the PANEL button on the HVAC module.
- Measure the voltage between blower motor speed control C271-C, circuit CH402 (YE/GN), harness side and ground.



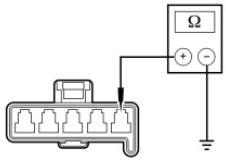
N0041919

- **Is the voltage greater than 10 volts?**

Yes
GO to K8 .

No
GO to K14 . **K8 CHECK CIRCUIT GD115 (BK/GY) FOR AN OPEN**

- Ignition OFF.
- Measure the resistance between blower motor speed control C271-A, circuit GD115 (BK/GY), harness side and ground.



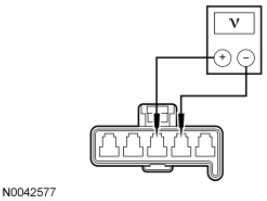
N0041918

- **Is the resistance less than 5 ohms?**

Yes
GO to K9 .

No
REPAIR circuit GD115 (BK/GY) for an open. TEST the system for normal operation. **K9 CHECK CIRCUIT VH101 (WH/VT) FOR GROUND SIGNAL**

- Ignition ON.
- Press the PANEL button on the HVAC module. Adjust the blower motor setting to HI.
- Measure the voltage between blower motor speed control C271-B, circuit VH101 (WH/VT), harness side and blower motor speed control C271-C, circuit CH402 (YE/GN), harness side.



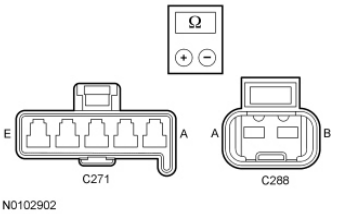
- **Is the voltage greater than 10 volts?**

Yes
GO to K10 .

No
GO to K17 . **K10 CHECK CIRCUITS VH219 (GY) AND VH301 (YE/BU) FOR AN OPEN**

- Measure the resistance between the blower motor connector, harness side and blower motor speed control, harness side using the following chart.

Blower Motor Connector	Circuit	Blower Motor Speed Control Connector
C288-A	VH219 (GY)	C271-E
C288-B	VH301 (YE/BU)	C271-D

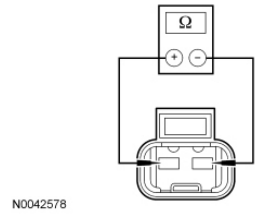


- **Are the resistances less than 5 ohms?**

Yes
GO to K11 .

No
REPAIR circuit VH219 (GY) or VH301 (YE/BU) for an open. TEST the system for normal operation. **K11 CHECK CIRCUITS VH219 (GY) AND VH301 (YE/BU) FOR A SHORT TOGETHER**

- Measure the resistance between blower motor C288-A, circuit VH219 (GY), harness side and blower motor C288-B, circuit VH301 (YE/BU), harness side.

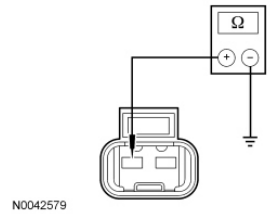


- **Is the resistance greater than 10,000 ohms?**

Yes
GO to K12 .

No
REPAIR circuits VH219 (GY) and VH301 (YE/BU) for a short together. TEST the system for normal operation. **K12 CHECK CIRCUIT VH219 (GY) FOR A SHORT TO GROUND**

- Measure the resistance between ground and blower motor C288-A, circuit VH219 (GY), harness side.

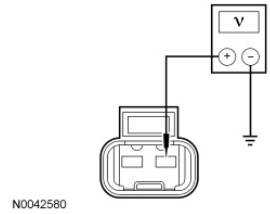


- **Is the resistance greater than 10,000 ohms?**

Yes
GO to K13 .

No
REPAIR circuit VH219 (GY) for a short to ground. TEST the system for normal operation. **K13 CHECK CIRCUIT VH301 (YE/BU) FOR A SHORT TO VOLTAGE**

- Ignition ON.
- Measure the voltage between ground and blower motor C288-B, circuit VH301 (YE/BU), harness side.

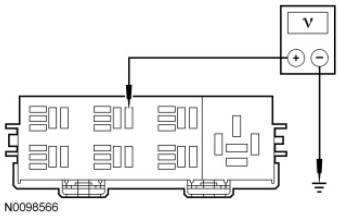


- **Is any voltage present?**

Yes
REPAIR circuit VH301 (YE/BU) for a short to voltage. TEST the system for normal operation.

No
GO to K16 . **K14 CHECK THE RELAY SWITCH POWER CIRCUIT FOR AN OPEN**

- Measure the voltage between blower motor relay socket pin 3, circuit SBB35 (BU/RD) and ground.



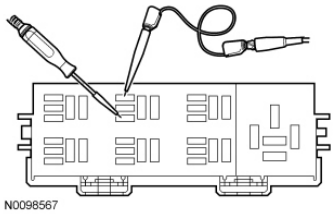
- **Is the voltage greater than 10 volts?**

Yes
GO to K15 .

No
VERIFY Battery Junction Box (BJB) fuse 35 (40A) is OK. If OK, REPAIR circuit SBB35 (BU/RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. **K15 CHECK THE MODULE OUTPUT**

> ***NOTICE:*** **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section or equivalent. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.**

- Ignition ON.
- With the engine running, connect a 12-volt test lamp between blower motor relay socket pin 2, circuit CH123 (VT/GN) and socket pin 1, circuit CBP45 (YE).



- **Does the test lamp illuminate?**

Yes
CARRY OUT the blower motor relay component test.

Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing.

If the relay tests OK, REPAIR circuit CH402 (YE/GN) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No

GO to K17 . **K16 CHECK THE BLOWER MOTOR SPEED CONTROL CONNECTION**

- Clear the DTCs.
- Disconnect the blower motor speed control connector.
- Check for:
  - ♦ corrosion.
  - ♦ pushed-out terminals.
  - ♦ damaged terminals.
- Connect and correctly seat the connector.
- Carry out the HVAC On-Demand Self Test.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new blower motor speed control. REFER to Section 412-01 . CLEAR the DTCs. TEST the system for normal operation.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation. **K17 CHECK THE MODULE CONNECTION**

- Inspect the module connectors for:
  - ♦ corrosion.
  - ♦ pushed-out terminals.
  - ♦ damaged terminals.
- Connect and correctly seat all the HVAC module connectors.
- Clear the DTCs.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test L: The Blower Motor Does Not Operate Correctly - DATC

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

Under normal operation, the blower motor relay coil receives a ground from the HVAC module through circuit CH123 (VT/GN). The coil receives ignition voltage through circuit CBP45 (YE). Voltage is supplied to the relay switch contact through circuit SBB06 (BN/RD). When the relay coil is energized, voltage is delivered to the blower motor speed control through circuit CH402 (YE/GN). Ground for the blower motor speed control is provided by circuit GD115 (BK/GY). Voltage for the motor is provided through circuit VH301 (YE/BU) from the blower motor speed control. Ground for the motor is provided through circuit VH219 (GY) from the blower motor speed control. The HVAC module sends a Pulse-Width Modulation (PWM) signal to the blower motor speed control through circuit VH101 (WH/VT) to control the blower speed.

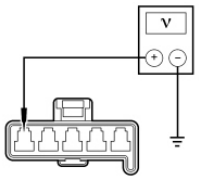
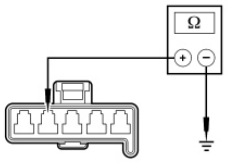
- DTC B10AF:14 (Blower Fan Relay: Circuit Short to Ground or Open) - The module senses no voltage on the relay coil ground circuit, indicating an open or a short directly to ground.
- DTC B10B9:14 (Blower Control: Circuit Short to Ground or Open) - The module senses no voltage on the blower motor control PWM circuit, indicating an open or a short directly round.

This pinpoint test is intended to diagnose the following:

- Fuse(s)
- Wiring, terminals or connectors
- Blower motor speed control
- HVAC module - Dual Automatic Temperature Control (DATC)

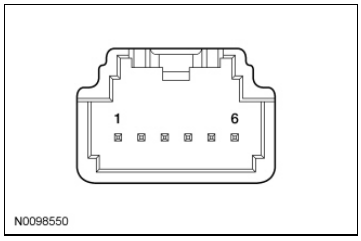
PINPOINT TEST L: THE BLOWER MOTOR DOES NOT OPERATE CORRECTLY - DATC

Test Step	Result / Action to Take
L1 CHECK THE HVAC MODULE FOR DTCs	
• Ignition ON. • Check the HVAC module for DTCs. • **Are any DTCs present?**	**Yes** **For DTC B10AF:14** , REPAIR circuit CH123 (VT/GN) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **For DTC B10B9:14** , REPAIR circuit VH101 (WH/VT) for a short to ground. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to L2 .
L2 VERIFY THE BLOWER MOTOR OPERATION	
• Ignition ON. • Press the panel button on the HVAC module. Adjust the blower motor setting to LO and then to HI. • **Does the blower motor operate at any setting?**	If the blower motor operates always in HI, GO to L4 . If the blower motor is always ON, CARRY OUT the blower motor relay component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. If the relay tests OK, GO to L3 . **No** GO to Pinpoint Test K .
L3 CHECK CIRCUIT VH301 (YE/BU) FOR A SHORT TO VOLTAGE	

• Ignition OFF. • Disconnect: Blower Motor Speed Control C271. • Disconnect: Blower Motor C288. • Ignition ON. • Measure the voltage between ground and blower motor speed control C271-E, circuit VH301 (YE/BU), harness side.  N0042582 • **Is any voltage present?**	**Yes** REPAIR circuit VH301 (YE/BU) for a short to voltage. TEST the system for normal operation. **No** GO to L5 .
L4 CHECK CIRCUIT VH219 (GY) FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between ground and blower motor speed control C271-D, circuit VH219 (GY), harness side.  N0098188 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new blower control. TEST the system for normal operation. If the condition returns, GO to L5 . **No** REPAIR circuit VH219 (GY) for a short to voltage. TEST the system for normal operation.
L5 CHECK THE MODULE CONNECTION	
• Inspect the module connectors for: ♦ corrosion. ♦ pushed-out terminals. ♦ damaged terminals. • Connect and correctly seat all the HVAC module connectors. • Clear the DTCs. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Component Tests

Temperature Sensor - In-Vehicle



Ambient Temperature	Resistance Between Pins 2 and 5
-40°C (-40°F)	869,073-1,061,986 ohms
-15°C (5°F)	196,465-231,213 ohms
0°C (32°F)	89,982-102,514 ohms
15°C (59°F)	44,261-49,503 ohms
25°C (77°F)	28,500-31,500 ohms
35°C (95°F)	18,563-20,751 ohms
60°C (140°F)	6,971-8,001 ohms
85°C (185°F)	2,959-3,474 ohms

Air Inlet Mode Door Actuator

Actuator PinsApprox. Resistance8 and 108,000-12,000 ohms8 and 91-10,000 ohms9 and 101-10,000 ohms51 and 671-85 ohms

General Specifications

Item	Specification
A/C Compressor Oil	
NOTICE: Use of any A/C compressor oil other than what is specified for the specific vehicle configuration will damage the A/C compressor and contaminate the refrigerant system. For non-hybrid vehicles with a pulley driven (conventional) A/C compressor, PAG Refrigerant Compressor Oil only must be used. For hybrid vehicles with an electric A/C compressor, Motorcraft® Electric A/C Compressor Oil must be used.	

Material

Item	Specification	Fill Capacity
Motorcraft® Electric A/C Compressor Oil YN-32	-	Hybrid vehicles only 130 ml (4.4 fl oz)
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B	Non-hybrid vehicles only 177 ml (6 fl oz)

Motorcraft® R-134a Refrigerant YN-19 (US); CYN-16-R (Canada)	WSH-M17B19-A	0.62 kg (22 oz) (1.38 lb)

General Specifications

Item	Specification
Magnetic Clutch	
Air gap between pulley and clutch disc	0.3-0.6 mm (0.012-0.024 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolts	25	18	-
A/C compressor bracket bolts	25	18	-
A/C compressor clutch disc and hub bolt	14	-	124
A/C compressor discharge fitting nut (hybrid)	15	133	
A/C compressor manifold bolt	15	-	133
A/C compressor nut	25	18	-
A/C compressor stud	9	-	80
A/C compressor suction fitting nut (hybrid)	15	-	133
A/C pressure relief valve	10	-	89
A/C pressure transducer	10	-	89
Auxiliary coolant flow pump bracket bolts	25	18	-
Compressor manifold and tube suction fitting nut	15	-	133
Condenser fitting nut (inlet and outlet)	15	-	133
Condenser-to-evaporator line fitting nut	15	-	
Evaporator outlet line fitting nut	15	-	133
Evaporator-to-compressor suction line bracket bolt	6	-	53
Heater core and evaporator core housing nuts	9	-	80
High-pressure Schrader-type valve	2.5	-	22
High-pressure service gauge port valve cap	0.8	-	7
Low-pressure Schrader-type valve	1.8	-	16
Low-pressure service gauge port valve cap	0.8	-	7
Radiator bracket bolts	10	-	89
Thermostatic Expansion Valve (TXV) fitting nut	15	-	133
manifold and tube bracket bolt	8	-	71
Washer reservoir filler neck bolt	6	-	53

Air Conditioning

The refrigerant system components include the following:

- Pulley-driven A/C compressor (non-hybrid)
- Electric A/C compressor (hybrid)
- A/C clutch assembly (non-hybrid)
- A/C condenser core
- A/C evaporator core
- Receiver/drier cartridge
- Connecting refrigerant lines
- Thermostatic Expansion Valve (TXV)

The refrigerant system incorporates an A/C compressor controlled by the PCM through an A/C clutch relay. The HVAC module sends an A/C request signal to the Instrument Cluster (IC), which relays the request to the PCM. An evaporator discharge air temperature sensor is used to disengage the A/C compressor clutch when the evaporator core temperature falls below an acceptable temperature.

The A/C compressor clutch will only be engaged by the PCM if all of the following conditions are met:

- The HVAC module is set to a mode which provides an A/C request to the PCM via the IC .
- The evaporator discharge air temperature sensor is reading an acceptable temperature.
- The A/C pressure transducer is reading an acceptable pressure in the high side of the refrigerant system.
- The A/C compressor relay is switched to the closed position by the PCM.
- The engine coolant temperature is not excessively high.
- The PCM has not detected a Wide Open Throttle (WOT) condition.

NOTE: To prevent erroneous readings that can result from underhood heat sources, the PCM uses data from several sources to calculate ambient temperature. The vehicle must be driven for a sufficient time, speed and distance after startup before the calculated ambient temperature is updated in the PCM. If a vehicle is moved from a below-freezing environment to a warm environment (such as being moved from outside into a garage or when delivered from a cold climate to a warm climate), the minimal amount of driving may not be sufficient for the calculated ambient temperature to be updated. In this event, the PCM will believe the ambient temperature is too low for A/C operation and, to prevent an increased risk of compressor slugging or damage, will not engage the A/C compressor in any mode. To manually reset the PCM calculated ambient temperature to the current temperature, run the vehicle until the thermostat opens and then clear the PCM Keep Alive Memory (KAM). For the KAM resetting procedure, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual. When the PCM KAM is reset, the ambient temperature will reset to the current higher value (a value closer to actual surrounding conditions) and the A/C compressor will operate normally.

An A/C pressure relief valve is installed in the A/C compressor to protect the refrigerant system against excessively high refrigerant pressures.

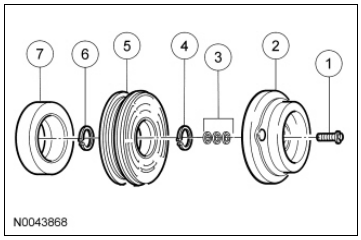
Refrigerant flow into the evaporator core is metered by a TXV .

A/C Compressor and Clutch Assembly - Non-Hybrid

NOTE: Internal A/C compressor components are not serviced separately. The A/C compressor is serviced only as an assembly. The clutch disc and hub, A/C compressor pulley and bearing and clutch field coil are serviceable.

The A/C compressor has the following characteristics:

- A non-serviceable shaft seal
- A pressure relief valve is installed in the rear of the compressor to protect the refrigerant system against excessively high refrigerant pressures
- The A/C compressor uses PAG oil or equivalent. This oil contains special additives required for the A/C compressor
- The A/C compressor oil may have some slightly dark-colored streaks while maintaining normal oil viscosity. This is normal for this A/C compressor because of break-in wear that can discolor the oil
- Use standard oil matching procedures when installing new compressors



Item	Part Number	Description
1	W712303	A/C clutch disc and hub bolt
2	19D786	A/C clutch disc and hub
3	19D648	A/C clutch disc and hub spacers
4	W712302	A/C compressor pulley snap ring
5	19D784	A/C compressor pulley
6	W712301	A/C clutch field coil snap ring
7	1998	A/C clutch field coil

When battery voltage is applied to the A/C compressor clutch field coil, the clutch plate and hub assembly is drawn toward the A/C clutch pulley. The magnetic force locks the clutch plate and hub assembly and the A/C clutch pulley together as one unit, causing the compressor shaft to rotate. When battery voltage is removed from the A/C compressor clutch field coil, springs in the clutch plate and hub assembly move the clutch plate away from the A/C clutch pulley.

Electric A/C Compressor - Hybrid

NOTICE: **Motorcraft® Electric Compressor Oil YN-32 only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric Compressor Oil YN-32 to the refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. For the Refrigerant Oil Adding procedure, refer to Section 412-00A .**

Hybrid vehicles are equipped with a variable-speed electric A/C compressor that is powered by the high-voltage traction battery system. The electric A/C compressor allows for A/C operation to continue even when the vehicle is in full electric mode and the gasoline engine is not running. The Air Conditioning Compressor Module (ACCM) is an integral part of the electric A/C compressor and cannot be removed from the compressor.

A/C Pressure Relief Valve

NOTE: If the A/C compressor is operating within limits and the A/C pressure relief valve is venting, or if the A/C pressrelief valve is leaking around the threads, replace the A/C pressure relief valve and O-ring. If the A/C pressure relief valve still vents after it is replaced, diagnose the refrigerant system for a restriction.

An A/C pressure relief valve is incorporated in the A/C compressor to prevent damage to the A/C compressor and other system components by relieving unusually high system discharge pressure buildups. For specifications regarding operating pressure(s), refer to Section 412-00A .

The A/C pressure relief valve is a separate component and can be replaced separately from the A/C compressor. It is necessary to recover the refrigerant before removing the A/C pressure relief valve.

A/C Condenser

The A/C condenser is an aluminum fin-and-tube design heat exchanger located in front of the vehicle radiator. It cools compressed refrigerant gas by allowing air to pass over fins and tubes to extract heat and by condensing gas to liquid refrigerant as it is cooled.

The receiver/drier is incorporated onto the LH side of the condenser core. The receiver/drier (desiccant) cartridge is a separate component and can be removed and installed separately from the condenser core.

On 3.5L vehicles only, the top portion of the condenser/power steering combo cooler is partitioned from the refrigerant system and is used for power steering fluid cooling.

Receiver/Drier Cartridge

NOTE: Installation of a new receiver/drier cartridge is not required when repairing the A/C system, except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier cartridge. Damage to the receiver/drier cartridge includes physical damage or moisture contamination. Moisture contamination results only from a complete loss of refrigerant, and equalization of the refrigerant system pressure with atmospheric pressure for a period longer than one hour. If even a slight amount of positive refrigerant pressure is present in the refrigerant system before repairs are carried out, the receiver/drier cartridge does not need to be replaced.

The receiver/drier is integral to the A/C condenser. It stores high-pressure liquid after it leaves the condenser core. A receiver/drier (desiccant) cartridge mounted inside the receiver/drier removes any retained moisture from the refrigerant. The receiver/drier cartridge is a separate component and can be removed and installed separately from the A/C condenser.

Evaporator Core

The evaporator core is an aluminum plate/fin type and is located in the heater core and evaporator core housing. A mixture of refrigerant and oil enters the bottom of the evaporator core through the evaporator core inlet tube and continues out of the evaporator core through the evaporator core outlet tube as a vapor. Air from the blower motor is cooled and dehumidified as it flows through the evaporator core fins.

Thermostatic Expansion Valve (TXV)

The TXV is located between the evaporator core inlet and outlet tubes and the TXV manifold and tube

assembly at the rear of the engine compartment. The TXV provides a restriction to the flow of refrigerant from the high-pressure side of the refrigerant system and separates the low-pressure and high-pressure sides of the refrigerant system. Refrigerant entering and exiting the evaporator core passes through the TXV through 2 separate flow paths. An internal temperature sensing bulb senses the temperature of the refrigerant flowing out of the evaporator core and adjusts an internal pin-type valve to meter the refrigerant flow into the evaporator core. The internal pin-type valve decreases the amount of refrigerant entering the evaporator core at lower temperatures and increases the amount of refrigerant entering the evaporator core at higher temperatures.

Evaporator Discharge Air Temperature Sensor

The evaporator discharge air temperature sensor contains a thermistor which receives a reference voltage from the PCM. The thermistor then varies the resistance to the reference voltage based on the evaporator discharge air temperature. The resulting voltage is returned to the PCM where it is interpreted as an evaporator discharge air temperature reading.

The PCM maintains evaporator core temperature and prevents icing of the evaporator core, by disengaging the A/C compressor clutch (non-hybrid) or decreasing the electric A/C compressor speed (hybrid) when the evaporator discharge air temperature sensor reading falls below acceptable levels, and by engaging the A/C compressor clutch (non-hybrid) or increasing the electric A/C compressor speed (hybrid) when the discharge air temperature rises above acceptable levels.

The evaporator discharge air temperature sensor is located inside of the heater core and evaporator core housing in the air-stream leaving the evaporator core.

A/C Pressure Transducer

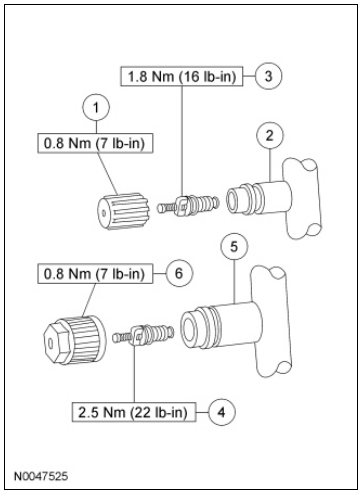
The A/C pressure transducer monitors the compressor discharge pressure and sends a variable voltage signal representing the pressure to the PCM. The PCM will interrupt A/C compressor operation (non-hybrid), or decrease the electric A/C compressor speed (hybrid) in the event that the A/C pressure transducer indicates high system discharge pressures. It is also used to sense low charge conditions. If the pressure is below a predetermined value for a given ambient temperature, the PCM will not allow the A/C compressor to operate.

The A/C pressure transducer is located on the high-pressure side of the TXV manifold and tube assembly near the TXV fitting.

Service Gauge Port Valves

The high-pressure service gauge port valve is located on the condenser-to-evaporator line.

The low-pressure service gauge port valve is located on the TXV manifold and tube assembly.



Item	Part Number	Description
1	19D702	Low-pressure service gauge port valve cap
2	-	Low-pressure service gauge port valve
3	19D701	Low-pressure Schrader-type valve
4	19D701	High-pressure Schrader-type valve
5	-	High-pressure service gauge port valve
6	19D702	High-pressure service gauge port valve cap

The fitting is an integral part of the refrigeration line or component.

- Special couplings are required for both the high-side and low-side service gauge ports.
- A very small amount of leakage will always be detectable around the Schrader-type valve with the service gauge port valve cap removed, and is considered normal. A new Schrader-type valve core can be installed if the seal leaks excessively.
- The service gauge port valve caps are used as primary seals in the refrigerant system to prevent leakage through the Schrader-type valves from reaching the atmosphere. Always install and tighten the A/C service gauge port valve caps to the correct torque after they are removed.

Refrigerant System Dye

NOTICE: **Fluorescent refrigerant system dye mixed with PAG oil should never be added to hybrid vehicle Air Conditioning (A/C) systems equipped with an electric A/C compressor. Addition of fluorescent refrigerant system dye containing PAG oil will damage the electric A/C compressor and contaminate the refrigerant system.**

Fluorescent refrigerant system dye is added to the refrigerant system at the factory to assist in refrigerant system leak diagnosis using a Rotunda-approved UV blacklight. It is not necessary to add additional dy the refrigerant system before diagnosing leaks, even if a significant amount of refrigerant has been removed from the system. Additional refrigerant system dye should only be added if more than 50% of the refrigerant system lubricant capacity has been lost due to a fitting separation or hose rupture. Refer to Section 412-00A .

For hybrid vehicles equipped with an electric compressor, additional refrigerant system dye should only be added by installing a new receiver/drier cartridge. Replacement receiver/drier cartridges include a fluorescent dye "wafer" which will dissolve after approximately one hour of continued A/C operation. Fluorescent refrigerant system dye mixed with PAG oil should never be used in hybrid vehicles with an electric A/C compressor.

Air Distribution and Filtering

NOTE: This vehicle is equipped from the factory with a cabin air filter. For filter maintenance intervals, refer to Section 100-03 .

There are 2 sources of air available to the air distribution system:

- Outside air
- Recirculated air

Recirculated air is always used when the HVAC module is set to the MAX A/C mode on vehicles equipped with Electronic Manual Temperature Control (EMTC). Vehicles equipped with Electronic Automatic Temperature Control (EATC) use recirculated air when the RECIRC function is selected in any mode other than DEFROST, or when required by the HVAC module in the AUTOMATIC mode. On hybrid vehicles only, the air inlet door may stop in a mid-position if required for increased cooling performance as determined by the HVAC module.

Air distribution within the vehicle is determined by the EMTC system settings or the EATC system in the AUTOMATIC mode. The air distribution mode on vehicles equipped with EATC can be overridden by the driver if desired. Airflow mode control doors are used to direct airflow within the heater core and evaporator core housing. Electric mode door actuators are used to position these airflow mode doors.

NOTE: For the passenger side temperature setting on hybrid vehicles equipped with a dual-zone Electronic Automatic Temperature Control (EATC) and a Front Controls Interface Module (FCIM) built on or after 4/08/2009 to be functional, a passenger must be seated in the front passenger seat. If the front passenger seat is not occupied, the HVAC module will control the system based only on the driver side temperature setting. The HVAC module receives a Medium Speed Controller Area Network (MS-CAN) signal from the FCIM to indicate if the front passenger seat is occupied.

Vehicles equipped with dual-zone EATC use 2 separate temperature blend doors. This allows individual temperature settings to be selected for the RH and LH air outlets. The airflow mode doors are not partitioned for separate RH and LH airflow positions. Therefore, the airflow mode will always remain similar for the RH and LH sides of the vehicle regardless of the temperatures selected.

Air enters the passenger compartment from the:

- instrument panel registers.
- floor duct.
- windshield defroster.
- side window demisters.
- rear footwell duct.

Passenger compartment air is exhausted from the vehicle through open windows or body air vents.

Control Components

Electronic Manual Temperature Control (EMTC)

The Electronic Manual Temperature Control (EMTC) components are used to select:

- air inlet source (outside or recirculated).
- blower motor speed.
- discharge air temperature (temperature blend).
- discharge air location (defrost, panel, floor).
- A/C compressor operation.

Control System Inputs

HVAC Module

The HVAC module integrates the temperature control, blower motor switch, airflow mode selection, A/C request button, recirculated air request button and rear defog switch into a single unit.

The temperature control switch setting determines air temperature. Movement of the temperature display from COOL (blue) to WARM (red) causes a corresponding movement of the temperature blend door and determines the air discharge temperature that the air distribution system will maintain. The temperature control switch is an integral part of the HVAC module and cannot be installed separately.

The blower motor speed switch is mounted in the HVAC module and controls blower motor speed by adding or bypassing resistors in the blower motor resistor in all modes except OFF. The blower motor speed switch is an integral part of the HVAC module and cannot be installed separately.

The airflow mode setting determines air discharge location. Depressing each airflow mode selector button causes a corresponding movement of the airflow mode doors and determines the air discharge location. The airflow mode selector buttons are an integral part of the HVAC module and cannot be installed separately.

The A/C request button determines A/C compressor operation, except when the function selected is OFF, MAX or DEFROST. The A/C request button is an integral part of the HVAC module and cannot be installed separately.

The recirculated air request button can select recirculated air in any mode except DEFROST, and fresh air in any mode except MAX A/C or OFF.

The rear defog button signals activation of the heated backlight. The rear defog button is an integral part of the HVAC module and cannot be installed separately.

Control System Outputs

The EMTC system has 3 system outputs.

Blower Motor Speed

The blower motor speed switch varies the blower motor ground circuit resistance by adding or bypassing series resistance in the blower motor resistor. Increased resistance will lower the blower motor speed, and lowered resistance will increase blower motor speed. When the blower motor is in the HI (4) position, the blower motor resistor is bypassed.

The blower motor resistor is located on the heater core and evaporator core housing near the blower motor.

Temperature Blend Door Position

The temperature blend door actuator moves the temperature blend door on command from the HVAC module.

The temperature blend door actuator contains a reversible electric motor and a potentiometer. The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the temperature blend door. The HVAC module powers the actuator motor to move the temperature blend door to the desired position. The desired position is set by the vehicle occupants using the temperature selector knob.

Airflow Mode Door Position

The airflow mode door actuator uses a cam and lever assembly to position the airflow mode doors on command from the HVAC module. The mode door actuator contains a reversible electric motor and potentiometer. The potentiometer allows the HVAC module to monitor the position of the airflow mode doors. The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the airflow mode doors. The HVAC module powers the actuator motor to move the airflow mode doors to the desired position. The desired position is set by the vehicle occupants using the mode selector buttons.

The airflow (defrost/panel/floor) mode door actuator is located on the heater core and evaporator core housing to the right of the steering column.

Air Inlet Mode Door Position

The air inlet mode door actuator moves the air inlet door between the fresh and RECIRC positions on command from the HVAC module. The air inlet mode door actuator is driven to, and will automatically stop at, the full RECIRC or full fresh air inlet position and does not require a potentiometer circuit to monitor its position. The air inlet mode door does not stop at any point between the RECIRC or fresh air inlet position.

The air inlet mode door actuator is located on the air inlet duct near the RH cowl side panel.

Electronic Automatic Temperature Control (EATC)

The HVAC module analyzes input from the following major sources:

- Temperature, airflow direction, blower, A/C and RECIRC selection (made by the vehicle occupants)
- In-vehicle temperature sensor (non-hybrid)
- In-vehicle temperature and humidity sensor (hybrid)
- Ambient air temperature sensor
- Solar radiation sensor (sunload sensor)

- Vehicle speed
- Engine coolant temperature
- Occupant Classification Sensor (OCS) (hybrid only)

Using these inputs, the HVAC module determines the correct conditions for the following outputs:

- A/C compressor operation
- Blower motor speed
- RH and LH temperature blend door positions
- DEFROST/PANEL/FLOOR airflow mode door position
- Air inlet mode door position

Control System Inputs

The EATC system has 4 control system inputs.

HVAC Module - Without Navigation System

The HVAC module on vehicles not equipped with the navigation system provides an interface for the vehicle occupants to control the climate control system, or automatically controls the system in the AUTO mode. The Front Display Interface Module (FDIM) displays set temperature, airflow direction and blower speed.

The HVAC module is mounted to the center instrument panel finish panel below the Front Controls Interface Module (FCIM).

HVAC Module - With Navigation System

Vehicles equipped with the navigation system use a remote HVAC module that is separate from the control interface. The FCIM provides the interface for the vehicle occupants to control the climate control system. When selections are made, the FCIM communicates the selections to the HVAC module over the Medium Speed Controller Area Network (MS-CAN). The remote HVAC module controls the climate control system based on the FCIM selections or will automatically control the climate control system in the AUTO mode.

The HVAC module is mounted to the instrument panel support behind the FCIM .

In-Vehicle Temperature Sensor - Non-Hybrid

The in-vehicle temperature sensor contains a thermistor, which measures the in-vehicle air temperature and sends that reading to the HVAC module. An aspirator hose is connected between the heater core and evaporate housing and the in-vehicle temperature sensor. The aspirator hose uses airflow through the heater core and evaporator core housing to create a Venturi-type suction in the hose to draw in-vehicle air through the in-vehicle temperature sensor (across the thermistor).

The in-vehicle temperature sensor is mounted to the instrument panel to the right of the steering column with the aspirator hose connected to the heater core and evaporator core housing near the LH temperature blend door actuator.

In-Vehicle Temperature and Humidity Sensor - Hybrid

The in-vehicle temperature and humidity sensor contains 2 thermistors, which separately measure the in-vehicle air temperature and humidity and send those readings to the HVAC module. The in-vehicle temperature sensor has an integral electric fan within the sensor that draws in-vehicle air across the thermistors.

The in-vehicle temperature and humidity sensor is mounted to the instrument panel to the right of the steering column.

Solar Radiation Sensor (Sunload Sensor)

The solar radiation sensor supplies information to the HVAC module indicating sunload.

Ambient Temperature Sensor

The ambient temperature sensor signal is received by the HVAC module and indicates the outside air temperature. The ambient temperature sensor is located in front of the radiator on the radiator support.

Control System Outputs

The EATC system has 3 control system outputs.

NOTE: For the passenger side temperature setting on hybrid vehicles equipped with a dual-zone Electronic Automatic Temperature Control (EATC) and a Front Controls Interface Module (FCIM) built on or after 4/08/2009 to be functional, a passenger must be seated in the front passenger seat. If the frontassenger seat is not occupied, the HVAC module will control the system based only on the driver side temperature setting. The HVAC module receives a Medium Speed Controller Area Network (MS-CAN) signal from the FCIM to indicate if the front passenger seat is occupied.

Blower Motor Speed

The blower motor speed control controls the blower motor speed by converting low power signals from the HVAC module to a high-current, variable ground feed for the blower motor. The HVAC module adjusts blower motor speed based on the difference between the in-vehicle temperature sensor signal and set temperature. A delay function is used to provide a gradual increase or decrease in blower motor speed under all conditions.

The blower motor speed control is located on the heater core and evaporator core housing near the blower motor.

Temperature Blend Door Positions

The dual-zone EATC system uses 2 temperature blend door actuators to control 2 separate temperature blend doors. The temperature blend doors independently vary the LH side and RH side temperature settings, as desired. The temperature blend door actuators each contain a reversible electric motor and a potentiometer. The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the temperature blend door. The HVAC module powers the actuator motors to move the temperature blend doors to the desired positions. The desired temperature blend door positions are calculated by the HVAC module based on the set temperature, in-vehicle temperature, ambient temperature and sunload.

The LH temperature blend door actuator is located on the heater core and evaporator core housing near the accelerator pedal. The RH temperature blend door actuator is located on the heater core and evaporator core housing to the left of the glove compartment.

Airflow Mode Door Position

The airflow mode door actuator uses a cam and lever assembly to position the airflow mode doors on command from the HVAC module. The mode door actuator contains a reversible electric motor and

potentiometer. The potentiometer allows the HVAC module to monitor the position of the airflow mode doors. The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the airflow mode doors. The HVAC module powers the actuator motor to move the airflow mode doors to the desired position. The HVAC module determines the desired airflow mode door position based on the calculated outlet temperature.

The airflow mode door actuator is located on the heater core and evaporator core housing to the right of the accelerator pedal.

Air Inlet Mode Door Actuator - Non-hybrid

The air inlet mode door actuator moves the air inlet door between the fresh and RECIRC positions on command from the HVAC module. The air inlet mode door actuator is driven to, and will automatically stop at, the full RECIRC or full fresh air inlet position and does not require a potentiometer circuit to monitor its position. The air inlet mode door does not stop at any point between the RECIRC or fresh air inlet position.

The air inlet mode door actuator is located on the airnlet duct near the RH cowl side panel.

Air Inlet Mode Door Actuator - Hybrid

The air inlet mode door actuator moves the air inlet door between the fresh and RECIRC positions on command from the HVAC module. The airflow mode door actuator contains a reversible electric motor and potentiometer. The potentiometer allows the HVAC module to monitor the position of the air inlet mode door. The potentiometer circuit consists of a 5-volt reference signal connected to one end of a variable resistor, and a signal ground connected to the other. A signal circuit is connected to a contact wiper, which is driven along the variable resistor by the actuator shaft. The signal to the HVAC module from the contact wiper indicates the position of the air inlet mode door. The HVAC module powers the actuator motor to move the air inlet mode door to the desired position. The HVAC module determines the desired air inlet mode door position based on the calculated outlet temperature.

The air inlet mode door actuator is located on the air inlet duct near the RH cowl side panel.

Heating and Ventilation

The heating and ventilation system has the following features:

- Controls the temperature and, during A/C operation, reduces the relative humidity of the air inside the vehicle
- Delivers heated or cooled air to maintain the vehicle interior temperature and comfort level
- Cooling or heating can be adjusted to maintain the desired temperature
- Uses a reheat method to provide conditioned air to the passenger compartment
- All airflow from the blower motor passes through the A/C evaporator core
- Temperature blending is controlled by the temperature blend door(s), which regulate(s) the amount of air that flows through and around the heater core, where it is then mixed and distributed

Heater Core

The heater core consists of fins and tubes arranged to extract heat from the engine coolant and transfer the heat to air passing through the plenum.

Blower Motor

The blower motor pulls air from the air inlet and forces it into the heater core and evaporator core housing where it is mixed and distributed.

Heater Core and Evaporator Core Housing

The heater core and evaporator core housing directs airflow from the blower motor through the evaporator core and heater core. All airflow from the blower motor passes through the evaporator core. The airflow is then directed through or around the heater core by the temperature blend door(s). Vehicles equipped with dual-zone Electronic Automatic Temperature Control (EATC) use a partitioned heater core and evaporator core housing with 2 electric actuator-positioned temperature blend doors. This allows for separate temperatures to be selected for the driver and passenger sides of the passenger compartment. Manual systems and single-zone EATC systems use a single electric actuator-positioned temperature blend door to direct airflow through or around the heater core.

Auxiliary Coolant Flow Pump

An auxiliary coolant flow pump is used only on hybrid vehicles to improve engine coolant circulation at low engine speeds or when the engine is OFF.

The auxiliary coolant flow pump will be disabled when any of the following conditions are present:

- The climate control module is set to the OFF position.
- The ambient temperature is above 32°C (90°F).
- The coolant temperature is less than -10°C (14°F).
- The engine speed is above 4,000 rpm.

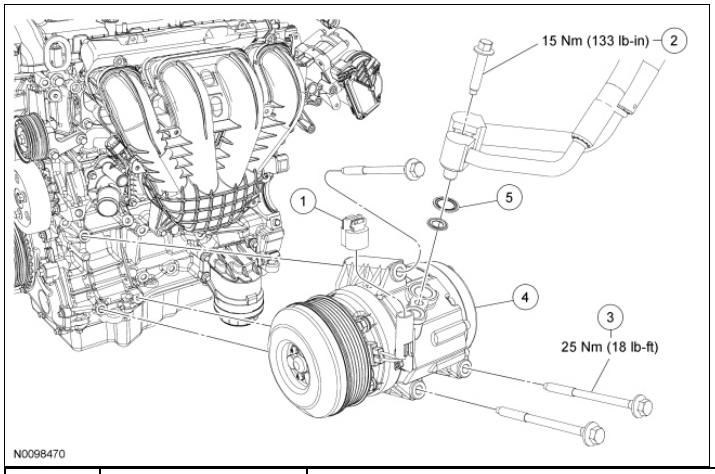
When none of the listed conditions are present, the auxiliary coolant flow pump is controlled by a strategy included in the PCM software. The control strategy monitors the ambient temperature, coolant temperature and engine rpm. As the ambient temperature and/or coolant temperature increase, the auxiliary coolant flow pump will shut down at lower engine speeds. For example, when both the ambient temperature is above 16°C (60°F) and the engine coolant temperature is above 66°C (150°F), the control strategy will shut off the auxiliary coolant flow pump at 2,000 rpm. When both the ambient temperature is above 24°C (75°F) and the engine coolant temperature is above 66°C (150°F), the control strategy will shut off the auxiliary coolant flow pump regardless of engine speed.

To verify auxiliary coolant flow pump operation, allow the vehicle to cool in a cool location. Start the engine and let the engine idle until it shuts down automatically. Select the FLOOR mode on the HVAC module at the highest temperature setting and HI blower speed. If the auxiliary coolant flow pump is inoperative or is not producing adequate coolant flow, the passenger compartment air discharge temperature will quickly decrease and further diagnosis is required. Refer to Section 412-00B . If the auxiliary coolant flow pump is operating normally, the passenger compartment air discharge temperature will remain steady, or slowly decrease.

Air Conditioning (A/C) Compressor - 2.5L

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



Item	Part Number	Description
1	-	Field coil electrical connector (part of 12B637)
2	W701625	A/C compressor manifold bolt
3	W711824	A/C compressor bolt (3 required)
4	19703	A/C compressor
5	19B596	Gasket seal (2 pieces from kit required)

Removal and Installation

NOTICE: **If installing a new Air Conditioning (A/C) compressor due to an internal failure of the old unit, the following procedures must be carried out to remove contamination from the A/C system. Failure to remove contamination from the A/C system, if present, will result in poor A/C performance and/or damage to the new A/C compressor and other components.**

- If A/C flushing equipment is available, carry out flushing of the A/C system prior to installing a new A/C compressor. For additional information, refer to Section 412-00A .
- If A/C flushing equipment is not available, carry out filtering of the A/C system after a new A/C compressor has been installed. For additional information, refer to Section 412-00A .
- Install a new Thermostatic Expansion Valve (TXV), as directed by the A/C flushing or filtering procedure.
- Install a new receiver/drier cartridge as directed by the A/C flushing or filtering procedure.

NOTICE: **Use only the Air Conditioning (A/C) refrigerant compressor oil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate**

and damage the A/C system.

NOTE: Installation of a new receiver/drier cartridge is not required when repairing the A/C system, except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier cartridge. Damage to the receiver/drier cartridge includes physical damage or moisture contamination. Moisture contamination results only from a complete loss of refrigerant, and equalization of the refrigerant system pressure with atmospheric pressure for a period longer than one hour. If even a slight amount of positive refrigerant pressure is present in the refrigerant system before repairs are carried out, the receiver/drier cartridge does not need to be replaced.

1. If flushing of the A/C system has not been carried out, recover the refrigerant. For additional information, refer to Section 412-00A .

2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

3. Disconnect the field coil electrical connector.

4. Remove the A/C compressor manifold bolt.
   - Discard the gasket seals.
   - To install, tighten to 15 Nm (133 lb-in).

5. Remove the drive belt from the A/C compressor pulley.

6. Remove the 3 A/C compressor bolts.
   - To install, tighten to 25 Nm (18 lb-ft).

7. Remove the A/C compressor.

8. To install, reverse the removal procedure.
   - Install new gasket seals.
   - If filtering of the A/C system is not to be carried out, add the correct amount of clean PAG oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

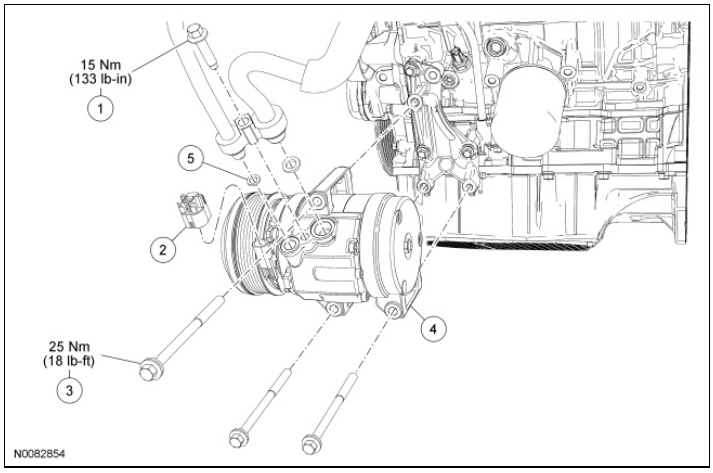
9. If filtering of the A/C system is not to be carried out, evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Air Conditioning (A/C) Compressor - 3.0L, 3.5L

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B

NOTE: 3.0L shown, 3.5L similar.



Item	Part Number	Description
1	W701625	A/C compressor manifold bolt
2	-	Field coil electrical connector (part of 12B637)
3	W710649	A/C compressor bolt (3 required for 3.0L) (2 required for 3.5L)
4	19703	A/C compressor
5	19B596	Gasket seal (2 pieces from kit required)

Removal and Installation

NOTICE: **If installing a new Air Conditioning (A/C) compressor due to an internal failure of the old unit, the following procedures must be carried out to remove contamination from the A/C system. Failure to remove contamination from the A/C system, if present, will result in poor A/C performance and/or damage to the new A/C compressor and other components.**

- If A/C flushing equipment is available, carry out flushing of the A/C system prior to installing a new A/C compressoadditional information, refer to Section 412-00A .
- If A/C flushing equipment is not available, carry out filtering of the A/C system after a new A/C compressor has been installed. For additional information, refer to Section 412-00A .

- Install a new Thermostatic Expansion Valve (TXV), as directed by the A/C flushing or filtering procedure.
- Install a new receiver/drier cartridge as directed by the A/C flushing or filtering procedure.

NOTICE: **Use only the Air Conditioning (A/C) refrigerant compressor oil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate and damage the A/C system.**

NOTE: Installation of a new receiver/drier cartridge is not required when repairing the A/C system, except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier cartridge. Damage to the receiver/drier cartridge includes physical damage or moisture contamination. Moisture contamination results only from a complete loss of refrigerant, and equalization of the refrigerant system pressure with atmospheric pressure for a period longer than one hour. If even a slight amount of positive refrigerant pressure is present in the refrigerant system before repairs are carried out, the receiver/drier cartridge does not need to be replaced.

All vehicles

1. If flushing of the A/C system has not been carried out, recover the refrigerant. For additional information, refer to Section 412-00A .

2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

3. Remove the lower engine splash shield (if equipped).

4. Remove the drive belt from the A/C compressor pulley.

5. Remove the A/C compressor manifold bolt.
   - Discard the gasket seals.
   - To install, tighten to 15 Nm (133 lb-in).

6. Disconnect the field coil electrical connector.

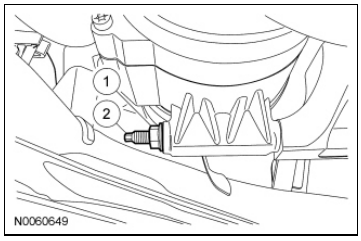
3.0L vehicles

7. Remove the 3 A/C compressor bolts.
   - To install, tighten to 25 Nm (18 lb-ft).

3.5L vehicles

8. Remove the 2 A/C compressor bolts.
   - To install, tighten to 25 Nm (18 lb-ft).

9. Remove the A/C compressor stud.
   1. Remove the A/C compressor nut.
   2. Remove the A/C compressor stud.
      - ♦ To install, tighten the stud to 9 Nm (80 lb-in).
      - ♦ To install, tighten the nut to 25 Nm (18 lb-ft).



All vehicles

10. Remove the A/C compressor.

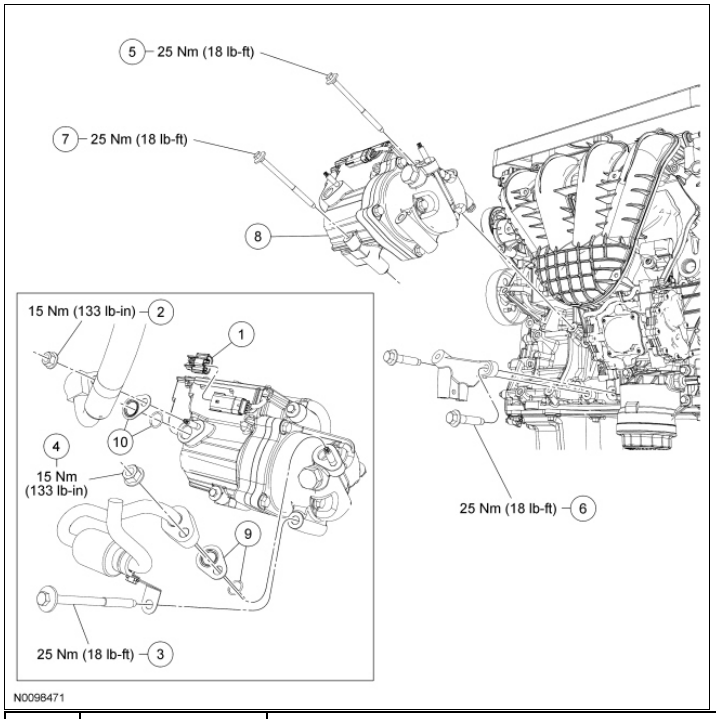
11. To install, reverse the removal procedure.
    - Install new gasket seals.
    - If filtering of the A/C system is not to be carried out, add the correct amount of clean PAG oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

12. If filtering of the A/C system is not to be carried out, evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Air Conditioning (A/C) Compressor - Hybrid

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-



Item	Part Number	Description
1	-	A/C compressor electrical connector (part of 14290)
2	W520413	A/C compressor suction fitting nut
3	W701626	Lower rear A/C compressor bolt
4	W520413	A/C compressor discharge fitting nut
5	W701626	Upper A/C compressor bolt
6	W500320	A/C compressor bracket bolt (2 required)
7	W701626	Lower front A/C compressor bolt
8	19703	A/C compressor
9	19B596	O-ring seal and gasket seal kit
10	19B596	O-ring seal and gasket seal kit

Removal and Installation

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehition of any oil other than Motorcraft® Electric A/C Compressor Oil to the**

hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .

NOTICE: **Service electric Air Conditioning (A/C) compressors are shipped with a small amount of electric compressor oil already installed which may not match the nominal amount required by the refrigerant system. Before installing a new service electric A/C compressor, the correct electric compressor oil level must be determined based on the amount of oil removed along with the old electric A/C compressor. Refer to the Refrigerant Oil Adding procedure in Section 412-00A . Failure to correctly match the electric compressor oil amount will result in damage to the electric A/C compressor and other refrigerant system components.**

NOTICE: **If installing a new Air Conditioning (A/C) compressor due to an internal failure of the old unit, the following procedures must be carried out to remove contamination from the A/C system. Failure to remove contamination from the A/C system, if present, will result in poor A/C performance and/or damage to the new A/C compressor and other components.**

- If A/C flushing equipment is available, cary out flushing of the A/C system prior to installing a new A/C compressor. For additional information, refer to Section 412-00A .
- If A/C flushing equipment is not available, carry out filtering of the A/C system after a new A/C compressor has been installed. For additional information, refer to Section 412-00A .
- Install a new Thermostatic Expansion Valve (TXV), as directed by the A/C flushing or filtering procedure.
- Install a new receiver/drier cartridge as directed by the A/C flushing or filtering procedure.

NOTE: Installation of a new receiver/drier cartridge is not required when repairing the A/C system, except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier cartridge. Damage to the receiver/drier cartridge includes physical damage or moisture contamination. Moisture contamination results only from a complete loss of refrigerant, and equalization of the refrigerant system pressure with atmospheric pressure for a period longer than one hour. If even a slight amount of positive refrigerant pressure is present in the refrigerant system before repairs are carried out, the receiver/drier cartridge does not need to be replaced.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

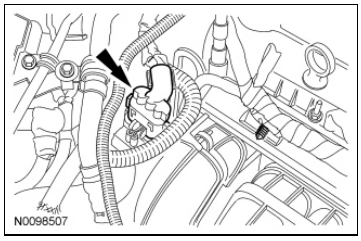
2. Depower the high-voltage traction battery system. For additional information, refer to Section 414-03 .

3. Recover the refrigerant. For additional information, refer to Section 412-00A .

4. *NOTICE:* **Failure to disconnect high-voltage cable connectors as instructed may result in damage to the connectors.**

   Release the clips and locking tabs and disconnect the interlock connector and the high-voltage cable connector at the Air Conditioning Compressor Module (ACCM).

   - Press the locking clip in the white interlock connector and disengage the white connector before releasing the locking clip on the orange portion of the high-voltage connector. The white interlock connector will not come completely apart until the orange portion is released.



5. Detach the A/C compressor high-voltage electrical connector pin-type retainer and reposition the compressor high-voltage electrical connector below the coolant hoses.

6. Remove the condenser inlet fitting nut and disconnect the fitting.
   - Discard the gasket seal.
   - To install, tighten to 15 Nm (133 lb-in).

7. Disconnect the A/C compressor electrical connector.

8. Remove the A/C compressor suction fitting nut and disconnect the fitting.
   - Discard the gasket seal.
   - To install, tighten to 15 Nm (133 lb-in).

9. Detach the wire harness pin-type retainers from the vacuum pump bracket and A/C compressor bracket.

10. Detach the wire harness pin-type retainer from the front subframe.

11. Remove the lower rear A/C compressor bolt.
    - To install, tighten to 25 Nm (18 lb-ft).

12. Remove the A/C compressor discharge fitting nut and remove the compressor-to-condenser discharge line.
    - Discard the O-ring seal and gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

13. Remove the upper A/C compressor bolt.
    - To install, tighten to 25 Nm (18 lb-ft).

14. Remove the 2 A/C compressor bracket bolts and remove the A/C compressor bracket.
    - To install, tighten to 25 Nm (18 lb-ft).

15. Remove the lower front A/C compressor bolt.
    - To install, tighten to 25 Nm (18 lb-ft).

16. Remove the A/C compressor.

17. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

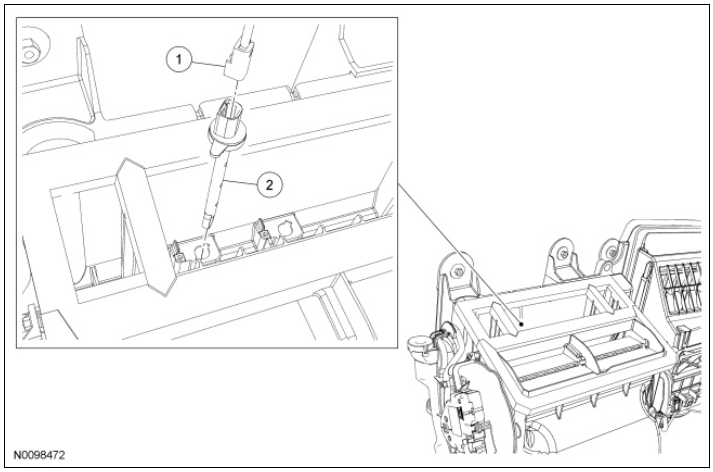
    To install, reverse the removal procedure.

    - Install new O-ring seals and gasket seals.

- Add the correct amount of clean electric A/C compressor oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

18. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Air Conditioning (A/C) Evaporator Discharge Air Temperature Sensor

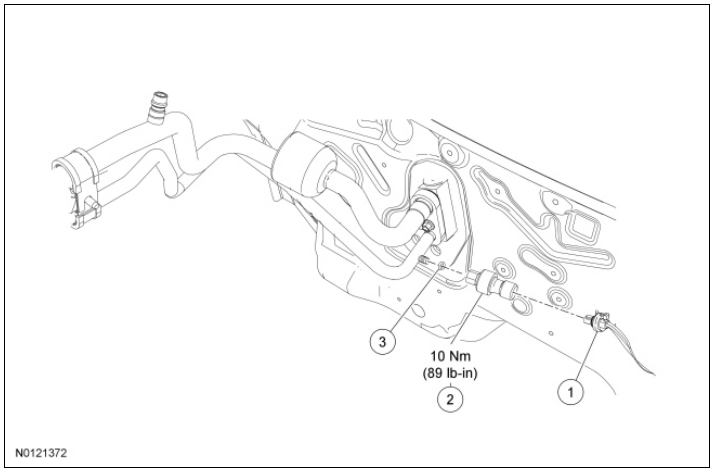


Item	Part Number	Description
1	-	A/C evaporator discharge air temperature sensor electrical connector (part of 19D887)
2	19C734	A/C evaporator discharge air temperature sensor

Removal and Installation

1. Remove the instrument panel. For additional information, refer to Section 501-12 .
2. Rotate the A/C evaporator discharge air temperature sensor counterclockwise and pull upward to detach it from the heater core and evaporator core housing.
3. Disconnect the A/C evaporator discharge air temperature sensor electrical connector.
4. Remove the evaporator discharge air temperature sensor.
5. To install, reverse the removal procedure.

Air Conditioning (A/C) Pressure Transducer



Item	Part Number	Description
1	-	A/C pressure transducer electrical connector (part of 14290)
2	19D594	A/C pressure transducer
3	19E889	O-ring seal

1. Disconnect the A/C pressure transducer electrical connector.

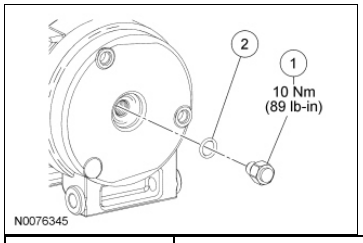
2. Remove the A/C pressure transducer.
   - To install, tighten to 10 Nm (89 lb-in).

3. To install, reverse the removal procedure.
   - Install a new O-ring seal.

Air Conditioning (A/C) Pressure Relief Valve

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



Item	Part Number	Description
1	19D644	A/C pressure relief valve
2	-	O-ring seal (part of 19D644)

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Recover the refrigerant. For additional information, refer to Section 412-00A .

3. Remove the A/C pressure relief valve and O-ring seal.
   - To install, tighten to 10 Nm (89 lb-in).

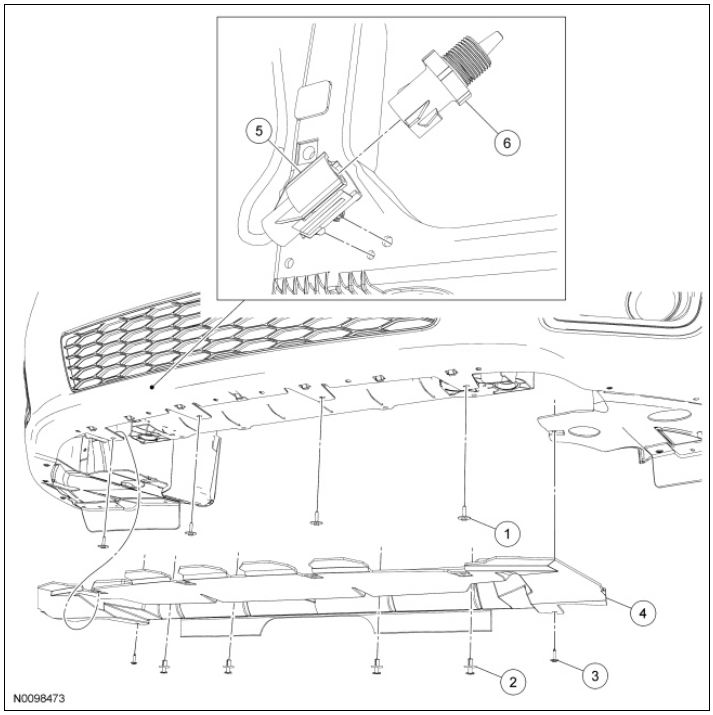
4. **NOTE:** A new O-ring seal will already be installed on the new A/C pressure relief valve service part.

   To install, reverse the removal procedure.

   - Add the correct amount of clean PAG refrigerant oil to the refrigerant system. For additional information, refer to Section 412-00A .

5. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Ambient Air Temperature Sensor



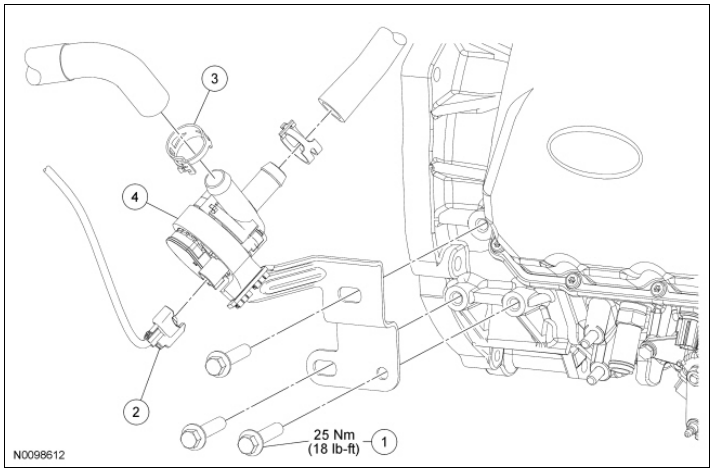
Item	Part Number	Description
1	W709976	Lower radiator air deflector front screw (4 required)
2	N807389	Lower radiator air deflector pin-type retainer (4 required)
3	W706805	Lower radiator air deflector rear screw (2 required)
4	8327	Lower radiator air deflector
5	-	Ambient air temperature sensor electrical connector (part of 14290)
6	19E642	Ambient air temperature sensor

Removal and Installation

1. Remove the 4 lower radiator air deflector front screws.
2. Remove the 4 lower radiator air deflector pin-type retainers.
3. Remove the 2 lower radiator air deflector rear screws.
4. Remove the lower radiator air deflector.
5. Detach and disconnect the ambient air temperature sensor electrical connector.
6. Remove the ambient air temperature sensor.

7. To install, reverse the removal procedure.

Auxiliary Coolant Flow Pump



Item	Part Number	Description
1	W500233	Auxiliary coolant flow pump bracket bolt (3 required)
2	-	Auxiliary coolant flow pump electrical connector (part of 19D649)
3	8287	Heater hose clamp (2 required)
4	18D473	Auxiliary coolant flow pump

Removal and Installation

1. Drain the engine coolant. For additional information, refer to Section 303-03B .

2. Remove the 3 auxiliary coolant flow pump bolts.
   - To install, tighten to 25 Nm (18 lb-ft).

3. Disconnect the auxiliary coolant flow pump electrical connector.

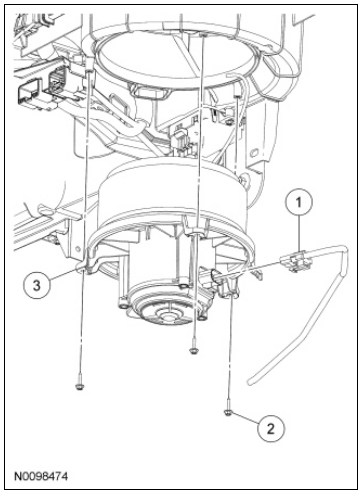
4. Release the 2 heater hose clamps and disconnect the 2 heater hoses from the auxiliary coolant flow pump.

5. Remove the auxiliary coolant flow pump.

6. To install, reverse the removal procedure.

7. Fill the engine coolant level. For additional information, refer to Section 303-03B .

Blower Motor



Item	Part Number	Description
1	-	Blower motor electrical connector (part of 19D887)
2	W712320	Blower motor screw (3 required)
3	19805	Blower motor

Removal and Installation

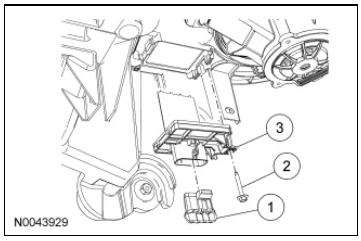
MKZ vehicles

1. Remove the RH lower instrument panel insulator.

All vehicles

2. Disconnect the blower motor electrical connector.
3. Remove the 3 blower motor screws.
4. Remove the blower motor.
5. To install, reverse the removal procedure.

Blower Motor Resistor

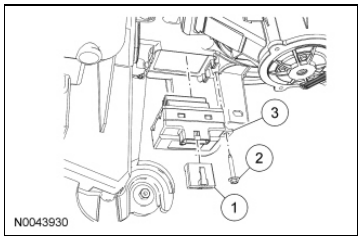


Item	Part Number	Description
1	-	Blower motor resistor electrical connector (part of 19D887)
2	-	Blower motor resistor screw
3	18591	Blower motor resistor

Removal and Installation

1. Disconnect the blower motor resistor electrical connector.
2. Remove the blower motor resistor screw.
3. Remove the blower motor resistor.
4. To install, reverse the removal procedure.

Blower Motor Speed Control



Item	Part Number	Description
1	-	Blower motor speed control electrical connector (part of 19D887)
2	-	Blower motor speed control screw
3	19E624	Blower motor speed control

Removal and Installation

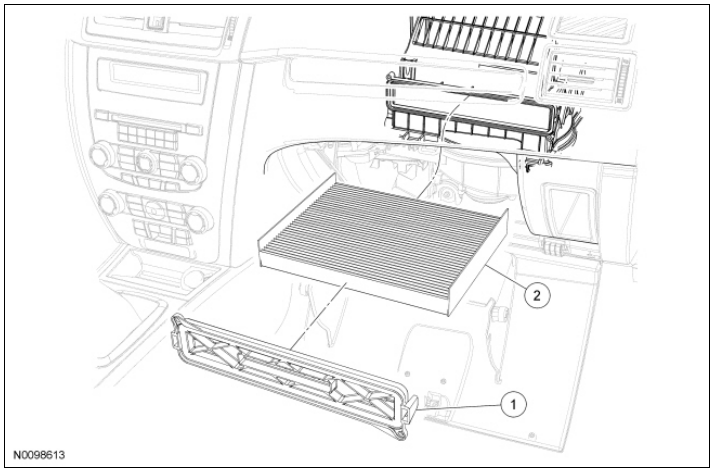
MKZ vehicles

1. Remove the RH lower instrument panel insulator.

All vehicles

2. Disconnect the blower motor speed control electrical connector.
3. Remove the blower motor speed control screw.
4. Remove the blower motor speed control.
5. To install, reverse the removal procedure.

Cabin Air Filter



Item	Part Number	Description
1	99020C34	Cabin air filter access door
2	19N619	Cabin air filter

Removal and Installation

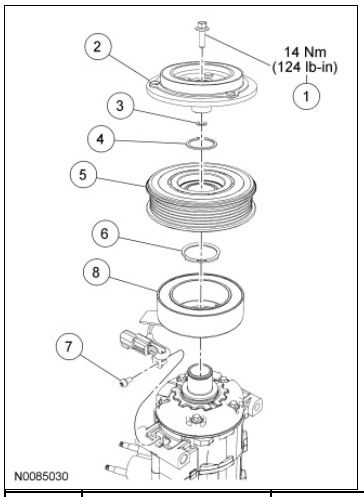
1. Remove the glove compartment.
2. Detach and remove the cabin air filter access door.
3. **NOTE:** The RH flap on the cabin air filter must be deflected downward to clear the glove compartment damper when removing and installing the filter.

   Remove the cabin air filter.
4. To install, reverse the removal procedure.

Clutch and Clutch Field Coil

Special Tool(s)

 ST2946-A	Holding Fixture, Compressor Clutch Disc and Hub 412-134

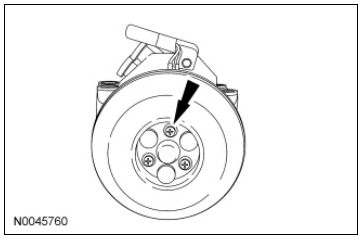


Item	Part Number	Description
1	W712303	A/C clutch disc and hub bolt
2	19D786	A/C clutch disc and hub
3	19D648	A/C clutch disc and hub spacers
4	W712302	A/C compressor pulley snap ring
5	19D784	A/C compressor pulley
6	W712301	A/C clutch field coil snap ring
7	W712300	A/C clutch field coil electrical connector clip screw
8	19D798	A/C clutch field coil

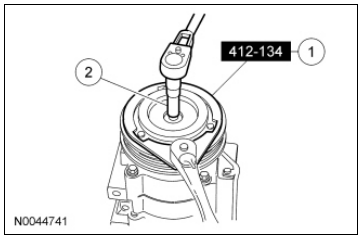
Removal

1. Remove the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor - 2.5L or Air Conditioning (A/C) Compressor - 3.0L, 3.5L in this section.

2. Remove the 3 screws and the A/C clutch shield (if equipped).



3. Remove the A/C clutch disc and hub bolt.
    1. Hold the A/C clutch disc and hub with the Compressor Clutch Disc and Hub Holding Fixture.
    2. Remove the A/C clutch disc and hub bolt.

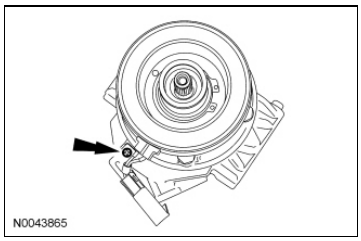


4. Remove the A/C clutch disc and hub.

5. Remove the A/C compressor pulley snap ring.

6. Remove the A/C compressor pulley.

7. Remove the A/C clutch field coil electrical connector clip screw.



8. Remove the A/C clutch field coil snap ring.

9. Remove the A/C clutch field coil.

Installation

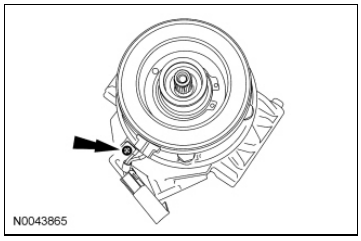
1. Visually inspect the A/C clutch disc and hub, A/C compressor pulley and A/C clutch field coil for damage.
    - Inspect for physical damage, including cracked or melted components or discoloration due to excessive heat.
    - Inspect for excessive wear, including grooving in the A/C clutch disc and hub or A/C compressor pulley that is more than fingernail depth.
    - Inspect for roughness in the A/C compressor pulley bearing.

2. Clean the A/C clutch field coil and pulley mounting surfaces.

3. Install the A/C clutch field coil.

4. Install the A/C clutch field coil snap ring.

5. Install the A/C clutch field coil electrical connector clip screw.



6. **NOTE:** The A/C clutch pulley is a tight fit on the A/C compressor head. It must be correctly aligned during installation.

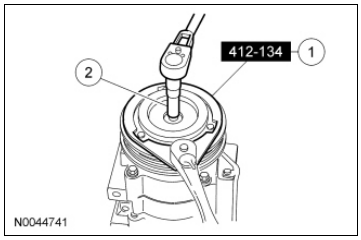
   Install the A/C clutch pulley.

7. Install the A/C clutch pulley snap ring.

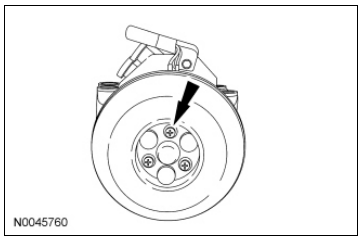
8. Place one nominal thickness A/C clutch disc and hub spacer inside the clutch hub spline opening.

9. Install the A/C clutch disc and hub assembly.

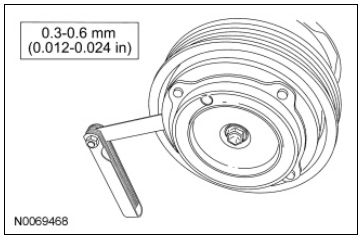
10. Install the A/C clutch disc and hub bolt.
    1. Hold the A/C clutch disc and hub with the Compressor Clutch Disc and Hub Holding Fixture.
    2. Install the A/C clutch disc and hub bolt.
    - Tighten to 14 Nm (124 lb-in).



11. Install the A/C clutch shield and the 3 screws (if equipped).



12. Measure and adjust the clutch air gap by removing or adding A/C clutch hub spacers.

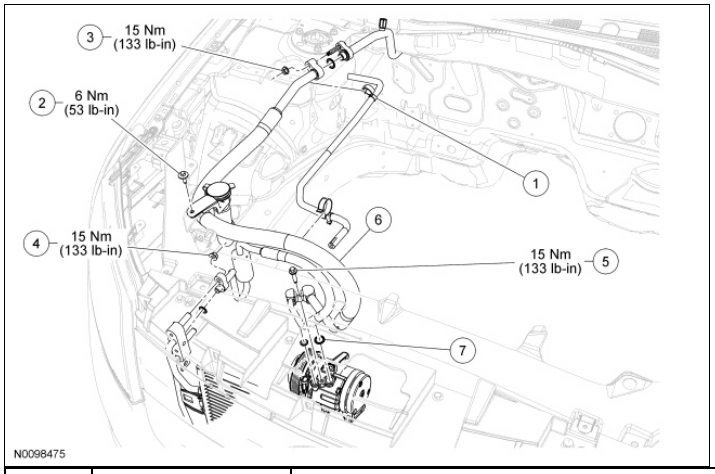


13. Install the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor - 2.5L or Air Conditioning (A/C) Compressor - 3.0L, 3.5L in this section.

Compressor Manifold and Tube Assembly - 2.5L

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



Item	Part Number	Description
1	-	Coolant reservoir hose retainer (part of 8276)
2	W503924	Washer reservoir filler neck bolt
3	W520413	Compressor manifold and tube suction fitting nut
4	W520413	Condenser inlet fitting nut
5	W701625	Compressor manifold bolt
6	19D734	Compressor manifold and tube assembly
7	19B596	Gasket seal (4 pieces from kit required)

Removal and Installation

NOTICE: **Use only the Air Conditioning (A/C) refrigerant compressor oil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate and damage the A/C system.**

1. Recover the refrigerant. For additional information, refer to Section 412-00A .

2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

3. Detach the coolant reservoir hose retainers from the compressor manifold and tube assembly.

4. Remove the washer reservoir filler neck bolt.
   - To install, tighten to 6 Nm (53 lb-in).

5. Remove the compressor manifold and tube suction fitting nut and disconnect the fitting.
    - Discard the gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

6. Remove the condenser inlet fitting nut and disconnect the fitting.
    - Discard the gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

7. Remove the lower engine splash shield (if equipped).

8. Remove the compressor manifold bolt and detach the manifold from the A/C compressor.
    - Discard the gasket seals.
    - To install, tighten to 15 Nm (133 lb-in).

9. Remove the compressor manifold and tube assembly.

10. To install, reverse the removal procedure.
    - Install new gasket seals.
    - Add the correct amount of clean PAG oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

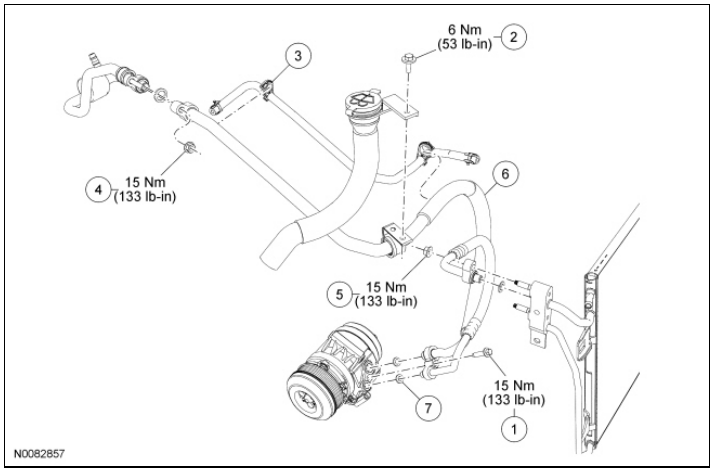
11. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Compressor Manifold and Tube Assembly - 3.0L, 3.5L

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B

NOTE: 3.0L shown, 3.5L similar.



Item	Part Number	Description
1	W701625	Compressor manifold bolt
2	W503924	Washer reservoir filler neck bolt
3	-	Coolant reservoir hose retainer (2 required)
4	W520413	Compressor manifold and tube suction fitting nut
5	W520413	Condenser inlet fitting nut
6	19D734	Compressor manifold and tube assembly
7	19B596	Gasket seal (4 pieces from kit required)

Removal and Installation

NOTICE: **Do not stress or bend the aluminum lines on the compressor manifold and tube assembly to facilitate removal. Bending or squeezing the lines together may damage the welds and lead to premature failure of the line.**

NOTICE: **Use only the Air Conditioning (A/C) refrigerant compoil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate and damage the A/C system.**

All vehicles

1. Recover the refrigerant. For additional information, refer to Section 412-00A .

2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

3. Remove the lower engine splash shield (if equipped).

4. Remove the compressor manifold bolt and detach the manifold from the A/C compressor.
   - Discard the gasket seals.
   - To install, tighten to 15 Nm (133 lb-in).

5. Detach the 2 coolant reservoir hose retainers from the compressor manifold and tube assembly.

6. Remove the washer reservoir filler neck bolt.
   - To install, tighten to 6 Nm (53 lb-in).

7. Remove the compressor manifold and tube suction fitting nut and disconnect the fitting.
   - Discard the gasket seal.
   - To install, tighten to 15 Nm (133 lb-in).

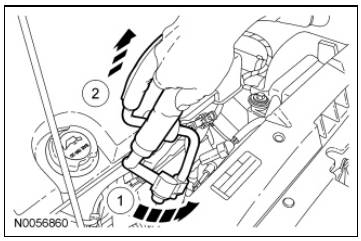
8. Remove the condenser inlet fitting nut and disconnect the fitting.
   - Discard the gasket seal.
   - To install, tighten to 15 Nm (133 lb-in).

3.5L vehicles

9. **NOTE:** Be sure not to strike the A/C lines against any hard object such as the exhaust manifold when removing the compressor manifold and tube assembly.

   Remove the compressor manifold and tube assembly.

   1. Rotate the compressor manifold and tube counterclockwise enough to allow it to be lifted between the exhaust manifold shield and alternator.
   2. Remove the compressor manifold and tube assembly.



3.0L vehicles

10. **NOTE:** Be sure not to strike the A/C lines against any hard object such as the exhaust manifold when removing the compressor manifold and tube assembly.

    Remove the compressor manifold and tube assembly.

All vehicles

11. To install, reverse the removal procedure.
    - Install new gasket seals.

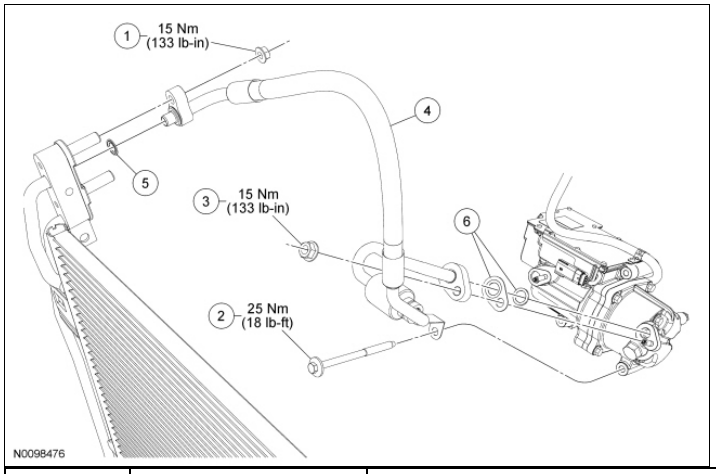
- Add the correct amount of clean PAG oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

12. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Compressor to Condenser Discharge Line - Hybrid

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-



Item	Part Number	Description
1	W520413	Condenser inlet fitting nut
2	W701626	Lower rear A/C compressor bolt
3	W520413	A/C compressor discharge fitting nut
4	19D734	Compressor-to-condenser discharge line
5	19B596	Gasket seal (1 piece from kit required)
6	19B596	O-ring seal and gasket seal kit

Removal and Installation

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Recover the refrigerant. For additional information, refer to Section 412-00A .

3. Disconnect the condenser inlet fitting nut and disconnect the fitting.
   - Discard the gasket seal.
   - To install, tighten to 15 Nm (133 lb-in).

4. Remove the lower rear A/C compressor bolt.
    - To install, tighten to 25 Nm (18 lb-ft).

5. Remove the A/C compressor discharge fitting nut and remove the compressor-to-condenser discharge line.
    - Discard the gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

6. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil tthe hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

   To install, reverse the removal procedure.

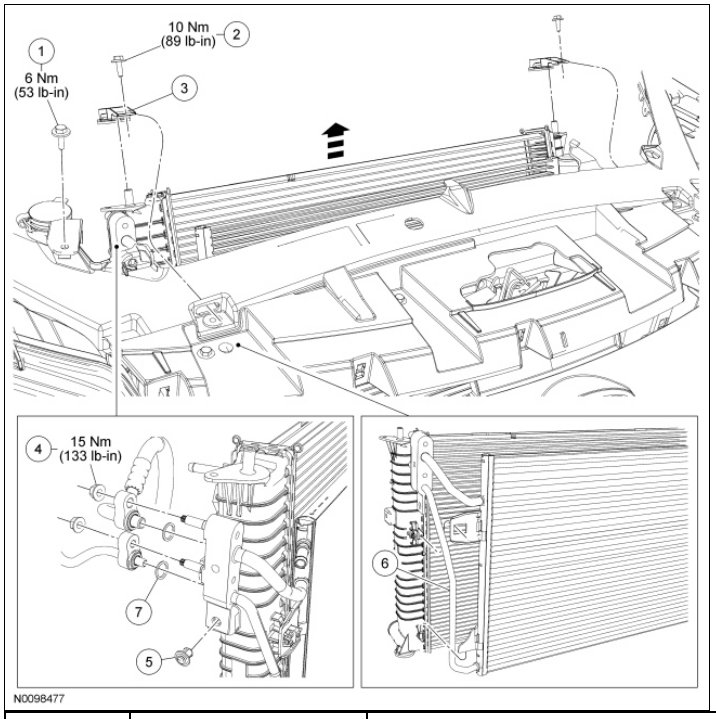
    - Install a new O-ring seal and new gasket seals.
    - Add the correct amount of clean electric A/C compressor oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

7. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Condenser Core - 2.5L, 3.0L, Hybrid

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



Item	Part Number	Description
1	W503924	Washer reservoir filler neck bolt
2	W500214	Radiator bracket bolt (2 required)
3	8A193	Radiator bracket (2 required)
4	W520413	Condenser fitting nut (2 required)
5	W711622	Condenser manifold pin-type retainer
6	19712	Condenser core
7	19B596	Gasket seal (2 pieces from kit required)

Removal and Installation

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil**

to the hybrid vehicle refrigerant system will damage the electric Air Conditioning ressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .

NOTICE: **Use only the Air Conditioning (A/C) refrigerant compressor oil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate and damage the A/C system.**

All vehicles

1. Recover the refrigerant. For additional information, refer to Section 412-00A .

2.5L or 3.0L vehicles

2. Remove the Air Cleaner (ACL). For additional information, refer to Section 303-12A or Section 303-12B .

All vehicles

3. Remove the engine cooling fan. For additional information, refer to Section 303-03A or Section 303-03B .

4. Remove the washer reservoir filler neck bolt.
    - To install, tighten to 6 Nm (53 lb-in).

3.0L vehicles

5. Remove the Thermostatic Expansion Valve (TXV) suction fitting nut and disconnect the fitting.
    - Discard the gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

All vehicles

6. Remove the 2 condenser fitting nuts and disconnect the fittings.
    - Discard the gasket seals.
    - To install, tighten to 15 Nm (133 lb-in).

7. Remove the 2 radiator bracket bolts and remove the 2 radiator brackets.
    - To install, tighten to 10 Nm (89 lb-in).

8. Remove the condenser manifold pin-type retainer.

9. Detach the 2 condenser core retaining clips and detach the condenser core from the radiator.

10. Remove the condenser core.

11. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must b used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

    To install, reverse the removal procedure.

    - Install new gasket seals.

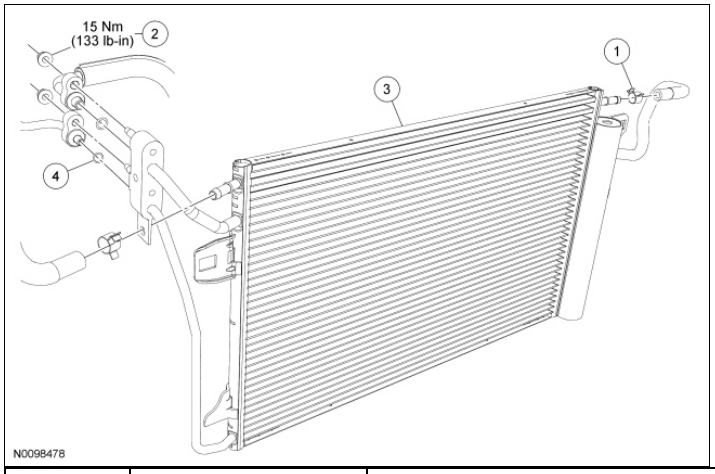
- Add the correct amount of clean PAG oil (non-hybrid vehicles) or electric A/C compressor oil (hybrid vehicles) to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

12. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Condenser Core - 3.5L

Material

Item	Specification
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



Item	Part Number	Description
1	W525884	Power steering hose clamp (2 required)
2	W520413	Condenser fitting nut (2 required)
3	19712	Condenser core
4	19B596	Gasket seal (2 pieces from kit required)

Removal and Installation

NOTICE: **Use only the Air Conditioning (A/C) refrigerant compressor oil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate and damage the A/C system.**

1. Recover the refrigerant. For additional information, refer to Section 412-00A .
2. Remove adiator. For additional information, refer to Section 303-03A .
3. Release the 2 power steering cooler hose clamps and disconnect the power steering cooler hoses from the condenser core.
4. Remove the 2 condenser fitting nuts and disconnect the fittings.
   - Discard the gasket seals.
   - To install, tighten to 15 Nm (133 lb-in).
5. Remove the condenser core.

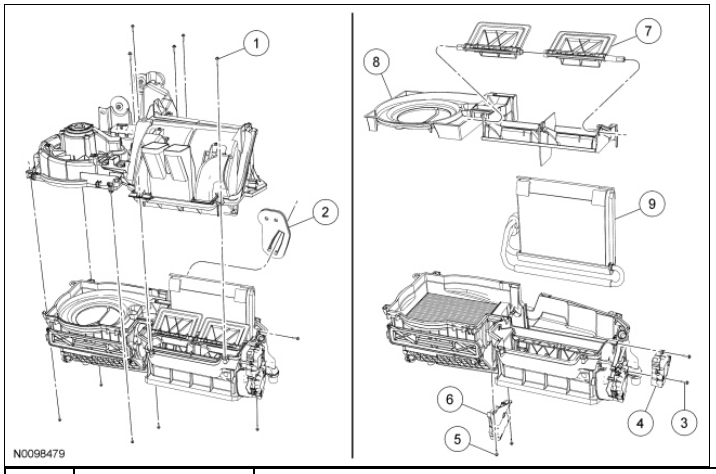
6. To install, reverse the removal procedure.
    - Install new gasket seals.
    - Add the correct amount of clean PAG oil. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

7. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Evaporator Core

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



Item	Part Number	Description
1	W712320	Evaporator core cover screw (11 required)
2	19W700	Dash panel seal
3	W712320	LH temperature blend door actuator screw (2 required)
4	19E616	LH temperature blend door actuator
5	W712320	RH temperature blend door actuator screw (2 required)
6	19E616	RH temperature blend door actuator
7	18B545	Temperature blend door (2 required)
8	19930	Heater core and evaporator core housing divider
9	19860	Evaporator core

Removal and Installation

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

NOTICE: **Use only the Air Conditioning (A/C) refrigerant compressor oil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate and damage the A/C system.**

NOTE: If an evaporator core leak is suspected, the evaporator core must be leak tested before it is removed from the vehicle.

All vehicles

1. Remove the heater core and evaporator core housing. For additional information, refer to Heater Core And Evaporator Core Housing in this section.
2. Detach the wire harness from the heater core and evaporator core housing.
3. Remove the 11 evaporator core cover screws.
4. Separate the 2 halves of the heater core and evaporator core housing.
5. Remove the dash panel seal.
6. Remove the 2 LH temperature blend door actuator screws and detach the actuator.

Dual-zone Electronic Automatic Temperature Control (EATC) vehicles

7. Remove the 2 RH temperature blend door actuator screws and detach the actuator.
8. Remove the 2 temperature blend doors.

Electronic Manual Temperature Control (EMTC) vehicles

9. Remove the temperature blend door.

All vehicles

10. Remove the heater core and evaporator core housing divider from the heater core and evaporator core housing.
11. Remove the evaporator core.
12. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

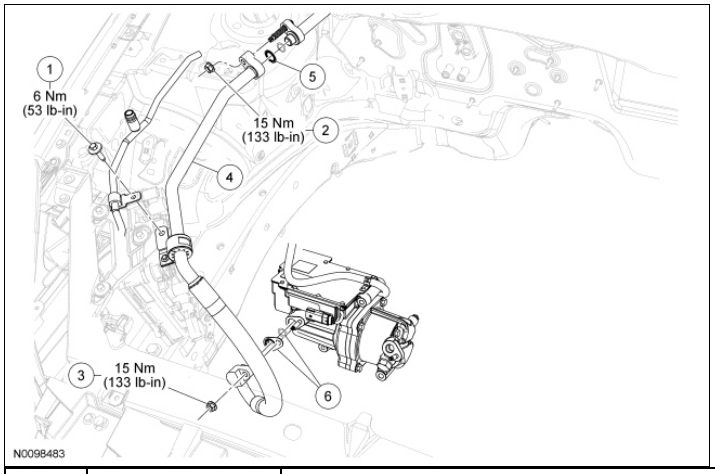
    To install, reverse the removal procedure.

    - Add the correct amount of clean PAG oil (non-hybrid) or electric A/C compressor oil (hybrid) to the refrigerant system. For additional information, refer to Section 412-00A .

Evaporator to Compressor Suction Line - Hybrid

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-



Item	Part Number	Description
1	W712963	Evaporator-to-compressor suction line bracket bolt
2	W520413	Evaporator outlet line fitting nut
3	W520413	A/C compressor suction fitting nut
4	19D734	Evaporator-to-compressor suction line
5	19B596	Gasket seal
6	19B596	O-ring seal and gasket seal kit

Removal and Installation

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

1. Recover the refrigerant. For additional information, refer to Section 412-00A .

2. Detach the block heater wire harness clip from the evaporator-to-compressor suction line (if equipped).

3. Remove the evaporator-to-compressor suction line bracket bolt.
   - To install, tighten to 6 Nm (53 lb-in).

4. Remove the evaporator outlet line fitting nut and disconnect the fitting.
    - Discard the gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

5. Remove the A/C compressor suction fitting nut and disconnect the fitting.
    - Discard the gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

6. Remove the evaporator-to-compressor suction line.

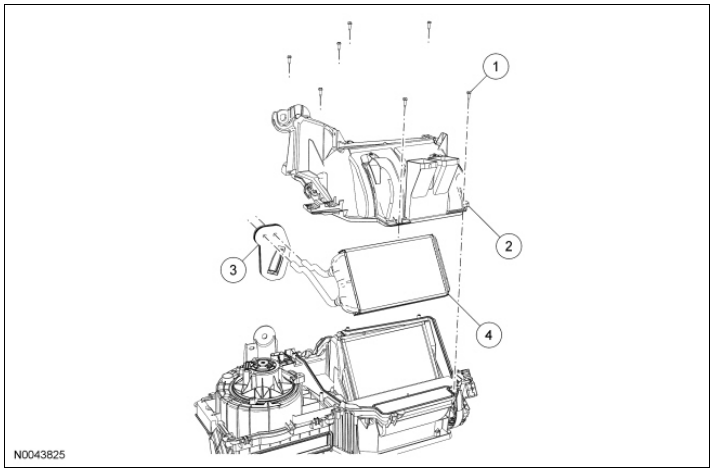
7. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

   To install, reverse the removal procedure.

    - Install a new O-ring seal and new gasket seals.
    - Add the correct amount of clean electric A/C compressor oil to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

8. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Heater Core



Item	Part Number	Description
1	W712320	Heater core cover screw (8 required)
2	18B300	Heater core cover
3	19C593	Dash panel seal
4	18476	Heater core

Removal and Installation

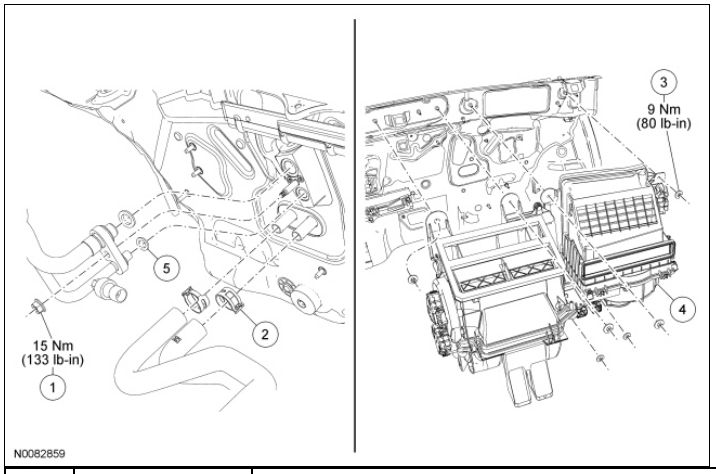
NOTE: If a heater core leak is suspected, the heater core must be pressure leak tested before it is removed from the vehicle. For additional information, refer to Section 412-00A .

1. Remove the heater core and evaporator core housing. For additional information, refer to Heater Core And Evaporator Core Housing in this section.
2. Detach the wire harness from the heater core cover.
3. Remove the 8 heater core cover screws.
4. Remove the heater core cover.
5. Remove the dash panel seal from the heater core tubes.
6. Remove the heater core.
7. To install, reverse the removal procedure.

Heater Core And Evaporator Core Housing

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



Item	Part Number	Description
1	W520413	Thermostatic Expansion Valve (TXV) fitting nut
2	8287	Heater hose clamp (2 required)
3	N621907	Heater core and evaporator core housing nut (6 required)
4	-	Heater core and evaporator core housing
5	19B596	Gasket seal (2 pieces from kit required)

Removal and Installation

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

NOTICE: **Use only the Air Condg (A/C) refrigerant compressor oil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate and damage the A/C system.**

3.5L vehicles

1. Remove the lower cowl panel grille. For additional information, refer to Section 501-02 .

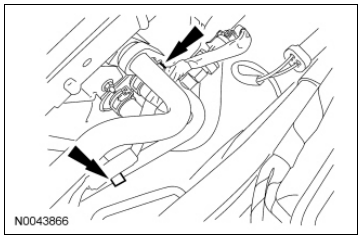
All vehicles

2. Recover the refrigerant. For additional information, refer to Section 412-00A .

3. Drain the engine coolant. For additional information, refer to Section 303-03A .

4. Remove the instrument panel. For additional information, refer to Section 501-12 .

5. Disconnect the A/C pressure transducer electrical connector and detach the wire harness from the Thermostatic Expansion Valve (TXV) stud.



6. Remove the TXV fitting nut and disconnect the fitting.
   - Discard the gasket seals.
   - To install, tighten to 15 Nm (133 lb-in).

7. Release the 2 heater hoses clamps and disconnect the hoses from the heater core.

8. Remove the 6 heater core and evaporator core housing nuts.
   - To install, tighten to 9 Nm (80 lb-in).

9. Remove the heater core and evaporator core housing.

10. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

    To instl, reverse the removal procedure.

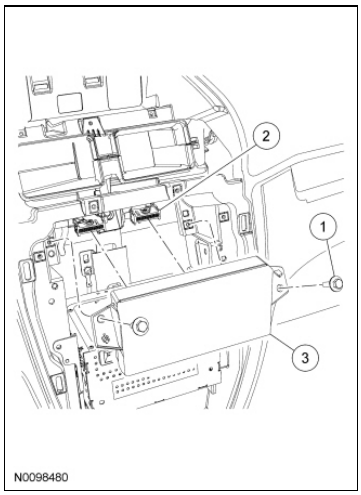
    - Install new gasket seals.
    - Add the correct amount of clean PAG oil (non-hybrid) or electric A/C compressor oil (hybrid) to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

11. Fill the engine coolant level. For additional information, refer to Section 303-03A .

12. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

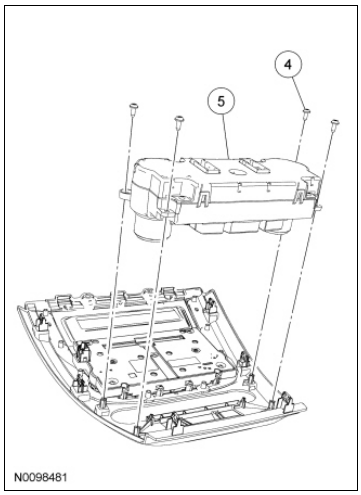
Heating Ventilation Air Conditioning (HVAC) Module - Fusion, Milan

With Navigation System



Item	Part Number	Description
1	W707628	HVAC module screw (2 required)
2	-	HVAC module electrical connector (2 required) (part of 14401)
3	19980	HVAC module

Without Navigation System



Item	Part Number	Description
4	W506942	HVAC module screw (4 required)
5	19980	HVAC module

Removal and Installation

Vehicles equipped with navigation system

1. Remove the Front Display Interface Module (FDIM). For additional information, refer to Section 415-00 .
2. Remove the 2 HVAC module screws.
3. Disconnect the 2 HVAC module electrical connectors and remove the HVAC module.

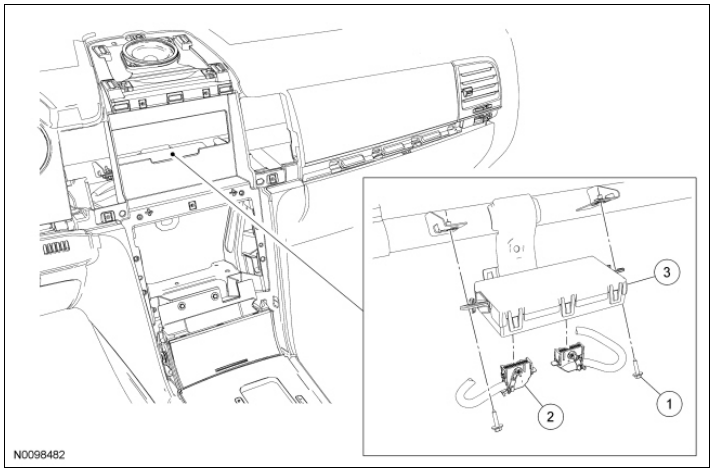
Vehicles without navigation system

4. Remove the center instrument panel finish panel. For additional information, refer to Section 501-12 .
5. Remove the 4 HVAC module screws and remove the HVAC module.

All vehicles

6. To install, reverse the removal procedure.

Heating Ventilation Air Conditioning (HVAC) Module - MKZ

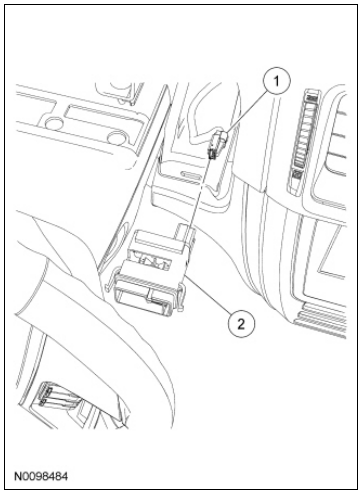


Item	Part Number	Description
1	W707628	HVAC module screw (2 required)
2	-	HVAC module electrical connector (part of 14401)
3	19980	HVAC module

Removal and Installation

1. Remove the Front Display Interface Module (FDIM). For additional information, refer to Section 415-00 .
2. Remove the 2 HVAC module screws.
3. Disconnect the 2 HVAC module electrical connectors.
4. Remove the HVAC module.
5. To install, reverse the removal procedure.

In-Vehicle Temperature and Humidity Sensor - Hybrid



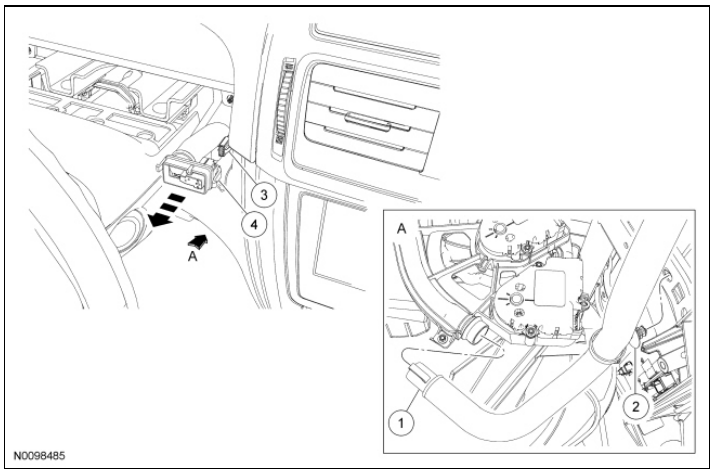
Item	Part Number	Description
1	-	In-vehicle temperature and humidity sensor electrical connector (part of 14401)
2	19C734	In-vehicle temperature and humidity sensor

Removal and Installation

1. Remove the instrument cluster finish panel. For additional information, refer to Section 501-12 .
2. Disconnect the in-vehicle temperature and humidity sensor electrical connector.
3. Remove the in-vehicle temperature and humidity sensor.
4. To install, reverse the removal procedure.

In-Vehicle Temperature Sensor - Fusion, Milan

Fusion, Milan



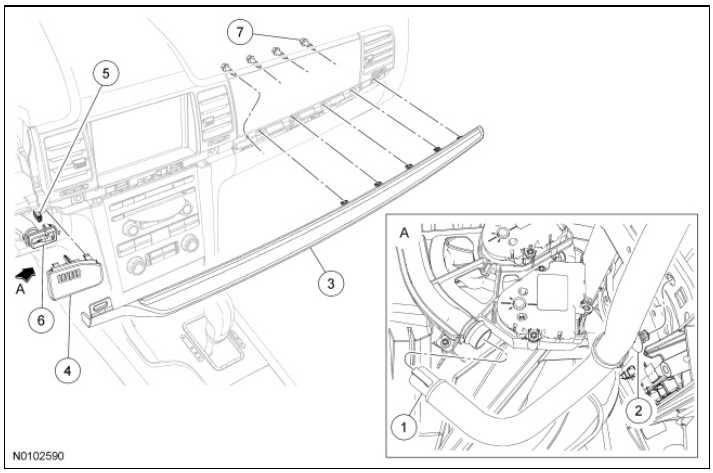
Item	Part Number	Description
1	-	In-vehicle temperature sensor aspirator hose connection (part of 19C734)
2	-	In-vehicle temperature sensor aspirator hose pin-type retainer (part of 19C734)
3	-	In-vehicle temperature sensor electrical connector (part of 14401)
4	19C734	In-vehicle temperature sensor

Removal and Installation

1. Remove the instrument cluster finish panel. For additional information, refer to Section 501-12 .
2. Disconnect the in-vehicle temperature sensor aspirator hose connection at the heater core and evaporator core housing.
3. Detach the in-vehicle temperature sensor aspirator hose pin-type retainer.
4. Disconnect the in-vehicle temperature sensor electrical connector.
5. Remove the itemperature sensor and aspirator hose assembly.
6. To install, reverse the removal procedure.

In-Vehicle Temperature Sensor - MKZ

MKZ



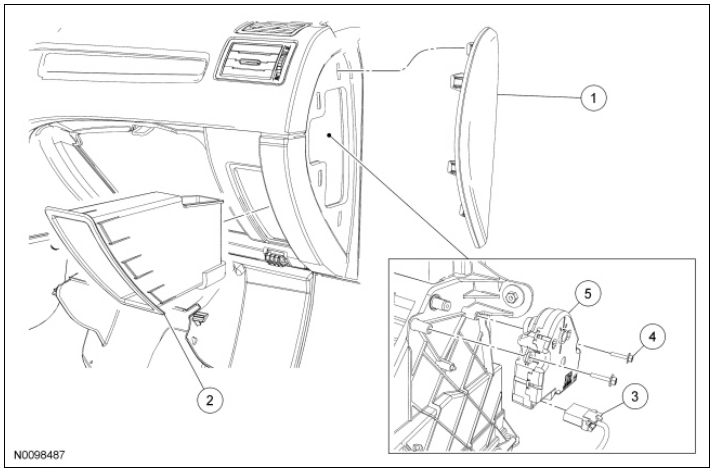
Item	Part Number	Description
1	-	In-vehicle temperature sensor aspirator hose connection (part of 19C734)
2	-	In-vehicle temperature sensor aspirator hose pin-type retainer (part of 19C734)
3	54044A90	RH instrument panel finish moulding
4	54046A76	In-vehicle temperature sensor grille
5	-	In-vehicle temperature sensor electrical connector (part of 14401)
6	19C734	In-vehicle temperature sensor
7	W707607	RH instrument panel finish moulding screw (4 required)

Removal and Installation

1. Remove the instrument cluster finish panel. For additional information, refer to Section 501-12 .
2. Disconnect the in-vehicle temperature sensor aspirator hose connection at the heate evaporator core housing.
3. Detach the in-vehicle temperature sensor aspirator hose pin-type retainer.
4. Lower the glove compartment.
5. Remove the 4 RH instrument panel finish moulding screws.
6. Remove the RH instrument panel finish moulding.
7. Detach the in-vehicle temperature sensor grille from the instrument panel.

8. Detach the in-vehicle temperature sensor grille from the in-vehicle temperature sensor.
9. Disconnect the in-vehicle temperature sensor electrical connector.
10. Remove the in-vehicle temperature sensor and aspirator hose assembly.
11. To install, reverse the removal procedure.

Mode Door Actuator - Air Inlet Door

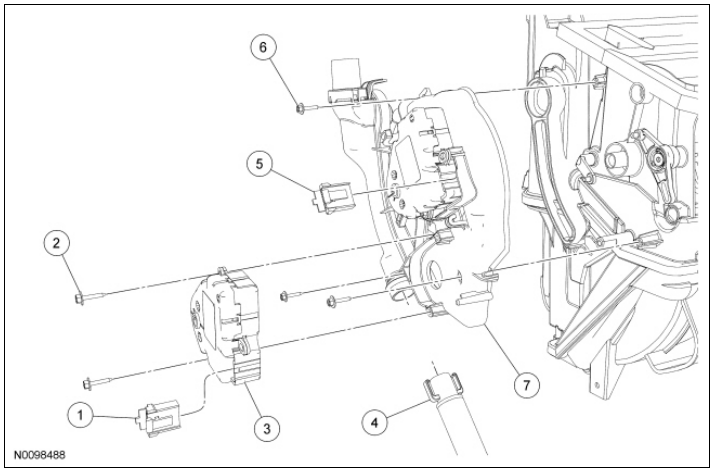


Item	Part Number	Description
1	04480	Instrument panel side finish panel
2	5406010	Glove compartment storage bin
3	-	Air inlet mode door actuator electrical connector (part of 19D887)
4	W712320	Air inlet mode door actuator screw (2 required)
5	19E616	Air inlet mode door actuator

Removal and Installation

1. Lower the glove compartment.
2. Remove the RH instrument panel end panel.
3. Remove the glove compartment storage bin.
4. Disconnect the air inlet mode door actuator electrical connector.
5. Remove the 2 air inlet mode door actuator screws.
6. Remove the air inlet mode door actuator.
7. To install, reverse the removal procedure.

Mode Door Actuator - Defrost/Panel/Floor Door



Item	Part Number	Description
1	-	LH temperature blend door actuator electrical connector (part of 19D887)
2	W712320	LH temperature blend door actuator screw (2 required)
3	19E616	LH temperature blend door actuator
4	-	In-vehicle temperature sensor aspirator hose connection (part of 19C734)
5	-	DEFROST/PANEL/FLOOR mode door actuator electrical connector (part of 19D887)
6	W712320	DEFROST/PANEL/FLOOR mode door actuator and cam assembly screw
7	19C772	DEFROST/PANEL/FLOOR mode door actuator and cam assembly

Removal and Installation

1. Remove the instrument panel. For additional information, refer to Section 501-12 .
2. Disconnect the LH temperature blend dor electrical connector.
3. Remove the 2 LH temperature blend door actuator screws.
4. Remove the LH temperature blend door actuator.
5. Disconnect the in-vehicle temperature sensor aspirator hose connection.
6. Disconnect the DEFROST/PANEL/FLOOR mode door actuator electrical connector.
7. Remove the 3 DEFROST/PANEL/FLOOR mode door actuator and cam assembly screws.
8. Remove the DEFROST/PANEL/FLOOR mode door actuator and cam assembly.

9. To install, reverse the removal procedure.

10. **NOTE:** The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out calibration, carry out the following steps.

    Remove the Smart Junction Box (SJB) fuse 15 for at least one minute.

11. **NOTE:** When the ignition switch is switched to the ON position, the HVAC module will initialize and calibrate the actuators. Calibration of the actuators will take approximately 30 seconds.

    Reinstall SJB fuse 15. Turn the ignition switch to the ON position and wait 30 seconds before verifying correct DEFROST/PANEL/FLOOR operation.

Receiver Drier Cartridge

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B

Removal and Installation

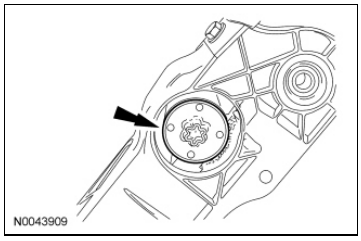
NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

NOTICE: **Use only the Air Conditioning (A/C) refrigerant compressor oil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate and damage the A/C system.**

NOTICE: **Care must be taken to minimize exposure of the receiver/drier cartridge to outside air. If multiple Air Conditioning (A/C) system components are being removed and installed, the receiver/drier cartridge should be installed last. The new receiver/drier cartridge should not be removed from its packaging until it is ready to be installed. Evacuation of the A/C system must be started as soon as the receiver/drier cartridge is installed. Excessive exposure of the receiver/drier cartridge to outside air will result in moisture contamination of the receiver/drier cartridge desiccant.**

NOTE: Installation of a new receiver/drier cartridge is not required when repairing the A/C system, except when there is physical evidence of contamination from a failed A/C compressor or damage to the rec/drier cartridge. Damage to the receiver/drier cartridge includes physical damage or moisture contamination. Moisture contamination results only from a complete loss of refrigerant, and equalization of the refrigerant system pressure with atmospheric pressure for a period longer than one hour. If even a slight amount of positive refrigerant pressure is present in the refrigerant system before repairs are carried out, the receiver/drier cartridge does not need to be replaced.

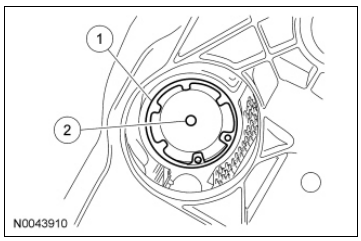
1. Recover the refrigerant. For additional information, refer to Section 412-00A .
2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer Section 100-02 .
3. Remove the lower radiator air deflector.
4. Unscrew and remove the plastic receiver/drier cap.



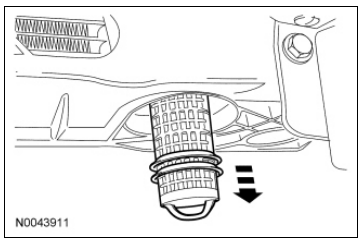
5. **NOTE:** If the receiver/drier plug is difficult to remove, open a refrigerant system fitting to relieve any vacuum created during refrigerant recovery, and attempt to remove the plug again.

   Remove the receiver/drier plug.

   1. Push the receiver/drier plug upwards and remove the snap ring.
   2. Install the bolt included with the A/C desiccant cartridge service kit in the center of the receiver drier plug and remove the plug.



6. Using a suitable tool, grasp the receiver/drier cartridge grab handle and remove the receiver/drier cartridge.



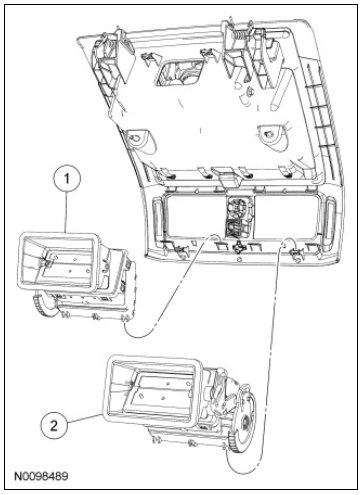
7. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

   To install, reverse the removal procedu.

   - Lubricate the receiver/drier plug O-ring seals using residual refrigerant oil from inside the receiver/drier.
   - Add the correct amount of clean PAG oil (non-hybrid) or electric A/C compressor oil (hybrid) to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

8. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Register - Center, Fusion/Milan

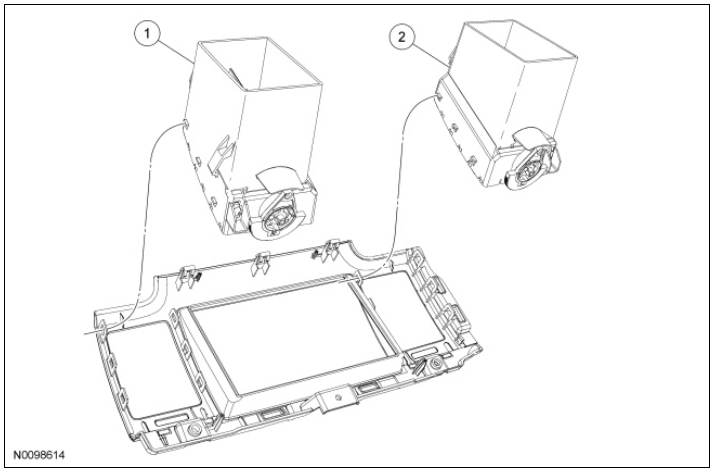


Item	Part Number	Description
1	19893	RH center instrument panel register
2	19893	LH center instrument panel register

Removal and Installation

1. Remove the instrument panel upper storage compartment. For additional information, refer to Section 501-12 .
2. Release the clips on each register and remove the 2 center instrument panel registers.
3. To install, reverse the removal procedure.

Register - Center, MKZ

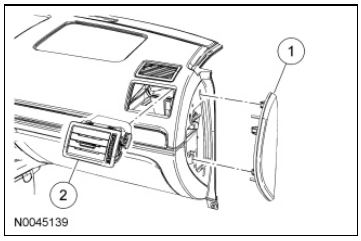


Item	Part Number	Description
1	19893	RH center register
2	19893	LH center register

Removal and Installation

1. Remove the center instrument panel finish panel. For additional information, refer to Section 501-12 .
2. Detach the RH and LH center register clips and remove the RH and LH center registers.
3. To install, reverse the removal procedure.

Register - Driver and Passenger Side, Fusion/Milan



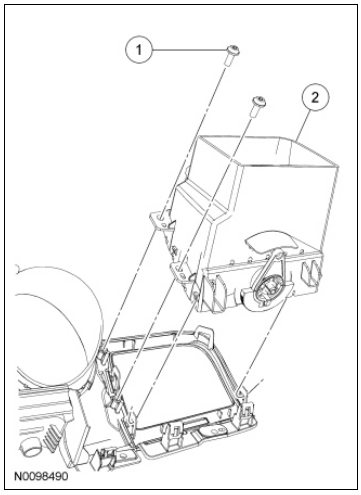
Item	Part Number	Description
1	04480 RH/ 04481 LH	Instrument panel side finish panel
2	19893	Register

Removal and Installation

NOTE: Passenger side register shown, driver side similar.

1. Remove the instrument panel end panel.
2. Working through the instrument panel end panel opening, release the 2 lower register clips and remove the driver or passenger side instrument panel register.
3. To install, reverse the removal procedure.

Register - LH, MKZ

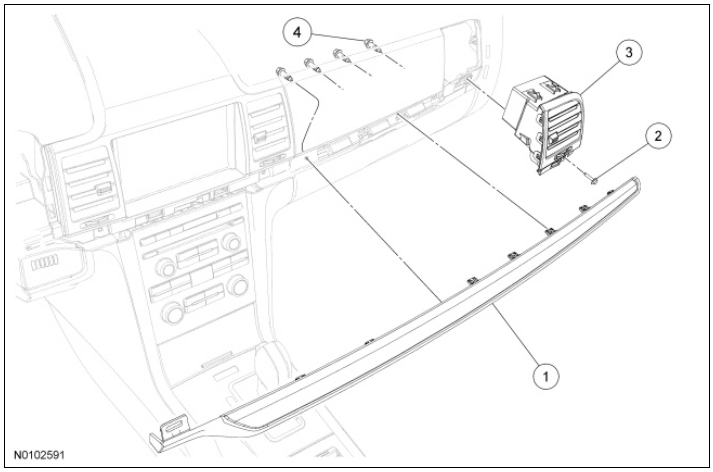


Item	Part Number	Description
1	-	LH instrument panel register screw (2 required)
2	19893	LH instrument panel register

Removal and Installation

1. Remove the instrument cluster finish panel. For additional information, refer to Section 501-12 .
2. Remove the 2 LH instrument panel register screws.
3. Remove the LH register.
4. To install, reverse the removal procedure.

Register - RH, MKZ

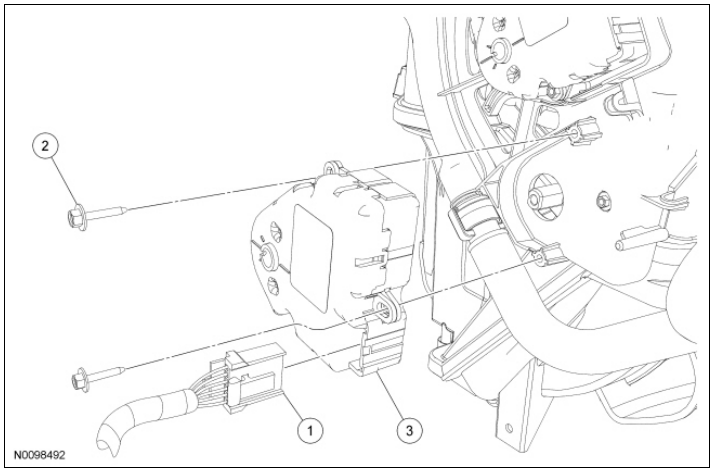


Item	Part Number	Description
1	54044A90	RH instrument panel finish moulding
2	-	RH register screw
3	19893	RH register
4	W707607	RH instrument panel finish moulding screw (4 required)

Removal and Installation

1. Remove the instrument cluster finish panel. For additional information, refer to Section 501-12 .
2. Lower the glove compartment.
3. Remove the 4 RH instrument panel finish moulding screws.
4. Remove the RH instrument panel finish moulding.
5. Remove the RH register screw.
6. Remove the RH register.
7. To install, reverse the removal procedure.

Temperature Blend Door Actuator - LH



Item	Part Number	Description
1	-	LH temperature blend door actuator electrical connector (part of 19D887)
2	W712320	LH temperature blend door actuator screw (2 required)
3	19E616	LH temperature blend door actuator

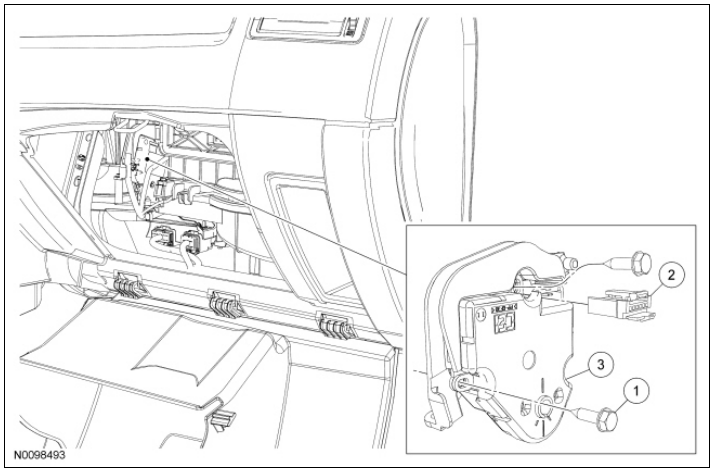
Removal and Installation

NOTE: The LH temperature blend door actuator can be accessed from below the LH side of the instrument panel to the right of the accelerator pedal.

1. Disconnect the LH temperature blend door actuator.
2. Remove the 2 LH temperature blend door actuator screws.
3. Remove the LH temperature blend door actuator.
4. To install, reverse the removal procedure.
5. **NOTE:** The purpose of the module actuator position calibration is to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out calibration, carry out the following steps.

   Remove the Smart Junction Box (SJB) fuse 15 for at least one minute.
6. **NOTE:** When the ignition switch is switched to the ON position, the HVAC module will initialize and calibrate the actuators. Calibration of the actuators will take approximately 30 seconds. SJB fuse 15. Turn the ignition switch to the ON position and wait 30 seconds before verifying correct DEFROST/PANEL/FLOOR operation.

Temperature Blend Door Actuator - RH, Dual-Zone EATC



Item	Part Number	Description
1	W712320	RH temperature blend door actuator screw (2 required)
2	-	RH temperature blend door actuator electrical connector (part of 19D887)
3	19E616	RH temperature blend door actuator

Removal and Installation

1. Remove the passenger air bag module. For additional information, refer to Section 501-20B .
2. Disconnect the RH temperature blend door actuator electrical connector.
3. Remove the 2 RH temperature blend door actuator bracket screws.
4. Detach the wire harness from the RH temperature blend door actuator bracket.
5. Remove the RH temperature blend door actuator.
6. To install, reverse the removal procedure.
7. **NOTE:** The purpose of the module actuator position calibris to allow the HVAC module to reinitialize and calibrate the actuator stop points. To carry out calibration, carry out the following steps.

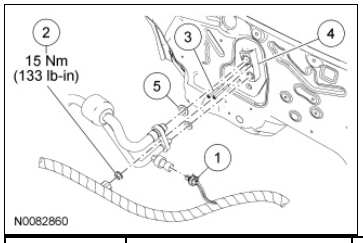
   Remove the Smart Junction Box (SJB) fuse 15 for at least one minute.
8. **NOTE:** When the ignition switch is switched to the ON position, the HVAC module will initialize and calibrate the actuators. Calibration of the actuators will take approximately 30 seconds.

   Reinstall SJB fuse 15. Turn the ignition switch to the ON position and wait 30 seconds before verifying correct DEFROST/PANEL/FLOOR operation.

Thermostatic Expansion Valve

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



Item	Part Number	Description
1	-	A/C pressure transducer electrical connector (part of 14290)
2	W520413	Thermostatic Expansion Valve (TXV) fitting nut
3	W712321	TXV bolt (2 required)
4	19849	TXV
5	19B596	Gasket seal (4 pieces from kit required)

Removal and Installation

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

NOTICE: **Use only the Air Conditioning (A/C) refrigerant compressor oil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate and damage the A/C system.**

1. Recover the refrigerant. For additional information, refer to Section 412-00A .
2. Disconnect the A/C pressure transducer electrical connector and detach the wire harness from the Thermostatic Expansion Valve (TXV) stud.
3. Remove the TXV fitting nut and disconnect the fitting.

- Discard the gasket seals.
- To install, tighten to 15 Nm (133 lb-in).

4. Remove the 2 TXV bolts.

5. Remove the TXV .
   - Discard the gasket seals.

6. ***NOTICE:*** **Motorcraft® Electric A/C Compressor Oil only must be used as a refrierant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

   To install, reverse the removal procedure.

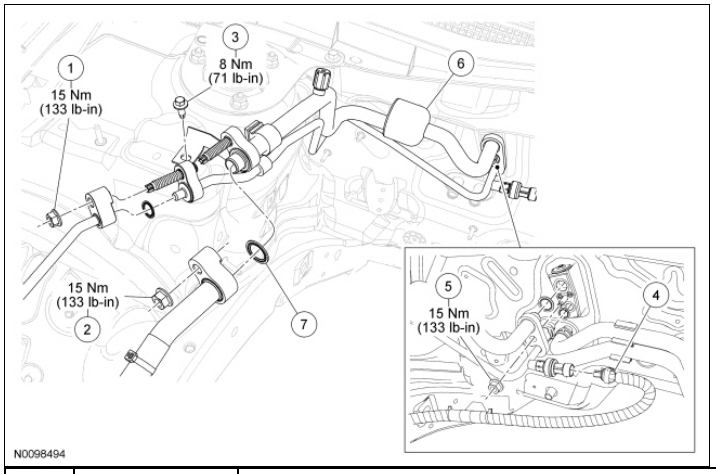
   - Install new gasket seals.
   - Add the correct amount of clean PAG oil (non-hybrid) or electric A/C compressor oil (hybrid) to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

7. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Thermostatic Expansion Valve Manifold and Tube Assembly

Material

Item	Specification
Motorcraft® Electric A/C Compressor Oil YN-32	-
Motorcraft® PAG Refrigerant Compressor Oil YN-12-D	WSH-M1C231-B



Item	Part Number	Description
1	W520413	Condenser-to-evaporator line fitting nut
2	W520413	Compressor manifold and tube suction fitting nut
3	W707399	Thermostatic Expansion Valve (TXV) manifold and tube bracket bolt
4	14290	A/C pressure transducer electrical connector
5	W520413	TXV fitting nut
6	19835	TXV manifold and tube assembly
7	19B596	Gasket seal (4 pieces from kit required)

Removal and Installation

NOTICE: **Motorcraft® Electric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

NOTICE: **Use only the Air Conditioning (A/C) refrigerant compressor oil specified for this vehicle configuration. Use of any A/C refrigerant compressor oil other than what is specified will contaminate**

and damage the A/C system.

All vehicles

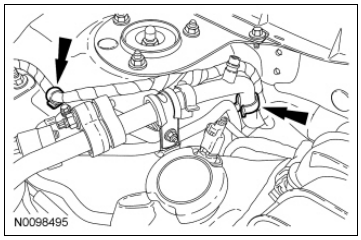
1. Recover the refrigerant. For additional information, refer to Section 412-00A .

3.5L vehicles

2. Remove the lower cowl panel grille. For additional information, refer to Section 501-02 .

Non-hybrid vehicles

3. Detach the wire harness pin-type retainer at the front of the RH shock tower and detach the 2 wire harness clips from the Thermostatic Expansion Valve (TXV) manifold and tube assembly.



All vehicles

4. Remove the condenser-to-evaporator line fitting nut and disconnect the fitting.
   - Discard the gasket seal.
   - To install, tighten to 15 Nm (133 lb-in).

5. Remove the compressor manifold and tube suction fitting nut and disconnect the fitting.
   - Discard the gasket seal.
   - To install, tighten to 15 Nm (133 lb-in).

6. Remove the TXV manifold and tube bracket bolt.
   - To install, tighten to 8 Nm (71 lb-in).

7. Disconnect the A/C pressure transducer electrical connector and detach the wire harness from the TXV manifold and tube assembly.

8. Remove the TXV fitting nut and disconnect the fitting.
   - Discard the gasket seals.
   - To install, tighten to 15 Nm (133 lb-in).

9. Remove the TXV manifold and tube assembly.

10. ***NOTICE:*** **Motorcraft® Elecric A/C Compressor Oil only must be used as a refrigerant system lubricant for hybrid vehicles. Addition of any oil other than Motorcraft® Electric A/C Compressor Oil to the hybrid vehicle refrigerant system will damage the electric Air Conditioning (A/C) compressor and contaminate the refrigerant system. Refer to the Refrigerant Oil Adding procedure in Section 412-00A .**

    To install, reverse the removal procedure.

    - Install new O-ring seals and new gasket seals.

- Add the correct amount of clean PAG oil (non-hybrid) or electric A/C compressor oil (hybrid) to the refrigerant system. For additional information, refer to the Refrigerant Oil Adding procedure in Section 412-00A .

11. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00A .

Instrument Cluster and Panel Illumination

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

Illumination is used to provide backlighting to the dimmable and non-dimmable switches and control components.

If the exterior lamps are activated during daytime sunload conditions by the autolamp system, the Instrument Panel Cluster (IPC) message center (non-Hybrid) or the Liquid Crystal Display (LCD) (Hybrid), Audio Control Module (ACM), Front Controls Interface Module (FCIM), Front Display Interface Module (FDIM), the HVAC module and switch illumination remain at full intensity and do not dim from the instrument panel dimmer switch during this condition. If the vehicle travels under a bridge or a tunnel, the low level of ambient light causes the illumination level of the IPC message center (non-Hybrid) or the LCD (Hybrid), the ACM , the FCIM , the FDIM , the HVAC module and switches to change to the level set by the instrument panel dimmer switch. The IPC message center (non-Hybrid) or the LCD (Hybrid), the ACM , the FCIM , the FDIM , the HVAC module and switch illumination change back to full intensity when the intense ambient light is restored.

Dimmable Backlighting

The dimmable switches and components are illuminated when the parking lamps are ON. The digital dimmer switch is a double detent rocker switch used to control all dimmable interior illuminated components, and to control the courtesy lamps. The first up detent increases dimmable backlighting intensity. The first down detent decreases dimmable backlighting intensity.

The second up detent turns on the courtesy lamps. The second down detent turns the courtesy lamps off unless other features are still requesting the courtesy lamps on.

The dimmable switches and components consist of:

- Ambient lighting/traction control switch (if equipped) (Fusion)
- Ambient lighting select switch (if equipped) (MKZ)
- Ambient lighting dimmer switch (if equipped) (MKZ)
- Audio Control Module (ACM)
- Luggage compartment lid release switch
- Door lock control switches (MKZ)
- Front Controls Interface Module (FCIM)
- Front Display Interface Module (FDIM)
- Hazard flasher lamp switch (Fusion)
- Headlamp switch
- HVAC module
- Instrument Panel Cluster (IPC)
- Instrument panel dimmer switch
- Memory set switch (MKZ)
- Message center switch (Fusion)
- Speed control switches
- Steering wheel audio control switches
- Floor shifter
- Window control switches (MKZ)

Non-Dimmable Backlighting

The non-dimmable lighting switches and components are illuminated when the accessory delay relay is energized. The non-dimmable switches and components are illuminated at full lamp intensity. The non-dimmable lighting switches and components consist of:

- Cigar lighter (MKZ)
- Door lock control switches (Fusion)
- Roof opening panel switch (if equipped)
- Window control switches (Fusion)

Instrument Cluster and Panel Illumination

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit 105-R025D or equivalent

Principles of Operation

Dimmable Backlighting

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

When the parking lamps are on, the SJB sends a pulse-width modulated voltage to the hardwired dimmable components and switches based on input received from the instrument panel dimmer switch.

The SJB also sends a message over the network to the Audio Control Module (ACM), Front Controls Interface Module (FCIM), Front Display Interface Module (FDIM), the HVAC module, and the Instrument Panel Cluster (IPC) to indicate the backlighting intensity level. If the receiving module receives invalid backlighting data from the SJB for 5 seconds or less, the receiving module defaults the backlighting to the last setting.

If the receiving module does not receive the backlighting status message from the SJB or if the data received is deemed invalid for more than 5 seconds, the receiving module sets a DTC in continuous memory and defaults the backlighting to full nighttime intensity.

Fixed Backlighting

For Fusion, when the accessory delay relay is energized, switched voltage is supplied to the window control and door lock control switches.

For MKZ, when the accessory delay relay is energized, switched voltage is supplied to the roof opening panel switch and the cigar lighter.

Field-Effect Transistor (FET) Protection

Field-Effect Transistor (FET) is a type of transistor that when used with module software can be used to monitor and control current flow on module outputs. The FET protection strategy is used to prevent module damage in the event of excessive current flow.

The SJB utilizes a FET protective circuit strategy for many of its outputs (for example, a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down (turns off the voltage or ground provided by the module) when a fault event is detected. A continuous DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET circuit protection to allow the circuit to function. The next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection) and the circuit remains shorted, the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When each tolerance level is reached, the continuous DTC that was stored on the first failure cannot be cleared by a command to clear the continuous DTCs. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC B106E and the associated continuous DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns.

When the first or second level is reached, the continuous DTC (associated with the short circuit) sets along with DTC B106E. These DTCs can be cleared using the module on-demand self-test, then the Clear DTC operation on the scan tool (if the on-demand test shows the fault corrected). The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs B106F and B1342 set along with the associated continuous DTC. This DTC cannot be cleared and the module must be replaced.

The SJB FET protected output circuit for the instrument panel illumination system is the backlighting output circuit.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Smart Junction Box (SJB) fuse(s): ♦ 10 (15A) (dimmable illumination) ♦ 41 (15A) (non-dimmable illumination) • Wiring, terminals or connectors • Illuminated components

- SJB

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

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

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

DTC Charts

Smart Junction Box (SJB) DTC Chart

DTC	Description	Action
B106E	Solid State Driver Disabled Due to Short Circuit	The module has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The SJB cannot enable the output until the cause of the short is corrected. ADDRESS all other DTCs first. After the cause of the concern is corrected, CLEAR the DTCs. REPEAT the self-test.
B106F	Module Disabled Due to External Fault	The module has permanently disabled an output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the SJB can withstand. The cause of the excessive current draw MUST be corrected before a new SJB is installed. ADDRESS all other DTCs first. After the cause of the concern is corrected, INSTALL a new SJB . TEST the system for normal operation.
B213A		GO to Pinpoint Test A .

	Digital Dimmer Switch Input Circuit Failure	
B29B7	White Lighting Output Circuit Open	If the backlighting components are inoperative, GO to Pinpoint Test B . If the backlighting components are always on, GO to Pinpoint Test C .
B29B8	White Lighting Output Circuit Short to Ground	GO to Pinpoint Test C .
B2A32	LED Backlighting Output Circuit Open	If the backlighting components are inoperative, GO to Pinpoint Test B . If the hardwired backlighting components are always on, GO to Pinpoint Test C .
B2A33	LED Backlighting Output Circuit Short to Ground	GO to Pinpoint Test B .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: All Dimmable Illumination Does Not Dim/Increase Brightness

Refer to Wiring Diagrams Cell 71 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Cluster and Panel Illumination for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends voltage signals to the instrument panel dimmer switch to monitor a request to turn up the dimmable lighting, turn down the dimmable lighting and to turn the courtesy lamps on or off. When the instrument panel dimmer switch is placed in the first detent up or down, the corresponding input signal is routed to ground indicating a request to turn the dimmable lighting up or down. When the instrument panel dimmer switch is pressed to the second detent, the dome lamp request input circuit is routed to ground in addition to the dimmer up or dimmer down input circuit. The SJB needs a dimmer up/down input circuit and the dome lamp request input circuit to turn the courtesy lamps on or off from the instrument panel dimmer switch.

When the parking lamps or headlamps are ON, the Smart Junction Box (SJB) monitors the input from the instrument panel dimmer switch to increase or decrease the dimmable lighting intensity.

If the dim up/dim down or the dome lamp request input circuit is shorted to ground for longer than 17 seconds, the SJB defaults the backlighting to full nighttime brightness.

- DTC B213A (Digital Dimmer Switch Input Circuit Failure) - a continuous and on-demand DTC that sets when the SJB detects a short to ground from the dimmer up, dimmer down or dome lamp on/off request input circuit.

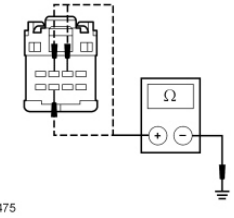
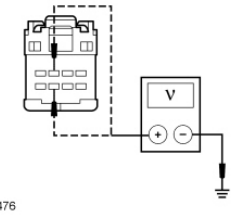
This pinpoint test is intended to diagnose the following:

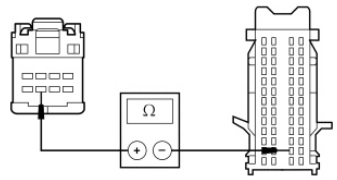
- Wiring, terminals, or connectors
- Instrument panel dimmer switch
- SJB

PINPOINT TEST A: ALL DIMMABLE ILLUMINATION DOES NOT DIM/INCREASE BRIGHTNESS

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

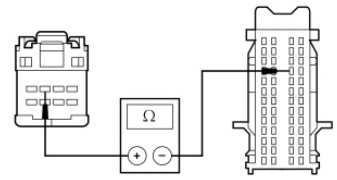
Test Step	Result / Action to Take
A1 CHECK FOR RECORDED DTCs FROM THE SJB SELF-TEST	
• Ignition OFF. • Check the recorded DTCs from the SJB on-demand self-test. • **Is DTC B213A present?**	**s** GO to A2 . **No** GO to A4 .
A2 REPEAT THE SJB SELF-TEST WITH THE INSTRUMENT PANEL DIMMER SWITCH DISCONNECTED	
• Disconnect: Instrument Panel Dimmer Switch C2065. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Clear the DTCs and repeat the SJB on-demand self-test. • **Is on-demand DTC B213A still present?**	**Yes** GO to A3 . **No** INSTALL a new instrument panel dimmer switch. REFER to Instrument Panel Dimmer Switch in this section. TEST the system for normal operation.
A3 CHECK THE INSTRUMENT PANEL DIMMER SWITCH INPUT CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280b. • Measure the resistance between the instrument panel dimmer switch , harness side and ground as follows: **Connector-Pin** / **Circuit** C2065-2 / CLN28 (GN/BU) C2065-3 / CLN27 (WH/BN) C2065-7 / CLN12 (YE)	**Yes** GO to A9 . **No** REPAIR the circuit in question for a short to ground. CLEAR the DTCs. REPEAT the self-test.

 N0102475 • **Are the resistances greater than 10,000 ohms?**	
A4 CHECK THE INSTRUMENT PANEL DIMMER SWITCH	
• Disconnect: Instrument Panel Dimmer Switch C2065. • Carry out the instrument panel dimmer switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Is the instrument panel dimmer switch OK?**	**Yes** GO to A5 . **No** INSTALL a new instrument panel dimmer switch. REFER to Instrument Panel Dimmer Switch in this section. TEST the system for normal operation.
A5 CHECK THE INSTRUMENT PANEL DIMMER SWITCH DIM UP AND DIM DOWN INPUT CIRCUITS FOR VOLTAGE	
• Ignition ON. • Measure the voltage between the instrument panel dimmer switch C2065-7, circuit CLN12 (YE), harness side and ground; and between the instrument panel dimmer switch C2065-3, circuit CLN27 (WH/BN), harness side and ground.  N0102476 • **Are the voltages greater than 10 volts?**	**Yes** GO to A7 . **No** GO to A6 .
A6 CHECK THE INSTRUMENT PANEL DIMMER SWITCH DIM UP AND DIM DOWN CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: SJB C2280b. • Measure the resistance between the instrument panel dimmer switch C2065-7, circuit CLN12 (YE), harness side and the SJB C2280b-28, circuit CLN12 (YE), harness side.	**Yes** GO to A9 . **No** REPAIR the circuit in question for an open. TEST the system for normal operation.



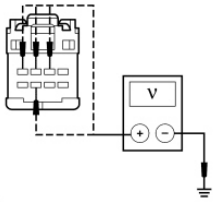
N0099755

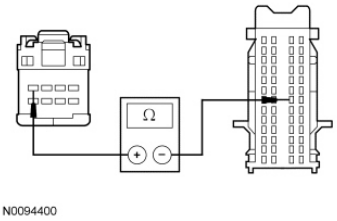
- Measure the resistance between the instrument panel dimmer switch C2065-3, circuit CLN27 (WH/BN), harness side and the SJB C2280b-36, circuit CLN27 (WH/BN), harness side.



N0099756

- **Are the resistances less than 5 ohms?**

A7 CHECK THE INSTRUMENT PANEL DIMMER SWITCH INPUT AND RETURN CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280b. • Ignition ON. • Measure the voltage between the instrument panel dimmer switch , harness side and ground as follows: **Connector-Pin / Circuit** C2065-2 — CLN28 (GN/BU) C2065-3 — CLN27 (WH/BN) C2065-4 — RLN29 (WH/OG) C2065-7 — CLN12 (YE)  N0102477 • **Is any voltage present?**	**Yes** REPAIR the circuit in question for a short to voltage. TEST the system for normal operation. **No** GO to A8 .

A8 CHECK THE INSTRUMENT PANEL DIMMER SWITCH RETURN CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between the instrument panel dimmer switch C2065-4, circuit RLN29 (WH/OG), harness side and the SJB C2280b-33, circuit RLN29 (WH/OG), harness side.  N0094400 • **Is the resistance less than 5 ohms?**	**Yes** GO to A9 . **No** REPAIR circuit CLN27 (WH/BN) for an open. TEST the system for normal operation.
A9 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: All Dimmable Switch Illumination Is Inoperative

Refer to Wiring Diagrams Cell 71 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Cluster and Panel Illumination for schematic and connector information.

Normal Operation

When the parking lamps are on, the Smart Junction Box (SJB) sends a Pulse Width Modulated (PWM) voltage to the hardwired dimmable illumination sources based on the input received from the instrument panel dimmer switch.

DTC Description	Fault Trigger Conditions
• B106E - Solid State Driver Disabled Due to Short Circuit	A continuous DTC that sets when the SJB has temporarily shut down the output driver. The module has temporarily disabled the backlighting output because an excessive current draw exists (such as a short to ground). The SJB cannot enable the backlighting output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.

• B106F - Module Disabled Due to External Fault	A continuous DTC that seten the SJB has permanently shut down the output driver. The module has permanently disabled the backlighting output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the SJB can withstand. The cause of the excessive current draw MUST be corrected before a new SJB is installed.
• B2A32 - LED Backlighting Output Circuit Open	An on-demand DTC that sets when the SJB detects an open from the backlighting output circuit.
• B2A33 - LED Backlighting Output Circuit Short To Ground	A continuous and on-demand DTC that sets when the SJB detects a short to ground from the backlighting output circuit. The DTC also sets when fuse 10 (15A) has failed or is removed.
• B29B7 - White Lighting Output Circuit Open	An on-demand DTC that sets when the SJB detects an open from the white lighting (backlighting) circuit.
• B29B8 - White Lighting Output Circuit Short to Ground	A continuous and on-demand DTC that sets when the SJB detects a short to ground from the white lighting (backlighting) output circuit. This DTC also sets when fuse 10 (15A) has failed or is removed.

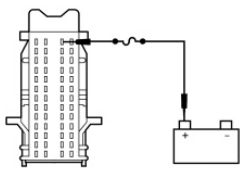
This pinpoint test is intended to diagnose the following:

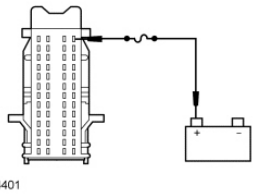
- Fuse
- Wiring, terminals or connectors
- SJB

PINPOINT TEST B: ALL DIMMABLE SWITCH ILLUMINATION IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK FOR RECORDED SJB DTCs FROM THE SELF-TEST	
• Use the recorded results from the SJB self-test. • **Is DTC B2A33 or DTC B29B8 present?**	**Yes** VERIFY the SJB fuse 10 (15A) is OK. IfK, GO to B2 . If not OK, REFER to the Wiring Diagrams Manual to identify the

	possible causes of the circuit short. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the backlighting output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** GO to B2 .
B2 BYPASS THE SJB	
NOTE: If the jumper wire fails, refer to the Wiring Diagrams Manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, test the system for normal operation. If DTC B106E is present, Clear the DTCs **and** repeat the self-test **(required to enable the backlighting output driver if DTC B106E is present).** TEST the system for normal operation. If DTC B106F is present, install a new SJB . Refer to Section 419-10 . TEST the system for normal operation. • Ignition OFF. • Disconnect: SJB C2280b. • For Fusion, connect a fused jumper wire between the SJB C2280b-39, circuit VLN04 (VT/GY), harness side and battery positive.  N0064547 • For MKZ, connect a fused jumper wire between the SJB C2280b-52, circuit VLN37 (BU/WH), harness side and battery positive.	**Yes** REMOVE the jumper wire. GO to B3 . **No** REMOVE the jumper wire. REPAIR circuit VLN04 (VT/GY) (Fusion) or circuit VLN37 (BU/WH) (MKZ) for an open. CLEAR the DTCs. REPEAT the self-test.

 N0094401 • **Do the backlighting components illuminate?**	
B3 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test C: All Dimmable Switch Illumination Is Always On

Refer to Wiring Diagrams Cell 71 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Cluster and Panel Illumination for schematic and connector information.

Normal Operation

When the parking lamps are on, the Smart Junction Box (SJB) sends a Pulse Width Modulated (PWM) voltage to the hardwired dimmable illumination sources based on the input received from the instrument panel dimmer switch.

- DTC B2A32 (LED Backlighting Output Circuit Open) - an on-demand DTC that sets when the SJB detects a short to voltage from the backlighting output circuit.
- DTC B29B7 (White Lighting Output Circuit Open) - an on-demand DTC that sets when the SJB detects a short to voltage from the white lighting (backlighting) output circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- SJB

PINPOINT TEST C: ALL DIMMABLE SWITCH ILLUMINATION IS ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 CHECK THE EXTERIOR LIGHTING	

• Ignition ON. • Observe the exterior lighting components. • **Are any exterior lighting components illuminated?**	**Yes** REFER to Section 417-01 . **No** GO to C2 .
C2 CHECK THE SJB BACKLIGHTING OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280b. • Ignition ON. • **Do the dimmable backlighted components continue to illuminate?**	**Yes** REPAIR circuit VLN04 (VT/GY) (Fusion) or circuit VLN37 (BU/WH) (MKZ) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to C3 .
C3 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: The Steering Wheel Control Illumination Is Inoperative

Refer to Wiring Diagrams Cell 71 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Cluster and Panel Illumination for schematic and connector information.

Normal Operation

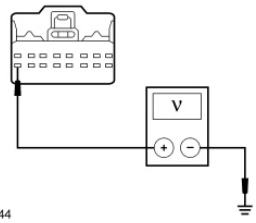
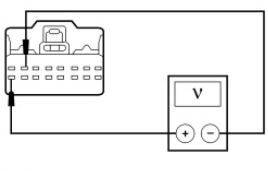
The Smart Junction Box (SJB) sends a Pulse Width Modulated (PWM) voltage to the steering wheel controls through the clockspring. The voltage passes through the clockspring to the steering wheel control switches.

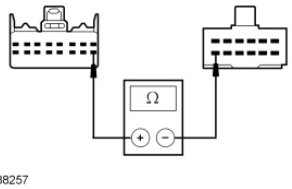
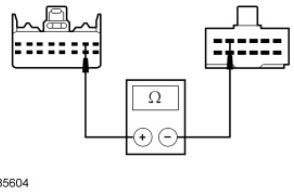
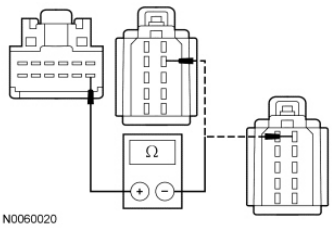
This pinpoint test is intended to diagnose the following:

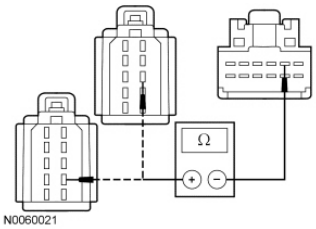
- Wiring, terminals or connectors
- Steering wheel control switch(es)
- Steering wheel harness
- Clockspring

PINPOINT TEST D: THE STEERING WHEEL CONTROL ILLUMINATION IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 CHECK THE OTHER DIMMABLE LIGHTING SWITCHES	
• Ignition OFF. • Place the headlamp switch in the PARKING LAMPS ON position. • Increase the backlighting brightness to the highest setting. • **Are all the dimmable switches inoperative?**	**Yes** GO to Pinpoint Test B . **No** GO to D2 .
D2 CHECK FOR VOLTAGE TO THE CLOCKSPRING	
• Place the headlamp switch in the OFF position. • Depower the Supplemental Restraint System (SRS). Refer to Section 501-20B . • Disconnect: Clockspring C218a. • Connect: Negative Battery Cable. • Place the headlamp switch in the PARKING LAMPS ON position. • Rotate the instrument panel dimmer switch to the full illumination position. • Measure the voltage between the clockspring C218a-16, circuit VLN04 (VT/GY) (Fusion) or circuit VLN37 (BU/WH) (MKZ), harness side and ground.  N0026444 • **Is the voltage greater than 10 volts?**	**Yes** GO to D3 . **No** REPAIR circuit VLN04 (VT/GY) (Fusion) or circuit VLN37 (BU/WH) (MKZ). REPOWER the SRS . REFER to Section 501-20B . TEST the system for normal operation.
D3 CHECK FOR VOLTAGE TO THE CLOCKSPRING USING THE CONNECTOR GROUND	
• Measure the voltage between the clockspring C218a-16, circuit VLN04 (VT/GY) (Fusion) or circuit VLN37 (BU/WH) (MKZ), harness side and the clockspring C218a-7, circuit GD116 (BK/VT), harness side.  N0090351 • **Is the voltage greater than 10 volts?**	**Yes** GO to D4 . **No** REPAIR circuit GD116 (BK/VT) for an open. REPOWER the SRS . REFER to Section 501-20B . TEST the system for normal operation.
D4 CHECK THE CLOCKSPRING FOR AN OPEN	

• Remove the driver air bag module. Refer to Section 501-20B . • Disconnect: Upper Clockspring C218b. • Measure the resistance between the clockspring C218a pin 16, component side and the upper clockspring C218b pin 7, component side.  N0088257 • Measure the resistance between the clockspring C218a pin 7, component side and the upper clockspring C218b pin 2, component side.  N0085604 • **Are the resistances less than 5 ohms?**	**Yes** GO to D5 . **No** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation.
D5 CHECK THE STEERING WHEEL HARNESS VOLTAGE CIRCUIT FOR AN OPEN	
• Disconnect: Steering Wheel Switches C2997 and C2998. • Measure the resistance between the upper clockspring C218b-7, circuit VLN04 (VT/GY), harness side and the LH steering wheel switch C2998-2, circuit VLN04 (VT/GY), harness side; and between the upper clockspring C218b-7, circuit VLN04 (VT/GY), harness side and the RH steering wheel switch C2997-1, circuit VLN04 (VT/GY), harness side.  N0060020 • **Are the resistances less than 5 ohms?**	**Yes** GO to D6 . **No** REPAIR or INSTALL a new steering wheel harness. INSTALL the driver air bag module. REFER to Section 501-20B . TEST the system for normal operation.
D6 CHECK THE STEERING WHEEL HARNESS GROUND CIRCUIT FOR AN OPEN	

• Measure the resistance between the LH steering wheel switch C2998-4, circuit GD165 (BK), harness side and the clockspring C218b-2, circuit GD165 (BK), harness side; and between the RH steering wheel switch C2997-3, circuit GD165 (BK), harness side and the clockspring C218b-2, circuit GD165 (BK), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** INSTALL new steering wheel controls as necessary. REFER to Section 419-03 or Section 415-00 . TEST the system for normal operation. **No** REPAIR or INSTALL a new steering wheel harness. INSTALL the driver air bag module. REFER to Section 501-20B . TEST the system for normal operation.

Pinpoint Test E: One or More Switch Illumination Is Inoperative

Refer to Wiring Diagrams Cell 71 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Cluster and Panel Illumination for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends a Pulse Width Modulated (PWM) voltage to the dimmable components. When the accessory delay relay is energized, voltage is supplied to the door lock control switches (Fusion), roof opening panel switch and the cigar lighter.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Ambient lighting/traction control switch (Fusion)
- Cigar lighter (MKZ)
- Luggage compartment lid release switch
- Door lock control switches (MKZ)
- Floor shifter
- Hazard flasher lamp switch (Fusion)
- Headlamp switch
- Instrument panel dimmer switch
- Memory set switch (MKZ)
- Message center switch (Fusion)
- Roof opening panel switch (if equipped)
- Window control switches (MKZ)
- Floor shifter
- SJB

PINPOINT TEST E: ONE OR MORE SWITCH ILLUMINATION IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 CHECK THE VOLTAGE TO THE SINGLE ILLUMINATION SOURCE	
NOTE: If the headlamp switch is the inoperative source, unplug the headlamp switch connector to measure the illumination circuit voltage. Unplugging the connector causes the SJB to turn the exterior lights on by default for 10 minutes, so it is unnecessary to turn the headlamp switch on. • Ignition OFF. • Disconnect: Inoperative Illumination Source. • Ignition ON. • Place the headlamp switch in the PARKING LAMPS ON position. • Increase the backlighting brightness to the highest setting. • Measure the voltage between the inoperative illumination source, harness side and ground as follows: **Fusion**	**Yes** For the instrument panel dimmer switch, window control switch, cigar lighter, door lock control switch, roof opening panel switch, luggage compartment lid release switch, ambient lighting/traction control switch, hazard flasher lamp switch, or floor shifter, INSTALL a new component in question. TEST the system for normal operation. For all others, GO to E2 . **No** REPAIR the voltage supply circuit in question for an open. TEST the system for normal operation.

Component	Connector-Pin	Circuit
Ambient lighting/traction control switch (Fusion)	C2304-6	VLN04 (VT/GY)
Luggage compartment lid release switch	C2269-3	VLN04 (VT/GY)
Floor shifter	C3233-4	VLN04 (VT/GY)
Hazard flasher lamp switch	C2039-3	VLN04 (VT/GY)
Headlamp switch	C205-1	VLN04 (VT/GY)
Instrument panel dimmer switch	C2065-1	VLN04 (VT/GY)
Message center switch	C253-3	VLN04 (VT/GY)
Roof opening panel switch	C912-1	CBP41 (BU)
LH door lock switch	C505-2	CBP41 (BU)
RH door lock switch	C605-2	CBP41 (BU)

MKZ

Component	Connector-Pin	Circuit
Luggage compartment lid release switch	C2269-3	VLN37 (BU/WH)
Floor shifter	C3233-4	VLN37 (BU/WH)
Headlamp switch	C205-1	VLN37 (BU/WH)
Instrument panel dimmer switch	C2065-1	VLN37 (BU/WH)
Memory set switch	C503-6	VLN37 (BU/WH)
LH door lock control switch	C505-2	VLN37 (BU/WH)
RH door lock control switch	C605-2	VLN37 (BU/WH)
LH front window control switch	C535a-7	VLN37 (BU/WH)
RH front window control switch	C624-1	VLN37 (BU/WH)
LH rear window control switch	C701-4	VLN37 (BU/WH)
RH rear window control switch	C819-4	VLN37 (BU/WH)
Cigar lighter	C370-2	CBP41 (BU)
Roof opening panel switch	C912-1	CBP41 (BU)

- **Is the voltage greater than 10 volts?**

E2 CHECK THE VOLTAGE TO THE SINGLE ILLUMINATION SOURCE USING THE CONNECTOR GROUND

- Measure the voltage between the inoperative illumination source connector, harness side as follows:

Yes
INSTALL a new component in question. TEST the system for normal operation.

No
REPAIR the ground circuit in question for an open. TEST the system for normal operation.

Fusion

Component	Connector-Pin/ Circuit	Connector-Pin/ Circuit
Headlamp switch	C205-1 VLN04 (VT/GY)	C205-8 GD116 (BK/VT)
Message center switch	C253-3 VLN04 (VT/GY)	C253-6 GD116 (BK/VT)

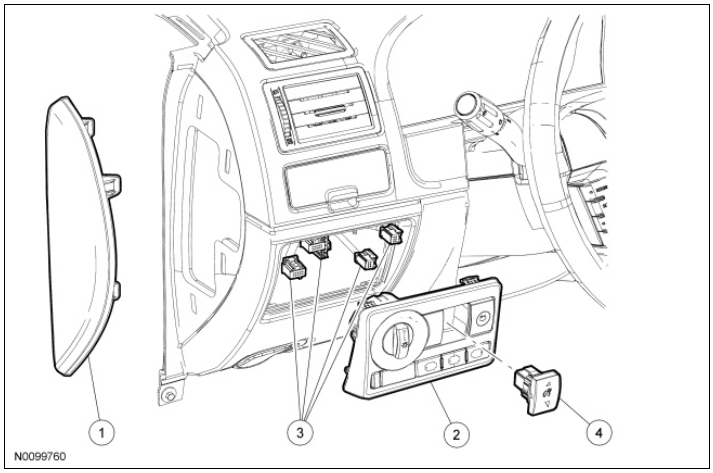
MKZ

Component	Connector-Pin/ Circuit	Connector-Pin/ Circuit
Headlamp switch	C205-1 VLN37 (BU/WH)	C205-8 GD116 (BK/VT)
Memory set switch	C503-6 VLN37 (BU/WH)	C503-5 GD126 (BK/WH)

- **Is the voltage greater than 10 volts?**

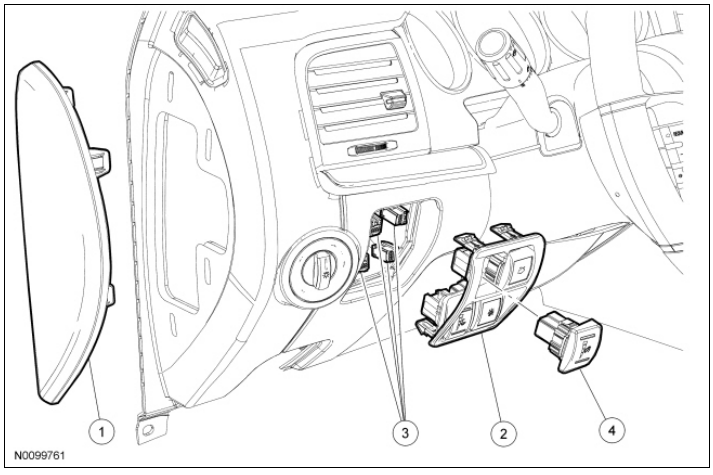
Instrument Panel Dimmer Switch

Fusion



Item	Part Number	Description
1	5404481	Instrument panel side finish panel
2	5404338	Switch bezel
3	-	Instrument panel dimmer switch electrical connectors (part of 14401)
4	11961	Instrument panel dimmer switch

MKZ



Item	Part Number	Description
1	5404481	Instrument panel side finish panel
2	5404338	Switch bezel
3	-	Instrument panel dimmer switch electrical connectors (part of 14401)

4	-	Instrument panel dimmer switch

Removal and Installation

1. Remove the instrument panel side finish panel.
2. **NOTE:** The switch bezel assembly is removed by releasing tabs and pushing out from behind.

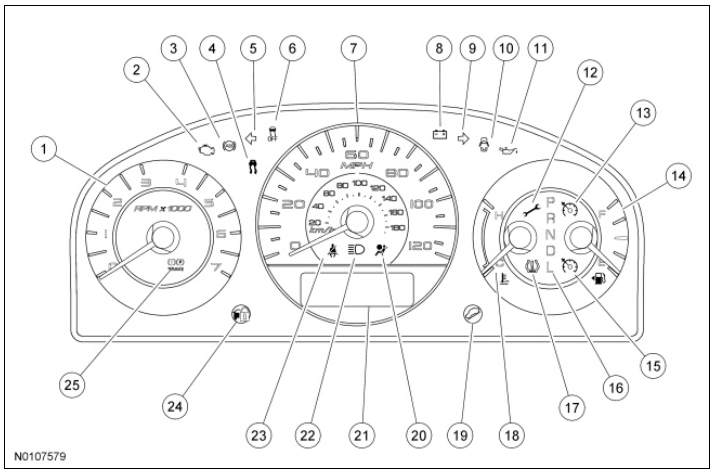
   Release the tabs and remove the switch bezel assembly.

   - Disconnect the electrical connectors.
3. Release the 2 tabs and remove the instrument panel dimmer switch from the switch bezel.
4. To install, reverse the removal procedure.

Instrument Panel Cluster (IPC)

Fusion Non-Hybrid

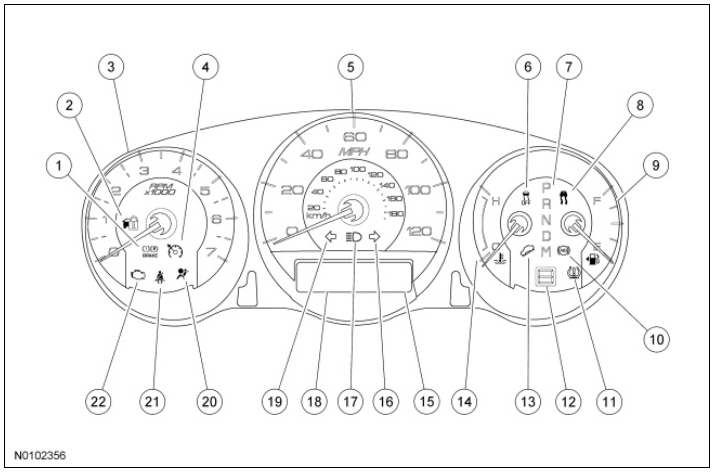
NOTE: Non-select shift shown, select shift IPC similar.



Item	Part Number	Description
1	-	Tachometer
2	-	Malfunction Indicator Lamp (MIL)
3	-	ABS warning indicator
4	-	Traction control indicator
5	-	LH turn indicator
6	-	Traction control disabled indicator
7	-	Speedometer
8	-	Charging system warning indicator
9	-	RH turn indicator
10	-	Door/hood ajar warning indicator
11	-	Low oil pressure warning indicator
12	-	Powertrain malfunction (wrench) warning indicator
13	-	Cruise control on indicator
14	-	Fuel gauge
15	-	Cruise control engaged indicator
16	-	PRNDL display (displays PRNDM with select shift)
17	-	Tire Pressure Monitoring System (TPMS) warning indicator
18	-	Engine coolant temperature gauge
19	-	Grade assist indicator (without select shift)
20	-	Air bag warning indicator
21	-	Message center

22	-	High beam indicator
23	-	Safety belt warning indicator
25	-	Brake warning indicator

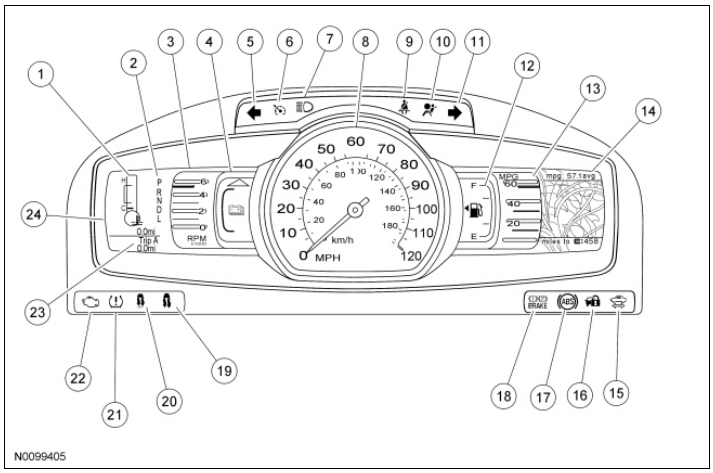
MKZ Non-Hybrid



Item	Part Number	Description
1	-	Brake warning indicator
2	-	Anti-theft indicator
3	-	Tachometer
4	-	Cruise control engaged indicator
5	-	Speedometer
6	-	Traction control disabled indicator
7	-	PRNDL display
8	-	Traction control indicator
9	-	Fuel gauge
10	-	ABS warning indicator
11	-	TPMS warning indicator
12	-	Select shift gear indicator
13	-	Grade assist indicator (without select shift)
14	-	Engine coolant temperature gauge
15	-	area
16	-	RH turn indicator
17	-	High beam indicator
18	-	Message center
19	-	LH turn indicator
20	-	Air bag warning indicator
21	-	Safety belt warning indicator
22	-	MIL

Hybrid

NOTE: Fusion Hybrid enlighten display shown, MKZ Hybrid and other hybrid displays similar.



Item	Part Number	Description
1	-	Engine coolant temperature gauge
2	-	PRNDL display
3	-	Tachometer/EV gauge
4	-	High voltage battery indicator
5	-	LH turn indicator
6	-	Cruise control engaged indicator
7	-	High beam indicator
8	-	Speedometer
10	-	Air bag warning indicator
11	-	RH turn indicator
12	-	Fuel gauge
13	-	Fuel efficiency gauge
14	-	Efficiency information display
15	-	Ready to drive indicator
16	-	Anti-theft indicator (Fusion/Milan Hybrid only)
17	-	ABS warning indicator
18	-	Brake warning indicator
19	-	Traction control indicator
20	-	Traction control disable indicator
21	-	TPMS warning indicator
22	-	MIL
23	-	Odometer display
24	-	Message center indicator display area

MyKey®

The MyKey® feature allows the customer to program a restricted driving mode that is tied to one or more keys known as a MyKey®. When a MyKey® is in use, the IPC provides the following functions:

- The IPC continuously provides a periodical Belt-Minder® warning chime until the driver and passenger safety belts are buckled. When the Belt-Minder® is issued, the ACM is muted and the

message center displays BUCKLE UP TO UNMUTE RADIO.
- If the MyKey® speed limiter feature is turned on and the vehicle speed approaches 130 km/h (80 mph), the message center displays VEHICLE NEAR TOP SPEED along with a chime.
- If the MyKey® speed limiter feature is turned on and the vehicle speed reaches 130 km/h (80 mph), the message center displays TOP SPEED MYKEY SETTING along with a chime.
- If the speed warning is selected at one of the pre-set values (75, 90, 105 km/h [45, 55, 65 mph]) and the vehicle approaches the pre-set speed, the message center displays CHECK SPEED DRIVE SAFELY along with a chime.
- If the traction control always on feature is turned on and the MyKey® driver presses the traction control switch to disable traction control, the message center displays ADVDTAC ON MYKEY SETTING.
- At 120 km (75 miles) of remaining fuel, the IPC illuminates the low fuel indicator (if equipped) and the message center displays the appropriate Distance To Empty (DTE) along with a chime.
- MyKey® miles driven by the MyKey® user can be found in the information d
- The number of MyKey® programmed and administrator keys can be found in the information and system check displays.
- The parking aid, Blind Spot Information System (BLIS®) Cross Traffic Alert (CTA) and collision avoidance warning menus are disabled in the message center to force these features always on.

When an administrator key is in use, the IPC provides the following functions:

- The message center provides a menu that guides the user to create a MyKey® programmed key. When the maximum MyKey® limit is reached, the MyKey® creation menu is no longer available.
- The message center provides menus for setting 4 optional MyKey® features:
    - MyKey® 80 MPH speed limiter
    - MyKey® pre-selected speed warning
    - MyKey® radio volume limiter
    - Traction control on/off
- The message center provides a menu to clear all MyKey® programmed keys at once.
- MyKey® mileages driven by the MyKey® user can be found in system check function of the message center.
- The number of MyKey® and administrator keys can be found in the system check function of the message center.

Refer to Section 419-01B for additional information on the MyKey® features.

Non-Hybrid

The Instrument Panel Cluster (IPC) contains gauges, informational indicators, warning indicators, message center and message center indicators (MKZ only) that are designed to provide the driver with a system status and to er that certain conditions exist in the vehicle.

The IPC uses a message center display area for basic informational items such as the odometer, trip odometer, text-based messages and for message center warning indicator displays.

Startup (Welcome) Mode

The IPC provides a startup mode also known as a welcome strategy. When the vehicle receives a Remote Keyless Entry (RKE) request, the IPC illuminates the gauge pointers and graduation bars. When the key is inserted into the ignition switch, the IPC illuminates only the graduation bars. When the ignition is placed into the RUN or START position, the IPC begins its prove-out stage.

During the prove-out stage, the IPC sweeps then zeros all gauges while illuminating all LED indicators for a predetermined time.

Gauges

Gauges provide information to the driver indicating the status of systems. The systems that use gauges are as follows:

- Engine coolant temperature
- Engine rpm
- Fuel level
- Vehicle speed

Informational Indicators

Informational indicators provide information to the driver of conditions that exist in the vehicle. The informational indicators are grouped into the following systems/subsystems:

- Engine/powertrain control
    - ♦ All-Wheel Drive (AWD)
    - ♦ Electronic Throttle Control (ETC)
    - ♦ Fuel level
    - ♦ Malfunction Indicator Lamp (MIL)
    - ♦ Transaxle
- Lighting
    - ♦ High beam
    - ♦ Turn signal
- Vehicle control
    - ♦ Anti-theft
    - ♦ Cruise control
    - ♦ Traction control

Warning Indicators

Warning indicators provide information to the driver of conditions that could potentially cause personal injury or alter vehicle performance. The warning indicators are grouped into the following systems/subsystems:

- Engine/powertrain control
    - ♦ Charging system
    - ♦ Low engine oil pressure
- Occupant/driver safety
    - ♦ Door/hood ajar
    - ♦ Safety belt
    - ♦ Tire Pressure Monitoring System (TPMS)
    - ♦ Supplemental Restraint System (SRS) (air bag)
- Vehicle control
    - ♦ ABS
    - ♦ Brake system

Message Center Warning Indicators (MKZ Only)

Message center warning indicators illuminate in the message center and replace the typical indicator and warning lamps using the same iconic representation that are typically used as indicators or warning indicators in the IPC . When multiple warnings exist, the message center warning indicators rotate through each display until each condition has been corrected. The systems that use message center warning indicators include:

- Engine/powertrain control

    - Charging system
    - Low engine oil pressure
    - Low fuel
- Occupant/driver safety
    - Door/Hood ajar

Hardwired Inputs

The hardwired inputs are provided from the following systems or components:

- Compass
- Engine oil pressure switch
- Fuel level
- Message center switch
- Park detect
- Passive Anti-Theft System (PATS) transceiver
- Traction control disable switch

Network Messaged Inputs

Module messaging is becoming the standard for sending and receiving information required to operate the IPC . For a complete list of module messages with the message origination sources, refer to Section 418-00 .

The status and information messages that the IPC requires from other vehicle inputs are grouped into the following systems/subsystems:

- ABS
    - Anti-lock braking
    - Traction control
- Base brake system
    - Brake fluid level status
    - Parking brake status
- Lighting system
    - LH/RH turn
    - High beam
- Powertrain
    - Charging
    - Engine emission system
    - Engine rpm
    - Engine temperature
    - Grade assist (without select shift)
    - Transmission range
    - Vehicle speed
- SRS
- TPMS

Hybrid

The hybrid Instrument Panel Cluster (IPC) contains gauges, informational indicators, warning indicators, message center and message center indicators that are designed to provide the driver with a system status and to alert the driver that certain conditions exist in the vehicle. The instrument cluster uses digital displays for all non-text information except the speedometer. The speedometer is the only analog gauge used.

The IPC uses a message center display area for basic informational items such as the odometer, trip odometer,

text-based messages and message center warning indicator displays.

Startup (Welcome) Mode

The IPC provides a startup mode also known as a welcome strategy. When the vehicle receives a Remote Keyless Entry (RKE) request, the IPC begins the wake up sequence by illuminating the display areas on the RH and LH sides of the speedometer in ice blue followed by the grass and cloud image on each display area when the driver door is opened.

When the key is placed into the ignition, the speedometer pointer illuminates for approximately 30 seconds or until the key is transitioned to the RUN position.

Once the key is transitioned to the RUN position, the IPC continues the startup sequence through a series of stages that sweep and zero the speedometer, while illuminating the remaining gauges and digital displays starting at the center and moving outward. During this phase, the digital gauges sweep from zero or the lowest position to the highest position then return to display the current input value. The IPC also carries out the bulb prove-out during this phase of the startup mode.

As part of the startup mode, the IPC displays the **Press Info to View Demo** for the first 800 km (500 miles). From 800 km (500 miles) to 1,600 km (1,000 miles), the IPC displays **Demo and Tutorial Can Be Started Within SETUP Mode** . After 1,600 km (1,000 miles), the text disappears from the startup mode but the demo mode remains selectable through the setup menu.

Gauges

All gauges are digital displays except the speedometer which uses an analog gauge. Gauges provide information to the driver indicating the status of systems. The systems that use gauges are as follows:

- Electric vehicle
- Engine coolant temperature
- Engine rpm
- Fuel efficiency
- Fuel level
- High voltage battery
- Vehicle speed

Informational Indicators

Informational indicators provide information to the driver of conditions that exist in the vehicle. The informational indicators are grouped into the following systems/subsystems:

- Engine/powertrain control
    - ♦ Malfunction Indicator Lamp (MIL)
    - ♦ Hybrid ready
- Lighting
    - ♦ High beam
    - ♦ Turn signal
- Vehicle control
    - ♦ Anti-theft
    - ♦ Cruise control
    - ♦ Traction control

Warning Indicators

Warning indicators provide information to the driver of conditions that could potentially cause personal injury or alter vehicle performance. The warning indicators are grouped into the following systems/subsystems:

- Occupant/driver safety
  - ♦ Safety belt
  - ♦ Tire Pressure Monitoring System (TPMS)
  - ♦ Supplemental Restraint System (SRS) (air bag)
- Vehicle control
  - ♦ ABS
  - ♦ Brake system

Message Center Warning Indicators

Message center warning indicators illuminate in the message center and replace the typical indicator and warning lamps using the same iconic representation that are typically used as indicators or warning indicators in the IPC . When multiple warnings exist, the message center warning indicators rotate through each display until each condition has been corrected. The systems that use message center warning indicators include:

- Engine/powertrain control
  - ♦ Charging system
  - ♦ Electronic Throttle Control (ETC)
  - ♦ Engine temperature
  - ♦ High voltage battery
  - ♦ Fuel level
  - ♦ Motor temperature
  - ♦ Oil pressure
  - ♦ Transaxle
- Occupant/driver safety
  - ♦ Door ajar
  - ♦ Trunk ajar

Hardwired Inputs

The hardwired inputs are provided from the following systems or components:

- Compass
- Engine oil pressure switch
- Fuel level
- Message center switch
- Park detect
- Passive Anti-Theft System (PATS) transceiver
- Traction control disable switch

Network Messaged Inputs

Module messaging is becoming the standard for sending and receiving information required to operate the IPC . For a complete list of module messages with the message origination sources, refer to Section 418-00 .

The status and information messages that the IPC requires from other vehicle inputs are grouped into the following systems/subsystems:

- ABS
  - ♦ Anti-lock braking
  - ♦ Traction control

- Base brake system
    - ♦ Brake fluid level status
    - ♦ Parking brake status
- Lighting system
    - ♦ LH/RH turn
    - ♦ High beam
- Powertrain
    - ♦ Charging system
    - ♦ ETC
    - ♦ High voltage battery
    - ♦ Engine emission system
    - ♦ Engine rpm
    - ♦ Engine temperature
    - ♦ Motor temperature
    - ♦ Transaxle
    - ♦ Vehicle speed
- SRS
- TPMS

Information And Message Center

The message center is a fixed format display, integrated into the Instrument Panel Cluster (IPC). The message center functions are controlled by the message center switch. The message center displays important vehicle information by constantly monitoring different vehicle systems and informs the driver of vehicle operations, notifying the driver of potential vehicle problems by displaying a warning message pertaining to the system in which a fault has been detected.

The message center switch is located as follows:

- For MKZ, in the Front Controls Interface Module (FCIM).
- For hybrid and Fusion non-hybrid, on the LH side of the steering wheel incorporated into the steering wheel switch.

The message center provides the following features:

- Information displays
- Setup displays
- System check messages
- System warning messages

The message center information is selected through a set of 3 buttons:

- INFO
- SETUP
- RESET

Message Center Configuration

The message center has the capability to configure items such as units (English or metric), autolamp delay, to enable/disable a variety of options such as autolock, auto-unlock and easy entry/easy exit (if equipped).

On configurable items such as autolock, auto-unlock or easy entry/easy exit, the message center indicates the appropriate selection (ON/OFF) by bracketing the selection. For example, if the driver selects the autolock feature on, the message would display as follows: AUTOLOCK â ©ON> OFF. If the driver selects the autolock off, the message would display as follows: AUTOLOCK ON â ©OFF>.

Oil Change Minder

NOTE: On early build vehicles, the PCM uses time and distance calculations stored in Keep Alive Memory (KAM) in the PCM to help determine the oil change minder status. If the PCM KAM is reset or lost for any reason (battery disconnect, PCM disconnect or dead battery), the oil change minder is disabled and the oil life reset procedure needs to be carried out through the message center to re-enable the oil minder function.

The message center provides an oil change minder to inform the driver that an oil change is required. The duration of the interval between oil changes is calculated in the PCM based an a maximum mileage of 16,093 km (10,000 miles) or 1 year for normal driving. The PCM calculates and provides an oil life status message to the IPC . The IPC further converts the remaining oil life using the driver's configured oil life start value and displays the oil life percentage, indicating the remaining oil life. The oil change minder can be reset at any time by the driver. Refer to Message Center Configuration in this section.

Oil Life and Oil Life Start Value

The oil life is displayed in percentages. The oil life start value is used to increase or decrease the starting point of the oil life. The oil life start value can be changed back to the maximum of approximately 16,093 km (10,000 miles) if the value was previously changed or to lower the value by 10% increments down to 10%. Each 10% reduction lowers the oil life in both mileage and time (days).

Compass Display

Vehicles Without Navigation

The compass signal originates from the compass module, which is integrated into the auto-dimming interior mirror.

The compass reading is incorporated into the Front Display Interface Module (FDIM).

The vehicle heading is displayed as a 1 or 2 character display located in the upper RH side of the FDIM and indicates the current direction of the vehicle (N, NE, E, SE, S, SW, W, or NW). The compass continuously re-calibrates due to changes in the magnetic field and remains accurate during most driving conditions.

On Fusion, the Front Controls Interface Module (FCIM) buttons that allow the driver to operate (change) the calibration and zone setting procedures are located below the FDIM .

On MKZ, the buttons that allow the driver to operate (change) the calibration and zone setting procedures are located on the FDIM .

The compass display is on with the ignition in the ON or START position. When the ignition is first turned to the ON or START position, there is a momentary delay of approximately 6 seconds before the compass display illuminates. If the battery saver has been activated and the ignition is turned to ON or START, the momentary delay before the compass display illuminates is approximately 3 seconds. The compass display turns off as soon as the ignition is turned to the OFF or ACC position.

Vehicles With Navigation

The compass signal originates from the Global Positioning System (GPS) antenna. No calibration or zone adjustment is available, as the compass heading is based on the GPS signal. Refer to Section 415-00 for information on the GPS signal.

Compass Accuracy (Without Navigation)

Driving near power lines, or driving in the area of large iron or steel structures can temporarily change the compass heading. If the compass remains inaccurate after driving near such objects, calibrate the compass. Refer to Compass Calibration in this section.

Most geographic areas (zones) have a magnetic north compass point that varies slightly from the northerly direction on maps. This variation is 4 degrees between the adjacent zones and becomes noticeable as the vehicle crosses multiple zones. A correct zone setting eliminates the error. Refer to Compass Zone Adjustment in this section.

Fusion and MKZ (Non-Hybrid)

Information Displays (INFO button)

The information displays are non-timed modes. The selected mode remains on until the driver presses a message center button to change the mode or it is overridden by another mode. The information display

modes are:

- Odometer
- Trip odometer A or B
- MyKeyÂ® miles
- Distance To Empty (DTE)
- Average fuel economy
- Instantaneous fuel economy
- Trip elapsed drive time A or B
- Blank display

Setup Displays (SETUP button)

The setup displays are timed modes and terminate after a finite interval. The setup display modes are:

- System check
- Oil life
- Units (English/metric)
- Autolamp
- Autolock
- Auto-unlock
- Blind Spot Information System (BLISÂ®) (if equipped)
- Cross Traffic Alert (CTA) system (if equipped)
- Easy entry/easy exit (MKZ only)
- Create MyKeyÂ®
- MyKeyÂ® setup
- Clear MyKeyÂ®
- Parking aid (reverse sensing) (if equipped)
- Language

System Check Displays (RESET button)

By pressing the RESET button on the message center switch, the message center cycles through each of the system check displays being monitored. For each of the monitored systems, the message center indicates either an OK message or a warning message for 2-4 seconds.

The system check provides a check of the following systems:

- XXX% oil life
- All doors closed
- Trunk closed
- BLISÂ® (if equipped)
- CTA system (if equipped)
- Brake system
- Fuel level

System Warning Messages

The system warning messages alert the driver to possible problems or malfunctions in the vehicle operating systems. The message center displays the last selected feature if there are no additional warning messages. Once a warning message has been displayed, the message must be acknowledged to allow full functionality of the message center. Press the RESET button (base message center) or the OK button (optional message center) to acknowledge and clear the warning message.

The warning messages are divided into 3 basic categories:

- Cannot be cleared until the condition is corrected.
- Reappears 10 minutes after pressing the select/reset button.
- Reappears if the condition clears then reoccurs within the same ignition ON-OFF cycle.

When the IPC receives a request to display an informational warning message or a fault condition warning message, the message center may display one of the following warning messages:

Body

- BLIND SPOT NOT AVAILABLE (if equipped)
- BLIND SPOT SYSTEM FAULT (if equipped)
- CROSS TRAFFIC NOT AVAILABLE (if equipped)
- CROSS TRAFFIC SYSTEM FAULT (if equipped)
- DRIVER DOOR AJAR
- INTKEY COULD NOT PROGRAM (displayed when an attempt is made to program an invalid key or more than the maximum number of keys allowed by the Remote Keyless Entry (RKE) system).
- PASSENGER DOOR AJAR
- REAR LEFT DOOR AJAR
- REAR RIGHT DOOR AJAR
- REMOVE OBJECTS NEAR PASS SEAT
- SENSOR BLOCKED SEE MANUAL (if equipped)
- TO STOP ALARM START VEHICLE
- TRUNK AJAR
- VEHICLE COMING FROM LEFT (if equipped)
- VEHICLE COMING FROM RIGHT (if equipped)

Chassis

- BRAKE FLUID LEVEL LOW
- CHECK BRAKE SYSTEM
- CHECK PARK AID (if equipped)
- LOW TIRE PRESSURE
- PARK BRAKE ENGAGED
- POWER STEERING ASSIST FAULT (2.5L and 3.0L only)
- SERVICE ADVANCETRAC
- SERVICE POWER STEERING (2.5L and 3.0L only)
- SERVICE POWER STEERING NOW (2.5L and 3.0L only)
- TIRE PRESSURE MONITOR FAULT
- TIRE PRESSURE SENSOR FAULT

MyKeyÂ®

- KEY COULD NOT PROGRAM
- VEHICLE SPEED 130 KM/H (80 MPH) MAX
- MYKEY ACTIVE DRIVE SAFELY
- SPEED LIMITED TO 130 KM/H (80 MPH)
- CHECK SPEED DRIVE SAFELY
- VEHICLE NEAR TOP SPEED
- TOP SPEED MYKEY SETTING
- BUCKLE UP TO UNMUTE AUDIO
- ADVTRAC ON MYKEY SETTING

Powertrain

- CHECK AWD (if equipped)
- CHECK FUEL FILL INLET
- FUEL LEVEL LOW
- OIL LIFE CHANGE SOON
- OIL CHANGE REQUIRED

Service Procedure Displays

In addition to the warning messages, the message center provides messages that are displayed during repair procedures to indicate certain states of a procedure. The following are the service repair procedures displayed in the message center:

Tire Pressure Monitoring System (TPMS) Tire Training

- TIRES NOT TRAINED-REPEAT
- TRAIN LEFT FRONT TIRE
- TRAIN LEFT REAR TIRE
- TRAIN RIGHT FRONT TIRE
- TRAIN RIGHT REAR TIRE
- TRAINING COMPLETE

Hybrid

There are two basic viewing areas used for control and dissemination of the information related to the message center functions. The LH side of the Instrument Panel Cluster (IPC) displays the primary navigation and selections available. The RH side of the IPC displays instructions that assist the operator with controlling, selecting and maneuvering through the message center functions. The RH side only displays the instructions when the vehicle is stopped and returns to the IPC indication mode while the vehicle is in motion.

Information Displays (INFO button)

The information displays are non-timed modes. The selected mode remains on until the driver presses the INFO button to change the display. The information display modes are:

- Trip odometer A or B
- Average fuel economy
- Trip elapsed drive time A or B
- MyKeyÂ® miles
- Blank display

Setup Displays (SETUP button)

The setup displays are timed modes and terminate after a finite interval. To enter the setup menu, press the SETUP button once then repeatedly press the SETUP button to scroll through and select an item in the setup menu. The message center highlights the selected item in the LH side of the setup menu.

With the desired item highlighted, press the RESET button to select the item and move to the RH side of the setup menu. A check mark is displayed next to the current selection.

The setup displays are as follows:

- Display settings
- Vehicle settings

- System check
- Demo
- Tutorials
- Resets

Display Settings

With the display settings selection highlighted, press the RESET button to move to the RH side of the display settings selection of the setup menu (a check mark is displayed next to the current selection). Press the SETUP button to scroll through and select the item in the RH menu then press the RESET button to select the item.

The display settings are as follows:

- Display mode
  - Inform
  - Enlighten
  - Engage
  - Empower
- Fuel economy
  - On
  - Off
- Efficiency gauge
  - Efficiency leaves
  - FE history graph
  - None
- FE History Length
  - 10 minutes
  - 20 minutes
  - 60 minutes
- Language
  - English
  - French
  - Spanish
- Units
  - English
  - Metric

Efficiency Leaves

The 2 fuel efficiency display modes for the efficiency gauge provide similar information but in an entirely different format. Both display modes provide the average miles per gallon at the top of the display and the distance to empty at the bottom of the display. The efficiency leaves displays a leaf and vine display that changes as the vehicle driving efficiency changes. As driving efficiency increases, the efficiency leaves display adds more leaves and vines. The history graph can be displayed using 10, 20 or 60 minute intervals and is updated every 1, 2 or 6 minutes respectively. Each new average is added to the left side of the graph shifting the last update to the right.

Vehicle Settings

With the vehicle settings selection highlighted, press the RESET button to move to the RH side of the vehicle settings selection of the setup menu (a check mark is displayed next to the current selection). Press the SETUP button to scroll through and select the item in the RH menu then press the RESET button to select the item.

The vehicle settings are as follows:

- Autolamp
  - 0 seconds
  - 10 seconds
  - 20 seconds
  - 30 seconds
  - 60 seconds
  - 90 seconds
  - 120 seconds
  - 180 seconds
- Auto unlock
  - On
  - Off
- Autolock
  - On
  - Off
- Blind Spot (if equipped)
  - On
  - Off
- Cross Traffic Alert (if equipped)
  - On
  - Off
- Oil Life
  - Set to 100%
  - Set to 90%
  - Set to 80%
  - Set to 70%
  - Set to 60%
  - Set to 50%
  - Set to 40%
  - Set to 30%
  - Set to 20%
  - Set to 10%
- Rear Park Aid (if equipped)
  - On
  - Off

MyKeyÂ® Settings

- Create MyKeyÂ®
- MyKeyÂ® AdvTrac
  - Manual
  - Always on
- MyKeyÂ® speed
  - 130 km/h/80 mph
  - Off
- MyKeyÂ® chimes
  - Off
  - 75 km/h/45 mph
  - 90 km/h/55 mph
  - 105 km/h/65 mph
- MyKeyÂ® volume
  - Limited
  - Not limited
- Clear MyKeyÂ®

System Check

With the system check selection highlighted, press the RESET button to move to the RH side of the system check selection of the setup menu. Press RESET to start the system check.

The system check menu is as follows:

- Oil life
- Electric drive
- Charging system
- Door ajar
- Trunk ajar
- Electronic Power Assist Steering (EPAS)
- Blind spot (if equipped)
- Cross traffic alert (if equipped)
- Brake system
- Brake fluid
- Parking brake
- Tire pressure
- Passenger seat
- Parking aid
- Fuel fill inlet
- Fuel level (mi/km)
- MyKeyÂ® used
- MyKeyÂ®(s) programmed
- Admin key(s) programmed

System Warning Messages

System warnings alert the operator to possible problems or malfunctions in the vehicle operating system. When multiple warnings are displayed, the message center cycles all the warnings by displaying each one for several seconds. The system warning messages are displayed in the LH side of the IPC .

All warning messages are considered as active or non-active. Active warnings are those where the monitored system detects a current fault condition. Once the fault condition is corrected, the warning then becomes non-active. Both active and non-active warnings can be reset but if the warning is active, it continues to be displayed once it is reset.

All new warnings along with any associated message center warning indicators are displayed in a large format for 2 seconds and cannot be reset until the 2 second time has elapsed. Once the 2 seconds has elapsed, the warning can be reset by pressing the RESET button. Once the RESET button is pressed, the warning is considered an old warning and is displayed in a smaller format. If there are multiple warnings present, each warning displays (2 seconds for new warnings and 4 seconds for old warnings) in the order the message center received the warnings.

The message center displays the temperature gauge and PRNDL once all messages are reset and there are no more new warning messages. This allows full functionality of the message center by pressing the message center switch RESET button to clear the warning message. Warning messages that have been reset are divided into 2 categories where the message:

- Returns every 10 minutes
- Returns every key cycle

When the IPC receives a request to display an informational warning message or a fault condition warning

message, the message center may display one of the following warning messages:

Body

- BLIND SPOT NOT AVAILABLE (if equipped)
- BLIND SPOT SYSTEM FAULT (if equipped)
- CROSS TRAFFIC NOT AVAILABLE (if equipped)
- CROSS TRAFFIC SYSTEM FAULT (if equipped)
- DRIVER DOOR AJAR
- INTKEY COULD NOT PROGRAM (displayed when an attempt is made to program an invalid key or more than the maximum number of keys allowed by the Remote Keyless Entry (RKE) system).
- PASSENGER DOOR AJAR
- REAR LEFT DOOR AJAR
- REAR RIGHT DOOR AJAR
- REMOVE OBJECTS NEAR PASS SEAT
- SENSOR BLOCKED SEE MANUAL (if equipped)
- TO STOP ALARM START VEHICLE
- TRUNK AJAR
- VEHICLE COMING FROM LEFT (if equipped)
- VEHICLE COMING FROM RIGHT (if equipped)

Chassis

- BRAKE FLUID LEVEL LOW
- CHECK BRAKE SYSTEM
- CHECK PARK AID (if equipped)
- LOW TIRE PRESSURE
- PARK BRAKE ENGAGED
- POWER STEERING ASSIST FAULT
- SERVICE ADVANCETRAC
- SERVICE POWER STEERING
- SERVICE POWER STEERING NOW
- TIRE PRESSURE MONITOR FAULT
- TIRE PRESSURE SENSOR FAULT

MyKeyÂ®

- KEY COULD NOT PROGRAM
- VEHICLE SPEED 130 KM/H (80 MPH) MAX
- MYKEY ACTIVE DRIVE SAFELY
- SPEED LIMITED TO 130 KM/H (80 MPH)
- CHECK SPEED DRIVE SAFELY
- VEHICLE NEAR TOP SPEED
- TOP SPEED MYKEY SETTING
- BUCKLE UP TO UNMUTE AUDIO
- ADVTRAC ON MYKEY SETTING

Powertrain

- STOP SAFELY NOW
- HIGH ENGINE TEMPERATURE
- HIGH MOTOR TEMPERATURE
- CHECK AWD (if equipped)
- CHECK FUEL FILL INLET

- FUEL LEVEL LOW
- OIL LIFE CHANGE SOON
- OIL CHANGE REQUIRED

Service Procedure Displays

In addition to the warning messages, the message center provides messages that are displayed during repair procedures to indicate certain states of a procedure. The following are the service repair procedures displayed in the message center:

Tire Pressure Monitoring System (TPMS) Tire Training

- TIRES NOT TRAINED-REPEAT
- TRAIN LEFT FRONT TIRE
- TRAIN LEFT REAR TIRE
- TRAIN RIGHT FRONT TIRE
- TRAIN RIGHT REAR TIRE
- TRAINING COMPLETE

Warning Chimes

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The warning chimes are designed to provide the driver with an audible warning that acts as a supplemental alert. The only deviation from this strategy is the air bag chime which is used to alert the driver that the primary alerting system (air bag warning indicator) does not operate. The Instrument Panel Cluster (IPC) controls all warning chimes based on messages received from external modules.

The warning chime system consists of the following:

- IPC
- Key-in-ignition warning switch (part of the ignition switch)
- Restraints Control Module (RCM)
- SJB

The following chimes are controlled by the IPC :

- Air bag warning
- Belt-Minder®
- Door ajar
- Headlamps on
- Hybrid electric vehicle engine off reminder
- Key-in-ignition
- Message center
- Parking brake on
- Perimeter alarm
- Safety belt warning
- ServiceRoll Stability Control (RSC®) warning
- Turn signal/hazard
- Turn signal left on
- Memory feedback (if equipped)

Instrumentation, Message Center and Warning Chimes

Special Tool(s)

 ST3093-A	Fluke 77-1V Digital Multimeter FLU77-4 or equivalent
 ST1473-A	Instrument Gauge System Tester 014-R1063 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

NOTE: When installing a new Instrument Panel Cluster (IPC), it is necessary to upload the module configuration to the scan tool. Following installation of the IPC , download the module configuration from the scan tool into the new IPC . Refer to Section 418-01 to carry out the Programmable Module Installation (PMI). It is also necessary to carry out a parameter reset procedure whenever a new IPC or PCM (non-hybrid) or Transmission Control Module (TCM) (hybrid) is installed. Refer to Section 419-01B .

The IPC utilizes a microprocessor to control the gauge, indicator, message center and warning chime functions. Data is sent to the IPC over the Medium Speed Controller Area Network (MS-CAN) and the High Speed Controller Area Network (HS-CAN) bus lines and through hardwired circuitry from individual components. The IPC uses each input to output an action to the gauges or indicators.

It is very important to understand:

- where the input originates.
- all the information necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input control the output of the feature, or does it output a message over the communication network to another module.
- which module controls the output of the feature.

Instrument Panel Cluster (IPC)

IPC Gateway Function

The IPC acts as a gateway module by receiving information in one format and transmitting it to other modules using another format. For example, the IPC receives the vehicle speed data from the PCM over the HS-CAN , converts the data into an MS-CAN message and sends (gateways) the message to other network modules such as the HVAC module, the Audio Front Control Module (ACM) and the SJB . This enables network communication between modules that do not communicate using the same network (HS-CAN or the MS-CAN).

IPC Network Messages

The IPC uses input messages from other modules to control the gauges, informational indicators and warning indicators over the communication networks. If a required message is missing or invalid for less than 5 seconds, the gauge or indicator that requires the message remains at the last commanded state based upon the last known good message. For example, if the brake status message is missing for less than 5 seconds and the brake warning indicator was on, the indicator remains in the on state until the next good message is received. If the message remains missing or invalid for greater than 5 seconds, the IPC sets a U-code DTC and the output becomes a default action for the indicator or gauge. Each indicator or gauge utilizes a different default strategy depending on the nature of the indication. Refer to the normal operation descriptions located before each individual pinpoint test for further description of the default action specific to each indicator or gauge. If the messaged input to the cluster returns at any time, the normal function of the gauge or indicator resumes.

NOTE: Whenever a network message is suspected as missing and confirmed by a missing message DTC (U-code), it is important to look for other symptoms that may also be present in the IPC and throughout the vehicle. Once a DTC is set in the IPC , it may be helpful to review the complete message list available in Section 418-00 to see what other modules also rely on the same message and run the self-test for those modules. If the message is missing from other modules, the same DTC may also be set in those modules. Confirmation of missing messages common to multiple modules may indicate that the originating module is the source of the concern or the communication network may be experiencing some problems.

IPC Configuration

The IPC contains items that are configurable. Configurable items include customer preference items, which can also be set with a scan tool. The remaining configurable items can be set only through the PMI procedure or by using As-Built data. Refer to Section 418-01 .

IPC Configuration Parameters

Customer Preference Parameter	As-Built Parameter
-	ABS
-	Adaptive headlamps
-	Average fuel economy metric display type
-	Autolamp delay
-	Autolock
-	Auto-unlock
-	Belt-Minder®
-	Cluster plant mode
-	Compass
-	Cross traffic

-	Default oil life
-	Easy entry/easy exit
-	Engineering test mode
-	Electronic Power Assist Steering (EPAS)
-	English/metric default (Units)
-	Flex-fuel
-	Fuel tank size
-	Gallon display type
-	
-	Key-in-ignition warning chime
-	Language
-	MyKey®
-	Navigation
-	Number of fuel senders
-	Number of fuel tanks
-	Overspeed warning chime (gulf coast countries)
-	Rear park aid
-	Reverse mirror
-	Roll Stability Control (RSC®) chime
-	Transmission Control Module (TCM) (stand alone/integrated TCM -PCM
-	Select shift
-	Side detect
-	Speedometer calibration (Europe/North America)
-	Traction control/interactive vehicle dynamics/ RSC®
Tire Pressure Monitoring System (TPMS)	
-	Welcome
-	2-Wheel Drive (2WD)/Four-Wheel Drive (4WD)/All-Wheel Drive (AWD)

IPC Configuration Parameters - Hybrid

Customer Preference Parameter	As-Built Parameter
-	ABS
-	Average fuel economy metric display type
-	Autolamp delay
-	Autolock
-	Auto-unlock
-	Belt-Minder®
-	Cluster plant mode
-	Compass

-	Cross traffic
-	Daytime illumination
-	Default oil life
-	Electronic stability control/Roll Stability Control (RSC®) warning
English/metric default (Units)	
-	Flex-fuel
-	Fuel tank size
-	Gallon display type
-	IKT
-	Key-in-ignition warning chime
-	Language
-	MyKey®
-	Navigation
-	Number of fuel senders
-	Number of fuel tanks
-	Overspeed warning chime (gulf coast countries)
-	Park aid front
-	Park aid rear
-	Side detect
-	Speedometer calibration
-	Traction control/interactive vehicle dynamics/
-	Transmission Control Module (TCM)
-	Tire Pressure Monitoring System (TPMS)
-	Transmission type (manual/automatic)
-	Vehicle brand (Ford/Mercury/Lincoln)
-	2-Wheel Drive (2WD)/Four-Wheel Drive (4WD)/All-Wheel Drive (AWD)

IPC Software Flashing

The IPC is capable of receiving updated software after the end of line production. This software updating is called software flashing and is only carried out when a Technical Service Bulletin (TSB) provides the direction to do so. Follow all instructions on the TSB when flashing the IPC .

IPC Prove-Out

The IPC carries out a display prove-out to verify that all module controlled warning/indicator lamps and monitored systems are g correctly within the IPC . When the ignition is in the ON mode with the engine off, the indicators illuminate to prove-out according to the following table:

Non-Hybrid

Indicator	Indicator Type	Prove-Out Duration

ABS	Warning	3 seconds
Air bag	Warning	6 seconds
Anti-theft indicator	Informational	3 seconds
Brake	Warning	3 seconds
Charging system	Informational	Engine start up
Door/hood ajar	Informational	No prove-out
Grade assist (without select shift)	Informational	No prove-out
High beam	Informational	No prove-out
Low engine oil pressure	Warning	Engine startup
Malfunction Indicator Lamp (MIL)	Warning	Engine startup
Powertrain malfunction (wrench)	Warning	3 seconds
RH/LH turn signals	Informational	No prove-out
Safety belt	Warning	65 seconds if the safety belt is unbuckled, turns off when the safety belt is buckled
Cruise control engaged	Informational	No prove-out
Cruise control on	Informational	No prove-out
Tire Pressure Monitoring System (TPMS)	Warning	3 seconds
Traction control	Informational	3 seconds
Traction control disabled	Informational	3 seconds

Hybrid

Indicator	Indicator Type	Prove-Out Duration
ABS	Warning	3 seconds
Air bag	Warning	6 seconds
Anti-theft indicator	Informational	3 seconds
Brake	Warning	3 seconds
High beam	Informational	No prove-out
Malfunction Indicator Lamp (MIL)	Warning	Engine startup
Ready to drive	Informational	No prove-out
RH/LH turn signals	Informational	No prove-out
Safety belt	Warning	65 seconds if the safety belt is unbuckled, turns off when the safety belt is buckled
Cruise control	Informational	No prove-out
Tire Pressure Monitoring System (TPMS)	Warning	3 seconds
Traction control	Informational	3 seconds
Traction control disabled	Informational	3 seconds

Information And Message Center

The message center is an integral part of the IPC that receives and acts upon much of the same information that is input and used to operate the IPC gauges, informational indicators, warning indicators and warning chimes. For all vehicles except hybrid, the message center is a 2-line display located in the center of the IPC . On hybrid vehicles, the message center is split between the LH and RH side of the IPC with the controls displayed on the LH side and instructions displayed on the RH side. The hybrid message center also uses message center indicators either as stand alone indications or combined with text messages and are displayed in the LH display area.

All message center functions are controlled by a 3-button message center switch, which is hardwired to the IPC . The message center switch consists of 3 buttons and a resistor ladder with a different resistor associated with each switch button. The IPC sends out a reference voltage to the message center switch and monitors the voltage drop that results from the voltage flowing through the resistor when a message center button is pressed. The voltage drop will vary depending upon the resistance of each button, providing a specific indication to the IPC which switch is pressed.

NOTE: Compass zone adjustment and calibration proceedures are only applicable to vehicles without navigation. For vehicles with navigation, refer to Section 415-00 .

Compass

The compass display (located in the Front Display Interface Module (FDIM)) receives battery voltage from the SJB . The compass module (integral to the auto-dimming interior mirror) provides hardwired vehicle directional inputs to the Instrument Panel Cluster (IPC), which sends the compass information to the FDIM over the Medium Speed Controller Area Network (MS-CAN). The compass is capable of self-calibrating. This decreases the need to manually set the compass. If the compass is displaying a heading (and not displaying the C or CAL indicator), the compass is in auto-calibration mode. In this mode, the compass automatically calibrates for changes in vehicle magnetics over the life of the vehicle. This auto-calibration mode makes sure the compass heading is always accurate. If the compass displays the C or CAL indicator for an extended period of time (longer than 5 seconds), this indicates the compass has been placed in the manual calibration mode and therefore, requires manual calibration. Refer to Compass Calibration in this section.

Warning Chimes

The IPC uses inputs that are hardwired to individual components and messages that are sent from the other modules over the HS-CAN or MS-CAN to control the warning chime functions.

Warning Chime Characteristics

Each warning chime has unique characteristics to identify and differentiate each warning chime. The warning chimes use volume, chime frequency, length of time the chime sounds and the number of chime tones to identify which chime is sounding. The IPC prioritizes the chimes according to a preset hierarchy programmed into the IPC software. When more than one chime request is received by the IPC , the most important chime sounds. If a lower priority chime is currently sounding, the higher priority request takes over and replaces the lower priority chime.

There are 3 different chimes as listed below:

- Repetitive
- Single tone
- Tick-tock

The following table provides a summary of the chime characteristics.

Instrument Panel Cluster (IPC) Chime Characteristics

Chime Name	Chime Type	Condition/Description
Air bag	Repetitive	Consists of five sets of chime sequences that make up a chime cycle. Each chime sequence consists of 5 1-second chime tones followed by a 5 second delay. The IPC sounds 5 chime sequences then turns off the air bag chime for approximately 30 minutes. If the condition still exists, the air bag chime repeats the chime cycle.
Belt-Minder® A/B	Repetitive	The chime sounds 6 chime tones/safety belt warning indicator flash sequences for as long as the IPC receives the Belt-Minder® chime request.
Door ajar	Repetitive	The chime sounds repetitive tones for as long as the IPC receives a dooajar chime command.
Headlamps on	Repetitive	The chime sounds repetitive tones for as long as the headlamps or the parking lamps are on and the IPC receives the chime on command.
Hybrid Electric Vehicle (HEV) engine off	Repetitive	The chime sounds 5 chime tones with the ignition in RUN, the transaxle in PARK (P) and the driver door open or ajar.
Key-in-ignition	Repetitive	The chime sounds repetitive tones for as long as the key is in the ignition with the ignition in OFF or ACC and the driver door is ajar.
Memory feedback	Single	This is a single tone chime that sounds when the IPC receives a chime command as confirmation that the memory seat has been successfully set.
Message center	Single	This is a single tone chime that sounds once per ignition cycle whenever the IPC receives a new message commanding on one of the message center warnings.
Parking brake on	Repetitive	The chime sounds repetitive tones for as long as the parking brake is applied and the IPC receives the chime on command.
Perimeter alarm	Repetitive	The chime sounds 3 sequences of chime tones. The first sequence sounds 12 tones when the driver door is opened using a key and the alarm is armed. The second sequence sounds 9 chime tones followed by the third sequence of 12 tones.
Safety belt	Repetitive	The chime sounds 6 times or as long as the safety belt is unbuckled and the IPC receives the chime on command.
Service Roll Stability Control (RSC®)	Repetitive	The chime sounds 3 tones for as long as the IPC receives a chime on command from the ABS module following an initial 8-second delay.
Turn signal left on	Repetitive	Repetitive chime tone for as long as the RH or LH turn signal is on, the vehicle has travelled 3.2 km (2.0 miles) and the IPC receives the chime on command.
Turn signal	Tick-tock	Repetitive tick-tock tones for as long as the RH or LH turn signal command is received by the IPC .

Air Bag Secondary Warning Chime

The air bag secondary warning chime warns that the air bag warning indicator light does not work correctly and that a Supplemental Restraint System (SRS) fault condition exists. The IPC monitors the air bag warning indicator status internally. When a fault is present in the air bag warning indicator and the IPC receives an air bag warning indicator on request from the Restraints Control Module (RCM), the air bag secondary warning chime sounds.

The air bag secondary warning chime sounds for 1 second on then 1 second off for 5 seconds (5 1-second chime tones) then pauses for 5 seconds and repeats the chime on/off sequence for 5 minutes. The IPC then turns off the air bag chime for approximately 30 minutes and repeats the cycle if the condition still exists.

The air bag secondary warning chime inputs are:

- Ignition state.
- Air bag warning indicator chime request communicated by the RCM to the IPC .

Belt-Minder®

The Belt-Minder® is configurable. To configure without using a scan tool, refer to Belt-Minder® Deactivating/Activating in this section.

The Belt-Minder® feature supplements the current safety belt warning function and is enabled after the current safety belt warning is complete. The Belt-Minder® reminds the driver that the driver or passenger safety belt is unbuckled by intermittently and simultaneously sounding a chime and illuminating the safety belt warning indicator in the IPC once the vehicle speed has exceeded 9.7 km/h (6 mph). The Belt-Minder® remains active for 5 minutes from the time it is started.

While activated, the Belt-Minder® chime provides a series of 6 chime/safety belt warning indicator flash sequences that when combined, make up a chime cycle. Each chime/safety belt warning indicator sequence consists of a 1-second chime tone and safety belt warning indicator on/off state. The Belt-Minder® chime and the safety belt warning indicator sound and flash for 6 seconds, then the chime stops and the safety belt warning indicator remains on for 30 seconds. The IPC repeats the chime cycle for 5 minutes.

If the vehicle speed drops below 5 km/h (3 mph) once the Belt-Minder® chime has activated, the chime turns off and the safety belt warning indicator remains on. When the vehicle speed exceeds (6 mph) again, the Belt-Minder® chime resumes.

The IPC also provides a toll booth feature which allows the driver or passenger to unbuckle their safety belt after the safety belts were initially buckled, providing 1 minute without warnings after the vehicle exceeds 9.7 km/h (6 mph) again with a safety belt unbuckled.

NOTE: Whenever the vehicle is operated using MyKey®, the RCM enables the Belt-Minder®.

When MyKey® is in use, the driver cannot configure the Belt-Minder® off. Once the Belt-Minder® is activated, the Belt-Minder® continues to chime periodically (does not time out after 5 minutes) and the audio system is muted until the driver and passenger safety belts are fastened. Refer to Section 419-01B for more information on the MyKey® feature.

The Belt-Minder® warning chime inputs are the:

- Ignition state.
- Driver or passenger safety belt warning chime request communicated by the RCM to the IPC through the HS-CAN .
- Safety belt warning indicator request communicated by the RCM to the IPC through the HS-CAN .

Door Ajar Warning Chime

The door ajar warning chime warns that a door is ajar. The door ajar warning chime is a single chime with a 1 second duration. The door ajar chime sounds when the driver or passenger doors become ajar while the ignition switch is in the RUN position.

The door ajar warning chime inputs are the:

- Ignition state.
- Door ajar, liftgate or liftgate glass message from the SJB .

Headlamps On Warning Chime

The headlamps on warning chime warns that the headlamps or parking lamps are on when the driver door is ajar and the key is removed from the ignition lock cylinder. The headlamps on warning chime sounds if the driver door is ajar and the headlamp switch is in the PARK or HEADLAMP position and the ignition is OFF with the key out.

The headlamps on warning chime stops sounding when any one of the above conditions are removed.

The headlamps on warning chime inputs are:

- Ignition state.
- Key-in-ignition status to the SJB .
- Door ajar input from the driver door ajar switch to the SJB .
- Headlamp switch input to the SJB .
- Headlamps on chime request communicated by the SJB to the IPC through the MS-CAN .

Hybrid Electric Vehicle (HEV) Engine Off Chime

The HEV engine off chime sounds to remind the driver that the engine is not running and the vehicle is ready to drive. The HEV warning chime sounds when the key is in RUN, the driver door is ajar and the transaxle is in PARK (P).

The HEV warning chime inputs are:

- Ignition state.
- Door ajar input from the driver door ajar switch to the SJB .
- Door ajar status communicated from the SJB to the IPC through the MS-CAN .
- Transaxle park status communicated by the PCM to the IPC through the HS-CAN .

Key-In-Ignition Warning Chime

The key-in-ignition warning chime warns that the key is still in the ignition lock cylinder when the driver door is ajar. The key-in-ignition warning chime sounds when the driver door is ajar, the key is in the ignition lock cylinder and in the OFF or ACC position.

The key-in-ignition warning chime stops sounding when the driver door is closed, the key is removed from the ignition lock cylinder, or if the ignition switch is turned to the ON position.

The key-in-ignition warning chime inputs are:

- Ignition state.
- Key-in-ignition switch position to the SJB .
- Door ajar input from the driver door ajar switch to the SJB .

- Key-in-ignition chime request communicated by the SJB to the IPC through the MS-CAN .

Message Center Warning Chime

The message center warning chime feature is used to draw the driver's attention to the message center display to view a new warning message or message center warning indicator displayed. The IPC provides a single one-second tone whenever a new warning message is displayed in the message center. If multiple warning messages are present, the IPC sounds a chime for each of the warning messages that are present.

Memory Feedback Feature Chime

The purpose of the memory feedback feature chime is to inform the driver that their preferences have been successfully programmed through the memory set procedure.

The memory feature chime inputs are:

- Ignition RUN/START status.
- Memory feedback chime request communicated by the Driver Seat Module (DSM) to the IPC over the MS-CAN .

Parking Brake Warning Chime

The parking brake warning chime warns that the parking brake is engaged when the vehicle is in motion. The parking brake warning chime sounds if the ignition is in RUN mode, the parking brake is engaged, and the vehicle speed is greater than 5 km/h (3 mph).

The parking brake warning chime stops sounding if the parking brake is released, the ignition is not in the RUN mode, if the vehicle speed is less than 5 km/h (3 mph), or after 90 seconds from the time the chime is activated.

The parking brake warning chime inputs are:

- Ignition state.
- Parking brake switch status communicated by the SJB to the IPC through the MS-CAN .
- Vehicle speed data communicated by the PCM to the SJB through the MS-CAN .
- Parking brake warning chime request communicated by the SJB to the IPC .

Perimeter Alarm Chime

The perimeter alarm chime warning is used to alert the driver that the perimeter alarm is armed when the driver door is unlocked with a key. The perimeter alarm warning chime is only functional when a key is used to unlock the driver door. If the key fob or keypad (if equipped) is used to unlock the door, the perimeter alarm is disarmed and the perimeter alarm warning chime does not sound. The perimeter alarm warning chime sounds for 12 seconds when the driver door is opened and turns off when the perimeter alarm is disarmed (either by using the key fob, keypad or turning the key to the ON position). After the 12 second chime duration, the chime stops sounding and the perimeter alarm activates, sounding the horn and flashing the turn signal lights.

The perimeter alarm chime inputs are:

- Ignition state.
- Passive Anti-Theft System (PATS) armed/disarmed status.
- Driver door ajar input to the SJB .
- Perimeter alarm chime request from the SJB to the IPC through the MS-CAN .

Safety Belt Warning Chime

The safety belt warning chime warns that the safety belt is not fastened. The safety belt warning chime sounds for 6 seconds when the driver safety belt is not fastened and the ignition switch is transitioned from the OFF or ACC position to the ON or START position.

The safety belt warning chime stops sounding when the safety belt is fastened, when the ignition is switched from the ON or START position to the OFF or ACC position, or when the chime has sounded for approximately 6 seconds.

The safety belt warning chime inputs are:

- Ignition state.
- Driver or passenger safety belt warning chime request communicated by the RCM to the IPC through the HS-CAN .

Service Roll Stability Control (RSC®) Warning Chime

The service RSC® warning chime warns that the ABS module has detected a fault condition in the RSC® system. The SERVICE ADVANCETRAC message is also displayed along with the chime.

The service RSC® chime sounds for approximately 3 seconds following an initial delay of 8 seconds following key ON. The RSC® chime stops sounding when the ignition switch is turned from the RUN/START position to the OFF/LOCK or ACC position or when fault condition is repaired.

The service RSC® warning chime inputs are:

- Ignition state.
- Service RSC® chime request communicated by the ABS module to the IPC through the HS-CAN .

Turn Signal Left On Warning Chime

The turn signal left on warning chime warns that the turn signal has not been cancelled. The turn signal left on warning chime sounds if the left or right turn signal is on and the vehicle has traveled more than 3.2 km (2.0 miles).

The turn signal left on warning chime stops sounding if the turn signal is turned off, or if the ignition is switched to the OFF or ACC position.

The turn signal left on warning chime inputs are:

- Ignition state.
- Turn signal on data communicated by the SJB to the IPC through the MS-CAN .
- Odometer rolling count data communicated by the PCM to the IPC through the HS-CAN .

Turn/Hazard On Tone

Since the turn/hazard flasher is an electronic funcion of the SJB , the on/off sound that used to be present with standard bi-metal flashers is no longer present. To provide an audible sound and indicate that the RH/LH turn or hazard indicators are on, the IPC provides a tick-tock tone along with the visual turn signal indicators.

The turn/hazard on tone inputs are:

- Left turn indicator signal from the SJB to the IPC through the MS-CAN .
- Right turn indicator signal from the SJB to the IPC through the MS-CAN .

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Accessory drive belt • Brake fluid level • Compass module (integral to the auto-dimming interior mirror) • Engine oil level • Engine coolant level • Front Display Interface Module (FDIM) • Fuel tank • Fuel evaporative system • Tire pressure • Tire size	• Smart Junction Box (SJB) fuse(s): ♦ 14 (7.5A) (FDIM) (compass display) ♦ 26 (10A) ♦ 29 (5A) ♦ 41 (15A) (compass module) • Wiring, terminals or connectors • Instrument Panel Cluster (IPC)

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the IPC , SJB , PCM, ABS module and Restraints Control Module (RCM).

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

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Instrument Panel Cluster (IPC) , GO to Symptom Chart - Information And Message Center , or GO to Symptom Chart - Warning Chimes .

Instrument Panel Cluster (IPC) Dealer Test Mode - Non-Hybrid

To enter the IPC self-diagnostic mode, begin with the ignition key in the OFF position. Press and hold the message center SETUP and RESET buttons. Turn the key to the RUN position and hold the buttons until the display indicates ENGINEERING TEST MODE at the top of the right hand display (usually within 3 to 5 seconds) then release both buttons. Press the RESET button once to advance through each stage of the self-test. To exit the IPC self-test mode, turn the ignition to the OFF position.

NOTE: If the message center detects a non-resettable fault condition that it is reporting out on such as door ajar, the dealer test mode session cannot be entered until the fault condition has been corrected and the message removed. If the dealer test mode session is interrupted by the fault condition display (such as door ajar), the session can be resumed by pressing the RESET button.

NOTE: Some of the displays listed in the table below use xxx's to represent a numeric or alpha-numeric value. The value may display the same amount of characters represented by the xxx's or there may be more/less depending on the type of display. For example: VEHICLE SPEED xxxx.x MPH may display VEHICLE SPEED 25 MPH. Note that there were 4 x's in the display description but only 2 digits in the actual display.

Fusion

First Line Display	Second Line Display	Description
ENGINEERING	TEST MODE	Initial entry display into the self-test mode.
GAUGE	TEST	Carries out the gauge sweep of all gauges, then displays the present gauge values. Also carries out the checksum test on Read-Only Memory (ROM).
All VF segments illuminated	-	Carries out the prove-out of all dot matrix pixels in all characters.
TELLTALE	TEST	Illuminates all the microprocessor-controlled lamps and LEDs.
PART NUMBER	xxxx-xx	Return to normal operation of all microprocessor-controlled lamps/LEDs and displays the alpha-numeric prefix and suffix of the IPC part number.
ROM LEVEL	$xxxx	Displays the hexadecimal ROM level and type.
$xxxx	Displays the hexadecimal EEPROM level and type.	
SW RELEASE	xx/xx/xx	

		Displays the software release date in mm/dd/yy format stored in Non-Volatile Memory (NVM).
ROM CHECKSUM	$xxxxxxxx	Shows the ROM checksum data. $xxxxxxxx PASS = passed. $xxxxxxxx FAIL = failed. $--- CALC = calculating the checksum.
MANUFACTURE	DATE $xxxx	Displays hexadecimal coding of the final manufacturing test date.
MANUF CONFIG	BYTE 1 $xx	Displays hexadecimal coding of vehicle options NVM for line 1 of As-Built data for ABS/traction control/interactive vehicle dynamics, oil life threshold, Tire Pressure Monitoring System (TPMS) and Belt-Minder®.
B&A CONFIG	BYTE 1-6 $xx	Displays hexadecimal coding of vehicle options NVM for lines 1 through 6 of As-Built data.
CONTINUOUS	DTC $xxxxxx	Displays DTCs in 16-bit hexadecimal format. DTCs displayed are those detected in continuous operation not during self-test. If no DTCs are present, the DTC: None is displayed.
VEHICLE SPEED	xxx.x MPH	Displays the English speed value being inputs in tenths of mph to the Instrument Panel Cluster (IPC), the speedometer indicates the present filtered speed. If the High Speed Controller Area Network (HS-CAN) message is missing, the second line displays ---.- MPH. If the HS-CAN message is invalid, the second line displays INV MPH. If the vehicle speed input is an unknown value, UNKNOWN MPH is displayed.
VEHICLE SPEED	xxx.x km/h	Displays the metric speed value being inputs in tenths of km/h to the IPC , the speedometer indicates the present filtered speed. If the HS-CAN message is missing, the second line displays ---.- km/h. If the HS-CAN message is invalid, the second line displays INVALID km/h. If the vehicle speed input is an unknown value, UNKNOWN km/h is displayed.
TACHOMETER	xxxx RPM	Displays the tachometer value being input in rpm to the IPC . The tachometer indicates the present filtered rpm. If the HS-CAN message is missing, the second line displays ---.- RPM. If the HS-CAN message is invalid, the second line displays INV RPM.

		If the engine speed input is an unknown value, UNKNOWN RPM is displayed.
FUEL 1 LEVEL	xxx INSTANT	Displays the present primary (fuel pump module) unfiltered fuel level. 000-009 = short circuit. 010-254 = normal range. 255 = open. INV = invalid input.
FUEL 2 LEVEL	xxx INSTANT	Displays the present secondary (fuel level sender) unfiltered fuel level. 000-009 = short circuit. 010-254 = normal range. 255 = open. INV = invalid input.
FUEL 1 LEVEL %	STATUS xxx	Display present filtered primary (fuel pump module) input for fuel level percent status. 000-254 = normal range. 0255= open or short circuit detected. INV = invalid input.
FUEL 2 LEVEL %	STATUS xxx	Display present filtered secondary (fuel level sender) input for fuel level percent status. 000-254 = normal range. 0255= open or short circuit detected. INV = invalid input.
INSTANT DTE	xxx MILES	**NOTE:** This display may differ from the DTE displayed in the INFO menu of the message center due to the use of the unfiltered DTE calculation. Displays the calculated (unfiltered) Distance To Empty (DTE) in miles. --- = invalid input.
RAFE DTE	xx.x MPG	Displays the running fuel economy in decimal. If the fuel raw average fuel economy message is missing, the second line displays ---.- MPG. If the fuel raw average fuel economy message is invalid, the second line displays INVALID MPG.

FUEL 1 ON/OF/SZ	xxx xxx	Displays the key on, key off, and zero speed samples for the fuel pump module. If the input is invalid, the message center displays--- ---.
FUEL 2 ON/OF/SZ	xxx xxx xxx	Displays the key on, key off, and zero speed samples for the secondary fuel level input (fuel level sender). If the input is invalid, the message center displays --- --- ---.
F1 #S ON/OFF/SZ	xxx xxx xxx	Displays the number of valid samples used for key on, key off, and zero speed samples for the primary fuel level input (fuel pump module).
F2 #S ON/OFF/SZ	xxx xxx xxx	Displays the number of valid samples used for key on, key off, and zero speed samples for the secondary fuel level input (fuel level sender).
COOLANT TEMP	xxx C	Displays the last temperature gauge input value from the PCM over the HS-CAN in degrees C, temperature gauge indicates the present filtered temperature. If the temperature message is missing, the second line displays --- C. If the temperature message is invalid, the second line displays INV C.
ODOMETER	xxx COUNTS	Displays the unfiltered odometer rolling count input received over the HS-CAN from the PCM, in decimal. If the odometer rolling count data is missing, the second line displays --- COUNTS. If the odometer rolling count data is invalid, the second line displays INV counts.
COMPASS TX=$xx	CLUSTER RX=$xx	Display data received from the compass module and transmitted by the IPC to the compass module. If there is a communication concern with the compass module, the message center displays $--. If the compass is configured off, the message center displays, COMPASS CONFIGURED OFF.
BATTERY	xxx.x VOLTS	Displays the present battery reading in volts at the IPC input pin.
DIMMING CMD	xxx	Displays the dimming command message in percentage from the SJB over the MS-CAN . If the dimming command message is missing, the second line displays ---. If the dimming command message is invalid, the second line displays INV.
DIMVAL $xx	LITVAL $xx	Displays the dimming and lighting values from the SJB over the MS-CAN . 0-21 = normal range with 0 indicating off.

		22-253 = out of range. 254 = unknown value. 255 = invalid value. If the dimming and lighting value messages are missing, the line displays ---. If the dimming and lighting value messages are invalid, the line displays INV. If the dimming value is OK and the lighting value is unknown, DIMVAL xxx LITVAL UN is displayed. If the dimming value is invalid and the lighting value is unknown, DIMVAL INV LITVAL UN is displayed.
MC SWITCH	xxx A/D CNTS	Displays current message center switch input analog/digital counts in decimal (0-255).
LOW WASHER	SWITCH xxxx	Display the hardwired low washer fluid status received from the washer fluid level switch. The message center displays HIGH or LOW depending upon the state of the low washer fluid switch.
OIL PRESSURE	SWITCH xxx	Display the hardwired engine oil pressure status received from the engine oil pressure switch. The message center displays HIGH or LOW depending upon the state of the engine oil pressure switch.
LAST CHIME	SOUNDED xxxxxx	Displays the last chime that sounded. STBELT = safety belt, AIRBAG = air bag secondary, KEYIN = key in ignition, TRNSIG = turn signal reminder, DOOR = door ajar, HDLMPS = headlamps on, MSGCTR = message center warning tone, PRKBRK = park brake warning, BLTMDR = Belt-Minder® and MEMORY = memory feedback. If the input is unknown, the message center displays ---.
DIGITAL PORT 0-9, A, B, C, E or F	$xx	Displays 8 bit hexadecimal value of the digital port readings.
ANALOG PORT 0-9	$xx	Displays 10 bit hexadecimal value of the analog port readings.
GAUGE	TEST	Repeats the test display cycle.

Instrument Panel Cluster (IPC) Dealer Test Mode - Hybrid

To enter the IPC self-diagnostic mode, begin with the ignition key in the OFF position. Press and hold the message center SETUP and RESET buttons. Turn the key to the RUN position and hold the buttons until the display indicates ENGINEERING TEST MODE at the top of the right hand display (usually within 3 to 5 seconds) then release both buttons. Press the RESET button once to advance through each stage of the self-test. To exit the IPC self-test mode, turn the ignition to the OFF position.

The dealer test mode displays multiple items in a viewing window on the RH side of the IPC . Each button press advances the viewing window to the next set of items.

NOTE: If the message center detects a non-resettable fault condition that it is reting out on such as door ajar, the dealer test mode session cannot be entered until the fault condition has been corrected and the message removed. If the dealer test mode session is interrupted by the fault condition display (such as door ajar), the session can be resumed by pressing the RESET button.

NOTE: Some of the displays listed in the table below use xxx's to represent a numeric or alpha-numeric value. The value may display the same amount of characters represented by the xxx's or there may be more/less depending on the type of display. For example: DTC HIST CURR xxxxxx x x may display DTC HIST CURR C10000 X. Note that there were 8 x's in the display description but only 7 digits in the actual display.

Button Press	Viewing Window Display	Description
1	ENGINEERING TEST MODE	Initial entry display into the self-test mode.
2	ANALOG GAUGE TEST	Carries out the gauge sweep of the speedometer, then displays the present gauge value. Also carries out the checksum test on Read-Only Memory (ROM).
3	TELLTALE TEST	Illuminates all the microprocessor-controlled lamps and LEDs.
4	PartNo: xxxx-xx VIP sw: xxxx-xx GIP sw: xx.xx.xxx eeprom sw: xx.xx Man Date: xxxxxx B&A ConfigByte: xx xx xx xx xx xx	Displays the IPC part number, manufacturing date, Electrically Erasable Programmable Read-Only Memory (EEPROM) and the end of line configuration.
5	Inst Fuel xx/xxxx Fuel Level % xx.xx State % #Sample OFF x x ON x x SZ x x	Displays the fuel level inputs used to indicate fuel level.
6	Vehicle Speed x.x km/h	Displays the current vehicle speed and engine rpm inputs received over the HS-CAN .

	x.x mph Tachometer x rpm	
7	DTE xxx km xxx mi RAFE xx.xx kml xx.xx MPG x-xx l/100 km	Displays the instantaneous fuel economy inputs received from the PCM over the HS-CAN .
8	Odo cnts: x Trip A: xxx.x km Trip A: xxx.x mi Trip B: xxx.x km Trip B: xxx.x mi Battery: x.x v	Displays the odometer values received from the PCM over the HS-CAN and the battery voltage input.
9	Dim Step: xx/xx Dim Gauge: xxx Dim Pointer: xxx Dim Display: xxxx	Displays the illumination dimming input and current dimming settings.
10	MC A2D SW1: xx MC A2D SW1: xx Oil Press SW: xx Coolant Temp: xx Compass: xx x Last Chime: xxxxxxxx	Displays the current message center switch button state, oil pressure switch state, coolant temperature, compass and the last chime sounded.
11	DTC HIST CURR xxxxxx x x	Displays any stored DTC information as a historical code, current code or both.
12	ENGINEERING TEST MODE	Initial entry display into the self-test mode.

DTC Charts

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

Instrument Panel Cluster (IPC) DTC Chart

DTC	Description	Action
B109E:42	Remote Keyless Entry: General Memory Failure	REFER to Section 501-14 .
B109E:51	Remote Keyless Entry: Not Programmed	REFER to Section 501-14 .
B109E:86	Remote Keyless Entry: Signal Invalid	REFER to Section 501-14 .
B10D5:13	PATS Antenna: Circuit Open	REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).
B10D7:05	PATS Key: System Programming Failure	REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).
B10D7:51	PATS Key: Not Programmed	REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).
B10D7:87	PATS Key: Missing Message	REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).
B10D7:8F	PATS Key: Erratic	REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).
B10D8:00	PATS Key Less Than Minimum Programmed: No Sub-Type Information	REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).
B10D9:87	PATS Transponder: Missing Message	REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).
B10DA:51	PATS PCM Identifier: Not Programmed	REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).
B10DA:61	PATS PCM Identifier: Signal Calculation Failure	REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).
B10DA:86	PATS PCM Identifier: Signal Invalid	REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).
B1A82:09	External Trip Switch: Component Failure	CLEAR the DTCs. REPEAT the self-test. If DTC B1A82:09 returns on Fusion, INSTALL a new cruise control switch. REFER to Section 419-03 . CLEAR the DTCs. REPEAT the self-test. If DTC B1A82:09 returns on MKZ, INSTALL a new Front Controls Interface Module (FCIM). REFER to Section 415-00 . CLEAR the DTCs. REPEAT the self-test.

		If DTC B1A82:09 returns on hybrid vehicles, INSTALL a new LH steering wheel switch. REFER to Section 419-03 . CLEAR the DTCs. REPEAT the self-test.
B1A82:11	External Trip Switch: Circuit Short to Ground	GO to Pinpoint Test AU .
B1A82:13	External Trip Switch: Circuit Open	GO to Pinpoint Test AU .
C0089:11	TCS Disable Switch: Circuit Short To Ground	REFER to Section 206-09 .
P0460:11	Fuel Level Sensor A Circuit: Circuit Short to Ground	With a single sender L-shaped fuel tank, GO to Pinpoint Test B . With a dual sender saddle-type fuel tank, GO to Pinpoint Test C .
P0460:13	Fuel Level Sensor A Circuit: Circuit Open	With a single sender L-shaped fuel tank, GO to Pinpoint Test B . With a dual sender saddle-type fuel tank, GO to Pinpoint Test C .
P1243:06	Second Fuel Pump Fault or Ground Fault: Algorithm Based Failure	GO to Pinpoint Test C .
P1346:11	Fuel Level Sensor B Circuit: Circuit Short to Ground	GO to Pinpoint Test C .
P1346:13	Fuel Level Sensor B Circuit: Circuit Open	GO to Pinpoint Test C .
P1534:01	Restraint Deployment Indicator Circuit: General Electrical Failure	INSTALL a new Instrument Panel Cluster (IPC). REFER to Instrument Panel Cluster (IPC) in this section.
P1706:00	High Vehicle Speed Observed in Park: No Sub-Type Information	GO to Pinpoint Test AJ .
P1706:62	High Vehicle Speed Observed in Park: Signal Compare Failure	GO to Pinpoint Test AJ .
U0002:88	High Speed CAN Communication Bus Performance: Bus Off	REFER to Section 418-00 .
U0011:88	Medium Speed CAN Communication Bus Performance: Bus Off	REFER to Section 418-00 .
U0100:00	Lost Communication With ECM /PCM "A": No Sub-Type Information	GO to Pinpoint Test BF .
U0101:00	Lost Communication With TCM : No Sub-Type Information	GO to Pinpoint Test BG .
U0102:00	Lost Communication With Transfer Case Control Module: No Sub-Type Information	GO to Pinpoint Test BH .
U010F:00	Lost Communication With Air Conditioning Control Module: No Sub-Type Information	GO to Pinpoint Test BI .

U0111:00	Lost Communication With Battery Energy Control Module "A": No Sub-Type Information	GO to Pinpoint Test BJ .
U0121:00	Lost Communication With Anti-Lock Brake System (ABS) Control Module: No Sub-Type Information	GO to Pinpoint Test BK .
U0131:00	Lost Communication With Power Steering Control Module: No Sub-Type Information	GO to Pinpoint Test BL .
U0140:00	Lost Communication With Body Control Module: No Sub-Type Information	GO to Pinpoint Test BM .
U0151:00	Lost Communication With Restraints Control Module: No Sub-Type Information	GO to Pinpoint Test BN .
U0154:00	Lost Communication With Restraints Occupant Classification Sensor (OCS): No Sub-Type Information	GO to Pinpoint Test BO .
U0159:00	Lost Communication With Parking Assist Control Module "A": No Sub-Type Information	GO to Pinpoint Test BP .
U0161:00	Lost Communication With Compass Module: No Sub-Type Information	GO to Pinpoint Test CA .
U0163:00	Lost Communication With Navigation Control Module: No Sub-Type Information	GO to Pinpoint Test BQ .
U0164:00	Lost Communication With HVAC Control Module: No Sub-Type Information	GO to Pinpoint Test BR .
U0184:00	Lost Communication With Radio: No Sub-Type Information	GO to Pinpoint Test BS .
U0208:00	Lost Communication With "Seat Control Module A": No Sub-Type Information	GO to Pinpoint Test BT .
U0232:00	Lost Communication With Side Obstacle Detection Control Module Left: No Sub-Type Information	GO to Pinpoint Test BU .
U0233:00	Lost Communication With Side Obstacle Detection Control Module Right: No Sub-Type Information	GO to Pinpoint Test BV .
U0298:00	Lost Communication With DC to DC Control Module "A":	GO to Pinpoint Test BW .

	No Sub-Type Information	
U0401:68	Invalid Data Received from ECM /PCM A: Event Information	DTC U0401:68 is set when the IPC receives invalid network data from the PCM. RETRIEVE and REPAIR all non-network DTCs in the other modules on the network. REFER to Section 419-10 for a list of all DTCs.
U0402:68	Invalid Data Received from TCM : Event Information	DTC U0402:68 is set when the IPC receives invalid network data from the Transmission Control Module (TCM). RETRIEVE and REPAIR all non-network DTCs in the TCM and other modules on the network. REFER to Section 419-10 for a list of all DTCs.
U040A:68	Invalid Data Received from Air Conditioning Control Module: Event Information	DTC U040A:68 is set when the IPC receives invalid network data from the HVAC module. RETRIEVE and REPAIR all non-network DTCs in the HVAC and other modules on the network. REFER to Section 419-10 for a list of all DTCs.
U0412:68	Invalid Data Received from Battery Energy Control Module A: Event Information	DTC U0412:68 is set when the IPC receives invalid network data from the Battery Pack Sensor Module (BPSM). RETRIEVE and REPAIR all non-network DTCs in the BCM-HVTB and other modules on the network. REFER to Section 419-10 for a list of all DTCs.
U0415:68	Invalid Data Received from Anti-Lock Brake System (ABS) Control Module: Event Information	DTC U0415:68 is set when the IPC receives invalid network data from the ABS module. RETRIEVE and REPAIR all non-network DTCs in the ABS module and other modules on the network. REFER to Section 419-10 for a list of all DTCs.
U0422:68	Invalid Data Received from Body Control Module: Event Information	**NOTE:** If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. DTC U0422:68 is set when the IPC receives invalid network data from the Smart Junction Box (SJB) for backlighting, brake fluid level or Tire Pressure Monitoring System (TPMS). RETRIEVE and REPAIR all non-network DTCs in the SJB and other modules on the network. REFER to Section 419-10 for a list of all DTCs.
U0430:68	Invalid Data Received from Tire Pressure Monitor Module: Event Information	DTC U0430:68 is set when the IPC receives invalid network data from the SJB for TPMS . RETRIEVE and REPAIR all non-network DTCs in the SJB and other modules on the network. REFER to Section 419-10 for a list of all DTCs.
U0452:68	Invalid Data Received from Restraints Control Module: Event Information	DTC U0452:68 is set when the IPC receives invalid network data from the Restraints Control Module (RCM). RETRIEVE and REPAIR all non-network DTCs in the RCM and other modules on the network. REFER to Section 419-10 for a list of all DTCs.
U0462:00	Invalid Data Received from Compass Module: No Sub Type Information	GO to Pinpoint Test CA .
U0462:68	Invalid Data Received from Compass Module: Event Information	REFER to Section 419-10 for a list of all DTCs
U0533:68	Invalid Data Received from Side Obstacle Detection Control Module-Left: Event Information	REFER to Section 419-04 for a list of all DTCs.
U0534:68		REFER to Section 419-04 for a list of all DTCs.

	Invalid Data Received from Side Obstacle Detection Control Module-Right: Event Information	
U0599:68	Invalid Data Received from DC to DC Converter Control Module "A": Event Information	DTC U0599:68 is set when the IPC receives invalid network data from the DC to DC Converter Control Module (DC/DC). RETRIEVE and REPAIR all non-network DTCs in the DC/DC and other modules on the network. REFER to Section 419-10 for a list of all DTCs.
U2100:00	Initial Configuration Not Complete: No Sub-Type Information	CARRY OUT the PMI procedure for the IPC . REFER to Section 418-01 .
U3000:41	Control Module: General Checksum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:41 returns, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
U3000:42	Control Module: General Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:42 returns, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
U3000:43	Control Module: Special Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:43 returns, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
U3000:44	Control Module: Data Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:44 returns, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
U3000:45	Control Module: Program Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:45 returns, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
U3000:46	Control Module: Calibration/Parameter Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:46 returns, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test BX .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test BY .
U300A:62	Ignition Switch: Signal Compare Failure	GO to Pinpoint Test BZ .
U300A:64	Ignition Switch: Signal Plausibility Failure	GO to Pinpoint Test BZ .

Smart Junction Box (SJB) DTC Chart

DTC	Description	Action
B2479	Brake Park Switch Circuit Short to Ground	GO to Pinpoint Test T .
B1352	Ignition Key-In Circuit Failure	If the chime sounds with the door ajar and no key in the ignition, GO to Pinpoint Test AY . If the key-in-ignition chime is inoperative, GO to Pinpoint Test AZ .
C1125	Brake Fluid Level Sensor Input Circuit Failure	GO to Pinpoint Test T .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

PCM DTC Chart

DTC	Description	Action
P0460	Fuel Level Sensor A Circuit	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test B for single sender L-shaped fuel tank or GO to Pinpoint Test C for dual sender saddle-type fuel tank.
P0461	Fuel Level Sensor A Circuit Range/Performance	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test B for single sender L-shaped fuel tank or GO to Pinpoint Test C for dual sender saddle-type fuel tank.
P0462	Fuel Level Sensor A Circuit Low	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test B for single sender L-shaped fuel tank or GO to Pinpoint Test C for dual sender saddle-type fuel tank.
P0463	Fuel Level Sensor A Circuit High	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test B for single sender L-shaped fuel tank or GO to Pinpoint Test C for dual sender saddle-type fuel tank.
P2065	Fuel Level Sensor B Circuit	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test C .
P2066	Fuel Level Sensor B Circuit Range/Performance	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first.

		If sent here from the PC/ED manual, GO to Pinpoint Test C .
P2067	Fuel Level Sensor B Circuit Low	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test C .
P2068	Fuel Level Sensor B Circuit High	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first. If sent here from the PC/ED manual, GO to Pinpoint Test C .
All other DTCs	-	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Charts

Symptom Chart - Instrument Panel Cluster (IPC)

Symptom Chart - Information And Message Center

Symptom Chart - Warning Chimes

Pinpoint Tests

Pinpoint Test A: The Instrument Panel Cluster (IPC) Is Inoperative

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

With the ignition in the START or RUN mode, the Instrument Panel Cluster (IPC) receives voltage from the Smart Junction Box (SJB) fuse 29 (5A). With the ignition in the OFF mode, the IPC receives its keep-alive voltage from the SJB fuse 26 (10A). The IPC grounding is through a single ground. The IPC sets DTC U300A:62 in continuous memory and on-demand if the RUN/START input is open or if the SJB fuse 29 (5A) has failed.

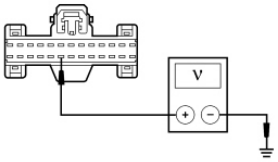
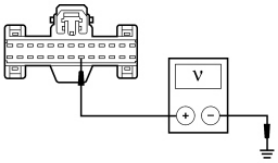
This pinpoint test is intended to diagnose the following:

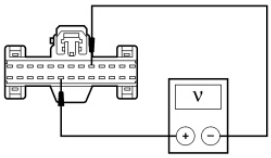
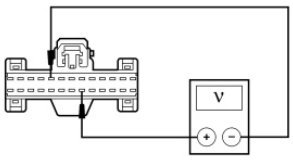
- Fuse(s)
- Wiring, terminals or connectors
- IPC

PINPOINT TEST A: THE IPC IS INOPERATIVE

NOTICE: **Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take

A1 RETRIEVE THE RECORDED DTCs FROM THE CONTINUOUS IPC SELF-TEST	
• Check for recorded IPC DTCs from the continuous self-test. • **Is DTC U300A:62 recorded?**	**Yes** VERIFY SJB fuse 29 (5A) is OK. If OK, GO to Pinpoint Test BZ . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. **No** GO to A2 .
A2 CHECK THE IPC VOLTAGE SUPPLY	
• Ignition OFF. • Disconnect: IPC C220 . • For the non-hybrid, measure the voltage between the IPC C220-21, circuit SBP26 (YE/RD), harness side and ground.  N0094461 • For the hybrid, measure the voltage between the IPC C220-19, circuit SBP26 (YE/RD), harness side and ground.  N0094462 • **Is the voltage greater than 10 volts?**	**Yes** GO to A3 . **No** VERIFY SJB fuse 26 (10A) is OK. If OK, REPAIR the circuit for an open. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. TEST the system for normal operation.
A3 CHECK THE IPC GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • For the non-hybrid, measure the voltage between the IPC C220-21, circuit SBP26 (YE/RD), harness side and the IPC C220-5, circuit GD116 (BK/VT), harness side.	**Yes** GO to A4 . **No** REPAIR circuit GD116 (BK/VT) for an open. TEST the system for normal operation.

 N0099813 • For the hybrid, measure the voltage between the IPC C220-19, circuit SBP26 (YE/RD), harness side and the IPC C220-9, circuit GD116 (BK/VT), harness side.  N0094464 • **Is the voltage greater than 10 volts?**	
A4 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: Incorrect Fuel Gauge Indication - Single Sender L-Shaped Fuel Tank

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The fuel pump module is hardwired to the Instrument Panel Cluster (IPC) between the signal circuit and the signal return circuit, which is grounded internally within the IPC . The fuel level sender (float and card) is a variable resistor attached to the fuel pump module that ranges from 180 ohms ± 4 ohms at empty (E) and 10 ohms ± 2 ohms at full (F). The IPC provides a reference voltage to the fuel pump module on the signal circuit. Ae fuel level changes, a float actuates a variable resistor on the fuel level sender (float and card), raising or lowering the fuel level signal voltage depending on the resistance of the fuel level sender. The IPC monitors the changes in voltage and commands the fuel gauge with a corresponding movement of the pointer.

On flex-fuel vehicles, basic fuel level indication is the same as gasoline vehicles, except that the flex-fuel vehicles require a DC-AC interface (internal to the IPC), used to prevent chemical reactions created by the interaction of A/C current with the fuel.

The IPC uses 4 different operating modes to calculate the fuel level:

- Anti-slosh (default mode)
- Ignition OFF fueling
- Ignition ON fueling
- Recovery

After a fuel fill up, the time for the fuel gauge to move from empty (E) to full (F) ranges from 2 seconds to 55 minutes depending on which operating mode the fuel gauge is in.

Anti-Slosh Mode

The default fuel gauge mode is called the anti-slosh mode. To prevent fuel gauge changes from fuel slosh (gauge instability due to changes in fuel sensor readings caused by fuel moving around in the tank), the fuel gauge takes approximately 55 minutes to go from empty (E) to full (F).

Key OFF Fueling Mode

The ignition OFF fueling mode (2 seconds to read empty [E] to full [F]) requires 3 conditions be met:

- The ignition must be in the OFF mode when refueling the vehicle.
- At least 15% of the vehicle's fuel capacity must be added to the fuel tank.
- The IPC must receive a valid ignition ON fuel sensor reading within one second of the ignition being put into the RUN mode. The key ON sample readings are considered valid if the fuel sensor reading is between 10 ohms ± 2 ohms and 180 ohms ± 4 ohms.

If these conditions are not met, the fuel gauge stays in the anti-slosh mode, which results in a slow to read full (F) event.

Key ON Fueling Mode

The ignition ON fueling mode (approximately 60 seconds to read empty [E] to full [F]) requires the following conditions be met:

- Engine speed greater than 0 rpm.
- The transaxle is in PARK (P) or NEUTRAL (N).
- The ignition is in the RUN mode.
- At least 15% of the vehicle's fuel capacity must be added to the fuel tank.

In ignition ON fueling mode, a 30-second timer activates after the transaxle is put into the PARK (P) or NEUTRAL (N) position. When the 30-second time has elapsed and at least 15% of the vehicle's fuel capacity has been added, the fuel gauge response time is 60 seconds to read from empty (E) to full (F). When the transaxle is shifted out of PARK (P) or NEUTRAL (N), the fuel gauge strategy reverts to the anti-slosh mode. The ignition ON fueling mode prevents slow to read full events from happening if the customer refuels the vehicle with the ignition in the RUN mode.

Recovery Mode

Recovery mode is incorporated into the IPC strategy to recover from a missing fuel level input after a refueling event. Missing fuel level inputs result from intermittent opens in the fuel sensor or its circuits. Recovery mode (empty [E] to full [F] approximately 20 minutes) is initiatewhen the following 2 conditions are met:

- The IPC is in the anti-slosh (default) mode.
- The actual fuel level in the tank is greater than what is being displayed by the fuel gauge.

Instrument Panel Cluster (IPC) DTCs

DTC Description	Fault Trigger Conditions
• P0460:11 - Fuel Level Sensor A Circuit: Circuit Short to Ground	A continuous and on-demand DTC that sets in the IPC if the IPC detects that the fuel pump module is out of range on the input circuit with a short to ground for 33 seconds. The IPC defaults the fuel gauge to empty (E), once the IPC detects a fault and sets DTC P0460:11.
• P0460:13 - Fuel Level Sensor A Circuit: Circuit Open	A continuous and on-demand DTC that sets in the IPC he IPC detects that the fuel pump module is out of range on the input circuit with an open or short to voltage on the input or return circuits for 33 seconds. The IPC defaults the fuel gauge to empty (E), once the IPC detects a fault and sets DTC P0460:13.

PCM DTCs

DTC Description	Fault Trigger Conditions
• P0460 - Fuel Level Sensor A Circuit	Sets when the PCM determines the value of the fuel level input signal is stuck, that the fuel level input signal does not change or does not correspond with the calculated fuel usage.
• P0461 - Fuel Level Sensor A Circuit Range/Performance	Sets when the PCM determines the fuel level input signal repeatedly moves in and out of range, exceeding the minimum or maximum allowable calibrated parameters for a specified fuel fill percentage in the fuel tank.
• P0462 - Fuel Level Sensor A Circuit Low	Sets in the PCM when the PCM detects a short to ground on the fuel pump module signal circuit based on the messaged input received from the IPC .
• P0463 - Fuel Level Sensor A Circuit High	Sets in the PCM when the PCM detects an open or a short to voltage on the fuel pump module signal circuit based on the messaged input received from the IPC .

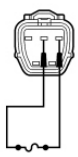
This pinpoint test is intended to diagnose the following:

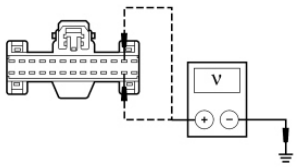
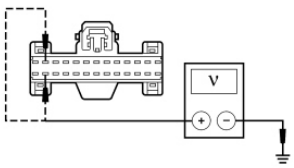
- Wiring, terminals or connectors
- Fuel pump module
- Fuel level sender (float and card)
- Fuel tank
- IPC

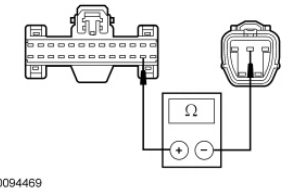
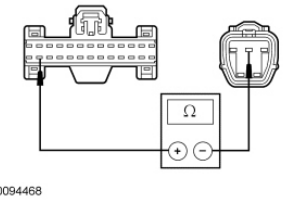
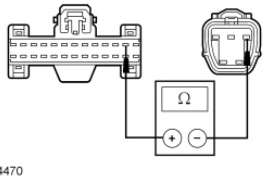
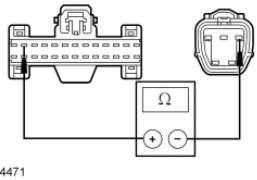
PINPOINT TEST B: INCORRECT FUEL GAUGE INDICATION - SINGLE SENDER L-SHAPED FUEL TANK

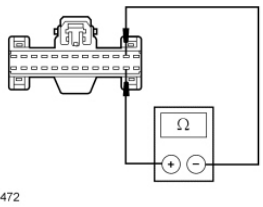
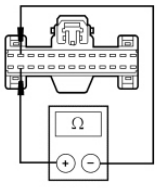
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

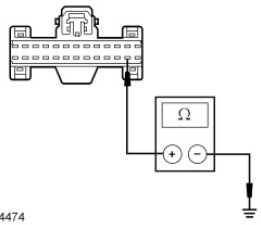
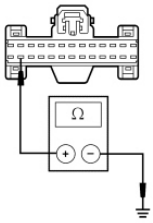
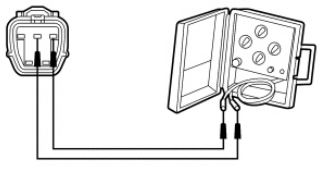
NOTE: Following any fuel gauge repairs, remove fuse 26 (10A) for one minute then reinstall to reset the fuel gauge timers.

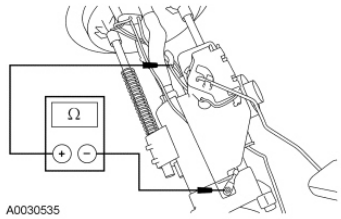
Test Step	Result / Action to Take
B1 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs rded?**	**Yes** For DTC P0460:13, GO to B3 . For DTC P0460:11, GO to B7 . For all other DTCs, REFER to DTC Charts in this section. **No** GO to B2 .
B2 CARRY OUT THE IPC FUEL GAUGE ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • **NOTE:** Make sure to set the scan tool to empty or 0% before beginning this test. • Select the IPC fuel gauge (FUELLEVEL) active command. Command the fuel gauge from 0% to 25%, 50%, 75% and 100% while observing the fuel gauge. • **Does the fuel gauge begin at E (empty), move to approximately 1/8-1/4, just under 1/2, 3/4 and F (full)?**	**Yes** GO to B10 . **No** GO to B13 .
B3 CHECK THE FUEL PUMP MODULE FOR AN OPEN	
• Ignition OFF. • Disconnect: Fuel Pump Module C433 . • Connect a fused jumper wire between the fuel pump module C433-1, circuit RMC32 (GN/BU), harness side and the fuel pump module C433-2, circuit VMC11 (YE/VT), harness side.  N0053609 • Ignition ON. • Wait one minute.	**Yes** REMOVE the jumper wire. GO to B12 . **No** REMOVE the jumper wire. GO to B4 .

• Enter the following diagnostic mode on the scan tool: IPC Self-Test . • **NOTE:** DTC P0460:13 may also be present when carrying out this step and should be ignored at this time. • Repeat the IPC self-test. • Retrieve the IPC continuous DTCs. • **Is DTC P0460:11 retrieved?**	
B4 CHECK THE FUEL LEVEL SIGNAL AND RETURN CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: IPC C220 . • Ignition ON. • For non-hybrid, measure the voltage between the IPC C220-15, circuit VMC11 (YE/VT), harness side and ground; and between the IPC C220-2, circuit RMC32 (GN/BU), harness side and ground.  N0094467 • For hybrid, measure the voltage between the IPC C220-25, circuit VMC11 (YE/VT), harness side and ground; and between the IPC C220-12, circuit RMC32 (GN/BU), harness side and ground.  N0094466 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test. **No** GO to B5 .
B5 CHECK THE FUEL LEVEL SIGNAL CIRCUIT FOR AN OPEN	
• Ignition OFF. • For non-hybrid, measure the resistance between the IPC C220-15, circuit VMC11 (YE/VT), harness side and the fuel pump module assembly C433-2, circuit VMC11 (YE/VT), harness side.	**Yes** GO to B6 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 N0094469 • For hybrid, measure the resistance between the IPC C220-25, circuit VMC11 (YE/VT), harness side and the fuel pump module assembly C433-2, circuit VMC11 (YE/VT), harness side.  N0094468 • **Is the resistance less than 5 ohms?**	
B6 CHECK THE FUEL LEVEL RETURN CIRCUIT FOR AN OPEN	
• For non-hybrid, measure the resistance between the IPC C220-2, circuit RMC32 (GN/BU), harness side and the fuel pump module assembly C433-1, circuit RMC32 (GN/BU), harness side.  N0094470 • For hybrid, measure the resistance between the IPC C220-12, circuit RMC32 (GN/BU), harness side and the fuel pump module assembly C433-1, circuit RMC32 (GN/BU), harness side.  N0094471 • **Is the resistance less than 5 ohms?**	**Yes** GO to B13 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B7 CHECK THE FUEL PUMP MODULE FOR A SHORT TO GROUND	

• Disconnect: Fuel Pump Module C433 . • Ignition ON. • Wait one minute. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • **NOTE:** DTC P0460:11 may also be present when carrying out this step and should be ignored at this time. • Repeat the IPC self-test. • Retrieve the IPC continuous DTCs. • **Is DTC P0640:13 retrieved?**	**Yes** GO to B12 . **No** GO to B8 .
B8 CHECK THE FUEL LEVEL SIGNAL AND RETURN CIRCUITS FOR A SHORT TOGETHER	
• Ignition OFF. • Disconnect: IPC C220 . • On non-hybrid, measure the resistance between the IPC C220-15, circuit VMC11 (YE/VT), harness side and the IPC C220-2, circuit RMC32 (GN/BU), harness side.  N0094472 • On hybrid, measure the resistance between the IPC C220-25, circuit VMC11 (YE/VT), harness side and the IPC C220-12, circuit RMC32 (GN/BU), harness side.  N0094473 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B9 . **No** REPAIR the circuits. CLEAR the DTCs. REPEAT the self-test.
B9 CHECK THE FUEL LEVEL SIGNAL CIRCUIT FOR A SHORT TO GROUND	
• For non-hybrid, measure the resistance between the IPC C220-15, circuit VMC11 (YE/VT), harness side and ground.	**Yes** GO to B13 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 N0094474 • For hybrid, measure the resistance between the IPC C220-25, circuit VMC11 (YE/VT), harness side and ground.  N0094475 • **Is the resistance greater than 10,000 ohms?**	
B10 CHECK THE FUEL LEVEL INPUT TO THE IPC	
NOTE: Since the IPC may be in anti-slosh fuel indication mode, the self-test and tester values may not match the fuel gauge readings. The actual gauge indication should be disregarded during this test step. • Ignition OFF. • Disconnect: Fuel Pump Module Assembly C433 . • Connect one lead of the instrument gauge system tester to the fuel pump module assembly C433-2, circuit VMC11 (YE/VT), harness side and the other lead to the fuel pump module assembly C433-1, circuit RMC32 (GN/BU), harness side.  N0026539 • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC PIDs . • **NOTE:** It is extremely important to confirm the gauge tester settings with an ohmmeter to make sure that the gauge tester is in the correct position. Failure to follow this check may result in inaccurate test results.	**Yes** DISCONNECT the instrument gauge system tester. GO to B11 . **No** DISCONNECT the instrument gauge system tester. GO to B13 .

• Monitor the IPC fuel level (FLI) PID, with the gauge tester set at 180 ohms, 90 ohms, 55 ohms, 30 ohms and 10 ohms. • **Does the PID begin at approximately 0%, move to 25%, 50%, 75% then 100%?**	
B11 CHECK THE FUEL TANK	
• Check the fuel tank for any damage or deformation. • **Is the fuel tank OK?**	**Yes** GO to B12 . **No** VERIFY the fuel level sensor and fuel pump module are OK. INSTALL a new fuel tank. REFER to Section 310-01A (non-hybrid) or Section 310-01B (hybrid). CLEAR the DTCs. REPEAT the self-test.
B12 CHECK THE FUEL LEVEL SENDER (FLOAT AND CARD)	
NOTE: The fuel level sender (float and card) resistance measures between 180 ohms ± 4 ohms at the lower stop position and 10 ohms ± 2 ohms at the upper stop position. • Remove the fuel pump module. Refer to Section 310-01A (non-hybrid) or Section 310-01B (hybrid). • **NOTE:** Disconnect the fuel level sender (float and card) input wire from the fuel pump module for this measurement. • Measure the resistance between the fuel level sender (float and card) input wire and the fuel level sender (float and card) ground while slowly moving the float arm between the lower and upper stop position.  • **Does the resistance slowly decrease from approximately 180 ohms at the lower stop to 10 ohms at the upper stop?**	**Yes** INSTALL a new fuel pump module. REFER to Section 310-01A (non-hybrid) or Section 310-01B (hybrid). CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new fuel level sender (float and card). REFER to Section 310-01A (non-hybrid) or Section 310-01B (hybrid). CLEAR the DTCs. REPEAT the self-test.
B13 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

• Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test C: Incorrect Fuel Gauge Indication - Dual Sender Saddle-Type Fuel Tank

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The fuel tank is a saddle tank design with 2 variable resistance senders, driven by floats, that provide resistances related to fuel level in each side of the fuel tank to the Instrument Panel Cluster (IPC). The fuel level is determined using variable resistance fuel sender units, with an approximate resistance range between 180 ohms ± 4 ohms at empty (E) and 10 ohms ± 2 ohms at full (F). The IPC provides a reference voltage to the fuel pump module (LH side) and fuel level sensor (RH side) through individual signal circuits and receives a return through the signal return circuits from both the fuel pump module and fuel level sensor. As the fuel level changes, a float actuates a variable resistor on the fuel pump module and fuel level sensor, raising or lowering the fuel level signal voltage depending on the resistance of the fuel level sender (flt and card). The IPC monitors the changes in voltage from both senders and commands the fuel gauge with a corresponding movement of the pointer. If the IPC detects the fuel level sensor circuitry is open, the fuel gauge defaults to the fuel pump module value only and the fuel gauge indicates empty (E). If the IPC detects the fuel pump module circuitry is open, the fuel gauge defaults to the empty position.

On flex-fuel vehicles, basic fuel level indication is the same as gasoline vehicles, except that the flex-fuel vehicles require a DC-AC interface (internal to the IPC), used to prevent chemical reactions created by the interaction of A/C current with the fuel.

The IPC uses 4 different operating modes to calculate the fuel level:

- Anti-slosh (default mode)
- Ignition OFF fueling
- Ignition ON fueling
- Recovery

After a fuel fill up, the time for the fuel gauge to move from empty (E) to full (F) ranges from 2 seconds to 55 minutes depending on which operating mode the fuel gauge is in.

Anti-Slosh Mode

The default fuel gauge mode is called the anti-slosh mode. To prevent fuel gauge changes from fuel slosh (gauge instability due to changes in fuel sensor readings caused by fuel moving around in the tank), the fuel gauge takes approximately 55 minutes to go from empty (E) to full (F).

Key OFF Fueling Mode

The ignition OFF fueling mode (2 seconds to read empty [E] to full [F]) requires 3 conditions be met:

- The ignition must be in the OFF mode when refueling the vehicle.
- At least 15% of the vehicle's fuel capacity must be added to the fuel tank.
- The IPC must receive a valid ignition ON fuel sensor reading within one second of the ignition being put into the RUN mode. The key ON sample readings are considered valid if the fuel sensor reading is

between 10 ohms ± 2 ohms and 180 ohms ± 4 ohms.

If these conditions are not met, the fuel gauge stays in the anti-slosh mode, which results in a slow to read full (F) event.

Key ON Fueling Mode

The ignition ON fueling mode (approximately 60 seconds to read empty [E] to full [F]) requires the following conditions be met:

- Engine speed greater than 0 rpm.
- The transaxle is in PARK (P) or NEUTRAL (N).
- The ignition is in the RUN mode.
- At least 15% of the vehicle's fuel capacity must be added to the fuel tank.

In ignition ON fueling mode, a 30-second timer activates after the transaxle is put into the PARK (P) or NEUTRAL (N) position. When the 30-second time has elapsed and at least 15% of the vehicle's fuel capacity has been added, the fuel gauge response time is 60 seconds to read from empty (E) to full (F). When the transaxle is shifted out of PARK (P) or NEUTRAL (N), the fuel gauge strategy reverts to the anti-slosh mode. The ignition ON fueling mode prevents slow to read full events from happening if the customer refuels the vehicle with the ignition in the RUN mode.

Recovery Mode

Recovery mode is incorporated into the IPC strategy to recover from a missing fuel level input after a refueling event. Missing fuel level inputs result from intermittent opens in the fuel sensor or its circuits. Recovery mode (empty [E] to full [F] approximately 20 minutes) is initiated when the following 2 conditions are met:

- The IPC is in the anti-slosh (default) mode.
- The actual fuel level in the tank is greater than what is being displayed by the fuel gauge.

Instrument Panel Cluster (IPC) DTCs

DTC Description	Fault Trigger Conditions
• P0460:11 - Fuel Level Sensor A Circuit: Circuit Short to Ground	A continuous and on-demand DTC that sets in the IPC if the IPC detects that the fuel pump module is out of range on the signal circuit with a short to ground for 33 seconds. The IPC defaults the fuel gauge to empty (E), once the IPC detects a fault d sets DTC P0460:11.
• P0460:13 - Fuel Level Sensor A Circuit: Circuit Open	A continuous and on-demand DTC that sets in the IPC if the IPC detects that the fuel pump module is out of range on the signal circuit with an open or short to voltage for 33 seconds. The IPC defaults the fuel gauge to empty (E), once the IPC detects a fault and sets DTC P0460:13.
• P1346:11 - Fuel Level Sensor B Circuit: Circuit Short to Ground	A continuous and on-demand DTC that sets in the IPC if the IPC detects that the fuel level sensor is out of range on the signal circuit with a short to ground for 33 seconds. The IPC defaults the fuel

	gauge to empty (E), once the IPC detects a fault and sets DTC P1346:11.
• P1346:13 - Fuel Level Sensor B Circuit: Circuit Open	A continuous and on-demand DTC that sets in the IPC if the IPC detects that the fuel level sensor is out of range on the signal circuit with an open or short to voltage for 33 seconds. The IPC defaults the fuel gauge to empty (E), once the IPC detects a fault and sets DTC P1346:13.
NOTE: Normal operation of the fuel delivery system allows the fuel sensor side of the fuel tank (RH side) to have less fuel than the side with the fuel pump module (LH side). P1243:06 - Second Fuel Pump Fault or Ground Fault: Algorithm Based Failure	Sets when the IPC detects a large discrepancy in the amount of fuel (based on input from both fuel sensors) between both sides of the fuel tank.

PCM DTCs

DTC Description	Fault Trigger Conditions
• P0460 - Fuel Level Sensor A Circuit	Sets when the PCM determines the value of the fuel level input signal is stuck, that the fuel level input signal does not change or does not correspond with the calculated fuel usage.
• P0461 - Fuel Level Sensor A Circuit Range/Performance	Sets when the PCM determines the fuel level input signal repeatedly moves in and out of range, exceeding the minimum or maximum allowable calibrated parameters for a specified fuel fill percentage in the fuel tank.
• P0462 - Fuel Level Sensor A Circuit Low	Sets in the PCM when the PCM detects a short to ground on the fuel pump module signal circuit based on the messaged input received from the IPC .
• P0463 - Fuel Level Sensor A Circuit High	Sets in the PCM when the PCM detects an open or a short to voltage on the fuel pump module signal circuit based on the messaged input received from the IPC .
• P2065 - Fuel Level Sensor B Circuit	Sets when the PCM determines the value of the fuel level sensor input signal is stuck, that the fuel level input signal does not change or does not correspond with the calculated fuel usage.
• P2066 - Fuel Level Sensor B Circuit Range/Performance /TD>	Sets when the PCM determines the fuel level sensor input signal repeatedly moves in and out of range, exceeding the minimum or maximum allowable calibrated parameters for a specified fuel fill percentage in the fuel tank.
• P2067 - Fuel Level Sensor B Circuit Low	Sets in the PCM when the PCM detects a short to ground on the fuel level sensor signal circuit based on the messaged input received from the IPC .
• P2068 - Fuel Level Sensor B Circuit High	Sets in the PCM when the PCM detects an open or short to voltage on the fuel level sensor signal circuit on the messaged input received from the IPC .

This pinpoint test is intended to diagnose the following:

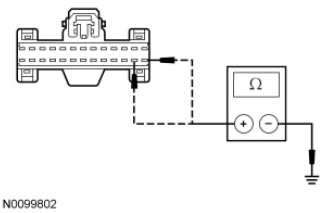
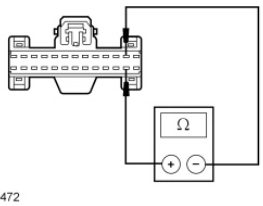
- Wiring, terminals or connectors
- Fuel tank transfer tube
- Fuel pump module (LH side)
- Fuel level sensor (RH side)
- Fuel level sender (float and card)
- Fuel lines
- Fuel tank
- IPC

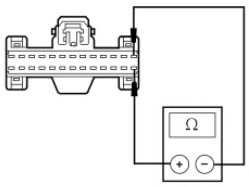
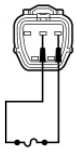
PINPOINT TEST C: INCORRECT FUEL GAUGE INDICATION - DUAL SENDER SADDLE-TYPE FUEL TANK

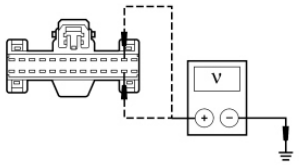
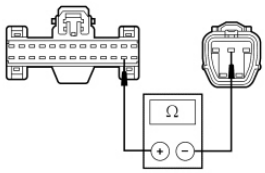
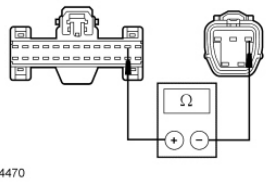
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

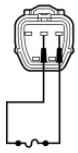
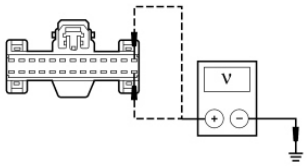
NOTE: Following any fuel gauge repairs, remove fuse 26 (10A) for one minun reinstall to reset the fuel gauge timers.

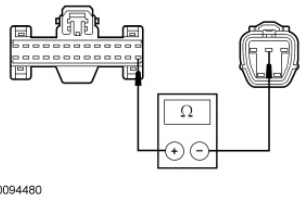
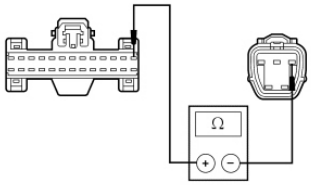
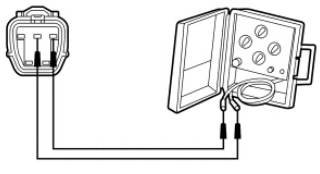
Test Step	Result / Action to Take
C1 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Ignition OFF. • Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC P0460:11 or P1346:11, GO to C3 . For DTC P0460:13, GO to C7 . For DTC P1346:13, GO to C11 . For DTC P1243:06, GO to C15 . **No** GO to C2 .
C2 CARRY OUT THE IPC FUEL GAUGE ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • **NOTE:** Make sure to set the scan tool to empty or 0% before beginning this test. • Select the IPC fuel gauge (FUELLEVEL) active command. Command the fuel gauge from 0% to 25%, 50%, 75% and 100% while observing the fuel gauge. • **Does the fuel gauge begin at E (empty), move to approximately 1/8-1/4, just under 1/2, 3/4 and F (full)?**	**Yes** GO to C15 . **No** GO to C21 .
C3 CHECK THE FUEL SENSOR FOR A SHORT TO GROUND	
• Disconnect: Fuel Pump Module C433 (DTC P0460:11) or Fuel Level Sensor C3270 (DTC P1346:11) .	**Yes** INSTALL a new fuel pump module (DTC P0460:11) or fuel level sensor

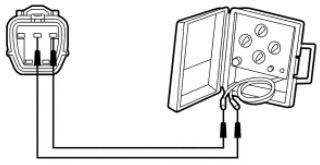
• Ignition ON. • Wait one minute. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • **NOTE:** DTC P0460:11 or P1346:11 may also be present. • Repeat the IPC on-demand self-test. • **Is DTC P0460:13 or P1346:13 retrieved?**	(DTC P1346:11). REFER to Section 310-01A . CLEAR the DTCs. REPEAT the self-test. **No** GO to C4 .
C4 CHECK THE FUEL LEVEL SIGNAL CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: IPC C220 . • Measure the resistance between the IPC C220-15 (DTC P0460:11), circuit VMC11 (YE/VT), harness side and ground; or between the IPC C220-14 (DTC P1346:11), circuit VMC23 (GN/OG), harness side and ground.  N0099802 • **Is the resistance greater than 10,000 ohms?**	**Yes** For DTC P0460:11, GO to C5 . For DTC P1346:11, GO to C6 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
C5 CHECK THE FUEL PUMP MODULE SIGNAL AND RETURN CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between the IPC C220-15, circuit VMC11 (YE/VT), harness side and between the IPC C220-2, circuit RMC32 (GN/BU), harness side.  N0094472 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C21 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
C6 CHECK THE FUEL LEVEL SENSOR SIGNAL AND RETURN CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between the IPC C220-14, circuit VMC23 (GN/OG), harness side and the IPC C220-1, circuit RMC33 (WH/VT), harness side.	**Yes** GO to C21 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

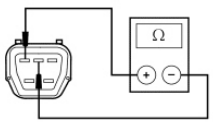
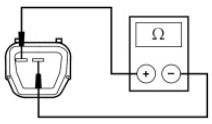
 N0094477 • **Is the resistance greater than 10,000 ohms?**	
C7 CHECK THE FUEL PUMP MODULE FOR AN OPEN	
• Ignition OFF. • Disconnect: Fuel Pump Module C433 . • Connect a fused jumper wire between the fuel pump module C433-1, circuit RMC32 (GN/BU), harness side and the fuel pump module C433-2, circuit VMC11 (YE/VT), harness side.  N0053609 • Ignition ON. • Wait one minute. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • **NOTE:** DTC P0460:13 may also be present when carrying out this step and should be ignored at this time. • Repeat the IPC self-test. • Retrieve the IPC continuous DTCs. • **Is DTC P0460:11 retrieved?**	**Yes** REMOVE the jumper wire. GO to C20 . **No** REMOVE the jumper wire. GO to C8 .
C8 CHECK THE FUEL LEVEL SIGNAL AND RETURN CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: IPC C220 . • Ignition ON. • Measure the voltage between the IPC C220-15, circuit VMC11 (YE/VT), harness side and ground; and between the IPC C220-2, circuit RMC32 (GN/BU), harness side and ground.	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test. **No** GO to C9 .

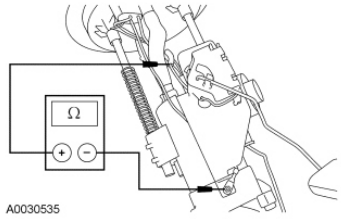
 N0094467 • **Is any voltage present?**	
C9 CHECK THE FUEL LEVEL SIGNAL CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between the IPC C220-15, circuit VMC11 (YE/VT), harness side and the fuel pump module assembly C433-2, circuit VMC11 (YE/VT), harness side.  N0094469 • **Is the resistance less than 5 ohms?**	**Yes** GO to C10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
C10 CHECK THE FUEL LEVEL RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between the IPC C220-2, circuit RMC32 (GN/BU), harness side and the fuel pump module assembly C433-1, circuit RMC32 (GN/BU), harness side.  N0094470 • **Is the resistance less than 5 ohms?**	**Yes** GO to C21 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
C11 CHECK THE FUEL LEVEL SENSOR CIRCUITRY FOR AN OPEN	
• Connect a fused jumper wire between the fuel level sensor C3270-2, circuit VMC23 (GN/OG), harness side and the fuel level sensor C3270-1, circuit RMC33 (WH/VT), harness side.	**Yes** REMOVE the jumper wire. INSTALL a new fuel level sensor. REFER to Section 310-01A . CLEAR the DTCs. REPEAT the self-test. **No**

 N0053609 • Ignition ON. • Wait one minute. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • **NOTE:** DTC P1346:13 may also be present when carrying out this step and should be ignored at this time. • Repeat the IPC self-test. • Retrieve the IPC continuous DTCs. • **Is DTC P1346:11 retrieved?**	REMOVE the jumper wire. GO to C12 .
C12 CHECK THE FUEL LEVEL SENSOR CIRCUITRY FOR A SHORT TO VOLTAGE	
• Disconnect: IPC C220 . • Ignition ON. • Measure the voltage between the IPC C220-14, circuit VMC23 (GN/OG), harness side and ground; and between the IPC C220-1, circuit RMC33 (WH/VT), harness side and ground.  N0094478 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test. **No** GO to C13 .
C13 CHECK THE FUEL LEVEL SENSOR SIGNAL CIRCUIT FOR AN OPEN	
• Measure the resistance between the IPC C220-14, circuit VMC23 (GN/OG), harness side and the fuel level sensor C3270-2, circuit VMC23 (GN/OG), harness side.	**Yes** GO to C14 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 N0094480 • **Is the resistance less than 5 ohms?**	
C14 CHECK THE FUEL LEVEL SENSOR RETURN CIRCUIT FOR AN OPEN	
• Measure the resistance between the IPC C220-1, circuit RMC33 (WH/VT), harness side and the fuel level sensor C3270-1, circuit RMC33 (WH/VT), harness side.  N0094479 • **Is the resistance less than 5 ohms?**	**Yes** GO to C21 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
C15 CHECK THE FUEL LEVEL INPUT TO THE IPC	
NOTE: Since the IPC may be in anti-slosh fuel indication mode, the self-test and tester values may not match the fuel gauge readings. The actual gauge indication should be disregarded during this test step. • Ignition OFF. • Disconnect: Fuel Pump Module Assembly C433 . • Connect one lead of the instrument gauge system tester to the fuel pump module assembly C433-2, circuit VMC11 (YE/VT), harness side and the other lead to the fuel pump module assembly C433-1, circuit RMC32 (GN/BU), harness side.  N0026539 • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC PIDs . • **NOTE:** It is extremely important to confirm the gauge tester settings with an ohmmeter to make sure that the	**Yes** DISCONNECT the instrument gauge system tester. GO to C16 . **No** DISCONNECT the instrument gauge system tester. GO to C21 .

gauge tester is in the correct position. Failure to follow this check may result in inaccurate test results. • Monitor the IPC fuel level (FUELLVL1) PID, with the gauge tester set at 180 ohms, 90 ohms, 55 ohms, 30 ohms and 10 ohms. • **Does the PID begin at approximately 3%, move to 70%, 127%, 185% then 251%?**	
C16 CHECK THE FUEL LEVEL INPUT TO THE IPC	
NOTE: Since the IPC may be in anti-slosh fuel indication mode, the self-test and tester values may not match the fuel gauge readings. The actual gauge indication should be disregarded during this test step. • Ignition OFF. • Disconnect: Fuel Level Sensor C3270 . • Connect one lead of the instrument gauge system tester to the fuel pump module assembly C3270-2, circuit VMC23 (GN/OG), harness side and the other lead to the fuel pump module assembly C3270-1, circuit RMC33 (WH/VT), harness side.  N0026539 • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC PIDs . • **NOTE:** It is extremely important to confirm the gauge tester settings with an ohmmeter to make sure that the gauge tester is in the correct position. Failure to follow this check may result in inaccurate test results. • Monitor the IPC fuel level (FUELLVL2) PID, with the gauge tester set at 180 ohms, 90 ohms, 55 ohms, 30 ohms and 10 ohms. • **Does the PID begin at approximately 3%, move to 70%, 127%, 185% then 251%?**	**Yes** DISCONNECT the instrument gauge system tester. GO to C17 . **No** DISCONNECT the instrument gauge system tester. GO to C21 .
C17 INSPECT THE FUEL TANK	
• Visually inspect the fuel tank for any damage or deformation. • **Is the fuel tank OK?**	**Yes** GO to C18 . **No** INSTALL a new fuel tank. REFER to Section 310-01A . CLEAR the DTCs. REPEAT the self test.
C18 INSPECT THE FUEL TANK TRANSFER TUBE CONNECTIONS	

• Remove the fuel pump module and the fuel level sensor. Refer to Section 310-01A . • Inspect the fuel tank transfer tube, connections, the fuel pump module and the fuel level sensor for any damage or deformation. • **Are the fuel tank transfer tube, connections, the fuel pump module and the fuel level sensor OK?**	**Yes** GO to C19 . **No** INSTALL a new fuel tank transfer tube, fuel pump module or fuel level sensor as necessary. REFER to Section 310-01A . CLEAR the DTCs. REPEAT the self test.
C19 CHECK THE FUEL PUMP MODULE AND THE FUEL LEVEL SENSOR FOR CORRECT OPERATION	
NOTE: The resistance varies from 180 ± 4 ohms when empty (E) to 10 ± 2 ohms when full (F). • For the fuel pump module, measure the resistance between the fuel pump module C433 pin 1, component side and the fuel pump module C433 pin 2, component side while slowly moving the float arm from the bottom to the top of travel.  N0068798 • For the fuel level sensor, measure the resistance between the fuel level sensor C3270 pin 1, component side and the fuel level sensor C3270 pin 2, component side while slowly moving the float arm from the bottom to the top of travel.  N0068801 • **Does the resistance start at approximately 180 ohms with the float at the bottom of travel and slowly increase to approximately 10 ohms at the top of travel?**	**Yes** For DTC P1243:06, INSTALL a new fuel tank transfer tube or fuel level sensor as required. REFER to Section 310-01A . CLEAR the DTCs. REPEAT the self test. For no DTCs, the concern may have been caused by an intermittent input to the IPC most likely caused by corrosion on one of the fuel level senders (float and card). **No** For the fuel pump module, GO to C20 . For the fuel level sensor, INSTALL a new fuel level sensor. REFER to Section 310-01A . CLEAR the DTCs. REPEAT the self-test.
C20 CHECK THE FUEL LEVEL SENDER (FLOAT AND CARD)	

NOTE: The fuel level sender (float and card) resistance measures between 180 ohms ± 4 ohms at the lower stop position and 10 ohms ± 2 ohms at the upper stop position. • Remove the fuel pump module or fuel level sensor. Refer to Section 310-01A . • **NOTE:** Disconnect the fuel level sender (float and card) input wire from the fuel pump module for this measurement. • Measure the resistance between the fuel level sender (float and card) input wire and the fuel level sender (float and card) ground while slowly moving the float arm between the lower and upper stop position.  • **Does the resistance slowly decrease from approximately 180 ohms at the lower stop to 10 ohms at the upper stop?**	**Yes** INSTALL a new fuel pump module or fuel level sensor as necessary. REFER to Section 310-01A . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new fuel level sender (float and card). REFER to Section 310-01A . CLEAR the DTCs. REPEAT the self-test.
C21 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test D: The Temperature Gauge Is Inoperative

Normal Operation

The PCM uses the Cylinder Head Temperature (CHT) sensor to measure the engine temperature. The Instrument Panel Cluster (IPC) receives the engine temperature data from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus. The IPC monitors the engine temperature data received from the PCM and commands the temperature gauge indication with a corresponding movement of the pointer.

The non-hybrid and hybrid temperature gauges appear differently but essentially function the same. The non-hybrid gauge is an analog gauge with a needle that points to a specified area of the gauge depending on

the data received from the PCM. The hybrid gauge is a digital display that appears as a thermometer. The fill color of the thermometer is blue when the temperature is between the cold and normal ranges. When the temperature indicates an overheating condition, the fill color turns to red.

If the engine temperature data is missing for 5 seconds or less or if the IPC receives invalid engine temperature data for 5 seconds or less, the IPC defaults the temperature gauge to the last setting, based upon the last known good temperature status message. If the IPC does not receive the engine temperature status message for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the temperature gauge to cold (C). If the engine temperature data is deemed invalid by the IPC for 5 seconds or more, the IPC sets DTC U0401:68 and defaults the temperature gauge to cold (C).

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative tachometer, speedometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST D: THE TEMPERATURE GAUGE IS INOPERATIVE

Test Step	Result / Action to Take
D1 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs first. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to D2 .
D2 CARRY OUT THE TEMPERATURE GAUGE ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • **NOTE:** The coolant temperature should range between 0-59°C (32-138°F) with the gauge in the cold (C) range, between 60-120°C (140-248°F) with the gauge in the normal or mid-range and above 123°C (253°F) with uge in the hot (H) range. • Select the IPC temperature gauge (ENGCOOLNT) active command. Command the temperature gauge according to the following table:	**Yes** GO to D3 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

<table><tr><th>Temperature Command</th><th>Gauge Position</th></tr><tr><td>0%</td><td>Full cold (C)</td></tr><tr><td>50%</td><td>Just under the center of the gauge (mid-range) (non-hybrid) Just above the center of the gauge (mid-range) (hybrid)</td></tr><tr><td>100%</td><td>Full hot (H)</td></tr></table> • **Does the temperature gauge start at cold (C), move to the mid-range and end at full hot (H)?**	
D3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For DTC U0401:68, RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and Section 419-10 for a list of all DTCs. For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation.

Pinpoint Test E: Incorrect Temperature Gauge Indication

Normal Operation

The PCM uses the Cylinder Head Temperature (CHT) sensor to measure the engine temperature. The Instrument Panel Cluster (IPC) receives the engine temperature data from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus. The IPC monitors the engine temperature data received from the PCM and commands the temperature gauge indication with a corresponding movement of the pointer.

The non-hybrid and hybrid temperature gauges appear differently but essentially function the same. The non-hybrid gauge is an analog gauge with a needle that points to a specified area of the gauge depending on the data received from the PCM. The hybrid gauge is a digital display that appears as a thermometer. The fill color of the thermometer is blue when the temperature is between the cold and normal ranges. When the temperature indicates an overheating condition, the fill color turns to red.

If the engine temperature data is missing for 5 seconds or less or if the IPC receives invalid engine temperature data for 5 seconds or less, the IPC defaults the temperature gauge to the last setting, based upon the last known good temperature status message. If the IPC does not receive the engine temperature status message for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the temperature gauge to cold (C). If the engine temperature data is deemed invalid by the IPC for 5 seconds or more, the IPC sets DTC U0401:68 and defaults the temperature gauge to cold (C).

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative tachometer, speedometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM concern
- IPC

PINPOINT TEST E: INCORRECT TEMPERATURE GAUGE INDICATION

Test Step	Result / Action to Take
E1 CHECK FOR CORRECT OPERATION OF THE COOLING SYSTEM	
• Verify that the engine cooling system and thermostat are functioning correctly. • **Does the engine cooling system and thermostat operate correctly?**	**Yes** GO to E2 . **No** REFER to Section 303-03A (non-hybrid) or Section 303-03B (hybrid).
E2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs first. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to E3 .
E3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For DTC U0401:68, RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and Section 419-10 for a list of all DTCs.

	For all other DTCs, REFER to DTC Charts in this section. **No** GO to E4 .
E4 CARRY OUT THE TEMPERATURE GAUGE ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • **NOTE:** The coolant temperature should range between 0-59°C (32-138°F) with the gauge in the cold (C) range, between 60-120°C (140-248°F) with the gauge in the normal or mid-range and above 123°C (253°F) with the gauge in the hot (H) range. • Select the IPC temperature gauge (ENGCOOLNT) active command. Command the temperature gauge according to the following table: **Temperature Command** / **Gauge Position** 0% / Full cold (C) 20% / Beginning of the normal band 50% / Just under the center of the gauge (mid-range) (non-hybrid) Just above the center of the gauge (mid-range) (hybrid) 90% / Beginning of the hot (H) band 100% / Full hot (H) • **Does the temperature gauge indicate the correct temperature according to the above specifications?**	**Yes** GO to E5 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
E5 CHECK THE COOLANT TEMPERATURE INPUT USING THE DEALER TEST MODE	
• Ignition ON. • Enter the IPC dealer test mode. • **NOTE:** The display below uses xxx's to represent a numeric or alpha-numeric value. The value may display the same amount of characters represented by the xxx's or there may be more/less depending on the type of display and that the minus symbol in parenthesis only appears if the temperature is below 0°C. For example: COOLANT TEMP xxx C (non-hybrid) or Coolant Temp: xx (hybrid) may display COOLANT TEMP 20 C	**Yes** The temperature gauge is operating correctly at this time. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

(non-hybrid). • Scroll through the displays to COOLANT TEMP xxx C (non-hybrid) or Coolant Temp: xx (hybrid). • Start the engine and run the engine through a variety of engine temperatures. • **NOTE:** The coolant temperature should range between 0-59°C (32-138°F) with the gauge in the cold (C) range, between 60-120°C (140-248°F) with the gauge in the normal or mid-range and above 123°C (253°F) with the gauge in the hot (H) range. • Monitor the engine temperature input to the IPC and the coolant temperature gauge indication. • **Does the engine input agree with the position of the temperature gauge indication?**	

Pinpoint Test F: The Speedometer Is Inoperative

Normal Operation

The Instrument Panel Cluster (IPC) receives the Vehicle Speed Sensor (VSS) signal from the PCM (non-hybrid) or from the Transmission Control Module (TCM) (hybrid) over the High Speed Controller Area Network (HS-CAN) communication bus. The PCM or TCM receives the VSS input from the Output Shaft Speed (OSS). The IPC monitors the VSS input from the PCM or TCM and commands the speedometer with a corresponding movement of the pointer.

If the vehicle speed data is missing for 5 seconds or less or if the IPC receives invalid vehicle speed data for 5 seconds or less, the IPC defaults the speedometer to the last setting, based upon the last known good vehicle speed message. If the IPC does not receive the vehicle speed data for more than 5 seconds, the IPC sets DTC U0100:00 (non-hybrid) or U0101:00 (hybrid) in continuous memory and defaults the speedometer to 0 km/h (0 mph). If the vehicle speed data received is deemed invalid by the IPC for 5 seconds or more, the IPC sets DTC U0401:68 (non-hybrid) or U0402:68 and defaults the speedometer to 0 km/h (0 mph).

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative tachometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- PCM (non-hybrid)
- TCM (hybrid)
- IPC

PINPOINT TEST F: THE SPEEDOMETER IS INOPERATIVE

Test Step	Result / Action to Take
F1 RETRIEVE THE RECORDED DTCs FROM THE PCM AND TCM KOEO SELF-TEST	
• Check for recorded PCM and TCM DTCs from the Key ON Engine OFF (KOEO) self-test.	**Yes** DIAGNOSE all PCM and TCM DTCs first. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

<table>
<tr><td>

- **Are any DTCs recorded?**

</td><td>

No
GO to F2 .

</td></tr>
<tr><td>

F2 CARRY OUT THE SPEEDOMETER ACTIVE COMMAND USING THE SCAN TOOL

</td><td></td></tr>
<tr><td>

- Ignition ON.
- Enter the following diagnostic mode on the scan tool: IPC DataLogger .
- Select the IPC speedometer (SPDOMETER) active command. Command the speedometer according to the following table while monitoring the speedometer.

Speedometer Command	Gauge Position
0%	0 km/h (0 mph)
50%	97 km/h (60 mph)
100%	193 km/h (120 mph)

- **Does the speed begin at 0 km/h (0 mph) move to 97 km/h (60 mph) then 193 km/h (120 mph) and return to 0 km/h (0 mph)?**

</td><td>

Yes
GO to F3 .

No
INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

</td></tr>
<tr><td>

F3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST

</td><td></td></tr>
<tr><td>

- Check for recorded DTCs from the IPC self-test.
- **Are any DTCs recorded?**

</td><td>

Yes
For DTC U0100:00 (non-hybrid), GO to Pinpoint Test BF .

For DTC U0101:00 (hybrid), GO to Pinpoint Test BG .

For DTC U0401:68 (non-hybrid) or U0402:68 (hybrid), RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and Section 419-10 for a list of all DTCs.

For all other DTCs, REFER to DTC Charts in this section.

No
For non-hybrid vehicles, INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation.

For hybrid vehicles, INSTALL a new transaxle (TCM).

</td></tr>
</table>

	REFER to Section 307-01C . TEST the system for normal operation.

Pinpoint Test G: Incorrect Speedometer Indication

Normal Operation

The Instrument Panel Cluster (IPC) receives the Vehicle Speed Sensor (VSS) signal from the PCM (non-hybrid) or from the Transmission Control Module (TCM) (hybrid) over the High Speed Controller Area Network (HS-CAN) communication bus. The PCM or TCM receives the VSS input from the Output Shaft Speed (OSS). The IPC monitors the VSS input from the PCM or TCM and commands the speedometer with a corresponding movement of the pointer.

The IPC provides a tolerance which biases the speed indication and displays between 3% below and 7% higher than actual vehicle speed. This means that with an actual vehicle speed of 96.6 km/h (60 mph), the speedometer may indicate between 93.7-103.3 km/h (58.2-64.2 mph). Other factors that could potentially affect the speedometer accuracy are incorrect tire size, tire size configuration and axle ratio configuration.

If the vehicle speed data is missing for 5 seconds or less or if the IPC receives invalid vehicle speed data for 5 seconds or less, the IPC defaults the speedometer to the last setting, based upon the last known good vehicle speed message. If the IPC does not receive the vehicle speed data for more than 5 seconds, the IPC sets DTC U0100:00 (non-hybrid) or U0101:00 (hybrid) in continuous memory and defaults the speedometer to 0 km/h (0 mph). If the vehicle speed data received is deemed invalid by the IPC for 5 seconds or more, the IPC sets DTC U0401:68 (non-hybrid) or U0402:68 and defaults the speedometer to 0 km/h (0 mph).

Factors that could potentially affect the accuracy of the speedometer are configurable items such as axle ratio and tire size.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative tachometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- Tire size configuration
- Axle ratio or driveline type configuration
- PCM concern
- IPC

PINPOINT TEST G: INCORRECT SPEEDOMETER INDICATION

Test Step	Result / Action to Take
G1 OBSERVE THE SPEEDOMETER OPERATION	
• Ignition ON. • Observe the speedometer while driving the vehicle at various speeds and stopping frequently. • **Does the speedometer begin at 0 km/h (0 mph), indicate the different vehicle speeds and fully return to**	**Yes** GO to G2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

the 0 km/h (0 mph) position when the vehicle is stopped?	
G2 CHECK THE TIRE SIZE CONFIGURATION	
• Enter the following diagnostic mode on the scan tool: Module Programming . • **NOTE:** The correct tire size can be found on the vehicle certification label on the LH B-pillar. Refer to Section 100-01 . • Select programmable parameters and verify that the vehicle has the correct tire size according to the certification label and the tire size is correctly configured in the PCM. • **Is the tire size correct and is the tire size parameter correctly configured?**	**Yes** GO to G3 . **No** CONFIGURE the tire size. TEST the system for normal operation.
G3 CHECK THE AXLE RATIO OR DRIVELINE TYPE CONFIGURATION	
• Enter the following diagnostic mode on the scan tool: Module Programming . • Select programmable parameters and verify that the axle ratio or driveline type is correctly configured in the PCM. • **Is the axle ratio or driveline type parameter correctly configured?**	**Yes** GO to G4 . **No** CONFIGURE the axle ratio or driveline type. TEST the system for normal operation.
G4 RETRIEVE THE RECORDED DTCs FROM THE PCM AND TCM KOEO SELF-TEST	
• Check for recorded PCM and TCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM and TCM DTCs first. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to G5 .
G5 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00 (non-hybrid), GO to Pinpoint Test BF . For DTC U0100:01 (hybrid), GO to Pinpoint Test BG . For DTC U0401:68 (non-hybrid) or U0402:68 (hybrid), RETRIEVE and REPAIR all non-network DTCs in the

	PCM and other modules on the network. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and Section 419-10 for a list of all DTCs. For all other DTCs, REFER to DTC Charts in this section. **No** GO to G6 .
G6 CARRY OUT THE IPC SPEEDOMETER ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC speedometer (SPDOMETER) active command. Command the speedometer according to the following table while monitoring the speedometer. • **Does the speedometer indicate the approximate speed according to the**	**Yes** GO to G7 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Speedometer Command	Gauge Position
0%	0 km/h (0 mph)
10%	19 km/h (12 mph)
20%	39 km/h (24 mph)
30%	58 km/h (36 mph)
40%	77 km/h (48 mph)
50%	97 km/h (60 mph)
60%	116 km/h (72 mph)
70%	135 km/h (84 mph)
80%	154 km/h (96 mph)
90%	174 km/h (108 mph)
100%	193 km/h (120 mph)

above specifications?	
G7 CHECK THE PCM VSS PIDs	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger . • Select the PCM vehicle speed (VSS) PID and monitor the PID while driving the vehicle at 32 km/h (20 mph), 64 km/h (40 mph) and 97 km/h (60 mph). • **Does the speedometer indicate between 31-34 km/h (19-21 mph), 63-69 km/h (39-43 mph) and 93-103 km/h (58-64 mph) at the 3 PCM PID values?**	**Yes** The speedometer is operating correctly at this time. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test H: The Odometer Is Inoperative

Normal Operation

The Instrument Panel Cluster (IPC) receives the odometer rolling count data from the PCM (non-hybrid) or the Transmission Control Module (TCM) (hybrid) over the High Speed Controller Area Network (HS-CAN) communication bus. The IPC monitors the odometer rolling count input and commands the odometer with a display in the message center display area.

If the IPC does not receive the odometer rolling count data or if the rolling count data is deemed invalid for less than 5 seconds, the IPC displays the mileage based upon the last known good input.

If the IPC does not receive the odometer rolling count data or if the rolling count data is deemed invalid from the PCM for 5 seconds, the IPC sets DTC U0100:00 (non-hybrid) or U0101:00 (hybrid) in continuous memory and defaults the odometer display to all dashes (-----).

If the Non-Volatile Memory (NVM) is corrupted, the message center displays ERROR.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, tachometer, temperature gauge.

This pinpoint test is intended to diagnose the following:

- PCM (non-hybrid)
- TCM (hybrid)
- IPC

PINPOINT TEST H: THE ODOMETER IS INOPERATIVE

Test Step	Result / Action to Take
H1 CHECK FOR CORRUPTED NVM	
• Ignition ON.	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in

• Observe the message center display area. • **Does the odometer display ERROR?**	this section. TEST the system for normal operation. **No** GO to H2 .
H2 RETRIEVE THE RECORDED DTCs FROM THE PCM AND TCM KOEO SELF-TEST	
• Check for recorded PCM and TCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM and TCM DTCs first. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to H3 .
H3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00 (non-hybrid), GO to Pinpoint Test BF . For DTC U0101:00 (hybrid), GO to Pinpoint Test BG . For DTC U0401:68 (non-hybrid) or U0402:68 (hybrid), RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and Section 419-10 for a list of all DTCs. For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test I: The Tachometer Is Inoperative

Normal Operation

The PCM uses the Crankshaft Position (CKP) sensor to measure the engine rpm. The PCM sends the Instrument Panel Cluster (IPC) the data over the High Speed Controller Area Network (HS-CAN) communication bus, to command the tachometer gauge according to the data.

The non-hybrid and hybrid tachometers appear differently but function essentially the same. The non-hybrid gauge is an analog gauge with a needle that points to a specified area of the gauge depending on the data received from the PCM. The hybrid gauge is a digital display that provides a bar, which indicates engine rpm when the gas engine is running. When the vehicle transitions into electric vehicle mode, the EV gauge replaces the tachometer. The hybrid tachometer is only displayed in the enlighten display mode.

If the engine rpm data is invalid for 5 seconds or less or if the IPC does not receive the engine rpm data for 5 seconds or less, the IPC defaults the tachometer to the last setting, based upon the last known good rpm message. If the IPC does not receive the engine rpm data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the tachometer to 0 rpm. If the engine rpm data is deemed

invalid by the IPC for 5 seconds or more, the IPC sets DTC U0401:68 and defaults the tachometer to 0 rpm.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST I: THE TACHOMETER IS INOPERATIVE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>I1 CARRY OUT THE TACHOMETER ACTIVE COMMAND USING THE SCAN TOOL</td><td></td></tr>
<tr><td>
NOTE: On hybrid vehicles, verify that the IPC display mode is set to the enlighten mode setting before beginning diagnostics.

• Ignition ON.
• Enter the following diagnostic mode on the scan tool: IPC DataLogger .
• Start the engine.
• NOTE: On hybrid, make sure to set the scan tool to 0 rpm before beginning this test.
• Select the IPC tachometer (TACH_IND) active command. Command the tachometer according to the following table while monitoring the tachometer.

<table>
<tr><th>Tachometer Command</th><th>Gauge Position</th></tr>
<tr><td>0%</td><td>0 rpm</td></tr>
<tr><td>50%</td><td>3,500 rpm (non-hybrid)

3,000 rpm (hybrid)</td></tr>
<tr><td>100%</td><td>7,000 rpm (non-hybrid)

6,000 rpm (hybrid)</td></tr>
<tr><td>0%</td><td>0 rpm</td></tr>
</table>
• Does the tachometer start at 0 rpm, move to 3,500 rpm, 7,000 rpm and then return to 0 rpm?
</td><td>
Yes
GO to I2 .

No
INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
</td></tr>
</table>

I2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs first. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to I3 .
I3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For DTC U0401:68, RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and Section 419-10 for a list of all DTCs. For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation.

Pinpoint Test J: Incorrect Tachometer Indication

Normal Operation

The PCM uses the Crankshaft Position (CKP) sensor to measure the engine rpm. The PCM sends the Instrument Panel Cluster (IPC) the data over the High Speed Controller Area Network (HS-CAN) communication bus, to command the tachometer according to the data.

The non-hybrid and hybrid tachometers appear differently but function essentially the same. The non-hybrid gauge is an analog gauge with a needle that points to a specified area of the gauge depending on the data received from the PCM. The hybrid gauge is a digital display that provides a bar, which indicates engine rpm when the gas engine is running. When the vehicle transitions into electric vehicle mode, the EV gauge replaces the tachometer. The hybrid tachometer is only displayed in the enlighten display mode.

The hybrid requires two messages sent from the PCM to operate the tachometer. The first message is an engine active message indicating that the vehicle is in the gas engine operating mode. The second message required for the tachometer is the actual engine rpm data.

If the engine rpm data is invalid for 5 seconds or less or if the IPC does not receive the engine rpm data for 5 seconds or less, the IPC defaults the tachometer to the last setting, based upon the last known good rpm message. If the IPC does not receive the engine rpm data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the tachometer to 0 rpm. If the engine rpm data is deemed invalid by the IPC for 5 seconds or more, the IPC sets DTC U0401:68 and defaults the tachometer to 0 rpm.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- PCM concern
- IPC

PINPOINT TEST J: INCORRECT TACHOMETER INDICATION

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>J1 CARRY OUT THE TACHOMETER ACTIVE COMMAND USING THE SCAN TOOL</td><td></td></tr>
<tr><td>

NOTE: On hybrid vehicles, verify that the IPC display mode is set to the enlighten mode setting before beginning diagnostics.

- Ignition ON.
- Enter the following diagnostic mode on the scan tool: IPC DataLogger .
- Start the engine.
- **NOTE:** On hybrid, make sure to set the scan tool to 0 rpm before beginning this test.
- Select the IPC tachometer (TACH_IND) active command. Command the tachometer according to the following table while monitoring the tachometer.

<table>
<tr><th>Tachometer Command</th><th>Non-Hybrid Gauge Position</th><th>Hybrid Gauge Position</th></tr>
<tr><td>0%</td><td>0 rpm</td><td>0 rpm</td></tr>
<tr><td>10%</td><td>700 rpm</td><td>600 rpm</td></tr>
<tr><td>20%</td><td>1,400 rpm</td><td>1,200 rpm</td></tr>
<tr><td>30%</td><td>2,100 rpm</td><td>1,800 rpm</td></tr>
<tr><td>40%</td><td>2,800 rpm</td><td>2,400 rpm</td></tr>
<tr><td>50%</td><td>3,500 rpm</td><td>3,000 rpm</td></tr>
<tr><td>60%</td><td>4,200 rpm</td><td>3,600 rpm</td></tr>
<tr><td>70%</td><td>4,900 rpm</td><td>4,200 rpm</td></tr>
<tr><td>80%</td><td>5,600 rpm</td><td>4,800 rpm</td></tr>
<tr><td>90%</td><td>6,300 rpm</td><td>5,400 rpm</td></tr>
<tr><td>100%</td><td>7,000 rpm</td><td>6,000 rpm</td></tr>
</table>

- **Does the tachometer indicate the approximate rpm according to the above specification?**

</td><td>

Yes
GO to J2 .

No
INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

</td></tr>
<tr><td>J2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST</td><td></td></tr>
</table>

• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs first. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to J3 .
J3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For DTC U0401:68, RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and Section 419-10 for a list of all DTCs. For all other DTCs, REFER to DTC Charts in this section. **No** GO to J4 .
J4 CHECK THE ENGINE RPM INPUT USING THE IPC DEALER TEST MODE	
• Ignition ON. • Enter the IPC dealer test mode. • **NOTE:** The display below uses xxx's to represent a numeric or alpha-numeric value. The value may display the same amount of characters represented by the xxx's or there may be more/less depending on the type of display. For example: TACHOMETER xxx RPM (non-hybrid) or Tachometer x rpm (hybrid) may display TACHOMETER 650 RPM (non-hybrid) or Tachometer 650 rpm (hybrid). • Scroll through the displays to TACHOMETER xxx RPM (non-hybrid) or Tachometer x rpm (hybrid). • Start the engine and operate the engine at 1,000, 1,500 and 2,000 rpm while monitoring both the tachometer and the engine rpm input in the dealer test mode. • **Does the engine rpm input agree approximately with the position of the tachometer indication?**	**Yes** The tachometer is operating correctly at this time. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test K: The EV Gauge Is Inoperative (Hybrid)

Normal Operation

The EV gauge is an extension of the tachometer display. When the vehicle shifts into electric vehicle mode or the ignition is in the RUN position with the engine off, the EV gauge replaces the tachometer display in the Instrument Panel Cluster (IPC). The IPC receives the EV gauge data from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus, and engages and commands the EV gauge according to the data received. The EV gauge is only available in the enlighten display mode.

For the IPC to switch to the EV gauge, the PCM first stops providing the message indicating that the vehicle is in engine active mode and begins sending electric power flow data to the IPC .

If the electric motor data is invalid for 5 seconds or less or if the IPC does not receive the electric motor data for 5 seconds or less, the IPC defaults the EV gauge to the last setting, based upon the last known good electric motor message. If the IPC does not receive the electric motor data from the PCM for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the EV gauge to 0 rpm. If the electric motor data is deemed invalid by the IPC for 5 seconds or more, the IPC sets DTC U0401:68 and defaults the EV gauge to 0.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, temperature gauge or odometer.

This pinpoint test is intended to diagnose the following:

- PCM concern
- IPC

PINPOINT TEST K: THE EV GAUGE IS INOPERATIVE (HYBRID)

NOTE: The gas engine must be off with the vehicle operating in electric vehicle mode for the EV gauge to operate.

Test Step	Result / Action to Take
K1 VERIFY THAT THE IPC IS IN THE CORRECT DISPLAY SETTING	
• Ignition ON. • Using the setup menu, verify that the IPC is in the enlighten display mode. • **Is the IPC in the enlighten display mode?**	**Yes** GO to K2 . **No** SET the display setting to enlighten mode.
K2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF	**Yes** DIAGNOSE all PCM DTCs first. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

(KOEO) self-test. • **Are any DTCs recorded?**	**No** GO to K3 .
K3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For DTC U0401:68, RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and Section 419-10 for a list of all DTCs. For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test L: The High Voltage Battery Gauge Is Inoperative (Hybrid)

Normal Operation

The Instrument Panel Cluster (IPC) provides 4 indication modes for the high voltage battery gauge depending upon which display mode the IPC is set to display. Each display mode incrementally adds additional functional indications. The first indication mode displays the current state of charge of the Battery Pack Sensor Module (BPSM). The second and third indication modes indicate whether the BPSM is in the charge or assist mode. When in charge mode, an up arrow is displayed at the top of the gauge. When in assist mode, a down arrow is displayed at the bottom of the gauge. The fourth indication mode displays a circular set of arrows around the battery and a brighter green arrow at the top of the gauge to indicate that the vehicle is in regenerative braking mode.

The IPC requires multiple operational messages from 3 separate modules sent over the High Speed Controller Area Network (HS-CAN) communication bus to control the high voltage battery gauge. The following table provides a summary of the messages and the originating module.

Operational Message	Originating Module	High Voltage Battery Gauge Indication Mode
• Measured state of charge	BPSM	Current state of charge mode
• Current	BPSM	Charge and assist mode
• Voltage	BPSM	Charge and assist mode
• Motor speed slow	Transmission Control Module (TCM)	Regenerative braking mode
	ABS module	Regenerative braking mode

• Hybrid electric vehicle torque modification		

If the state of charge data is missing or invalid for less than 5 seconds, the IPC defaults the state of charge indicator to the last state, based upon the last known good state of charge data received. If the state of charge data is invalid for 5 seconds or more, the IPC sets DTC U0412:68 and defaults the state of charge indicator to the full low position. If the state of charge data is missing for 5 seconds or more, the IPC sets DTC U0111:00 and defaults the state of charge indicator to the full low position.

If the current/voltage data is missing or invalid for less than 5 seconds, the IPC defaults the charge and assist arrows to the last state, based upon the last known good current/voltage data received. If the current/voltage data is invalid for 5 seconds or more, the IPC sets DTC U0412:68 and defaults the charge and assist arrows off. If the current/voltage data is missing for 5 seconds or more, the IPC sets DTC U0111:00 and defaults the charge and assist arrows off.

If the motor speed data is missing or invalid for less than 5 seconds, the IPC defaults the regenerative braking symbol and up arrow to the last state, based upon the last known good motor speed slow message received. If the motor speed data is invalid for 5 seconds or more, the IPC sets DTC U0402:68 and defaults the regenerative braking symbol and up arrow off. If the motor speed data is missing for 5 seconds or more, the IPC sets DTC U0101:00 and defaults the regenerative braking symbol and up arrow off.

If the torque modification data is missing or invalid for 5 seconds or more, the IPC defaults the regenerative braking symbol and up arrow off. If the motor speed data is invalid for 5 seconds or more, the IPC sets DTC U0415:68 and defaults the regenerative braking symbol and up arrow off. If the motor speed data is missing for 5 seconds or more, the IPC sets DTC U0121:00 and defaults the regenerative braking symbol and up arrow off.

This pinpoint test is intended to diagnose the following:

- High voltage battery concern
- Transaxle concern
- ABS concern
- IPC

PINPOINT TEST L: THE HIGH VOLTAGE BATTERY GAUGE IS INOPERATIVE (HYBRID)

Test Step	Result / Action to Take
L1 RETRIEVE THE RECORDED DTCs FROM THE BPSM SELF-TEST	
• Check for recorded BPSM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all BPSM DTCs first. REFER to Section 414-03 . **No** GO to L2 .
L2 RETRIEVE THE RECORDED DTCs FROM THE TCM SELF-TEST	
• Check for recorded TCM DTCs from the self-test.	**Yes** DIAGNOSE all TCM DTCs first. REFER to Section 307-01C .

• **Are any DTCs recorded?**	**No** GO to L3 .
L3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded ABS module DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all ABS module DTCs first. REFER to Section 206-09 . **No** GO to L4 .
L4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test M: The Fuel Efficiency Gauge Is Inoperative (Hybrid)

Normal Operation

The Instrument Panel Cluster (IPC) receives the fuel usage data from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus. The IPC monitors the fuel usage inputs and provides an instantaneous display of the miles per gallon.

This pinpoint test is intended to diagnose the following:

- PCM concern
- Transmission Control Module (TCM) concern
- IPC

PINPOINT TEST M: THE FUEL EFFICIENCY GAUGE IS INOPERATIVE (HYBRID)

Test Step	Result / Action to Take
M1 VERIFY THAT THE IPC IS IN THE CORRECT DISPLAY SETTING	
• Ignition ON. • Using the setup menu, verify that the IPC is in the enlighten, engage or empower display mode. • **Is the IPC in the enlighten, engage or empower display mode?**	**Yes** GO to M2 . **No** SET the display setting to the enlighten, engage or empower mode.
M2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	

• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs first. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to M3 .
M3 RETRIEVE THE RECORDED DTCs FROM THE TCM SELF-TEST	
• Check for recorded TCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all TCM DTCs first. REFER to Section 307-01C . **No** GO to M4 .
M4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For DTC U0101:00, GO to Pinpoint Test BG . For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test N: The Accessory Power Gauge Is Inoperative (Hybrid)

Normal Operation

The accessory power gauge indicates the amount of non-propulsion electrical demands that the vehicle accessories are placing on the electrical system. Examples of non-propulsion accessories are air conditioning, lighting, audio and the rear window defroster. The accessory power gauge is only displayed in the empower display mode. When in use, these accessories use up electrical power that reduces the overall stored energy that could be used to drive the electric motor. The accessory power gauge indicates the amount of power the accessories are using up. Thus a rising gauge indicates that there is an increasing demand on the available power and a falling gauge indication indicates that the demand from the accessories is reduced.

The Instrument Panel Cluster (IPC) receives the accessory power data from the air conditioning control module and the DC to DC Converter Control Module (DC/DC) over the High Speed Controller Area Network (HS-CAN) communication bus.

The IPC requires multiple operational messages to control the accessory power gauge. The following table provides a summary of the messages and the originating module.

Operational Message	Originating Module
	Air conditioning control module

• Actual power consumption	
• DC to DC high voltage current	DC/DC
• DC to DC high voltage	DC/DC

If the actual power consumption data is missing or invalid for less than 5 seconds, the IPC defaults the accessory power gauge to the last state, based upon the last known good actual power consumption data received. If the actual power consumption data is invalid for 5 seconds or more, the IPC sets DTC U040A:68 and defaults the accessory power gauge to the full low position. If the actual power consumption data is missing for 5 seconds or more, the IPC sets DTC U010F:00 and defaults the accessory power gauge to the full low position.

If the DC to DC current/voltage data is missing or invalid for less than 5 seconds, the IPC defaults the accessory power gauge to the last state, based upon the last known good DC to DC current/voltage data received. If the DC to DC current/voltage data is invalid for 5 seconds or more, the IPC sets DTC U0599:68 and defaults the accessory power gauge to the full low position. If the DC to DC current/voltage data is missing for 5 seconds or more, the IPC sets DTC U0298:00 and defaults the accessory power gauge to the full low position.

This pinpoint test is intended to diagnose the following:

- Air conditioning control module
- DC/DC
- IPC

PINPOINT TEST N: THE ACCESSORY POWER GAUGE IS INOPERATIVE (HYBRID)

Test Step	Result / Action to Take
N1 VERIFY THAT THE IPC IS IN THE CORRECT DISPLAY SETTING	
• Ignition ON. • Using the setup menu, verify that the IPC is in the empower display mode. • **Is the IPC in the empower display mode?**	**Yes** GO to N2 . **No** SET the display setting to empower mode.
N2 RETRIEVE THE RECORDED DTCs FROM THE AIR CONDITIONING CONTROL MODULE SELF-TEST	
• Check for recorded air conditioning control module DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all air conditioning control module DTCs first. REFER to Section 307-01C . **No** GO to N3 .
N3 RETRIEVE THE RECORDED DTCs FROM THE	

DC/DC SELF-TEST	
• Check for recorded DC/DC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all DC/DC DTCs first. REFER to Section 414-05 . **No** GO to N4 .
N4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test O: The Vehicle Power Gauge Is Inoperative (Hybrid)

Normal Operation

The vehicle power gauge indicates the power demand when the transaxle is in DRIVE (D) range. The vehicle power gauge is only displayed in the empower display mode. The vehicle power gauge display provides the gasoline engine on/off threshold using a green box on the lower end of the gauge and a gauge display indicating the amount of acceleration demand through the accelerator pedal. As the accelerator is pressed during normal driving, the gauge display increases until the acceleration or power demand is great enough to require the assistance of the gasoline engine.

When the power demand is low and the vehicle is in the electric vehicle mode, the EV display at the bottom of the gauge illuminates. Under certain circumstances such as system warm up or battery charging, the gasoline engine runs regardless of how low the power demand is from the driver. In this case, the green box on the lower portion of the gauge indicating the gasoline engine on/off threshold is not displayed.

The Instrument Panel Cluster (IPC) receives the vehicle power data from the PCM and Battery Pack Sensor Module (BPSM) over the High Speed Controller Area Network (HS-CAN) communication bus.

If the PCM data is missing or invalid for less than 5 seconds, the IPC defaults the vehicle power gauge to the last state, based upon the last known good actual power consumption data received. If the PCM data is invalid for 5 seconds or more, the IPC sets DTC U0401:68 and defaults the vehicle power gauge to the full low position. If the PCM data is missing for 5 seconds or more, the IPC sets DTC U0100:00 and defaults the vehicle power gauge to the full low position.

If the current/voltage data is missing or invalid for less than 5 seconds, the IPC defaults the vehicle power gauge to the last state, based upon the last known good current/voltage data received. If the current/voltage data is invalid for 5 seconds or more, the IPC sets DTC U0412:68 and defaults the vehicle power gauge to the full low position. If the current/voltage data is missing for 5 seconds or more, the IPC sets DTC U0111:00 and defaults the vehicle power gauge to the full low position.

This pinpoint test is intended to diagnose the following:

- PCM
- BPSM

- IPC

PINPOINT TEST O: THE VEHICLE POWER GAUGE IS INOPERATIVE (HYBRID)

Test Step	Result / Action to Take
O1 VERIFY THAT THE IPC IS IN THE CORRECT DISPLAY SETTING	
• Ignition ON. • Using the setup menu, verify that the IPC is in the empower display mode. • **Is the IPC in the empower display mode?**	**Yes** GO to O2 . **No** SET the display setting to empower mode.
O2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs first. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to O3 .
O3 RETRIEVE THE RECORDED DTCs FROM THE BPSM SELF-TEST	
• Check for recorded BPSM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all BPSM DTCs first. REFER to Section 414-03 . **No** GO to O4 .
O4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test P: The Split Power Gauge Is Inoperative (Hybrid)

Normal Operation

The split power gauge is actually a dual gauge indication. The LH side of the gauge provides the propulsion power supplied by the electric motor in the electric vehicle mode. The RH side of the gauge provides the propulsion power supplied by the gasoline engine. When the vehicle is powered by the electric motor in electric vehicle mode, the gauge illuminates the EV icon at the bottom of the gauge. The split power gauge is only displayed in the engage display mode.

The Instrument Panel Cluster (IPC) receives the split power gauge data from the PCM and the Battery Pack Sensor Module (BPSM) over the High Speed Controller Area Network (HS-CAN) communication bus.

The IPC requires multiple operational messages to control the split power gauge. The following table provides a summary of the messages and the originating module.

Operational Message	Originating Module
• Engine active	PCM
• Engine speed	PCM
• Hybrid Electric Vehicle (HEV) estimated engine torque	PCM
• Current	BPSM
• Voltage	BPSM

If the PCM data is missing or invalid for less than 5 seconds, the IPC defaults the split power gauge to the last state, based upon the last known good actual power consumption data received. If the PCM data is invalid for 5 seconds or more, the IPC sets DTC U0401:68 and defaults the split power gauge to the full low position. If the PCM data is missing for 5 seconds or more, the IPC sets DTC U0100:00 and defaults the split power gauge to the full low position.

If the current/voltage data is missing or invalid for less than 5 seconds, the IPC defaults the split power gauge to the last state, based upon the last known good current/voltage data received. If the current/voltage data is invalid for 5 seconds or more, the IPC sets DTC U0412:68 and defaults the split power gauge to the full low position. If the current/voltage data is missing for 5 seconds or more, the IPC sets DTC U0111:00 and defaults the split power gauge to the full low position.

This pinpoint test is intended to diagnose the following:

- PCM concern
- High voltage battery concern
- IPC

PINPOINT TEST P: THE SPLIT POWER GAUGE IS INOPERATIVE (HYBRID)

Test Step	Result / Action to Take
P1 VERIFY THAT THE IPC IS IN THE CORRECT DISPLAY SETTING	
• Ignition ON. • Using the setup menu, verify that the IPC is in the engage display	**Yes** GO to P2 . **No**

mode. • **Is the IPC in the engage display mode?**	SET the display setting to engage mode.
P2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs first. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to P3 .
P3 RETRIEVE THE RECORDED DTCs FROM THE BPSM SELF-TEST	
• Check for recorded BPSM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all BPSM DTCs first. REFER to Section 414-03 . **No** GO to P4 .
P4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test R: The Low Oil Pressure Warning Indicator Is Never/Always On (Non-Hybrid)

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) provides a reference voltage to the engine oil pressure switch. When the oil pressure is within normal ranges, the engine oil pressure switch closes to ground, pulling the reference voltage low in the IPC . The IPC senses the low reference voltage and turns off the low oil pressure warning indicator. When the engine oil pressure is low, the engine oil pressure switch opens, sending the reference voltage high in the IPC . The IPC senses the high voltage and turns the low oil pressure warning indicator on.

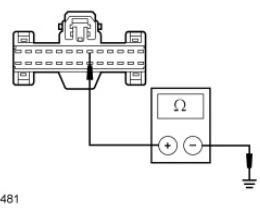
This pinpoint test is intended to diagnose the following:

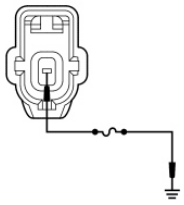
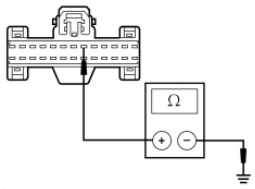
- Wiring, terminals or connectors
- Engine oil pressure switch
- Base engine oil pressure concern
- IPC

PINPOINT TEST R: THE LOW OIL PRESSURE WARNING INDICATOR IS NEVER/ALWAYS ON (NON-HYBRID)

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
R1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC low oil pressure warning indicator (OIL_P_LOW) active command. Command the low oil pressure warning indicator on and off while observing the low oil pressure warning indicator. • **Does the low oil pressure warning indicator illuminate when commanded on, and turn off when commanded off?**	**Yes** If the original symptom is the low oil pressure warning indicator is always on, GO to R4 . If the original symptom is the low oil pressure warning indicator is never on, GO to R2 . **No** GO to R7 .
R2 CHECK FOR A STUCK CLOSED ENGINE OIL PRESSURE SWITCH	
• Ignition OFF. • Disconnect: Engine Oil Pressure Switch C103 . • Ignition ON. • Observe the low oil pressure warning indicator. • **Does the low oil pressure warning indicator turn on?**	**Yes** INSTALL a new Engine Oil Pressure (EOP) switch. REFER to Section 303-01A (2.5L), Section 303-01B (3.0L) or Section 303-01C (3.5L). TEST the system for normal operation. **No** GO to R3 .
R3 CHECK OIL PRESSURE INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: IPC C220 . • Measure the resistance between the IPC C220-6, circuit CMC24 (GY), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to R7 . **No** REPAIR the circuit. TEST the system for normal operation.

R4 CHECK FOR A STUCK OPEN ENGINE OIL PRESSURE SWITCH	
• Ignition OFF. • Disconnect: Engine Oil Pressure Switch C103 . • Connect a fused jumper wire between the engine oil pressure switch, C103-1, circuit CMC24 (GY), harness side and ground.  N0002760 • Ignition ON. • Observe the low oil pressure warning indicator. • **Does the low oil pressure warning indicator turn off?**	**Yes** REMOVE the jumper wire. GO to R6 . **No** LEAVE the jumper wire connected. GO to R5 .
R5 CHECK OIL PRESSURE INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Disconnect: IPC C220 . • With the jumper wire in place, measure the resistance between the IPC C220-6, circuit CMC24 (GY), harness side and ground.  N0094481 • **Is the resistance less than 5 ohms?**	**Yes** REMOVE the jumper wire. GO to R7 . **No** REMOVE the jumper wire. REPAIR the circuit. TEST the system for normal operation.
R6 CHECK THE OIL PRESSURE	
• Carry out the oil pressure test. Refer to Section 303-00 . • **Is the oil pressure within specification?**	**Yes** INSTALL a new Engine Oil Pressure (EOP) switch. REFER to Section 303-01A (2.5L), Section 303-01B (3.0L) or Section 303-01C (3.5L). TEST the system for normal operation. **No** REFER to Section 303-00 to continue diagnosis of the low engine oil pressure concern.

R7 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test S: The Brake Warning Indicator is Never On

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) uses 3 basic messaged inputs to control the brake warning indicator. The first 2 are the parking brake warning indicator switch and brake fluid level switch. The third is for the Electronic Brake Distribution (EBD) and the brake booster vacuum sensor, controlled by the ABS module. The parking brake warning indicator switch and the brake fluid level switch status are sent from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) communication bus. The EBD message is sent from the ABS module over the High Speed Controller Area Network (HS-CAN) communication bus lines. The parking brake warning indicator switch and brake fluid level switch are both hardwired to the SJB . The parking brake warning indicator switch is case grounded and the brake fluid level uses an external ground circuit.

The SJB provides a reference voltage to both the parking brake warning indicator switch and the brake fluid level switch. When the parking brake is applied, the parking brake warning indicator switch closes to ground, providing a ground to the SJB and pulling the parking brake input circuit low. When a low brake fluid level condition exists, the low brake fluid level switch closes to ground through the ground circuit, pulling the brake fluid level input circuit low. The SJB monitors the parking brake and the brake fluid level inputs sending the IPC a message to turn the brake warning indicator on or when the parking brake is applied. When the ABS module detects a base brake system concern or other ABS-related concerns that affect the EBD function, the ABS module sends a message to the IPC to illuminate both the ABS warning indicator and the brake warning indicator.

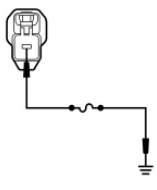
This pinpoint test is intended to diagnose the following:

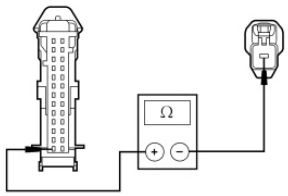
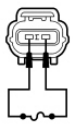
- Wiring, terminals or connectors
- Parking brake warning indicator switch
- Brake fluid level switch
- SJB
- IPC

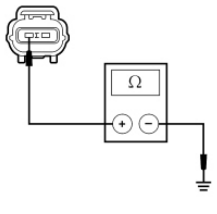
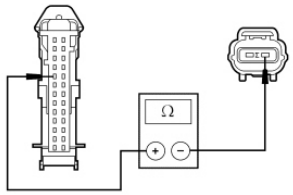
PINPOINT TEST S: THE BRAKE WARNING INDICATOR IS NEVER ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
S1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC brake warning indicator (PBA_LMP) active command. Command the brake warning indicator on while observing the brake warning indicator. • **Does the brake warning indicator illuminate when commanded on?**	**Yes** GO to S2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
S2 DETERMINE IF THE BRAKE WARNING INDICATOR OPERATES WITH THE PARKING BRAKE	
• Apply the parking brake while monitoring the brake warning indicator. • **Does the brake warning indicator illuminate with the parking brake applied?**	**Yes** GO to S6 . **No** GO to S3 .
S3 CHECK THE PARKING BRAKE WARNING INDICATOR SWITCH PID	
• Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Select the SJB parking brake PID (PRK_BRK). Monitor the parking brake PID while applying the parking brake. • **Does the PID agree with the parking brake position?**	**Yes** GO to S9 . **No** GO to S4 .
S4 CHECK THE PARKING BRAKE WARNING INDICATOR SWITCH	
• Disconnect: Parking Brake Warning Indicator Switch C306 . • Connect a fused jumper wire between the parking brake warning indicator switch C306-1, circuit CMC25 (WH/VT), harness side and ground.  N0026569 • **Does the brake warning indicator illuminate?**	**Yes** REMOVE the jumper wire. INSTALL a new parking brake warning indicator switch. TEST the system for normal operation. **No** REMOVE the jumper wire. GO to S5 .

S5 CHECK THE PARKING BRAKE SIGNAL CIRCUIT FOR AN OPEN	
• Disconnect: SJB C2280c . • Measure the resistance between the SJB C2280c-1, circuit CMC25 (WH/VT), harness side and the parking brake warning indicator switch C306-1, circuit CMC25 (WH/VT), harness side and ground.  N0094482 • **Is the resistance less than 5 ohms?**	**Yes** GO to S9 . **No** REPAIR the circuit. TEST the system for normal operation.
S6 CHECK THE BRAKE FLUID LEVEL SWITCH OPERATION	
• Ignition OFF. • Disconnect: Brake Fluid Level Switch C124 . • Ignition ON. • Connect a fused jumper wire between the brake fluid level switch C124-1, circuit CMC19 (GY/VT), harness side and the brake fluid level switch C124-2, circuit GD121 (BK/YE), harness side.  N0026571 • **Does the brake warning indicator illuminate?**	**Yes** REMOVE the jumper wire. INSTALL a new brake fluid level switch. TEST the system for normal operation. **No** REMOVE the jumper wire. GO to S7 .
S7 CHECK THE BRAKE FLUID LEVEL SWITCH GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the brake fluid level switch C124-2, circuit GD121 (BK/YE), harness side and ground.	**Yes** GO to S8 . **No** REPAIR the circuit. TEST the system for normal operation.

 N0026575 • **Is the resistance less than 5 ohms?**	
S8 CHECK THE BRAKE FLUID LEVEL INPUT CIRCUIT FOR AN OPEN	
• Disconnect: SJB C2280f . • Measure the resistance between the SJB C2280f-9, circuit CMC19 (GY/VT), harness side and the brake fluid level switch C124-1, circuit CMC19 (GY/VT), harness side.  N0094483 • **Is the resistance less than 5 ohms?**	**Yes** GO to S9 . **No** REPAIR the circuit. TEST the system for normal operation.
S9 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test T: The Brake Warning Indicator is Always On

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) uses 3 basic messaged inputs to control the brake warning indicator. The first 2 are the parking brake warning indicator switch and brake fluid level switch. The third is for the Electronic Brake Distribution (EBD) and the brake booster vacuum sensor, controlled by the ABS module. The parking brake warning indicator switch and the brake fluid level switch status are sent from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) communication bus. The EBD message is sent from the ABS module over the High Speed Controller Area Network (HS-CAN) communication bus lines. The parking brake warning indicator switch and brake fluid level switch are both hardwired to the SJB . The parking brake warning indicator switch is case grounded and the brake fluid level

uses an external ground circuit.

The SJB provides a reference voltage to both the parking brake warning indicator switch and the brake fluid level switch. When the parking brake is applied, the parking brake warning indicator switch closes to ground, providing a ground to the SJB and pulling the parking brake input circuit low. When a low brake fluid level condition exists, the low brake fluid level switch closes to ground through the ground circuit, pulling the brake fluid level input circuit low. The SJB monitors the parking brake and the brake fluid level inputs sending the IPC a message to turn the brake warning indicator on or when the parking brake is applied. When the ABS module detects a base brake system concern or other ABS-related concerns that affect the EBD function, the ABS module sends a message to the IPC to illuminate both the ABS warning indicator and the brake warning indicator.

If the brake fluid level or parking brake status messages are missing for more than 5 seconds, the IPC sets DTC U0140:00 and defaults the brake warning indicator on. If the IPC does not receive the ABS status message or the EBD message from the ABS module for more than 5 seconds, the IPC sets DTC U0121:00 and defaults the ABS warning indicator on.

- DTC B2479 (Park Brake Switch Circuit Short to Ground) - an on-demand DTC that sets when the SJB detects a short to ground on the parking brake warning indicator switch input circuit.
- DTC C1125 (Brake Fluid Level Sensor Input Circuit Failure) - a continuous and on-demand DTC that sets in the SJB if the SJB detects a short to ground on the brake fluid level input circuit.

NOTE: If DTC U0140:00 is set in the IPC , other symptoms may also be present such as Tire Pressure Monitoring System (TPMS), instrument panel backlighting, and door ajar indication.

NOTE: Whenever the IPC receives an EBD message from the ABS module, the IPC illuminates both the brake warning indicator and the ABS warning indicator simultaneously.

This pinpoint test is intended to diagnose the following:

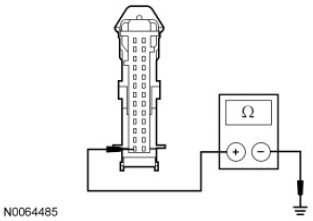
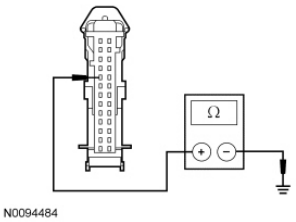
- Wiring, terminals or connectors
- Parking brake warning indicator switch
- Brake fluid level switch
- ABS concern
- SJB
- IPC

PINPOINT TEST T: THE BRAKE WARNING INDICATOR IS ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
T1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC brake warning indicator (PBA_LMP) active command. Command brake warning indicator on and off while observing the brake warning indicator.	**Yes** GO to T2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for

• **Does the brake warning indicator turn off when commanded off?**	normal operation.
T2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0140:00, GO to Pinpoint Test BM . For DTC U0121:00, GO to Pinpoint Test BK . For all other DTCs, REFER to DTC Charts in this section. **No** GO to T3 .
T3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded DTCs from the ABS module self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 206-09 . **No** GO to T4 .
T4 RETRIEVE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check for recorded DTCs from the SJB self-test. • **Is DTC B2479 recorded?**	**Yes** GO to T5 . **No** GO to T8 .
T5 CHECK THE PARKING BRAKE WARNING INDICATOR SWITCH PID	
• Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Select the SJB parking brake PID (PRK_BRAKE). Monitor the parking brake PID while applying and releasing the parking brake. • **Does the PID agree with the parking brake position?**	**Yes** GO to T10 . **No** GO to T6 .
T6 CHECK THE PARKING BRAKE WARNING INDICATOR SWITCH	
• Disconnect: Parking Brake Warning Indicator Switch C306 . • Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Select the SJB parking brake PID (PRK_BRAKE). Monitor the parking brake PID. • **Does the PID indicate the parking brake is released or off?**	**Yes** INSTALL a new parking brake warning indicator switch. CLEAR the DTCs. REPEAT the self-test. **No** GO to T7 .
T7 CHECK CIRCUIT CMC25 (WH/VT) FOR A SHORT TO GROUND	

• Ignition OFF. • Disconnect: SJB C2280c . • Measure the resistance between the SJB C2280c-1, circuit CMC25 (WH/VT), harness side and ground.  N0064485 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to T10 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
T8 CHECK THE BRAKE WARNING INDICATOR USING THE BRAKE FLUID LEVEL SWITCH	
• Ignition OFF. • Disconnect: Brake Fluid Level Switch C124 . • Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test . • Clear the SJB DTCs. Repeat the self-test. • **Is DTC C1125 still present?**	**Yes** GO to T9 . **No** INSTALL a new brake fluid level switch. CLEAR the DTCs. REPEAT the self-test.
T9 CHECK THE BRAKE FLUID LEVEL INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280f . • Measure the resistance between the SJB C2280f-9, circuit CMC19 (GY/VT), harness side and ground.  N0094484 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to T10 . **No** REPAIR the circuit. TEST the system for normal operation.
T10 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify that the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test U: The ABS Warning Indicator Is Never/Always On

Normal Operation

The ABS module provides the ABS status to the Instrument Panel Cluster (IPC) over the High Speed Controller Area Network (HS-CAN) communication bus. If a fault condition exists in the ABS, the ABS module sends the IPC a command to turn on the ABS warning indicator.

If the ABS status message is missing for less than 5 seconds, the ABS warning indicator remains in the last indication mode (on or off) based upon the last known good message received. If the ABS status message is missing for more than 5 seconds, the IPC sets DTC U0121:00 and defaults the ABS warning indicator on.

This pinpoint test is intended to diagnose the following:

- ABS module
- IPC

PINPOINT TEST U: THE ABS WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
U1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC ABS warning indicator (ABS_LAMP) active command. Command the ABS warning indicator on then off. Observe the ABS warning indicator. • **Does the ABS warning indicator turn on when commanded on and turn off when commanded off?**	**Yes** GO to U2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
U2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0121:00, GO to Pinpoint Test BK . For all other DTCs, REFER to DTC Charts in this section. **No** GO to U3 .
U3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
	Yes REFER to Section 206-09 .

• Check for recorded DTCs from the ABS module self-test. • **Are any DTCs recorded?**	**No** INSTALL a new ABS module. REFER to Section 206-09 . TEST the system for normal operation.

Pinpoint Test V: The Stability/Traction Control Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the stability/traction control data from the ABS module over the High Speed Controller Area Network (HS-CAN) communication bus. The stability/traction control indicator flashes when the vehicle stability/traction control is in active mode or is being controlled by the ABS module. The stability/traction control indicator turns on steady if a fault condition exists in the stability/traction control system. The IPC monitors the stability/traction control message from the ABS module and either flashes the stability/traction control indicator or turns it on steady depending on the condition.

Whenever a fault is detected in the ABS module and the ABS warning indicator is illuminated, the stability/traction control indicator also illuminates and stability/traction control is disabled.

If the stability/traction control status message is missing for less than 5 seconds, the stability/traction control indicator remains in the last indication mode (on or off) based upon the last known good message received. If the stability/traction control message is missing for more than 5 seconds, the IPC sets DTC U0121:00 in continuous memory and defaults the stability/traction control indicator on.

This pinpoint test is intended to diagnose the following:

- Stability/traction control concern
- ABS module
- IPC

PINPOINT TEST V: THE STABILITY/TRACTION CONTROL INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
V1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Enter the IPC active command mode and select the stability/traction control indicator (TC/IVD/RSCLMP) active command. Command the stability/traction control indicator on and off while observing the stability/traction control indicator. • **Does the stability/traction control indicator illuminate when commanded on, and turn off when commanded off?**	**Yes** GO to V2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
V2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test.	**Yes** For DTC U0121:00, GO to

• **Are any DTCs recorded?**	Pinpoint Test BK . For all other DTCs, REFER to DTC Charts in this section. **No** GO to V3 .
V3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded DTCs from the ABS module self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 206-09 . **No** INSTALL a new ABS module. REFER to Section 206-09 . TEST the system for normal operation.

Pinpoint Test W: The Stability/Traction Control Disabled Indicator Is Never/Always On

Normal Operation

The traction control switch is hardwired to the Instrument Panel Cluster (IPC). When the traction control switch is pressed, the IPC sends a message to the ABS module over the High Speed Controller Area Network (HS-CAN) communication bus indicating that the traction control switch has been pressed. The ABS module either disables or enables the stability/traction control system and sends a message back to the IPC to turn on or off the stability/traction control disabled indicator based upon the system state.

When a MyKey® programmed key is in use and the AdvanceTrac® on feature is configured always on, the stability/traction control system cannot be disabled and the stability/traction control indicator does not turn on when the traction control disable button is pressed. The stability/traction control indicator still functions normally to indicate a stability/traction control system fault and a stability/traction control active event.

If the traction control switch state message is missing for less than 5 seconds, the stability/traction control disabled indicator remains in the last indication mode (on or off) based upon the last known good message received. If the traction control switch state message is missing for more than 5 seconds, the IPC sets DTC U0121:00 in continuous memory and defaults the stability/traction control disabled indicator off.

This pinpoint test is intended to diagnose the following:

- A MyKey® programmed key is in use
- Stability/traction control cannot be disabled
- ABS module
- IPC

PINPOINT TEST W: THE STABILITY/TRACTION CONTROL DISABLED INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take		
W1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE			**Yes** GO to W2

SCAN TOOL		• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger. • Enter the IPC active command mode and select the stability/traction control disabled indicator (STAB_TC_LMP) active command. Command the stability/traction control disabled indicator on and off while observing the stability/traction control disabled indicator. • **Does the stability/traction control disabled indicator illuminate when commanded on and turn off when commanded off?**	. **No** INSTALL a new IPC. REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
W2 CHECK FOR THE KEY TYPE			
• Check if the key is a MyKey® programmed key or an administrator key. Refer to a target="_parent"	**Yes** GO to W3. **No**		

href="SCS~us~en~file=SCSSJ1BL.HTM~gen~ref.HTM" >Section 419-01B . • **Is the key an administrator key?**	If the MyKey® AdvanceTrac® on feature is configured always on, the system is normal. The stability/traction control system cannot be disabled when the AdvanceTrac® on feature is configured always on. If the MyKey® AdvanceTrac® on feature is not configured always on, GO to W3 .
W3 CHECK THE TRACTION CONTROL INPUT TO THE IPC	
• Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC stability/traction control indicator PID (STAB_CTRL_SW). • Monitor the traction control PID while pressing and releasing the traction control disable switch. • **Does the stability/traction control PID read RELEASED when the button is released and DEPRESSED when the button is pressed?**	**Yes** GO to W4 . **No** REFER to Section 206-09 to diagnose the traction control system cannot be disabled.
W4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC C0089:11, REFER to Section 206-09 . For DTC U0121:00, GO to Pinpoint Test BK . For all other DTCs, REFER to DTC Charts in this section. **No**

	GO to W5 .
W5 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST	
• Check for recorded DTCs from the ABS module self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 206-09 . **No** INSTALL a new ABS module. REFER to Section 206-09 . TEST the system for normal operation.

Pinpoint Test X: The Safety Belt Warning Indicator Is Never/Always On

Normal Operation

The Restraints Control Module (RCM) monitors the safety belt position through the safety belt buckle switch. The RCM provides the safety belt buckle status to the Instrument Panel Cluster (IPC) over the High Speed Controller Area Network (HS-CAN) communication bus.

If the safety belt status message is missing for less than 5 seconds, the safety belt warning indicator remains in the last indication mode (on or off) based upon the last known good message received. If the safety belt status message is missing for 5 seconds or more, the IPC sets DTC U0151:00 and defaults the safety belt warning indicator off.

This pinpoint test is intended to diagnose the following:

- RCM
- IPC

PINPOINT TEST X: THE SAFETY BELT WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
X1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC safety belt warning indicator (SBLT_LAMP) active command. Command the safety belt warning indicator on and off while observing the safety belt warning indicator. • **Does the safety belt warning indicator illuminate when commanded on, and turn off when**	**Yes** GO to X2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

commanded off?	
X2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U0151:00 recorded?**	**Yes** GO to Pinpoint Test BN . **No** GO to X3 .
X3 RETRIEVE THE RECORDED DTCs FROM THE RCM SELF-TEST	
• Check for recorded DTCs from the RCM self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 501-20B . **No** INSTALL a new RCM . REFER to Section 501-20B . TEST the system for normal operation.

Pinpoint Test Y: The Air Bag Warning Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the Supplemental Restraint System (SRS) status from the Restraints Control Module (RCM) over the High Speed Controller Area Network (HS-CAN) communication bus. If an SRS concern is detected, the RCM sets a DTC and sends a message to the IPC to turn on the air bag warning indicator.

If the SRS status message is missing for less than 5 seconds, the air bag warning indicator remains in the last indication mode (on or off) based upon the last known good message received. If the SRS status message is missing for more than 5 seconds, the IPC sets DTC U0151:00 and defaults the air bag warning indicator on.

This pinpoint test is intended to diagnose the following:

- RCM
- IPC

PINPOINT TEST Y: THE AIR BAG WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
Y1 CARRY OUT THE IPC AIR BAG WARNING INDICATOR ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC air bag warning indicator (AIRBAG_LMP) active command. Command the air bag warning indicator on and off while observing the air bag warning indicator.	**Yes** GO to Y2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

• **Does the air bag warning indicator illuminate when commanded on, and turn off when commanded off?**	
Y2 RETRIEVE THE RECORDED DTCs FROM THE RCM SELF-TEST	
• Check for recorded DTCs from the RCM self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 501-20B . **No** GO to Y3 .
Y3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0151:00, GO to Pinpoint Test BN . For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new RCM . REFER to Section 501-20B . TEST the system for normal operation.

Pinpoint Test Z: The Anti-Theft Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) interacts with the PCM (non-hybrid) or Transmission Control Module (TCM) (hybrid) and controls the Passive Anti-Theft System (PATS) function. The IPC controls the anti-theft indicator based upon the status of the PATS .

The anti-theft indicator proves out for 3 seconds when the key is turned to the ON or START position. If there is a PATS concern, the anti-theft indicator either flashes rapidly or glows steadily (for more than 3 seconds) when the ignition is switched to the ON or START mode. The PATS also flashes the anti-theft indicator every 2 seconds at ignition off to act as a visual theft deterrent for all vehicles.

This pinpoint test is intended to diagnose the following:

- PATS concern
- IPC

PINPOINT TEST Z: THE ANTI-THEFT INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
Z1 CHECK THE ANTI-THEFT INDICATOR OPERATION	
• Ignition ON.	**Yes** GO to Z2 .

• Enter the following diagnostic mode on the scan tool: IPC DataLogger. • Select the IPC anti-theft indicator (THEFT_LMP) active command. Command the anti-theft indicator on and off while observing the anti-theft indicator. • **Does the anti-theft indicator illuminate when commanded on and turn off when commanded off?**	**No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
Z2 RETRIEVE THE RECORDED DTCs FROM THE CONTINUOUS IPC SELF-TEST	
• Check for recorded IPC DTCs from the continuous self-test. • **Are any PATS -related DTCs recorded?**	**Yes** REFER to Section 419-01B (non-hybrid) or Section 419-01C (hybrid). **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test AA: The Door/Hood Ajar Warning Indicator Is Never/Always On (Fusion Non-Hybrid)

Normal Operation

The Instrument Panel Cluster (IPC) receives the door/hood ajar status for the LH front door, RH front door, LH rear door, the RH rear door and hood from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) communication bus. When the IPC receives a message from the SJB that the hood or one or more doors is open or ajar, the IPC turns on the door/hood ajar warning indicator.

If the door/hood ajar status message is missing for less than 5 seconds, the door/hood ajar warning indicator remains in the last indication mode (on or off) based upon the last known good message received. If the door/hood ajar status message is missing for more than 5 seconds, the IPC sets DTC U0140:00 and defaults the door/hood ajar warning indicator on.

NOTE: If DTC U0140:00 is set in the SJB , other symptoms may also be present in the IPC such as high beam indicator, RH/LH turn indicators, instrument panel backlighting and Tire Pressure Monitoring System (TPMS).

This pinpoint test is intended to diagnose the following:

- Interior lighting concern
- SJB
- IPC

PINPOINT TEST AA: THE DOOR/HOOD AJAR WARNING INDICATOR IS NEVER/ALWAYS ON (FUSION NON-HYBRID)

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take

AA1 CHECK THE INTERIOR LIGHTING OPERATION	
• Open and close each door while monitoring the courtesy lamps. • **Do the courtesy lamps operate correctly with each door?**	**Yes** GO to AA2 . **No** REFER to Section 417-02 .
AA2 CHECK THE HOOD AJAR SWITCH STATUS PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Select the SJB hood ajar switch PID (HOOD_SW). Monitor the PID with the hood closed and open. • **Does the PID agree with the status of the hood?**	**Yes** GO to AA3 **No** REFER to Section 419-01A to diagnose the hood ajar switch circuit.
AA3 CARRY OUT THE IPC DOOR/HOOD AJAR WARNING INDICATOR ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC door ajar warning indicator (DOOR_AJAR) active command. Command the door ajar warning indicator on and off while observing the door ajar warning indicator. • **Does the door ajar warning indicator illuminate when commanded on, and turn off when commanded off?**	**Yes** GO to AA4 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AA4 RETRIEVE THE RECORDED DTCs FROM THE CONTINUOUS IPC SELF-TEST	
• Check for recorded IPC DTCs from the continuous self-test. • **Is DTC U0140:00 recorded?**	**Yes** GO to Pinpoint Test BM . **No** GO to AA5 .
AA5 RETRIEVE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check for recorded DTCs from the SJB self-test. • **Are any SJB DTCs recorded?**	**Yes** REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 . **No** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.

Pinpoint Test AB: The LH/RH Turn Or High Beam Indicator Is Never/Always On

Normal Operation

When the multifunction switch is in the LH or RH TURN position or if the high beams are on, a message is sent to the Instrument Panel Cluster (IPC) from the Smart Junction Box (SJB) over the Medium Speed

Controller Area Network (MS-CAN) communication bus. The IPC upon receipt of the LH/RH turn or high beam on message, flashes the LH or RH turn signal indicator on and off or illuminates the high beam indicator.

This pinpoint test is intended to diagnose the following:

- Turn signal concern
- High beam concern
- SJB
- IPC

PINPOINT TEST AB: THE LH/RH TURN OR HIGH BEAM INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
AB1 DETERMINE THE FAULT CONDITION	
• Place the headlamps in the HIGH BEAM position. • Ignition ON. • Observe the high beam indicator. • **Does the high beam indicator illuminate?**	**Yes** GO to AB4 . **No** LEAVE the headlamps in the HIGH BEAM position. GO to AB2 .
AB2 CHECK THE HIGH BEAM HEADLAMPS OPERATION	
• Observe the high beam headlamps. • **Do the high beam headlamps operate correctly?**	**Yes** GO to AB3 . **No** REFER to Section 417-01 .
AB3 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Turn off the headlamps. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC high beam indicator (HIGH_BEAM). Command the high beam indicator on and off while observing the high beam indicator. • **Does the high beam indicator illuminate when commanded on, and turn off when commanded off?**	**Yes** GO to AB6 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AB4 CHECK THE LH OR RH TURN SIGNAL LAMPS OPERATION	
• Ignition ON. • Operate the LH or RH turn signal. Observe the exterior LH or RH turn lamps. • **Do the turn signal lamps operate correctly?**	**Yes** GO to AB5 . **No** REFER to Section 417-01 .
AB5 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
	Yes GO to AB6 .

• Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC RH or LH turn signal indicator (RH_TURN_L) or (LH_TURN_L) active command. Command the RH or LH turn signal indicator on and off while observing the LH or RH turn signal indicator. • **Does the LH or RH turn signal indicator illuminate when commanded on, and turn off when commanded off?**	**No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AB6 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0140:00, GO to Pinpoint Test BM . For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.

Pinpoint Test AC: The Tire Pressure Monitoring System (TPMS) Warning Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the Tire Pressure Monitoring System (TPMS) messages from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) communication bus. If the SJB determines that the tire pressure has exceeded the low tire pressure limits, a message is sent to the IPC to turn the TPMS warning indicator on. If a TPMS fault condition exists, the SJB sends a message to the IPC to flash the TPMS warning indicator for 75 seconds then the IPC turns the indicator on steady. If the TPMS is in the TPMS sensor training mode, the SJB sends a command to the IPC to flash the TPMS warning indicator throughout the procedure.

If the TPMS status message is missing or invalid for less than 5 seconds, the IPC defaults the TPMS warning indicator to the last setting (on or off), based upon the last known good message received. If the TPMS status message is missing for more than 5 seconds, DTC U0140:00 sets and the TPMS warning indicator flashes for approximately 75 seconds then turns the indicator on steady. If the message is invalid for more than 5 seconds, the IPC sets DTC U0430:068 (non-hybrid) or U0422:68 (hybrid) and flashes the TPMS warning indicator for approximately 75 seconds then turns the indicator on steady.

NOTE: If DTC U0140:00 is set in the SJB , other symptoms may also be present such as high beam indicator, RH/LH turn indicators, instrument panel backlighting, and door ajar indicator.

This pinpoint test is intended to diagnose the following:

- Tire pressure
- TPMS concern
- SJB
- IPC

PINPOINT TEST AC: THE TPMS WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
AC1 CHECK THE TIRE PRESSURE	
• Verify that the tire pressure in all tires meets the recommended tire pressures on the vehicle certification label. Refer to Section 100-01 . • **Do all the tires meet the recommended tire pressures?**	**Yes** GO to AC2 . **No** CORRECT the tire pressures. TEST the system for normal operation.
AC2 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the TPMS warning indicator (TPMWARN_LMP) active command. Command the TPMS warning indicator on and off while observing the TPMS warning indicator. • **Does the TPMS warning indicator illuminate when commanded on and turn off when commanded off?**	**Yes** GO to AC3 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AC3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the continuous self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0430:68 or DTC U0422:68, RETRIEVE and REPAIR all non-network DTCs in the SJB and all other modules on the network. REFER to Section 419-10 for a list of all DTCs. For all other DTCs, REFER to DTC Charts in this section. **No** GO to AC4 .
AC4 RETRIEVE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check for recorded DTCs from the SJB self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 419-10 for correct navigation of the DTC. **No** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.

Pinpoint Test AD: The Charging System Warning Indicator Is Never/Always On (Fusion Non-Hybrid)

Normal Operation

The charging system indicator is controlled by the Instrument Panel Cluster (IPC) based upon data received from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus.

If the charging system message is missing for less than 5 seconds, the charging system indicator remains in the last indication mode (on or off). If the charging system message is missing for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the charging system warning indicator on.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- PCM
- IPC

PINPOINT TEST AD: THE CHARGING SYSTEM WARNING INDICATOR IS NEVER/ALWAYS ON (FUSION NON-HYBRID)

Test Step	Result / Action to Take
AD1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC charging system warning indicator (CHARGE_LMP) active command. Command the charging system warning indicator on and off while observing the charging system warning indicator. • **Does the charging system warning indicator illuminate when commanded on, and turn off when commanded off?**	**Yes** GO to AD2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AD2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any charging system DTCs recorded?**	**Yes** REFER to Section 414-00 . **No** GO to AD3 .
AD3 CHECK THE CHARGING SYSTEM OPERATION	
• Check the charging system operation. Refer to Section 414-00 . • **Does the charging system operate correctly?**	**Yes** GO to AD4 . **No** REFER to Section 414-00 .

AD4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U0100:00 recorded?**	**Yes** GO to Pinpoint Test BF . **No** INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation.

Pinpoint Test AE: The Malfunction Indicator Lamp (MIL) Is Never/Always On

Normal Operation

The Malfunction Indicator Lamp (MIL) is controlled by the Instrument Panel Cluster (IPC) using data sent from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus. If the MIL status message is missing for less than 5 seconds, the MIL remains in the last indication mode (on or off).

If the MIL status message is missing for less than 5 seconds, the MIL remains in the last indication mode (on or off). If the MIL status message is missing for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the MIL on. If the MIL message is invalid for more than 5 seconds, the IPC defaults the MIL on.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST AE: THE MIL IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
AE1 CARRY OUT THE IPC WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC MIL (MIL_LAMP) active command. Command the MIL on and off while observing the MIL . • **Does the MIL illuminate when selected on, and turn off when selected off?**	**Yes** GO to AE2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AE2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	

• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs first. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to AE3 .
AE3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation.

Pinpoint Test AF: The Powertrain Malfunction (Wrench) Warning Indicator Is Never/Always On (Fusion Non-Hybrid)

Normal Operation

The Instrument Panel Cluster (IPC) receives the powertrain malfunction data from the PCM for the Electronic Throttle Control (ETC) status, from the Transmission Control Module (TCM) for the transaxle status and from the 4X4 control module for the All-Wheel Drive (AWD) status over the High Speed Controller Area Network (HS-CAN) communication bus.

When a fault condition exists in the ETC system, the PCM provides the IPC with a message to turn the powertrain malfunction (wrench) warning indicator on. When a fault condition exists in the transaxle, the TCM provides the IPC with a message to turn on the powertrain malfunction (wrench) indicator. When an AWD fault condition exists, the 4X4 control module sends the IPC a message to turn the powertrain malfunction (wrench) warning indicator on.

If the ETC status message is missing for less than 5 seconds, the powertrain malfunction (wrench) indicator remains in the last indication mode (on or off). If the ETC message is missing for greater than 5 seconds, the IPC sets DTC U0100:00 and defaults the powertrain malfunction (wrench) warning indicator on.

If the transaxle status message is missing for less than 5 seconds, the powertrain malfunction (wrench) indicator remains in the last indication mode (on or off). If the transaxle message is missing for greater than 5 seconds, the IPC sets DTC U0101:00 and defaults the powertrain malfunction (wrench) warning indicator on.

If the AWD status message is missing for less than 5 seconds, the powertrain malfunction (wrench) indicator remains in the last indication mode (on or off). If the AWD status message is missing for greater than 5 seconds, the IPC sets DTC U0102:00 and defaults the powertrain malfunction (wrench) warning indicator on.

This pinpoint test is intended to diagnose the following:

- ETC concern
- AWD concern

- Transaxle concern
- IPC

PINPOINT TEST AF: THE POWERTRAIN MALFUNCTION (WRENCH) WARNING INDICATOR IS NEVER/ALWAYS ON (FUSION NON-HYBRID)

Test Step	Result / Action to Take
AF1 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC powertrain malfunction (wrench) warning indicator (TRANSA_LMP) active command. Command the powertrain malfunction (wrench) warning indicator on and off while observing the powertrain malfunction (wrench) warning indicator. • **Does the powertrain malfunction (wrench) warning indicator illuminate when commanded on, and turn off when commanded off?**	**Yes** GO to AF2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AF2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For DTC U0101:00, GO to Pinpoint Test BG . For DTC U0102:00, GO to Pinpoint Test BH . For all other DTCs, REFER to DTC Charts in this section. **No** GO to AF3 .
AF3 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to AF4 .
AF4 RETRIEVE THE RECORDED DTCs FROM THE TCM SELF-TEST	

• Check for recorded TCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all TCM DTCs. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** DIAGNOSE all 4X4 control module DTCs. REFER to Section 308-07A .

Pinpoint Test AG: The Cruise Control Engaged Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the cruise control engaged signal from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus. When the cruise control is engaged, the PCM sends a message to the IPC to illuminate the cruise control engaged indicator.

If the cruise control engaged message is missing for less than 5 seconds, the cruise control engaged indicator remains in the last indication mode (on or off) based upon the last known good message received. If the cruise control engaged message is missing for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the cruise control engaged indicator off.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST AG: THE CRUISE CONTROL ENGAGED INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
AG1 CHECK THE CRUISE CONTROL OPERATION	
• Check the cruise control system for correct operation. • **Does the cruise control operate correctly?**	**Yes** GO to AG2 . **No** REFER to Section 419-03 .
AG2 CARRY OUT THE IPC INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC cruise control engaged indicator (CRUISE) active command. Command the cruise control engaged indicator on and off while	**Yes** GO to AG3 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal

observing the cruise control engaged indicator. • **Does the cruise control engaged indicator illuminate when commanded on, and turn off when commanded off?**	operation.
AG3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U0100:00 recorded?**	**Yes** GO to Pinpoint Test BF . **No** INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation.

Pinpoint Test AH: The Cruise Control On Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the cruise control on signal from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus. When the cruise control is turned on but not engaged, the PCM sends a message to the IPC to illuminate the cruise control on indicator.

If the cruise control on message is missing for less than 5 seconds, the cruise control on indicator remains in the last indication mode (on or off) based upon the last known good message received. If the cruise control on message is missing for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the cruise control on indicator off.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST AH: THE CRUISE CONTROL ON INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
AH1 CHECK THE SPEED CONTROL OPERATION	
• Check the cruise control system for correct operation. • **Does the cruise control operate correctly?**	**Yes** GO to AH2 . **No** REFER to Section 419-03 .
AH2 CARRY OUT THE IPC DEALER TEST MODE	
• Ignition ON.	**Yes** GO to AH3 .

• Enter the IPC dealer test mode. • Scroll through the displays to TELLTALE TEST and monitor the cruise control on (amber) indicator. • **Does the cruise control on (amber) indicator illuminate when in the dealer test mode and turn off when in normal operation mode?**	**No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AH3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U0100:00 recorded?**	**Yes** GO to Pinpoint Test BF . **No** INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation.

Pinpoint Test AI: The Grade Assist Indicator Is Never/Always On (Without Select Shift)

Normal Operation

The Instrument Panel Cluster (IPC) receives the grade assist on/off status from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus. When the grade assist function is selected off, the PCM sends a message to the IPC to illuminate the grade assist indicator.

If the grade assist on/off message is missing for less than 5 seconds, the grade assist indicator remains in the last state (on or off) based upon the last known good message. If the grade assist on/off message is missing for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the grade assist indicator off.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- Transaxle concern
- PCM
- Instrument Panel Cluster (IPC)

PINPOINT TEST AI: THE GRADE ASSIST INDICATOR IS NEVER/ALWAYS ON (WITHOUT SELECT SHIFT)

Test Step	Result / Action to Take
AI1 CHECK THE OPERATION OF THE GRADE ASSIST FUNCTION	
• Verify that the grade assist function operates when engaged and turns off when disengaged. • **Does the grade assist function operate correctly?**	**Yes** GO to AI2 . **No** REFER to Section 307-05A .

AI2 CARRY OUT THE IPC GRADE ASSIST INDICATOR ACTIVE COMMAND USING THE SCAN TOOL	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC grade assist indicator (TRAILER_LMP) active command. Command the grade assist indicator on and off while observing the grade assist indicator. • **Does the grade assist indicator illuminate when commanded on, and turn off when commanded off?**	**Yes** GO to AI3 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AI3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Is DTC U0100:00 recorded?**	**Yes** GO to Pinpoint Test BF . **No** GO to AI4 .
AI4 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation.

Pinpoint Test AJ: The PRNDL Indicator is Never/Always On

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) receives the transaxle range status and vehicle speed data from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus. On hybrid vehicles, the vehicle speed data is sent to the IPC from the Transmission Control Module (TCM) over the HS-CAN communication bus.

For all ranges other than PARK (P), the IPC displays the selected gear matching the input from the PCM.

For PARK (P), the IPC uses a park detect switch (part of the brake shift interlock) to signal the IPC that the shift lever is fully seated in the PARK position. The IPC compares the park detect switch input with the transaxle range status sent from the PCM. The IPC provides a reference voltage to the brake shift interlock on the park detect input circuit. When the gearshift is in PARK (P), the brake shift indicator routes the reference voltage to ground, pulling the circuit low. When the gearshift is moved out of PARK (P), the brake shift

interlock opens the ground sending the reference voltage high.

If the transaxle range status information is missing from the PCM for less than 5 seconds, the PRNDL displays the last selected range based upon the last good known message. If the transaxle range status information is missing from the PCM for 5 seconds or more, the IPC sets DTC U0100:00 and the PRNDL display is blank. If the park detect input is open, the PARK (P) display is blank when the transaxle is in PARK (P) but all other ranges are still displayed according to the selected range status. If the park detect input is shorted to ground and the messaged input indicates any range other than park, the PARK (P) display is blank once a fault is detected by the IPC (all other ranges are still displayed according to the selected range status).

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, tachometer, temperature gauge or odometer.

- DTC P1706:00 (High Vehicle Speed Observed in Park: No Sub-Type Information) (non-hybrid) - a continuous memory DTC that sets if the IPC detects a short to ground on the park detect input circuit with a Vehicle Speed Sensor (VSS) input over 16 km/h (10 mph), indicating that the vehicle is in motion.
- DTC P1706:62 (High Vehicle Speed Observed in Park: Signal Compare Failure) (hybrid) - a continuous memory DTC that sets if the IPC detects a short to ground on the park detect input circuit with a Vehicle Speed Sensor (VSS) input over 16 km/h (10 mph), indicating that the vehicle is in motion.

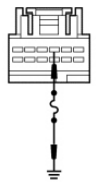
This pinpoint test is intended to diagnose the following:

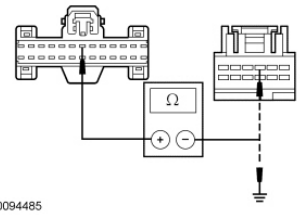
- Wiring, terminals or connectors
- Park detect switch (part of the selector lever)
- PCM
- IPC

PINPOINT TEST AJ: THE PRNDL INDICATOR IS NEVER/ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AJ1 CHECK THE PRNDL DISPLAY PARK OPERATION	
• Ignition ON. • Shift the selector lever through the different gear positions while observing the PRNDL display. • Place the selector lever in the PARK (P) position. • Observe the PRNDL display. • **Does the PRNDL display the difnt ranges according to the selector lever position including PARK (P)?**	**Yes** The system is functioning correctly at this time. **No** GO to AJ2 .
AJ2 RETRIEVE THE RECORD DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For all DTCs, CLEAR the DTCs. DRIVE the vehicle above 16 km/h (10 mph) for more than 5 seconds.

	REPEAT the self-test. If DTC U0100:00 is present, GO to Pinpoint Test BF . If DTC P1706:00 (non-hybrid) or P1706:62 (hybrid) is present, GO to AJ5 . **No** GO to AJ3 .
AJ3 RETRIEVE AND RECORD THE DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any PCM DTCs recorded?**	**Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to AJ4 .
AJ4 CHECK THE PARK DETECT INPUT TO THE IPC	
• Ignition OFF. • Disconnect: Selector Lever C3233 . • Install a fused jumper wire between the selector lever C3233-3, circuit CET52 (GN), harness side and ground.  N0099614 • Ignition ON. • Monitor the PRNDL indicator with the jumper wire installed and with the jumper wire removed. • **Does the PRNDL display P with the jumper wire installed and blank with the jumper wire removed?**	**Yes** INSTALL a new selector lever. REFER to Section 307-05A (non-hybrid) or Section 307-05B (hybrid). TEST the system for normal operation. **No** GO to AJ5 .
AJ5 CHECK THE PARK DETECT INPUT CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Disconnect: IPC C220 . • Measure the resistance between the IPC C220-7, circuit CET52 (GN), harness side and the selector lever C3233-3, circuit CET52 (GN), harness side; and between the IPC C220-7, circuit CET52 (GN), harness side and ground.	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

 • **Is the resistance less than 5 ohms between the IPC and the selector lever, and greater than 10,000 ohms between the IPC and ground?**	

Pinpoint Test AK: The Ready To Drive Indicator Is Never/Always On (Hybrid)

Normal Operation

The purpose of the ready to drive indicator is to inform the driver that the hybrid electric drivetrain is ready to operate. Since the engine can start and stop at different times while the vehicle is driven and operated in the electric vehicle mode, the ready to drive indicator is used so that the customer doesn't interpret the engine turning off as a stalled condition. The Instrument Panel Cluster (IPC) receives the electric vehicle ready to drive on/off command from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus.

If the electric vehicle ready to drive on/off command is missing for less than 5 seconds, the ready to drive indicator remains in the last indication mode (on or off) based upon the last known good message received. If the electric vehicle ready to drive on/off command is missing for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the ready to drive indicator off.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST AK: THE READY TO DRIVE INDICATOR IS NEVER/ALWAYS ON (HYBRID ONLY)

Test Step	Result / Action to Take
AK1 CARRY OUT THE READY TO DRIVE INDICATOR OPERATION	
• Ignition ON. • Monitor the ready to drive indicator. • Place the ignition in the START position then allow the key to return to the ON position and monitor the ready to drive indicator. • **Does the ready to drive indicator remain off in the ON position and illuminate after moving to the**	**Yes** The system is operating correctly at this time. The ready to drive indicator illuminates whenever the ignition is turned to the START position then returns to the RUN or ON position. **No** GO to AK2 .

START position?	
AK2 CARRY OUT THE IPC DEALER TEST MODE	
• Ignition ON. • Enter the IPC dealer test mode. • Scroll through the displays to display TELLTALE TEST and monitor the ready to drive indicator. • **Does the ready to drive indicator illuminate when in the dealer test mode and turn off when in normal operation mode?**	**Yes** GO to AK3 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AK3 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any PCM DTCs recorded?**	**Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to AK4 .
AK4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Is DTC U0100:00 recorded?**	**Yes** GO to Pinpoint Test BF . **No** INSTALL a new PCM. REFER to Section 303-14D . TEST the system for normal operation.

Pinpoint Test AL: The Stop Safely Hazard Message Center Warning Indicator Is Never/Always On (Hybrid)

Normal Operation

The stop safely hazard message center warning indicator informs the driver that a transaxle fault condition exists or a powertrain shutdown is about to occur and service on the vehicle is required. The PCM, the Transmission Control Module (TCM) and the Battery Pack Sensor Module (BPSM) provide the Instrument Panel Cluster (IPC) the stop safely hazard message center indicator request over the High Speed Controller Area Network (HS-CAN) communication bus.

If the stop safely hazard message center indicator request is missing or invalid for less than 5 seconds from any of the source modules (PCM, TCM or BPSM), the stop safely hazard message center warning indicator remains in the last indication mode (on or off) based upon the last known good message received.

If the stop safely hazard message center indicator request is missing for more than 5 seconds from the PCM, the IPC sets DTC U0100:00 in continuous memory and defaults the stop safely hazard message center warning indicator on.

If the stop safely hazard message center indicator request is missing for more than 5 seconds from the TCM , the IPC sets DTC U0101:00 in continuous memory and defaults the stop safely hazard message center

warning indicator on.

If the stop safely hazard message center indicator request is missing for more than 5 seconds from the BPSM , the IPC sets DTC U0111:00 in continuous memory and defaults the stop safely hazard message center warning indicator on.

This pinpoint test is intended to diagnose the following:

- Powertrain concern
- Traction battery concern
- Transaxle concern
- IPC

PINPOINT TEST AL: THE STOP SAFELY HAZARD MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON (HYBRID ONLY)

Test Step	Result / Action to Take
AL1 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors and the luggage compartment lid. • Ignition ON. • Open the driver door while monitoring the message center displays. • **Does the message center display the door ajar message center warning indicator along with the DRIVER DOOR AJAR text?**	**Yes** GO to AL2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AL2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any PCM DTCs recorded?**	**Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to AL3 .
AL3 RETRIEVE THE RECORDED DTCs FROM THE TCM SELF-TESTS	
• Check for recorded TCM DTCs from the continuous and on-demand self-tests. • **Are any TCM DTCs recorded?**	**Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to AL4 .
AL4 RETRIEVE THE RECORDED DTCs FROM THE BPSM SELF-TEST	
• Check for recorded BPSM DTCs from the continuous and on-demand self-tests. • **Are any BPSM DTCs recorded?**	**Yes** REFER to Section 419-10 . **No** GO to AL5 .

AL5 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test AM: The Powertrain Malfunction (Wrench) Message Center Warning Indicator Is Never/Always On (Non-Hybrid)

Normal Operation

The Instrument Panel Cluster (IPC) receives the powertrain malfunction data from the PCM for the Electronic Throttle Control (ETC) status and the transaxle status and from the 4X4 control module for the All-Wheel Drive (AWD) status over the High Speed Controller Area Network (HS-CAN) communication bus. When a fault condition exists in the ETC system or in the transaxle, the PCM provides the IPC with a message to turn the powertrain malfunction (wrench) warning indicator on. When a AWD fault condition exists, the 4X4 control module sends the IPC a message to turn the powertrain malfunction (wrench) warning indicator on.

If the ETC or transaxle message is missing for greater than 5 seconds, the IPC sets DTC U0100:00 and defaults the powertrain malfunction (wrench) warning indicator on.

If the AWD status message is missing for greater than 5 seconds, the IPC sets DTC U0102:00 and defaults the powertrain malfunction (wrench) warning indicator on.

NOTE: If U0100:00 is set in the IPC , other symptoms may also be present such as an inoperative speedometer, tachometer or temperature gauge.

This pinpoint test is intended to diagnose the following:

- ETC concern
- AWD concern
- Transaxle concern
- IPC

PINPOINT TEST AM: THE POWERTRAIN MALFUNCTION (WRENCH) MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON (NON-HYBRID)

Test Step	Result / Action to Take
AM1 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors and the luggage compartment lid. • Ignition ON. • Open the driver door while monitoring the message center displays. • **Does the message center display the door ajar message center warning indicator along with the**	**Yes** GO to AM2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal

DRIVER DOOR AJAR text?	operation.
AM2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For DTC U0102:00, GO to Pinpoint Test BH . For all other DTCs, REFER to DTC Charts in this section. **No** GO to AM3 .
AM3 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs first. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** REPAIR all 4x4 module DTCs. TEST the system for normal operation.

Pinpoint Test AN: The Powertrain Malfunction (Wrench) Message Center Warning Indicator Is Never/Always On (Hybrid)

Normal Operation

The Instrument Panel Cluster (IPC) receives the powertrain malfunction data from the PCM for the Electronic Throttle Control (ETC) status, the Transmission Control Module (TCM) for the transaxle status and the Battery Pack Sensor Module (BPSM) for the traction battery status over the High Speed Controller Area Network (HS-CAN) communication bus.

When a fault condition exists in the ETC system, the transaxle, or the traction battery system, the controlling module (PCM, BPSM or TCM) provides the IPC with a message to turn the powertrain malfunction (wrench) message center warning indicator on.

If the ETC status is missing for less than 5 seconds, the powertrain malfunction (wrench) message center warning indicator remains in the last indication mode (on or off) based upon the last known good message received. If the ETC status is missing for greater than 5 seconds, the IPC sets DTC U0100:00 and defaults the powertrain malfunction (wrench) message center warning indicator on.

If the transaxle status is missing for less than 5 seconds, the powertrain malfunction (wrench) message center warning indicator remains in the last indication mode (on or off) based upon the last known good message received. If the transaxle status is missing for greater than 5 seconds, the IPC sets DTC U0101:00 and defaults the powertrain malfunction (wrench) message center warning indicator on.

If the traction battery status is missing for less than 5 seconds, the powertrain malfunction (wrench) message center warning indicator remains in the last indication mode (on or off) based upon the last known good

message received. If the traction battery status is missing for greater than 5 seconds, the IPC sets DTC U0111:00 and defaults the powertrain malfunction (wrench) message center warning indicator on.

NOTE: If U0100:00 is set in the IPC , other symptoms may also be present such as an inoperative speedometer, tachometer or temperature gauge.

This pinpoint test is intended to diagnose the following:

- ETC concern
- Transaxle concern
- Traction battery concern
- IPC

PINPOINT TEST AN: THE POWERTRAIN MALFUNCTION (WRENCH) MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON (HYBRID)

Test Step	Result / Action to Take
AN1 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors and the luggage compartment lid. • Ignition ON. • Open the driver door while monitoring the message center displays. • **Does the message center display the door ajar message center warning indicator along with the DRIVER DOOR AJAR text?**	**Yes** GO to AN2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AN2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** GO to AN3 .
AN3 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all PCM DTCs first. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to AN4 .
AN4 RETRIEVE THE RECORDED DTCs FROM THE TCM SELF-TEST	
• Check for recorded TCM DTCs from the self-test. • **Are any DTCs recorded?**	**Yes** DIAGNOSE all TCM DTCs first. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No**

	REPAIR all BPSM DTCs. REFER to Section 414-03 .

Pinpoint Test AO: The Engine Or Motor Over-Temperature Message Center Warning Indicator Is Never/Always On (Hybrid)

Normal Operation

The Instrument Panel Cluster (IPC) receives the engine and motor over-temperature status from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus. If the PCM detects an engine or motor over-temperature condition, the PCM sends a command to the IPC to turn the engine or motor over-temperature message center warning indicator on. If the PCM determines that the engine is sufficiently overheated to enter into the fail-safe cooling mode, the PCM sends a command to the IPC to flash the engine or motor over-temperature message center warning indicator.

If the engine or motor over-temperature message is missing or invalid for less than 5 seconds, the engine or motor over-temperature message center warning indicator remains in the last state (on or off) based upon the last known good message received. If the engine over-temperature message is invalid for more than 5 seconds, the IPC sets DTC U0401:68 in continuous memory and defaults the engine or motor over-temperature message center warning indicator on. If the motor over-temperature message is invalid for more than 5 seconds, the IPC sets DTC U0401:68 in continuous memory and defaults the engine or motor over-temperature message center indicator off. If the engine over-temperature message is missing for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and defaults the engine or motor over-temperature message center warning indicator on.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST AO: THE ENGINE OR MOTOR OVER-TEMPERATURE MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON (HYBRID)

Test Step	Result / Action to Take
AO1 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors and the luggage compartment lid. • Ignition ON. • Open the driver door while monitoring the message center displays. • **Does the message center display the door ajar message center warning indicator along with the DRIVER DOOR AJAR text?**	**Yes** GO to AO2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

AO2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any PCM DTCs recorded?**	**Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to AO3 .
AO3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For DTC U0401:68, RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and Section 419-10 for a list of all DTCs. For all other DTCs, REFER to DTC Charts in this section. **No** INSTALL a new PCM. REFER to Section 303-14D . TEST the system for normal operation.

Pinpoint Test AP: The Low Fuel Message Center Warning Indicator Is Never On

Normal Operation

The low fuel message center indicator illuminates when the Distance To Empty (DTE) display is above 120 km (75 miles) (with a MyKey® programmed key) or 80 km (50 miles) (with an administrator key) to empty, the system is operating correctly. The low fuel warning is turned on when the DTE display is 120 km (75 miles) (with a MyKey® programmed key) or 80 km (50 miles) (with an administrator key) to empty or less.

This pinpoint test is intended to diagnose the following:

- IPC

PINPOINT TEST AP: THE LOW FUEL MESSAGE CENTER WARNING INDICATOR IS NEVER ON

Test Step	Result / Action to Take
AP1 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors and the luggage compartment lid. • Ignition ON.	**Yes** GO to AP2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in

• Open the driver door while monitoring the message cenr displays. • **Does the message center display the door ajar message center warning indicator along with the DRIVER DOOR AJAR text?**	this section. TEST the system for normal operation.
AP2 CHECK THE FUEL GAUGE OPERATION	
• Verify the fuel gauge is operating correctly and is not registering empty (E) or full (F) all the time. • **Does the fuel gauge operate correctly?**	**Yes** GO to AP3 **No** GO to Pinpoint Test B .
AP3 CHECK THE DTE	
• Scroll through the information displays in the message center to the DTE display. • **Does the DTE display indicate 120 km (75 miles) (with a MyKey® programmed key) or 80 km (50 miles) (with an administrator key) or less?**	**Yes** If the low fuel message center indicator is never on, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. If the low fuel message center warning indicator is always on, the system is operating correctly at this time. **No** If the low fuel message center warning indicator is always on, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. If the low fuel message center warning indicator is never on, the system is operating correctly at this time. The low fuel message center indicator turns on when the fuel level is at or below 120 km (75 miles) (with a MyKey® programmed key) or 80 km (50 miles) (with an administrator key).

Pinpoint Test AQ: The Low Oil Pressure Message Center Warning Indicator Is Never/Always On

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The oil pressure switch is hardwired to the Instrument Panel Cluster (IPC) and is a normally open switch. With egine oil pressure, the oil pressure switch closes to ground and opens without oil pressure.

Non-Hybrid

The IPC provides a reference voltage to the engine oil pressure switch. When the oil pressure is within normal ranges, the engine oil pressure switch closes to ground, pulling the reference voltage low in the IPC . With the oil pressure switch closed, the IPC senses the low reference voltage and turns off the low oil pressure message center warning indicator. When the engine oil pressure is low, the engine oil pressure switch opens, sending

the reference voltage high in the IPC . The IPC senses the high voltage and turns on the low oil pressure message center warning indicator.

Hybrid

Due to the need to turn the internal combustion engine on and off during operation with the key in the RUN position, the low oil pressure message center warning indicator requires two inputs. The first input is engine rpm and the second input is oil pressure switch state. When the IPC detects engine oil pressure and receives an rpm state over 500 rpm from the internal combustion engine, the IPC turns off the low oil pressure warning indicator. If the oil pressure switch indicates low oil pressure and the rpm is less than 500 rpm, the low oil pressure message center warning indicator remains off.

With the oil pressure switch closed, the IPC senses the low reference voltage and turns off the low oil pressure warning indicator, provided engine rpm is greater than 500 rpm. When the engine oil pressure is low, the engine oil pressure switch opens, sending the reference voltage high. The IPC senses the reference voltage has moved high and turns the low oil pressure warning indicator on.

The IPC receives the engine rpm status from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus.

If the engine rpm status is missing or invalid for less than 5 seconds, the IPC controls the low oil pressure message center warning based upon current oil pressure switch state and using the last known good rpm message received. If the engine rpm status is invalid for more than 5 seconds, the IPC assumes that the rpm is greater than 500 rpm and defaults full control of the low oil pressure message center warning indicator to the actual oil pressure switch state. If the engine rpm status is missing for more than 5 seconds, the IPC sets DTC U0100:00 in continuous memory and assumes that the rpm is greater than 500 rpm, defaulting full control of the low oil pressure message center warning indicator to the actual oil pressure switch state.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Engine oil pressure switch
- Base engine oil pressure concern
- IPC

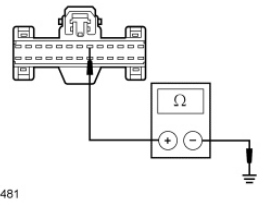
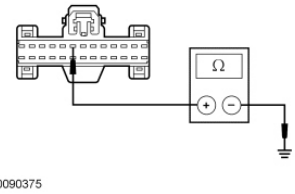
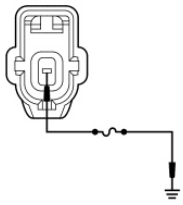
PINPOINT TEST AQ: THE LOW OIL PRESSURE MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON

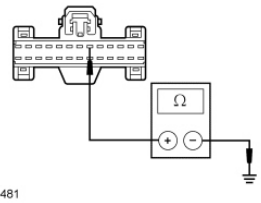
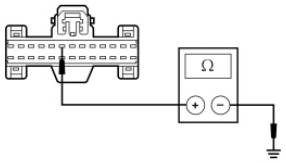
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AQ1 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors and the luggage compartment lid. • Ignition ON.	**Yes** For hybrid, GO to AQ2 . For non-hybrid, if the original symptom is the low oil pressure warning indicator is never on,

• Open the driver door while monitoring the message center displays. • **Does the message center display the door ajar message center warning indicator along with the DRIVER DOOR AJAR text?**	GO to AQ4 . For non-hybrid, if the original symptom is the low oil pressure warning indicator is always on, GO to AQ6 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AQ2 CHECK THE TACHOMETER	
• Set the message center to enlighten display mode. • Start the engine and observe the tachometer. • **Is rpm present and above 500 rpm on the tachometer?**	**Yes** If the original symptom is the low oil pressure indicator is on with the engine off and the vehicle in electric vehicle mode, GO to AQ3 . If the original symptom is the low oil pressure warning indicator is always on, GO to AQ6 . If the original symptom is the low oil pressure warning indicator is never on, GO to AQ4 . **No** GO to Pinpoint Test I .
AQ3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U0100:00 recorded?**	**Yes** GO to Pinpoint Test BF . **No** INSTALL a new IC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AQ4 CHECK FOR A STUCK CLOSED ENGINE OIL PRESSURE SWITCH	
• Ignition OFF. • Disconnect: Engine Oil Pressure Switch C103 . • Start the engine. • Observe the low oil pressure warning indicator. • **Does the low oil pressure warning indicator turn on?**	**Yes** INSTALL a new Engine Oil Pressure (EOP) switch. REFER to Section 303-01C (3.5L) or Section 303-01D (hybrid). TEST the system for normal operation. **No** GO to AQ5 .
AQ5 CHECK OIL PRESSURE INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: IPC C220 . • For non-hybrid, measure the resistance between the IPC C220-6, circuit CMC24 (GY), harness side and ground.	**Yes** GO to AQ9 . **No** REPAIR the circuit. TEST the system for normal operation.

 N0094481 • For hybrid, measure the resistance between the IPC C220-8, circuit CMC24 (GY), harness side and ground.  N0090375 • **Is the resistance greater than 10,000 ohms?**	
AQ6 CHECK FOR A STUCK OPEN ENGINE OIL PRESSURE SWITCH	
• Ignition OFF. • Disconnect: Engine Oil Pressure Switch C103 . • Connect a fused jumper wire between the engine oil pressure switch, C103-1, circuit CMC24 (GY), harness side and ground.  N0002760 • Start the engine. • Observe the low oil pressure warning indicator. • **Does the low oil pressure warning indicator turn off?**	**Yes** REMOVE the jumper wire. GO to AQ8 . **No** LEAVE the jumper wire connected. GO to AQ7 .
AQ7 CHECK OIL PRESSURE INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Disconnect: IPC C220 . • For non-hybrid, measure the resistance between the IPC C220-6, circuit CMC24 (GY), harness side and ground.	**Yes** REMOVE the jumper wire. GO to AQ9 . **No** REMOVE the jumper wire. REPAIR the circuit. TEST the system for normal operation.

 N0094481 • For hybrid, measure the resistance between the IPC C220-8, circuit CMC24 (GY), harness side and ground.  N0090375 • **Is the resistance less than 5 ohms?**	
AQ8 CHECK THE OIL PRESSURE	
• Carry out the oil pressure test. Refer to Section 303-00 . • **Is the oil pressure within specification?**	**Yes** INSTALL a new Engine Oil Pressure (EOP) switch. REFER to Section 303-01C (3.5L) or Section 303-01D (hybrid). TEST the system for normal operation. **No** REFER to Section 303-00 to continue diagnosis of the low engine oil pressure concern.
AQ9 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AR: The Door/hood Ajar Message Center Warning Indicator Is Never/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the door ajar status for the LH front door, RH front door, LH rear door, the RH rear door, the hood and the decklid (non-hybrid only) ajar switch status from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) communication bus. When the IPC

receives a message from the SJB that one or more doors, the hood or the decklid (non-hybrid only) are open or ajar, the IPC turns on the door/hood ajar message center warning indicator.

If the door/hood ajar status message is missing for less than 5 seconds, the door/hood ajar message center warning indicator remains in the last state (on or off) based upon the last known good message received for each of the door ajar states. If the door/hood ajar status message is missing for greater than 5 seconds, the IPC sets DTC U0140:00 and defaults the door/hood ajar message center warning indicator on.

NOTE: If DTC U0140:00 is set in the SJB , other symptoms may also be present in the IPC such as high beam indicator, RH/LH turn indicators, instrument panel backlighting and Tire Pressure Monitoring System (TPMS).

This pinpoint test is intended to diagnose the following:

- Interior lighting concern
- SJB
- IPC

PINPOINT TEST AR: THE DOOR/HOOD AJAR MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
AR1 CHECK THE INTERIOR LIGHTING OPERATION	
• Open and close each door while monitoring the courtesy lamps. • **Do the courtesy lamps operate correctly with each door?**	**Yes** GO to AR2 . **No** REFER to Section 417-02 .
AR2 CHECK THE HOOD AJAR SWITCH STATUS PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger. • Select the SJB hood ajar switch PID (HOOD_SW). Monitor the PID with the hood closed and open. • **Does the PID agree with the status of the hood?**	**Yes** GO to AR3 . **No** REFER to Section 419-01A to diagnose the hood ajar switch circuit.
AR3 CHECK THE MESSAGE CENTER OPERATION	
• Ignition OFF. • Disconnect: PCM C175b . • Ignition ON. • Monitor the message center display area with the PCM disconnected. • **Does the message center display the powertrain malfunction (wrench) message center warning indicator?**	**Yes** GO to AR4 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

AR4 RETRIEVE THE RECORDED DTCs FROM THE CONTINUOUS IPC SELF-TEST	
• Check for recorded IPC DTCs from the continuous self-test. • **Is DTC U0140:00 recorded?**	**Yes** GO to Pinpoint Test BM . **No** GO to AR5 .
AR5 RETRIEVE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check for recorded DTCs from the SJB self-test. • **Are any SJB DTCs recorded?**	**Yes** REFER to Section 419-10 for correct navigation of the DTC. **No** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.

Pinpoint Test AS: The Charging System Message Center Warning Indicator Is Never/Always On

Normal Operation

The charging system indicator is controlled by the Instrument Panel Cluster (IPC) based upon data received from the PCM (non-hybrid) or the DC to DC Converter Control Module (DC/DC) (hybrid) over the High Speed Controller Area Network (HS-CAN) communication bus.

If the charging system message is missing for less than 5 seconds, the charging system message center warning indicator remains in the last state (on or off) based upon the last known good message received. If the charging system message is missing for more than 5 seconds, the IPC sets DTC U0100:00 (non-hybrid) or DTC U0298:00 (hybrid) in continuous memory and defaults the charging system warning indicator on.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, tachometer or odometer.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- PCM (non-hybrid)
- DC/DC (hybrid)
- IPC

PINPOINT TEST AS: THE CHARGING SYSTEM MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
AS1 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors and the luggage compartment lid. • Ignition ON.	**Yes** For non-hybrid, GO to AS2 . For hybrid, GO to AS4 .

• Open the driver door while monitoring the message center displays. • **Does the message center display the door ajar message center warning indicator along with the DRIVER DOOR AJAR text?**	**No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AS2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Are any charging system DTCs recorded?**	**Yes** REFER to Section 414-00 . **No** GO to AS3 .
AS3 CHECK THE CHARGING SYSTEM OPERATION	
• Check the charging system operation. Refer to Section 414-00 . • **Does the charging system operate correctly?**	**Yes** GO to AS4 . **No** REFER to Section 414-00 .
AS4 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** For DTC U0100:00, GO to Pinpoint Test BF . For DTC U0298:00, GO to Pinpoint Test BW . REFER to DTC Charts in this section. **No** If the charging system warning indicator is never on, the system is operating correctly at this time. If the charging system warning indicator is always on for non-hybrid vehicles, INSTALL a new PCM. REFER to Section 303-14C . TEST the system for normal operation. If the charging system warning indicator is always on for hybrid vehicles, REFER to Section 414-05 to diagnose the DC/DC charging system. TEST the system for normal operation.

Pinpoint Test AT: The Trunk Ajar Message Center Warning Indicator Is Never/Always On (Hybrid)

Refer to Wiring Diagrams Cell 113 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Luggage Compartment for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) receives the trunk ajar status from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) communication bus. The luggage compartment lid ajar switch (part of the luggage compartment lid latch) is hardwired to the SJB through the decklid ajar input circuit. The luggage compartment lid ajar switch is grounded through an external ground circuit. When the luggage compartment lid is ajar, the luggage compartment lid latch removes the ground to the luggage compartment lid ajar switch input. When the luggage compartment lid is closed, the luggage compartment lid release grounds the luggage compartment lid ajar switch.

When the SJB detects an open on the decklid ajar input circuit, the SJB sends a message to the IPC to turn on the trunk ajar message center indicator.

If the decklid ajar status message is missing for less than 5 seconds, the trunk ajar message center warning indicator remains in the last state (on or off) based upon the last known good message received. If the decklid ajar status message is missing for greater than 5 seconds, the IPC sets DTC U0140:00 and defaults the decklid ajar message center warning indicator on.

NOTE: If DTC U0140:00 is set in the SJB , other symptoms may also be present in the IPC such as high beam indicator, RH/LH turn indicators, instrument panel backlighting and Tire Pressure Monitoring System (TPMS).

This pinpoint test is intended to diagnose the following:

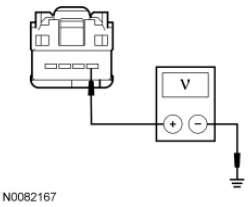
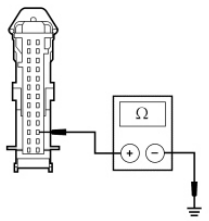
- Wiring, terminals or connectors
- Luggage compartment lid ajar switch (part of the luggage compartment lid latch)
- SJB
- IPC

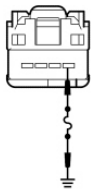
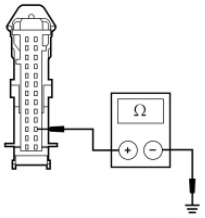
PINPOINT TEST AT: THE TRUNK AJAR MESSAGE CENTER WARNING INDICATOR IS NEVER/ALWAYS ON (HYBRID)

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AT1 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors, hood and luggage compartment lid. • Ignition ON. • Open the driver door while monitoring the message center displays. • **Does the door ajar message center warning indicator turn on?**	**Yes** GO to AT2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AT2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Retrieve the recorded DTCs from the IPC self-test.	**Yes** GO to Pinpoint Test BM .

• **Is DTC U0140:00 recorded?**	**No** GO to AT3 .
AT3 CHECK THE LUGGAGE COMPARTMENT LID LATCH OPERATION	
• Press the luggage compartment lid release switch. • **Does the luggage compartment lid release function operate?**	**Yes** GO to AT4 . **No** REFER to Section 501-14 .
AT4 CHECK THE LUGGAGE COMPARTMENT LID AJAR SWITCH	
• Ignition OFF. • Disconnect: Luggage Compartment Lid Latch C429 . • Ignition ON. • Measure the voltage between the luggage compartment lid latch C429-1, circuit CPL58 (GY/OG), harness side and ground.  N0082167 • **Is the voltage greater then 10 volts?**	**Yes** INSTALL a new luggage compartment lid latch. REFER to Section 501-14 . TEST the system for normal operation. **No** GO to AT5 .
AT5 CHECK THE DECKLID AJAR INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280c . • Measure the resistance between the SJB C2280c-16, circuit CPL58 (GY/OG), harness side and ground.  N0085708 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AT6 . **No** REPAIR the circuit. TEST the system for normal operation.
AT6 CHECK THE DECKLID AJAR INPUT CIRCUIT FOR AN OPEN	

• Disconnect: Negative Battery Cable . • Connect a fused jumper wire between the luggage compartment lid latch C429-1, circuit CPL58 (GY/OG), harness side and ground.  N0082169 • Measure the resistance between the SJB C2280c-16, circuit CPL58 (GY/OG), harness side and ground.  N0085708 • **Is the resistance less than 5 ohms?**	**Yes** GO to AT7 . **No** REPAIR the circuit. TEST the system for normal operation.
AT7 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AU: The Message Center Is Not Operating Correctly

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The message center shares the Instrument Panel Cluster (IPC) RUN/START voltage, keep alive memory voltage and the IPC logic ground to operate. The message center functionality is controlled through the message center switch and is hardwired to the IPC through separate signal and return circuits.

- DTC B1A82:11 (External Trip Switch: Circuit Short to Ground) - a continuous DTC that sets in the IPC if the IPC detects a short to ground on the message center signal circuit.
- DTC B1A82:13 (External Trip Switch: Circuit Open) - a continuous DTC that sets in the IPC if the IPC detects an open on the message center signal circuit.

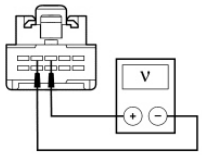
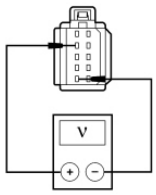
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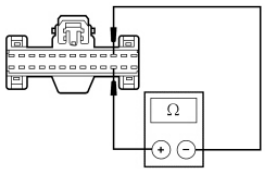
- Wiring, terminals or connectors
- Clockspring
- Front Controls Interface Module (FCIM) (MKZ only)
- Steering wheel switch (part of the cruise control switch)
- IPC

PINPOINT TEST AU: THE MESSAGE CENTER IS NOT OPERATING CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AU1 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC B1A82:11 or DTC B1A82:13 recorded?**	**Yes** GO to AU6 . **No** GO to AU2 .
AU2 CHECK THE IPC ODOMETER DISPLAY	
• Ignition ON. • Observe the odometer display in the message center. • **Is the odometer displayed?**	**Yes** For non-hybrid, GO to AU3 . For hybrid, GO to AU4 . **No** If the display is blank, PRESS the INFO button to see if the message center was previously set to the blank display. If the display remains blank, GO to Pinpoint Test A .
AU3 CARRY OUT THE IPC DEALER TEST MODE ALL SEGMENTS DISPLAY	
• **NOTE:** The all segments display is the second button press after entering the dealer test mode immediately following the gauge test. • Enter the IPC dealer test mode. Scroll through the displays until the message center displays all the segments. • **Does the message center display all the illuminate segments?**	**Yes** GO to AU4 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AU4 CHECK FOR VOLTAGE FROM THE IPC	

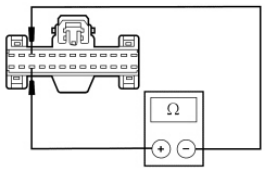
• Ignition OFF. • Disconnect: FCIM C2402 (MKZ) . • Disconnect: LH Steering Wheel Switch C2998 (Fusion). • Ignition ON. • For MKZ, measure the voltage between the FCIM C2402-3, circuit CMC29 (GN/VT), harness side and the FCIM C2402-4, circuit RMC27 (WH/BN), harness side.  N0082166 • For Fusion, measure the voltage between the LH steering wheel switch C2998-7, circuit CMC29 (GN/VT), harness side and the LH steering wheel switch C2998-10, circuit RMC27 (WH/BN), harness side.  N0094486 • **Is the voltage approximately 5 volts?**	**Yes** GO to AU5 . **No** GO to AU18 .
AU5 CHECK FOR THE MESSAGE CENTER SWITCH OPERATION	
• Ignition OFF. • Disconnect: IPC C220 . • Connect: FCIM C2402 (MKZ) . • Connect: LH Steering Wheel Switch C2998 (Fusion) . • For non-hybrid, measure the resistance between the IPC C220-16, circuit CMC29 (GN/VT), harness side and the IPC C220-3, circuit RMC27 (WH/BN), harness side while pressing the message center buttons according to the following table. **Message Center Button Press** / **Resistance** No button press — 7,200-7,800 ohms INFO — 123-133 ohms SETUP — 1,381-1,496 ohms RESET — 599-649 ohms	**Yes** GO to AU18 . **No** For MKZ, GO to AU17 . For Fusion, INSTALL a new cruise control switch. REFER to Section 419-03 . TEST the system for normal operation.



N0094487

- For hybrid, measure the resistance between the IPC C220-24, circuit CMC29 (GN/VT), harness side and the IPC C220-11, circuit RMC27 (WH/BN), harness side while pressing the message center buttons according to the following table.

Message Center Button Press	Resistance
No button press	7,200-7,800 ohms
INFO	123-133 ohms
SETUP	1,381-1,496 ohms
RESET	599-649 ohms



N0094488

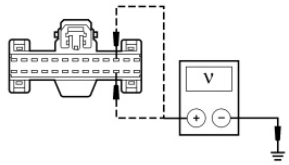
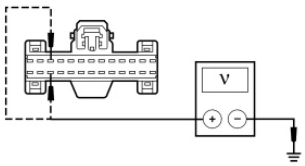
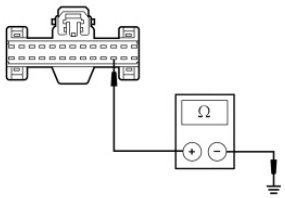
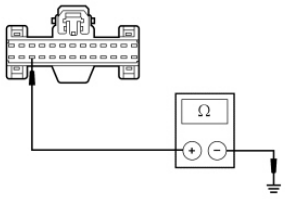
- **Is the resistance within the specifications for all positions?**

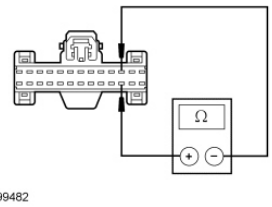
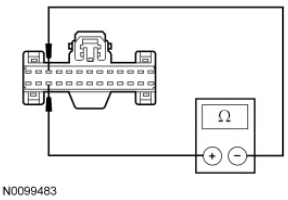
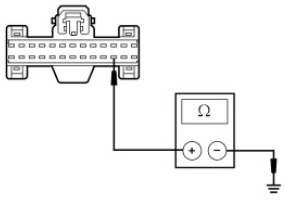
AU6 CHECK THE MESSAGE CENTER SIGNAL AND RETURN CIRCUITS FOR A SHORT TO VOLTAGE

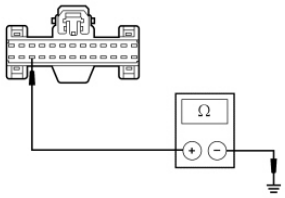
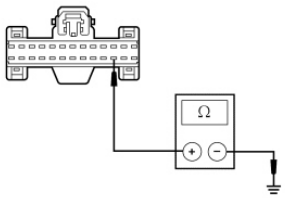
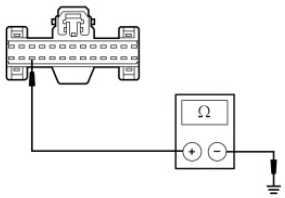
- Ignition OFF.
- Disconnect: IPC C220 .
- Ignition ON.
- For non-hybrid, measure the voltage between the IPC C220-16, circuit CMC29 (GN/VT), harness side and ground; and between the IPC C220-3, circuit RMC27 (WH/BN), harness side and ground.

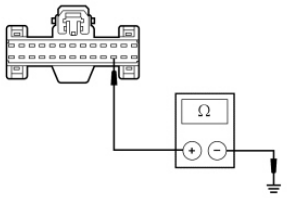
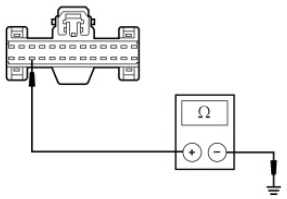
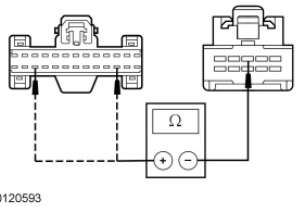
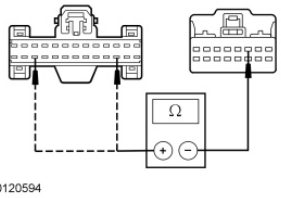
Yes
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

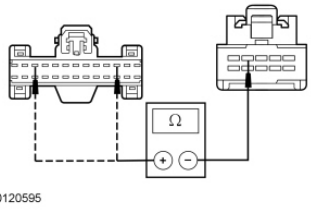
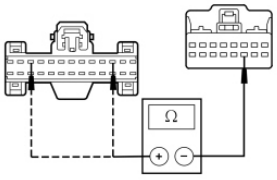
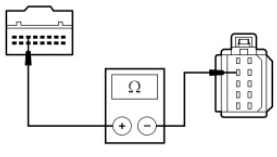
No
GO to AU7 .

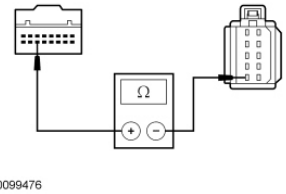
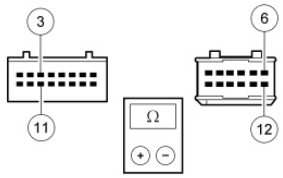
 N0094489 • For hybrid, measure the voltage between the IPC C220-24, circuit CMC29 (GN/VT), harness side and ground; and between the IPC C220-11, circuit RMC27 (WH/BN), harness side and ground.  N0094490 • **Is any voltage present?**	
AU7 CHECK THE MESSAGE CENTER SIGNAL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • For non-hybrid, measure the resistance between the IPC C220-16, circuit CMC29 (GN/VT), harness side and ground.  N0094491 • For hybrid, measure the resistance between the IPC C220-24, circuit CMC29 (GN/VT), harness side and ground.  N0094492 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AU8 . **No** GO to AU9 .
AU8 CHECK THE MESSAGE CENTER SIGNAL AND RETURN CIRCUITS FOR A SHORT TOGETHER	

• Ignition OFF. • For non-hybrid, measure the resistance between the IPC C220-16, circuit CMC29 (GN/VT), harness side and the IPC C220-3, circuit RMC27 (WH/BN), harness side.  N0099482 • For hybrid, measure the resistance between the IPC C220-24, circuit CMC29 (GN/VT), harness side and the IPC C220-11, circuit RMC27 (WH/BN), harness side.  N0099483 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AU12 . **No** REPAIR the circuit. Clear the DTCs. REPEAT the self-test.
AU9 CHECK THE MESSAGE CENTER SWITCH FOR A SHORT TO GROUND	
• Disconnect: FCIM C2402 (MKZ). • Disconnect: LH Steering Wheel Switch C2998 (Fusion). • For non-hybrid, measure the resistance between the IPC C220-16, circuit CMC29 (GN/VT), harness side and ground.  N0094491 • For hybrid, measure the resistance between the IPC C220-24, circuit CMC29 (GN/VT), harness side and ground.	**Yes** For Fusion, INSTALL a new cruise control switch. REFER to Section 419-03 . CLEAR the DTCs. REPEAT the self-test. For MKZ, GO to AU17 . **No** For Fusion, GO to AU10 . For MKZ, REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

 N0094492 • **Is the resistance greater than 10,000 ohms?**	
AU10 CHECK THE STEERING WHEEL HARNESS FOR A SHORT TO GROUND	
• Remove the driver air bag. Refer to Section 501-20B . • Disconnect: Clockspring C218b . • For non-hybrid, measure the resistance between the IPC C220-16, circuit CMC29 (GN/VT), harness side and ground.  N0094491 • For hybrid, measure the resistance between the IPC C220-24, circuit CMC29 (GN/VT), harness side and ground.  N0094492 • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR or INSTALL a new steering wheel switch harness. CLEAR the DTCs. REPEAT the self-test. **No** GO to AU11 .
AU11 CHECK THE CLOCKSPRING FOR A SHORT TO GROUND	
• Disconnect: Clockspring C218a . • For non-hybrid, measure the resistance between the IPC C220-16, circuit CMC29 (GN/VT), harness side and ground.	**Yes** INSTALL a new clockspring. REFER to Section 501-20B . CLEAR the DTCs. REPEAT the self-test. **No** REPAIR circuit CMC29 (GN/VT) for a short to ground. INSTALL the driver air bag. REFER to Section 501-20B . CLEAR the DTCs. REPEAT the self-test.

 N0094491 • For hybrid, measure the resistance between the IPC C220-24, circuit CMC29 (GN/VT), harness side and ground.  N0094492 • **Is the resistance greater than 10,000 ohms?**	
AU12 CHECK THE MESSAGE CENTER SIGNAL CIRCUIT FOR AN OPEN	
• Disconnect: FCIM C2402 (MKZ) . • Disconnect: Clockspring C218a (Fusion) . • For MKZ, measure the resistance between the IPC C220-16 (non-hybrid) or C220-24 (hybrid), circuit CMC29 (GN/VT), harness side and the FCIM C2402-3, circuit CMC29 (GN/VT), harness side.  N0120593 • For Fusion, measure the resistance between the IPC C220-24 (non-hybrid) or C220-24 (hybrid), circuit CMC29 (GN/VT), harness side and the clockspring C218a-3, circuit CMC29 (GN/VT), harness side.  N0120594 • **Are the resistances less than 5 ohms?**	**Yes** GO to AU13 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

AU13 CHECK THE MESSAGE CENTER RETURN CIRCUIT FOR AN OPEN	
• For MKZ, measure the resistance between the IPC C220-3 (non-hybrid) or C220-11 (hybrid), circuit RMC27 (WH/BN), harness side and the FCIM C2402-4, circuit RMC27 (WH/BN), harness side.  N0120595 • For Fusion, measure the resistance between the C220-3 (non-hybrid) or C220-11 (hybrid), circuit RMC27 (WH/BN), harness side and the clockspring C218a-11, circuit RMC27 (WH/BN), harness side.  N0120596 • **Are the resistances less than 5 ohms?**	**Yes** For MKZ, GO to AU17 . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the self-test. For Fusion, GO to AU14 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
AU14 CHECK THE MESSAGE CENTER SWITCH SIGNAL CIRCUIT FOR AN OPEN AT THE LH STEERING WHEEL SWITCH	
• Disconnect: LH Steering Wheel Switch C2998 . • Measure the resistance between the lower clockspring C218a pin 3, component side and the LH steering wheel switch C2998-7, circuit CMC29 (GN/VT), harness side.  N0099475 • **Is the resistance less than 5 ohms?**	**Yes** GO to AU15 . **No** GO to AU16 .
AU15 CHECK THE MESSAGE CENTER SWITCH RETURN CIRCUIT FOR AN OPEN AT THE LH STEERING WHEEL SWITCH	

• Measure the resistance between the lower clockspring C218a pin 11, component side and the LH steering wheel switch C2998-10, circuit RMC27 (WH/BN), harness side.  N0099476 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new cruise control switch. REFER to Section 419-03 . CLEAR the DTCs. REPEAT the self-test. **No** GO to AU16 .
AU16 CHECK THE CLOCKSPRING FOR AN OPEN	
• Remove the driver air bag. Refer to Section 501-20B . • Disconnect: Clockspring C218b . • Measure the resistance between the lower clockspring C218a pin 3, circuit component side and the upper clockspring C218b pin 6, component side; and between the lower clockspring C218a pin 11, component side and the upper clockspring C218b pin 12, component side.  N0099799 • **Is the resistance less than 5 ohms?**	**Yes** REPAIR or INSTALL a new steering wheel switch harness. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new clockspring. REFER to Section 501-20B . CLEAR the DTCs. REPEAT the self-test.
AU17 CHECK FOR CORRECT FCIM OPERATION	
• Disconnect the FCIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the FCIM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new FCIM . REFER to Section 415-00 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
AU18 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly.	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No**

• Operate the system and verify the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test AV: The CHECK FUEL FILL INLET Message Is Inoperative/Always On

Normal Operation

The PCM monitors the fuel tank evaporative emission system for significant leaks that occur following refueling of the vehicle. Once the PCM detects a fuel vapor leak, the PCM sends the Instrument Panel Cluster (IPC) a message over the High Speed Controller Area Network (HS-CAN) communication bus to turn on the CHECK FUEL FILL INLET message. DTC P0457 sets in the PCM following a successful cruise test, which is initiated when the vehicle is driven at a steady speed above 64 km/h (40 mph) for a duration of approximately 4-5 minutes. If the PCM is unable to successfully run the cruise test, the IPC does not receive the message from the PCM and the CHECK FUEL FILL INLET message remains off.

If the IPC does not receive the fuel cap off data from the PCM for 5 seconds or less, the IPC defaults the CHECK FUEL FILL INLET message to the last setting, based upon the last known good data message. If the IPC does not receive the fuel cap off data from the PCM for more than 5 seconds or if the data received is deemed invalid, the IPC sets DTC U0100:00 in continuous memory and defaults the CHECK FUEL FILL INLET message off.

NOTE: If DTC U0100:00 is set in the IPC , other observable symptoms may be an inoperative speedometer, temperature gauge (except hybrid) or odometer.

- DTC P0457 (Evaporative Emission System Leak Detected) (fuel cap loose/off) - sets in the PCM if a fuel tank pressure change greater than -23.7 kPa (-7 in-Hg) of vacuum within 30 seconds after refueling occurs, or there is an excessive purge (fuel vapor) flow of greater than 454 g (1.0 lb) per minute.

This pinpoint test is intended to diagnose the following:

- Evaporative emissions concern
- PCM
- IPC

PINPOINT TEST AV: THE CHECK FUEL FILL INLET MESSAGE IS INOPERATIVE/ALWAYS ON

Test Step	Result / Action to Take
AV1 CHECK THE MESSAGE CENTER DISPLAY OPERATION	
• Close all doors and the luggage compartment lid. • Ignition ON. • Open the driver door and observe	**Yes** GO to AV2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

the message center. • **Does the message center display DRIVER DOOR AJAR?**	
AV2 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST	
• Check for recorded PCM DTCs from the Key ON Engine OFF (KOEO) self-test. • **Is DTC P0457 recorded?**	**Yes** If the CHECK FUEL FILL INLET message is displayed, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. If the CHECK FUEL FILL INLET message is not displayed, GO to AV3 . **No** If the CHECK FUEL FILL INLET message is always displayed, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. If the CHECK FUEL FILL INLET message is not displayed, the system is operating normally at this time. If the capless fuel fill inlet was open and the CHECK FUEL FILL INLET message did not turn on, driving conditions may not have allowed for the PCM to run the cruise test and message the IPC to turn on the CHECK FUEL FILL INLET message.
AV3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded IPC DTCs from the self-test. • **Is DTC U0100 recorded?**	**Yes** GO to Pinpoint Test BF . **No** INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation.

Pinpoint Test AW: The SERVICE STEERING Message Is Inoperative/Always On

Normal Operation

The Instrument Panel Cluster (IPC) receives the Electronic Power Assist Steering (EPAS) system status from the Power Steering Control Module (PSCM) (part of the steering gear) through the High Speed Controller Area Network (HS-CAN) communication bus. When the PSCM detects a fault in the EPAS system, the PSCM sends a message to the IPC to turn on the SERVICE STEERING message in the message center.

This pinpoint test is intended to diagnose the following:

- EPAS system concern
- PSCM (part of the steering gear)
- IPC

PINPOINT TEST AW: THE SERVICE STEERING MESSAGE IS INOPERATIVE/ALWAYS ON

Test Step	Result / Action to Take
AW1 CHECK THE MESSAGE CENTER DISPLAY OPERATION	
• Close all doors and the luggage compartment lid. • Ignition ON. • Open the driver door and observe the message center. • **Does the message center display DRIVER DOOR AJAR?**	**Yes** GO to AW2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AW2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U0131:00 recorded?**	**Yes** GO to Pinpoint Test BL . **No** GO to AW3 .
AW3 RETRIEVE THE RECORDED DTCs FROM THE PSCM SELF-TEST	
• Check for recorded DTCs from the PSCM self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 211-00A . **No** INSTALL a new steering gear. REFER to Section 211-02 . TEST the system for normal operation.

Pinpoint Test AX: The TRUNK AJAR Message Is Inoperative/Always On

Refer to Wiring Diagrams Cell 113 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Luggage Compartment for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) receives the trunk ajar status from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) communication bus. The luggage compartment lid ajar switch (part of the luggage compartment lid latch) is hardwired to the SJB through the trunk ajar input circuit. The luggage compartment lid ajar switch is grounded externally. When the luggage compartment lid is ajar, the luggage compartment lid latch removes the ground to the luggage compartment lid ajar switch input to the SJB . When the luggage compartment lid is closed, the luggage compartment lid release grounds the luggage compartment lid ajar switch.

When the SJB detects an open on the trunk ajar input circuit, the SJB sends a message to the IPC to turn on the TRUNK AJAR message in the message center.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Luggage compartment lid ajar switch (part of the luggage compartment lid latch)
- SJB

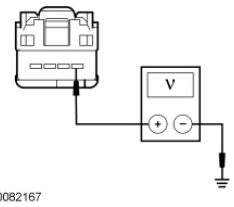
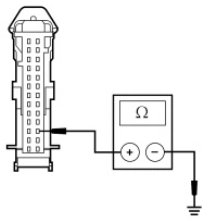
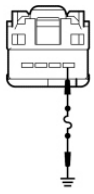
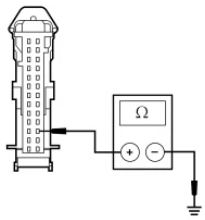
- IPC

PINPOINT TEST AX: THE TRUNK AJAR MESSAGE IS INOPERATIVE/ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AX1 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors, hood and luggage compartment lid. • Ignition ON. • Open the driver door while monitoring the message center displays. • **Does the message center display DRIVER DOOR AJAR?**	**Yes** GO to AX2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AX2 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Retrieve the recorded DTCs from the IPC self-test. • **Is DTC U0140:00 recorded?**	**Yes** GO to Pinpoint Test BM . **No** GO to AX3 .
AX3 CHECK THE LUGGAGE COMPARTMENT LID LATCH OPERATION	
• Press the luggage compartment lid release switch on the instrument panel. • **Does the luggage compartment lid release function operate?**	**Yes** GO to AX4 . **No** REFER to Section 501-14 .
AX4 CHECK THE LUGGAGE COMPARTMENT LID AJAR SWITCH	
• Ignition OFF. • Disconnect: Luggage Compartment Lid Latch C429 . • Ignition ON. • Measure the voltage between the luggage compartment lid latch C429-1, circuit CPL58 (GY/OG), harness side and ground.	**Yes** INSTALL a new luggage compartment lid latch. REFER to Section 501-14 . TEST the system for normal operation. **No** GO to AX5 .

 N0082167 • **Is the voltage greater then 10 volts?**	
AX5 CHECK THE TRUNK AJAR INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280c . • Measure the resistance between the SJB C2280c-16, circuit CPL58 (GY/OG), harness side and ground.  N0085708 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AX6 . **No** REPAIR the circuit. TEST the system for normal operation.
AX6 CHECK THE TRUNK AJAR INPUT CIRCUIT FOR AN OPEN	
• Disconnect: Negative Battery Cable . • Connect a fused jumper wire between the luggage compartment lid latch C429-1, circuit CPL58 (GY/OG), harness side and ground.  N0082169 • Measure the resistance between the SJB C2280c-16, circuit CPL58 (GY/OG), harness side and ground.  N0085708	**Yes** GO to AX7 . **No** REPAIR the circuit. TEST the system for normal operation.

• **Is the resistance less than 5 ohms?**	
AX7 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AY: The Chime Sounds When The Driver Door Is Ajar (No Key In Ignition And Headlamps Off)

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) receives the key-in-ignition warning status from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) communication bus.

The key-in-ignition warning switch (part of the ignition switch) is hardwired to the SJB through the key-in-ignition input circuit. When the key is inserted into the ignition lock cylinder, the key-in-ignition switch closes and supplies voltage to the SJB .

The SJB monitors the door ajar input from the LH front door and the key-in-ignition switch status. When the SJB detects a key-in-ignition voltage and the LH front door is open or ajar, the SJB sends the IPC a chime request message to sound the key-in-ignition warning chime.

- DTC B1352 (Ignition Key-In Circuit Failure) - an on-demand DTC that sets in the SJB if the SJB detects a short to voltage on the key-in-ignition switch input circuit or if the SJB detects ignition START, RUN/START or RUN/ACC inputs without the key-in-ignition input.

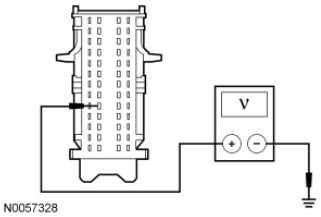
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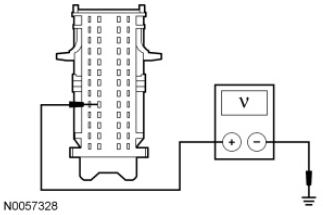
- Wiring, terminals or connectors
- Key-in-ignition warning switch (part of the ignition switch)
- SJB

PINPOINT TEST AY: THE CHIME SOUNDS WHEN THE DRIVER DOOR IS AJAR (NO KEY IN IGNITION AND HEADLAMPS OFF)

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AY1 CHECK THE IPC ILLUMINATION	

• Verify the IPC is not illuminated with the headlamp switch off. • **Does the IPC illumination operate correctly?**	**Yes** GO to AY2 . **No** REFER to Section 413-00 .
AY2 RETRIEVE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check for recorded DTCs from the SJB self-test. • **Is DTC B1352 present?**	**Yes** GO to AY3 . **No** GO to AY4 .
AY3 CHECK THE SJB IGNITION INPUT PIDs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Select and monitor the SJB PIDs ignition ACC (IGN_A_ECU), ignition OFF (IGN_O_ECU), ignition RUN (IGN_R_ECU), and ignition START (IGN_S_ECU) while cycling the ignition from ACC, OFF, RUN and START. • **Do the SJB PIDs match the ignition mode?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** REFER to Section 211-05 to diagnose the ignition outputs to the SJB .
AY4 CHECK THE KEY-IN-IGNITION INPUT CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280b . • Measure the voltage between the SJB C2280b-35, circuit CDC30 (BU/GY), harness side and ground.  • **Is any voltage present?**	**Yes** GO to AY5 . **No** GO to AY6 .
AY5 CHECK THE KEY-IN-IGNITION INPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Ignition Switch C250 . • Measure the voltage between the SJB C2280b-35, circuit CDC30 (BU/GY), harness side and ground.	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new ignition switch. REFER to Section 211-05 . TEST the system for normal operation.

 • **Is any voltage present?**	
AY6 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AZ: The Key-In-Ignition Warning Chime Is Inoperative

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) receives the key-in-ignition warning status from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) communication bus.

The key-in-ignition warning switch (part of the ignition switch) is hardwired to the SJB through the key-in-ignition input circuit. When the key is inserted into the ignition lock cylinder, the key-in-ignition switch closes and supplies voltage to the SJB .

The SJB monitors the door ajar input from the LH front door and the key-in-ignition switch status. When the SJB detects a key-in-ignition voltage and the LH front door is open or ajar, the SJB sends the IPC a chime request message to sound the key-in-ignition warning chime.

- DTC B1352 (Ignition Key-In Circuit Failure) - an on-demand DTC that sets in the SJB if the SJB detects an open on the key-in-ignition switch input circuit or if the SJB detects ignition START, RUN/START or RUN/ACC inputs without the key-in-ignition input.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Key-in-ignition switch (part of the ignition switch)
- SJB
- IPC

PINPOINT TEST AZ: THE KEY-IN-IGNITION WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
AZ1 CHECK THE SAFETBELT WARNING CHIME OPERATION	
• Ignition OFF. • Ignition ON. • Monitor the safety belt warning chime when the ignition is transitioned from OFF to RUN for 6 seconds. • **Does the safety belt warning chime operate for approximately 6 seconds?**	**Yes** GO to AZ2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
AZ2 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors, hood and luggage compartment lid. • Ignition ON. • Open the driver door while monitoring the message center displays. • **Does the message center display DRIVER DOOR AJAR?**	**Yes** GO to AZ3 . **No** GO to Pinpoint Test AA to diagnose the door/hood ajar warning indicator (non-hybrid) or GO to Pinpoint Test AR to diagnose the door ajar message center warning indicator (MKZ or hybrid).
AZ3 RETRIEVE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check for recorded DTCs from the SJB self-test. • **Is DTC B1352 present?**	**Yes** GO to AZ4 . **No** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
AZ4 CHECK THE IGNITION SWITCH	
• Ignition OFF. • Disconnect: Ignition Switch C250 . • Carry out the ignition switch component test. Refer to Wiring Diagrams Cell 149 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid) for component testing. • **Is the ignition switch OK?**	**Yes** REPAIR circuit CDC30 (BU/GY) for an open. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new ignition switch. REFER to Section 211-05 . CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test BA: The Headlamps On Warning Chime Is Inoperative

Normal Operation

The Smart Junction Box (SJB) receives the headlamp switch status from the headlamp switch. The SJB receives the LH front door ajar status from the LH front door ajar switch through hardwired circuitry.

The headlamps on warning chime sounds when the LH front door is opened with the ignition switch in the OFF position, no key-in-ignition input, and the headlamp switch is in the PARK or HEADLAMP ON position. The SJB communicates the headlamp on chime request to the Instrument Panel Cluster (IPC) over the Medium Speed Controller Area Network (MS-CAN) communication bus. The autolamps feature must not be selected for the headlamps on warning chime to operate.

This pinpoint test is intended to diagnose the following:

- Door ajar indication
- SJB
- IPC

PINPOINT TEST BA: THE HEADLAMPS ON WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
BA1 CHECK THE SAFETY BELT WARNING CHIME OPERATION	
• Ignition OFF. • Ignition ON. • Monitor the safety belt warning chime when the ignition switch is transitioned from OFF to RUN for 6 seconds. • **Does the safety belt warning chime operate for approximately 6 seconds?**	**Yes** GO to BA2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
BA2 CHECK THE EXTERIOR LAMPS OPERATION	
• Ignition OFF. • Place the headlamp switch in the PARK position. • **Do the parking lamps operate?**	**Yes** GO to BA3 . **No** REFER to Section 417-01 .
BA3 CHECK THE MESSAGE CENTER OPERATION	
• Close all doors, hood and luggage compartment lid. • Ignition ON. • Open the driver door while monitoring the message center displays. • **Does the message center display DRIVER DOOR AJAR?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** GO to Pinpoint Test AA to diagnose the door/hood ajar warning indicator (non-hybrid) or GO to Pinpoint Test AR to diagnose the door ajar message center warning indicator (MKZ or hybrid).

Pinpoint Test BB: The Turn Signal On Warning Chime Is Inoperative

Normal Operation

The turn signal on warning chime sounds when the vehicle travels more than 3.2 km (2.0 miles) with the turn signal on. The Smart Junction Box (SJB) communicates the turn signal switch status to the Instrument Panel Cluster (IPC) over the Medium Speed Controller Area Network (MS-CAN). The IPC receives the odometer rolling count data from the PCM over the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

- Odometer operation
- IPC

PINPOINT TEST BB: THE TURN SIGNAL ON WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
BB1 CHECK THE KEY-IN-IGNITION WARNING CHIME OPERATION	
• Ignition OFF. • Insert the key into the ignition lock cylinder. • Open the LH front door and observe the key-in-ignition warning chime operation. • **Does the key-in-ignition warning chime operate correctly?**	**Yes** GO to BB2 . **No** GO to Pinpoint Test AY (chime is always on) or GO to Pinpoint Test AZ (chime is inoperative).
BB2 CHECK THE TURN SIGNAL INDICATORS OPERATION	
• Ignition ON. • Verify the turn signal indicators operation. • **Do the turn signal indicators operate correctly?**	**Yes** GO to BB3 . **No** GO to Pinpoint Test AB .
BB3 CHECK THE ODOMETER FOR CORRECT OPERATION	
• Drive the vehicle and observe the odometer for correct operation. • **Does the odometer operate correctly?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** GO to Pinpoint Test H .

Pinpoint Test BC: The Safety Belt Warning Chime Does Not Operate Correctly/The Belt-Minder® Feature Does Not Operate Correctly

Normal Operation

The Instrument Panel Cluster (IPC) receives the safety belt and Belt-Minder® requests from the Restraints Control Module (RCM) over the High Speed Controller Area Network (HS-CAN). The safety belt warning

chime sounds for approximately 6 seconds when the driver safety belt is not fastened and the ignition is switched from the OFF or ACC to the RUN position.

The Belt-Minder® feature supplements the safety belt warning function and is enabled after the safety belt warning is complete. The Belt-Minder® simultaneously sounds the chime and illuminates the safeelt warning lamp in the IPC once the vehicle speed has exceeded 9.7 km/h (6 mph), and remains active for 5 minutes from the time it is started.

There are 2 Belt-Minder® strategies that are used and implemented by the IPC as commanded by the RCM . The 2 strategies are designed to provide an increased chime tone safety belt warning indicator flash activity. Belt-Minder® A provides 6 one-second sequences for the first minute of the Belt-Minder® warning. Belt-Minder® B provides 6 one-second sequences of 3 chime tones in rapid succession for the remainder of the Belt-Minder® warning.

NOTE: Whenever the vehicle is operated using MyKey®, the RCM enables the Belt-Minder®.

If the Belt-Minder® is deactivated using an administrator key and driven using a MyKey® key, the MyKey® system overrides the deactivation of Belt-Minder®. When MyKey® is in use, the driver cannot configure the Belt-Minder® off. Once the Belt-Minder® is activated, the Belt-Minder® continues to chime periodically (does not time out after 5 minutes) and the audio system is muted until the driver safety belt is fastened. Refer to Section 419-01B for more information on the MyKey® feature.

NOTE: Make sure that the Belt-Minder® chime operation is verified with the vehicle moving at least 9.7 km/h (6 mph).

This pinpoint test is intended to diagnose the following:

- Safety belt warning indication concern
- Belt-Minder® deactivated
- Speedometer concern
- IPC

PINPOINT TEST BC: THE SAFETY BELT WARNING CHIME IS INOPERATIVE/THE BELT-MINDER® FEATURE DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
BC1 CHECK THE KEY-IN-IGNITION WARNING CHIME OPERATION	
• Ignition OFF. • Insert the key into the ignition lock cylinder. • Open the LH front door and observe the key-in-ignition warning chime operation. • **Does the key-in-ignition warning chime operate correctly?**	**Yes** GO to BC2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
BC2 CHECK THE DRIVER SAFETY BELT BUCKLE SWITCH	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: RCM PIDs.	**Yes** GO to BC3 . **No**

• Monitor the RCM driver safety belt buckle PID (SBELT_D_ST) while buckling and unbuckling the driver safety belt. • **Does the PID display BUCKLED with the safety belt buckled and UNBUCKLED with the safety belt unbuckled?**	REFER to Section 501-20B .
BC3 CHECK THE SAFETY BELT WARNING INDICATOR FOR CORRECT OPERATION	
• Ignition ON. • Within one minute, buckle the LH front safety belt. • With the engine running, verify the safety belt warning indicator illuminates with the safety belt unbuckled and turns off when buckled. • **Does the safety belt warning indicator operate correctly?**	**Yes** GO to BC4 . **No** GO to Pinpoint Test X .
BC4 CHECK THE SPEEDOMETER OPERATION	
• Verify that the speedometer is operating correctly. • **Does the speedometer operate correctly?**	**Yes** GO to BC5 . **No** GO to Pinpoint Test F .
BC5 CHECK THE BELT-MINDER® CONFIGURATION	
NOTE: Verify that an administrator key is used for this test and **not** a MyKey® programmed key. When a MyKey® programmed key is used, the Belt-Minder® is automatically turned on and cannot be disabled (if previously disabled by an administrator, the Belt-Minder® remains disabled when an administrator key is used). • Verify that the Belt-Minder® is activated or configured on for the seating position in question. Refer to Belt-Minder® Deactivating/Activating in this section to configure without a scan tool. • **Is the Belt-Minder® activated for the seating position in question?**	**Yes** If the Belt-Minder® is always on above 5 km/h (3 mph) with the safety belt unfastened, the system is operating normally. If the Belt-Minder® is always on with the safety belt fastened or never on with the safety belt unfastened above 9.7 km/h (6 mph), INSTALL a new RCM . REFER to Section 501-20B . TEST the system for normal operation. **No** ACTIVATE the Belt-Minder® for thesition in question. REFER to Belt-Minder® Deactivating/Activating in this section. TEST the system for normal operation.

Pinpoint Test BD: The Parking Brake Warning Chime Is Inoperative

Normal Operation

The Instrument Panel Cluster (IPC) uses vehicle speed data sent from the PCM over the High Speed Controller Area Network (HS-CAN) communication bus and the parking brake switch status sent from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) to determine when to turn on the parking brake warning chime.

The SJB monitors and uses the ignition ON position, the parking brake on status, and vehicle speed that is greater than 5 km/h (3 mph). The parking brake warning chime stops sounding and resets if the parking brake is released, the ignition is not in the ON position, if the vehicle speed is below 5 km/h (3 mph), or after 90 seconds from the time the chime is activated.

NOTE: Make sure that the brake warning chime operation is verified with the vehicle moving at least 5 km/h (3 mph) with the parking brake slightly applied (just enough to turn the brake warning indicator on).

This pinpoint test is intended to diagnose the following:

- Brake warning indication concern
- Speedometer concern
- IPC

PINPOINT EST BD: THE PARKING BRAKE WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
BD1 CHECK THE KEY-IN-IGNITION WARNING CHIME OPERATION	
• Ignition OFF. • Insert the key into the ignition lock cylinder. • Open the LH front door and observe the key-in-ignition warning chime operation. • **Does the key-in-ignition warning chime operate correctly?**	**Yes** GO to BD2 . **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.
BD2 CHECK THE BRAKE WARNING INDICATOR FOR CORRECT OPERATION	
• Ignition ON. • Apply and release the parking brake. • **Does the brake warning indicator turn on when applied and turn off when released?**	**Yes** GO to BD3 . **No** GO to Pinpoint Test S (never on) or GO to Pinpoint Test T (always on).
BD3 CHECK THE SPEEDOMETER FOR CORRECT OPERATION	
• Ignition ON. • Drive the vehicle and verify that the speedometer is operating correctly. • **Does the speedometer operate correctly?**	**Yes** GO to BD4 . **No** GO to Pinpoint Test F .
BD4 RETRIEVE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check for recorded DTCs from the SJB self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 419-10 . **No** INSTALL a new IPC . REFER to Instrument Panel

	Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test BE: The Memory Feedback Warning Chime Is Inoperative

Normal Operation

The Instrument Panel Cluster (IPC) receives the memory feedback chime request from the Driver Seat Module (DSM) over the Medium Speed Controller Area Network (MS-CAN) communication bus. When a successful memory set procedure is carried out, the DSM sends a chime request to the IPC to sound the memory feedback chime.

This pinpoint test is intended to diagnose the following:

- DSM
- IPC

PINPOINT TEST BE: THE MEMORY FEEDBACK WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
BE1 CHECK THE KEY-IN-IGNITION WARNING CHIME OPERATION	
• Ignition OFF. • Insert the key into the ignition lock cylinder. • Open the LH front door and observe the key-in-ignition warning chime operation. • **Does the key-in-ignition warning chime operate correctly?**	**Yes** GO to BE2 . **No** GO to Pinpoint Test AZ .
BE2 CHECK THE MEMORY SET FEATURE	
• Verify that the memory set procedure can successfully change the memory preferences. • **Does the memory set procedure successfully change the memory preferences?**	**Yes** GO to BE3 . **No** REFER to Section 501-10 .
BE3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Are any DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** INSTALL a new DSM . REFER to Section 419-10 . TEST the system for normal operation.

Pinpoint Test BF: DTC U0100:00

Normal Operation

- DTC U0100:00 (Lost Communication With ECM /PCM "A": No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the PCM over the High Speed Controller Area Network (HS-CAN) are missing for greater than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

NOTE: Once the IPC sets DTC U0100:00, multiple gauges or indicators are likely to be inoperative in the IPC . Other modules that require data from the IPC all set communication DTCs and may also exhibit system function concer.

This pinpoint test is intended to diagnose the following:

- PCM
- IPC

PINPOINT TEST BF: DTC U0100:00

Test Step	Result / Action to Take
BF1 VERIFY THAT THE SCAN TOOL CAN COMMUNICATE WITH THE PCM	
• Connect the scan tool. • Check that a vehicle session can be established using the scan tool. • **Can a vehicle session be established?**	**Yes** GO to BF2 . **No** REFER to Section 418-00 to diagnose no communication with the PCM.
BF2 CHECK THE IPC CONTINUOUS MEMORY DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0100:00 retrieved again?**	**Yes** GO to BF3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BF3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BF4 .
BF4 CHECK FOR DTC U0100:00 SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory	**Yes** INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. TEST the system for normal operation.

DTCs from all modules. • **Is DTC U0100:00 set in the Restraints Control Module (RCM)?**	**No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test BG: DTC U0101:00

Normal Operation

- DTC U0101:00 (Lost Communication With TCM : No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Transmission Control Module (TCM) over the High Speed Controller Area Network (HS-CAN) are missing for greater than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- TCM
- IPC

PINPOINT TEST BG: DTC U0101:00

Test Step	Result / Action to Take
BG1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BG2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BG2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the TCM pass the network test?**	**Yes** GO to BG3 . **No** REFER to Section 418-00 .
BG3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BG4 .
BG4 RECHECK THE IPC DTCs	
• Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0101:00 still present?**	**Yes** GO to BG5 .

	No The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BG5 CHECK FOR DTC U0101 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0101 set in the PCM?**	**Yes** For Aisin AW21 transaxle, INSTALL a new TCM . REFER to Section 307-01A . CLEAR the DTCs. REPEAT the self-test. For the 6F35 transaxle, INSTALL a new PCM. REFER to Refer to the appropriate section in Group 303 for the procedure.. For the eCVT transaxle, INSTALL a new transaxle. REFER to Section 307-01C . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test BH: DTC U0102:00

Normal Operation

- DTC U0102:00 (Lost Communication With Transfer Case Control Module: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the 4X4 control module over the High Speed Controller Area Network (HS-CAN) are missing for greater than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- 4X4 control module
- IPC

PINPOINT TEST BH: DTC U0102:00

Test Step	Result / Action to Take
BH1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BH2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BH2 CHECK THE COMMUNICATION NETWORK	

• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the 4X4 control module pass the network test?**	**Yes** GO to BH3 . **No** REFER to Section 418-00 .
BH3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BH4 .
BH4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0102:00 still present?**	**Yes** GO to BH5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BH5 CHECK FOR DTC U0114, U0114:00 or U1900 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0114, U0114:00 or U1900 set in the ABS?**	**Yes** INSTALL a new 4X4 control module. REFER to Section 308-07A . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) . TEST the system for normal operation.

Pinpoint Test BI: DTC U010F:00

Normal Operation

- DTC U010F:00 (Lost Communication With Air Conditioning Control Module: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the HVAC module over the Medium Speed Controller Area Network (MS-CAN) are missing for greater than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- HVAC module
- IPC

PINPOINT TEST BI: DTC U010F:0

Test Step	Result / Action to Take
BI1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BI2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BI2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the HVAC module pass the network test?**	**Yes** GO to BI3 . **No** REFER to Section 418-00 .
BI3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BI4 .
BI4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U010F:00 still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U010F:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BJ: DTC U0111:00

Normal Operation

- DTC U0111:00 (Lost Communication With Battery Energy Control Module "A": No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Battery Pack Sensor Module (BPSM) over the High Speed Controller Area Network (HS-CAN) are missing

for greater than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- BPSM
- IPC

PINPOINT TEST BJ: DTC U0111:00

Test Step	Result / Action to Take
BJ1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BJ2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BJ2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the BPSM pass the network test?**	**Yes** GO to BJ3 . **No** REFER to Section 418-00 .
BJ3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BJ4 .
BJ4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0111:00 still present?**	**Yes** GO to BJ5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BJ5 CHECK FOR DTC U0111 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds.	**Yes** INSTALL a new BPSM . REFER to Section 414-03 . CLEAR the DTCs. REPEAT the self-test.

• Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0111 set in the PCM?**	**No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test BK: DTC U0121:00

Normal Operation

- DTC U0121:00 (Lost Communication With Anti-Lock Brake System [ABS] Control Module: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the ABS module over the High Speed Controller Area Network (HS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- ABS module
- IPC

PINPOINT TEST BK: DTC U0121:00

Test Step	Result / Action to Take
BK1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BK2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BK2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the ABS module pass the network test?**	**Yes** GO to BK3 . **No** REFER to Section 418-00 .
BK3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BK4 .
BK4 RECHECK THE IPC DTCs	

• Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0121:00 still present?**	**Yes** INSTALL a new ABS module. REFER to Section 206-09 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0121:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BL: DTC U0131:00

Normal Operation

- DTC U0131:00 (Lost Communication With Power Steering Control Module: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Power Steering Control Module (PSCM) over the High Speed Controller Area Network (HS-CAN) are missing for greater than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- PSCM
- IPC

PINPOINT TEST BL: DTC U0131:00

Test Step	Result / Action to Take
BL1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BL2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BL2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the PSCM pass the network test?**	**Yes** GO to BL3 . **No** REFER to Section 418-00 .
BL3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	

• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BL4 .
BL4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0131:00 still present?**	**Yes** GO to BL5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BL5 CHECK FOR DTC U0131:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0131:00 set in the ABS module?**	**Yes** INSTALL a new PSCM (part of the steering gear). REFER to Section 211-02 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test BM: DTC U0140:00

Normal Operation

- DTC U0140:00 (Lost Communication With Body Control Module: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Smart Junction Box (SJB) over the Medium Speed Controller Area Network (MS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- SJB
- IPC

PINPOINT TEST BM: DTC U0140:00

Test Step	Result / Action to Take
BM1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present.	**Yes** GO to BM2 . **No**

• **Is an observable symptom present?**	The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BM2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the SJB pass the network test?**	**Yes** GO to BM3 . **No** REFER to Section 418-00 .
BM3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BM4 .
BM4 RECHECK THE IPC DTCs	
• Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0140:00 still present?**	**Yes** GO to BM5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BM5 CHECK FOR DTC U0140 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0140 set in the Driver Seat Module (DSM) or the Driver Door Module (DDM)?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test BN: DTC U0151:00

Normal Operation

- DTC U0151:00 (Lost Communication With Restraints Control Module: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Restraints Control Module (RCM) over the High Speed Controller Area Network (HS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

Ts pinpoint test is intended to diagnose the following:

- RCM
- IPC

PINPOINT TEST BN: DTC U0151:00

Test Step	Result / Action to Take
BN1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BN2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BN2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the RCM pass the network test?**	**Yes** GO to BN3 . **No** REFER to Section 418-00 .
BN3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BN4 .
BN4 RECHECK THE IPC DTCs	
• Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0151:00 still present?**	**Yes** GO to BN5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BN5 CHECK FOR DTC U0151:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules.	**Yes** INSTALL a new RCM . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

• **Is DTC U0151:00 set in the Occupant Classification System Module (OCSM)?**	

Pinpoint Test BO: DTC U0154:00

Normal Operation

- DTC U0154:00 (Lost Communication With Occupant Classification Sensor [OCS]: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Occupant Classification System Module (OCSM) over the High Speed Controller Area Network (HS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- OCSM
- IPC

PINPOINT TEST BO: DTC U0154:00

Test Step	Result / Action to Take
BO1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BO2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BO2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the OCSM pass the network test?**	**Yes** GO to BO3 . **No** REFER to Section 418-00 .
BO3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BO4 .
BO4 RECHECK THE IPC DTCs	
• Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0154:00 still present?**	**Yes** GO to BO5 . **No** The system is operating correctly at this time. The

	DTC may have been set due to high network traffic or an intermittent fault condition.
BO5 CHECK FOR DTC U0154:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0154:00 set in the Restraints Control Module (RCM) module?**	**Yes** INSTALL a new OCSM . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation.

Pinpoint Test BP: DTC U0159:00

Normal Operation

- DTC U0159:00 (Lost Communication With Parking Assist Control Module "A": No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Parking Aid Module (PAM) over the Medium Speed Controller Area Network (MS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose e following:

- PAM
- IPC

PINPOINT TEST BP: DTC U0159:00

Test Step	Result / Action to Take
BP1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BP2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BP2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the PAM pass the network test?**	**Yes** GO to BP3 . **No** REFER to Section 418-00 .
BP3 RETRIEVE THE RECORDED DTCs FROM THE IPC	

SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BP4 .
BP4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0159:00 still present?**	**Yes** INSTALL a new PAM . REFER to Section 413-13 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0159:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BQ: DTC U0163:00

Normal Operation

- DTC U0163:00 (Lost Communication With Navigation Control Module: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Audio Front Control Module (ACM) over the High Speed Controller Area Network (HS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- ACM
- IPC

PINPOINT TEST BQ: DTC U0163:00

Test Step	Result / Action to Take
BQ1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BQ2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

BQ2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the ACM pass the network test?**	**Yes** GO to BQ3 . **No** REFER to Section 418-00 .
BQ3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BQ4 .
BQ4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0163:00 still present?**	**Yes** INSTALL a new ACM . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0163:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BR: DTC U0164:00

Normal Operation

- DTC U0164:00 (Lost Communication With HVAC Control Module: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the HVAC module over the Medium Speed Controller Area Network (MS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- HVAC module
- IPC

PINPOINT TEST BR: DTC U0164:00

Test Step	Result / Action to Take
BR1 VERIFY THE CUSTOMER CONCERN	

• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BR2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BR2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the HVAC module pass the network test?**	**Yes** GO to BR3 . **No** REFER to Section 418-00 .
BR3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BR4 .
BR4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0164:00 still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0164:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BS: DTC U0184:00

Normal Operation

- DTC U0184:00 (Lost Communication With Radio: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Audio Front Control Module (ACM) over the High Speed Controller Area Network (HS-CAN) are missing for greater than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- ACM
- IPC

PINPOINT TEST BS: DTC U0184:00

Test Step	Result / Action to Take
BS1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BS2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BS2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the ACM pass the network test?**	**Yes** GO to BS3 . **No** REFER to Section 418-00 .
BS3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BS4 .
BS4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0184:00 still present?**	**Yes** INSTALL a new ACM . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0184:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BT: DTC U0208:00

Normal Operation

- DTC U0208:00 (Lost Communication With "Seat Control Module A": No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Driver Seat Module (DSM) over the Medium Speed Controller Area Network (MS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- DSM

i>IPC

PINPOINT TEST BT: DTC U0208:00

Test Step	Result / Action to Take
BT1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BT2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BT2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the DSM pass the network test?**	**Yes** GO to BT3 . **No** REFER to Section 418-00 .
BT3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BT4 .
BT4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0208:00 still present?**	**Yes** INSTALL a new DSM . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0208:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for

	normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BU: DTC U0232:00

Normal Operation

- DTC U0232:00 (Lost Communication With Side Obstacle Detection Control Module Left: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Side Obstacle Detection Control Module - Left (SOD-L) over the High Speed Controller Area Network (HS-CAN) are missing for greater than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- SOD-L
- IPC

PINPOINT TEST BU: DTC U0232:00

Test Step	Result / Action to Take
BU1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BU2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BU2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the SOD-L pass the network test?**	**Yes** GO to BU3 . **No** REFER to Section 418-00 .
BU3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BU4 .

BU4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0232:00 still present?**	**Yes** INSTALL a new SOD-L . REFER to Section 419-04 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0232:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BV: DTC U0233:00

Normal Operation

- DTC U0233:00 (Lost Communication With Side Obstacle Detection Control Module Right: No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the Side Obstacle Detection Control Module - Right (SOD-R) over the High Speed Controller Area Network (HS-CAN) are missing for greater than 5 seconds. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- SOD-R
- IPC

PINPOINT TEST BV: DTC U0233:00

Test Step	Result / Action to Take
BV1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BV2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
BV2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test.	**Yes** GO to BV3 . **No** REFER to Section 418-00 .

• **Does the SOD-R pass the network test?**	
BV3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BV4 .
BV4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0233:00 still present?**	**Yes** INSTALL a new SOD-R . REFER to Section 419-04 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0232:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BW: DTC U0298:00

Normal Operation

- DTC U0298:00 (Lost Communication With DC to DC Control Module "A": No Sub-Type Information) - sets in the Instrument Panel Cluster (IPC) if data messages received from the DC to DC Converter Control Module (DC/DC) over the Medium Speed Controller Area Network (MS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- DC to DC Converter Control Module (DC/DC)
- IPC

PINPOINT TEST BW: DTC U0298:00

Test Step	Result / Action to Take
BW1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to BW2 . **No** The system is operating normally at this

	time. The DTC may have been set due to high network traffic or an intermittent faulcondition.
BW2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the DC/DC pass the network test?**	**Yes** GO to BW3 . **No** REFER to Section 418-00 .
BW3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** GO to Pinpoint Test BX (U3003:16) or GO to Pinpoint Test BY (U3003:17). **No** GO to BW4 .
BW4 RECHECK THE IPC DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0298:00 still present?**	**Yes** INSTALL a new DC/DC . REFER to Section 414-05 . CLEAR the DTCs. REPEAT the IPC self-test. If DTC U0298:00 is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test BX: DTC U3003:16

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) - sets in the Instrument Panel Cluster (IPC) in continuous memory if the IPC detects battery voltage below 9 volts on the voltage input circuit.

This pinpoint test is intended to diagnose the following:

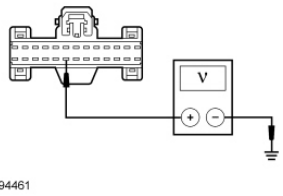
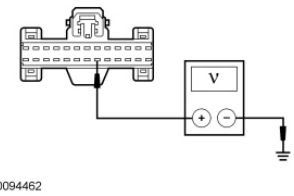
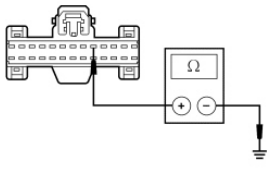
- Wiring, terminals or connectors
- High circuit resistance
- IPC

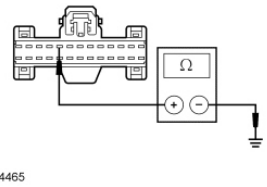
PINPOINT TEST BX: DTC U3003:16

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
BX1 RECHECK THE IPC DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC Self-Test . • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U3003:16 still present?**	**Yes** GO to BX2 . **No** The system is operating correctly at this time. The DTC may have been set due to a previous low battery voltage condition.
BX2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Enter the following diagnostic mode on the scan tool: PCM Self-Test . • Carry out the PCM Key ON Engine OFF (KOEO) self-test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC P0620, P0622, P0625, P0626 or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to BX3 .
BX3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify that the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to BX4 . **No** REFER to Section 414-01 .
BX4 CHECK THE IPC VOLTAGE INPUT	
• Measure and record the voltage at the battery. • Enter the following diagnostic mode on the scan tool: IPC DataLogger . • Select the IPC voltage input PID (MODULE_VOLT). Monitor the voltage PID and compare the reading with the recorded battery voltage. • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to BX7 . **No** GO to BX5 .
BX5 CHECK THE IPC VOLTAGE SUPPLY	

• Ignition OFF. • Disconnect: IPC C220 . • Ignition ON. • For non-hybrid, measure the voltage between the IPC C220-21, circuit SBP26 (YE/RD), harness side and ground.  N0094461 • For hybrid, measure the voltage between the IPC C220-19, circuit SBP26 (YE/RD), harness side and ground.  N0094462 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to BX6 . **No** REPAIR circuit SBP26 (YE/RD) for high resistance. CLEAR the DTC. REPEAT the self-test.
BX6 CHECK THE IPC GROUND CIRCUIT	
• Ignition OFF. • Disconnect: Negative Battery Cable . • On non-hybrid, measure the resistance between the IPC C220-5, circuit GD116 (BK/VT), harness side and ground.  N0099635 • On hybrid, measure the resistance between the IPC C220-9, circuit GD116 (BK/VT), harness side and ground.	**Yes** GO to BX7 . **No** REPAIR circuit GD116 (BK/VT) for high resistance. CLEAR the DTCs. REPEAT the self-test.

 • **Is the resistance less than 5 ohms?**	
BX7 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test BY: DTC U3003:17

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) - sets in the Instrument Panel Cluster (IPC) in continuous memory if the IPC detects battery voltage above 16 volts on the voltage input circuit.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- IPC

PINPOINT TEST BY: DTC U3003:17

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: DTC U3003:17 may be stored in the module memory due to past battery charging or vehicle jump starting events.

BY1 CHECK FOR DTC B1317, B1676, P0563 (PCM) OR U3003:17 SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test .	**Yes** REFER to Section 414-00 to diagnose an overcharging condition.

• Retrieve the continuous memory DTCs from all modules. • **Is DTC B1317, B1676, P0563 (PCM) or U3003:17 set in more than one module?**	**No** GO to BY2 .
BY2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to BY3 .
BY3 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test . • Clear the continuous memory DTCs. • Carry out the IPC self-test. • **Is DTC U3003:17 present?**	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test BZ: DTC U300A:62 Or U300A:64

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

With the ignition switch in the START or RUN position, the Instrument Panel Cluster (IPC) receives a RUN/START voltage input from the Smart Junction Box (SJB). The IPC also receives a networked ignition status from the SJB over the Medium Speed Controller Area Network (MS-CAN) communication bus.

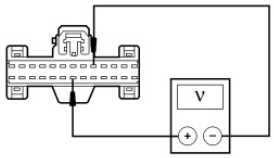
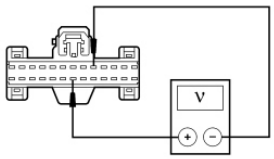
- DTC U300A:62 (Ignition Switch: Signal Compare Failure) - the IPC compares the networked input with the hardwired input and sets DTC U300A:62 in continuous memory and on-demand if a discrepancy is detected.
- DTC U300A:64 (Ignition Switch: Signal Plausibility Failure) - the IPC monitors the messaged START status and sets DTC U300A:64 in continuous memory and on-demand if the IPC detects a START input for 15 seconds. Once the fault condition is detected, the IPC retains limited functionality for 15 seconds then returns to full functionality.

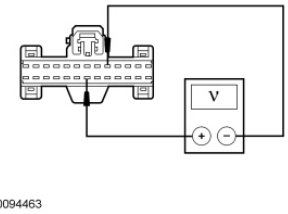
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- SJB
- IPC

PINPOINT TEST BZ: DTC U300A:62 OR U300A:64

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
BZ1 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U300A:62 recorded?**	**Yes** GO to BZ2 . **No** GO to BZ3 .
BZ2 CHECK THE IPC VOLTAGE SUPPLY	
• Ignition OFF. • Disconnect: IPC C220 . • Measure the voltage between the IPC C220-20, circuit CBP29 (WH/VT), harness side and the IPC C220-5, circuit GD116 (BK/VT), harness side.  N0094463 • Ignition ON. • Measure the voltage between the IPC C220-20, circuit CBP29 (WH/VT), harness side and the IPC C220-5, circuit GD116 (BK/VT), harness side.  N0094463 • Place the ignition in the START position. • Measure the voltage between the IPC C220-20, circuit CBP29 (WH/VT), harness side and the IPC C220-5, circuit GD116 (BK/VT), harness side.	**Yes** GO to BZ3 . **No** VERIFY the SJB fuse 29 (5A) is OK. If OK, REPAIR the circuit for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

 N0094463 • **Is the voltage 0 volts in the OFF position and greater than 10 volts in the RUN and START positions?**	
BZ3 CHECK THE SJB INPUT PIDs FROM THE IGNITION SWITCH	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger . • Select the SJB PIDs ignition ACC (IGN_A_ECU), ignition OFF (IGN_O_ECU), ignition RUN (IGN_R_ECU), and ignition START (IGN_S_ECU). Monitor the ignition PIDs while switching the ignition from ACC, OFF, RUN and START. • **Do the SJB PIDs match the ignition mode?**	**Yes** GO to BZ4 . **No** REFER to Section 211-05 to diagnose the ignition outputs to the SJB .
BZ4 CHECK THE IPC DTCs	
• Enter the following diagnostic mode on the scan tool: IPC Self-Test . • Repeat the IPC self-test. Clear the DTCs. • **Is DTC U300A:62 or DTC U300A:64 still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. If the DTC is still present, INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test CA: The Compass Is Inoperative

Refer to Wiring Diagrams Cell 124 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Mirrors for schematic and connector information.

NOTE: This procedure is only applicable to vehicles without navigation. For vehicles with navigation, refer to Section 415-00 .

Normal Operation

The compass module (integral to the auto-dimming interior mirror) provides vehicle directional inputs over the compass communication circuits to the Instrument Panel Cluster (IPC), which sends the compass information to the FDIM over the Medium Speed Controller Area Network (MS-CAN). The FDIM displays the compass direction according to the information that has been provided by the compass module to the IPC .

- DTC U0161:00 (Lost Communication With Compass Module: No Sub Type Information) - sets when the IPC does not receive any communication from the compass module for 5 seconds or longer.
- DTC U0462:68 (Invalid Data Received From Compass Module: Event Information) - sets when the IPC attempts a self-test of the compass module and its associated circuits and a failure results.

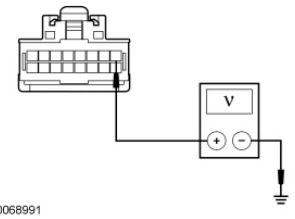
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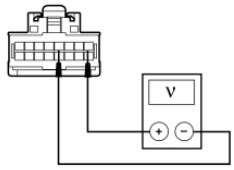
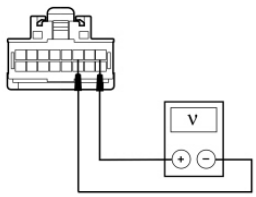
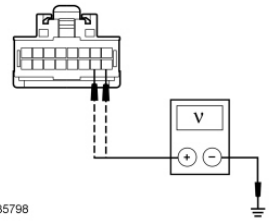
- Fuse(s)
- Wiring, terminals or connectors
- Compass module (integral to the auto-dimming interior mirror)
- FDIM (compass display)
- IPC

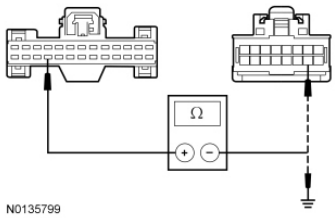
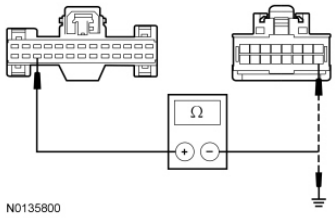
PINPOINT TEST CA: THE COMPASS IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Always set the zone and calibrate the compass before replacing an inaccurate compass module.

Test Step	Result / Action to Take
CA1 CHECK THE AUTO-DIMMING INTERIOR MIRROR VOLTAGE SUPPLY	
• Ignition OFF. • Disconnect: Auto-Dimming Interior Mirror C911 or C9039 (Camera Display Mirror). • Ignition ON. • Measure the voltage between the auto-dimming interior mirror C911-1 or C9039-1 (camera display mirror), circuit CBP41 (BU), harness side and ground.  N0068991 • **Is the voltage greater than 10 volts?**	**Yes** GO to CA2 . **No** VERIFY the BCM fuse 32 (15A). If OK, REPAIR circuit CBP32 (GN/VT) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.
CA2 CHECK THE COMPASS MODULE GROUND CIRCUIT FOR AN OPEN	
• If **not** equipped with a camera display mirror, measure the voltage between the auto-dimming interior mirror C911-1, circuit CBP41 (BU), harness side and auto-dimming interior mirror C911-4, circuit GD139 (BK/YE), harness side and ground.	**Yes** GO to CA3 . **No** REPAIR circuit GD133 (BK) for an open. CLEAR the DTCs. REPEAT the self-test.

 N0115951 • If equipped with a camera display mirror, measure the voltage between the auto-dimming interior mirror C9039-1, circuit CBP41 (BU), harness side and auto-dimming interior mirror C9039-3, circuit GD139 (BK/YE), harness side and ground.  N0135385 • **Is the voltage greater than 10 volts?**	
CA3 CHECK THE COMPASS COMMUNICATION CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: IPC C220. • Ignition ON. • Measure the voltage between the auto-dimming interior mirror C911-9 or C9039-9 (camera display mirror), circuit VMC31 (GY/BU), harness side and ground; and between the auto-dimming interior mirror C911-10 or C9039-10 (camera display mirror), circuit VMC30 (BU/GY), harness side and ground.  N0135798 • **Is any voltage present?**	**Yes** REPAIR the circuit in question for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to CA4 .
CA4 CHECK THE COMPASS COMMUNICATION PLUS (+) CIRCUIT FOR AN OPEN AND SHORT TO GROUND	

• Ignition OFF. • Measure the resistance between the IPC C220-23, circuit VMC30 (BU/GY), harness side and the auto-dimming interior mirror C911-10 or C9039-10 (camera display mirror), VMC30 (BU/GY), harness side; and between the IPC C220-23, circuit VMC30 (BU/GY), harness side and ground.  N0135799 • **Is the resistance less than 5 ohms between the IPC and the auto-dimming interior mirror, and greater than 10,000 ohms between the IPC and ground?**	**Yes** GO to CA5 . **No** REPAIR the circuit for an open or short to ground. CLEAR the DTCs. REPEAT the self-test.
CA5 CHECK THE COMPASS COMMUNICATION MINUS (-) CIRCUIT FOR AN OPEN AND SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the IPC C220-24, circuit VMC31 (GY/BU), harness side and the auto-dimming interior mirror C911-9 or C9039-9 (camera display mirror), VMC31 (GY/BU), harness side; and between the IPC C220-24, circuit VMC31 (GY/BU), harness side and ground.  N0135800 • **Is the resistance less than 5 ohms between the IPC and the auto-dimming interior mirror, and greater than 10,000 ohms between the IPC and ground?**	**Yes** GO to CA6 . **No** REPAIR the circuit for an open or short to ground. CLEAR the DTCs. REPEAT the self-test.
CA6 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly.	**Yes** INSTALL a new IPC . REFER to Instrument Panel Cluster (IPC) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been

• Operate the system and verify the concern is still present. • **Is the concern still present?**	caused by a loose or corroded connector.

Pinpoint Test CB: The Compass Is Inaccurate

NOTE: This procedure is only applicable to vehicles without navigation. For vehicles with navigation, there is no compass zone adjustment.

Normal Operation

The compass module (integral to the auto-dimming interior mirror) provides vehicle directional inputs over the communication circuits to the Instrument Panel Cluster (IPC), which sends the compass information to the Front Display Interface Module (FDIM) (compass display) over the Medium Speed Controller Area Network (MS-CAN). The FDIM displays the compass direction according to the information that has been provided by the compass module to the IPC . The compass display may provide inaccurate readings only if there is a concern with the compass module or the compass zone setting is incorrect or the compass is out of calibration.

This pinpoint test is intended to diagnose the following:

- Compass zone setting
- Compass calibration
- Compass module (integral to the auto-dimming interior mirror)

PINPOINT TEST CB: THE COMPASS IS INACCURATE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Always set the zone and calibrate the compass before replacing an inaccurate compass.

Test Step	Result / Action to Take
CB1 CHECK THE COMPASS ACCURACY	
• Position the vehicle and observe the compass display as follows: **Direction** / **Compass Display** North — N Northeast — NE East — E Southeast — SE	**Yes** The compass is OK. The concern may have been caused by an incorrect zone setting, or the compass was out of calibration. **No** INSTALL a new compass module. REFER to Auto-Dimming Interior Mirror in Section 501-09 . SET the zone. REFER to Compass Zone Adjustment in this section. CALIBRATE the compass. REFER to Compass Calibration in this section. TEST the system for normal operation.

South	S
Southwest	SW
West	W
Northwest	NW

- **Does the compass display as indicated?**

Message Center Configuration

Oil Life Reset - Non-Hybrid

NOTE: The oil life calculation is set at a maximum of approximately 12,070 km (7,500 miles) or 180 days (non-hybrid) or 16,093 km (10,000 miles) (hybrid).

1. Press and release the SETUP button 2 times to display OIL LIFE XXX% HOLD RESET = NEW.
2. Press and hold the RESET button for 2 seconds and release to reset the oil life to 100%.

Oil Life Start Value - Non-Hybrid

NOTE: The oil life start value is used to reset the oil life value back to the maximum of approximately 12,070 km (7,500 miles) or 180 days if the value was previously changed, or to lower the value from the maximum (12,070 km [7,500 miles] or 180 days) in 10% increments down to 10%.

1. Press and release the SETUP button 2 times to display OIL LIFE = XXX% HOLD RESET = NEW.
2. Press and hold the RESET button for 2 seconds and release to reset the oil life to 100%.
3. Release the RESET button then press and release the RESET button to lower the percentage by 10% (down to 10%) for each button press or return the value to 100%.

Oil Life Reset And Oil Life Start Value - Hybrid

NOTE: The oil life calculation is set at a maximum of approximately 16,093 km (10,000 miles) or 12 months.

NOTE: The message center is displayed on the LH side of the speedometer and is split into several different viewing panes.

1. Press and release the SETUP button to display VEHICLE SETTINGS in the LH viewing pane of the message center.
2. Press and release the RESET button to display the next viewing pane.
3. Press and release the SETUP button to select and highlight OIL LIFE in the LH viewing pane of the message center.>
4. **NOTE:** Once the RESET button is pressed, the message center highlights the currently selected oil life start value. This value can be changed or left as currently selected.

   Press and release the RESET button to display the move to the RH viewing pane of the message center and highlight SET TO xxx%.
5. Press and release the SETUP button to highlight the desired oil life start value.

6. **NOTE:** A pop-up window appears stating HOLD RESET FOR 2 SECONDS TO CONFIRM. PRESS INFO TO CANCEL.

   Press and release the RESET button.

7. Press and hold the RESET button for approximately 2 seconds to select and confirm the desired oil life start value.

Belt-Minder® Deactivating/Activating

Preration

NOTE: The driver and front passenger Belt-Minder® are deactivated/activated independently. When deactivating/activating one seating position, do not buckle the other position as this terminates the process.

1. Before deactivating/activating the Belt-Minder®, set the parking brake.
2. On automatic transaxles, place the selector lever in PARK (P).
3. On manual transaxles, place the shifter in NEUTRAL (N).
4. Place the ignition in the OFF mode.
5. Unbuckle the driver and front passenger safety belts.

Deactivating/Activating

1. Place the ignition in the RUN mode (do not start the engine).
2. Wait approximately 1 minute until the safety belt warning indicator turns off.
3. **NOTE:** Step 3 must be completed within 30 seconds after the safety belt warning indicator turns off.

   To disable the seating position, buckle then unbuckle the safety belt 3 times, ending in the unbuckled state.

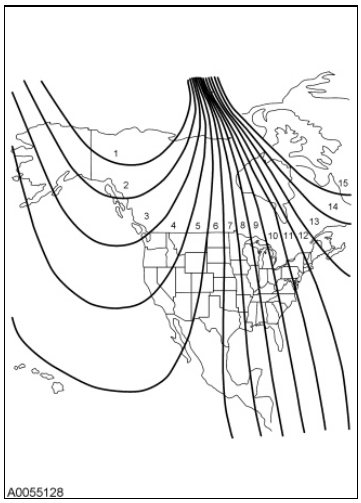
   - After Step 3, the safety belt warning indicator illuminates for 3 seconds.

4. Within 10 seconds of the safety belt warning indicator turning on, buckle then unbuckle the safety belt. This enables the Belt-Minder® if disabled and disables the Belt-Minder® if enabled.
   - This disables the Belt-Minder® feature for that seating position, if it is currently enabled. As confirmation, the safety belt warning indicator flashes 4 times per second for 3 seconds.
   - This enables the Belt-Minder® feature for that seating position, if it is currently disabled. As confirmation, the safety belt warning indicator flashes 4 times per second for 3 seconds, followed by 3 seconds with the light off followed by the safety belt warning indicator flashing 4 times per second for 3 seconds again.
5. The safety belt warning indicator flashing 4 times per second for 3 seconds provides confirmation that the Belt-Minder® is disabled.
6. The following sequence of events confirms the Belt-Minder® is enabled:
   - flashing of the safety belt warning indicator 4 times per second for 3 seconds
   - 3 seconds with the safety belt warning indicator off
   - flashing of the safety belt warning indicator 4 times per second for 3 seconds again
7. After confirmation, the deactivation/activation procedure is complete.

Compass Zone Adjustment

NOTE: This procedure is only applicable to vehicles without navigation.

1. Refer to the compass calibration zone map to select the correct compass zone setting for the geographic location of the vehicle.



2. With the ignition in the ON position, press and hold the Front Controls Interface Module (FCIM) (Fusion/Milan) or Front Display Interface Module (FDIM) (MKZ) 7 and 9 buttons (for approximately 5 seconds) until the compass display shows the current zone setting (ZONE XX). Release the 7 and 9 buttons.

3. **NOTE:** After the 7 and 9 buttons have been released for approximately 5 seconds, the compass display exits the zone setting mode.

   Before the zone setting mode turns off (within 5 seconds), momentarily press and release the 7 and 9 buttons to increase the zone increment by one. Set the zone display number to match the vehicle geographical location on the compass calibration zone map.

4. Release the 7 and 9 buttons for 5 seconds to exit the zone setting mode.

Compass Calibration

NOTE: This procedure is only applicable to vehicles without navigation.

1. **NOTE:** For optimum calibration, drive to an open, level location away from large metallic objects or structures. Switch off all non-essential electrical accessories (heated rear window, heater fan, A/C, map lamps, and wipers) and make sure all doors are closed.

   Start the vehicle.

2. **NOTE:** The vehicle remains in the CAL mode until the compass has been successfully calibrated.

   NOTE: While holding the Front Controls Interface Module (FCIM) (Fusion/Milan) or Front Display Interface Module (FDIM) (MKZ) 7 and 9 buttons down, the compass display first enters the ZONE setting mode (after 5 seconds) and then after another 5 seconds (10 seconds total), the compass display enters the CAL mode.

   Press and hold (for approximately 10 seconds) the 7 and 9 buttons until the CAL indicator appears in the display, then release the buttons.

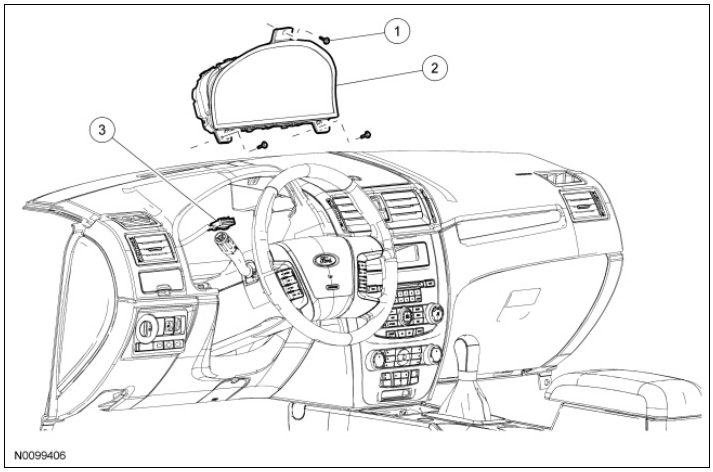
3. **NOTE:** If the CAL indicator does not turn off after the vehicle is driven in a circle at least 5 times, repeat the procedure.

   Drive the vehicle slowly at less than 5 km/h (3 mph) in a continuous circle until the CAL indicator disappears from the display and the compass heading is shown.

4. If the CAL indicator does not turn off after driving in a circle at least 5 times (and the procedure has been repeated at least once), install a new compass module (integral to the auto-dimming interior mirror). For additional information, refer to Auto-Dimming Interior Mirror in Section 501-09 .

Instrument Panel Cluster (IPC)

NOTE: Fusion shown, other vehicles similar.



Item	Part Number	Description
1	W707628	Screws (3 required)
2	10849	Instrument Panel Cluster (IPC)
3	-	Electrical connector (part of 14401)

Removal

NOTE: If installing a new Instrument Panel Cluster (IPC), all vehicle keys are erased during the parameter reset procedure. Verify at least 2 of the vehicle keys are available prior to carrying out this procedure.

1. If installing a new IPC , upload the module configuration to the scan tool. For additional information, refer to Section 418-01 , Programmable Module Installation (PMI).

2. Remove the IPC finish panel. For additional information, refer to Section 501-12 .

3. Remove the 3 screws and the IPC .
   - Disconnect the electrical connector.

Installation

1. Position the IPC in the instrument panel and connect the electrical connector.

2. Install the 3 screws.

3. Install the IPC finish panel. Refer to Section 501-12 .

4. **NOTE:** If a new IPC is installed, updated, or re-configured, the IPC and the PCM (non-hybrid) or Transmission Control Module (TCM) (hybrid) require a parameter reset to allow the IPC and the PCM or TCM to recognize each other. Failure to carry out the parameter reset to the IPC and the PCM or TCM can result in a no start condition.

If a new IPC was installed, updated or reconfigured, carry out the parameter reset procedure. For additional information, refer to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).

5. **NOTE:** The vehicles integrated keys (or standard Passive Anti-Theft System (PATS) keys) must be programmed to the new IPC .

   If a new IPC was installed, program the integrated keys. For additional information, refer to Section 419-01B (non-hybrid) or Section 419-01C (hybrid).

6. If a new IPC was installed, download the IPC configuration information from the scan tool into the new IPC . For additional information, refer to Section 418-01 , PMI .

Torque Specifications

Description	Nm	lb-in
Horn bolt	10	89

Horn

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The horn system consists of the following components:

- Horn switches (part of the steering wheel)
- Clockspring
- Horn relay (part of the SJB)
- Horn

The horn can be operated by pressing the switch on the steering wheel. It is also controlled by the SJB when it is utilized for the panic function, or during a perimeter anti-theft alarm event.

Horn Location

The horn is mounted on the RH side of the front subframe in the RH wheel well behind the front fender splash shield.

Horn

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit 105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The SJB supplies the control and switched voltage to the horn relay (part of the SJB). When the driver air bag is pressed, ground is supplied through the steering wheel to the horn relay. The horn relay is then energized, directing voltage to the horn and enabling the horn to sound.

The horn switch is comprised of 2 sets of contacts separated by springs. The lower set is connected to ground and the upper set is connected to the horn signal circuit. When the driver air bag module is pressed, it pushes down on the upper set of contacts, collapsing the springs and allowing the contacts to touch. When the contacts touch, it completes the circuit.

The SJB provides ground to the horn relay control side to sound the horn when the vehicle security system is armed, an intrusion is detected, or the panic alarm is activated.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Horn • Steering wheel harness	• Smart Junction Box (SJB) fuse 24 (20A) • Wiring, terminals or connectors

• Horn switches (part of the steering wheel)	• Clockspring • SJB

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, verify the symptom. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The Horn Is Inoperative

Refer to Wiring Diagrams Cell 44 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Horn/Cigar Lighter for schematic and connector information.

Normal Operation

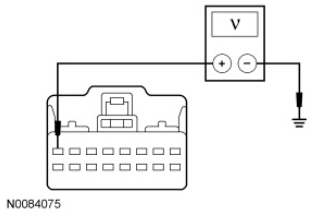
The Smart Junction Box (SJB) supplies the switched and control voltage to the horn relay (part of the SJB). When the horn switches (part of the steering wheel) are pressed, the switches are grounded to the steering wheel. Ground is then supplied to the horn relay, energizing the horn relay. The horn relay then sends voltage to the horn, enabling the horn to sound. The horn assembly has its own ground.

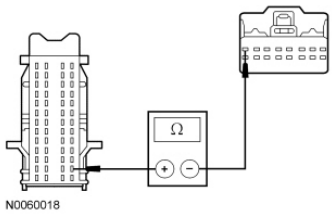
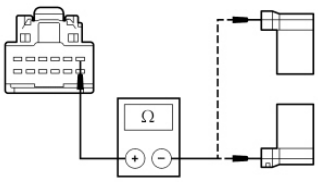
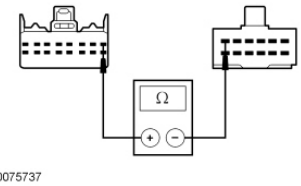
This pinpoint test is intended to diagnose the following:

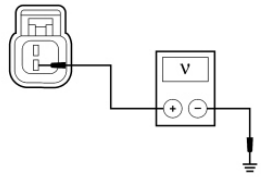
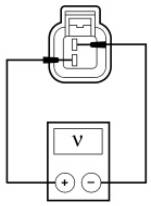
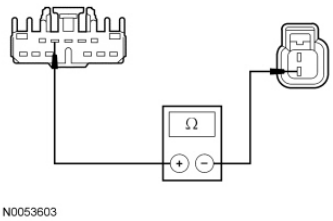
- Fuse
- Wiring, terminals or connectors
- Horn
- Clockspring
- Steering wheel harness
- Horn switches (part of the steering wheel)
- SJB

PINPOINT TEST A: THE HORN IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK THE SJB OUTPUT	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger. • Select the SJB horn PID (HORN). Active command the horn on and then off. • **Does the horn sound when commanded on?**	**Yes** GO to A2 . **No** VERIFY the SJB fuse 24 (20A) is OK. If OK, GO to A6 . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
A2 CHECK FOR VOLTAGE TO THE CLOCKSPRING	
• Connect: Negative Battery Cable. • Measure the voltage between the clockspring C218a-8, circuit CRH02 (BU/WH), harness side and ground.  N0084075 • **Is the voltage greater than 10 volts?**	**Yes** GO to A4 . **No** GO to A3 .
A3 CHECK THE HORN RELAY COIL GROUND CONTROL CIRCUIT FOR AN OPEN	
• Disconnect: SJB C2280b. • Measure the resistance between the SJB C2280b-41, circuit CRH02 (BU/WH), harness side and the clockspring C218a-8, circuit CRH02 (BU/WH), harness side.	**Yes** GO to A9 . **No** REPAIR circuit CRH02 (BU/WH) for an open. REPOWER the SRS .

 N0060018 • **Is the resistance less than 5 ohms?**	REFER to Section 501-20B . TEST the system for normal operation.
A4 CHECK THE STEERING WHEEL HARNESS FOR AN OPEN	
• Disconnect: Horn Switch C2996 and C2997. • Measure the resistance between the upper clockspring C218b-1, circuit CRH02 (BU/WH), harness side and the horn switch C2996-1, circuit CRH02 (BU/WH), harness side; and between the upper clockspring C218b-1, circuit CRH02 (BU/WH), harness side and the horn switch C2997-1, circuit CRH02 (BU/WH), harness side.  N0026922 • **Are the resistances less than 5 ohms?**	**Yes** GO to A5 . **No** REPAIR circuit CRH02 (BU/WH) for an open. INSTALL the driver air bag module. REFER to Section 501-20B . TEST the system for normal operation.
A5 CHECK THE CLOCKSPRING FOR AN OPEN	
• Measure the resistance between the clockspring C218a pin 8, component side and the clockspring C218b pin 1, component side.  N0075737 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new steering wheel. REFER to Section 211-04 . TEST the system for normal operation. **No** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation.
A6 CHECK FOR VOLTAGE TO THE HORN	
• Disconnect: Horn C131. • While pressing the horn switch, measure the voltage between the horn C131-2, circuit SRH01 (YE/RD), harness side and ground.	**Yes** GO to A7 . **No** GO to A8 .

 N0090544 • **Is the voltage greater than 10 volts?**	
A7 CHECK FOR VOLTAGE TO THE HORN USING THE CONNECTOR GROUND	
• While pressing the horn switch, measure the voltage between the horn C131-2, circuit SRH01 (YE/RD), harness side and the horn C131-1, circuit GD123 (BK/GY), harness side.  N0013171 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new horn. REFER to Horn in this section. TEST the system for normal operation. **No** REPAIR circuit GD123 (BK/GY) for an open. TEST the system for normal operation.
A8 CHECK THE HORN VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Disconnect: SJB C2280e. • Measure the resistance between the SJB C2280e-5, circuit SRH01 (YE/RD), harness side and the horn C131-2, circuit SRH01 (YE/RD), harness side.  N0053603 • **Is the resistance less than 5 ohms?**	**Yes** GO to A9 . **No** REPAIR circuit SRH01 (YE/RD) for an open. TEST the system for normal operation.
A9 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . REPOWER the SRS . REFER to Section 501-20B . TEST the system for normal operation. **No** The system is operating

	correctly at this time. The concern may have been caused by a loose or corroded connector. REPOWER the SRS . REFER to Section 501-20B .

Pinpoint Test B: The Horn Is Always On

Refer to Wiring Diagrams Cell 44 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Horn/Cigar Lighter for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) supplies the switched and control voltage to the horn relay (part of the SJB). When the horn switches (part of the steering wheel) are pressed, the switches are grounded to the steering wheel. Ground is then supplied to the horn relay, energizing the horn relay. The horn relay then sends voltage to the horn, enabling the horn to sound.

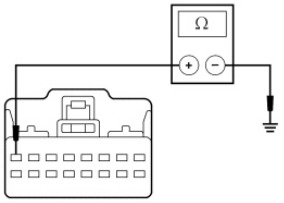
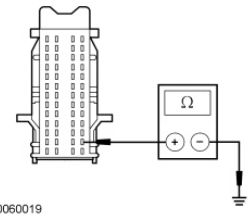
This pinpoint test is intended to diagnose the following:

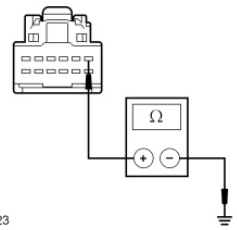
- Wiring, terminals or connectors
- Clockspring
- Steering wheel harness
- Horn switches (part of the steering wheel)
- SJB

PINPOINT TEST B: THE HORN IS ALWAYS ON

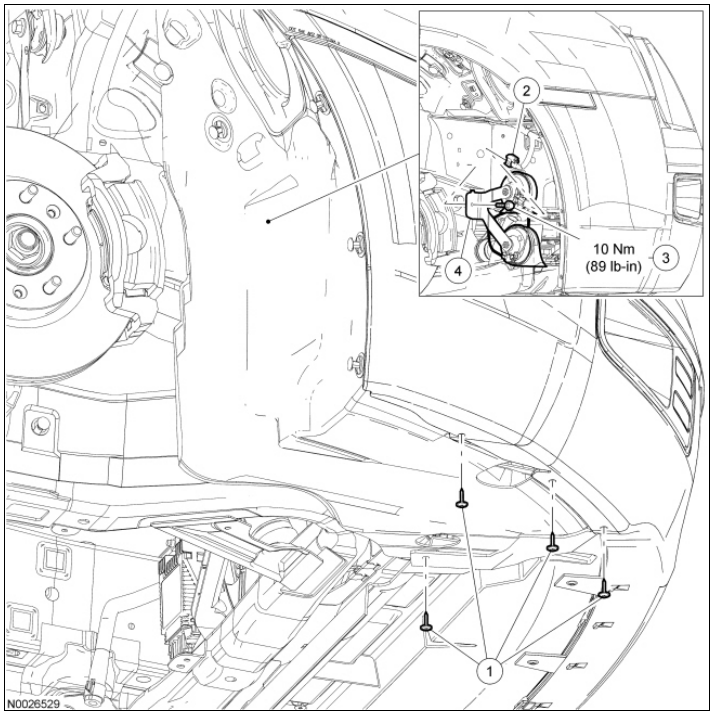
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK THE HORN POWER SUPPLY CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280e. • **Does the horn continue to sound?**	**Yes** REPAIR circuit SRH01 (YE/RD) for a short to voltage. TEST the system for normal operation. **No** GO to B2 .
B2 CHECK THE HORN SWITCH INPUT	
• Disconnect: SJB C2280b. • Connect: SJB C2280e. • **Does the horn continue to sound?**	**Yes** GO to B6 . **No** GO to B3 .
B3 CHECK THE HORN RELAY COIL GROUND CONTROLLED CIRCUIT FOR A SHORT TO GROUND	

• Depower the Supplemental Restraint System (SRS). Refer to Section 501-20B . • Disconnect: Clockspring C218a. • Measure the resistance between the clockspring C218a-8, circuit CRH02 (BU/WH), harness side and ground.  N0026775 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B4 . **No** REPAIR circuit CRH02 (BU/WH) for a short to ground. REPOWER the SRS . REFER to Section 501-20B . TEST the system for normal operation.
B4 CHECK THE CLOCKSPRING FOR A SHORT TO GROUND	
• Remove the driver air bag module. Refer to Section 501-20B . • Connect: Clockspring C218a. • Disconnect: Upper Clockspring C218b. • Measure the resistance between the SJB C2280b-41, circuit CRH02 (BU/WH), harness side and ground.  N0060019 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B5 . **No** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation.
B5 CHECK THE STEERING WHEEL HARNESS FOR A SHORT TO GROUND	
• Disconnect: Horn Switch C2996 and C2997. • Measure the resistance between the upper clockspring 218b-1, circuit CRH02 (BU/WH), harness side and ground.	**Yes** INSTALL a new steering wheel. REFER to Section 211-04 . TEST the system for normal operation. **No** REPAIR or INSTALL a new steering wheel harness. INSTALL the driver air bag module. REFER to Section 501-20B . TEST the system for normal operation.

 • **Is the resistance greater than 10,000 ohms?**	
B6 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Horn



Item	Part Number	Description
1	W706805	RH front fender splash shield screws (4 required)
2	-	Horn electrical connector (part of 14290)
3	W605784	Horn bolt
4	13832	Horn

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 4 RH front fender splash shield screws.
   - Pull the RH front fender splash shield downward to access the horn.

3. Disconnect the electrical connector.

4. Remove the bolt and the horn.
   - To install, tighten to 10 Nm (89 lb-in).

5. To install, reverse the removal procedure.

General Specifications

Item	Specification
Azimuth system check object position 1 (P1) and position 3 (P3) distance from sensor	30 cm (12 in) rear
Azimuth system check object position 2 (P2) distance from sensor	152 cm (60 in) rear

Parking Aid

The parking aid system consists of:

- Parking aid sensors (located in the rear bumper cover)
- Parking Aid Module (PAM) (located behind the LH rear seat trim panel)
- Parking aid speaker (located under the left side of the parcel shelf)
- Parking aid disable feature (integral to the Instrument Panel Cluster (IPC) message center)

The parking aid system calculates the distance to an object around the rear of the vehicle by the use of 3 ultrasonic sensors. The parking aid system detects objects behind the vehicle when the REVERSE (R) gear is selected.

Video (If Equipped)

The rear video camera system consists of the following:

- Video camera located in:
  - the license lamp housing (Fusion)
  - the luggage compartment lid (MKZ)
- Auto-dimming interior mirror (without navigation)
- Front Display Interface Module (FDIM) (with navigation)

The video camera is activated when REVERSE (R) is selected. The image from the rear video camera is displayed in the LH side of the auto-dimming interior mirror (without navigation) or the FDIM (with navigation).

Parking Aid

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit 105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The parking aid sensors detect objects approximately 152 cm (60 in) from the rear of the vehicle, 50 cm (1.6 ft) from the rear side of the vehicle, and 30 cm (12 in) above the ground. The Parking Aid Module (PAM) calculates the distance to an object within the 170 degree semicircular area around the rear of the vehicle. A variable warning tone is generated from a parking aid speaker. The parking aid speaker increases its warning tone rate as the vehicle gets closer to an obstacle. When an object is detected within 25 cm (10 in) of the sensors, the warning tone becomes continuous.

The parking aid speaker has a dual function for vehicles equipped with the parking aid system and cross traffic alert system. The parking aid speaker will emit an audible warning tone to notify the driver of impeding traffic from the side of the vehicle when backing out of parking spaces. Refer to Section 419-04 for cross traffic alert information.

The parking aid system is enabled when the ignition switch is in the RUN position and the REVERSE (R) gear is selected. The parking aid system is disabled if a fault is detected in 1 of the 3 sensors, the parking aid speaker, or the PAM . This is indicated by a warning and the message center will display the message "CHECK PARK AID".

The PAM is on the Medium Speed Controller Area Network (MS-CAN) and can be diagnosed with a scan tool. The PAM communicates with the scan tool, the Audio Control Module (ACM), the SOD-L , the SOD-R and the Instrument Panel Cluster (IPC). The following chart describes network messages used by the PAM :

NOTE: Both the MS-CAN and the High Speed Controller Area Network (HS-CAN) are used for intermodule communication. A gateway message is transferred from one network to another network through the IPC . Refer to Section 418-00 for network communication information.

PAM Network Communication Messages

Broadcast Message	Originating Module	Network Type	Receiving Module
Ignition switch position	IPC	MS-CAN	PAM
Parking aid sounder volume cutback request	PAM	MS-CAN	ACM
Parking aid enabled status	IPC	MS-CAN	PAM
Parking aid system status	PAM	MS-CAN	IPC
Transmission selector (PRNDL) range (gateway)	IPC	MS-CAN	PAM
Side obstacle detection cross traffic alert	SOD-L and SOD-R	MS-CAN	PAM
Vehicle speed (gateway)	IPC	MS-CAN	PAM

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Smart Junction Box (SJB) fuse 35 (10A) • Parking aid sensors

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the PAM .

9. **NOTE:** Follow the non-network DTC diagnostics (B-codes, C-codes, P-codes) prior to the network DTC diagnostics (U-codes).

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

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

PID Chart

PID	Description
IGN_V	Ignition voltage
LRO_DIST	Left rear outer sensor distance to object
RC_DIST	Rear center sensor distance to object
RRO_DIST	Right rear outer sensor distance to object
LRO_ATTEN	Left rear outer sensor attenuation
RC_ATTEN	Rear center sensor attenuation
RRO_ATTEN	Right rear outer sensor attenuation
TRANSGR	Transmission gear position

DTC Charts

Parking Aid Module (PAM) DTC Chart

DTC	Description	Action
B1299	Power Supply Sensor Circuit Short to Ground	GO to Pinpoint Test E .
B1342	ECU is Faulted	CLEAR the DTCs. REPEAT the Parking Aid Module (PAM) self-test. If DTC B1342 is retrieved again, INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. CLEAR all DTCs. Test the system for normal operation.
B2477	Module Configuration Failure	The PAM is not configured. REFER to Section 418-01 Programmable Module Installation (PMI) to configure the PAM . CLEAR all DTCs. Test the system for normal operation.
C1699	Left Rear Sensor Circuit Short to Vbat	GO to Pinpoint Test C .
C1700	Left Rear Sensor Circuit Failure or Blockage	GO to Pinpoint Test B .
C1701	Left Rear Sensor Circuit Fault	GO to Pinpoint Test D .
C1702	Right Rear Sensor Circuit Short to Vbatt	GO to Pinpoint Test C .
C1703	Right Rear Sensor Circuit Failure or Blockage	GO to Pinpoint Test B .
C1704	Right Rear Sensor Circuit Fault	GO to Pinpoint Test D .
C1705		GO to Pinpoint Test C .

	Rear Center Sensor Circuit Short to Vbat	
C1706	Rear Center Sensor Circuit Failure	GO to Pinpoint Test B .
C1707	Rear Center Sensor Circuit Fault	GO to Pinpoint Test D .
C1742	Rear Sounder Circuit Failure	GO to Pinpoint Test F .
C1743	Rear Sounder Circuit Short to Vbat	GO to Pinpoint Test F .
U0140	Lost Communication With Body Control Module (GEM)	GO to Pinpoint Test G .
U0155	Lost Communication With Instrument Panel Cluster (IPC) Control Module	GO to Pinpoint Test H .
U2051	One or More Calibration Files Missing/Corrupt	The PAM calibration data is corrupt or the module is not calibrated. REFER to Section 418-01 Programmable Module Installation (PMI) to configure the PAM . CLEAR all DTCs. Test the system for normal operation.

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The Parking Aid Is Inoperative/Does Not Operate Correctly

Normal Operation

The parking aid system is enabled when the ignition switch is in the RUN position and the REVERSE (R) gear is selected. The Parking Aid Module (PAM) receives a reverse gear input from the Instrument Panel Cluster (IPC) through the Medium Speed Controller Area Network (MS-CAN). A reference voltage and signal return is supplied to the parking aid sensors from the PAM . The PAM receives an input signal from each individual parking aid sensor. The system can be disabled through the message center which is part of the IPC .

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Parking aid sensors alignment
- Parking aid sensors
- PAM
- Rear bumper cover

PINPOINT TEST A: THE PARKING AID IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK THE DTCs FROM BOTH THE CONTINUOUS AND ON-DEMAND PAM SELF-TESTS	
• Check the PAM DTCs from the continuous and on-demand self-tests. • **Are any PAM DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** GO to A2 .
A2 CHECK THE MESSAGE CENTER FOR PARKING AID DISABLE OPERATION	
• While observing the IPC message center, disable and enable the parking aid system. • **Does the message center display PARK AID OFF when the parking aid system is disabled, and display PARK AID ON when the parking aid system is enabled?**	**Yes** GO to A3 . **No** REFER to Section 413-01 .
A3 CHECK FOR CORRECT REVERSE GEAR INPUT	
• Apply the parking brake. • Ignition ON. • Select REVERSE. • Enter the following diagnostic mode on the scan tool: PAM DataLogger. • Monitor the PAM PID (TRANSGR). • **Does the PID read REVERSE?**	**Yes** GO to A4 . **No** GO to A5 .
A4 CHECK THE PARKING AID SENSORS FOR CORRECT ALIGNMENT	
NOTE: If the vehicle was in a rear end collision, the parking aid sensors may not be aligned correctly. • Check the bumper for correct alignment. • Carry out the azimuth system check. Refer to Azimuth System Check in this section. • Carry out the elevation system check. Refer to Elevation System Check in this section. • **Does the parking aid system pass both system checks?**	**Yes** GO to A6 . **No** REALIGN or INSTALL a new bumper cover. REFER to Section 501-19 . If the vehicle was in a rear end collision, further body work may be required to bring the parking aid sensors into correct alignment.
A5 CHECK THE PCM FOR DIGITAL TR SENSOR DTCs	
• Check the PCM for DTCs P0705, P0706, P0708 and P0709.	**Yes** REFER to Section 307-01A , Section 307-01B , or Section 307-01C to continue diagnosis of the

<table>
<tr><td>• Are any of these DTCs present?</td><td>digital TR sensor.

No
GO to A7 .</td></tr>
<tr><td>A6 MONITOR THE PAM DISTANCE PIDs</td><td></td></tr>
<tr><td>• Enter the following diagnostic mode on the scan tool: PAM DataLogger.
• Monitor the PAM distance PIDs while moving a test object into and out of the azimuth field directly behind each of the rear sensors:

<table><tr><th>PID</th><th>Description</th></tr><tr><td>LRO_DIST</td><td>Left rear outer parking aid sensor distance</td></tr><tr><td>RC_DIST</td><td>Rear center parking aid sensor distance</td></tr><tr><td>RRO_DIST</td><td>Right rear outer parking aid sensor distance</td></tr></table>
• Do the PID readings correspond to the approximate distance between sensor and test object?</td><td>Yes
GO to A7 .

No
INSTALL a new sensor(s) for the one in question. REFER to Parking Aid Sensor in this section. TEST the system for normal operation.</td></tr>
<tr><td>A7 CHECK FOR CORRECT PAM OPERATION</td><td></td></tr>
<tr><td>• Disconnect the PAM connector.
• Check for:
♦ corrosion
♦ damaged pins
♦ pushed-out pins
• Connect the PAM connector and make sure it seats correctly.
• Operate the system and determine if the concern is still present.
• Is the concern still present?</td><td>Yes
INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.</td></tr>
</table>

Pinpoint Test B: DTCs C1700, C1703 And C1706

Refer to Wiring Diagrams Cell 131 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Parking Aid for schematic and connector information.

Normal Operation

The Parking Aid Module (PAM) supplies a reference voltage and signal return to the parking aid sensors. Each of the parking aid sensors has an individual input signal to the PAM . When an object is present behind the vehicle, the PAM receives an input signal from the sensors and determines the distance of the object to the

vehicle. A fault condition occurs when the PAM detects an open in the parking aid sensor circuits or the parking aid sensor input signal is shorted to ground.

- DTC C1700 (Left Rear Sensor Circuit Failure or Blockage) - a continuous and on-demand DTC that sets when any of the left rear parking aid sensor circuits are open or the sensor signal line is shorted to ground.
- DTC C1703 (Right Rear Sensor Circuit Failure or Blockage) - a continuous and on-demand DTC that sets when any of the right rear parking aid sensor circuits are open or the sensor signal line is shorted to ground.
- DTC C1706 (Rear Center Sensor Circuit Failure) - a continuous and on-demand DTC that sets when any of the rear center parking aid sensor circuits are open or the sensor signal line is shorted to ground.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Parking aid sensor(s)
- Parking aid bumper harness
- PAM

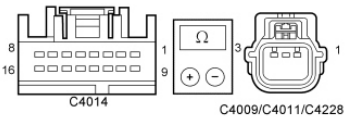
PINPOINT TEST B: DTCs C1700, C1703 AND C1706

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 RETRIEVE THE DTCs FROM THE PAM SELF-TEST	
• Check the PAM DTCs from the continuous and on-demand self-tests. • **Are multiple DTCs recorded?**	**Yes** GO to B2 . **No** For DTC C1700, C1703 or C1706 GO to B3 . For all other DTCs, REFER to DTC Charts in this section.
B2 CHECK THE BUMPER WIRING HARNESS	
• Inspect the bumper wiring harness for opens, shorts, grounds, or corrosion. • **Is the bumper wiring harness OK?**	**Yes** GO to B3 . **No** REPAIR or INSTALL a new bumper wiring harness. CLEAR the DTCs. TEST the system for normal operation.
B3 CHECK THE SENSOR CIRCUITRY FOR OPENS	

• Ignition OFF. • Disconnect: Suspect Parking Aid Sensor C4009, C4011 or C4228. • Disconnect: PAM C4014. • Measure the resistance between the PAM C4014, harness side and the suspect parking aid sensor, harness side as follows:	**Yes** GO to B4 . **No** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation.

DTC	Rear Sensor	PAM Connector-Pin	Sensor Connector-Pin	Circuit
C1700	LH outer	C4014-9	C4009-1	LMP07 (BU/WH)
C1700	LH outer	C4014-15	C4009-2	VMP15 (YE/GN)
C1700	LH outer	C4014-12	C4009-3	RMP07 (GN/WH)
C1703	RH outer	C4014-9	C4011-1	LMP07 (BU/WH)
C1703	RH outer	C4014-16	C4011-2	VMP17 (YE/OG)
C1703	RH outer	C4014-12	C4011-3	RMP07 (GN/WH)
C1706	Center	C4014-9	C4228-1	LMP07 (BU/WH)
C1706	Center	C4014-14	C4228-2	VMP14 (WH/OG)
C1706	Center	C4014-12	C4228-3	RMP07 (GN/WH)



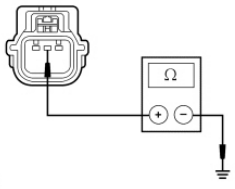
N0099409

- **Are the resistances less than 5 ohms?**

B4 CHECK THE SENSOR CIRCUITRY FOR SHORTS TO GROUND	
• Measure the resistance between the suspect parking aid sensor, harness side and ground as follows:	**Yes** If all of the parking aid sensors recorded DTCs, GO to B5 . If one or more parking aid sensor(s) recorded DTCs, INSTALL a new sensor(s) for the one in question.

	REFER to Parking Aid Sensor in this section. CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation.

DTC	Rear Sensor	Connector-Pin	Circuit
C1700	LH outer	C4009-2	VMP15 (YE/GN)
C1703	RH outer	C4011-2	VMP17 (YE/OG)
C1706	Center	C4228-2	VMP14 (WH/OG)



- **Is the resistance greater than 10,000 ohms?**

B5 CHECK FOR CORRECT PAM OPERATION	
• Disconnect the PAM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the PAM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test C: DTCs C1699, C1702 And C1705

Refer to Wiring Diagrams Cell 131 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Parking Aid for schematic and connector information.

Normal Operation

The Parking Aid Module (PAM) supplies a reference voltage and signal return to the parking aid sensors. Each of the parking aid sensors has an individual input signal to the PAM . When an object is present behind the vehicle, the PAM receives an input signal from the sensors and determines the distance of the object to the vehicle. A fault condition occurs when the PAM detects a short to voltage on the parking aid sensor signal circuit.

- DTC C1699 (Left Rear Sensor Circuit Short to Vbat) - a continuous and on-demand DTC that sets when the left rear parking aid sensor signal line is shorted to voltage.
- DTC C1702 (Right Rear Sensor Circuit Short to Vbat) - a continuous and on-demand DTC that sets when the right rear parking aid sensor signal line is shorted to voltage.
- DTC C1705 (Rear Center Sensor Circuit Short to Vbat) - a continuous and on-demand DTC that sets when the left rear center parking aid sensor signal line is shorted to voltage.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors

- Parking aid sensor(s)
- Parking aid bumper harness
- PAM

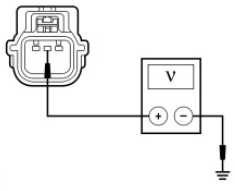
PINPOINT TEST C: DTCs C1699, C1702 AND C1705

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 RETRIEVE THE DTCs FROM THE PAM SELF-TESTS	
• Check the PAM DTCs from the continuous and on-demand self-tests. • **Are multiple DTCs recorded?**	**Yes** GO to C2 . **No** For DTC C1699, C1702 or C1705 GO to C3 . For all other DTCs, REFER to DTC Charts in this section.
C2 CHECK THE BUMPER WIRING HARNESS	
• Inspect the bumper wiring harness for opens, shorts, grounds, or corrosion. • **Is the bumper wiring harness OK?**	**Yes** GO to C3 . **No** REPAIR or INSTALL a new bumper wiring harness. CLEAR the DTCs. TEST the system for normal operation.
C3 CHECK THE SENSOR CIRCUITRY FOR SHORTS TO VOLTAGE	
• Ignition OFF. • Disconnect: Suspect Parking Aid Sensor C4009, C4011 or C4228. • Disconnect: PAM C4014. • Ignition ON. • Measure the voltage between the suspect parking aid sensor, harness side and ground as follows:	**Yes** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation. **No** GO to C4 .

DTC	Rear Sensor	Connector-Pin	Circuit
C1699	LH outer	C4009-2	VMP15 (YE/GN)
C1702	RH outer	C4011-2	VMP17 (YE/OG)

C1705	LH inner	C4228-2	VMP14 (WH/OG)



- **Is any voltage present?**

C4 CHECK THE PARKING AID SENSORS	
• Install a known good parking aid sensor(s) for each of the suspect parking aid sensor(s). • Clear the DTCs. Repeat the self-test. • Test the system for normal operation. • **Is the concern still present?**	**Yes** If all of the parking aid sensors recorded DTCs, GO to C5 . If one or more parking aid sensor(s) recorded DTCs, INSTALL a new sensor(s) for the one in question. REFER to Parking Aid Sensor in this section. CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation.
C5 CHECK FOR CORRECT PAM OPERATION	
• Disconnect the PAM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the PAM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test D: DTCs C1701, C1704 And C1707

Normal Operation

The Parking Aid Module (PAM) supplies a reference voltage and signal return to the parking aid sensors. Each of the parking aid sensors has an individual input signal to the PAM . When an object is present behind the vehicle, the PAM receives an input signal from the sensors and determines the distance of the object to the vehicle. A fault condition occurs when the PAM detects an open in the parking aid sensor circuits or the parking aid sensor input signal is shorted to ground.

The attenuation time for the rear parking aid sensors is the time required for a sensor to detect the distance to an object expressed in milliseconds (ms).

- DTC C1701 (Left Rear Sensor Circuit Fault) - a continuous and on-demand DTC that sets when the left rear parking aid sensor has internally failed or has an incorrect attenuation time.
- DTC C1704 (Right Rear Sensor Circuit Fault) - a continuous and on-demand DTC that sets when the right rear parking aid sensor has internally failed or has an incorrect attenuation time.
- DTC C1707 (Rear Center Sensor Circuit Fault) - a continuous and on-demand DTC that sets when the left rear center parking aid sensor has internally failed or has an incorrect attenuation time.

This pinpoint test is intended to diagnose the following:

- Dirty or obstructed parking aid sensor
- Parking aid sensor
- Parking aid bumper harness
- PAM

PINPOINT TEST D: DTCs C1701, C1704 AND C1707

Test Step	Result / Action to Take
D1 CHECK THE DTCs FROM THE PAM SELF-TESTS	
• Check the PAM DTCs from the continuous and on-demand self-tests. • **Are parking aid DTCs other than C1701, C1704 or C1707 recorded?**	**Yes** DIAGNOSE the other DTCs first. REFER to DTC Charts in this section. **No** GO to D2 .
D2 CHECK THE PARKING AID SENSOR OPERATION	
NOTE: Make sure the area around the vehicle is clear of anything that can activate the parking aid system. • Clean the rear bumper and sensors with high-pressure water. • Carry out the azimuth system check. Refer to Azimuth System Check in this section. • Carry out the elevation system check. Refer to Elevation System Check in this section. • **Does the parking aid system pass both system checks?**	**Yes** The system is operating correctly at this time. The concern may have been caused by a dirty or blocked parking aid sensor. CLEAR the DTCs. REPEAT the self-test. **No** GO to D3 .
D3 CHECK THE PARKING AID SENSOR DISTANCE PIDs	
• Make sure the suspect parking aid sensor(s) is flush-mounted in the bezel. • Ignition ON. • Enter the following diagnostic mode on the scan tool: PAM DataLogger. • With the brake pedal applied, shift the transmission into REVERSE (R) and monitor the parking aid sensor distance PID. The PID	**Yes** GO to D4 . **No** GO to D5 .

will read 255 cm (8.4 ft) on a correctly functioning sensor. • **Does the PID read 255 cm (8.4 ft)?**	
D4 CHECK THE PARKING AID SENSOR ATTENUATION PIDs	
• Check the parking aid sensor attenuation PIDs. • **Do the attenuation PIDs read between 0 and 16 ms?**	**Yes** GO to D6 . **No** GO to D5 .
D5 CHECK THE PARKING AID SENSORS	
• Install a new sensor for the suspect parking aid sensor. • Ignition ON. • Clear the DTCs. Repeat the self-test. Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** GO to D6 . **No** The cause of the concern was an inoperative parking aid sensor. The system is now operating correctly.
D6 CHECK FOR CORRECT PAM OPERATION	
• Disconnect the PAM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the PAM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test E: DTC B1299

Refer to Wiring Diagrams Cell 131 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Parking Aid for schematic and connector information.

Normal Operation

The Parking Aid Module (PAM) supplies a reference voltage and signal return to the parking aid sensors. Each of the parking aid sensors has an individual input signal to the PAM . When an object is present behind the vehicle, the PAM receives an input signal from the sensors and determines the distance of the object to the vehicle. A fault condition occurs when the PAM detects a short to ground or signal return circuit on the parking aid sensor voltage circuit.

- DTC B1299 (Power Supply Sensor Circuit Short to Ground) - sets when the sensor power supply circuit is shorted to ground or to the signal return circuit.

This pinpoint test is intended to diagnose the following:

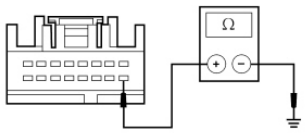
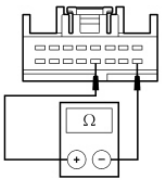
- Wiring, terminals or connectors
- Parking aid sensor(s)
- Parking aid bumper harness

- PAM

PINPOINT TEST E: DTC B1299

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 CHECK THE BUMPER WIRING HARNESS	
• Inspect the bumper wiring harness for opens, shorts, grounds, or corrosion. • **Is the bumper wiring harness OK?**	**Yes** GO to E2 . **No** REPAIR or INSTALL a new bumper wiring harness. CLEAR the DTCs. TEST the system for normal operation.
E2 CHECK THE LH OUTER SENSOR FOR AN INTERNAL SHORT	
• Ignition OFF. • Disconnect: Parking Aid Sensor C4009. • Ignition ON. • Clear the DTCs. Repeat the on-demand self-test. • **Is DTC B1299 still present?**	**Yes** GO to E3 . **No** INSTALL a new LH outer parking aid sensor. REFER to Parking Aid Sensor in this section. CLEAR the DTCs. TEST the system for normal operation.
E3 CHECK THE RH OUTER SENSOR FOR AN INTERNAL SHORT	
• Ignition OFF. • Disconnect: Parking Aid Sensor C4011. • Ignition ON. • Clear the DTCs. Repeat the on-demand self-test. • **Is DTC B1299 still present?**	**Yes** GO to E4 . **No** INSTALL a new RH outer parking aid sensor. REFER to Parking Aid Sensor in this section. CLEAR the DTCs. TEST the system for normal operation.
E4 CHECK THE CENTER SENSOR FOR AN INTERNAL SHORT	
• Ignition OFF. • Disconnect: Parking Aid Sensor C4228. • Ignition ON. • Clear the DTCs. Repeat the on-demand self-test. • **Is DTC B1299 still present?**	**Yes** GO to E5 . **No** INSTALL a new center parking aid sensor. REFER to Parking Aid Sensor in this section. CLEAR the DTCs. TEST the system for normal operation.
E5 CHECK PARKING AID SENSOR VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO GROUND	

• Ignition OFF. • Disconnect: PAM C4014. • **NOTE:** The parking aid sensors should remain disconnected in this step. • Measure the resistance between the PAM C4014-9, circuit LMP07 (BU/WH), harness side and ground.  N0057381 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to E6 . **No** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation.
E6 CHECK THE PARKING AID SENSOR VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO THE PARKING AID SENSOR GROUND CIRCUIT	
• Ignition OFF. • Measure the resistance between the PAM C4014-9, circuit LMP07 (BU/WH), harness side and the PAM C4014-12, circuit RMP07 (GN/WH).  N0058809 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to E7 . **No** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation.
E7 CHECK FOR CORRECT PAM OPERATION	
• Disconnect the PAM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the PAM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test F: DTC C1742 or DTC C1743

Refer to Wiring Diagrams Cell 131 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Parking Aid for schematic and connector information.

Normal Operation

When the parking aid sensors detect obstructions in the path behind the vehicle a variable rate warning tone is generated from a parking aid speaker. The parking aid speaker increases the warning tone rate as the vehicle gets closer to an obstacle. A fault condition occurs when the PAM detects an open, short to ground or short to voltage on the parking aid speaker circuits.

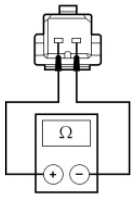
- DTC C1742 (Rear Sounder Circuit Failure) - sets when the sounder circuit is open or shorted to ground.
- DTC C1743 (Rear Sounder Circuit Short to Vbat) - sets when the sounder circuit is shorted to voltage.

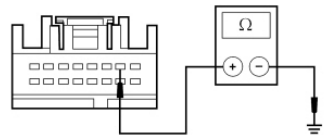
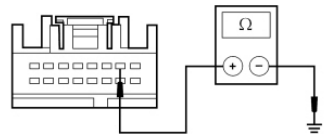
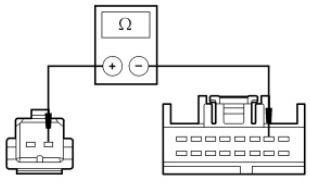
This pinpoint test is intended to diagnose the following:

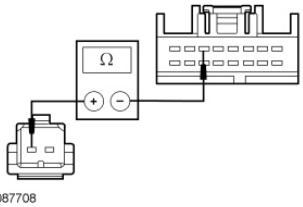
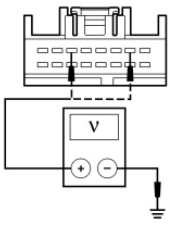
- Wiring, terminals or connectors
- PAM
- Parking aid speaker

PINPOINT TEST F: DTC C1742 OR DTC C1743

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 CHECK THE DTCs FROM THE PAM SELF-TESTS	
• Ignition ON. • Retrieve the PAM DTCs from the continuous and on-demand self-tests. • **Are parking aid DTCs other than C1742 or C1743 present?**	**Yes** Diagnose other DTCs first. REFER to DTC Charts in this section. **No** GO to F2 .
F2 MEASURE THE PARKING AID SPEAKER RESISTANCE	
• Disconnect: Parking Aid Speaker C4015. • Measure the resistance between the parking aid speaker pin 1, component side and the parking aid speaker pin 2, component side.  A0084828 • **Is the resistance between 40 and 60 ohms?**	**Yes** If DTC C1742 was recorded, GO to F3 . If DTC C1743 was recorded, GO to F7 . **No** INSTALL a new parking aid speaker. REFER to Parking Aid Speaker in this section. CLEAR the DTCs. REPEAT the self-test.
F3 CHECK THE PARKING AID SPEAKER (+) CIRCUIT FOR A SHORT TO GROUND	

• Connect: Parking Aid Speaker C4015. • Disconnect: PAM C4014. • Measure the resistance between the PAM C4014-2, circuit CMP09 (BN/BU), harness side and ground.  A0087706 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to F5 . **No** GO to F4 .
F4 CHECK THE PARKING AID SPEAKER (+) CIRCUIT FOR A SHORT TO GROUND WITH THE PARKING AID SPEAKER DISCONNECTED	
• Disconnect: Parking Aid Speaker C4015. • Measure the resistance between the PAM C4014-2, circuit CMP09 (BN/BU), harness side and ground.  A0087706 • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR circuit RMP09 (BU/GN). CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR circuit CMP09 (BN/BU). CLEAR the DTCs. TEST the system for normal operation.
F5 CHECK THE PARKING AID SPEAKER (+) CIRCUIT FOR AN OPEN	
• Disconnect: Parking Aid Speaker C4015. • Measure the resistance between the PAM C4014-2, circuit CMP09 (BN/BU), harness side and the parking aid speaker C4015-2, circuit CMP09 (BN/BU), harness side.  A0087707 • **Is the resistance less than 5 ohms?**	**Yes** GO to F6 . **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.
F6 CHECK THE PARKING AID SPEAKER (-) CIRCUIT FOR AN OPEN	

• Measure the resistance between the PAM C4014-6, circuit RMP09 (BU/GN), harness side and the parking aid speaker C4015-1, circuit RMP09 (BU/GN), harness side.  A0087708 • **Is the resistance less than 5 ohms?**	**Yes** GO to F8 . **No** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation.
F7 CHECK THE PARKING AID SPEAKER CIRCUITRY FOR SHORTS TO VOLTAGE	
• Ignition ON. • Measure the voltage between the PAM C4014-2, circuit CMP09 (BN/BU), harness side and ground; and between the PAM C4014-6, circuit RMP09 (BU/GN), harness side and ground.  A0087727 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation. **No** GO to F8 .
F8 CHECK FOR CORRECT PAM OPERATION	
• Disconnect the PAM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the PAM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. CLEAR the DTCs. REPEAT the self-test. CARRY OUT the scan tool data link test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test G: DTC U0140

Normal Operation

Several modules receive network messages from the Smart Junction Box (SJB) via the Medium Speed Controller Area Network (MS-CAN). The following information is included in the messages:

- ♦ Ignition switch position

All modules receiving a particular message should exhibit a symptom if the message is missing.

- DTC U0140 (Lost Communication With Body Control Module (GEM)) - set by the Parking Aid Module (PAM) when network messages are missing from the SJB for greater than 5 seconds with the ignition in RUN.

This pinpoint test is intended to diagnose the following:

- Module communication
- PAM
- SJB

PINPOINT TEST G: DTC U0140

Test Step	Result / Action to Take
G1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to G2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
G2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the SJB pass the network test?**	**Yes** GO to G3 . **No** REFER to Section 418-00 .
G3 RECHECK THE PAM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the PAM self-test. • **Is DTC U0140 still present?**	**Yes** GO to G4 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic.
G4 CHECK FOR DTC U0140 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool:	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No**

Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0140 set in any module?**	INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation.

Pinpoint Test H: DTC U0155

Normal Operation

Several modules receive network messages from the Instrument Panel Cluster (IPC) via the Medium Speed Controller Area Network (MS-CAN). The following information is included in the messages:

- ♦ Transmission gear selected
- ♦ Vehicle speed
- ♦ Parking aid disable switch status

All modules receiving a particular message should exhibit a symptom if the message is missing.

- DTC U0155 (Lost Communication With Instrument Panel Cluster (IPC) Control Panel) - set by the Parking Aid Module (PAM) when network messages are missing from the IC for greater than 5 seconds with the ignition in RUN.

This pinpoint test is intended to diagnose the following:

- Module communication
- PAM
- IPC

name="H">

PINPOINT TEST H: DTC U0155

Test Step	Result / Action to Take
H1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to H2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
H2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the IPC pass the network test?**	**Yes** GO to H3 . **No** REFER to Section 418-00 .
H3 RECHECK THE PAM DTCs	

NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the PAM self-test. • **Is DTC U0155 still present?**	**Yes** GO to H4 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic.
H4 CHECK FOR DTC U0155 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0155 set in any module?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . TEST the system for normal operation. **No** INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation.

Pinpoint Test I: The Audio Volume Cutback Command Is Inoperative

Normal Operation

A variable rate warning tone is generated by the parking aid sounder. While the sounder is active, the sounder increases its warning tone rate as the vehicle gets closer to an obstacle. When an object is detected within 46 cm (18 in) of the vehicle, the warning tone becomes continuous. A volume cutback request message is sent to the Audio Control Module (ACM) from the Parking Aid Module (PAM) over the Medium Speed Controller Area Network (MS-CAN) to decrease the volume of the ACM .

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- PAM
- ACM

PINPOINT TEST I: THE AUDIO VOLUME CUTBACK COMMAND IS INOPERATIVE

Test Step	Result / Action to Take
I1 VERIFY THE PAM COMMUNICATES WITH THE IC MESSAGE CENTER DISPLAY.	
• Apply the parking brake. • Ignition ON. • Apply the brake pedal and place the gear selector in REVERSE (R). • Disable/enable the parking aid system by pressing the reset button on the message center switch. • **Can the PAM be disabled/enabled in the IPC message center display?**	**Yes** GO to I3 . **No** GO to I2 .

I2 CHECK THE SCAN TOOL COMMUNICATION	
• **NOTE:** If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Carry out the network test using the scan tool. • **Does the ACM pass the network test?**	**Yes** GO to I3 . **No** REFER to Section 418-00 to diagnose network communication.
I3 CHECK FOR CORRECT PAM OPERATION	
• Disconnect the PAM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the PAM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PAM . REFER to Parking Aid Module (PAM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time.

Parking Aid - Video

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2574-A	Flex Probe Kit 105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

NOTE: The Luggage Compartment lid must be closed for correct operation of the video camera system.

The rear video camera system is used to assist the driver while reversing or parking the vehicle. For vehicles without navigation, the image of the area behind the vehicle is displayed in the LH side of the auto-dimming interior mirror assembly. For vehicles with navigation, the image of the area behind the vehicle is displayed in the Front Display Interface Module (FDIM). A dashed line on the displayed image represents the center of the vehicle and 3 color-coded lines (red, yellow, green) identify different zones between the rear of the vehicle and objects.

NOTICE: **The color-coded lines may not indicate accurate or consistent distances between objects located be the vehicle and the rear of the vehicle. This normal condition is due to variances in vehicle ride height, including, but not limited to, vehicle loading.**

For vehicles without navigation, the signal from the rear video camera is sent to the auto-dimming interior mirror display on a pair of shielded video circuits. For vehicles with navigation, the signal from the rear video camera is sent to the FDIM on a pair of shielded video circuits. The displayed video image is horizontally inverted and is viewed from the video camera perspective to mimic a conventional mirror image. The rear video camera system is active with the ignition in RUN and the transmission selector in the REVERSE (R) position.

For vehicles without navigation, the system remains active for approximately 3 seconds after the transmission selector is moved from the REVERSE (R) position. The rear video camera system cannot be disabled during these conditions.

For vehicles with navigation, the video system has a delay feature that keeps the image displayed on the FDIM until the vehicle reaches 8km/h (5 mph) when the vehicle is shifted out of REVERSE (R). The operator has the ability to turn the delay feature on or off with the on screen options in the FDIM . The image is not displayed if the vehicle is shifted into PARK (P).

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Luggage Compartment lid and video camera	• Smart Junction Box (SJB) fuse(s): ♦ 41 (15A) (without navigation) ♦ 35 (10A) • Wiring, terminals and connectors • Video camera • Auto-dimming interior mirror (without navigation) • Front Display Interface Module (FDIM) (with navigation)

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

4. If the fault is not visually evident, verify the symptom. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test J: The Rear Video Is Inoperative

Normal Operation

With the ignition switch in the RUN position, voltage is supplied to the rear video camera.

For vehicles without navigation, with the gear selector in REVERSE (R) position, a reverse voltage signal is sent to the auto-dimming interior mirror supplying power to the display in the mirror. The video camera signal is sent to the auto-dimming interior mirror. The video signal from the video camera displays an image on the LH side of the auto-dimming interior mirror.

For vehicles with navigation, with the gear selector in the REVERSE (R) position, a reverse signal is sent from the IPC to the Audio Control Module (ACM) over the Medium Speed Controller Area Network (MS-CAN), enabling the system. The video signal from the video camera displays an image on the Front Display Interface Module (FDIM).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Video camera

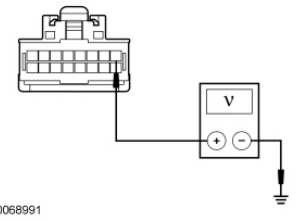
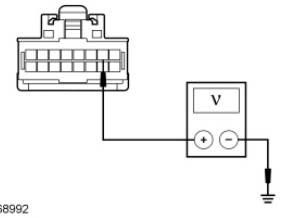
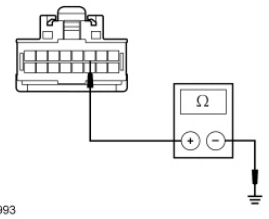
- Auto-dimming interior mirror (without navigation)
- FDIM (with navigation)

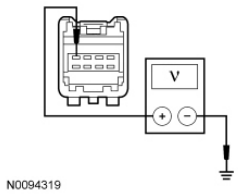
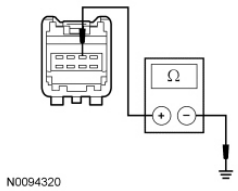
PINPOINT TEST J: THE REAR VIDEO IS INOPERATIVE

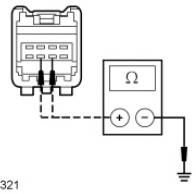
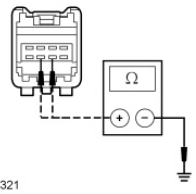
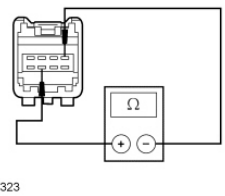
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

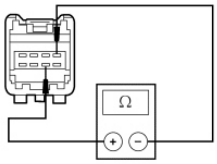
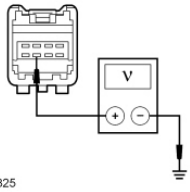
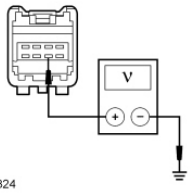
NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

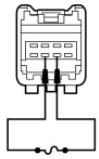
Test Step	Result / Action to Take
J1 VERIFY VEHICLE EQUIPMENT - NAVIGATION	
• **Is the vehicle equipped with navigation?**	**Yes** GO to J7 . **No** GO to J2 .
J2 CHECK THE REVERSING LAMPS OPERATION	
• Check the operation of the reversing lamps. • **Do the reversing lamps operate correctly?**	**Yes** GO to J3 . **No** REFER to Section 417-01 .
J3 CHECK FOR VIDEO CAMERA SIGNAL	
• Ignition OFF. • Apply the parking brake. • Ignition ON. • Select REVERSE. • Observe the auto-dimming interior mirror. • **Does the auto-dimming interior mirror momentarily display a blue screen?**	**Yes** GO to J9 . **No** GO to J4 .
J4 CHECK THE AUTO-DIMMING INTERIOR MIRROR VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Auto-Dimming Interior Mirror C9039. • Ignition ON. • Measure the voltage between the auto-dimming interior mirror C9039-1, circuit CBP41 (BU), harness side and ground.	**Yes** GO to J5 . **No** VERIFY the Smart Junction Box (SJB) fuse 41 (15A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. TEST the system for normal operation.

 N0068991 • **Is the voltage greater than 10 volts?**	
J5 CHECK THE AUTO-DIMMING INTERIOR MIRROR REVERSE INPUT CIRCUIT	
• Apply the parking brake. • Select REVERSE. • Measure the voltage between the auto-dimming interior mirror C9039-2, circuit CLS10 (GN/BN), harness side and ground.  N0068992 • **Is the voltage greater than 10 volts?**	**Yes** GO to J6 . **No** REPAIR the circuit. TEST the system for normal operation.
J6 CHECK THE AUTO-DIMMING INTERIOR MIRROR GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable. • Measure the resistance between the auto-dimming interior mirror C9039-3, circuit GD139 (BK/YE), harness side and ground.  N0068993 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new auto-dimming interior mirror. REFER to Section 501-09 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
J7 VERIFY THE REVERSE SIGNAL INPUT	
• Apply the parking brake. • Ignition ON. • Select REVERSE. • Check the IPC message center PRNDL indicator. • **Does REVERSE (R) appear in the message center?**	**Yes** GO to J8 . **No** REFER to Section 307-01A , Section 307-01B or Section 307-01C to diagnose the PRNDL.

J8 CHECK THE FDIM DISPLAY	
• Select REVERSE. • Observe the FDIM display. • **Does the FDIM display "PLEASE CHECK SURROUNDINGS FOR SAFETY" at the top of the display screen?**	**Yes** GO to J9 . **No** INSTALL a new FDIM . REFER to Section 415-00 . TEST the system for normal operation.
J9 CHECK THE VIDEO CAMERA VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Disconnect: Video Camera C4357. • Ignition ON. • Measure the voltage between the video camera C4357-1, circuit CBP35 (YE/GY), harness side and ground.  N0094319 • **Is the voltage greater than 10 volts?**	**Yes** GO to J10 . **No** VERIFY that the SJB fuse 35 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
J10 CHECK THE VIDEO CAMERA GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable. • Measure the resistance between the video camera C4357-3, circuit GD171 (BK/GY), harness side and ground.  N0094320 • **Is the resistance less than 5 ohms?**	**Yes** GO to J11 . **No** REPAIR the circuit. TEST the system for normal operation.
J11 CHECK THE VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the video camera C4357-6, circuit VMP19 (WH/GN), harness side and ground and the video camera C4357-7, circuit RMP19 (BN/VT), harness side and ground.	**Yes** GO to J13 . **No** GO to J12 .

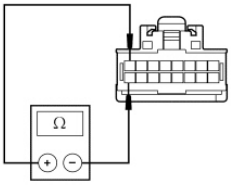
 N0094321 • **Are the resistances greater than 10,000 ohms?**	
J12 CHECK THE AUTO-DIMMING INTERIOR MIRROR (WITHOUT NAVIGATION) OR FDIM (WITH NAVIGATION) FOR AN INTERNAL SHORT	
• Disconnect: Auto-Dimming Interior Mirror C9039 (Without Navigation) or FDIM C2410 (With Navigation). • Measure the resistance between the video camera C4357-6, circuit VMP19 (WH/GN), harness side and ground and the video camera C4357-7, circuit RMP19 (BN/VT), harness side and ground.  N0094321 • **Are the resistances greater than 10,000 ohms?**	**Yes** For vehicles without navigation, INSTALL a new auto-dimming interior mirror. REFER to Section 501-09 . For vehicles with navigation, INSTALL a new FDIM . REFER to Section 415-00 . TEST the system for normal operation. **No** REPAIR the circuit in question. TEST the system for normal operation.
J13 CHECK THE VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VIDEO SHIELD	
• Measure the resistance between the video camera C4357-6, circuit VMP19 (WH/GN), harness side and the video camera C4357-4, circuit DMP19 (BK), harness side.  N0094323 • Measure the resistance between the video camera C4357-7, circuit RMP19 (BN/VT), harness side and the video camera C4357-4, circuit DMP19 (BK), harness side.	**Yes** GO to J14 . **No** REPAIR the circuit in question. TEST the system for normal operation.

 N0094322 • **Is the resistance greater than 10,000 ohms?**	
J14 CHECK THE VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VOLTAGE	
• Connect: Negative Battery Cable. • Ignition ON. • Measure the voltage between the video camera C4357-6, circuit VMP19 (WH/GN), harness side and ground.  N0094325 • Measure the voltage between the video camera C4357-7, circuit RMP19 (BN/VT), harness side and ground.  N0094324 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to J15 .
J15 CHECK VIDEO SIGNAL CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Auto-Dimming Interior Mirror (Without Navigation) C9039. • Disconnect: FDIM C2410 (With Navigation) . • Connect a fused jumper wire between the video camera C4357-6, circuit VMP19 (WH/GN), harness side and the video camera C4357-7, circuit RMP19 (BN/VT), harness side.	**Yes** REMOVE the jumper wire. CARRY OUT the video camera component test. If the camera is inoperative, INSTALL a new video camera. REFER to Video Camera in this section. TEST the system for normal operation. **No** REMOVE the jumper wire. GO to J16 .



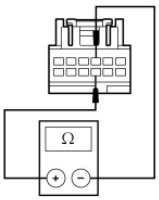
N0094326

- For vehicles without navigation, measure the resistance between the auto-dimming interior mirror C9039-8, circuit VMP19 (WH/GN), harness side and the auto-dimming interior mirror C9039-16, circuit RMP19 (BN/VT), harness side.



N0069002

- For vehicles with navigation, measure the resistance between the FDIM C2410-3, circuit VMP19 (WH/GN), harness side and the FDIM C2410-9, circuit RMP19 (BN/VT), harness side.



N0082111

- **Are the resistances less than 5 ohms?**

J16 CHECK VIDEO SIGNAL CIRCUIT (+) FOR AN OPEN

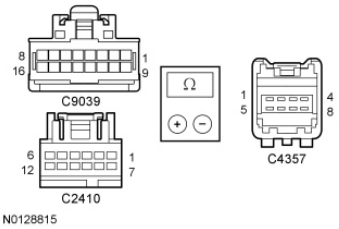
- Measure the resistance between the auto-dimming interior mirror (without navigation) or the FDIM (with navigation), harness side and the video camera, harness side.

Vehicle	Positive Meter Lead	Negative Meter Lead	Circuit
Fusion (without navigation)	C9039-8	C4357-6	VMP19 (WH/GN)
Fusion (with navigation)	C2410-3	C4357-6	VMP19 (WH/GN)

Yes
REPAIR circuit RMP19 (BN/VT).
TEST the system for normal operation.

No
REPAIR circuit VMP19 (WH/GN).
TEST the system for normal operation.

MKZ	C2410-3	C4357-6	VMP19 (WH/GN)



- **Is the resistance less than 5 ohms?**

Pinpoint Test K: Poor Image Quality

Normal Operation

For vehicles without navigation, with the gear selector in REVERSE (R) position, a reverse voltage signal is sent to the auto-dimming interior mirror supplying power to the display in the mirror. The video camera signal is sent to the auto-dimming interior mirror. The video signal from the video camera displays an image on the LH side of the auto-dimming interior mirror.

For vehicles with navigation, with the gear selector in the REVERSE (R) position, a reverse signal is sent from the IPC to the Audio Control Module (ACM) over the Medium Speed Controller Area Network (MS-CAN), enabling the system. The video signal from the video camera displays an image on the Front Display Interface Module (FDIM).

Poor image quality may be due to a loose ground or shield circuit in the camera wiring.

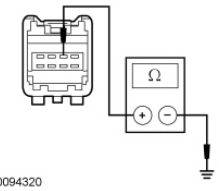
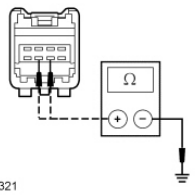
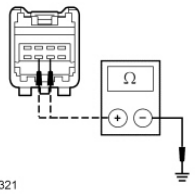
This pinpoint test is intended to diagnose the following:

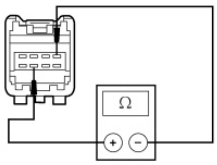
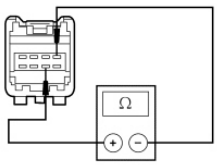
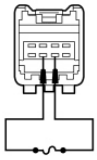
- Wiring, terminals or connectors
- Video camera

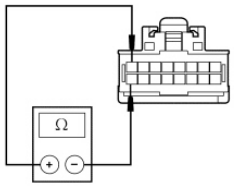
PINPOINT TEST K: POOR IMAGE QUALITY

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
K1 CHECK THE VIDEO CAMERA GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable. • Measure the resistance between the video camera C4357-3, circuit GD171 (BK/GY), harness side and ground.	**Yes** GO to K2 . **No** REPAIR the circuit. TEST the system for normal operation.

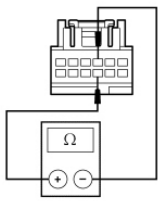
 N0094320 • **Is the resistance less than 5 ohms?**	
K2 CHECK THE VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the video camera C4357-6, circuit VMP19 (WH/GN), harness side and ground and the video camera C4357-7, circuit RMP19 (BN/VT), harness side and ground.  N0094321 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to K4 . **No** GO to K3 .
K3 CHECK THE AUTO-DIMMING INTERIOR MIRROR (WITHOUT NAVIGATION) OR FDIM (WITH NAVIGATION) FOR AN INTERNAL SHORT	
• Disconnect: Auto-Dimming Interior Mirror C9039 (Without Navigation) or FDIM C2410 (With Navigation). • Measure the resistance between the video camera C4357-6, circuit VMP19 (WH/GN), harness side and ground and the video camera C4357-7, circuit RMP19 (BN/VT), harness side and ground.  N0094321 • **Are the resistances greater than 10,000 ohms?**	**Yes** For vehicles without navigation, INSTALL a new auto-dimming interior mirror. REFER to Section 501-09 . For vehicles with navigation, INSTALL a new FDIM . REFER to Section 415-00 . TEST the system for normal operation. **No** REPAIR the circuit in question. TEST the system for normal operation.
K4 CHECK THE VIDEO CAMERA VIDEO SIGNAL CIRCUITS FOR A SHORT TO VIDEO SHIELD	

• Measure the resistance between the video camera C4357-6, circuit VMP19 (WH/GN), harness side and the video camera C4357-4, circuit DMP19 (BK), harness side.  N0094323 • Measure the resistance between the video camera C4357-7, circuit RMP19 (BN/VT), harness side and the video camera C4357-4, circuit DMP19 (BK), harness side.  N0094322 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to K5 . **No** REPAIR the circuit in question. TEST the system for normal operation.
K5 CHECK VIDEO SIGNAL CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Auto-Dimming Interior Mirror (Without Navigation) C9039. • Disconnect: FDIM C2410 (With Navigation) . • Connect a fused jumper wire between the video camera C4357-6, circuit VMP19 (WH/GN), harness side and the video camera C4357-7, circuit RMP19 (BN/VT), harness side.  N0094326 • For vehicles without navigation, measure the resistance between the auto-dimming interior mirror C9039-8, circuit VMP19 (WH/GN), harness side and the auto-dimming interior mirror C9039-16, circuit RMP19 (BN/VT), harness side.	**Yes** REMOVE the jumper wire. CARRY OUT the video camera component test. If the camera is inoperative, INSTALL a new video camera. REFER to Video Camera in this section. TEST the system for normal operation. **No** REMOVE the jumper wire. GO to K6 .



N0069002

- For vehicles with navigation, measure the resistance between the FDIM C2410-3, circuit VMP19 (WH/GN), harness side and the FDIM C2410-9, circuit RMP19 (BN/VT), harness side.



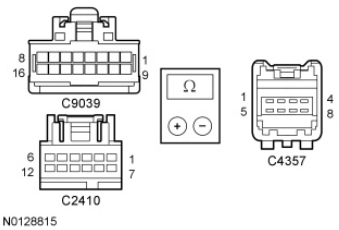
N0082111

- **Are the resistances less than 5 ohms?**

K6 CHECK VIDEO SIGNAL CIRCUIT (+) FOR AN OPEN

- Measure the resistance between the auto-dimming interior mirror (without navigation) or the FDIM (with navigation), harness side and the video camera, harness side.

Vehicle	Positive Meter Lead	Negative Meter Lead	Circuit
Fusion (without navigation)	C9039-8	C4357-6	VMP19 (WH/GN)
Fusion (with navigation)	C2410-3	C4357-6	VMP19 (WH/GN)
MKZ	C2410-3	C4357-6	VMP19 (WH/GN)



N0128815

- **Is the resistance less than 5 ohms?**

Yes
REPAIR circuit RMP19 (BN/VT). TEST the system for normal operation.

No
REPAIR circuit VMP19 (WH/GN). TEST the system for normal operation.

Pinpoint Test L: The Rear Video Mirror Display Is Always On (Vehicles Without Navigation)

Normal Operation

The video camera receives a supply voltage, with the ignition switch in the RUN position. When the gear selector is in the REVERSE (R) position, a reverse voltage signal is sent to the auto-dimming interior mirror supplying power to the display in the mirror. The video camera signal is sent to the auto-dimming interior mirror. The video signal from the video camera displays an image on the LH side of the auto-dimming interior mirror.

This pinpoint test is intended to diagnose the following:

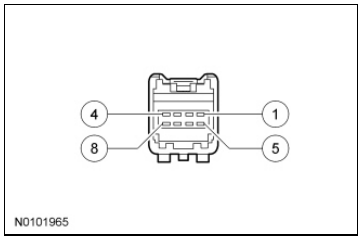
- Wiring, terminals or connectors
- Auto-dimming interior mirror

PINPOINT TEST L: THE REAR VIDEO MIRROR DISPLAY ALWAYS ON (VEHICLES WITHOUT NAVIGATION)

Test Step	Result / Action to Take
L1 CHECK THE REVERSING LAMPS OPERATION	
• Check the operation of the reversing lamps • **Do the reversing lamps operate correctly?**	**Yes** GO to X2 . **No** REFER to Section 417-01 .
L2 CHECK FOR CORRECT AUTO-DIMMING INTERIOR MIRROR OPERATION	
• Disconnect the auto-dimming interior mirror connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the auto-dimming interior mirror connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new auto-dimming interior mirror. REFER to Section 501-09 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Component Test - Video Camera

Fusion/MKZ



Measure the resistance between the video camera pins, component side, as follows:

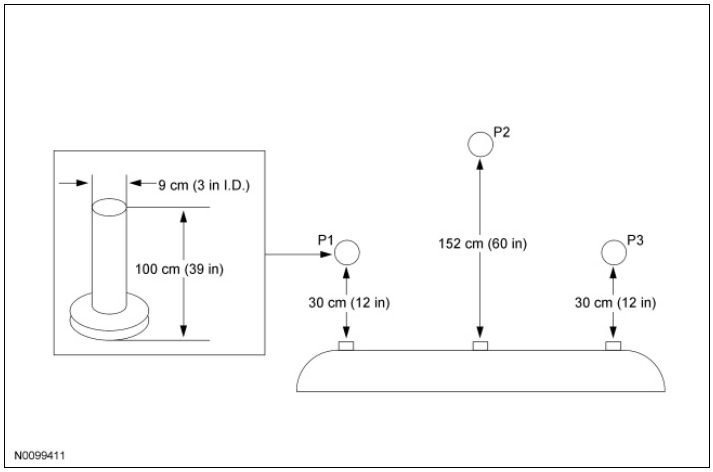
Video Camera Pins	Resistance		
3 and 6	38-49 ohms	3 and 7	39-48 ohms
6 and 7	74-101 ohms		
4 and 6	38-49 ohms		

If the resistance values for the video camera are within the specifications listed, the video camera is functional at this time.

If the resistance values for the video camera are not within the specifications listed, the video camera is inoperative at this time. Install a new video camera. Refer to Video Camera in this section. Test the system for normal operation.

Azimuth System Check

Minimum Detectable Object Locations



NOTE: The object used in this system check can be fabricated from 9 cm O.D. (3 in I.D) plastic pipe 100 cm (39 in) in length (available as Polyvinyl Chloride (PVC) pipe, or similar from a hardware or plumbing supply).

NOTE: The following Parking Aid Module (PAM) system check should be carried out with the vehicle on a level surface. The specified object locations are approximate, not absolute.

NOTE: The parking aid system will default to on when the ignition key is cycled from off to on.

NOTE: The scan tool may be used to monitor distance PIDs. The distance PIDs read between 0 and 255 cm (0 and 8 ft) on a correctly functioning system.

1. Turn the ignition to the ON position, engine off.

2. Set the parking brake on.

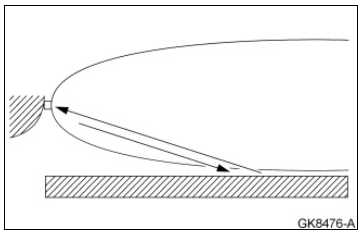
3. Place the gear shift in REVERSE (R).

4. Verify that the parking aid system detects the specified object when placed within the 3 specified locations (P1, P2, P3). The pipe should be inside of these locations.
   - The speaker should beep slowly when objects are detected on the outer edges of the detection zone, and increase as the object is moved closer to the vehicle.
     When the object is within 25 cm (10 in) of the rear bumper, the sounder should be on continuously.
   - If the Parking Aid Module (PAM) does not detect the object above, refer to Parking Aid in the Diagnosis and Testing portion of this section.

Elevation System Check

1. **NOTE:** The following system check should be carried out with the vehicle on a 3.0 m wide by 4.5 m deep (10 ft wide by 15 ft deep) smooth concrete surface, free of all obstacles and noise from fan and pneumatic tools.

   Turn the ignition to the ON position, engine off.

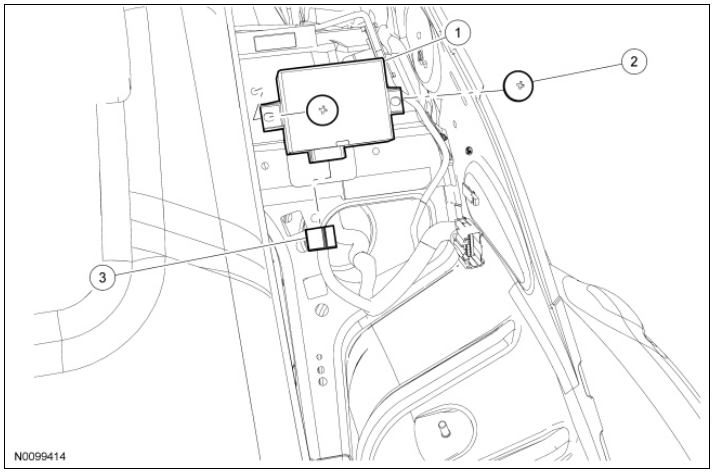


2. Set the parking brake.

3. Place the gear shift in REVERSE (R).

4. Verify that no audible alerts are heard. If audible alerts are heard, check to make sure the bumper is correctly installed and is not tilted downward so that the sensor is pointing at the ground.
   - If the audible warning tone is heard, refer to Parking Aid in the Diagnosis and Testing portion of this section.

Parking Aid Module (PAM)



Item	Part Number	Description
1	15K866	Parking Aid Module (PAM)
2	W706350	PAM screws (2 required)
3	-	PAM electrical connectors (part of 13A412)

Removal and Installation

1. **NOTE:** Module configuration is only required if a new Parking Aid Module (PAM) is being installed.

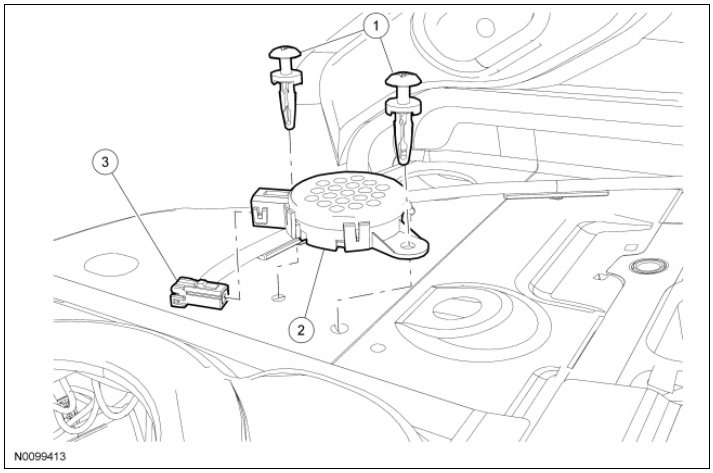
   Upload the PAM configuration information to the scan tool. For additional information, refer to PMI in Section 418-01 .

2. Remove the LH rear seat bolster. For additional information, refer to Section 501-10 .

3. Remove the 2 screws and the PAM .
   - Disconnect the electrical connectors.

4. To install, reverse the removal procedure.
   - Download the PAM configuration information. For additional information, refer to Section 418-01 .

Parking Aid Speaker



Item	Part Number	Description
1	W713167	Parking aid speaker push pins (2 required)
2	15K864	Parking aid speaker
3	-	Parking aid speaker electrical connector (part of 13A412)

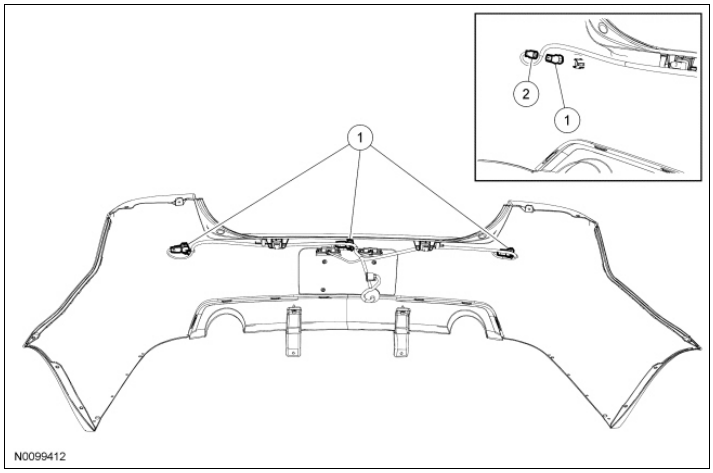
Removal and Installation

1. Remove the parcel shelf. For additional information, refer to Section 501-05 .

2. Remove the 2 push pins and the parking aid speaker.
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

Parking Aid Sensor



Item	Part Number	Description
1	15K859	Parking aid sensor(s)
2	-	Parking aid sensor electrical connectors (part of 14N139)

Removal and Installation

1. Remove the rear bumper cover. For additional information, refer to Section 501-19 .

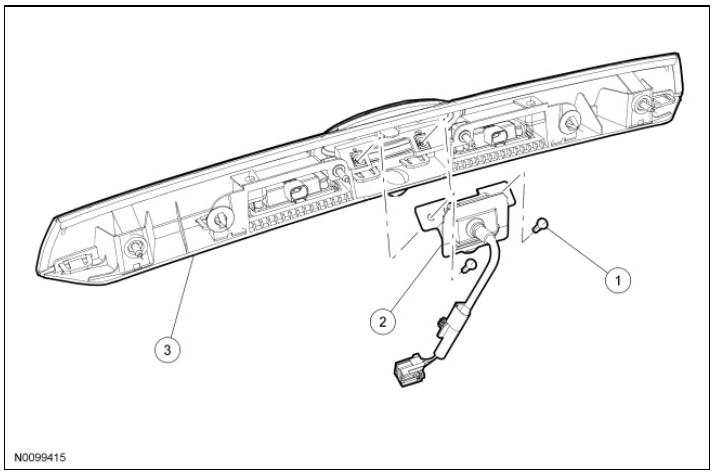
2. Disconnect the parking aid sensor(s) electrical connector(s).

3. Pry the retaining tabs with a suitable tool, such as a flat bladed screwdriver and remove the parking aid sensor(s).

4. To install, reverse the removal procedure.
   - Carry out the azimuth and elevation system check. For additional information, refer to Azimuth System Check and Elevation System Check in this section.

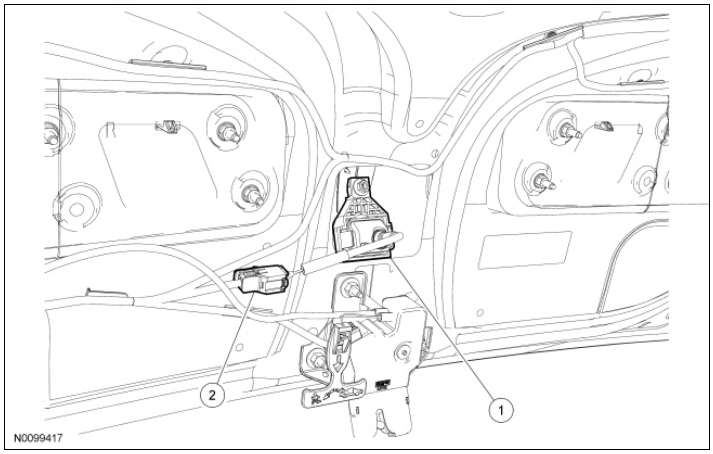
Video Camera

Fusion



Item	Part Number	Description
1	W506842	Video camera screws (2 required)
2	19G490	Video camera
3	-	Luggage compartment lid applique

MKZ



Item	Part Number	Description
1	19G490	Video camera
2	-	Video camera electrical connector (part of 13A412)

Removal and Installation

All vehicles

1. Remove the liftgate trim panel. For additional information, refer to Section 501-08 .
    - Position the water shield aside.

Fusion

2. Remove the luggage compartment lid panel applique. For additional information, refer to Section 501-08 .
    - Disconnect the electrical connector.

3. Remove the 2 screws and the video camera and bracket assembly.

MK

4. Remove the video camera by prying on the two outer retaining tabs with a suitable tool, such as a flat bladed screwdriver.
    - Disconnect the electrical connector.

All vehicles

5. To install, reverse the removal procedure.

Material

Item	Specification	Fill Capacity
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A	-

General Specifications

Item	Specification
Generator - 2.5L	
Generator pulley ratio	2.45:1
Rating	90 amps @ 700 rpm (min) to 150 amps @ 2,500 rpm (max)
Voltage regulator type	Electronic internal with generator
Generator - 3.0L	
Generator pulley ratio	2.60:1
Rating	90 amps @ 700 rpm (min) to 150 amps @ 2,500 rpm (max)
Voltage regulator type	Electronic internal with generator
Generator - 3.5L	
Generator pulley ratio	2.66:1
Rating	90 amps @ 700 rpm (min) to 150 amps @ 2,500 rpm (max)
Voltage regulator type	Electronic internal with generator

Torque Specifications

Description	Nm	lb-ft	lb-in
Generator B+ terminal nut	12	-	106
Generator bolts	47	35	-
Generator stud nuts	47	35	-
Generator stud (2.5L)	24	18	-
Generator stud (3.5L)	8	-	71
Generator upper air duct screws (2.5L)	4	-	35
Radial arm adapter nut	9	-	80

RH wheel splash shield screws	8	-	71

Charging System

The charging system is a negative ground system consisting of:

- a generator with an internal voltage regulator.
- a charging system warning indicator.
- a battery.
- circuitry and cables.
- a PCM.
- a radial arm adapter (if equipped, serviceable separately from the generator)

The generator is driven by the accessory drive belt. When the engine is started, the generator begins to generate AC which is internally converted to DC. The DC is controlled by the voltage regulator (located on the rear of the generator) and supplied to the battery. The PCM controls the voltage regulation set point, working with the generator internal voltage regulator over 2 control and communication circuits.

Principles of Operation

The PCM-controlled charging system, or "Smart Charge" charging system, determines the optimal voltage set point for the charging system and communicates this information to the voltage regulator. The "Smart Charge" charging system is designed to set 1 of 6 DTCs any time a charging system fault is present. All of the DTCs can set continuous faults, but not all DTCs will set as on-demand faults.

DTC	KOEO	KOER	Continuous
P0562	X	X	X
P0563		X [a]	X [a]
P0620			X
P0625		X	X
P0626		X	X
P065B			X

[a] Requires vehicle speed above 8 mph.

This system uses 2 communication lines between the PCM and the generator/voltage regulator. Both of these communication lines use Pulse-Width Modulation (PWM). The generator communication (GENCOM) line communicates the desired set point from the PCM to the voltage regulator. The generator monitor (GENMON) line communicates the generator load and error conditions to the PCM. The GENCOM command is only sent by the PCM when it is necessary to adjust the voltage set point. If the set point does not need to be changed, several seconds may elapse between PCM GENCOM commands. This normal operation will appear in the PID as occasional "bursts" of pulse-width commands. The third pin on the voltage regulator, the A circuit pin, is a circuit dedicated to monitor or sense battery voltage.

The PCM simultaneously controls and monitors the output of the generator. When the current consumption is high or the battery is discharged, the PCM will raise engine speed as needed to increase generator output. The generator charges the battery and at the same time supplies power for all of the electrical loads that are required. The battery is more effectively charged with a higher voltage when the battery is cold and a lower voltage when the battery is warm. The PCM is able to adjust the charging voltage according to the battery temperature by using a signal from the Intake Air Temperature (IAT) sensor. The PCM also uses other inputs to control charging system voltage such as the Vehicle Speed Sensor (VSS) and Engine Coolant Temperature (ECT). The voltage set point is calculated by the PCM and communicated to the voltage regulator by the GENCOM circuit based on the needs of the vehicle and the conditions.

The PCM turns off the generator during cranking to reduce the generator load and improve cranking speed. Once the engine starts, the PCM slowly increases generator output to desired voltage.

The PCM controls the charging system warning indicator by sending a message over the High Speed Controller Area Network (HS-CAN) to the Instrument Cluster (IC) or Instrument Panel Cluster (IPC). The IC / IPC will then control charging system warning indication based on the message from the PCM. The status of the PCM charging system warning indicator and/or message can be confirmed by viewing PCM PID generator fault indicator lamp (GENFIL). Any charging system fault detected by the PCM will result in 1 or more DTCs being set and the PID GENFIL having a status of On. If equipped with a charging system warning indicator, the IC / IPC will turn the indicator ON or OFF. If equipped with a message center, the IC / IPC will

display a CHECK CHARGING SYSTEM message. When the ignition is ON and the engine is OFF on vehicles equipped with a message center, the CHECK CHARGING SYSTEM message may not be displayed. For information regarding the IC / IPC and message center, refer to Section 413-01 .

Under certain circumstances, the charging system may have a concern, but will still keep the battery charged and the vehicle running. GENCOM is normally used to initiate charging, but the generator may charge with a fault in this circuit. If the engine is operated at greater than 2,000 rpm momentarily, the generator may "self-excite" or start charging on its own. The charging system warning indicator is illuminated and/or CHECK CHARGING SYSTEM message is displayed, and the generator operates in a default mode (approximately 13.5 volts) until the engine is turned off. When the engine is restarted and the engine is operated at greater than 2,000 rpm momentarily, the generator may again self-excite and again the charging system warning indicator is illuminated and/or CHECK CHARGING SYSTEM message is displayed.

The PIDs and their associated descriptions used in the charging system diagnosis are listed below:

PID Chart

PID	Description	Normal Display	Associated Circuit Name	Connector, Circuit
GENMON	Generator Monitor	Constant fluctuating percentage 3%-98%	Generator monitor (GENMON)	C102A-1, CDC15 (VT)
GENCMD	Generator Command	Fluctuating percentage or small intermittent bursts 3%-98%	Generator communication (GENCOM)	C102A-2, CDC10 (BU/OG)
GENVDSD	Generator Voltage Desired	Voltage varies by vehicle needs - May be controlled by an output state control	-	-
GENFIL	Generator Fault Indicator Lamp	OFF if charging system is OK	-	-
GENCMD_LF	Generator Command Line Fault	NO FAULT if GENCOM circuit (GENCMD PID) is OK	-	-
GENMON_HZ	Generator Monitor Frequency	Frequency value	-	-
VPWR	Module Supply Voltage	Within 0.5 volt of battery voltage	-	-
RPM	Engine Revolutions Per Minute	Engine rpm - May be controlled by an output state control	-	-

Inspection And Verification

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

⚠ WARNING: Batteries contain sulfuric acid and produce explosive gases. Work in a well-ventilated area. Do not allow the battery to come in contact with flames, sparks or burning substances. Avoid contact with skin, eyes or clothing. Shield eyes when working near the battery to protect against possible splashing of acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes, then get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always lift a plastic-cased battery with a battery carrier or with hands on opposite corners. Excessive pressure on the battery end walls may cause acid to flow through the vent caps, resulting in personal injury and/or damage to the vehicle or battery.

NOTICE: **Do not make jumper connections except as directed. Incorrect connections may damage the voltage regulator test terminals or fuses.**

NOTICE: **Do not allow any metal object to come in contact with the generator housing and internal diode cooling fins. A short circuit may result and burn out the diodes.**

NOTE: While carrying out any pinpoint test, disregard any DTCs set while following a specific pinpoint test. After the completion of a test, be sure to clear all DTCs in the PCM.

NOTE: All voltage measurements are referenced to the negative (-) battery post unless otherwise specified.

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Battery • Front End Accessory Drive (FEAD) belt • Generator pulley	• Wiring, terminals or connectors • Cables • Battery • Generator • Fuses

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

4. Verify the battery condition. Refer to Section 414-01 .

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

7. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
     - The air bag warning indicator prove-out (other indicators may NOT prove ignition is on) confirms ignition on. If ignition does not turn on, refer to Section 211-05 to diagnose no power in RUN.
   - refer to Section 418-00 , Inspection and Verification, to establish a scan tool session (without the ignition on).
   - verify the scan tool operation with a known good vehicle.

8. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .

NOTE: Use the Integrated Diagnostic System (IDS) feature that retrieves all Continuous Memory Diagnostic Trouble Codes (CMDTCs) from all modules at one time.

9. Retrieve CMDTCs from all modules.

10. **NOTE:** If no charging system DTCs are present, the charging system is operating correctly. If the charging system has a concern, it usually sets a charging system DTC.

    If the DTCs retrieved are related to the concern, go to the Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Master DTC Chart in Section 419-10 or Powertrain Control/Emissions Diagnosis (PC/ED) manual.

11. If no DTCs related to the concern are retrieved, go to the Symptom Chart in this section.

Diagnostic Trouble Code (DTC) Chart

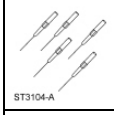
DTCs	Description	Source	Action
P0563	System Voltage High	PCM	GO to Pinpoint Test A .
P0563	System Voltage High	Various Modules	GO to Pinpoint Test A
P0620	Generator Control Circuit	PCM	GO to Pinpoint Test C .
P0625	Generator Field Terminal Circuit Low	PCM	GO to Pinpoint Test D .
P0626	Generator Field Terminal Circuit High	PCM	GO to Pinpoint Test D .
P065B	Generator Control Circuit Range/Performance	PCM	GO to Pinpoint Test E .
All other DTCs	-	Various Modules	REFER to the Master DTC Chart in Section 419-10 or the Powertrain Control/Emissions Diagnosis (PC/ED) manual. If directed to this section from another section, GO to Symptom Chart in this section.

Symptom Chart

Symptom Chart

Pinpoint Test

Special Tool(s)

 ST3104-A	Backprobe Pins POM 6411
 ST2574-A	Flex Probe Kit 300-NUD105-R025DE or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3094-A	Test Light SGT27000 or equivalent 250-350 mA incandescent bulb test lamp SGT27000
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Pinpoint Test A: System Voltage High

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

NOTE: DTC P0563, B1317 or B1676 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if vehicle accessories have been operating for an extended period of time without the engine running.

Normal Operation

With the engine running, the charging system supplies voltage to the battery and the vehicle electrical system through the battery B+ cable. The voltage that is supplied to the vehicle electrical system is used for the operation of the various vehicle systems and modules. Many modules monitor this voltage and if it rises above their calibrated set point, a DTC will be set.

- DTC P0563 (System Voltage High) - If the PCM detects a voltage from the charging system higher than 15.2 volts with vehicle speed above 8 km/h (5 mph), this DTC will be set.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Engine, generator and battery grounds
- Battery

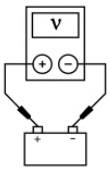
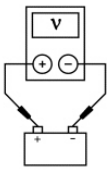
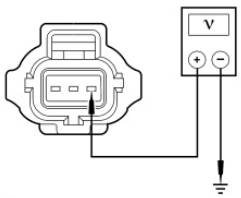
- Generator
- PCM

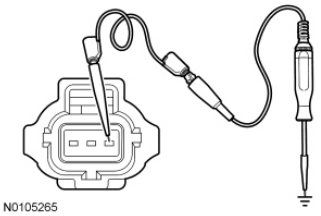
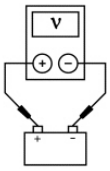
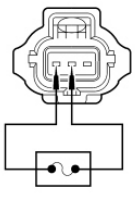
PINPOINT TEST A: SYSTEM VOLTAGE HIGH

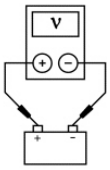
NOTE: Make sure battery voltage is greater than 12.2 volts prior to and during this pinpoint test.

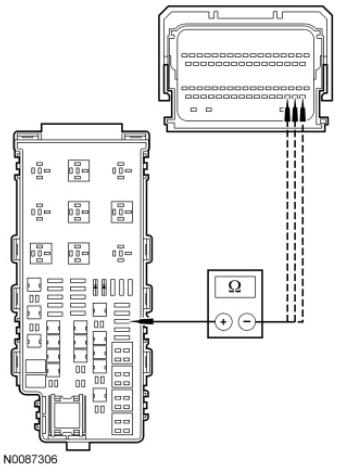
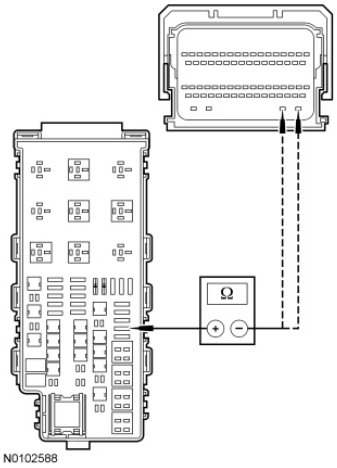
NOTE: Do not have a battery charger attached during vehicle testing.

Test Step	Result / Action to Take
A1 CHECK BATTERY CONDITION	
• Refer to Section 414-01 and carry out Pinpoint Test A: Battery Condition Test to determine if the battery can hold a charge and is OK for use. • **Does the battery pass the condition test?**	**Yes** GO to A2 . **No** INSTALL a new battery. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A2 CHECK FOR DTCs IN THE PCM	
• Enter the following diagnostic mode on the scan tool: Self Test - PCM. • **Is DTC P0620, P0625, P0626 or P065B present?**	**Yes** REFER to the DTC Chart in this section for the correct pinpoint test and DIAGNOSE those DTCs first. **No** GO to A3 .
A3 MONITOR PCM PID GENERATOR VOLTAGE DESIRED (GENVDSD)	
• Start the engine. • **NOTE:** Many of the PCM PIDs selected will be monitored later in this pinpoint test. • Select and monitor the following PCM PIDs: ♦ Generator Monitor (GENMON) ♦ Generator Command (GENCMD) ♦ Generator Voltage Desired (GENVDSD) ♦ Module Supply Voltage (VPWR) • Monitor the GENVDSD PID. • **Does the GENVDSD PID indicate 15.1 volts or less?**	**Yes** GO to A4 . **No** GO to A11 .
A4 MONITOR PCM PID GENERATOR VOLTAGE DESIRED (GENVDSD)	
• With the engine still running at idle, measure battery voltage and record.	**Yes** The fault is not present at this time. This may indicate an intermittent fault. CARRY OUT a wiggle test on the charging system circuits to try and RECREATE the concern. CHECK generator connections for corrosion, loose connections and/or bent

 AJ0210-A • Monitor the GENVDSD PID. • **Is battery voltage within ±0.6 volt of the PID GENVDSD?**	terminals. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A5 .
A5 MEASURE THE SENSE VOLTAGE	
• Ignition OFF. • Disconnect: Generator C102A. • Ignition ON. • Measure battery voltage and record.  AJ0210-A • Measure the voltage between generator C102A-3, circuit SBB17 (RD), harness side and ground.  N0105264 • **Is the A sense voltage equal to battery voltage?**	**Yes** GO to A6 . **No** VERIFY Battery Junction Box (BJB) fuse 17 (10A) is OK. If OK, REPAIR circuit SBB17 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A6 A SENSE CIRCUIT LOAD TEST	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** **NOTE:** This step puts a load on the A sense circuit. If there are corroded or loose connections, loading the circuit may help show the fault. A 250-350 mA incandescent 12-volt test lamp is required for this step. This circuit will not be	**Yes** GO to A7 . **No** REPAIR resistance due to corroded or loose connection on circuit SBB17 (RD). INSPECT generator C102A-3, circuit SBB17 (RD) for damage. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

loaded properly using an LED-style test lamp. • Using a 12-volt test lamp connected to ground, check for voltage at generator C102A-3, circuit SBB17 (RD), harness side.  N0105265 • **Does the test lamp illuminate?**	
A7 CHECK THE GENERATOR OUTPUT	
• Start the engine. • Increase engine rpm until generator starts to generate output. • With the engine running, measure battery voltage and record.  AJ0210-A • **Is the voltage above 14.5 volts?**	**Yes** INSTALL a new generator. REFER to Generator - 2.5L , Generator - 3.0L or Generator - 3.5L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A8 .
A8 MONITOR PCM PIDs GENERATOR COMMAND (GENCMD), GENERATOR MONITOR (GENMON) AND GENERATOR VOLTAGE DESGENVDSD)	
• Ignition OFF. • Connect a fused jumper wire between generator C102A-1, CDC15 (VT), harness side and generator C102A-2, circuit CDC10 (BU/OG), harness side.  N0074142 • Start the engine.	**Yes** GO to A9 . **No** INSTALL a new PCM. REFER to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L engines or Section 303-14C for 3.5L engines. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• Monitor the GENVDSD, GENMON and GENCMD PIDs. • Using the active command, set GENVDSD PID to 14 volts. • **Does the GENCMD PID read within 5% of GENMON PID?**	
A9 COMPARE PCM SUPPLY VOLTAGE (VPWR) PID TO BATTERY VOLTAGE	
• With the engine still running at idle, measure the battery voltage at the battery and monitor the PCM VPWR PID.  AJ0210-A • **Does PCM VPWR PID accurately display battery voltage within ±0.5 volt?**	**Yes** INSTALL a new generator. REFER to Generator - 2.5L , Generator - 3.0L or Generator - 3.5L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A10 .
A10 CHECK PCM SUPPLY VOLTAGE CIRCUITS	
• Ignition OFF. • Disconnect: Fused Jumper Wire. • Disconnect: PCM C175B (2.5L and 3.0L). • Disconnect: PCM C175E (3.5L). • For 2.5L and 3.0L vehicles, inspect the connector pins for damage. Measure resistance between BJB fuse 47 (15A), output side and: ♦ PCM C175B-51, circuit CBB47 (GN/BU), harness side. ♦ PCM C175B-52, circuit CBB47 (GN/BU), harness side. ♦ PCM C175B-53, circuit CBB47 (GN/BU), harness side.	**Yes** GO to A11 . **No** REPAIR high resistance or loose connections in the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0087306 • For 3.5L engines, measure the resistance between BJB Fuse 47 (15A) output side and: ♦ PCM C175E-67, circuit CBB46 (WH/BU) hness side. ♦ PCM C175E-68, circuit CBB46 (WH/BU) harness side.  N0102588 • **Are the resistances less than 0.5 ohm?**	
A11 CHECK FOR CORRECT PCM OPERATION	
• Ignition OFF. • Check the PCM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the PCM and generator, make sure the connectors seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L engines or Section 303-14C for 3.5L engines. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test B: System Voltage Low or Battery is Discharged

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the engine running, the charging system supplies voltage to the battery and the vehicle electrical system through the battery B+ cable. The PCM monitors this voltage through the battery positive post through the Battery Junction Box (BJB). If this voltage drops 1.5 volts or more below the generator voltage desired, this DTC will be set after 30 seconds.

- DTC P0562 (System Voltage Low) - If the PCM detects a voltage from the charging system that is 1.5 volts lower than the generator voltage desired, this DTC will be set.

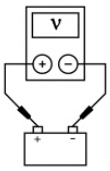
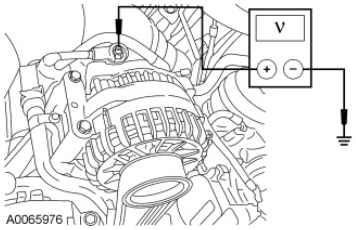
This pinpoint test is intended to diagnose the following:
- Fusible link
- Wiring, terminals or connectors
- Radial arm adapter
- Battery
- Generator
- PCM

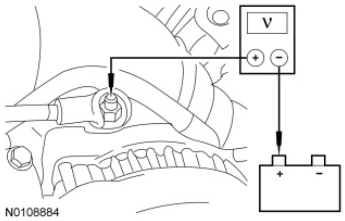
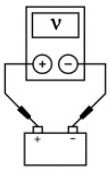
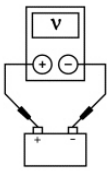
PINPOINT TEST B: SYSTEM VOLTAGE LOW OR BATTERY IS DISCHARGED

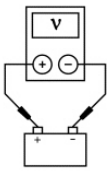
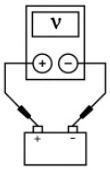
NOTE: Make sure battery voltage is greater than 12.2 volts prior to and during this pinpoint test.

NOTE: Do not have a battery charger attached during vehicle testing.

Test Step	Result / Action to Take
B1 CHECK FOR OTHER PCM DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - PCM. • **Is DTC P0620, P0625, P0626 or P065B present?**	**Yes** REFER to the DTC Chart in this section for the correct pinpoint test and DIAGNOSE those DTCs first. **No** GO to B2 .
B2 CHECK BATTERY CONDITION	
• Refer to Section 414-01 and carry out Pinpoint Test A: Battery Condition Test to determine if the battery can hold a charge and is OK for use. • **Does the battery pass the condition test?**	**Yes** GO to B3 . **No** INSTALL a new battery. REFER to Section 414-01 . TEST the system for normal operation.
B3 CHECK THE GENERATOR CONNECTIONS	

• Ignition OFF. • Inspect generator C102A connection. Connector should be installed correctly and tight. • Disconnect: Generator C102A. • Inspect generator C102A for bent and/or pushed-out pins. • Inspect generator C102B, B+ circuit SDC14 (RD) and radial arm adapter connection(s). Connection should be tight. • Measure the battery voltage.  AJ0210-A • Measure the voltage between generator C102B, B+ circuit SDC14 (RD) and ground.  A0065976 • **Are the generator C102B and radial arm adapter connections tight and does the generator B+ measure battery voltage?**	**Yes** GO to B4 . **No** TIGHTEN or INSTALL a new C102B (B+ nut) and/or radial arm adapter as needed. REFER to Specifications in this section. VERIFY the fusible link is OK. If the fusible link is OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B4 CHECK THE VOLTAGE DROP IN THE B+ CIRCUIT	
• Connect: Generator C102A. • Start the engine. • With the engine running at idle, headlamps on and blower on high, measure the voltage drop between generator B+ C102B, circuit SDC14 (RD) and the positive battery terminal.	**Yes** GO to B5 . **No** INSPECT circuit SDC14 (RD), radial arm adapter and the positive battery cable for loose connections, physical damage or wire corrosion. REPAIR as required. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0108884 • Carry out a wiggle test of the generator wiring and connections while measuring voltage drop. • **Is the voltage drop less than 0.5 volt?**	
B5 COMPARE PCM MODULE SUPPLY VOLTAGE (VPWR) PID	
• With the engine still running at idle, headlamps on and blower on high, measure the battery voltage at the battery and monitor the PCM VPWR PID.  AJ0210-A • **Does PCM VPWR PID display battery voltage within ±0.5 volt?**	**Yes** GO to B6 . **No** REPAIR high resistance or loose connections in the affected PCM power circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B6 CHECK PCM GROUND FOR HIGH RESISTANCE	
• Monitor PCM VPWR PID. • With the engine still running at idle, turn off all accessory loads, measure the battery voltage at the battery and note the PCM VPWR PID.  AJ0210-A • With the engine still running at idle, turn headlamps on and blower on high, measure the battery voltage at the battery and monitor the PCM VPWR PID.	**Yes b> GO to B7 .** **No** **REPAIR the affected PCM ground circuits. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.**

 AJ0210-A • **Does the VPWR PID read within ±0.5 volt with accessory loads on as compared to accessory loads off?**	
B7 MONITOR PID VPWR AT WOT	
• With the engine still running at idle, turn off all accessory loads, measure the battery voltage at the battery and monitor the PCM VPWR PID.  AJ0210-A • Monitor the VPWR PID and momentarily accelerate the engine to Wide Open Throttle (WOT) and release. Repeat this step 4-5 times while continuing to monitor the VPWR PID. • **Does the VPWR PID stay within 0.5 volt of battery voltage when the engine rpms are increased?**	**Yes** GO to B8 . **No** INSTALL a new PCM. REFER to Section 303-14A for 2.5L, Section 303-14B for 3.0L and Section 303-14C for 3.5L engines.
B8 CHECK FOR DISCHARGED BATTERY	
• With the engine still running at idle, measure the battery voltage at the battery. • Monitor PCM PIDs generator voltage desired (GENVDSD) and generator monitor (GENMON). • **Does GENMON PID frequently rise above 90% and battery voltage drop below GENVDSD PID by 0.5 volt or more?**	**Yes** CARRY OUT the Component Test, Battery - Drain Test. REFER to Section 414-01 . **No** VERIFY BJB fuse 17 (10A) is OK. If OK, REPAIR circuit SBB17 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test C: DTC P0620

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The PCM monitors the generator output via the GENMON circuit. The PCM uses the GENCOM circuit to command the generator to either increase or decrease output. If the GENCOM circuit (generator control circuit) or the A sense circuit are open or shorted to ground, the PCM will be unable to control the generator output. When the engine speed rises above approximately 2,000 rpm, the generator will default to a steady voltage output of approximately 13.5 volts and the PCM will send a request to the Instrument Cluster (IC) to illuminate the charging system warning indicator. A GENCOM circuit fault can be confirmed by viewing the PCM PID generator command line fault (GENCMD_LF) (YES status indicator fault).

- DTC P0620 (Generator Control Circuit) - If the GENCOM circuit or A sense circuit are open or shorted to ground, the PCM will set this DTC.

This pinpoint test is intended to diagnose the following:

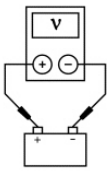
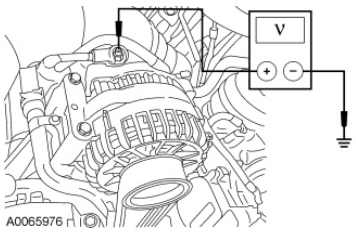
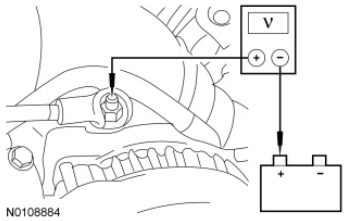
- Fuse
- Wiring, terminals or connectors
- Radial arm adapter
- Generator
- PCM

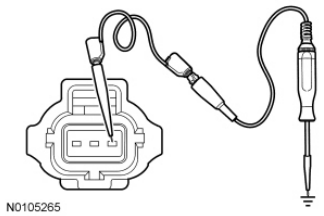
PINPOINT TEST C: DTC P0620

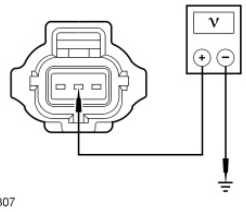
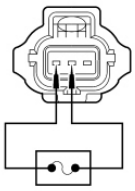
NOTE: Make sure battery voltage is greater than 12.2 volts prior to and during this pinpoint test.

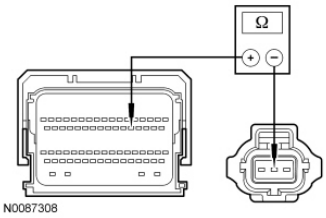
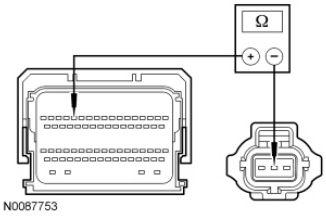
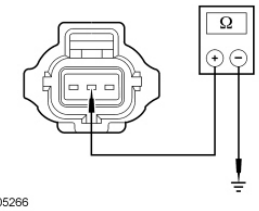
NOTE: Do not have a battery charger attached during vehicle testing.

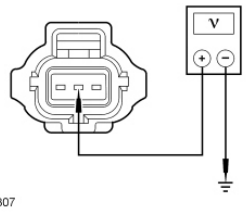
Test Step	Result / Action to Take
C1 CHECK THE BATTERY CONDITION	
• Refer to Section 414-01 and carry out Pinpoint Test A: Battery Condition Test to determine if the battery can hold a charge and is OK for use. • **Does the battery pass the condition test?**	**Yes** GO to C2 . br> **No** INSTALL a new battery. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C2 CHECK THE GENERATOR CONNECTIONS	
• Ignition OFF. • Inspect generator C102A connection. Connector should be installed correctly and tight. • Disconnect: Generator C102A. • Inspect generator C102A for bent and/or pushed-out pins. • Inspect generator C102B, B+ circuit SDC14 (RD) and radial arm connection(s). Connection should be tight. • Measure the battery voltage.	**Yes** GO to C3 . **No** TIGHTEN or INSTALL a new C102B (B+ nut) and/or radial arm adapter as needed. REFER to Specifications in this section. VERIFY the fusible link is OK. If the fusible link is OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal

 AJ0210-A • Measure the voltage between generator C102B, B+ circuit SDC14 (RD) and ground.  A0065976 • **Are the generator C102B and radial arm adapter connections tight and does the generator B+ measure battery voltage?**	operation.
C3 CHECK THE VOLTAGE DROP IN THE B+ CIRCUIT	
• Connect: Generator C102A. • Start the engine. • With the engine running at idle, headlamps on and blower on high, measure the voltage drop between generator B+ C102B, circuit SDC14 (RD) and the positive battery terminal.  N0108884 • Carry out a wiggle test of the generator wiring and connections while measuring voltage drop. • **Is the voltage drop less than 0.5 volt?**	**Yes** GO to C4 . **No** INSPECT circuit SDC14 (RD), radial arm adapter and the positive battery cable for loose connections, physical damage or wire corrosion. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C4 A SENSE CIRCUIT LOAD TEST	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe**	**Yes** GO to C5 . **No** VERIFY Battery Junction Box (BJB) fuse 17 (10A) is OK. If OK, REPAIR circuit SBB17 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible

directly on any connector. **NOTE:** This step puts a load on the A sense circuit. If there are corroded or loose connections, loading the circuit may help show the fault. A 250-350 mA incandescent 12-volt test lamp is required for this step. This circuit will not be loaded properly using an LED-style test lamp. • Ignition OFF. • Disconnect: Generator C102A. • Ignition ON. • Using a 12-volt test lamp connected to ground, check for voltage at generator C102A-3, circuit SBB17 (RD), harness side.  N0105265 • **Does the test lamp illuminate?**	causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C5 CHECK THE GENERATOR COMMAND LINE FAULT (GENCMD_LF) PID	
• Ignition OFF. • Connect: Generator C102A. • Start the engine. • **NOTE:** Many of the PCM PIDs selected will be monitored later in this pinpoint test. • Select and monitor the following PCM PIDs: ♦ Generator Monitor (GENMON) ♦ Generator Command (GENCMD) ♦ Generator Command Line Fault (GENCMD_LF) • With the engine running at idle, monitor the GENCMD_LF PID. • **Does the GENMON_LF PID indicate FAULT?**	**Yes** GO to C6 . **No** GO to C9 .
C6 CHECK THE GENERATOR COMMAND CIRCUIT FOR A SHORT TO POWER	
• Ignition OFF. • Disconnect: Generator C102A. • Ignition ON. • Measure the voltage between generator C102A-2, circuit CDC10 (BU/OG), harness side and ground.	**Yes** GO to C7 . **No** GO to C11 .

 N0087307 • **Does voltage read 1 volt or less?**	
C7 COMPARE THE PCM PIDs GENERATOR MONITOR (GENMON) AND GENERATOR COMMAND (GENCMD)	
• Ignition OFF. • Connect a fused jumper wire between generator C102A-1, circuit CDC15 (VT), harness side and generator C102A-2, circuit CDC10 (BU/OG), harness side.  N0074142 • Start the engine. • Monitor the GENMON and GENCMD PIDs while performing a wiggle test on the generator harness. • **Does the GENMON PID read within 5% of the GENCMD PID?**	**Yes** GO to C8 . **No** GO to C12 .
C8 CHECK THE GENERATOR COMMAND CIRCUIT FOR DAMAGE OR AN OPEN	
• Ignition OFF. • Disconnect: Fused Jumper Wire. • Disconnect: PCM C175B (2.5L or 3.0L). • Disconnect: PCM C175E (3.5L). • Inspect the following harness connectors for damaged or pushed-out pins: ♦ PCM C175B-53, circuit CDC10 (BU/OG) (2.5L or 3.0L) ♦ PCM C175E-13, circuit CDC10 (BU/OG) (3.5L) ♦ Generator C102B-2, circuit CDC10 (BU/OG) • For 2.5L or 3.0L engines, measure the resistance between PCM C175B-53, circuit CDC10 (BU/OG), harness side and generator C102A-2, circuit CDC10 (BU/OG, harness side.	**Yes** GO to C9 . **No** REPAIR circuit CDC10 (BU/OG). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0087308 • For 3.5L engines, measure the resistance between PCM C175E-13, circuit CDC10 (BU/OG), harness side and generator C102A-2, circuit CDC10 (BU/OG) harness side.  N0087753 • **Are the connectors and pins free of damage and is the resistance less than 5 ohms?**	
C9 CHECK THE GENERATOR COMMAND CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Generator C102A (if not previously disconnected). • Disconnect: PCM C175B (2.5L or 3.0L). • Disconnect: PCM C175E (3.5L). • Measure the resistance between the generator C102A-2, circuit CDC10 (BU/OG), harness side and ground.  N0105266 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C10 . **No** REPAIR circuit CDC10 (BU/OG). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C10 CHECK THE CHARGING SYSTEM CIRCUITS FOR INTERMITTENT FAULTS	
• Connect: Generator C102A. • Connect: PCM C175B (2.5L or 3.0L). • Connect: PCM C175E (3.5L). • Ignition ON. • Clear all DTCs.	**Yes** INSTALL a new generator. REFER to Generator - 2.5L , Generator - 3.0L or Generator - 3.5L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• Start the engine and let the engine run for 5 minutes. • Retrieve Continuous Memory Diagnostic Trouble Codes (CMDTCs) from all modules. • **Did any charging system DTC get stored into memory?**	**No** The fault is not present at this time. This may indicate an intermittent fault. CARRY OUT a wiggle test on the charging system circuits to try and RECREATE the concern. CHECK generator connections for corrosion, loose connections and/or bent terminals. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C11 CHECK THE GENERATOR COMMAND AND PCM FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PCM C175B (2.5L or 3.0L). • Disconnect: PCM C175E (3.5L). • Ignition ON. • Measure the voltage between generator C102A-2, circuit CDC10 (BU/OG), harness side and ground.  N0087307 • **Does voltage read 0 volt?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L engines or Section 303-14C for 3.5L engines. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR circuit CDC10 (BU/OG). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C12 INSPECT GENERATOR CONNECTORS AND CIRCUITS	
• Ignition OFF. • Disconnect: PCM C175B. • Inspect the following connector pins for damage and/or corrosion: ♦ PCM C175B-66, circuit GD113 (BK/YE) ♦ Generator C102A-1, circuit CDC15 (VT) ♦ Generator C102A-2, circuit CDC10 (BU/OG) • **Are the connectors and circuits OK?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L engines or Section 303-14C for 3.5L engines. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR high resistance or loose connections in the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test D: DTC P0625 or P0626

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The PCM monitors the generator output via the GENMON circuit (generator field terminal circuit). If the PCM cannot read the GENMON circuit due to an open or short to ground, when the engine rises above approximately 2,000 rpm, the generator will default to a steady voltage of approximately 13.5 volts and the PCM will send a request to the Instrument Cluster (IC) to illuminate the charging system warning indicator. A GENMON duty cycle of 3% or less indicates a short to ground fault is present and will result in DTC P0625 setting in the PCM. A GENMON duty cycle of 98% or more indicates an open or short to voltage fault is present and will result in DTC P0626 setting in the PCM.

- DTC P0625 (Generator Field Terminal Circuit Low) - If the GENMON circuit is shorted to ground, the A sense circuit is open or the B+ circuit is open, the PCM will set this DTC. This DTC can also be set by a faulted PCM or generator.
- DTC P0626 (Generator Field Terminal Circuit High) - If the GENMON circuit is open or shorted to power, the PCM will set this DTC. This DTC can also be set by a faulted PCM or generator.

This pinpoint test is intended to diagnose the following:

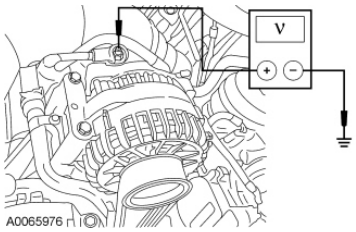
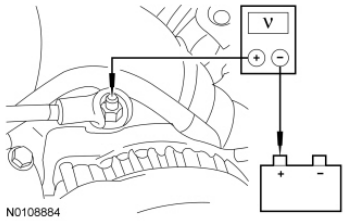
- Fuse
- Wiring, terminals or connectors
- Radial arm adapter
- Engine, generator and battery grounds
- Battery
- Generator
- PCM

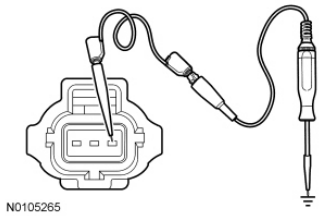
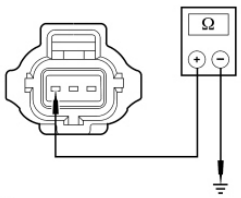
PINPOINT TEST D: DTC P0625 OR P0626

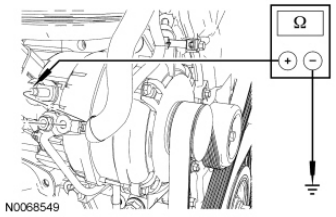
NOTE: Make sure battery voltage is greater than 12.2 volts prior to and during this pinpoint test.

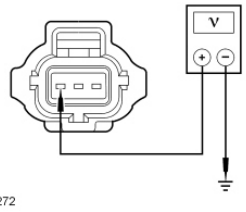
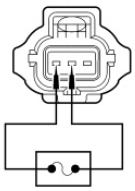
NOTE: Do not have a battery charger attached during vehicle testing.

Test Step	Result / Action to Take
D1 CHECK THE BATTERY CONDITION	
• Refer to Section 414-01 and carry out Pinpoint Test A: Battery Condition Test to determine if the battery can hold a charge and is OK for use. • **Does the battery pass the condition test?**	**Yes** GO to D2 . **No** INSTALL a new battery. REFER to Section 414-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D2 CHECK THE GENERATOR B+ CONNECTION	
• Ignition OFF. • Inspect generator C102B, circuit SDC14 (RD), harness side. Connection should be tight. • Inspect generator radial adapter connection on rear of generator. Connection should be tight. • Measure the voltage between generator C102B, circuit SDC14 (RD) and ground.	**Yes** GO to D3 . **No** TIGHTEN or INSTALL a new C102B (B+ nut) and/or radial arm adapter as needed. REFER to Specifications in this section. VERIFY the fusible link is OK. If the fusible link is OK, REPAIR circuit SDC14 (RD). If

 • **Are the generator C102B and radial arm adapter connections tight and does the generator B+ measure battery voltage?**	not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D3 CHECK THE VOLTAGE DROP IN THE B+ CIRCUIT	
• Start the engine. • With the engine running at idle, headlamps on and blower on high, measure the voltage drop between generator B+ C102B, circuit SDC14 (RD) and the positive battery terminal.  • Carry out a wiggle test of the generator wiring and connections while measuring voltage drop. • **Is the voltage drop less than 0.5 volt?**	**Yes** For DTC P0625, GO to D4 . For DTC P0626, GO to D6 . **No** INSPECT circuit SDC14 (RD), radial arm adapter and the positive battery cable for loose connections, physical damage or wire corrosion. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D4 A SENSE CIRCUIT LOAD TEST	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** **NOTE:** This step puts a load on the A sense circuit. If there are corroded or loose connections, loading the circuit may help show the fault. A 250-350 mA incandescent 12-volt test lamp is required for this step. This circuit will not be loaded properly using an LED-style test lamp. • Ignition OFF. • Disconnect: Generator C102A .	**Yes** GO to D5 . **No** VERIFY Battery Junction Box (BJB) fuse 17 (10A) is OK. If OK, REPAIR circuit SBB17 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• Ignition ON. • Using a 12-volt test lamp connected to ground, check for voltage at C102A-3, circuit SBB17 (RD), harness side.  N0105265 • **Does the test lamp illuminate?**	
D5 CHECK CIRCUIT CDC15 (VT) FOR DAMAGE OR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: PCM C175B (2.5L or 3.0L). • Disconnect: PCM C175E (3.5L). • Inspect the following harness connectors for damaged or pushed-out pins: ♦ PCM C175B-14, circuit CDC15 (VT) (2.5L or 3.0L) ♦ PCM C175E-26, circuit CDC15 (VT) (3.5L) ♦ Generator C102A-1, circuit CDC15 (VT) • Measure the resistance between generator C102A-1, circuit CDC15 (VT), harness side and ground.  N0105271 • **Are the connectors and pins free of damage and is the resistance greater than 10,000 ohms?**	**Yes** GO to D10 . **No** REPAIR the connector(s) and/or circuit CDC15 (VT). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D6 CHECK THE GENERATOR B+ RESISTANCE	
• Ignition OFF. • **NOTE:** Failure to disconnect the battery will result in false resistance readings. • Disconnect the battery. Refer to Section 414-01 . • Disconnect: Generator C102B. • Measure the resistance between generator C102B, component side and the generator	**Yes** GO to D7 . **No** INSTALL a new generator. REFER to Generator - 2.5L , Generator - 3.0L or Generator - 3.5L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the

housing.  • **Is the resistance greater than 25K ohms?**	system for normal operation.
D7 CHECK THE RESISTANCE OF THE VOLTAGE REGULATOR INTERNAL CIRCUITS TO GROUND	
• Disconnect: Generator C102A. • Measure the resistance between generator C102A, component side and ground. Refer to the following table. **Pin** / **Expected Resistance** 1 / Greater than 10K ohms 2 / Greater than 10K ohms 3 / Greater than 10K ohms • **Are the resistance values as indicated?**	D8 . **No** INSTALL a new generator. REFER to Generator - 2.5L , Generator - 3.0L or Generator - 3.5L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D8 CHECK CIRCUIT CDC15 (VT) FOR DAMAGE OR AN OPEN	
• Ignition OFF. • Disconnect: PCM C175B (2.5L or 3.0L). • Disconnect: PCM C175E (3.5L). • Inspect the following harness connectors for damaged or pushed-out pins: ♦ PCM C175B-14 (2.5L or 3.0L), circuit CDC15 (VT) ♦ PCM C175E-26 (3.5L), circuit CDC15 (VT) ♦ Generator C102A-1, cirDC15 (VT) • For 2.5L or 3.0L engines, measure the resistance between PCM C175B-14, circuit CDC15 (VT), harness side and generator C102A-1, circuit CDC15 (VT), harness side. • For 3.5L engines, measure the resistance between PCM C175E-26, circuit CDC15 (VT), harness side and generator C102A-1, circuit CDC15 (VT), harness side. • **Are the connectors and pins free of damage and is the resistance less than 5 ohms?**	**Yes** GO to D9 . **No** REPAIR the connector(s) and/or circuit CDC15 (VT). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

D9 CHECK CIRCUIT CDC15 (VT) FOR A SHORT TO POWER	
• Connect the battery. Refer to Section 414-01 . • Ignition ON. • Measure the voltage between generator C102A-1, circuit CDC15 (VT), harness side and ground.  N0105272 • **Is there any voltage present?**	**Yes** REPAIR the connector(s) and/or circuit CDC15 (VT). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to D10 .
D10 COMPARE THE PCM PIDs GENERATOR MONITOR (GENMON) AND GENERATOR COMMAND (GENCMD)	
• Ignition OFF. • Connect: PCM C175B (2.5L or 3.0L). • Connect: PCM C175E (3.5L). • Connect a fused jumper wire between generator C102A-1, circuit CDC15 (VT), harness side and generator C102A-2, circuit CDC10 (BU/OG), harness side.  N0074142 • Start the engine. • Using the active command, set the GENVDSD PID to 14.0 volts. • Monitor the GENMON and GENCMD PIDs while carrying out a wiggle test on the generator wiring harness. • **Does the GENMON PID read within 2% of the GENCMD PID?**	**Yes** INSTALL a new generator. REFER to Generator - 2.5L , Generator - 3.0L or Generator - 3.5L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to D11 .
D11 CHECK FOR CORRECT PCM OPERATION	
• Ignition OFF. • Disconnect: Fused Jumper Wire. • Check the PCM harness, generator harness, PCM component side and generator component side	**Yes** INSTALL a new PCM. REFER to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L engines or Section 303-14C for 3.5L engines. CLEAR the DTCs. REPEAT the

connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the PCM and/or generator connectors. Make sure the connectors seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test E: DTC P065B

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the engine running, the PCM expects to receive a valid generator monitor (GENMON) signal with a duty cycle greater than 5% and less than 98%. The PCM also monitors the state of the generator command (GENCMD) signal line to make sure it is not stuck high or stuck low. If the GENMON or GENCMD signal fluctuates between out-of-valid range, or stuck high, or stuck low, or some combination and normal, a DTC will be set. When engine speed rises above approximately 2,000 rpm, the generator will default to a steady voltage of approximately 13.5 volts and the PCM will send a request to the Instrument Cluster (IC) to illuminate the charging system warning indicator lamp.

- DTC P065B (Generator Control Circuit Range/Performance) - If the input frequency was continuously less than 80 Hz or more than 200 Hz the PCM will set this DTC. Additionally, if the signal shows a faulted condition that is happening in a fluctuating manner, the PCM will track the fluctuations between faulted and normal conditions. If the fluctuations occur frequently within a short amount of time, this DTC will also be set.

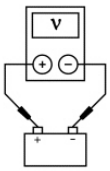
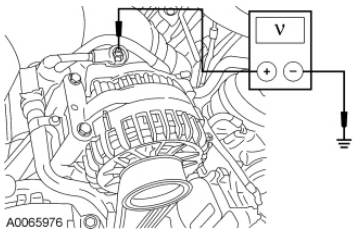
This pinpoint test is intended to diagnose the following:
- Wiring, terminals or connectors
- Radial arm adapter
- Generator
- PCM

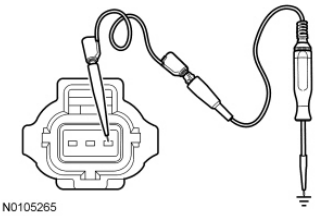
PINPOINT TEST E: DTC P065B

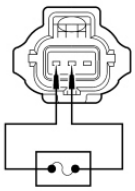
NOTE: Make sure battery voltage is greater than 12.2 volts prior to carrying out this pinpoint test.

NOTE: Do not have a battery charger attached during vehicle testing.

Test Step	Resul/ Action to Take
E1 CHECK THE BATTERY CONDITION	
• Refer to Section 414-01 and carry out Pinpoint Test A: Battery Condition Test to determine if the battery can hold a charge and is OK for use. • **Does the battery pass the condition test?**	**Yes** GO to E2 . **No** INSTALL a new battery. REFER to Section 414-01 . CLEAR the DTCs.

	REPEAT the self-test. TEST the system for normal operation.
E2 CHECK THE GENERATOR CONNECTIONS	
• Ignition OFF. • Inspect generator C102A connection. Connector should be installed correctly and tight. • Disconnect: Generator C102A. • Inspect generator C102A for bent and/or pushed-out pins. • Inspect generator C102B, B+ circuit SDC14 (RD) and radial arm connection(s). Connection should be tight. • Measure the battery voltage.  AJ0210-A • Measure the voltage between generator C102B, B+ circuit SDC14 (RD) and ground.  A0065976 • **Are the generator C102B and radial arm adapter connections tight and does the generator B+ measure battery voltage?**	**Yes** GO to E3 . **No** TIGHTEN or INSTALL a new C102B (B+ nut) and/or radial arm adapter as needed. REFER to Specifications in this section. VERIFY the fusible link is OK. If the fusible link is OK, REPAIR circuit SDC14 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E3 A SENSE CIRCUIT LOAD TEST	
NOTICE: **The following step uses a test light to simulate normal circuit loads. Use only the test light recommended in the Special Tools table at the beginning of this section. To avoid connector terminal damage, use the Flex Probe Kit for the test light probe connection to the vehicle. Do not use the test light probe directly on any connector.** **NOTE:** This step puts a load on the A sense circuit. If there are corroded or loose connections, loading the circuit may help show the fault. A 250-350 mA incandescent 12-volt test lamp is required for this step. This circuit will not be loaded properly using an LED-style test lamp.	**Yes** GO to E4 . **No** VERIFY Battery Junction Box (BJB) fuse 17 (10A) is OK. If OK, REPAIR circuit SBB17 (RD). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• Ignition ON. • Using a 12-volt test lamp connected to ground, check for voltage at C102A-3, circuit SBB17 (RD), harness side.  N0105265 • **Does the test lamp illuminate?**	
E4 CHECK THE PCM GENERATOR MONITOR FREQUENCY (GENMON_HZ) PID	
• Ignition OFF. • Connect: Generator C102A. • Start the engine. • **NOTE:** Many of the PCM PIDs selected will be monitored later in this pinpoint test. • Select and monitor the following PCM PIDs: ♦ Generator Voltage Desired (GENVDSD) ♦ Generator Monitor Frequency (GENMON_HZ) • Monitor the GENMON_HZ PID. • **Does the PID read between 80-200 Hz?**	**Yes** GO to E8 . **No** GO to E5 .
E5 CHECK THE PCM GENERATOR MONITOR FREQUENCY (GENMON_HZ) PID WITH GENERATOR C102A DISCONNECTED	
• Ignition OFF. • Disconnect: Generator C102A. • Start the engine. • Monitor the GENMON_HZ PID. • **Does the PID read between 0-2 Hz?**	**Yes** GO to E7 . **No** GO to E6 .
E6 CHECK GENERATOR CIRCUITRY	
• Ignition OFF. • ***NOTICE:*** **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool specified in the tool list in this section. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while making sure that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors and subsequent electrical faults.**	**Yes** INSPECT the harness for wire to wire shorts or insulation chaffing, mis-pinned connectors and correct wire colors and REPAIR generator circuit CDC15 (VT) as needed. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new PCM. REFER to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L engines or Section 303-14C for 3.5L engines.

• With PCM C175B (2.5L or 3.0L) or C175E (3.5L) connected, connect a fused jumper wire between PCM C175B-14 (2.5L or 3.0L) or C175E-26 (3.5L), circuit CDC15 (VT) and ground by carefully back probing the connector. • Start the engine. • Monitor the GENMON_HZ PID. • **Does the PID read 0 Hz?**	CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E7 MONITOR THE PCM PID GENERATOR MONITOR FREQUENCY (GENMON_HZ) WHILE ACTIVATING THE GENERATOR VOLTAGE DESIRED (GENVDSD) PID	
• Ignition OFF. • Connect a fused jumper wire between generator C102A-1, circuit CDC15 (VT), harness side and generator C102A-2, circuit CDC10 (BU/OG), harness side.  N0074142 • Start the engine. • With the engine running at idle, set the active command GENVDSD PID to 14 volts. • Monitor the GENMON_HZ PID. • **Does the GENMON_HZ PID read between 120-130 Hz?**	**Yes** INSTALL a new generator. REFER to Generator - 2.5L , Generator - 3.0L or Generator - 3.5L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new PCM. REFER to Section 303-14A for 2.5L engines, Section 303-14B for 3.0L engines or Section 303-14C for 3.5L engines. CLEAR the DTCs. REPEAT the self-test. TEST them for normal operation.
E8 CHECK THE PCM GENERATOR COMMAND LINE FAULT (GENCMD_LF) PID	
• With the engine running and all selectable loads OFF, monitor the PCM PID GENCMD_LF. • **Does the PCM PID GENCMD_LF fluctuate from YES FAULT to NO FAULT?**	**Yes** INSTALL a new generator. REFER to Generator - 2.5L , Generator - 3.0L or Generator - 3.5L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The fault is not present at this time. This may indicate an intermittent fault. CARRY OUT a wiggle test on the charging system circuits to try and RECREATE the concern. CHECK generator connections for corrosion, loose connections and/or bent terminals. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test F: The Generator is Noisy

Ro Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The generator is belt-driven by the engine accessory drive system. There are several sources of generator noise which include: bearing noise, electrical fault noise, generator or belt pulley misalignment. A generator with certain types of diode or stator failures may also produce an audible noise.

This pinpoint test is intended to diagnose the following:

- Accessory drive belt
- Loose bolts/brackets
- Generator/pulley

PINPOINT TEST F: THE GENERATOR IS NOISY

Test Step	Result / Action to Take
F1 CHECK FOR ACCESSORY DRIVE BELT NOISE AND LOOSE MOUNTING BRACKETS	
• Ignition OFF. • Check the accessory drive belt and tensioner for damage and correct installation. Refer to the appropriate section in Group 303 for the procedure.. • Check the accessory mounting brackets and generator pulley for looseness or misalignment. • **Is the accessory drive OK?**	**Yes** GO to F2 . **No** REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. for diagnosis and testing of the accessory drive system. TEST the system for normal operation.
F2 CHECK THE GENERATOR MOUNTING	
• Check the generator mounting for loose bolts or misalignment. • **Is the generator mounted correctly?**	**Yes** GO to F3 . **No** REPAIR as necessary. TEST the system for normal operation.
F3 CHECK THE GENERATOR FOR NOISE	
• With the engine running, use a stethoscope or equivalent listening device to probe the generator and the accessory drive area for unusual mechanical noise. • **Is the generator the noise source?**	**Yes** INSTALL a new generator. REFER to Generator - 2.5L , Generator - 3.0L or Generator - 3.5L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No**

	REFER to Section 303-00 to diagnose the source of the engine noise.

Pinpoint Test G: Radio Interference

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The generator radio suppression equipment reduces interference transmitted through the speakers by the vehicle electrical system.

This pinpoint test is intended to diagnose the following:

- Generator
- Wiring, terminals or connectors
- In-vehicle entertainment system

PINPOINT TEST G: RADIO INTERFERENCE

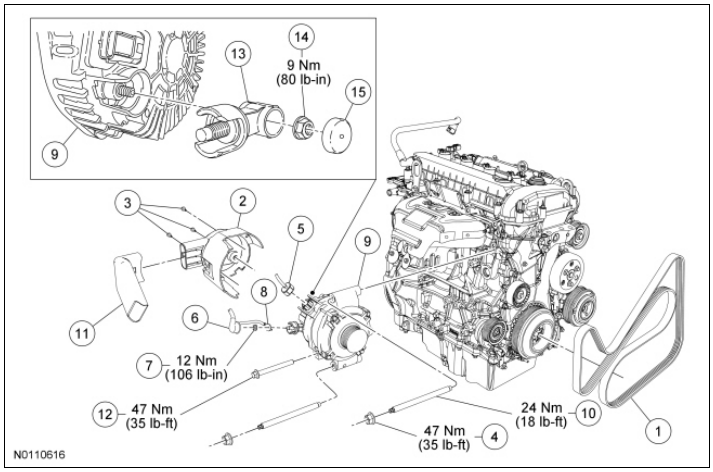
NOTE: If the OEM audio unit has been replaced with an aftermarket unit, the vehicle may not pass this test. Return the vehicle to OEM condition before following this pinpoint test.

NOTE: If the engine is operated at greater than 2,000 rpm momentarily, the generator will self-excite. Make sure when the generator is disconnected the engine rpm stays below 2,000 rpm. If it does rise above 2,000 rpm, turn the ignition to the off position and start the test over again.

NOTE: Inspect for any after market accessories that have been added to the vehicle. Check the wiring for these accessories and be sure they have not been attached to the generator circuits and are positioned away from the generator wiring.

Test Step	Result / Action to Take
G1 VERIFY THE GENERATOR IS THE SOURCE OF THE RADIO INTERFERENCE	
• Start the engine and allow the engine to idle. • Tune the audio unit to a station where the interference is present. • Ignition OFF. • Disconnect: Generator C102B. • Start the engine and allow the engine to idle, determine if the interference is still present. • **Is the interference present with the generator disconnected?**	**Yes** REFER to Section 415-00 for diagnosis and testing of the in-vehicle entertainment system. **No** INSTALL a new generator. REFER to Generator - 2.5L , Generator - 3.0L or Generator - 3.5L in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Generator - 2.5L



Item	Part Number	Description
1	8620	Front End Accessory Drive (FEAD) belt
2	10C392	Generator upper air duct
3	W500004	Generator upper air duct screws (3 required)
4	W520414	Generator stud nut (2 required)
5	-	Generator electrical connector (part of 12B637)
6	-	B+ protective cover (part of 14A280)
7	W705790-S	Generator B+ terminal nut
8	-	Generator B+ cable (part of 14A280)
9	10300	Generator
10	W709489	Generator stud (2 required)
11	10C392	Generator lower air duct
12	W500130	Generator bolt
13	10329	Radial arm adapter
14	-	Radial arm adapter nut (part of 10329)
15	-	Radial arm adapter cap (part of 10329)

Removal

NOTICE: **Do not allow any metal object to come i the generator housing and internal diode cooling fins. A short circuit may result and burn out the diodes. Failure to follow this instruction may result in component damage.**

NOTE: The radial arm adapter is a serviceable item. Do not replace the generator if the radial arm adapter is the only concern.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Disconnect the battery. For additional information, refer to Section 414-01 .

3. Remove the 4 RH lower splash shield screws.
4. Remove the 6 pushpins and the RH lower splash shield.
5. Rotate the Front End Accessory Drive (FEAD) belt tensioner clockwise and position the accessory drive belt aside.
6. Working from the top of the vehicle, press the locking tab to release the generator lower air duct from the generator and remove the lower air duct.
7. Remove the battery harness locator from the lower generator stud bolt.
8. Remove the lower generator bolt.
9. Remove the 2 generator stud nuts.
10. Position the generator B+ protective cover aside and remove the generator B+ terminal nut.
11. Position the generator B+ cable aside.
12. Disconnect the generator electrical connector.
13. Remove the 2 generator studs and remove the generator.
14. Remove the 3 screws and the generator upper air duct.

Installation

1. Position the generator upper air duct and install the 3 screws.
    - Tighten to 4 Nm (35 lb-in).
2. Working from the top of the vehicle, position the generator and install the generator upper stud hand-tight.
3. Install the generator lower stud hand-tight.
4. Install the generator B+ cable and install the generator B+ terminal nut.
    - Tighten to 12 Nm (106 lb-in).
5. Connect the generator electrical connector.
6. Position the generator B+ protective cover on the B+ terminal.
7. Working from under the vehicle, install the lower generator bolt hand-tight.
8. Working from the top of the vehicle, tighten the 2 generator studs to 24 Nm (18 lb-ft).
9. Tighten the 2 generator stud nuts to 47 Nm (35 lb-ft).
10. Tighten the generator bolt to 47 Nm (35 lb-ft).
11. Push the lower air duct onto the upper air duct until the locking tab is engaged.
12. Position the RH lower splash shield and install the 6 pushpins.

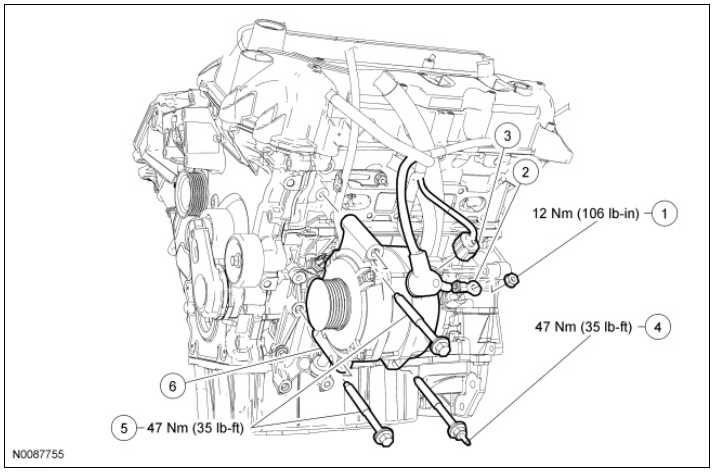
13. Position the RH wheel splash shield and install the 4 screws.
    - Tighten to 8 Nm (71 lb-in).

14. Position the harness locator on the generator stud.

15. Connect the battery. For additional information, refer to Section 414-01 .

16. Rotate the FEAD belt tensioner clockwise and position the accessory drive belt on the pulley.

Generator - 3.0L



Item	Part Number	Description
1	W706414	Generator B+ terminal nut
2	-	Generator B+ terminal (part of 14B060)
3	-	Generator electrical connector (part of 12B637)
4	W707669	Generator stud bolt
5	W704747	Generator bolts (2 required)
6	10300	Generator

Removal and Installation

1. Remove the A/C compressor. For additional information, refer to Section 412-01 .

2. Disconnect the battery. For additional information, refer to Section 414-01 .

start="3">
- Position the generator protective cover aside, remove the nut and position the generator B+ terminal aside.
    - To install, tighten to 12 Nm (106 lb-in).

4. Disconnect the generator electrical connector.

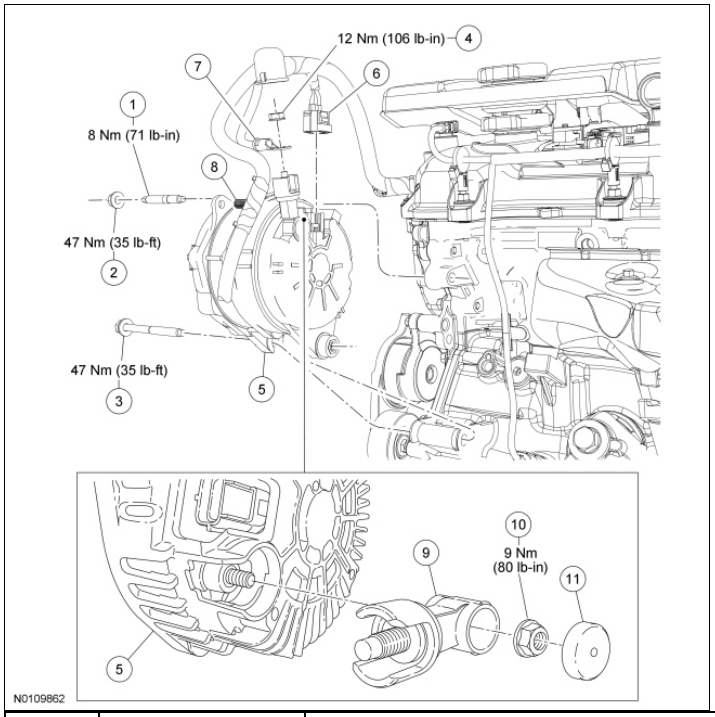
5. Remove the 3 bolts and the generator.
    - To install, tighten to 47 Nm (35 lb-ft).

6. To install, reverse the removal procedure.

Generator - 3.5L

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



Item	Part Number	Description
1	W712609	Generator stud
2	W520414	Generator stud nut
3	W709986	Generator bolt
4	W706414	Generator B+ terminal nut
5	10300	Generator
6	-	Generator electrical connector (part of 14B060)
7	-	Generator B+ terminal (part of 14B060)
8	-	Pin-type retainer, wiring harness
9	10329	Radial arm adapter
10	-	Radial arm adapter nut (part of 10329)
11	-	Radial arm adapter cap (part of 10329)

Removal and Installation

NOTE: The radial arm adapter is em. Do not replace the generator if the radial arm adapter is the only concern.

1. Remove the A/C compressor. For additional information, refer to Section 412-01 .

2. Disconnect the battery. For additional information, refer to Section 414-01 .

3. Position the generator protective cover aside, remove the nut and position the generator B+ terminal aside.
    - To install, tighten to 12 Nm (106 lb-in).

4. Disconnect the generator electrical connector.
    - Detach the pin-type retainer and wiring harness.

5. Remove the oil filter.
    - Lubricate the oil filter seal with clean engine oil before installation.

6. Position the engine wiring harness aside.

7. Remove the generator stud nut.
    - To install, tighten to 47 Nm (35 lb-ft).

8. Remove the generator bolt and the generator.

9. To install, reverse the removal procedure.

General Specifications

Item	Specification
Battery	
Cold Cranking Amps (CCA) measured at -18°C (0°F)	390 CCA - 2.5L hybrid vehicles 500 CCA - All other vehicles
Voltage	12 volts

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery cable body ground terminal bolt	12	-	106
Battery cable starter motor B+ terminal nut	12	-	106
Battery cable terminal nuts	7	-	62
Battery cable transaxle ground terminal bolt/nut	17	-	150
Battery hold-down bracket bolt/nut	10	-	89
Battery Junction Box (BJB) cable terminal nut	9	-	80
Battery tray bolt/nut	9	80	
Generator B+ terminal nut	12	-	106
Starter motor solenoid wire terminal nut	5	-	44
Tie-rod end nut	48	35	-

Battery and Cables

Vehicles are equipped with a 12-volt, maintenance-free battery.

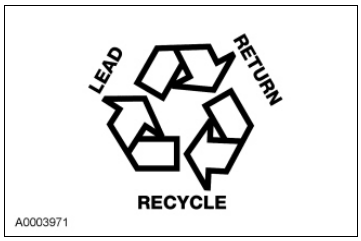
The battery and cable system consists of the following components:

- Battery
- Battery cable assembly
- Battery tray

The battery is a 12V DC source connected in a negative ground system. The battery case is sealed with 2 vent holes to release gases. The battery has 3 major functions:

- Engine cranking power source
- Voltage stabilizer for the electrical system
- Temporary power source when electrical loads exceed the generator output current

Ford Motor Company strongly recommends that lead-acid batteries be returned to an authorized recycling facility for disposal.



Principles of Operation

Battery Eye Operation

The battery eye indicates the state-of-charge of the battery by responding to the specific gravity of a single battery cell electrolyte. The battery eye has a viewing plate, 2 colored balls of different specific gravity and a small passage. As the state-of-charge and specific gravity changes, the balls change their position in the passageway and subsequently display a different color in the viewing eye. The primary purpose of the battery is to be a quick indicator of state-of-charge for assembly plants and dealership pre-delivery processes.

The color of the battery eye indicates the approximate state-of-charge.

- Red - indicates low state-of-charge.
- Yellow/Black - indicates between high and low state-of-charge.
- Green - indicates high state-of-charge.
- No color can occur after the battery has been in service for several years and some of the plate material has coated the balls.
- A clear battery eye can occur if the battery case becomes damaged and the electrolyte has fallen below the plates.

NOTE: The battery eye may remain red for a period of time (up to several days), even after the battery is fully charged, because the acid is not yet fully mixed.

Do not install a new battery based solely on the indication of the battery eye. The battery eye color simply indicates the battery state-of-charge, not its condition. For example, a red or yellow/black battery eye usually indicates the battery is discharged, not defective. If the battery eye indicates the battery may be discharged, it is necessary to recharge the battery before testing its condition.

Charging a Battery

Batteries discharge while the vehicle is on the dealer lot or parked by the customer for an extended period of time due to normal parasitic key-off loads. Also, vehicles still in dealer inventory or in long-term storage may be driven short distances with heavy electrical loads. Over a period of time (30 days or more), this could result in vehicles having shallow or deeply discharged batteries.

- Deeply discharged - A battery that is drained over a prolonged period of time, such as an unsold vehicle or a vehicle in storage, to the point the battery is dead.
- Shallow discharge - A battery that is drained by leaving an accessory on for several hours or a few days and has a very low charge.

The vehicle charging system is designed to supply the electrical power needed to maintain the battery near full charge during normal vehicle use. The charging system is not capable of bringing a deeply discharged battery back to near fuln a short amount of time such as allowing the vehicle to idle for 15 minutes to "recharge the battery". Discharged batteries should be charged using an external charger.

NOTE: Battery chargers have improved greatly with the addition of the new generation pulse chargers. These chargers pulse current into the battery, breaking down the sulfation layer on the battery plates and generally reduce charging times to less than an hour.

NOTE: Cold batteries will not readily accept a charge. Therefore, batteries should be allowed to warm to approximately 5°C (41°F) before charging. This may require 4 to 8 hours at room temperature.

The following chart summarizes 2 recommended methods of charging.

Type of Battery Discharge	Pulse Charger	Standard Charger
Deeply discharged	Follow directions supplied with the pulse charger	2 to 8 hours and may take up to an hour to accept initial charge
Shallow discharge	45 minutes to an hour charge	2 hours below (40A) on manual setting or medium automatic setting

Inspection And Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Battery • Battery mounting	• Battery cables • Battery posts

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

4. If the fault is not visually evident, GO to Pinpoint Test A in the Pinpoint Test procedure.

Pinpoint Test

Special Tool(s)

 ST3285-A	GR 1 190 V3.0 Intelligent Diagnostic Charger 162-00036 or equivalent

Pinpoint Test A: Battery Condition Test

Normal Operation

Battery condition is determined by measuring battery terminal voltage after a specific discharge current is applied for a specified time period.

This pinpoint test is intended to diagnose the following:

- Battery charge
- Battery

PINPOINT TEST A: BATTERY CONDITION TEST

Test Step	Result / Action to Take
A1 TEST THE BATTERY CONDITION	
NOTE: A red test-eye indicates the battery is discharged, not necessarily defective. **NOTE:** Failure to fully charge the battery before retesting may cause false readings. • Verify the battery condition using the Intelligent Diagnostic Charger. • **Is the battery OK?**	**Yes** RETURN the battery to service. **No** If the analyzer reads REPLACE BATTERY or REPLACE-BAD CELL, INSTALL a new battery. REFER to Battery in this section.

Component Test

Battery - Drain Tests

⚠ WARNING: Batteries contain sulfuric acid and produce explosive gases. Work in a well-ventilated area. Do not allow the battery to come in contact with flames, sparks or burning substances. Avoid contact with skin, eyes or clothing. Shield eyes when working near the battery to protect against possible splashing of acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes, then get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in serious personal injury.

NOTICE: **To prevent damage to the meter, do not crank the engine or operate accessories that draw more than 10A.**

NOTE: No factory-equipped vehicle should have more than a 50 mA (0.050 amp) draw.

Check for current drains on the battery in excess of 50 mA (0.050 amp) with all the electrical accessories off and the vehicle at rest for at least 40 minutes. Current drains can be tested with the following procedure.

NOTE: Many electronic modules draw 10 mA (0.010 amp) or more continuously.

NOTE: Typically, a drain of approximately 1 amp is attributed to an engine compartment lamp, glove compartment lamp or interior lamp staying on continually. Other component failures or wiring shorts are located by selectively pulling fuses to pinpoint the location of the current drain. When the current drain is found, the meter reading falls to an acceptable level. If the drain is still not located after checking all the fuses, it may be due to the generator. Disconnect the generator and retest.

NOTE: To curately test the drain on a battery, an in-line ammeter must be used between the negative battery post and its respective cable. Use of a test lamp or voltmeter is not an accurate method.

1. Drive the vehicle at least 5 minutes and over 48 km/h (30 mph) to turn on and activate the vehicle systems.

2. After driving the vehicle and before testing, make sure the junction box(es)/fuse panel(s) is accessible without turning on the interior lights or the underhood lights.

3. Allow the vehicle to sit with the key out of the ignition for at least 40 minutes to allow the modules to time out/power down.

4. Connect a fused jumper wire (30A) between the negative battery cable and the negative battery post to prevent modules from resetting.

5. Disconnect the negative battery cable from the negative battery post without breaking the connection of the jumper wire.

6. **NOTE:** It is very important that continuity is not broken between the battery and the negative battery cable when connecting the meter. If this happens, the entire 40-minute procedure must be repeated.

Connect the battery tester between the negative battery cable and the post. The meter must be capable of reading milliamps and should have a 10-amp capability.

7. **NOTE:** If the meter settings need to be switched or the test leads need to be moved to another jack, the jumper wire must be reinstalled to avoid breaking continuity.

   Remove the jumper wire.

8. Note the amperage draw. Draw varies from vehicle to vehicle depending on the equipment package. Compare to a similar vehicle for reference.

NOTE: If the vehicle sits for an extended period of time and the battery drains, there is the possibility of a control module staying alive and not going into sleep mode. If a module does stay alive, it can also result in battery drain. If a module is suspect, isolate individual modules by disconnecting each module one at a time and note if the excessive draw goes away.

NOTE: For vehicles equipped with aftermarket bodies or boxes which contain electrical connections, disconnect the aftermarket to factory connections to isolate the body from the chassis.

9. If the current draw is excessive, remove the fuses from the Battery Junction Box (BJB) one at a time and note the current drop. When the current level drops to an acceptable level after removing a fuse, the circuit containing the excessive draw has been located. The excessive draw can be isolated by continuing to pull sub system fuses. Do not reinstall the fuses until testing is finished. To correctly isolate each of the circuits, all of the fuses may need to be removed, then install one fuse and note the amperage draw, remove the fuse and install the next fuse. Continue this process with each fuse.
   - Once the main circuit is identified, continue to remove the fuses from the Smart Junction Box (SJB) one at a time and note the current reading. Do not reinstall the fuses until testing is finished. To correctly isolate each of the circuits, all of the fuses may need to be removed, then install one fuse and note the amperage draw, remove the fuse and install the next fuse. Continue this process with each fuse.

10. Check the wiring diagrams for any circuits that run from the battery without passing through the BJB or the SJB . If the current draw is still excessive, disconnect these circuits until the draw is found. Also, disconnect the generator electrical connections and retest if the draw cannot be located. The generator may be internally shorted, causing the current drain.

Battery Disconnect

⚠ WARNING: Batteries contain sulfuric acid and produce explosive gases. Work in a well-ventilated area. Do not allow the battery to come in contact with flames, sparks or burning substances. Avoid contact with skin, eyes or clothing. Shield eyes when working near the battery to protect against possible splashing of acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes, then get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always deplete the backup power supply before repairing or installing any new front or side air bag supplemental restraint system (SRS) component and before servicing, removing, installing, adjusting or striking components near the front or side impact sensors or the restraints control module (RCM). Nearby components include doors, instrument panel, console, door latches, strikers, seats and hood latches. Refer to the Description and Operation portion of Section 501-20B for location of the RCM and impact sensor(s). To deplete the backup power supply energy, disconnect the battery ground cable and wait at least 1 minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped). Failure to follow these instructions may result in serious personal injury or death in the event of an accidental deployment.

⚠ WARNING: Always lift a plastic-cased battery with a battery carrier or with hands on opposite corners. Excessive pressure on the battery end walls may cause acid to flow through the vent caps, resulting in personal injury and/or damage to the vehicle or battery.

⚠ WARNING: Battery posts, terminals and related accessories contain lead and lead components. Wash hands after handling. Failure to follow these instructions may result in serious personal injury.

NOTE: When the battery (or PCM) is disconnected and connected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The charging system set point may also vary. The vehicle may need to be driven to relearn its strategy.

1. On hybrid vehicles, remove the Air Cleaner (ACL) assembly. For additional information, refer to Section 303-12A .

2. **NOTE:** When disconnecting the battery ground cable to interrupt power to the vehicle electrical system, disconnect the battery ground cable only. It is not necessary to disconnect the positive battery cable.

   Disconnect the battery ground terminal.

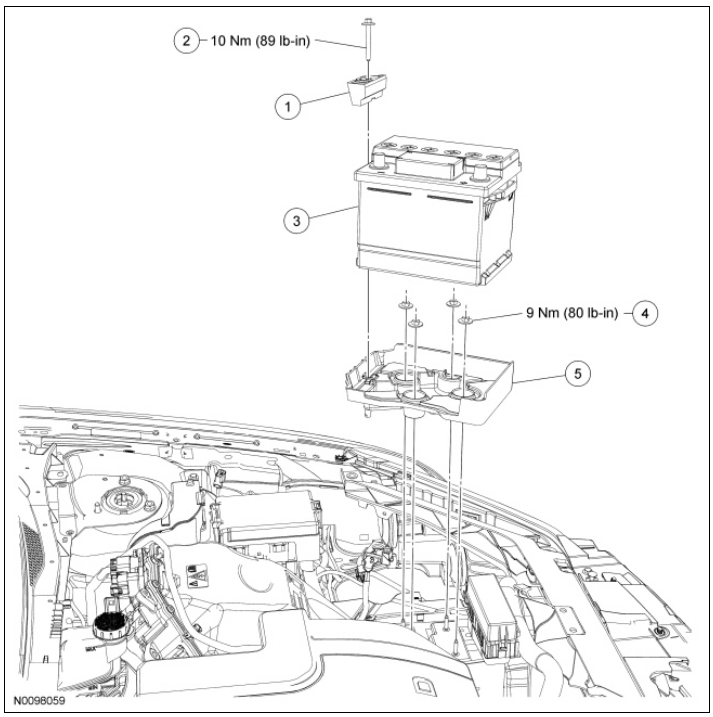
   - To connect, tighten to 7 Nm (62 lb-in).

3. Disconnect the positive battery terminal.
   - To connect, tighten to 7 Nm (62 lb-in).

4. To connect, reverse the disconnect procedure.

Battery and Battery Tray - Exploded View

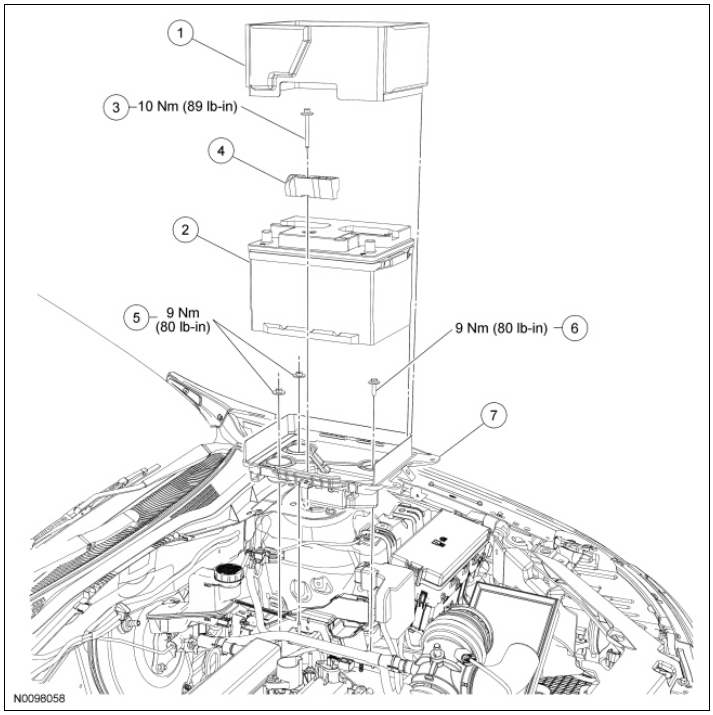
Battery and Battery Tray, Hybrid Vehicles



Item	Part Number	Description
1	-	Battery hold-down bracket
2	-	Battery hold-down bracket bolt
3	10655	Battery
4	W700430	Battery tray nut (4 required)
5	10723	Battery tray

Battery and Battery Tray, All Other Vehicles

NOTE: 3.0L and 3.5L engine shown, 2.5L similar.



Item	Part Number	Description
1	10A687	Battery cover (3.0L and 3.5L only)
2	10655	Battery
3	-	Battery hold-down bracket bolt
4	-	Battery hold-down bracket
5	W700430	Battery tray nuts
6	W710610	Battery tray bolt
7	10723	Battery tray

1. For additional information, refer to the procedures in this section.

Battery

Removal and Installation

⚠ WARNING: Batteries contain sulfuric acid and produce explosive gases. Work in a well-ventilated area. Do not allow the battery to come in contact with flames, sparks or burning substances. Avoid contact with skin, eyes or clothing. Shield eyes when working near the battery to protect against possible splashing of acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes, then get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Always deplete the backup power supply before repairing or installing any new front or side air bag supplemental restraint system (SRS) component and before servicing, removing, installing, adjusting or striking components near the front or side impact sensors or the restraints control module (RCM). Nearby components include doors, instrument panel, console, door latches, strikers, seats and hood latches. Refer to the Description and Operation portion of Section 501-20B for location of the RCM and impact sensor(s). To deplete the backup power supply energy, disconnect the battery ground cable and wait at least 1 minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped). Failure to follow these instructions may result in serious personal injury or death in the event of an accidental deployment.

⚠ WARNING: Always lift a plastic-cased battery with a battery carrier or with hands on opposite corners. Excessive pressure on the battery end walls may cause acid to flow through the vent caps, resulting in personal injury and/or damage to the vehicle or battery.

NOTE: When the battery (or PCM) is disconnected and connected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The charging system set point may also vary. The vehicle may need to be driven to relearn its strategy.

1. Disconnect the battery. For additional information, refer to Battery Disconnect in this section.

2. Remove the bolt and the battery hold-down bracket.
   - To install, tighten to 10 Nm (89 lb-in).

3. If equipped, remove the battery heat shield.

4. Remove the battery.

5. To install, reverse the removal procedure.

Battery Tray

Removal and Installation

1. Remove the battery. For additional information, refer to Battery in this section.

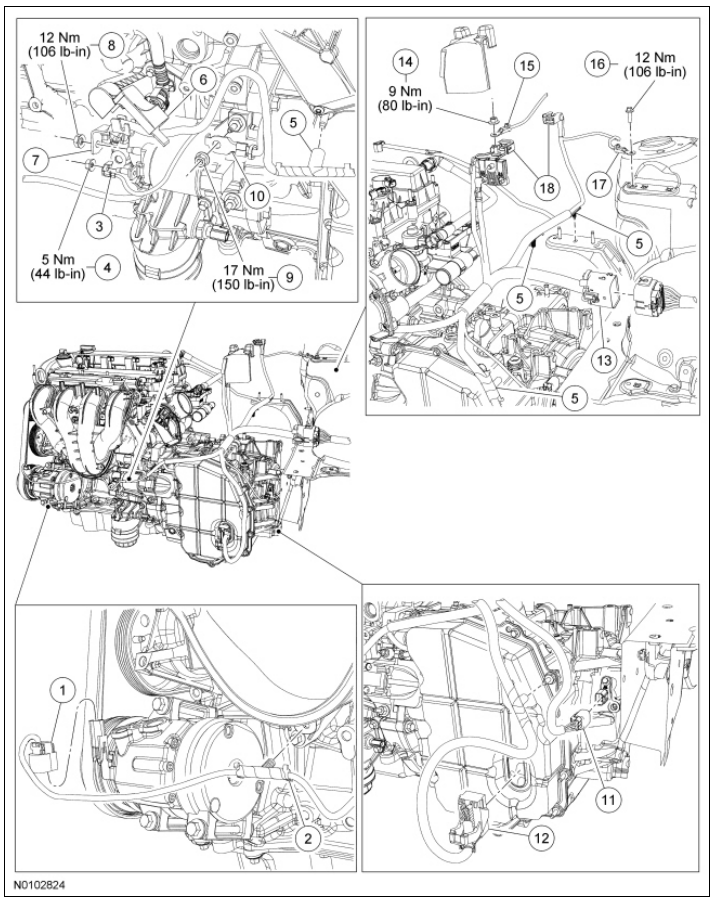
2. Remove the battery tray fasteners.
   - Hybrid vehicles use 4 nuts.
   - All other vehicles use 1 bolt and 2 nuts.
   - To install, tighten to 9 Nm (80 lb-in).

3. Remove the battery tray.

4. To install, reverse the removal procedure.

Battery Cables - 2.5L

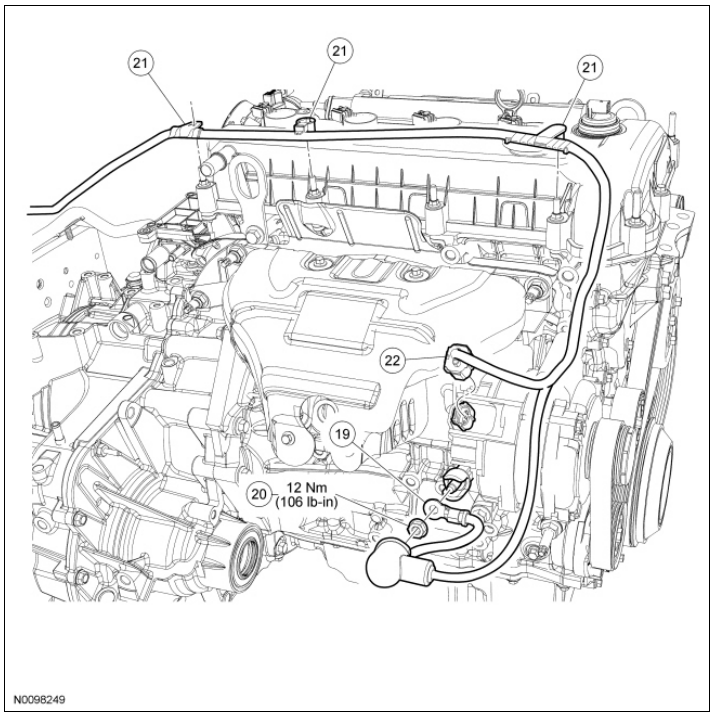
View 1 of 2



Item	Part Number	Description
1	-	A/C compressor clutch field electrical connector (part of 14B060)
2	-	Wiring harness retainer (part of 14B060)
3	-	Starter motor solenoid wire terminal (part of 14B060)
4	W705790	Starter motor solenoid wire terminal nut
5	-	Battery cable retainer (part of 14B060)
6	11N087	Starter solenoid terminal cover
7	-	Battery cable starter solenoid terminal (part of 14B060)
8	W706414	Battery cable starter solenoid terminal nut

9	W520513	Battery cable transaxle ground terminal nut			
10	-	Battery cable transaxle ground terminal (part of 14B060)			
11	-	Automatic transaxle turbine speed sensor connector (part of 14B060)			
12	-	Automatic transaxle electrical connector (part of 14B060)			
13	-	Battery cable in-line harness electrical connector (part of 14B060)	14	-	Battery Junction Box (BJB) cable terminal nut
15	-	BJB terminal			
16	W705936	Battery cable body ground terminal bolt			
17	-	Battery cable body ground terminal (part of 14B060)			
18	14B060	Battery cables			

View 2 of 2



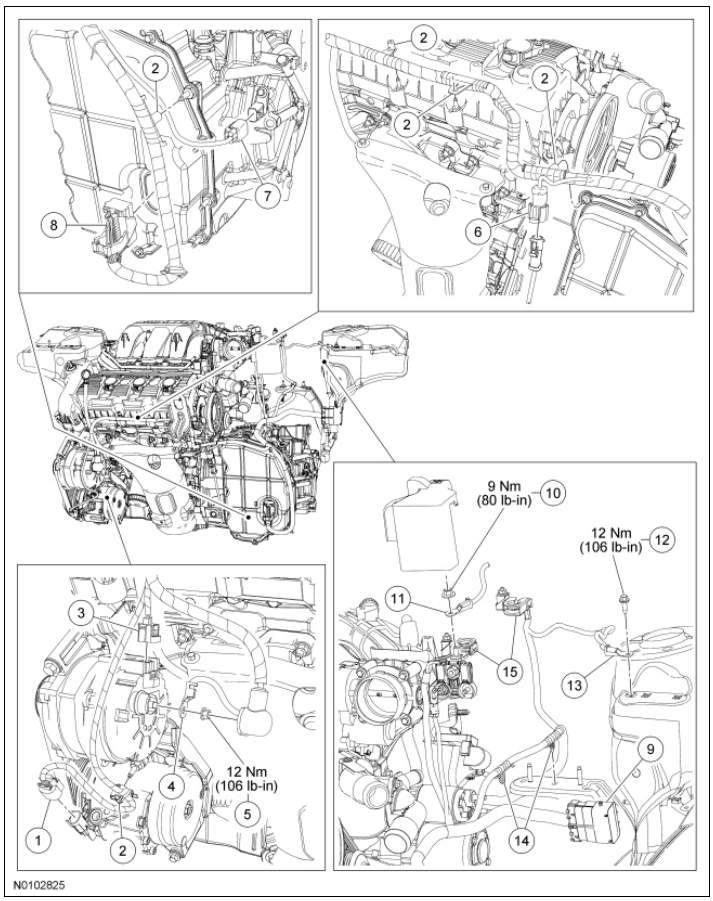
Item	Part Number	Description
19	-	Generator B+ terminal (part of 14B060)
20	W706414	Generator B+ terminal nut
21	-	Battery cable locator (part of 14B060)
22	-	Generator electrical connector (part of 14B060)

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the battery tray. For additional information, refer to Battery Tray in this section.
3. Remove the bolt and position the battery cable body ground terminal aside.
    - To install, tighten to 12 Nm (106 lb-in).
4. Remove the nut and position the Battery Junction Box (BJB) cable terminal aside.
    - To install, tighten to 9 Nm (80 lb-in).
5. Disconnect the battery cable in-line harness connector from the engine compartment wiring harness and position aside.
6. Release the 2 wiring harness retainers from the body.
7. Disconnect the A/C compressor clutch field electrical connector and position aside.
8. Release the wiring harness retainer from the intake manifold.
9. Remove the starter solenoid terminal cover.
10. Remove the nut and position the battery cable starter solenoid terminal aside.
    - To install, tighten to 12 Nm (106 lb-in).
11. Remove the nut and position the starter motor solenoid wire terminal aside.
    - To install, tighten to 5 Nm (44 lb-in).
12. Remove the nut and position the battery cable transaxle ground terminal aside.
    - To install, tighten to 17 Nm (150 lb-in).
13. Release the wiring harness retainer from the transaxle stud bolt.
14. Disconnect the transaxle electrical connector and position aside.
15. Disconnect the turbine speed sensor electrical connector and position aside.
16. Position the generator protective cover aside, remove the nut and position the generator B+ terminal aside.
    - To install, tighten to 12 Nm (106 lb-in).
17. Disconnect the generator electrical connector and move aside.
18. Release the 3 battery cable locators from the valve cover.
19. Remove the battery cables.
20. To install, reverse the removal procedure.

Battery Cables - 3.0L

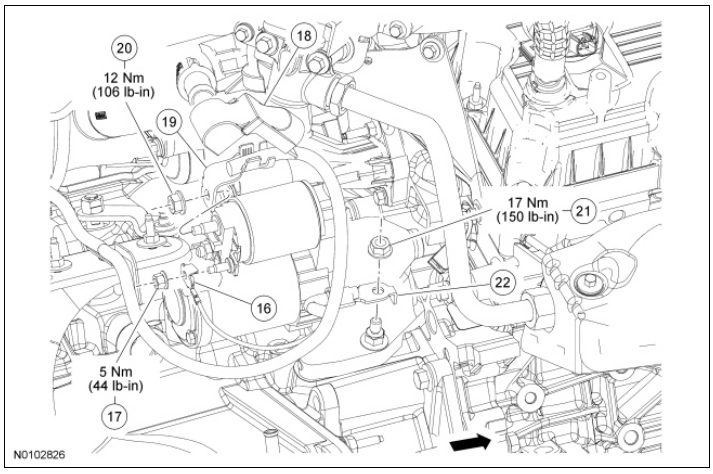
View 1 of 2



Item	Part Number	Description
1	-	A/C compressor clutch field electrical connector (part of 14B060)
2	-	Wiring harness locator (part of 14B060)
3	-	Generator electrical connector (part of 14B060)
4	-	Generator B+ terminal (part of 14B060)
5	W706414	Generator B+ terminal nut
6	-	Heated Oxygen Sensor (HO2S) electrical connector (part of 14B060)
7	-	Automatic transaxle turbine speed sensor connector (part of 14B060)
8	-	

		Automatic transaxle electrical connector (part of 14B060)
9	-	Battery cable in-line harness electrical connector (part of 14B060)
10	-	Battery Junction Box (BJB) cable terminal nut
11	-	BJB terminal
12	W705936	Battery cable body ground terminal bolt
Battery cable body ground terminal (part of 14B060)		
14	-	Battery cable retainer (part of 14B060)
15	14B060	Battery cables

View 2 of 2



Item	Part Number	Description
16	-	Starter motor solenoid wire terminal (part of 14B060)
17	W705790	Starter motor solenoid wire terminal nut
18	11N087	Starter solenoid terminal cover
19	-	Battery cable starter solenoid terminal (part of 14B060)
20	W706414	Battery cable starter solenoid terminal nut
21	W705790	Battery cable transaxle ground terminal nut
22	-	Battery cable transaxle ground terminal (part of 14B060)

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Sec2 .

2. Remove the battery tray. For additional information, refer to Battery Tray in this section.

3. Remove the bolt and position the battery cable body ground terminal aside.
   - To install, tighten to 12 Nm (106 lb-in).

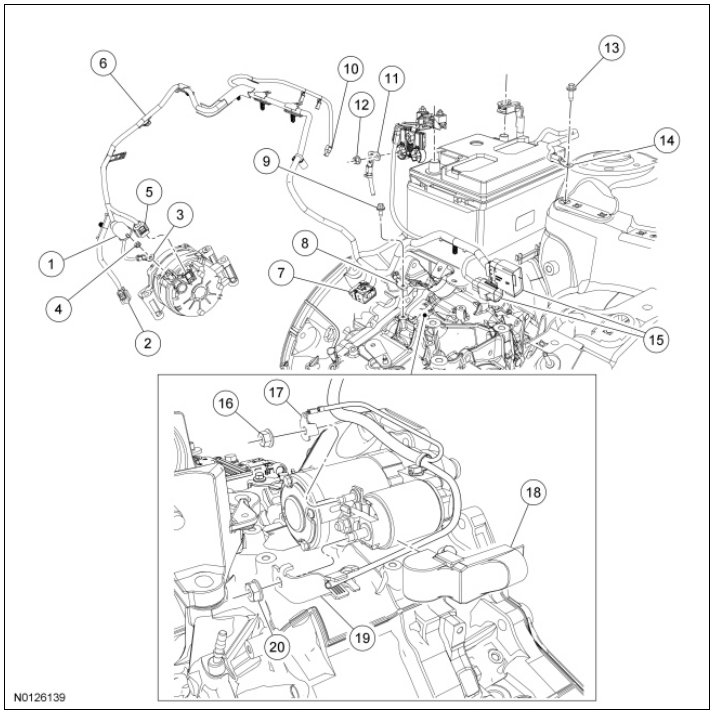
4. Remove the nut and position the Battery Junction Box (BJB) cable terminal aside.
    - To install, tighten to 9 Nm (80 lb-in).
5. Disconnect the battery cable in-line harness connector from the engine compartment wiring harness and position aside.
6. Release the 2 battery cable retainers from the body.
7. Disconnect the A/C compressor clutch field electrical connector and position aside.
8. Release the wiring harness locator from the generator mounting stud.
9. Position the generator protective cover aside, remove the nut and position the generator B+ terminal aside.
    - To install, tighten to 12 Nm (106 lb-in).
10. Disconnect the generator electrical connector and position aside.
11. Release the wiring harness locators from the valve cover.
12. Disconnect the Heated Oxygen Sensor (HO2S) electrical connector electrical connector and position aside.
13. Release the wiring harness locator from the transaxle stud bolt.
14. Disconnect the transaxle electrical connector and position aside.
15. Release the wiring harness locator from the transaxle stud bolt.
16. Disconnect the turbine speed sensor electrical connector and position aside.
17. Remove the starter solenoid terminal cover.
18. Release the battery cable retainer from the transaxle.
19. Remove the nut and position the battery cable starter solenoid terminal aside.
    - To install, tighten to 12 Nm (106 lb-in).
20. Remove the nut and position the starter motor solenoid wire terminal aside.
    - To install, tighten to 5 Nm (44 lb-in).
21. Remove the nut and position the battery cable engine ground terminal aside.
    - To install, tighten to 17 Nm (150 lb-in).
22. Remove the battery cables.
23. To install, reverse the removal procedure.

Battery Cables - 3.5L

Special Tool(s)

 ST1408-A	Remover, Tie-Rod End 211-105 (T85M-3395-A

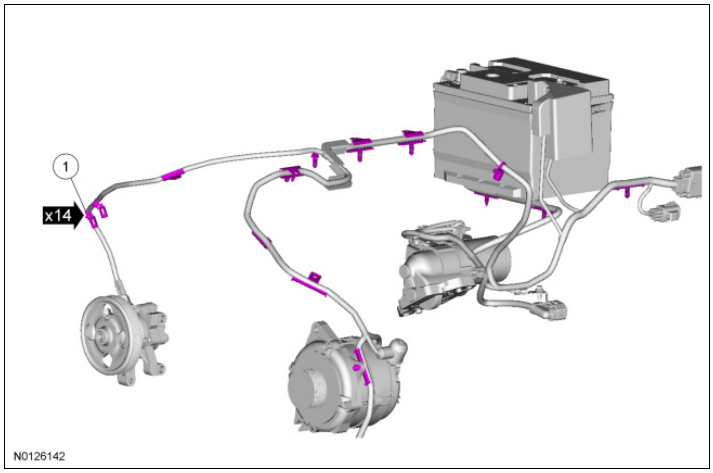
Component Connections



Item	Part Number	Description
1	-	Generator terminal cover (part of 14300)
2	-	A/C compressor electrical connector (part of 14300)
3	-	Generator B+ terminal (part of 14300)
4	W706414	Generator B+ terminal nut - 12 Nm (106 lb-in)
5	-	Generator electrical connector (part of 14300)
6	14300	Battery cable
7	-	Transmission Control Module (TCM) electrical connector (part of 14300)
8	-	Battery cable transaxle ground terminal (part of 14300)
9	W503271	ansaxle ground terminal bolt - 10 Nm (89 lb-in)
10	-	

		Power steering pressure switch electrical connector (part of 14300)
11	-	Battery Junction Box (BJB) cable terminal (part of 14290)
12	W705790	BJB cable terminal nut - 9 Nm (80 lb-in)
13	W705936	Battery cable body ground terminal bolt - 12 Nm (106 lb-in)
14	-	Battery cable body ground terminal (part of 14300)
15	-	In-line electrical connectors (part of 14300)
16	W705790	Starter motor solenoid wire terminal nut - 5 Nm (44 lb-in)
17	-	Starter motor solenoid terminal (part of 14300)
18	11N087	Starter motor solenoid terminal cover
19	-	Battery cable starter motor B+ terminal (part of 14300)
20	W706414	Battery cable starter motor B+ terminal nut - 12 Nm (106 lb-in)

Harness Retainers



Item	Part Number	Description
1		

Material

Item	Specification	Fill Capacity
Instant Gel Adhesive TA-19	WSK-M2G402-A4	-
Threadlock and Sealer TA-25	WSK-M2G351-A5	-

General Specifications

Item	Specification
High Voltage Traction Battery	
Battery chemistry	Nickel metal hydride
Battery system capacity	5.5 amp-hours
Standard voltage	275 volts
Low Voltage Battery	
Voltage	12 volts

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor manifold and suction tube fitting nut	15	-	133
A/C evaporator inlet fitting nut	15	-	133
Battery Energy Control Module (BECM) nuts	9	-	80
Battery Pack Sensor Module (BPSM) nuTD valign="top" align="center">9	-	80	
High-voltage Bussed Electrical Center (BEC) cover nuts	9	-	80
High-voltage BEC cover screws	9	-	80
High-voltage BEC nut	9	-	80
High-voltage cable shield nuts	9	-	80
High-voltage cable strain relief bolt	9	-	80
High-voltage cable connector and bracket assembly nuts	9	-	80
High-voltage cable connector and bracket assembly screw	6	-	53
High-voltage/high- current positive cable nut	15	lign="top" align="center">133	
High-voltage/high- and low-current negative cable nut	15	-	133
High-voltage/low-current cable nuts	4	-	35
High Voltage Traction Battery (HVTB) cable nuts	15	-	133

HVTB cooling inlet duct nuts	6	-	53
HVTB ground strap-to-chassis bolt	12	-	106
HVTB mounting bolts	20	-	177
Hydraulic Control Unit (HCU) bracket bolts	23	17	-

High-Voltage Traction Battery

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **The High Voltage Traction Battery (HVTB) in a Hybrid Electric Vehicle (HEV) can be affected and damaged by excessively high temperatures. The temperature in some body shop paint booths can exceed 60°C (140°F). Therefore, during refinishing operations, the paint booth temperature must be set at or below 60°C (140°F) with a bake time of 45 minutes or less. Temperatures in excess of 60°C (140°F) or bake durations longer than 45 minutes will require the HVTB be removed from the vehicle prior to placing in the paint booth.**

The vehicle is principally powered by an internal combustion engine, much like any ordinary vehicle. However, it also transforms the energy that is normally wasted during stop and go operation (when coasting and braking) into electricity, which is stored in the High Voltage Traction Battery (HVTB) until the moment it is needed by the Electronically Controlled Continuously Variable Transmission (eCVT) traction motor or the 12-volt system. The traction motor is used to support the engine during acceleration and uphill drivn low-speed driving situations, the vehicle may move under only battery power, without the internal combustion engine running. The internal combustion engine may automatically shut off when the vehicle is stopped/idling or when coasting under 75 km/h (47 mph) and will restart when the accelerator is depressed, when the traction motor needs assistance, or if the HVTB state-of-charge is low. This avoids using excess fuel when the vehicle is not in motion. The vehicle does not need to be plugged into an external source of electricity to be recharged. The energy provided by the engine and the regenerative braking, via the eCVT traction motor and generator motor, charges the HVTB .

The HVTB assembly, located behind the rear seat backrest, consists of the following components:

- HVTB
- HVTB service disconnect plug
- Battery Energy Control Module (BECM)
- High-voltage Bussed Electrical Center (BEC)
- HVTB connector and bracket (mounted to the high-voltage BEC)
- Battery Pack Sensor Module (BPSM)
- High-voltage low-current fuse (mounted in the high-voltage BEC)
- HVTB system wire harness
- HVTB cooling fan and jumper harness (accessed from the trunk area)
- HVTB cooling inlet duct
- HVTB cooling outlet duct (accessed from the trunk area)
- HVTB inlet air temperature sensor
- HVTB cooling inlet duct plate
- HVTB ground strap
- High-voltage BEC cover

All of the HVTB assembly components listed above can be individually serviced except the HVTB and the HVTB system wire harness. The HVTB and HVTB system wire harness are serviced as part of the entire HVTB assembly which includes all of the components in the list above except the HVTB cooling inlet duct

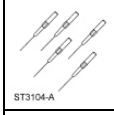
plate.

The high-voltage system also includes of the following components:

- High-voltage cable assembly
- eCVT , including motor generators and regenerative braking. For information on the eCVT , refer to Section 307-01C and the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- DC to DC Converter Control Module (DC/DC) located on the RH frame rail, behind the radiator support. For information on the DC/DC , refer to Section 414-05 .
- Air Conditioning Compressor Module (ACCM) and A/C compressor assembly located on lower LH side of the engine block. For information on the ACCM and A/C compressor assembly, refer to Section 412-01 .

High-Voltage Traction Battery

Special Tool(s)

 ST3104-A	Backprobe Pins POM6411
 ST2574-A	Flex Probe Kit 300-NUD105-R025DE or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

The High Voltage Traction Battery (HVTB) consists of D-cell type batteries packaged into modules which deliver approximately 275 volts DC to the high-voltage system. The HVTB provides cranking power to the high-voltage generator motor inside the Electronically Controlled Continuously Variable Transmission (eCVT). The HVTB also supplies electrical energy to the traction motor (also internal to the eCVT) to propel the vehicle when it is operating in electric mode only or to assist the gasoline engine (heavy acceleration). When the engine is operating or the vehicle is moving, the high-voltage generator motor generates high-voltage AC electricity. High-voltage AC generated by the generator motor can be used by the traction motor or to re-charge the HVTB .

When the HVTB is being charged, high-voltage is converted from high-voltage AC to high-voltage DC electrical power inside the eCVT and transmitted through the high-voltage cables to the HVTB .

The high-voltage DC electrical power is converted to low-voltage DC electrical power through the DC to DC Converter Control Module (DC/DC). This low-voltage high-current DC electrical power is then supplied to the 12-volt battery through the low-voltage battery cables.

The high-voltage system has a floating ground. The floating ground is designed to completely isolate the high-voltage system from the vehicle chassis. The high-voltage cables are fully insulated (isolated) from all vehicle components and circuits. There are no common connections (such as body grounds) used to conduct the high-voltage power. The Battery Energy Control Module (BECM) monitors this system for any leakage of current to the normal electrical system (similar to a household ground fault interrupter).

Battery Energy Control Module (BECM)

The BECM manages the condition of the HVTB to control its charging and discharging. The BECM also manages the cooling of the HVTB by controlling a fan attached to the HVTB cooling outlet duct. The BECM communicates with other vehicle modules on the High Speed Controller Area Network (HS-CAN) bus.

The BECM receives the following hard-wired inputs:

- HVTB interlock status
- Battery Pack Sensor Module (BPSM) information and status, via a dedicated (not accessible by a scan tool) CAN between the BECM and BPSM
- Immediate shutdown request from the Transmission Control Module (TCM)
- Event notification status from the Restraints Control Module (RCM)
- Vehicle HS-CAN
- BPSM power, ground and control circuits
- HVTB inlet air temperature sensor
- HVTB cooling fan feedback

The BECM provides the following outputs:

- HVTB cooling fan Pulse Width Modulated (PWM) supply voltage
- Vehicle HS-CAN information

The BECM receives HS-CAN messages from the following modules:

- PCM
- TCM
- Instrument Panel Cluster (IPC)
- RCM
- DC/DC

The PCM HS-CAN messages received by the BECM include:

- Gas engine status (running or off)
- Contactor control request status
- Current vehicle mode (power up, engine wait, shutdown, etc.)
- Ready light request
- Battery estimated current
- Transaxle gear position
- R-Mode Rebalance enable request
- Engine speed
- Throttle plate position
- Engine coolant temperature
- Ambient air inlet temperature

The TCM HS-CAN messages received by the BECM include:

- Vehicle speed, via the TCM
- TCM high-voltage input, via the TCM

The DC/DC HS-CAN messages received by the BECM include:

- DC/DC high-voltage input
- DC/DC high-voltage current
- DC/DC low-voltage input
- DC/DC over-temperature status
- DC/DC operation status

Battery Pack Sensor Module (BPSM)

The BPSM communicates with the BECM over a dedicated (not accessible by a scan tool) CAN bus. The BPSM provides the current, voltage and temperature status of the HVTB to the BECM . This information is needed by the BECM to control the HVTB and to determine the HVTB ability to receive and provide power to the vehicle.

DC to DC Converter Control Module (DC/DC)

The DC/DC converter is a liquid-cooled component that converts high-voltage (179-343 volt) DC power to low-voltage (12 volt) DC power. The converter provides power to the vehicle 12-volt battery and low-voltage electrical systems. The PCM controls the operation of the DC/DC through an enable message from the PCM to the DC/DC . For information on the DC/DC , refer to Section 414-05 .

Electronically Controlled Continuously Variable Transmission (eCVT)

The eCVT includes an internal generator motor and an internal traction motor. For information on the eCVT and its operation, refer to Section 307-01C and the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

The eCVT generator motor generates high-voltage electricity for charging of the HVTB and/or providing power to the traction motor. The generator motor is also used to start the gas engine. The generator motor is an internal part of the eCVT and it cannot be repaired, only installed new as an assembly.

The eCVT traction motor is used to accelerate the vehicle from a stop when driving under electric power. The traction motor is also used to recover energy during regenerative braking. The traction motor receives power from the HVTB and/or from the eCVT generator motor. The traction motor is an internal part of the eCVT and it cannot be repaired, only installed new as an assembly.

The regenerative braking system is designed to recapture some of the energy from braking and deceleration events. It accomplishes this through the use of the traction motor and generator motor. This recaptured energy is used to charge the HVTB . If the HVTB is adequately charged, the recaptured energy is used for gas engine braking to slow the vehicle. The regenerative brake system is a series system. A series system is one in which powertrain braking is used first, up to the limits of the powertrain torque capacity and battery capacity. After optimum regeneration is used, the friction brakes are applied to supplement braking demands. For information on regenerative braking, refer to Section 206-09 .

High-Voltage Bussed Electrical Center (BEC)

The high-voltage Bussed Electrical Center (BEC) acts as an interface between the high-voltage cables and the HVTB . The high-voltage BEC houses the 3 contactors (precharge, positive and negative) which, when commanded closed by the BECM , connect the HVTB to various components for high-voltage consumption and/or charging of the HVTB . The high-voltage BEC design enables distribution of high-voltage to the high-current side (eCVT) and low-current side (DC/DC and Air Conditioning Compressor Module (ACCM)). The low-current side is protected by a high-voltage/low-current 40A fuse. Any fault resulting in excessive current on the low-current side will open the fuse, but will not affect operation of the high-current side. The high-voltage BEC contains the contactors, the current sensor and the high-voltage/low-current 40 amp fuse.

The high-voltage BEC also interfaces with the BECM for monitoring of the high-voltage cable interlock circuit and control of the contactors. The high-voltage BEC also houses the current sensor which is monitored by the BPSM . The current sensor is used to help determine the load or rate of charge of the HVTB by sensing current flow into or out of the HVTB .

High-Voltage Cable Assembly

All cables that carry high voltage are integrated into one high-voltage cable assembly that runs between the

DC/DC , the eCVT , the ACCM and the HVTB (via the high-voltage BEC). Within the high-voltage cable assembly are 4 basic circuits:

- The high-voltage/high-current cables between the HVTB and the eCVT .
- The high-voltage/low-current cables from the HVTB to the DC/DC and the ACCM .
- The interlock circuit consists of small-gauge wiring wrapped around the high-voltage cables. The interlock circuit connectors are built in with the high-voltage cable connectors, and are either disconnected simultaneously with the high-voltage cable or must be disconnected before disconnecting the high-voltage cable, depending upon the type of connector being serviced.
- The LED and high-voltage AC wiring between the DC/AC inverter and AC power point. For information on the DC/AC inverter system, refer to Section 414-05 .

High Voltage Traction Battery (HVTB)

The HVTB is a nominal 275 volts (actual operating range of 179-343 volts) DC energy source that receives high-voltage electrical power when required from the eCVT . The HVTB also supplies high-voltage electrical power when required to the eCVT , DC/DC and/or the ACCM .

The HVTB system is connected to a floating ground system that keeps it isolated from the vehicle's 12-volt system. All charging and maintenance of the HVTB is managed by the BECM . Sensing of the HVTB (battery state-of-charge, internal temperature, battery load) is done by the BPSM .

HVTB Service Disconnect Plug

The HVTB uses a service disconnect plug which connects directly to the HVTB . The service disconnect plug has an internal circuit which includes a fuse. When the service disconnect plug is removed from the HVTB , high voltage is no longer supplied to the high-voltage BEC , although there is still high voltage available on 2 circuits monitored by the BPSM .

R-Mode Rebalance

Individual cells can deviate over the life of the HVTB . The purpose of the R-Mode Rebalance is to equalize the individual cell charges. By rebalancing the cells the HVTB will maintain top efficiency. The rebalance process charges the battery pack to near a full state of charge and keeps each individual cell charge within a prescribed range of each other. The R-Mode Rebalance is sometimes run during vehicle operation as needed and is controlled by the BECM . In some situations the BECM may not be able to properly adjust the cell levels on its own and a DTC may be set. The DTC would direct the technician to perform a service R-Mode Rebalance. This is done with the use of a scan tool by following the directions within the service function.

Vehicle Shut Down

A vehicle shut down signal is sent when the battery is about to open the contactors due to an internal fault or has just opened the contactors due to an external input (external module commanding contactors to be opened such as a crash event, interlock circuit failure, etc.). When vehicle shut down occurs, the Stop Safely warning indicator will be illuminated warning that the vehicle will be shut down within a matter of seconds and that the operator should pull off the road as soon as possible. Depending on the fault condition that lead to the shut down, the vehicle may or may not re-start if the condition has corrected itself. If the fault condition is severe enough, the fault will have to be repaired and DTCs cleared before the vehicle will re-start.

Inspection and Verification

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes

approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

NOTE: Verify the service disconnect plug is properly inserted and locked into the lock position.

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• High-voltage cables • Electronically Controlled Continuously Variable Transmission (eCVT) • Air inlet grille and duct • Air outlet duct • High Voltage Traction Battery (HVTB) cooling fan	• Battery Junction Box (BJB) fuse(s): ♦ 17 (10A) ♦ 47 (10A) ♦ 48 (20A) • Smart Junction Box (SJB) fuse 3 (15A) • Power sustain relay • Circuitry • Air inlet thermistor • HVTB cooling fan • DC to DC Converter Control Module (DC/DC) • eCVT • HVTB • High-voltage Bussed Electrical Center (BEC) • Service disconnect plug • 12-volt battery

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the VCM .

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

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

8. Carry out the self-test diagnostics for the PCM and the BECM .

9. If the PCM DTCs retrieved are related to a driveability concern, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual before proceeding to the next step.

10. If the BECM DTCs retrieved are related to the concern, go to the Battery Energy Control Module (BECM) DTC Chart to continue diagnosis.

DTC Charts

Battery Energy Control Module (BECM) DTC Chart

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

NOTE: Network DTCs (U-codes) are often a result of intermittent concerns such as damaged wiring or low battery voltage occurrences. Additionally, vehicle service procedures such as module reprogramming often set network DTCs. Replacing a module to resolve a network DTC is unlikely to resolve the concern. To prevent repeat network DTC concerns, inspect all network wiring, especially connectors. Test the vehicle battery condition, refer to Section 414-01 .

DTC	Description	Action
B10A2:16	Crash Input: Circuit Voltage Below Threshold	MEASURE voltage at Battery Energy Control Module (BECM) C4237A-41, circuit CBB48 (GY/YE), harness side and C4237A-42, circuit CBB48 (GY/YE), harness side. If less than 12 volts, INSPECT Battery Junction Box (BJB) fuse 48 (20A). If the fuse is OK, REPAIR the circuit. If 12 volts is present, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B11D5:68	Restraint Event Notification: Vehicle Disabled: Event Information	**NOTE:** This DTC indicates the Restraints Control Module (RCM) is outputting a fuel cutoff/crash event. RETRIEVE DTCs from the RCM and REFER to Section 501-20B for further diagnosis.
B11D8:11	Restraint Event Notification: Circuit Short To Ground	GO to Pinpoint Test AC .

B11D8:15	Restraint Event Notification: Circuit Short To Battery Or Open	GO to Pinpoint Test AD .
B11D8:31	Restraint Event Notification: No Signal	With the ignition in the ON position, MEASURE frequency at BECM C4237A-46, circuit CR167 (YE/VT) by back-probing the connector. If frequency is 9-11 Hz, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. If frequency is not 9-11 Hz, CHECK RCM and PCM for DTCs. REFER to Section 501-20B or the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If no DTCs are present, INSTALL a new RCM . REFER to Section 501-20B .
B11D8:36	Restraint Event Notification: Signal Frequency Too Low	With the ignition in the ON position, MEASURE frequency at BECM C4237A-46, circuit CR167 (YE/VT) by back-probing the connector. If frequency is 9-11 Hz, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. If frequency is not 9-11 Hz, CHECK RCM and PCM for DTCs. REFER to Section 501-20B or the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If no DTCs are present, INSTALL a new RCM . REFER to Section 501-20B .
B11D8:37	Restraint Event Notification: Signal Frequency Too High	With the ignition in the ON position, MEASURE frequency at BECM C4237A-46, circuit CR167 (YE/VT) by back-probing the connector. If frequency is 9-11 Hz, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. If frequency is not 9-11 Hz, CHECK RCM and PCM for DTCs. REFER to Section 501-20B or the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If no DTCs are present, INSTALL a new RCM . REFER to Section 501-20B .
B11D8:38	Restraint Event Notification: Signal Frequency Incorrect	With the ignition in the ON position, MEASURE frequency at BECM C4237A-46, circuit CR167 (YE/VT) by back-probing the

		connector. If frequency is 9-11 Hz, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. If frequency is not 9-11 Hz, CHECK RCM and PCM for DTCs. REFER to Section 501-20B or the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If no DTCs are present, INSTALL a new RCM . REFER to Section 501-20B .
P0A0A:00	High Voltage System Interlock Circuit: No Sub Type Information	GO to Pinpoint Test A .
P0A0C:00	High Voltage System Interlock Circuit Low: No Sub Type Information	GO to Pinpoint Test AQ .
P0A7D:00 [a]	Hybrid Battery Pack State of Charge Low: No Sub Type Information	GO to Pinpoint Test B .
P0A7E:00	Hybrid Battery Pack Over Temperature: No Sub Type Information	If other BECM DTCs are present, address them first. If DTC P0A7E is the only DTC present, GO to Pinpoint Test C .
P0A80:00 [a]	Replace Hybrid Battery Pack: No Sub Type Information	**NOTE:** This DTC signals the High Voltage Traction Battery (HVTB) is at the end of expected life. The customer may choose not to install a new battery pack due to the cost of replacement. If a new HVTB is not installed, the customer will experience reduced fuel economy and reduced power, which will eventually lead to a complete failure of the HVTB and the vehicle being unable to start. INSTALL a new HVTB . REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P0A81:00	Hybrid Battery Pack Cooling Fan 1 Control Circuit/Open: No Sub Type Information	If BECM DTC P0A82:00 is also present, diagnose that DTC first. If DTC P0A81:00 is the only DTC present, GO to Pinpoint Test D .
P0A82:00	Hybrid Battery Pack Cooling Fan 1 Performance/Stuck Off: No Sub Type Information	GO to Pinpoint Test E .
P0A8B:64	14 Volt Power Module System Voltage: Signal Plausibility Failure	GO to Pinpoint Test F .
P0A9D:00	Hybrid Battery Temperature Sensor A Circuit Low: No Sub Type Information	GO to Pinpoint Test G .
P0A9E:00		GO to Pinpoint Test G .

	Hybrid Battery Temperature Sensor A Circuit High: No Sub Type Information	
P0AA1:00[a]	Hybrid Battery Positive Contactor Circuit Stuck Closed: No Sub Type Information	GO to Pinpoint Test H .
P0AA2:00	Hybrid Battery Positive Contactor Circuit Stuck Open: No Sub Type Information	GO to Pinpoint Test H .
P0AA4:00[a]	Hybrid Battery Negative Contactor Circuit Stuck Closed: No Sub Type Information	GO to Pinpoint Test I .
P0AA5:00	Hybrid Battery Negative Contactor Circuit Stuck Open: No Sub Type Information	GO to Pinpoint Test I .
P0AA6:00	Hybrid Battery Voltage System Isolation Fault: No Sub Type Information	GO to Pinpoint Test J .
P0AA7:00	Hybrid Battery Voltage Isolation Sensor Circuit: No Sub Type Information	CLEAR the DTCs and REPEAT the self-test. If the DTC is still present. INSTALL a new Battery Pack Sensor Module (BPSM). REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P0AA9:00	Hybrid Battery Voltage Isolation Sensor Circuit Low: No Sub Type Information	CLEAR the DTCs and REPEAT the self-test. If the DTC is still present. INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P0AAA:00	Hybrid Battery Voltage Isolation Sensor Circuit High: No Sub Type Information	CLEAR the DTCs and REPEAT the self-test. If the DTC is still present, INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P0AAE:00	Hybrid Battery Pack Air Temperature Sensor A Circuit Low: No Sub Type Information	GO to Pinpoint Test K .
P0AAF:00	Hybrid Battery Pack Air Temperature Sensor A Circuit High: No Sub Type Information	GO to Pinpoint Test K .
P0ABC:00	Hybrid Battery Pack Voltage Sense A Circuit Low: No Sub Type Information	GO to Pinpoint Test L .
P0ABD:00	Hybrid Battery Pack Voltage Sense A Circuit High: No Sub Type Information	GO to Pinpoint Test M .
P0AC0:00	Hybrid Battery Pack Current Sensor A Circuit	GO to Pinpoint Test T .

	Range/Performance: No Sub Type Information	
P0AC1:00	Hybrid Battery Pack Current Sensor A Circuit Low: No Sub Type Information	GO to Pinpoint Test T .
P0AC2:00	Hybrid Battery Pack Current Sensor A Circuit High: No Sub Type Information	GO to Pinpoint Test T .
P0AC7:00	Hybrid Battery Temperature Sensor B Circuit Low: No Sub Type Information	GO to Pinpoint Test N .
P0AC8:00	Hybrid Battery Temperature Sensor B Circuit High: No Sub Type Information	GO to Pinpoint Test N .
P0ACC:00	Hybrid Battery Temperature Sensor C Circuit Low: No Sub Type Information	GO to Pinpoint Test O .
P0ACD:00	Hybrid Battery Temperature Sensor C Circuit High: No Sub Type Information	GO to Pinpoint Test O .
P0AD9:00	Hybrid Battery Positive Contactor Control Circuit/Open GM: No Sub Type Information	GO to Pinpoint Test P .
P0ADA:00	Hybrid Battery Positive Contactor Control Circuit Range/Performance: No Sub Type Information	GO to Pinpoint Test R .
P0ADC:00 [a]	Hybrid Battery Positive Contactor Control Circuit High: No Sub Type Information	GO to Pinpoint Test U .
P0ADD:00	Hybrid Battery Negative Contactor Control Circuit/Open: No Sub Type Information	GO to Pinpoint Test Q .
P0ADE:00	Hybrid Battery Negative Contactor Control Circuit Range/Performance: No Sub Type Information	GO to Pinpoint Test R .
P0AE0:00 [a]	Hybrid Battery Negative Contactor Control Circuit High: No Sub Type Information	GO to Pinpoint Test AH .
P0AE1:00 [a]	Hybrid Battery Precharge Contactor Circuit: No Sub Type Information	**NOTE:** This DTC is set by a no-start, caused when the contactor precharge circuit fails and the HVTB contactors do not close. A low 12-volt battery may also cause this DTC. The master vehicle stop safely hazard (red triangle) warning indicator in the Instrument Cluster (IC) will illuminate. This DTC is also set by a fault in the DC to DC Converter Control Module (DC/DC) enable circuit, the high-voltage bus, Electronically Controlled

		Continuously Variable Transmission (eCVT) or the DC/AC inverter and high-voltage wiring. GO to Pinpoint Test AI .
P0AE5:00 [a]	Hybrid Battery Precharge Contactor Circuit Range/Performance: No Sub Type Information	GO to Pinpoint Test AJ .
P0AE7:00 [a]	Hybrid Battery Precharge Contactor Circuit High: No Sub Type Information	GO to Pinpoint Test AK .
P0AEA:00	Hybrid Battery Temperature Sensor D Circuit Low: No Sub Type Information	GO to Pinpoint Test S .
P0AEB:00	Hybrid Battery Temperature Sensor D Circuit High: No Sub Type Information	GO to Pinpoint Test S .
P0AFB:00	Hybrid Battery System Voltage High: No Sub Type Information	GO to Pinpoint Test V .
P0AFC:04	Hybrid Battery Pack Sensor Module: System Internal Failure	CLEAR the DTCs and REPEAT the self-test. If DTC returns, INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P0AFC:49	Hybrid Battery Pack Sensor Module: Internal Electronic Failure	CLEAR the DTCs and REPEAT the self-test. If the DTC is still present, INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P0AFC:4A	Hybrid Battery Pack Sensor Module: Incorrect Component Installed	CLEAR the DTCs and REPEAT the self-test. If the DTC is still present, INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P0AFC:67	Hybrid Battery Pack Sensor Module: Signal Incorrect After Event	GO to Pinpoint Test AL .
P0AFD:00	Hybrid Battery Pack Temperature Too Low: No Sub Type Information	GO to Pinpoint Test W .
P0B10:00	Hybrid Battery Pack Current Sensor B Circuit Low: No Sub Type Information	GO to Pinpoint Test X .
P0B12:00	Hybrid Battery Pack Current Sensor B Circuit Intermittent/Erratic: No Sub Type Information	GO to Pinpoint Test X .
P0B1B:00	Hybrid Battery Pack Voltage Sense C Circuit Low: No Sub Type Information	GO to Pinpoint Test Y .
P0B1C:00	Hybrid Battery Pack Voltage Sense C Circuit High: No Sub Type Information	GO to Pinpoint Test AM .

P0B24:00	Hybrid Battery A Voltage Unstable: No Sub Type Information	**NOTE:** This DTC indicates the HVTB has cell modules with a voltage variation and should be replaced. The customer may choose not to install a new battery pack due to the cost of replacement. If a new HVTB is not installed, the customer will experience reduced fuel economy and reduced power, which will eventually lead to a complete failure of the HVTB and the vehicle being unable to start. INSTALL a new HVTB . REFER to High-Voltage Traction Battery in this section.
P0B25:00	Hybrid Battery A Voltage Low: No Sub Type Information	**NOTE:** The customer may choose not to install a new battery pack due to the cost of replacement. If a new HVTB is not installed, the customer will experience reduced fuel economy and reduced power, which will eventually lead to a complete failure of the HVTB and the vehicle being unable to start. CHECK for other DTCs and diagnose any other DTCs first. If no other DTCS are present, INSTALL a new HVTB . REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P0B36:00	High Voltage Service Disconnect Circuit High: No Sub Type Information	GO to Pinpoint Test AN .
P0B37:00	High Voltage Service Disconnect Open: No Sub Type Information	GO to Pinpoint Test AO .
P0B3D:00	Hybrid Battery Voltage Sense A Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B3E:00	Hybrid Battery Voltage Sense A Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B42:00	Hybrid Battery Voltage Sense B Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B43:00	Hybrid Battery Voltage Sense B Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B47:00	Hybrid Battery Voltage Sense C Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B48:00	Hybrid Battery Voltage Sense C Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B4C:00	Hybrid Battery Voltage Sense D Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B4D:00	Hybrid Battery Voltage Sense D Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B51:00		GO to Pinpoint Test AP .

	Hybrid Battery Voltage Sense E Circuit Low: No Sub Type Information	
P0B52:00	Hybrid Battery Voltage Sense E Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B56:00	Hybrid Battery Voltage Sense F Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B57:00	Hybrid Battery Voltage Sense F Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B5B:00	Hybrid Battery Voltage Sense G Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B5C:00	Hybrid Battery Voltage Sense G Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B60:00	Hybrid Battery Voltage Sense H Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B61:00	Hybrid Battery Voltage Sense H Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B65:00	Hybrid Battery Voltage Sense I Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B66:00	Hybrid Battery Voltage Sense I Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B6A:00	Hybrid Battery Voltage Sense J Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B6B:00	Hybrid Battery Voltage Sense J Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B6F:00	Hybrid Battery Voltage Sense K Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B70:00	Hybrid Battery Voltage Sense K Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B74:00	Hybrid Battery Voltage Sense L Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B75:00	Hybrid Battery Voltage Sense L Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B79:00	Hybrid Battery Voltage Sense M Circuit Low: No	GO to Pinpoint Test AP .

	Sub Type Information	
P0B7A:00	Hybrid Battery Voltage Sense M Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B7E:00	Hybrid Battery Voltage Sense N Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B7F:00	Hybrid Battery Voltage Sense N Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B83:00	Hybrid Battery Voltage Sense O Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B84:00	Hybrid Battery Voltage Sense O Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B88:00	Hybrid Battery Voltage Sense P Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B89:00	Hybrid Battery Voltage Sense P Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B8D:00	Hybrid Battery Voltage Sense Q Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B8E:00	Hybrid Battery Voltage Sense Q Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B92:00	Hybrid Battery Voltage Sense R Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B93:00	Hybrid Battery Voltage Sense R Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B97:00	Hybrid Battery Voltage Sense S Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B98:00	Hybrid Battery Voltage Sense S Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0B9C:00	Hybrid Battery Voltage Sense T Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0B9D:00	Hybrid Battery Voltage Sense T Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0BA1:00	Hybrid Battery Voltage Sense U Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0BA2:00		GO to Pinpoint Test AP .

	Hybrid Battery Voltage Sense U Circuit High: No Sub Type Information	
P0BA6:00	Hybrid Battery Voltage Sense V Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0BA7:00	Hybrid Battery Voltage Sense V Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0BAB:00	Hybrid Battery Voltage Sense W Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0BAC:00	Hybrid Battery Voltage Sense W Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0BB0:00	Hybrid Battery Voltage Sense X Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0BB1:00	Hybrid Battery Voltage Sense X Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0BB5:00	Hybrid Battery Voltage Sense Y Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0BB6:00	Hybrid Battery Voltage Sense Y Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0BBA:00	Hybrid Battery Voltage Sense Z Circuit Low: No Sub Type Information	GO to Pinpoint Test AP .
P0BBB:00	Hybrid Battery Voltage Sense Z Circuit High: No Sub Type Information	GO to Pinpoint Test AP .
P0BC4:00	Hybrid Battery Temperature Sensor E Circuit Low	GO to Pinpoint Test Z .
P0BC5:00	Hybrid Battery Temperature Sensor E Circuit High	GO to Pinpoint Test Z .
P1A0A:11	Immediate Shutdown Signal A: Circuit Short To Ground	GO to Pinpoint Test AA .
P1A0A:12 [a]	Immediate Shutdown Signal A: Circuit Short To Battery	GO to Pinpoint Test AA .
P1A0A:15	Immediate Shutdown Signal A: Circuit Short To Battery Or Open	GO to Pinpoint Test AA .
P1A15:11	Immediate Shutdown Signal B: Circuit Short To Ground	GO to Pinpoint Test AB .
P1A15:12 [a]	Immediate Shutdown Signal B: Circuit Short To Battery	GO to Pinpoint Test AB .
P1A15:15	Immediate Shutdown Signal B: Circuit Short To Battery	GO to Pinpoint Test AB .

	Or Open	
U0074:00	Control Module Communication Bus "B" Off: No Sub Type Information	GO to Pinpoint Test AE .
U0100:00	Lost Communication With ECM/PCM "A": No Sub Type Information	**NOTE:** DTC U0100:00 indicates lost communication with the PCM. REFER to Section 418-00 to diagnose the lost communication with the PCM.
U0101:00	Lost Communication with Transmission Control Module (TCM): No Sub Type Information	**NOTE:** DTC U0101:00 indicates lost communication with the TCM . REFER to Section 418-00 to diagnose the lost communication with the TCM .
U0151:00	Lost Communication Restraints Control Module: No Sub Type Information	**NOTE:** DTC U0151:00 indicates lost communication with the RCM . REFER to Section 418-00 to diagnose the lost communication with the RCM .
U0155:00	Lost Communication Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	**NOTE:** DTC U0155:00 indicates lost communication with the IPC module. REFER to Section 418-00 to diagnose the lost communication with the IPC module.
U0298:00	Lost Communication to DC to DC Converter Control Module "A": No Sub Type Information	**NOTE:** DTC U0298:00 indicates lost communication with the DC/DC . REFER to Section 418-00 to diagnose the lost communication with the DC/DC .
U029A:00	Lost Communication with Hybrid Battery Pack Sensor Module: No Sub Type Information	**NOTE:** DTC U029A:00 indicates lost communication with the BPSM . Diagnose any other BECM DTCs first. If no other BECM DTCs are present, check the dedicated CAN circuits BECM C4237B-2, circuit J1-A02, harness side and BPSM C4238B-23, circuit J1-A02, harness side; and between BECM C4237B-18, circuit J1-A18, harness side and BPSM C4238B-22, circuit J1-A18, harness side for faults. If OK, INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
U0300:05	Internal Control Module Software Incompatibility: System Programming Failure	CONFIGURE the BECM . REFER to Section 418-01 to CARRY OUT Programmable Module Installation (PMI). If the concern is still present, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
U0335:00	Software Incompatibility with Hybrid Battery Pack Sensor Module: No Sub Type Information	CONFIGURE the BECM and BPSM . REFER to Section 418-01 to CARRY OUT Programmable Module Installation (PMI). CLEAR the DTCs. REPEAT the self-test. If the concern is still present, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs.

		REPEAT the self-test. If the concern is still present, INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
U0336:00	Software Incompatibility with Restraints Control Module: No Sub Type Information	**NOTE:** DTC U0336:00 indicates the BECM received an undetermined value from the RCM fuel pump cutoff request message. RETRIEVE RCM DTCs. REFER to Section 501-20B for further diagnosis of the RCM .
U0401:66 [a]	Invalid Data Received From ECM/PCM A: Signal Has Too Many Transitions/Events	CARRY OUT PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for further diagnosis of the PCM DTCs.
U0401:68	Invalid Data Received From ECM/PCM A: Event Information	**NOTE:** DTC U0401:68 indicates a High Speed Controller Area Network (HS-CAN) message from the PCM is outside normal limits due to a faulty PCM input. RETRIEVE the PCM DTCs related to engine speed or ambient air temperature. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for further diagnosis of the PCM DTCs.
U0402:68	Invalid Data Received From TCM : Event Information	**NOTE:** DTC U0402:68 indicates a HS-CAN message from the TCM is outside normal limits due to a faulty TCM input. RETRIEVE TCM DTCs related to vehicle speed or high-voltage input. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for further diagnosis of the TCM .
U0424:68	Invalid Data Received From HVAC Control Module: Event Information	**NOTE:** DTC U0424:68 indicates a HS-CAN message from the IC module (gateway message, originates from HVAC control module on Medium Speed Controller Area Network (MS-CAN) is outside normal limits due to a faulty HVAC control module input. RETRIEVE HVAC control module DTCs related to recirculation door, airflow or blower motor operation. REFER to Section 412-00B for further diagnosis of the HVAC control module.
U0452:00	Invalid Data Received From Restraints Control Module: No Sub Type Information	**NOTE:** DTC U0452:00 indicates a HS-CAN message from the RCM is outside normal limits. The BECM received an invalid fuel pump cutoff request message. RETRIEVE RCM DTCs. REFER to Section 501-20B for further diagnosis of the RCM .
U0599:68	Invalid Data Received From DC to DC Converter Control Module "A": Event Information	**NOTE:** DTC U0599:68 indicates a HS-CAN message from the DC/DC is outside normal limits. The BECM received an invalid low-voltage or high-voltage message. RETRIEVE DC/DC DTCs. REFER to Section 414-05 for further diagnosis of the DC/DC .
U1003:49	System Clock: Internal Electronic Failure	CLEAR DTCs and REPEAT self test. If the DTC is still present, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
U1006:00		GO to Pinpoint Test AE .

	Sub Network Controller Area Network (CAN) Initialization Failure: No Sub Type Information	
U200D:12	Control Module Output Power A: Circuit Short To Battery	MEASURE voltage at the BECM C4237B-51, circuit J1-A51, harness side with ignition in the OFF position. If no voltage is present, INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. If voltage is present, INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
U200D:13	Control Module Output Power A: Circuit Open	MEASURE voltage at the BECM C4237B-51, circuit J1-A51, harness side with ignition in the ON position. If voltage is less than 10 volts, REPAIR the circuit. If voltage is greater than 10 volts, INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
U3000:04	Control Module: System Internal Failure	CLEAR DTCs and VERIFY the 12-volt battery is in good condition and fully charged. Let vehicle sit a minimum of 7 hours without an ignition cycle. REPEAT the self-test. If DTC returns, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If DTC does not return, return the vehicle to the customer. Concern is not present at this time.
U3000:41 [a]	Control Module: General Checksum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC returns, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If DTC does not return, return the vehicle to the customer. Concern is not present at this time.
U3000:46	Control Module: Calibration/Parameter Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC returns, INSTALL a new BECM and run R-Mode Rebalance using a scan tool. REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If DTC does not return, return the vehicle to the customer. Concern is not present at this time.
U3001:00 [a]	Control Module Improper Shutdown: No Sub Type Information	GO to Pinpoint Test AF .

U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AF .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test AF .
U3003:62	Battery Voltage: Signal Compare Failure	GO to Pinpoint Test AG .

[a] Reports as a continuous memory (historical) DTC only.

Transmission Control Module (TCM) DTC Chart

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

DTC	Description	Action
P0A0A:00	High Voltage System Interlock Circuit: No Sub Type Information	GO to Pinpoint Test A .
All other DTCs	-	REFER to the Transmission Control Module (TCM) DTC chart in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Symptom Chart

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

ConditionPossible SourcesAction

- The High Voltage Traction Battery (HVTB) is noisy

- HVTB cooling fan
- Obstructions

- With the ignition in the ON position and the engine ON or OFF, listen in the HVTB area for unusl or excessive noise. COMPARE the noise to a similar vehicle. If noise from the fan is excessive, INSPECT the inlet and outlet air ducts for obstructions. If no obstructions are found and the fan is still noisy, INSTALL a new fan. REFER to High-Voltage Traction Battery Cooling Fan in this section.

- The low-voltage battery is discharged or voltage is low

- 12-volt battery
- DC/DC
- 12-volt battery cables

- REFER to Section 414-05 to diagnose the DC to DC Converter Control Module (DC/DC).

Pinpoint Tests

Pinpoint Test A: DTC P0A0A:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Energy Control Module (BECM) checks for continuity of the high-voltage system interlock circuit. The interlock circuit must have continuity before high-voltage will be supplied to the vehicle. The interlock circuit voltage travels through each of the high-voltage components and high-voltage cables and back to the BECM . This fault will illuminate the stop safely hazard (red triangle) warning indicator and shut down the vehicle.

- DTC P0A0A:00 (High Voltage System Interlock Circuit: No Sub Type Information) - Fault sets when the BECM does not sense interlock circuit continuity. This indicates the interlock circuit is open.

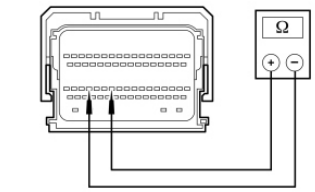
This pinpoint test is intended to diagnose the following:
- Air Conditioning Compressor Module (ACCM)
- BECM
- DC to DC Converter ControModule (DC/DC)
- Transmission Control Module (TCM) (part of Electronically Controlled Continuously Variable Transmission (eCVT))
- High-voltage cables

PINPOINT TEST A: DTC P0A0A:00

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

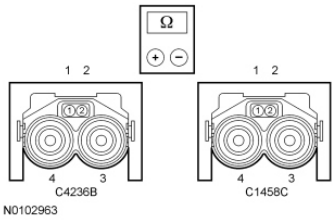
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take

A1 CHECK BECM PID HIGH VOLTAGE INTERLOCK INPUT STATUS (VOLTINTINP)	
• Ignition ON. • Connect the scan tool. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • Monitor the BECM PID VOLTINTINP. • **Does the PID VOLTINTINP read closed?**	**Yes** Concern is not present at this time and may be intermittent. INSPECT all high-voltage connections. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A2 .
A2 MEASURE RESISTANCE OF INTERLOCK CIRCUIT	
• Ignition OFF. • Disconnect: BECM C4237B. • Measure the resistance between BECM C4237B-44, circuit J1-A44 harness side and BECM C4237B-47, circuit J1-A47 harness side.  N0108918 • Repeat the measurement between BECM C4237B-44, circuit J1-A44 harness side and BECM C4237B-47, circuit J1-A47 harness side while wiggling the connectors and flexing the wire harness, where accessible. • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A3 .
A3 CHECK INTERLOCK CIRCUIT TO TCM	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the High Voltage Traction Battery (HVTB) system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect the 12-volt battery. Refer to Section 414-01 . • Disconnect: High-voltage Bussed Electrical Center (BEC) C4236B. • Disconnect: TCM C1458C.	**Yes** GO to A4 . **No** INSTALL new high-voltage cables. REFER to High-Voltage Cables in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

- Measure the resistance between high-voltage BEC C4236B, harness side and TCM C1458C, harness side as follows:

BEC C4236B	Circuit	TCM C1458C
C4236B-1	CYB04 (VT/BN)	C1458C-1
C4236B-2	CYB03 (BN/YE)	C1458C-2



- Repeat the measurement between BEC C4236B, harness side and TCM C1458C, harness side while wiggling the connectors and flexing the wire harness, where accessible.
- **Are the resistances less than 5 ohms?**

A4 CHECK INTERLOCK CIRCUIT TO ACCM AND DC/DC

- Disconnect: BEC C4236A.
- Disconnect: ACCM C1469B.
- Disconnect: DC/DC C1457A.
- Measure the resistance between high-voltage BEC C4236A, harness side, ACCM C1469B, harness side and DC/DC C1457A, harness side as follows:

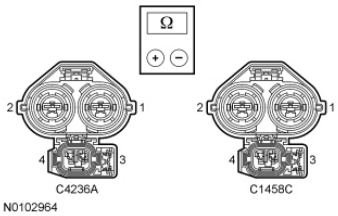
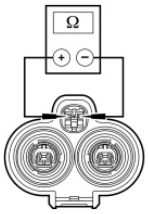
BEC C4236A	Circuit	DC/DC C1457A
C4236A-3	CYD02 (WH/BN)	C1457A-3

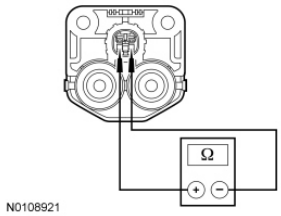
BEC C4236A	Circuit	ACCM C1469B
C4236A-4	CYB03 (BN/YE)	C1469B-4

ACCM C1469B	Circuit	DC/DC C1457A
C1469B-3	CYD01 (BN/WH)	C1457A-4

Yes
GO to A5 .

No
INSTALL new high-voltage cables. REFER to High-Voltage Cables in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0102964 • Repeat the measurements between BEC C4236A, harness side, ACCM C1469B, and DC/DC C1457A, harness side while wiggling the connectors and flexing the wire harness, where accessible. • **Are the resistances less than 5 ohms?**	
A5 CHECK DC/DC INTERLOCK RESISTANCE	
• Measure the resistance between DC/DC C1457A pin 3 and pin 4, component side.  N0108919 • **Is the resistance less than 5 ohms?**	**Yes** GO to A6 . **No** INSTALL a new DC/DC . REFER to Section 414-05 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A6 CHECK ACCM INTERLOCK RESISTANCE	
• Measure the resistance between ACCM C1469B, pin 3 and pin 4, component side.  N0108920 • **Is the resistance less than 5 ohms?**	**Yes** GO to A7 . **No** INSTALL a new ACCM and A/C compressor assembly. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
A7 CHECK TCM INTERLOCK RESISTANCE	
• Measure the resistance between TCM C1458C, pin 1 and pin 2, component side.	**Yes** GO to A8 . **No** INSTALL a eCVT . REFER to Section 307-01C . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 • **Is the resistance less than 5 ohms?**	
A8 CHECK THE HIGH-VOLTAGE CABLES USING BECM PID HIGH VOLTAGE INTERLOCK INPUT STATUS (VOLTINTINP)	
• Install new high-voltage cables. Refer to High-Voltage Cables in this section. • Connect the 12-volt battery. Refer to Section 414-01 . • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • Monitor the BECM PID VOLTINTINP. • **Does the PID VOLTINTINP read closed?**	**Yes** Repair is complete. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to A9 .
A9 CHECK THE DC/DC USING BECM PID HIGH VOLTAGE INTERLOCK INPUT STATUS (VOLTINTINP)	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect the 12-volt battery. Refer to Section 414-01 . • Install a new DC/DC . Refer to Section 414-05 . • Connect the 12-volt battery. Refer to Section 414-01 . • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • Monitor the BECM PID VOLTINTINP. • **Does the PID VOLTINTINP read closed?**	**Yes** Repair is complete. CLEAR the DTCs. REPEAT the self-test. TEST the systefor normal operation. **No** GO to A10 .
A10 CHECK THE ACCM USING BECM PID HIGH VOLTAGE INTERLOCK INPUT STATUS (VOLTINTINP)	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal**	**Yes** Repair is complete. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No**

injury or death. • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect the 12-volt battery. Refer to Section 414-01 . • Install a new ACCM . Refer to Section 412-01 . • Connect the 12-volt battery. Refer to Section 414-01 . • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • Monitor the BECM PID VOLTINTINP. • **Does the PID VOLTINTINP readlosed?**	GO to A11 .
A11 CHECK THE HVTB USING BECM PID HIGH VOLTAGE INTERLOCK INPUT STATUS (VOLTINTINP)	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect the 12-volt battery. Refer to Section 414-01 . • Install a new HVTB (includes HVTB system wire harness). Refer to High-Voltage Traction Battery in this section. • Connect the 12-volt battery. Refer to Section 414-01 . • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • Monitor the BECM PID VOLTINTINP. • **Does the PID VOLTINTINP read closed?**	**Yes** Repair is complete. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new eCVT . REFER to Section 307-01C . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test B: DTC P0A7D:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Energy Control Module (BECM) monitors the High Voltage Traction Battery (HVTB) state-of-charge. When voltage drops to a low level, the vehicle will shut down and/or will not start/re-start until the voltage level has been increased to a nominal level. This condition may occur if the vehicle has been stored for an extended period of time. The stop safely hazard (red triangle) warning indicator will illuminate and the vehicle will shut down and not re-start.

- P0A7D:00 (Hybrid Battery Pack State Of Charge Low: No Sub Type Information) - Fault sets when the ignition switch is first turned to the ON position, or when the ignition switch is in the START position and battery pack voltage falls below a threshold. Reports as a continous memory (historical) DTC only.

This pinpoint test is intended to diagnose the following:

- HVTB

PINPOINT TEST B: DTC P0A7D:00

Test Step	Result / Action to Take
B1 RETRIEVE ALL BECM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Do any DTCs other than P0A7D:00 exist?**	**Yes** REFER to the Battery Energy Control Module (BECM) DTC Chart and diagnose all other DTCs first. **No** GO to B2 .
B2 MONITOR BECM PIDs HYBRID BATTERY MINIMUM BATTERY MODULE VOLTAGE (HEVMINVOLT) AND HYBRID BATTERY PACK VOLTAGE (BATPACKVOLT)	
• Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • Monitor BECM PIDs HEVMINVOLT and BATPACKVOLT. • **Is HEVMINVOLT above 4.8 volts and/or BATPACKVOLT above 158 volts?**	**Yes** Concern not present at this time. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test C: DTC P0A7E:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine running or OFF, the Battery Energy Control Module (BECM) monitors and maintains the High Voltage Traction Battery (HVTB) temperature within a specific range. The HVTB has an external fan that circulates air within the HVTB so a specific temperature range is maintained. A thermistor is mounted to the inlet air duct which monitors inlet air temperature along with 5 thermistors inside the HVTB which all monitor HVTB temperature. The ideal HVTB temperature is 25°C

(77°F) with a desired range of 20°C (68°F) to 30°C (86°F). The BECM will shut the vehicle down and the powertrain malfunction (wrench) warning indicator will illuminate when the fault condition is present.

- DTC P0A7E:00 (Hybrid Battery Pack Over Temperature: No Sub Type Information) - Fault sets if the HVTB temperature exceeds 60°C (140°F).

This pinpoint test is intended to diagnose the following:

- HVTB fan
- HVTB inlet air duct
- BECM

PINPOINT TEST C: DTC P0A7E:00

Test Step	Result / Action to Take
C1 CHECK BECM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0A81:00 or P0A82:00 retrieved?**	**Yes** For DTC P0A81:00, GO to Pinpoint Test D . For DTC P0A82:00, GO to Pinpoint Test E . **No** GO to C2 .
C2 VERIFY THE HVTB FAN IS OPERATIONAL	
• Carry out the self-test of the BECM while noting the HVTB cooling fan operation. • **Did the HVTB cooling fan operate during self-test?**	**Yes** GO to C3 . **No** GO to Pinpoint Test D .
C3 VERIFY THE VEHICLE INLET AND OUTLET AIR DUCTS ARE CLEAR	
• Ignition OFF. • Open the trunk and fold down the rear seat back to gain access to the HVTB . • Check the outlet air duct in the trunk on the side of the battery and air inlet duct at the bottom of the battery in the passenger compartment for any debris or obstruction. • **Are the inlet and outlet air ducts free of debris or obstructions?**	**Yes** GO to C4 . **No** REMOVE the debris or obstruction from air inlet or outlet duct. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C4 CHECK THE HVTB FAN OPERATION	
• Start the engine. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • Monitor the BECM PIDs Fan Speed Demanded (FAN_DEM) and Fan Speed Indicated (FAN_IND). • Using the output state control FAN_DEM,	**Yes** GO to C5 . **No** INSTALL a new HVTB cooling fan. REFER to High-Voltage Traction Battery Cooling Fan in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

set the fan speed to 3,000 rpm. • Monitor the PID FAN_IND. • **Does the PID FAN_IND read between 2,400 and 3,150?**	
C5 CHECK BECM PID HYBRID BATTERY TEMPERATURE (BATT_TEMP)	
• Drive the vehicle while monitoring the BECM PIDs FAN_IND and BATT_TEMP. • When PID BATT_TEMP reaches 35°C (95°F) monitor PID FAN_IND. • **Does PID FAN_IND read at least 1,500 rpm?**	**Yes** GO to C6 . **No** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
C6 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test D: DTC P0A81:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine running or OFF (the engine must have started at least once after the ignition was cycled to ON), the external fan for the High Voltage Traction Battery (HVTB) circulates air to maintain a specific temperature range. The fan operation is controlled by the Battery Energy Control Module (BECM) based upon information received from thermistors located inside the HVTB . The stop safely hazard (red triangle) warning indicator or powertrain malfunction (wrench) warning indicator will illuminate when a fault condition is present.

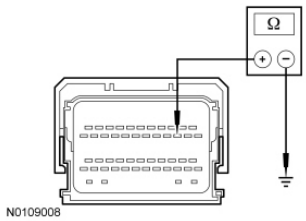
- P0A81:00 (Hybrid Battery Pack Cooling Fan 1 Control Circuit Open: No Sub Type Information) - Fault sets if the BECM fan control output circuit indicates a fault for 5 seconds or more.

This pinpoint test is intended to diagnose the following:

- BECM
- Cooling fan
- HVTB

PINPOINT TEST D: DTC P0A81:00

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 RETRIEVE ALL BECM DTCs	
• Ignition OFF. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: lf-Test - BECM . • **Is DTC P0A81:00 or P0A82:00 present?**	**Yes** GO to D2 . **No** INSPECT inline C4013 and HVTB cooling fan C4232 for pushed-out or corroded pins and REPAIR as necessary. WIGGLE the wiring harness. REPEAT the self-test. If DTC P0A81:00 or DTC P0A82:00 is retrieved, GO to D2 . If no DTCs are retrieved, The concern may have been caused by pushed-out or corroded pins. RETURN the vehicle to the customer.
D2 CHECK FOR A SHORT TO GROUND IN THE FAN CONTROL CIRCUIT	
• Ignition OFF. • Disconnect: HVTB Cooling Fan C4232. • Disconnect: BECM C4237A. • Measure the resistance between BECM C4237A-14, circuit VYB18 (WH/GN), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D3 CHECK HVTB COOLING FAN GROUND CIRCUIT	
• Connect: BECM C4237A. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM (fan still disconnected).	**Yes** INSTALL a new fan. REFER to High-Voltage Traction Battery Cooling Fan in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• **Is DTC P0A82:00 present?**	**No** GO to D4 .
D4 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test E: DTC P0A82:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine running or OFF (the engine must have started at least once after the ignition was cycled to ON), the external fan for the High Voltage Traction Battery (HVTB) circulates air to maintain a specific temperature range. The fan operation is controlled by the Battery Energy Control Module (BECM) based upon information received from thermistors located inside the HVTB . The BECM monitors the frequency returned to the BECM from the fan to determine actual fan speed. This signal may be incorrect if the fan or wiring are at fault. Powertrain malfunction (wrench) warning indicator will illuminate.

- P0A82:00 (Hybrid Battery Pack Cooling Fan 1 Performance/Stuck Off: No Sub Type Information) - Fault sets when cooling fan speed does not match what was commanded by the BECM for 8 seconds.

This pinpoint test is intended to diagnose the following:

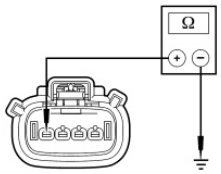
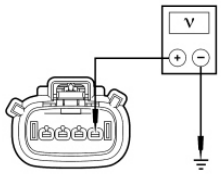
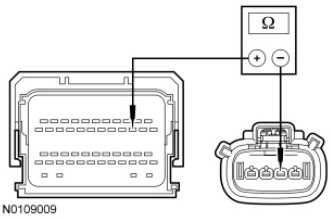
- Fuse
- Wiring, terminals or connectors
- HVTB cooling fan
- BECM

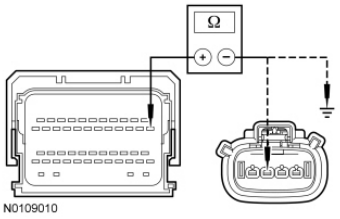
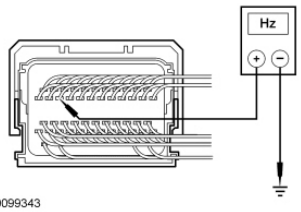
PINPOINT TEST E: DTC P0A82:00

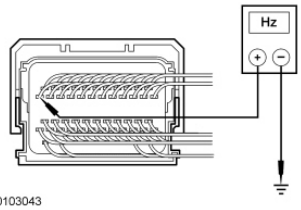
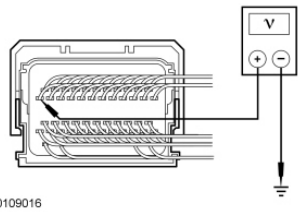
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 RETRIEVE ALL BECM DTCs	
• Ignition OFF. • Connect the scan tool.	**Yes** GO to E2 .

• Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self-Test - BECM . • **Is DTC P0A81:00 or P0A82:00 present?**	**No** INSPECT inline C4013 and HVTB cooling fan C4232 for pushed-out or corroded pins and REPAIR as necessary. WIGGLE the wiring harness. REPEAT the self-test. If DTC P0A81:00 or DTC P0A82:00 is retrieved, GO to E2 . If no DTCs are retrieved, The concern may have been caused by pushed-out or corroded pins. RETURN the vehicle to the customer.
E2 VERIFY THE VEHICLE INLET AND OUTLET AIR DUCTS ARE CLEAR	
• Ignition OFF. • Open the trunk and fold down the rear seat back to gain access to the HVTB . • Check the outlet air duct in the trunk on the side of the battery and air inlet duct at the bottom of the battery in the passenger compartment for any debris or obstruction. • **Are the inlet and outlet air ducts free of debris or obstructions?**	**Yes** GO to E3 . **No** REMOVE the debris or obstruction from air inlet or outlet duct. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E3 CHECK HVTB COOLING FAN SPEED	
• Connect the scan tool. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • Ignition in the ON position. • Using the output state control PID Fan Speed Demanded (FAN_DEM), set the HVTB cooling fan speed to approximately 3,000 rpm. • Monitor the PID Fan Speed Indicated (FAN_IND). • **Does the PID FAN_IND read between 2,700 and 3,300?**	**Yes** END output state control. GO to E8 . **No** END output state control. GO to E4 .
E4 CHECK HVTB COOLING FAN GROUND CIRCUIT	
• Ignition OFF. • Disconnect: HVTB Cooling Fan C4232. • Measure the resistance between HVTB cooling fan C4232-4, circuit GD128 (BK/GN), harness side and ground.	**Yes** GO to E5 . **No** REPAIR high resistance or an open in the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0099345 • **Is the resistance less than 5 ohms?**	
E5 CHECK HVTB COOLING FAN POWER CIRCUIT	
• Ignition ON. • Measure the voltage between HVTB cooling fan C4232-1, circuit SBP03 (BU/RD), harness side and ground.  N0099344 • **Is the voltage greater than 10 volts?**	**Yes** GO to E6 . **No** VERIFY the Smart Junction Box (SJB) fuse 3 (15A) is OK. If the fuse is OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E6 CHECK FOR AN OPEN FAN CONTROL CIRCUIT	
• Ignition OFF. • Disconnect: BECM C4237A. • Measure the resistance between BECM C4237A-14, circuit VYB18 (WH/GN), harness side and HVTB cooling fan C4232-2, circuit VYB18 (WH/GN), harness side .  N0109009 • **Is the resistance less than 5 ohms?**	**Yes** GO to E7 . **No** REPAIR high resistance or an open in the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E7 CHECK FOR AN OPEN OR A SHORT TO GROUND IN THE FAN FEEDBACK CIRCUIT	
• Measure the resistance between BECM C4237A-12, circuit VYB19 (GY/VT), harness side and HVTB cooling fan C4232-3, circuit VYB19 (GY/VT), harness side.	**Yes** GO to E8 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for

• Measure the resistance between BECM C4237A-12, circuit VYB19 (GY/VT), harness side and ground.  • **Is the resistance of the circuit less than 5 ohms and greater than 10,000 ohms to ground?**	normal operation.
E8 MEASURE SIGNAL FROM BECM FOR FAN CONTROL CIRCUIT	
• Connect: BECM C4237A (leave fan disconnected). • Ignition ON. • Using the output state control PID Fan Speed Demanded (FAN_DEM), set the HVTB cooling fan speed to approximately 3,000 rpm. • Measure the frequency by back-probing between BECM C4237A-14, circuit VYB18 (WH/GN), harness side and ground.  • **Is the frequency approximately 90-110 Hz?**	**Yes** GO to E9 . **No** GO to E11 .
E9 MEASURE SIGNAL FROM BECM FOR FAN FEEDBACK CIRCUIT	
• With the ignition still in the ON position and the HVTB cooling fan still commanded to 3,000 rpm, measure the frequency by back-probing between BECM C4237A-12, circuit VYB19 (GY/VT), harness side and ground.	**Yes** GO to E11 . **No** GO to E10 .

 • **Is the frequency approximately 205-245 Hz?**	
E10 MEASURE VOLTAGE FROM BECM FOR FAN FEEDBACK CIRCUIT	
• With the ignition still in the ON position and the HVTB cooling fan still commanded to 3,000 rpm, measure the voltage by back-probing between BECM C4237A-12, circuit VYB19 (GY/VT), harness side and ground.  • **Is the voltage approximately 3 to 7 volts?**	**Yes** GO to E11 . **No** INSTALL a new HVTB cooling fan. REFER to High-Voltage Traction Battery Cooling Fan in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
E11 CHECK FOR CORRECT BECM OPERATION	
• Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self-Test - BECM . • Operate the system and determine if the concern is still present. • **Is the original DTC stilesent?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test F: DTCs P0A8B:64

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

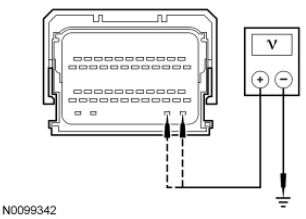
With the ignition in the ON position and the engine running or OFF (the engine must have started at least once after the ignition was cycled to ON), the Electronically Controlled Continuously Variable Transmission (eCVT) engages the generator (also in the eCVT), which charges the High Voltage Traction Battery (HVTB) and supplies high-voltage to the DC to DC Converter Control Module (DC/DC). The DC/DC charges the low-voltage battery which is used to power the PCM and low voltage components. The DC/DC steps the high voltage down to 12 volts (operating range of 13.3-14.7 volts). This DTC may indicate a low state-of-charge in the 12-volt battery or a Battery Energy Control Module (BECM) fault. If the 12-volt battery has recently had the terminals disconnected/cleaned or if a new 12-volt battery has been recently installed, this DTC will also be set. When a fault is present, the system will attempt to continue normal operation. There is no warning indicator for this fault.

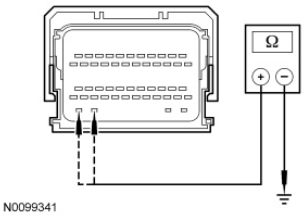
- DTC P0A8B:64 (14 Volt Power Module System Voltage: Signal Plausibility) - Fault sets when voltage less than 2.5 volts or greater than 25 volts on the BECM input circuit is detected.

This pinpoint test is intended to diagnose the following:
- 12-volt battery
- Circuitry
- BECM

PINPOINT TEST F: DTC P0A8B:64

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 CHECK FOR 12-VOLT INPUT	
• Ignition OFF. • Disconnect: BECM C4237A. • Ignition ON. • Measure the voltage between BECM C4237A-47, circuit SBB17 (RD), harness side and ground; and between BECM C4237A-48, circuit SBB17 (RD), harness side and ground.  • **Are the voltages greater than 10 volts?**	**Yes** GO to F2 . **No** VERIFY the Smart Junction Box (SJB) fuse 17 (10A) is OK. If the fuse is OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
F2 CHECK FOR GROUND CIRCUIT	

• Ignition OFF. • Measure the resistance between BECM C4237A-49, circuit GD126 (BK/WH), harness side and ground; and between BECM C4237A-50, circuit GD126 (BK/WH), harness side and ground.  • **Are the resistances less than 5 ohms?**	**Yes** GO to F3 . **No** REPAIR the circuit(s) as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
F3 CHECK FOR CORRECT BECM OPERATION	
• Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test G: DTC P0A9D:00 or P0A9E:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine running or OFF, the Battery Pack Sensor Module (BPSM) monitors the High Voltage Traction Battery (HVTB) internal temperature. The BPSM communicates the HVTB temperature (in addition to other information) to the Battery Energy Control Module (BECM) through a dedicated Controller Area Network (CAN). There is also a HVTB inlet air temperature sensor mounted to the inlet air duct which monitors inlet air temperature to the HVTB . The BECM uses the information from the various temperature sensors to control and maintain HVTB temperature by controlling the HVTB cooling fan. The ideal HVTB temperature is 25°C (77°F) with a desired range of 20°C (68°F) to 30°C (86°F).

- P0A9D:00 (Hybrid Battery Temperature Sensor A Circuit Low: No Sub Type Information) - Fault sets if BECM senses an open or short to ground in the thermistor circuitry.
- P0A9E:00 (Hybrid Battery Temperature Sensor A Circuit High: No Sub Type Information) - Fault sets if BECM senses a short to power in the thermistor circuitry.

This pinpoint test is intended to diagnose the following:
- HVTB

- BPSM

PINPOINT TEST G: DTCs P0A9D:00 OR P0A9E:00

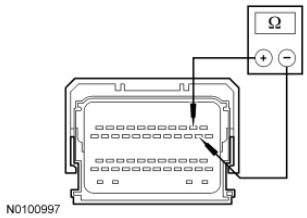
⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

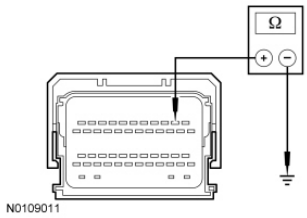
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
G1 MEASURE THERMISTOR RESISTANCE FROM BPSM	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: BPSM C4238B. • Measure the resistance between BPSM C4238B-2, circuit J2-B2, harness side and BPSM C4238B-13, circuit J2-B13, harness side. Use the following table to determine if the resistance values are correct.	**Yes** GO to G2 . **No** INSTALL a HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Temperature Range	Resistance Range
-30°C (-22°F) to -21°C (-5°F)	132,571 ohms - 76,491 ohms
-20°C (-4°F) to -11°C (13°F)	77,380 ohms - 46,573 ohms
-10°C (14°F) - 0°C (32°F)	46,762 ohms - 27,965 ohms
0°C (32°F) - 10°C (51°F)	29,164 ohms - 18,115 ohms
11°C (52°F) - 20°C (68°F)	17,931 ohms - 12,037 ohms
21°C (69°F) - 30°C (86°F)	11,842 ohms - 8,155 ohms
31°C (87°F) - 40°C (104°F)	7,850 ohms - 5,624 ohms
41°C (105°F) - 50°C (122°F)	5,602 ohms - 3,957 ohms



- **Is the resistance value correct for the temperature?**

G2 CHECK THERMISTOR FOR A SHORT TO GROUND	
• Measure the resistance between BPSM C4238B-2, circuit J2-B2, harness side and the battery case.  • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test H: DTC P0AA1:00 or P0AA2:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

When the ignition is turned on, the Battery Energy Control Module (BECM) makes various vehicle checks. If these checks are normal, the BECM sends a signal to the contactor to close and supply high-voltage power to the vehicle. The stop safely hazard (red triangle) warning indicator will illuminate for both DTCs. For DTC P0AA1:00, the vehicle will not start at next ignition cycle. For P0AA2:00, the vehicle is shut down.

- DTC P0AA1:00 (Hybrid Battery Positive Contactor Circuit Stuck Closed: No Sub Type Information) - If the contactor is stuck closed, this DTC will be set.
- DTC P0AA2:00 (Hybrid Battery Positive Contactor Circuit Stuck Open: No Sub Type Information) - If the contactor is stuck open for 2 seconds, this DTC will be set. Reports as a continuous memory (historical) DTC only.

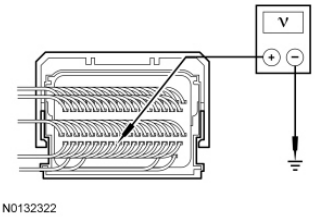
This pinpoint test is intended to diagnose the following:

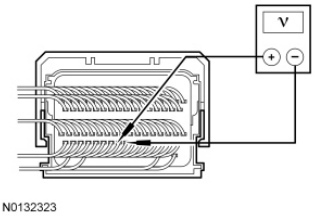
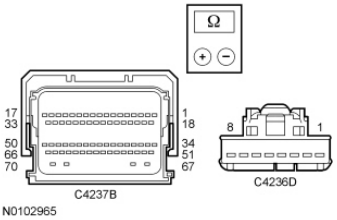
- High-voltage Bussed Electrical Center (BEC)
- BECM
- High Voltage Traction Battery (HVTB)

PINPOINT TEST H: DTC P0AA1:00 OR P0AA2:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
H1 MEASURE VOLTAGE AT THE BECM CONNECTOR	
• Ignition ON. • Measure the voltage between BECM C4237B-58, circuit J1-A58, harness side and ground by back-probing the BECM connector.  N0132322 • **Is the voltage between 5-6 volts?**	**Yes** GO to H2 . **No** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
H2 MEASURE VOLTAGE AT THE BECM CONNECTOR	

• Measure the voltage between BECM C4237B-58, circuit J1-A58, harness side and BECM C4237B-59, circuit J1-A59, harness side by back-probing the BECM connector.  N0132323 • **Is the voltage between 5-6 volts?**	**Yes** GO to H3 . **No** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
H3 CHECK CONTACTOR WIRING	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect the 12-volt battery. Refer to Section 414-01 . • Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: BECM C4237B. • Disconnect: High-voltage BEC C4236D. • Measure the resistance between high-voltage BEC C4236D-1, circuit J1-A58, harness side and BECM C4237B-58, circuit J1-A58, harness side; and between high-voltage BEC C4236D-2, circuit J1-A59 harness side and BECM C4237B-59, circuit J1-A59, harness side.  N0102965 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test I: DTC P0AA4:00 or P0AA5:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

When the ignition is turned on, the Battery Energy Control Module (BECM) makes various vehicle checks. If these checks are normal, the BECM sends a signal to the contactor to close which will supply power to the vehicle. The stop safely hazard (red triangle) warning indicator will illuminate for both DTCs. For DTC P0AA4:00, the vehicle will not start at the next ignition cycle. For P0AA5:00, the vehicle is shut down.

- DTC P0AA4:00 (Hybrid Battery Negative Contactor Circuit Stuck Closed: No Sub Type Information) - If the contactor is stuck closed, this DTC will be set. Reports as a continous memory (historical) DTC only.
- DTC P0AA5:00 (Hybrid Battery Negative Contactor Circuit Stuck Open: No Sub Type Information) - If the contactor is stuck open for 2 seconds, this DTC will be set.

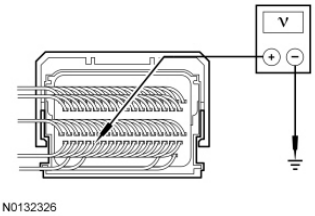
This pinpoint test is intended to diagnose the following:

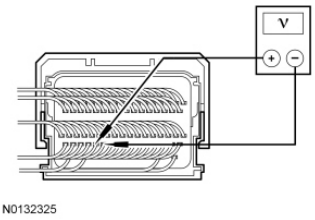
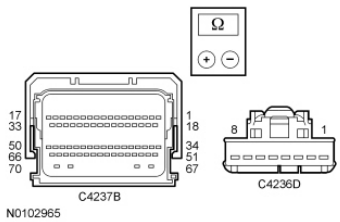
- BECM
- High-voltage Bussed Electrical Center (BEC)
- High Voltage Traction Battery (HVTB)

PINPOINT TEST I: DTC P0AA4:00 OR P0AA5:00

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orangee covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
I1 MEASURE VOLTAGE AT THE BECM CONNECTOR	
• Ignition ON. • Measure voltage between BECM C4237B-55, circuit J1-A55 harness side and ground, by back-probing the BECM connector.  N0132326 • **Is the voltage between 5-6 volts?**	**Yes** GO to I2 . **No** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
I2 MEASURE VOLTAGE AT THE BECM CONNECTOR	

• Ignition ON. • Measure voltage between BECM C4237B-55, circuit J1-A55, harness side, and BECM C4237B-56, circuit J1-A56, harness side, by back-probing the BECM connector.  N0132325 • **Is the voltage between 5-6 volts?**	**Yes** GO to I3 . **No** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
I3 CHECK CONTACTOR WIRING	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect the 12-volt battery Refer to Section 414-01 . • Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: BECM C4237B. • Disconnect: High-voltage BEC C4236D. • Measure the resistance between high-voltage BEC C4236D-7, circuit J1-A55, harness side and BECM C4237B-55, circuit J1-A55, harness side; and between high-voltage BEC C4236D-8, circuit J1-A56, harness side and BECM C4237B-56, circuit J1-A56, harness side.  N0102965 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test J: DTC P0AA6:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine running or OFF (the engine must have run at least once after the ignition was cycled to ON), the Battery Energy Control Module (BECM) monitors the electrical isolation (leakage resistance) between the high-voltage system and the vehicle chassis. A resistance value of less than 147,000 ohms is a failure. There are 2 types of failures. A mild fault will only illuminate the powertrain malfunction (wrench) warning indicator. A severe fault will illuminate the stop safely hazard (red triangle) warning indicator and the vehicle will not start at the next ignition cycle. The normal resistance value is between 950,000-1,330,000+ ohms.

- DTC P0AA6:00 (Hybrid Battery Voltage System Isolation Fault: No Sub Type Information) - If the BECM detects a high-voltage system leakage this DTC will be set. If the BECM detects a high-voltage system severe leakage, the vehicle will not restart and the BECM will set this DTC.

This pinpoint is intended to diagnose the following:
- DC to DC Converter Control Module (DC/DC)
- High-voltage cables
- High Voltage Traction Battery (HVTB)
- Electronically Controlled Continuously Variable Transmission (eCVT)
- Moisture/water penetration of high-voltage connectors
- A/C compressor

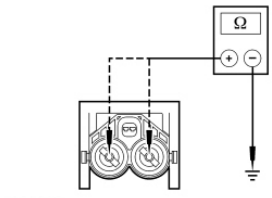
PINPOINT TEST J: DTC P0AA6:00

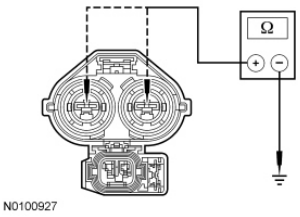
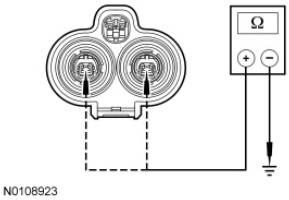
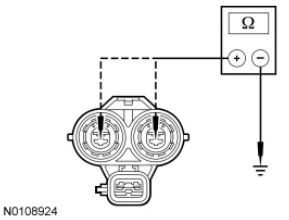
⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. Theigh-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

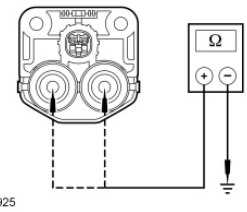
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: If DTC P0A78 or DTC P0A7A is present in the Transmission Control Module (TCM), diagnose those DTCs first. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Test Step	Result / Action to Take
J1 MONITOR THE LEAKAGE RESISTANCE PIDs	
• Ignition ON. • Connect the scan tool. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • **NOTE:** Clear the BECM DTCs or the vehicle may not start. • Start the engine. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • With the engine running, monitor the following BECM PIDs:	**Yes** CLEAR the DTCs. REPEAT the self-test. If the DTC is not present at this time, INSPECT the high-voltage system for any physical damage. With the service plug disconnected, INSPECT the high-voltage cables between the HVTB and eCVT and between HVTB and DC/DC or A/C compressor for chafing or damaged insulation. If damage is found, INSTALL new-high voltage cables. REFER to High-Voltage Cables in this section. If no damage was found,

♦ Leakage Resistance (Bus+) PID (LEAKRESPOS) ♦ Leakage Resistance (Bus-) PID (LEAKRESNEG) ♦ Leakage Resistance (Overall) PID (LEAKRESALL) • **Do the PIDs read greater than 147,000 ohms for at least 10 seconds?**	RETURN the vehicle to the customer. **No** GO to J2 .
J2 CHECK THE HVTB TO TCM HIGH-VOLTAGE CABLES	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect the 12-volt battery. Refer to Section 414-01 . • Disconnect: High-Voltage Bussed Electrical Center (BEC) C4236B. • Disconnect: TCM C1458C. • Measure the resistance between high-voltage BEC C4236B-3, circuit HYT04 (OG/BK), harness side and ground; and between high-voltage BEC C4236B-4, circuit HYT03 (OG/BK), harness side and ground while performing a wiggle test of the high-voltage cables.  N0100926 • **Are the resistances greater than 147,000 ohms?**	**Yes** GO to J3 **No** INSTALL new high-voltage cables. REFER to High-Voltage Cables in this section.
J3 CHECK THE ACCM AND DC/DC HIGH VOLTAGE CABLES	
• Disconnect: ACCM C1469B. • Disconnect: High-Voltage BEC C4236A. • Disconnect: DC/DC C1457A. • Measure the resistance between DC/DC C1457A-2, circuit HYT03 (OG/WH), harness side and ground; and between DC/DC C1457A-1, circuit HYT04	**Yes** GO to J4 . **No** INSTALL new high-voltage cables. REFER to High-Voltage Cables in this section. CLEAR the DTCs. REPEAT the

(OG/BK), harness side and ground while performing a wiggle test of the high-voltage cables.  N0100927 • **Are the resistances greater than 147,000 ohms?**	self-test. TEST the system for normal operation.
J4 CHECK THE DC/DC	
• Measure the resistance between DC/DC C1457 pin 1, component side and ground; and between DC/DC C1457 pin 2, component side and ground.  N0108923 • **Are the resistances greater than 147,000 ohms?**	**Yes** GO to J5 . **No** INSTALL a new DC/DC . REFER to DC/DC in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
J5 CHECK THE ACCM	
• Measure the resistance between Air Conditioning Compressor Module (ACCM) C1469B pin 1, component side and ground; and between ACCM C1469B pin 2, component side and ground.  N0108924 • **Are the resistances greater than 147,000 ohms?**	**Yes** GO to J6 . **No** INSTALL a new ACCM and A/C compressor assembly. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
J6 CHECK THE TCM	
• Measure the resistance between Transmission Control Module (TCM) C1458C pin 3, component side and ground; and between TCM C1458C pin 4, component side and ground.	**Yes** GO to J7 . **No** INSTALL a new Electronically Controlled Continuously Variable Transmission (eCVT). REFER to Section

 • **Are the resistances greater than 147,000 ohms?**	307-01C . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
J7 CHECK THE HIGH-VOLTAGE CABLES	
• Install new high-voltage cables. Refer to High-Voltage Cables in this section. • Connect the 12-volt battery. Refer to Section 414-01 . • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • **NOTE:** Clear the BECM DTCs or the vehicle may not start. • Start the engine. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • With the engine running, monitor the following BECM PIDs: ♦ Leakage Resistance (Bus+) PID (LEAKRESPOS) ♦ Leakage Resistance (Bus-) PID (LEAKRESNEG) ♦ Leakage Resistance (Overall) PID (LEAKRESALL) • **Do the PIDs read greater than 147,000 ohms for at least 10 seconds?**	**Yes** Repair is complete. TEST the system for normal operation. **No** GO to J8 .
J8 CHECK THE DC/DC	
WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect the 12-volt battery. Refer to Section 414-01 . • Install a new DC/DC . Refer to Section 414-05 . • Connect the 12-volt battery. Refer to Section 414-01 . • Connect: Service Disconnect Plug. • Ignition ON.	**Yes** Repair is complete. TEST the system for normal operation. **No** GO to J9 .

• Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • **NOTE:** Clear the BECM DTCs or the vehicle may not start. • Start the engine. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • With the engine running, monitor the following BECM PIDs: ♦ Leakage Resistance (Bus+) PID (LEAKRESPOS) ♦ Leakage Resistance (Bus-) PID (LEAKRESNEG) ♦ Leakage Resistance (Overall) PID (LEAKRESALL) • **Do the PIDs read greater than 147,000 ohms for at least 10 seconds?**	
J9 CHECK THE ACCM	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect the 12-volt battery. Refer to Section 414-01 . • Install a new ACCM . Refer to Section 412-01 . • Connect the 12-volt battery. Refer to Section 414-01 . • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • **NOTE:** Clear the BECM DTCs or the vehicle may not start. • Start the engine. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • With the engine running, monitor the foing BECM PIDs: ♦ Leakage Resistance (Bus+) PID (LEAKRESPOS) ♦ Leakage Resistance (Bus-) PID (LEAKRESNEG) ♦ Leakage Resistance (Overall) PID (LEAKRESALL) • **Do the PIDs read greater than 147,000 ohms for at least 10 seconds?**	**Yes** Repair is complete. TEST the system for normal operation. **No** GO to J10 .

J10 CHECK THE HVTB	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect the 12-volt battery. Refer to Section 414-01 . • Install a new HVTB . Refer to High-Voltage Traction Battery in this section. • Connect the 12-volt battery. Refer to Section 414-01 . • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • **NOTE:** Clear the BECM DTCs or the vehicle may not start. • Start the engine. • Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • With the engine running, monitor the following BECM PIDs: ♦ Leakage Resistance (Bus+) PID (LEAKRESPOS) ♦ Leakage Resistance (Bus-) PID (LEAKRESNEG) ♦ Leakage Resistance (Overall) PID (LEAKRESALL) • **Do the PIDs read greater than 147,000 ohms for at least 10 seconds?**	**Yes** Repair is complete. TEST the system for normal operation. **No** INSTALL a new eCVT . REFER to Section 307-01C . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test K: DTC P0AAE:00 or P0AAF:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine running or OFF, the Battery Pack Sensor Module (BPSM) monitors the High Voltage Traction Battery (HVTB) internal temperature. The BPSM communicates the HVTB temperature (in addition to other information) to the Battery Energy Control Module (BECM) through a dedicated Controller Area Network (CAN). There is also a HVTB inlet air temperature sensor mounted to the inlet air duct which monitors inlet air temperature to the HVTB . The BECM uses the information from the various temperature sensors to control and maintain HVTB temperature by controlling the HVTB cooling fan. The ideal HVTB temperature is 25°C (77°F) with a desired range of 20°C (68°F) to 30°C (86°F).

- P0AAE:00 (Hybrid Battery Pack Air Temperature Sensor A Circuit Low: No Sub Type Information) - Fault sets if the BECM senses greater than 90°C (194°F) from the HVTB inlet air temperature sensor for 10 seconds or more. Extreme ambient temperatures could also set this DTC.
- P0AAF:00 (Hybrid Battery Pack Air Temperature Sensor A Circuit High: No Sub Type Information) - Fault sets if the BECM senses less than -45°C (-49°F) from the HVTB inlet airensor for 10 seconds or more. Extreme ambient temperatures could also set this DTC.

This pinpoint test is intended to diagnose the following:
- HVTB inlet air temperature sensor
- BECM
- HVTB

PINPOINT TEST K: DTC P0AAE:00 OR P0AAF:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

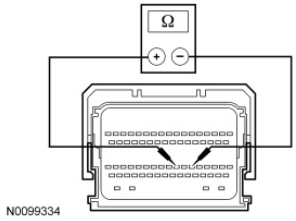
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>K1 MEASURE THERMISTOR RESISTANCE FROM BECM</td><td></td></tr>
<tr><td>
⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.

• Ignition OFF.
• Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section.
• Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section.
• Disconnect: Battery Energy Control Module (BECM) C4237B.
• Measure the resistance between BECM C4237B-39, circuit J1-A39, harness side and BECM C4237B-41, circuit J1-A41, harness side. Use the following table to determine if the resistance values are correct.

<table>
<tr><th>Temperature Range</th><th>Resistance Range</th></tr>
<tr><td>-30°C (-22°F) to -20°C (-5°F)</td><td>52,594 ohms - 28,582 ohms</td></tr>
<tr><td>-20°C (-4°F) to -10°C (13°F)</td><td>28,582 ohms - 16,120 ohms</td></tr>
</table>
</td><td>671 ohms - 469 ohms</td></tr>
</table>

-10°C (14°F) - 0°C (32°F)	16,120 ohms - 9,399 ohms
0°C (32°F) - 10°C (51°F)	9,399 ohms - 5,685 ohms
10°C (52°F) - 20°C (68°F)	5,685 ohms - 3,511 ohms
20°C (69°F) - 30°C (86°F)	3,511 ohms - 2,240 ohms
30°C (87°F) - 40°C (104°F)	2,240 ohms - 1,465 ohms
40°C (105°F) - 50°C (122°F)	1,465 ohms - 980 ohms
50°C (122°F) - 60°C (140°F)	980 ohms - 671 ohms



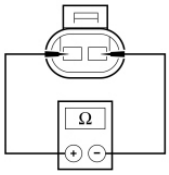
- **Is the resistance value correct for the temperature?**

Yes
GO to K3 .

No
GO to K2 . **K2 MEASURE THERMISTOR RESISTANCE AT THE THERMISTOR**

- Disconnect: HVTB Inlet Air Temperature Sensor C4253.
- Measure the resistance between HVTB inlet air temperature sensor C4253 pin 1 and pin 2, component side. Use the following table to determine if the resistance values are correct.

Resistance Range	
-30°C (-22°F) to -20°C (-5°F)	52,594 ohms - 28,582 ohms
-20°C (-4°F) to -10°C (13°F)	28,582 ohms - 16,120 ohms
-10°C (14°F) - 0°C (32°F)	16,120 ohms - 9,399 ohms
0°C (32°F) - 10°C (51°F)	9,399 ohms - 5,685 ohms
10°C (52°F) - 20°C (68°F)	5,685 ohms - 3,511 ohms
20°C (69°F) - 30°C (86°F)	3,511 ohms - 2,240 ohms
30°C (87°F) - 40°C (104°F)	2,240 ohms - 1,465 ohms
40°C (105°F) - 50°C (122°F)	1,465 ohms - 980 ohms
50°C (122°F) - 60°C (140°F)	980 ohms - 671 ohms
60°C (140°F) - 70°C (158°F)	671 ohms - 469 ohms



N0108926

- **Is the resistance value correct for the temperature?**

Yes
INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No
INSTALL a new HVTB inlet air temperature thermistor. REFER to High-Voltage Traction Battery Inlet Air Temperature Sensor in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **K3 CHECK FOR CORRECT BECM OPERATION**

- Ignition OFF.
- Check the BECM harness and component side connectors for:
  - ♦ corrosion.
  - ♦ pushed-out/bent pins.
- Connect the BECM and make sure the connectors seat correctly.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test L: DTC P0ABC:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Pack Sensor Module (BPSM) monitors battery pack voltage using voltage sensors within the High Voltage Traction Battery (HVTB). The BPSM communicates normal pack voltage to the Battery Energy Control Module (BECM) via a dedicated Controller Area Network (CAN). Nominal voltage should be between 179-343 volts.

- P0ABC:00 (Hybrid Battery Pack Voltage Sense A Circuit Low: No Sub Type Information) - Fault is set when BPSM senses voltage less than 172 volts for 1 second or more.

This pinpoint test is intended to diagnose the following:
- BPSM
- HVTB

PINPOINT TEST I: DTC P0ABC:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

Test Step	Result / Action to Take
I1 RETRIEVE ALL BECM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Do any DTCs other than P0ABC:00 exist?**	**Yes** REFER to the Battery Energy Control Module (BECM) DTC Chart and diagnose all other DTCs first. **No** GO to I2 .
I2 INSTALL A NEW BPSM	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service itructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Install a new BPSM . Refer to Battery Pack Sensor Module (BPSM) in this section. • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs -	**Yes** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The repair is now complete. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0ABC:00 retrieved?**	

Pinpoint Test M: DTC P0ABD:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Pack Sensor Module (BPSM) monitors battery pack voltage using voltage sensors within the High Voltage Traction Battery (HVTB). The BPSM communicates normal pack voltage which should be between 179-343 volts.

- P0ABD:00 (Hybrid Battery Pack Voltage Sense A Circuit High: No Sub Type Information) - Fault is set when BPSM senses voltage greater than 350 volts.

This pinpoint test is intended to diagnose the following:
- BPSM
- HVTB

PINPOINT TEST M: DTC P0ABD:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

Test Step	Result / Action to Take
M1 RETRIEVE ALL BECM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Do any DTCs other than P0ABD:00 exist?**	**Yes** REFER to the Battery Energy Control Module (BECM) DTC Chart and diagnose all other DTCs first. **No** GO to M2 .
M2 INSTALL A NEW BPSM	
	Yes

⚠ **WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering t system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.** ⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Install a new BPSM . Refer to Battery Pack Sensor Module (BPSM) in this section. • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0ABD:00 retrieved?**	INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The repair is now complete. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test N: DTC P0AC7:00 or P0AC8:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine running or OFF, the Battery Pack Sensor Module (BPSM) monitors the High Voltage Traction Battery (HVTB) internal temperature. The BPSM communicates the HVTB temperature (in addition to other information) to the Battery Energy Control Module (BECM) through a dedicated Controller Area Network (CAN). There is also a HVTB inlet air temperature sensor mounted to the inlet air duct which monitors inlet air temperature to the HVTB . The BECM uses the information from the various temperature sensors to control and maintain HVTB temperature by controlling the HVTB cooling fan. The ideal HVTB temperature is 25°C (77°F) with a desired range of 20°C (68°F) to 30°C (86°F).

- P0AC7:00 (Hybrid Battery Temperature Sensor B Circuit Low: No Sub Type Information) - Fault sets if BECM senses an open or short to ground in the thermistor circuitry.
- P0AC8:00 (Hybrid Battery Temperature Sensor B Circuit High) - Fault sets if BECM senses an short to power in the thermistor circuitry.

This pinpoint test is intended to diagnose the following:

- HVTB
- BPSM

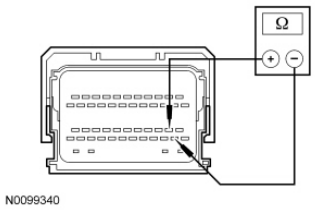
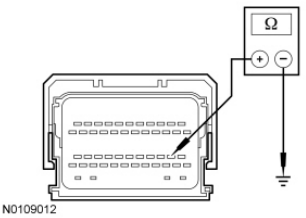
PINPOINT TEST N: DTCs P0A7:00 OR P0AC8:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
N1 MEASURE THERMISTOR RESISTANCE FROM BPSM	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: BPSM C4238B. • Measure the resistance between BPSM C4238B-25, circuit J2-B25, harness side and BPSM C4238B-36, circuit J2-B36, harness side.	**Yes** GO to N2 . **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Use the following table to determine if the resistance values are correct. **Temperature Range** / **Resistance Range** -30°C (-22°F) to -21°C (-5°F) — 132,571 ohms - 76 ohms -20°C (-4°F) to -11°C (13°F) — 77,380 ohms - 46,573 ohms -10°C (14°F) - 0°C (32°F) — 46,762 ohms - 27,965 ohms 0°C (32°F) - 10°C (51°F) — 29,164 ohms - 18,115 ohms 11°C (52°F) - 20°C (68°F) — 17,931 ohms - 12,037 ohms 21°C (69°F) - 30°C (86°F) — 11,842 ohms - 8,155 ohms 31°C (87°F) - 40°C (104°F) — 7,850 ohms - 5,624 ohms 41°C (105°F) - 50°C (122°F) — 5,602 ohms - 3,957 ohms  N0099340 • **Is the resistance value correct for the temperature?**	
N2 CHECK THERMISTOR FOR A SHORT TO GROUND	
• Measure the resistance between BPSM C4238B-25, circuit J2-B25, harness side and the battery case.  N0109012 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test O: DTC P0ACC:00 or P0ACD:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine running or OFF, the Battery Pack Sensor Module (BPSM) monitors the High Voltage Traction Battery (HVTB) internal temperature. The BPSM communicates the HVTB temperature (in addition to other information) to the Battery Energy Control Module (BECM) through a dedicated Controller Area Network (CAN). There is also a HVTB inlet air temperature sensor mounted to the inlet air duct which monitors inlet air temperature to the HVTB . The BECM uses the information from the various temperature sensors to control and maintain HVTB temperature by controlling the HVTB cooling fan. The ideal HVTB temperature is 25°C (77°F) with a desired range of 20°C (68°F) to 30°C (86°F).

- P0ACC:00 (Hybrid Battery Temperature Sensor C Circu: No Sub Type Information) - Fault sets if BECM senses an open or short to ground in the thermistor circuitry.
- P0ACD:00 (Hybrid Battery Temperature Sensor C Circuit High: No Sub Type Information) - Fault sets if BECM senses an short to power in the thermistor circuitry.

This pinpoint test is intended to diagnose the following:
- BPSM
- HVTB

PINPOINT TEST O: DTC P0ACC:00 OR P0ACD:00

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

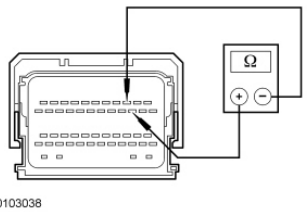
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
O1 MEASURE THERMISTOR RESISTANCE FROM BPSM	
⚠ **WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.**	**Yes** GO to O2 . **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.

- Ignition OFF.
- Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section.
- Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section.
- Disconnect: BPSM C4238B.
- Measure the resistance between BPSM C4238B-3, circuit J2-B3, harness side and BPSM C4238B-14, circuit J2-B14, harness side. Use the following table to determine if the resistance values are correct.

Temperature Range	Resistance Range
-30°C (-22°F) to -21°C (-5°F)	132,571 ohms - 76,491 ohms
-20°C (-4°F) to -11°C (13°F)	77,380 ohms - 46,573 ohms
-10°C (14°F) - 0°C (32°F)	46,762 ohms - 27,965 ohms
0°C (32°F) - 10°C (51°F)	29,164 ohms - 18,115 ohms
11°C (52°F) - 20°C (68°F)	17,931 ohms - 12,037 ohms
21°C (69°F) - 30°C (86°F)	11,842 ohms - 8,155 ohms
	7,850 ohms - 5,624 ohms
41°C (105°F) - 50°C (122°F)	5,602 ohms - 3,957 ohms



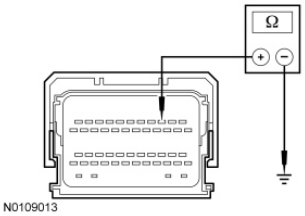
N0103038

- **Is the resistance value correct for the temperature?**

O2 CHECK THERMISTOR FOR A SHORT TO GROUND

- the resistance between BPSM C4238B-3, circuit J2-B3, harness side and the battery case.

Yes
INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 • **Is the resistance greater than 10,000 ohms?**	**No** INSTALL a HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test P: DTC P0AD9:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

When the ignition is turned on, the Battery Energy Control Module (BECM) makes various vehicle checks. If these checks are normal, the BECM sends a signal to the contactor to close which will supply power to the high-voltage vehicle systems. The Battery Pack Sensor Module (BPSM) monitors the battery voltage from inside the High Voltage Traction Battery (HVTB) and the high-voltage Bussed Electrical Center (BEC). If there is no high voltage to the positive contactor, the BECM will set the DTC and shut down the vehicle. The stop safely hazard (red triangle) warning indicator will illuminate.

- P0AD9:00 (Hybrid Battery Positive Contactor Control Circuit Open/GM: No Sub Type Information) - If there is no high voltage to the positive contactor, this DTC will be set.

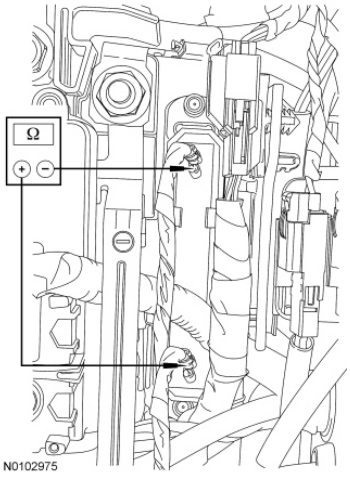
This pinpoint test is intended to diagnose the following:
- BECM
- High-voltage BEC
- HVTB

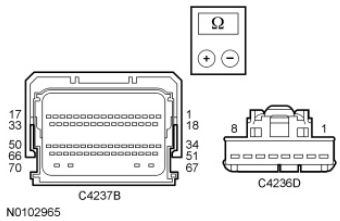
PINPOINT TEST P: DTC P0AD9:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Flure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
P1 MEASURE CONTACTOR RESISTANCE	
⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always	**Yes** GO to P2 .

install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: High-voltage BEC C4236D. • Measure the resistance between the: ♦ BEC C4236D pin 1 and pin 2, component side. ♦ BEC C4236D pin 4 and pin 5, component side. • **Are the resistances between 5-50 ohms?**	**No** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P2 CHECK CONTACTOR RESISTOR	
• With the service disconnect plug removed, measure the resistance of the precharge resistor in the BEC .  • **Is the resistance between 6-10 ohms?**	**Yes** GO to P3 . **No** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
P3 MEASURE CIRCUIT RESISTANCE	
• Disconnect: BECM C4237B. • Measure the resistance between the high-voltage BEC C4236D-1, circuit J1-A58, harness side and BECM C4237B-58, circuit J1-A58, harness side. • Measure the resistance between the high-voltage BEC C4236D-2, circuit J1-A59, harness side, and BECM C4237B-59, circuit J1-A59, harness side.	**Yes** GO to P4 . **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

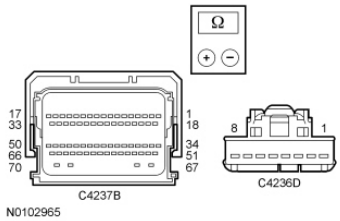


- **Are the resistances less than 5 ohms?**

P4 CHECK FOR OPEN IN CIRCUIT

- Measure the resistance between high-voltage BEC C4236D, harness side and BECM C4237B, harness side as follows:

High-Voltage BEC	Circuit	BECM
C4236D-4	J1-A61	C4237B-61
C4236D-5	J1-A62	C4237B-62



- **Are the resistances less than 5 ohms?**

Yes
GO to P5 .

No
INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

P5 CHECK FOR CORRECT BECM OPERATION

- Ignition OFF.
- Check the BECM harness and component side connectors for:
  - ♦ corrosion.
  - ♦ pushed-out/bent pins.
- Connect the BECM and make sure the connectors seat correctly.
- Operate the system and determine if the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test Q: DTC P0ADD:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

When the ignition is turned on, the Battery Energy Control Module (BECM) makes various vehicle checks. If these checks are normal, the BECM sends a signal to the contactor to close which will supply power to the high-voltage vehicle systems. The Battery Pack Sensor Module (BPSM) monitors the battery voltage from inside the High Voltage Traction Battery (HVTB) and compares it to voltage on the high-voltage Bussed Electrical Center (BEC) contactors. If there is no high voltage to the negative contactor, the BECM will set the DTC and shut down the vehicle. The stop safely hazard (red triangle) warning indicator will illuminate and the vehicle will shut down.

- P0ADD:00 (Hybrid Battery Negative Contactor Control Circuit Open: No Sub Type Information) - If there is no high voltage to the negative contactor, this DTC will be set.

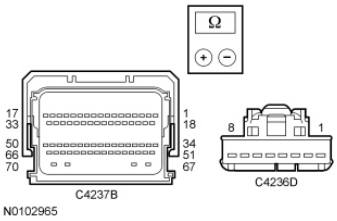
This pinpoint test is intended to diagnose the following:
- BECM
- High-voltage BEC
- HVTB

PINPOINT TEST Q: DTC P0ADD:00

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
Q1 MEASURE CONTACTOR RESISTANCE	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: High-voltage BEC C4236D. • Measure the resistance between high-voltage BEC C4236D pin 7 and pin 8, component side. • **Is the resistance between 5-50 ohms?**	**Yes** GO to Q2 . **No** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
Q2 MEASURE CIRCUIT RESISTANCE	

• Disconnect: BECM C4237B. • Measure the resistance between: ♦ high-voltage BEC C4236D-7, circuit J1-A55, harness side and BECM C4237B-55, circuit J1-A55, harness side. ♦ high-voltage BEC C4236D-8, circuit J1-A56, harness side and BECM C4237B-56, circuit J1-A56, harness side.  • **Are the resistances less than 5 ohms?**	**Yes** GO to Q3 . **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
Q3 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test R: DTC P0ADA:00 or P0ADE:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

When the ignition is turned on, the Battery Energy Control Module (BECM) makes various vehicle checks. If these checks are normal, the BECM sends a signal to the contactor to close which will supply power to the high-voltage vehicle systems. The Battery Pack Sensor Module (BPSM) monitors the battery voltage from inside the High Voltage Traction Battery (HVTB) and the high-voltage Bussed Electrical Center (BEC). The powertrain malfunction (wrench) warning indicator will be illuminated when a fault is present.

- P0ADA:00 (Hybrid Battery Positive Contactor Control Circuit Range/Performance: No Sub Type Information) - This DTC will set if positive contactor voltage is below or above 179-343 volts for 1 second or more.
- P0ADE:00 (Hybrid Battery Negative Contactor Control Circuit Range/Performance: No Sub Type

Information) - This DTC will set if voltage at the negative contactor is below or above 179-343 volts for 1 second or more.

This pinpoint test is inte to diagnose the following:

- BPSM
- High-voltage BEC
- HVTB

PINPOINT TEST R: DTC P0ADA:00 OR P0ADE:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

Test Step	Result / Action to Take
R1 RETRIEVE ALL BECM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Do any DTCs other than P0ADA:00 or P0ADE:00 exist?**	**Yes** REFER to the Battery Energy Control Module (BECM) DTC Chart and diagnose all other DTCs first. **No** GO to R2 .
R2 INSTALL A NEW HIGH-VOLTAGE BEC	
⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Install a new high-voltage BEC . Refer to High-Voltage Bussed Electrical Center in this section. • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Did DTC P0ADA:00 or P0ADE:00 return?**	**Yes** GO to R3 . **No** The repair is now complete. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
R3 INSTALL A NEW BPSM	

⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Install a new BPSM . Refer to Battery Pack Sensor Module (BPSM) in this section. • Connect: Service Disconnect Plug. • Ignition ON. • Using the scan tool, clear any BECM DTCs. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Did DTC P0ADA:00 or P0ADE:00 return?**	**Yes** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The repair is now complete. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test S: DTC P0AEA:00 or P0AEB:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine running or OFF, the Battery Pack Sensor Module (BPSM) monitors the High Voltage Traction Battery (HVTB) internal temperature. The BPSM communicates the HVTB temperature (in addition to other information) to the Battery Energy Control Module (BECM) through a dedicated Controller Area Network (CAN). There is also a HVTB inlet air temperature sensor mounted to the inlet air duct which monitors inlet air temperature to the HVTB . The BECM uses the information from the various temperature sensors to control and maintain HVTB temperature by controlling the HVTB cooling fan. The ideal HVTB temperature is 25°C (77°F) with a desired range of 20°C (68°F) to 30°C (86°F).

- P0AEA:00 (Hybrid Battery Temperature Sensor D Circuit Low: No Sub Type Information) - Fault sets if BECM senses an open or short to ground in the thermistor circuitry.
- P0AEB:00 (Hybrid Battery Temperature Sensor D Circuit High: No Sub Type Information) - Fault sets if the BECM senses a short to power in the thermistor circuitry.

This pinpoint test is intended to diagnose the following:
- BPSM
- HVTB

PINPOINT TEST S: DTC P0AEA:00 OR P0AEB:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The

high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>S1 MEASURE THERMISTOR RESISTANCE FROM BPSM</td><td></td></tr>
<tr><td>
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.

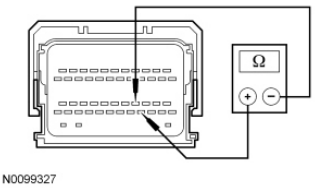
⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.

• Ignition OFF.
• Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section.
• Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section.
• Disconnect: BPSM C4238B.
• Measure the resistance between BPSM C4238B-27, circuit J2-B27, harness side and BPSM C4238B-38, circuit J2-B38, harness side. Use the following table to determine if the resistance values are correct.

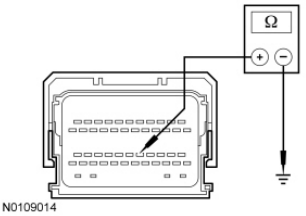
<table>
<tr><th>Temperature Range</th><th>Resistance Range</th></tr>
<tr><td>-30°C (-22°F) to -21°C (-5°F)</td><td>132,571 ohms - 76,491 ohms</td></tr>
<tr><td>-20°C (-4°F) to -11°C (13°F)</td><td>77,380 ohms - 46,573 ohms</td></tr>
</table>
</td><td>
Yes
GO to S2 .

No
INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section.
CLEAR the DTCs.
REPEAT the self-test.
TEST the system for normal operation.
</td></tr>
</table>

-10°C (14°F) - 0°C (32°F)	46,762 ohms - 27,965 ohms
0°C (32°F) - 10°C (51°F)	29,164 ohms - 18,115 ohms
11°C (52°F) - 20°C (68°F)	17,931 ohms - 12,037 ohms
21°C (69°F) - 30°C (86°F)	11,842 ohms - 8,155 ohms
31°C (87°F) - 40°C (104°F)	7,850 ohms - 5,624 ohms
41°C (105°F) - 50°C (122°F)	5,602 ohms - 3,957 ohms



- **Is the resistance value correct for the temperature?**

S2 CHECK THERMISTOR FOR A SHORT TO GROUND	
• Measure the resistance between BPSM C4238B-27, circuit J2-B27, harness side and the battery case.  • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test T: DTC P0AC0:00, P0AC1:00 or P0AC2:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Pack Sensor Module (BPSM) measures current flow through the contactors using current sensors mounted within the Bussed Electrical Center (BEC). The BPSM uses a 5-volt reference to the current sensors and measures the return voltage. This return voltage is translated into current flow by the BPSM . This information is communicated to the Battery Energy Control Module (BECM) via a dedicated Controller Area Network (CAN).

- P0AC0:00 (Hybrid Battery Pack Current Sensor A Circuit Range/Performance: No Sub Type Information) - Fault is set when the reference voltage offset is outside the normal range.
- P0AC1:00 (Hybrid Battery Pack Current Sensor A Circuit Low: No Sub Type Information) - Fault is set when the reference voltage is below 0.25 volt.
- P0AC2:00 (Hybrid Battery Pack Current Sensor A Circuit High: No Sub Type Information) - Fault is set when the reference voltage is above 4.75 volt.

This pinpoint test is intended to diagnose the following:

- High-voltage BEC
- BECM
- BPSM
- High Voltage Traction Battery (HVTB)

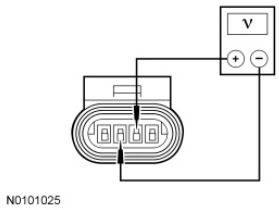
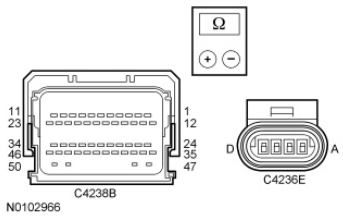
PINPOINT TEST T: DTC P0AC0:00, P0AC1:00 OR P0AC2:00

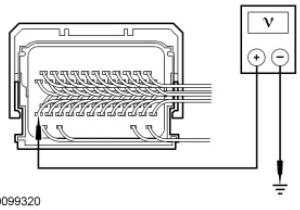
⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

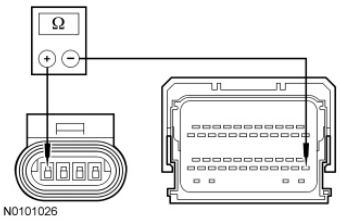
⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
T1 RETRIEVE ALL BECM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0B10:00 present?**	**Yes** GO to T2 **No** GO to T4 .
T2 MEASURE VOLTAGE AT CURRENT SENSOR CONNECTOR	
⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section.	**Yes** GO to T4 . **No** GO to T3 .

• Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: High-voltage BEC C4236E. • Ignition ON. • Measure the voltage between high-voltage BEC C4236E-B, circuit J2-B12, harness side and high-voltage BEC C4236E-C, circuit J2-B1, harness side.  N0101025 • **Is the voltage between 4.5 and 5.5 volts?**	
T3 CHECK CURRENT SENSOR CIRCUITS	
⚠ **WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Disconnect: BPSM C4238B. • With the service disconnect plug removed, measure the resistance between high-voltage BEC C4236E-B, circuit J2-B12, harness side and BPSM C4238B-12, circuit J2-B27, harness side; and between high-voltage BEC C4236E-C, circuit J2-B1, harness side and BPSM C4238B-1, circuit J2-B1, harness side.  N0102966 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
T4 MEASURE VOLTAGE AT BPSM CONNECTOR	

⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • If not previously removed, remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Connect: BEC C4236E (if previously disconnected). • Ignition ON. • With the service disconnect plug removed, measure the voltage between BPSM C4238B-35, circuit J2-B35, harness side and ground by back-probing the BPSM connector.  N0099320 • **Is the voltage between 2.25 and 2.75 volts?**	**Yes** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to T5 .
T5 CHECK CURRENT SENSOR SIGNAL CIRCUIT	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Disconnect: BPSM C4238B. • With the service disconnect plug removed, measure the resistance between high voltage BEC C4236E-D, circuit J2-B35, harness side and	**Yes** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new HVTB (includes

BPSM C4238B-35, circuit J2-B35, harness side.  • **Is the resistance less than 5 ohms?**	HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test U: DTC P0ADC:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

When the ignition is turned on, the Battery Energy Control Module (BECM) makes various vehicle checks. If these checks are normal, the BECM sends a signal to the contactor to close which will supply high-voltage power to the vehicle. If an overcurrent condition is sensed by the BECM , the stop safely hazard (red triangle) warning indicator is illuminated and the vehicle will shut down and/or not start.

- P0ADC:00 (Hybrid Battery Positive Contactor Control Circuit High: No Sub Type Information) - If the BECM detects overcurrent on the contactor control circuit for 1 second or more, this DTC will be set. Reports as a continuous memory (historical) DTC only.

This pinpoint test is intended to diagnose the following:

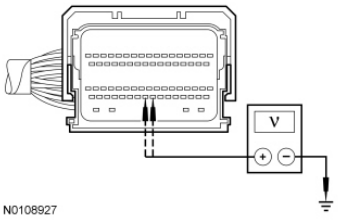
- BECM
- High-voltage Bussed Electrical Center (BEC)
- High Voltage Traction Battery (HVTB)

PINPOINT TEST U: DTC P0ADC:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may relt in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
U1 CHECK FOR SHORT IN CIRCUIT	
• Ignition OFF. • Disconnect: BECM C4237B. • Ignition ON. • Measure the voltage between BECM C4237B-58, circuit J1-A58, harness side and ground; and between BECM C4237B-59, circuit J1-A59, harness side and ground.  • **Is any voltage present?**	**Yes** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to U2 .
U2 MEASURE CONTACTOR COIL RESISTANCE	
⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: High-voltage BEC C4236D. • Measure the resistance between high-voltage BEC C4236D pin 1 and pin 2, component side. • **Is the resistance between 5-50 ohms?**	**Yes** GO to U3 . **No** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
U3 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion.	**Yes** INSTALL a new BECM . REFER to Battery Energy Control

♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Connect: High-Voltage BEC C4236D. • Install the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Connect: Service Disconnect Plug. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test V: DTC P0AFB:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

During vehicle operation, the High Voltage Traction Battery (HVTB) normal operating voltage range is between 179-343 volts. The electrical system is monitored by the Battery Energy Control Module (BECM) and Battery Pack Sensor Module (BPSM). As the voltage is used in the HVTB , a request to charge the battery is sent on the High Speed Controller Area Network (HS-CAN) to the Electronically Controlled Continuously Variable Transmission (eCVT) to send voltage to the battery to charge the battery and bring the operating voltage back to peak operating conditions. If battery voltage becomes too high, an over-charge condition is indicated. When battery voltage is too high, the stop safely hazard (red triangle) warning indicator is illuminated and the vehicle will shut down.

- P0AFB:00 (Hybrid Battery System Voltage High: No Sub Type Information) - Fault sets if the HVTB voltage is high for 10 seconds or more.

This pinpoint test is intended to diagnose the following:
- BECM
- BPSM

PINPOINT TEST V: DTC P0AFB:00

Test Step	Result / Action to Take
V1 RETRIEVE ALL BECM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM .	**Yes** REFER to the Battery Energy Control Module (BECM) DTC Chart and diagnose all other DTCs first. **No** GO to V2 .

• **Do any DTCs other than P0AFB:00 exist?**	
V2 MONITOR BECM PID HYBRID BATTERY PACK VOLTAGE (BATPACKVOLT)	
• Monitor BECM PID BATPACKVOLT. • **Is PIDs BATPACKVOLT below 344 volts?**	**Yes** INSTALL a new BPSM span>. REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test W: DTC P0AFD:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine ON or OFF, the Battery Pack Sensor Module (BPSM) monitors and maintains the High Voltage Traction Battery (HVTB) temperature in a specific range. A thermistor is mounted to the inlet air duct which monitors inlet air temperature along with thermistors inside the HVTB which monitor HVTB temperature. The ideal HVTB temperature is 25°C (77°F) with a desired range of 20°C (68°F) to 30°C (86°F). The HVTB is not designed to operate in temperatures below -40°C (-40°F). The Battery Energy Control Module (BECM) controls the temperature by adjusting the HVTB cooling fan speed. The BPSM communicates the HVTB and inlet air temperature to the BECM through a dedicated Controller Area Network (CAN).

- P0AFD:00 (Hybrid Battery Pack Temperature Too Low: No Sub Type Information) - Fault code sets if a thermistor within the battery senses temperature inside the battery was -40°C (-40°F).

This pinpoint test is intended to diagnose the following:

- BPSM
- HVTB

PINPOINT TEST W: DTC P0AFD:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this

vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
W1 MEASURE THERMISTOR RESISTANCE FROM BPSM	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: BPSM C4238B.	**Yes** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new ge Traction Battery" class="popup" onmouseover="this.className='popupnounderline';" onmouseout="this.className='popup';">HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

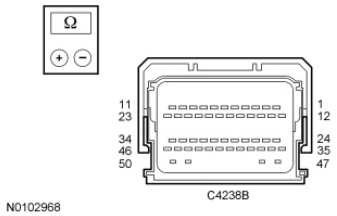
- Measure the resistance of each of the thermistors located within the HVTB . Use the following charts to determine pin location and expected resistance values.

Connector Pins

Thermistor	Connector	Pins
Thermistor A	C4238B	2 and 13
Thermistor B	C4238B	25 and 36
Thermistor C	C4238B	3 and 14
Thermistor D	C4238B	27 and 38
Thermistor E	C4238B	26 and 37

Temperature Range	Resistance Range
-30°C (-22°F) to -21°C (-5°F)	132,571 ohms - 76,491 ohms
-20°C (-4°F) to -11°C (13°F) 77,380 ohms - 46,573 ohms	
-10°C (14°F) - 0°C (32°F)	46,762 ohms - 27,965 ohms
0°C (32°F) - 10°C (51°F)	29,164 ohms - 18,115 ohms
11°C (52°F) - 20°C (68°F)	17,931 ohms - 12,037 ohms
21°C (69°F) - 30°C (86°F)	11,842 ohms - 8,155 ohms
31°C (87°F) - 40°C (104°F)	7,850 ohms - 5,624 ohms

41°C (105°F) - 50°C (122°F)	5,602 ohms - 3,957 ohms



- **Are the resistance values correct for the temperature?**

Pinpoint Test X: DTC P0B10:00 or P0B12:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Pack Sensor Module (BPSM) measures current flow through the contactors using current sensors mounted within the Bussed Electrical Center (BEC). The BPSM uses a 5-volt reference to the current sensors and measures the return voltage. This return voltage is translated into current flow by the BPSM .

- P0B10:00 (Hybrid Battery Pack Current Sensor B Circuit Low: No Sub Type Information) - Fault is set when the reference voltage is below 0.25 volt.
- P0B12:00 (Hybrid Battery Pack Current Sensor B Circuit Intermittent/Erratic: No Sub Type Information) - Fault is set when the reference voltage is outside of the normal 0.25-4.75 volt range.

This pinpoint test is intended to diagnose the following:

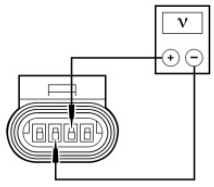
- High-voltage BEC
- BPSM
- High Voltage Traction Battery (HVTB)

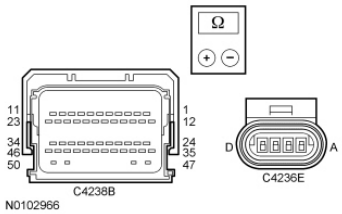
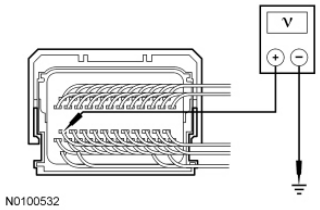
PINPOINT TEST X: DTC P0B10:00 OR P0B12:00

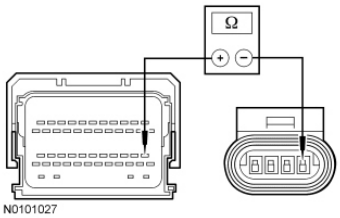
⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided throhigh-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
X1 RETRIEVE ALL BECM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0B10:00 present?**	**Yes** GO to X2 . **No** GO to X4 .
X2 MEASURE VOLTAGE AT CURRENT SENSOR CONNECTOR	
⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: High-voltage BEC C4236E. • Ignition ON. • Measure the voltage between high-voltage BEC C4236E-B, circuit J2-B12, harness side and high-voltage BEC C4236E-C, circuit J2-B1, harness side.  N0101025 • **Is the voltage between 4.5 and 5.5 volts?**	**Yes** GO to X4 . **No** GO to X3 .
X3 CHECK CURRENT SENSOR CIRCUITS	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.	**Yes** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• Disconnect: BPSM C4238B. • With the service disconnect plug removed, measure the resistance between high-voltage BEC C4236E-B, circuit J2-B12, harness side and BPSM C4238B-12, circuit J2-B12, harness side; and between high-voltage BEC C4236E-C, circuit J2-B1, harness side and BPSM C4238B-1, circuit J2-B1, harness side.  • **Are the resistances less than 5 ohms?**	**No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
X4 MEASURE VOLTAGE AT BPSM CONNECTOR	
⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • If not previously removed, remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Connect: High-voltage BEC C4236E (if previously disconnected). • Ignition ON. • With the service disconnect plug removed, measure the voltage between BPSM C4238B-24, circuit J2-B24, harness side and ground by back-probing the Battery Energy Control Module (BECM) connector.  	**Yes** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to X5 .

• **Is the voltage between 2.25 and 2.75 volts?**	
X5 CHECK CURRENT SENSOR SIGNAL CIRCUIT	
• Ignition OFF. • Disconnect: BPSM C4238B. • With the service disconnect plug removed, measure the resistance between high-voltage BEC C4236E-A, circuit J2-B24, harness side and BPSM C4238B-24, circuit J2-B24, harness side.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test Y: DTC P0B1B:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Pack Sensor Module (BPSM) monitors battery pack voltage by measuring voltage within the High Voltage Traction Battery (HVTB). The BPSM then broadcasts the voltage value via the dedicated Controller Area Network (CAN) to the BECM . Normal pack voltage should be between 179-343 volts.

- P0B1B:00 (Hybrid Battery Pack Voltage Sense C Circuit Low: No Sub Type Information) - Fault is set when BPSM senses low voltage.

This pinpoint test is intended to diagnose the following:

- HVTB
- BPSM

PINPOINT TEST Y: DTC P0B1B:00

Test Step	Result / Action to Take
Y1 RETRIEVE THE BECM DTCs	
	Yes

• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Are any DTCs other than P0B1B:00 retrieved?**	REFER to the Battery Energy Control Module (BECM) DTC Chart and diagnose all other DTCs first. **No** GO to Y2 .
Y2 INSTALL A NEW BPSM	
• Ignition OFF. • Install a new BPSM . Refer to Battery Pack Sensor Module (BPSM) in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0B1B:00 retrieve**	**Yes** GO to Y3 . **No** REPAIR is complete. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
Y3 INSTALL A NEW BECM	
• Ignition OFF. • Install a new BECM . Refer to Battery Energy Control Module (BECM) in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0B1B:00 retrieved?**	**Yes** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR is complete. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test Z: DTC P0BC4:00 or P0BC5:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

With the ignition in the ON position and the engine running or OFF, the Battery Pack Sensor Module (BPSM) monitors the High Voltage Traction Battery (HVTB) internal temperature. The BPSM communicates the HVTB temperature (in addition to other information) to the Battery Energy Control Module (BECM) through a dedicated Controller Area Network (CAN). There is also a HVTB inlet air temperature sensor mounted to the inlet air duct which monitors inlet air temperature to the HVTB . The BECM uses the information from the various temperature sensors to control and maintain HVTB temperature by controlling the HVTB cooling

fan. The ideal HVTB temperature is 25°C (77°F) with a desired range of 20°C (68°F) to 30°C (86°F).

- P0BC4:00 (Hybrid Battererature Sensor E Circuit Low: No Sup Type Information) - Fault sets if the BECM senses an open or short to ground in the thermistor circuitry.
- P0BC5:00 (Hybrid Battery Temperature Sensor E Circuit High: No Sub Type Information) - Fault sets if the BECM senses an short to power in the thermistor circuitry.

This pinpoint test is intended to diagnose the following:
- BPSM
- HVTB

PINPOINT TEST Z: DTC P0BC4:00 OR P0BC5:00

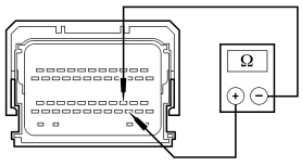
⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death. ⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
Z1 MEASURE THERMISTOR RESISTANCE FROM BPSM	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section.	**Yes** GO to Z2 . **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

- Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section.
- Disconnect: BPSM C4238B.
- Measure the resistance between BPSM C4238B-26, circuit J2-B26, harness side and BPSM C4238B-37, circuit J2-B37, harness side. Use the following table to determine if the resistance values are correct.

Temperature Range	Resistance Range	
-30°C (-22°F) to -21°C (-5°F)	132,571 ohms - 76,491 ohms	
-20°C (-4°F) to -11°C (13°F)	77,380 ohms - 46,573 ohms	
-10°C (14°F) - 0°C (32°F)	46,762 ohms - 27,965 ohms	
0°C (32°F) - 10°C (51°F)	29,164 ohms - 18,115 ohms	
11°C (52°F) - 20°C (68°F)	17,931 ohms - 12,037 ohms	
21°C (69°F) - 30°C (86°F)	11,842 ohms - 8,15D valign="top" align="center">31°C (87°F) - 40°C (104°F)	7,850 ohms - 5,624 ohms
41°C (105°F) - 50°C (122°F)	5,602 ohms - 3,957 ohms	

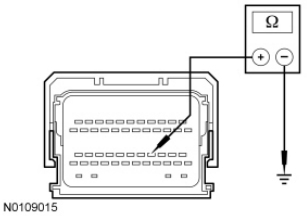


N0099328

- **Is the resistance value correct for the temperature?**

Z2 CHECK THERMISTOR FOR A SHORT TO GROUND | r>

- Measure the resistance between BPSM C4238B-26, circuit J2-B26, harness side and the battery case.



N0109015

- **Is the resistance greater than 10,000 ohms?**

Yes
INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No

	INSTALL a HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in the section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test AA: DTC P1A0A:11, P1A0A:12 or P1A0A:15

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Transmission Control Module (TCM) monitors immediate shutdown inputs from the Battery Energy Control Module (BECM). When the TCM detects an input out of the expected range, the BECM will set this DTC.

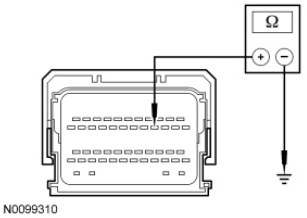
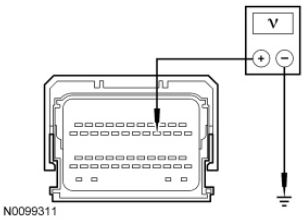
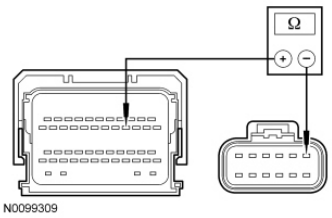
- P1A0A:11 (Immediate Shutdown Signal A: Circuit Short to Ground) - This DTC is set when the rapid shutdown circuit A is shorted to ground for 2 secos or more.
- P1A0A:12 (Immediate Shutdown Signal A: Circuit Short to Battery) - This DTC is set when the rapid shutdown circuit is shorted to battery for 1 second or more. This DTC sets during vehicle shutdown and reports as a continuous memory (historical) DTC only.
- P1A0A:15 (Immediate Shutdown Signal A: Circuit Short to Battery or Open) - This DTC is set when the circuit is shorted to battery or open for 2 seconds or more.

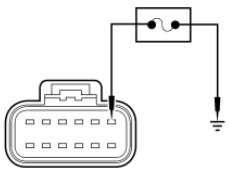
This pinpoint test is intended to diagnose the following:
- BECM
- TCM

PINPOINT TEST AA: DTCs P1A0A:11, P1A0A:12 OR P1A0A:15

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AA1 CHECK CIRCUIT FOR SHORT TO GROUND	
• Ignition OFF. • Disconnect: BECM C4237A. • Disconnect: TCM C1458A. • Measure the resistance of BECM C4215, circuit CYB16 (BN/VT), harness side and ground.	**Yes** GO to AA2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0099310 • **Is the resistance greater than 10,000 ohms?**	
AA2 CHECK CIRCUIT FOR SHORT TO BATTERY	
• Ignition ON. • Measure the voltage between BECM C4237A-15, circuit CYB16 (BN/VT), harness side and ground.  N0099311 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to AA3 .
AA3 CHECK CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between BECM C4237A-15, circuit CYB16 (BN/VT), harness side and TCM C1458A-6 circuit CYB16 (BN/VT), harness side.  N0099309 • **Is the resistance less than 5 ohms?**	**Yes** For DTC P1A0A:11 and P1A0A:12, GO to AA4 . For DTC P1A0A:15, GO to AA5 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AA4 RETRIEVE BECM DTCs	
• Connect: BECM C4237A (leave TCM C1458A disconnected). • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **NOTE:** When retrieving DTCs with TCM C1458A disconnected, DTC P1A0A:15 would normally be present.	**Yes** GO to AA6 . **No** CARRY OUT self-test of the TCM and REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of TCM DTCs.

• **Is DTC P1A0A:11 or P1A0A:12 retrieved?**	
AA5 RETRIEVE BECM DTCs WHILE GROUNDING CIRCUIT	
• Connect: BECM C4237A. • Connect a fused jumper wire between TCM C1458A-6, circuit CYB16 (BN/VT), harness side and ground.  N0102969 • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **NOTE:** When retrieving DTCs with TCM C1458A -6 shorted to ground, DTC P1A0A:11 would normally be present. • **Is DTC P1A0A:15 retrieved?**	**Yes** GO to AA6 . **No** CARRY OUT self-test of the TCM and REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of TCM DTCs. If no DTCs are retrieved, INSTALL a new Electronically Controlled Continuously Variable Transmission (eCVT). REFER to Section 307-01C .
AA6 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Connect: TCM C1458A. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test AB: DTC P1A15:11, P1A15:12 or P1A15:15

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

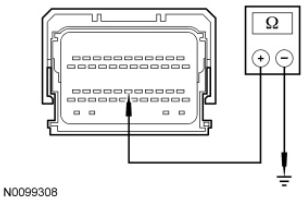
The Transmission Control Module (TCM) monitors immediate shutdown inputs from the Battery Energy Control Module (BECM). When the TCM detects an input out of the expected range, the BECM will set this DTC.

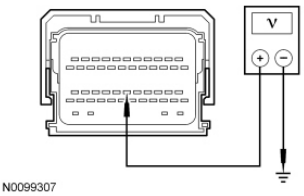
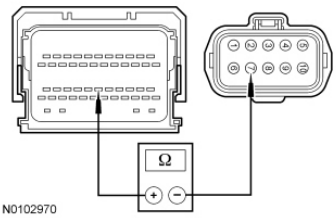
- P1A15:11 (Immediate Shutdown Signal B: Circuit Short to Ground) - This DTC is set when the circuit is shorted to ground.
- P1A15:12 (Immediate Shutdown Signal B: Circuit Short to Battery) - This DTC is set when the circuit is shorted to battery. This DTC sets during vehicle shutdown and reports as a continuous memory (historical) DTC only.
- P1A15:15 (Immediate Shutdown Signal B: Circuit Short to Battery or Open) - This DTC is set when the circuit is shorted to battery or open.

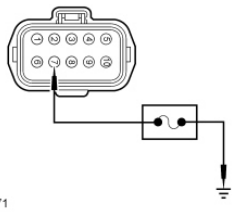
This pinpoint test is intended to diagnose the following: span title="Battery Energy Control Module" class="popup" onmouseover="this.className='popupnounderline';" onmouseout="this.className='popup';">BECM
- Electronically Controlled Continuously Variable Transmission (eCVT)

PINPOINT TEST AB: DTCs P1A15:11, P1A15:12 OR P1A15:15

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AB1 CHECK CIRCUIT FOR SHORT TO GROUND	
• Ignition OFF. • Disconnect: BECM C4237A. • Disconnect: TCM C1458B. • Measure the resistance of BECM C4237A-29, circuit CYB17 (BU/GY), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AB2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AB2 CHECK CIRCUIT FOR SHORT TO BATTERY	
• Ignition ON. • Measure the voltage between BECM C4237A-29, circuit CYB17 (BU/GY), harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to AB3 .

 • **Is any voltage present?**	
AB3 CHECK CIRCUIT FOR AN OPEN	
• Ignition OFF. • Measure the resistance between BECM C4237A-29, circuit CYB17 (BU/GY), harness side and TCM C1458B-7, circuit CYB17 (BU/GY), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** For DTC P1A15:11 and P1A15:12, GO to AB4 . For DTC P1A15A:15, GO to AB5 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AB4 RETRIEVE BECM DTCs	
• Connect: BECM C4237A (leave TCM C1458B disconnected). • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **NOTE:** When retrieving DTCs with TCM C1458AB disconnected, DTC P1A15:15 would normally be present. • **Is DTC P1A15:11 or P1A15:12 retrieved?**	**Yes** GO to AB6 . **No** CARRY OUT self-test of the TCM and REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of TCM DTCs. If no DTCs are retrieved, INSTALL a new eCVT . REFER to Section 307-01C .
AB5 RETRIEVE BECM DTCs	
• Connect: BECM C4237A. • Connect a fused jumper wire between TCM C1458B-7, circuit CYB17 (BU/GY), harness side and ground.	**Yes** GO to AB6 . **No** CARRY OUT self-test of the TCM and REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of TCM DTCs.

 N0102971 • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM • **NOTE:** When retrieving DTCs with TCM C1458AB-7 shorted to ground, DTC P1A15:11 would normally be present. • **Is DTC P1A15:15 retrieved?**	
AB6 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Connect: TCM C1458B. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test AC: DTC B11D8:11

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

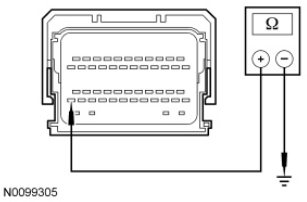
The Battery Energy Control Module (BECM) monitors the impact notification output from the Restraints Control Module (RCM). The RCM outputs a Pulse-Width Modulation (PWM) voltage on the circuit based on status. If an event is indicated, the BECM will initiate shutdown of the High Voltage Traction Battery (HVTB) system. If the BECM senses a fault on the circuit, it will illuminate the powertrain malfunction (wrench) warning indicator and set a DTC.

- B11D8:11 (Restraint Event Notification: Circuit Short to Ground) - This DTC sets when the BECM detects a short to ground on the event notification signal circuit for 5 seconds or more.

This pinpoint test is intended to diagnose the following:
- Fuel Pump (FP) control module
- RCM
- BECM

PINPOINT TEST AC: DTC B11D8:11

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AC1 CHECK CIRCUIT FOR SHORT TO GROUND	
• Ignition OFF. • Disconnect: BECM C4237A. • Disconnect: RCM C310A. • Disconnect: FP Control Module C446. • Measure the resistance of BECM C4237A-46, circuit CR167 (YE/VT), harness side to ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AC2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AC2 CHECK BECM DTCs	
• Connect: BECM C4237A. • Connect: RCM C310A. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC B11D8:11 retrieved?**	**Yes** GO to AC3 . **No** INSTALL a new FP control module. REFER to Section 303-04D . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AC3 RETRIEVE BECM DTCs	
• Ignition OFF. • Disconnect: RCM C310A. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM .	**Yes** GO to AC4 . **No** INSTALL a new RCM . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• **Is DTC B11D8:11 retrieved?**	
AC4 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Connect: RCM C310A. • Connect: Fuel Pump (FP) C446. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test AD: DTC B11D8:15

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Energy Control Module (BECM) monitors the impact notification output from the Restraints Control Module (RCM). The RCM outputs a Pulse-Width Modulation (PWM) voltage on the circuit based on status. If an impact notification is indicated, the BECM will initiate shutdown of the High Voltage Traction Battery (HVTB) system. If the BECM senses a fault on the circuit, it will illuminate the powertrain malfunction (wrench) warning indicator and set a DTC.

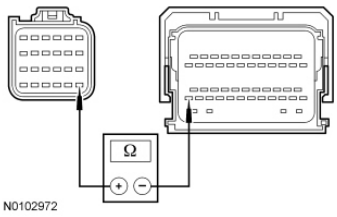
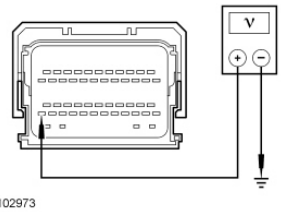
- B11D8:15 (Restraint Event Notification: Circuit Short to Battery or Open) - The DTC sets when the BECM detects an open or short to voltage on the event notification signal circuit for 5 seconds or more.

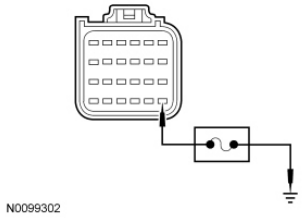
This pinpoint test is intended to diagnose the following:
- Circuitry
- Fuel Pump (FP) control module
- RCM
- BECM

PINPOINT TEST AD: DTC B11D8:15

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AD1 CHECK CIRCUIT FOR AN OPEN	&nb;

• Ignition OFF. • Disconnect: BECM C4237A. • Disconnect: RCM C310A. • Disconnect: FP Control Module C446. • Ignition ON. • Measure the resistance between BECM C4237A-46, circuit CR167 (YE/VT), harness side and RCM C310A-19, circuit CR167 (YE/VT), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to AD2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AD2 CHECK CIRCUIT FOR SHORT TO POWER	
• Ignition OFF. • Measure the voltage between BECM C4237A-46, circuit CR167 (YE/VT), harness side and ground.  • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to AD3 .
AD3 CHECK BECM DTCs	
• Connect: BECM C4237A. • Connect: RCM C310A. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC B11D8:15 retrieved?**	**Yes** GO to AD4 . **No** INSTALL a new FP control module. REFER to Section 303-04D . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AD4 RETRIEVE BECM DTCs WITH RCM GROUNDED	

• Ignition OFF. • Disconnect: RCM C310A. • Connect a fused jumper wire between RCM C310A-19, circuit CR167 (YE/VT), harness side and ground.  N0099302 • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **NOTE:** When retrieving DTCs with RCM C310A-19 shorted to ground, DTC B11D8:36 would normally be present. • **Does DTC B11D8:15 appear?**	**Yes** GO to AD5 . **No** INSTALL a new RCM . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AD5 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Connect: RCM C310A. • Connect: FP Control Module C446. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test AE: DTC U0074:00 or U1006:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

During normal vehicle operation the Battery Energy Control Module (BECM) and Battery Pack Sensor Module (BPSM) communicate with each other providing information each module needs to properly monitor and control the high-voltage system This communication is done over a dedicated Controller Area Network (CAN).

- U0074:00 (Control Module Communication Bus "B" Off: No Sub Type Information) - Fault sets if

the BECM detects the dedicated CAN is off.
- U1006:00 (Sub Network CAN Initialization Failure: No Sub Type Information) - Fault sets if the BECM detects the dedicated CAN hardware does not initialize for 1 second or more.

This pinpoint test is intended to diagnose the following:
- BECM
- BPSM
- High Voltage Traction Battery (HVTB)

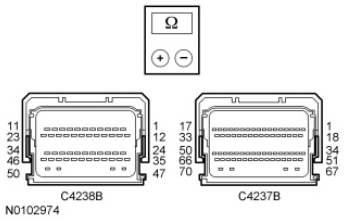
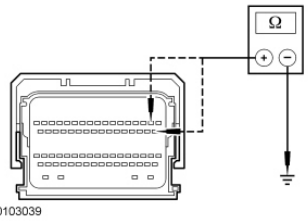
PINPOINT TEST AE: DTC U0074:00 OR U1006:00

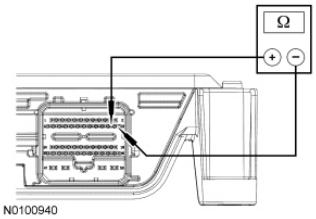
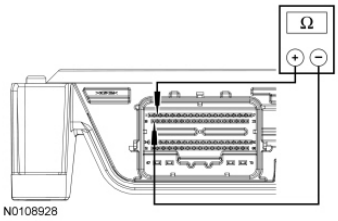
⚠ WAR: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AE1 CHECK CAN CIRCUITS	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section.	**Yes** GO to AE2 . **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

• Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: BPSM C4238B. • Disconnect: BECM C4237B. • Measure the resistance between BECM C4237B-2, circuit J1-A02, harness side and BPSM C4238B-23, circuit J1-A02, harness side; and between BECM C4237B-18, circuit J1-A18, harness side and BPSM C4238B-22, circuit J1-A18, harness side.  • **Are the resistances less than 5 ohms?**	
AE2 CHECK CIRCUITS FOR SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between BECM C4237B-2, circuit J1-A02, harness side and ground; and between BECM C4237B-18, circuit J1-A18, harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AE3 . **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AE3 MEASURE BPSM TERMINATION RESISTANCE	
⚠ **WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Measure the resistance between BPSM C4238B pin 22 and pin 23, component side.	**Yes** GO to AE4 . **No** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 • **Is the resistance between 108 and 132 ohms?**	
AE4 MEASURE BECM TERMINATION RESISTANCE	
• Measure the resistance between BECM C4237B pin 2 and pin 18, component side.  • **Is the resistance between 108 and 132 ohms?**	**Yes** GO to AE5 . **No** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AE5 RETEST AND ISOLATE MODULES	
• Connect: BECM C4237B (leave BPSM C4238B disconnected). • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC U0074:00 or U1006:00 retrieved?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test AF: DTCs U3001:00, U3003:16 and U3003:17

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

During normal vehicle operation, the 12-volt battery supplies voltage to the Battery Energy Control Module (BECM) in order for the BECM to operate. If this voltage is low or not available, the BECM cannot function correctly.

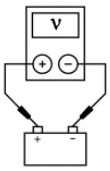
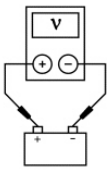
- U3001:00 (Control Module Improper Shutdown: No Sub Type Information) - Fault sets if the BECM loses its 12-volt power source unexpectedly and shuts down improperly. Reports as a continuous memory (historical) DTC only.
- U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) - Fault sets if the BECM 12-volt power source falls below 8 volts for at least 5 seconds.
- U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) - Fault sets if the BECM 12-volt power source goes above 16 volts for at least 5 seconds.

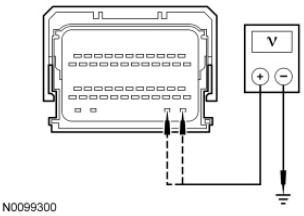
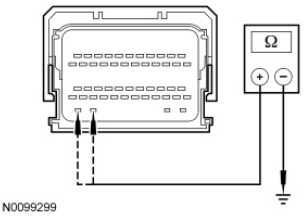
This pinpoint test is intended to diagnose the following:
- 12-volt battery
- Circuitry
- DC to DC Converter Control Module (DC/DC)
- BECM

PINPOINT TEST AF: DTCs U3001:00, U3003:16 AND U3003:17

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AF1 RETRIEVE ALL CMDTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - All CMDTCs . • **Is DTC B1316, B1318, B1676, P0562, P0563, U3001:00, U3003:16 or U3003:17 present in more than 1 module?**	**Yes** REFER to Section 414-05 to diagnose the DC/DC . **No** GO to AF2 .
AF2 CHECK 12-VOLT BATTERY	
• Carry out the 12-volt battery condition test. Refer to Section 414-01 . • **Did the 12-volt battery pass the condition test?**	**Yes** GO to AF3 . **No** INSTALL a new battery. REFER to Section 414-01 for further information. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AF3 MEASURE DC/DC OUTPUT VOLTAGE	
• Start the engine. • For DTC U3003:17, turn off all accessories for a minimum of 2 minutes. • For DTCs U3001:00 and U3001:16, turn on the headlamps and HVAC fan for a minimum of 2	**Yes** GO to AF4 . **No** CARRY OUT self-test of the DC/DC and REFER to Section 414-05 to diagnose the

minutes. • Measure 12-volt battery voltage.  AJ0210-A • **Is the voltage 13-15.2 volts?**	DC/DC .
AF4 COMPARE BATTERY VOLTAGE BECM PID MAIN ECU VOLTAGE SUPPLY (MAINBECMV)	
• Enter the following diagnostic mode on the scan tool: DataLogger - BECM . • Monitor the BECM PID MAINBECMV. • **Does the PID read 8-16 volts?**	**Yes** GO to AF7 . **No** If the PID reads less than 8 volts, GO to AF5 . If the PID reads at least 16 volts, INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAthe self-test. TEST the system for normal operation.
AF5 MEASURE BECM INPUT VOLTAGE	
• Ignition OFF. • Disconnect: BECM C4237A. • Measure 12-volt battery voltage.  AJ0210-A • Measure the voltage between BECM C4237A-47, SBB17 (RD), harness side and ground and BECM C4237A-48, SBB17 (RD), harness side and ground.	**Yes** GO to AF6 . **No** VERIFY Battery Junction Box (BJB) fuse 47 (15A) is OK. If the fuse is OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0099300 • **Are the BECM circuit voltages equal to 12-volt battery voltage?**	
AF6 CHECK BECM GROUND	
• Measure the resistance between BECM C4237A-49, GD126 (BK/WH), harness side and ground; and BECM C4237A-50, GD126 (BK/WH), harness side and ground.  N0099299 • **Are the resistances less than 5 ohms?**	**Yes** GO to AF7 . **No** REPAIR high resistance or open in the affected circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AF7 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test AG: DTC U3003:62

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

During normal vehicle operation the 12-volt battery supplies voltage to the Battery Energy Control Module (BECM) in order for the BECM to operate. The BECM compares the voltage of the DC to DC Converter Control Module (DC/DC) which is communicated via the High Speed Controller Area Network (HS-CAN).

- U3003:62 (Battery Voltage: Signal Compare Failure) - Fault sets wn the BECM does a compare with the DC to DC Converter Control Module (DC/DC) and the input voltages to both modules do not match.

This pinpoint test is intended to diagnose the following:
- DC/DC
- BECM

PINPOINT TEST AG: DTCs U3003:62

Test Step	Result / Action to Take
AG1 RETRIEVE BECM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Are any DTCs other than U3003:62 retrieved?**	**Yes** REFER to the Battery Energy Control Module (BECM) DTC Chart and diagnose all other DTCs first. **No** GO to AG2 .
AG2 RETRIEVE DC/DC DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • **Are any DTCs retrieved?**	**Yes** REFER to Section 414-05 to diagnose DC/DC DTCs. **No** GO to AG3 .
AG3 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test AH: DTC P0AE0:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

When the ignition is turned on, the Battery Energy Control Module (BECM) makes various vehicle checks. If these checks are normal, the BECM sends a signal to the contactor to close, which will supply high-voltage power to the vehicle. If an overcurrent condition is sensed by the BECM , the stop safely hazard (red triangle) warning indicator is illuminated and the vehicle will shut down and/or not start.

- P0AE0:00 (Hybrid Battery Negative Contactor Control Circuit High: No Sub Type Information) - If the BECM detects overcurrent on the contactor control circuit for 16 milliseconds or more, this DTC will be set. Reports as a continuous memory (historical) DTC only.

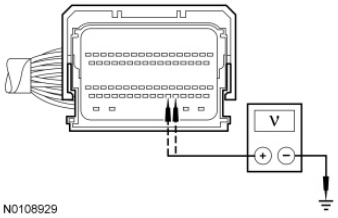
This pinpoint test is intended to diagnose the following:

- Circuitry
- High Voltage Traction Battery (HVTB)
- BECM /span>
- High-Voltage Bussed Electrical Center (BEC)

PINPOINT TEST AH: DTC P0AE0:00

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AH1 CHECK FOR SHORT IN CIRCUIT	
• Ignition OFF. • Disconnect: BECM C4237B. • Ignition ON. • Measure the voltage between BECM C4237B-55, circuit J1-A55, harness side and ground; and between BECM C4237B-56, circuit J1-A56, harness side and ground.  • **Is any voltage present?**	**Yes** GO to AH2 . **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AH2 MEASURE CONTACTOR COIL RESISTANCE	
	Yes GO to AH3 .

⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: High-voltage BEC C4236D. • With the service disconnect plug removed, measure the resistance between high-voltage BEC C4236 pin 7 and pin 8, component side. • **Is the resistance between 5-50 ohms?**	**No** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AH3 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Connect: High-voltage BEC C4236D. • Install the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Connect: Service Disconnect Plug. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test AI: DTC P0AE1:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

When the ignition is turned on, the Battery Energy Control Module (BECM) makes various vehicle checks. If these checks are normal, the BECM sends a signal to the contactor to close, which will supply high-voltage power to the vehicle. If a precharge contactor overcurrent condition is sensed by the BECM , the stop safely hazard (red triangle) warning indicator is illuminated and the vehicle will shut down and/or not start.

- DTC P0AE1:00 (High Voltage Battery Precharge Contactor Circuit: No Sub Type Information) - Fault sets when the precharge contactor attempts to close and current flow exceeds set values. This could indicate a short in the high-volta system. Reports as a continuous memory (historical) DTC only.

This pinpoint test is intended to diagnose the following:

- High-voltage cables
- DC to DC Converter Control Module (DC/DC)
- BECM
- High Voltage Traction Battery (HVTB)
- Transmission Control Module (TCM)

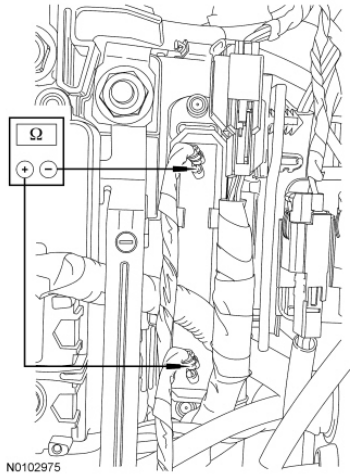
PINPOINT TEST AI: DTC P0AE1:00

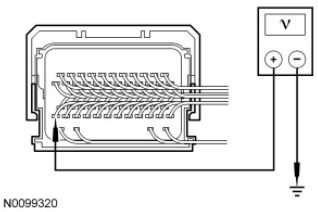
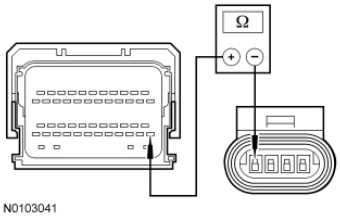
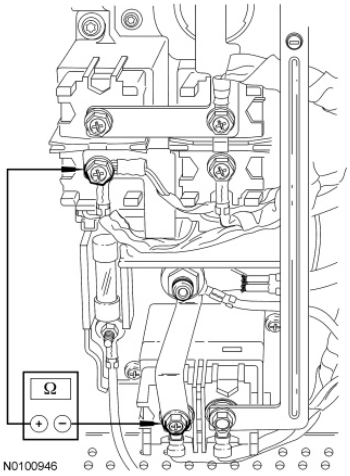
⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

⚠ **WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.**

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AI1 CHECK BECM DTCs	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0AA6:00 retrieved?**	**Yes** For DTC P0AA6:00, GO to Pinpoint Test J . **No** GO to AI2 .
AI2 RETRIEVE TCM DTCs	
• Enter the following diagnostic mode on the scan tool: Self Test - TCM . • **Are any TCM DTCs retrieved?**	**Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and diagnose those DTCs first. **No** GO to AI3 .
AI3 CHECK CONTACTOR RESISTOR	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install t cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.**	**Yes** GO to AI4 . **No** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center

• Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • With the service disconnect plug removed, measure the resistance of the precharge resistor in the high-voltage BEC .  • **Is the resistance between 6 and 10 ohms?**	in this section. CLEAR the DTCs. REPEAT the self-test.
AI4 MEASURE VOLTAGE AT BPSM CONNECTOR	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition ON. • With the service disconnect plug removed, measure the voltage between BPSM C4238B-35, circuit J2-B35, harness side and ground by back-probing at C4238B-35.	**Yes** GO to AI7 . **No** GO to AI5 .

 N0099320 • **Is the voltage between 2.25 and 2.75 volts?**	
AI5 CHECK CONTACTOR CIRCUIT FOR AN OPEN	
• Ignition OFF. • With the service disconnect plug removed, measure the resistance between high-voltage BEC C4236E-D, circuit J2-B35, harness side and BPSM C4238B-35, circuit J2-B35, harness side.  N0103041 • **Is the resistance less than 5 ohms?**	**Yes** GO to AI6 . **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AI6 CHECK FOR OPEN CONTACTOR	
• With the service disconnect plug removed, measure the resistance between the 2 points of the high-voltage BEC as shown.  N0100946 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AI7 CHECK THE HIGH-VOLTAGE CABLES	
• Install new high-voltage cables. Refer to High-Voltage Cables in this section. • Install the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Connect: Service Disconnect Plug.	**Yes** GO to AI8 . **No** Repair is complete.

• Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0AE1:00 retrieved?**	
AI8 CHECK THE DC/DC	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Install a new DC/DC . Refer to Section 414-05 . • Connect: Service Disconnect Plug. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0AE1:00 retrieved?**	**Yes** INSTALL a new ACCM and A/C compressor assembly. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the self-test. **No** Repair is complete.

Pinpoint Test AJ: DTC P0AE5:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

When the ignition is turned on, the Battery Energy Control Module (BECM) makes various vehicle checks. If these checks are normal, the BECM sends a signal to the contactor to close, which will supply high-voltage power to the vehicle. If the BECM senses the precharge contactor fails to close the stop safely hazard (red triangle) warning indicator is illuminated and the vehicle will shut down and/or not start.

- P0AE5:00 (Hybrid Battery Precharge Contactor Control Circuit Range/Performance: No Sub Type Information) - If the BECM signal to close the contactor fails, this DTC will be set. Reports as a continuous memory (historical) DTC only.

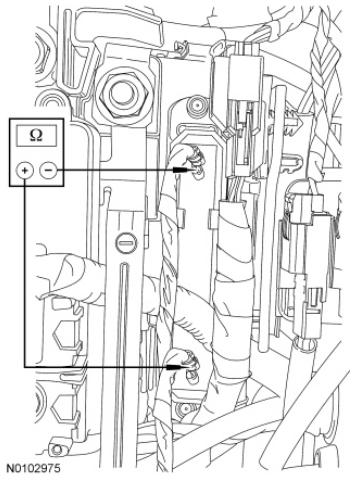
This pinpoint test is intended to diagnose the following:

- BECM
- High-voltage Bussed Electrical Center (BEC)
- High Voltage Traction Battery (HVTB)

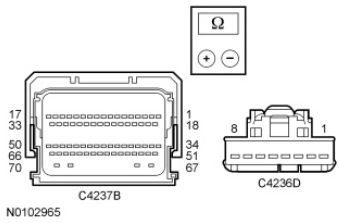
PINPOINT TEST AJ: DTC P0AE5:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AJ1 CHECK CONTACTOR RESISTOR	
⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • With the service disconnect plug removed, measure the resistance of the precharge resistor in the BEC .  • **Is the resistance between 6-10 ohms?**	**Yes** GO to AJ2 . **No** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AJ2 MEASURE CONTACTOR COIL RESISTANCE	
• Disconnect: High-voltage BEC C4236D. • With the service disconnect plug removed, measure the resistance between high-voltage BEC C4236D pin 4 and pin 5, component side.	**Yes** GO to AJ3 . **No** INSTALL a new high-voltage

<table>
<tr><td>• Is the resistance between 5-50 ohms?</td><td>BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</td></tr>
<tr><td>AJ3 CHECK FOR OPEN IN CIRCUIT</td><td></td></tr>
<tr><td>• Measure the resistance between high-voltage BEC C4236D, harness side and BECM C4237B, harness side as follows:

<table><tr><th>High-Voltage BEC</th><th>Circuit</th><th>BECM</th></tr><tr><td>C4236D-4</td><td>J1-A61</td><td>C4237B-61</td></tr><tr><td>C4236D-5</td><td>J1-A62</td><td>C4237B-62</td></tr></table>
 
• Are the resistances less than 5 ohms?</td><td>Yes
INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No
INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</td></tr>
</table>

Pinpoint Test AK: DTC P0AE7:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

When the ignition is turned on, the Battery Energy Control Module (BECM) makes various vehicle checks. If these checks are normal, the BECM sends a signal to the contactor to close, which will supply power to the vehicle. If an overcurrent condition is sensed by the BECM , the stop safely hazard (red triangle) warning indicator is illuminated and the vehicle will shut down and/or not start.

- P0AE7:00 (Hybrid Battery Precharge Contactor Control Circuit High: No Sub Type Information) - If the BECM detects overcurrent on the contactor control circuit for 16 milliseconds or more, this DTC will be set. Reports as a continuous memory (historical) DTC only.

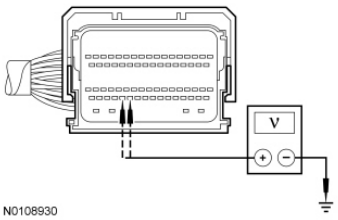
This pinpoint test is intended to diagnose the following:

- BECM
- High-voltage Bussed Electrical Center (BEC)
- Circuitry

PINPOINT TEST AK: DTC P0AE7:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire coveri. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AK1 CHECK FOR SHORT IN CIRCUIT	
• Measure the voltage between BECM C4237B-61, circuit J1-A61, harness side and ground; and between BECM C4237B-62, circuit J1-A62, harness side and ground.  • **Is any voltage present?**	**Yes** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to AK2 .
AK2 MEASURE CONTACTOR COIL RESISTANCE	
⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect: High-voltage BEC C4236D. • With the service disconnect removed, measure the resistance between high-voltage BEC C4236D pin 4 and pin 5, component side. • **Is the resistance between 5-50 ohms?**	**Yes** GO to AK3 . **No** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AK3 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion.	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test.

♦ pushed-out/bent pins. • Connect the BECM and make sure the connectors seat correctly. • Connect: High-voltage BEC C4236D. • Install the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Connect: Service Disconnect Plug. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test AL: DTC P0AFC:67

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

During normal vehicle operation the Battery Energy Control Module (BECM) and Battery Pack Sensor Module (BPSM) communicate with each other providing information each module needs to properly monitor and control the high-voltage system. This communication is done over a dedicated Controller Area Network (CAN). If the BECM senses a fault with leakage and/or contactor monitoring, BECM functions do not operate correctly, the powertrain malfunction (wrench) warning indicator illuminates and the DTC is set.

- P0AFC:67 (Hybrid Battery Pack Sensor Module: Signal Incorrect After Event) - Fault sets if a BECM leakage and/or contactor monitoring fault is present and BECM functions do not operate as commanded.

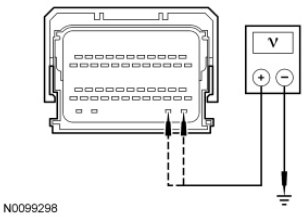
This pinpoint test is intended to diagnose the following:
- BECM
- BPSM
- High Voltage Traction Battery (HVTB)

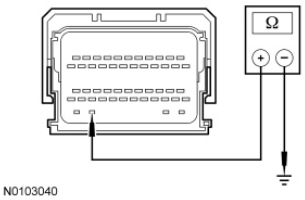
PINPOINT TEST AL: DTC P0AFC:67

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness taper orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

⚠ **WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.**

NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AL1 CHECK BPSM CIRCUITS FOR VOLTAGE	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Remove the high-voltage Bussed Electrical Center (BEC) cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: BPSM C4238B. • Ignition ON. • With the service disconnect plug removed, measure the voltage between BPSM C4238B-47, circuit J1-A66, harness side and ground; and between BPSM C4238B-48, circuit J1-A65, harness side and ground.  • **Are the voltages greater than 10 volts?**	**Yes** GO to AL2 . **No** GO to AL8 .
AL2 CHECK BPSM GROUND CIRCUIT FOR OPEN	
• Ignition OFF. • With the service disconnect plug removed, measure the resistance between BPSM C4238B-49, circuit J1-A70, harness side and ground.	**Yes** GO to AL3 . **No** GO to AL8 .



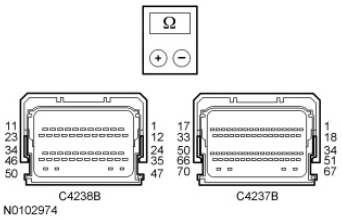
- **Is the resistance less than 5 ohms?**

AL3 CHECK DEDICATED CAN CIRCUITS

⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.

- Disconnect: BECM C4237B.
- With the service disconnect plug removed, measure the resistance between BPSM C4238B, harness side and BECM C4237B, harness side as follows:

BPSM	Circuit	BECM
C4238B-23	J1-A02	C4237B-2
C4238B-22	J1-A18	C4237B-18



- **Are the resistances less than 5 ohms?**

Yes
GO to AL4 .

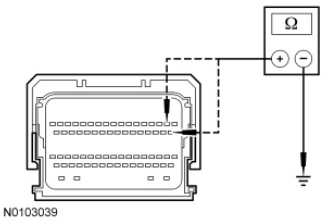
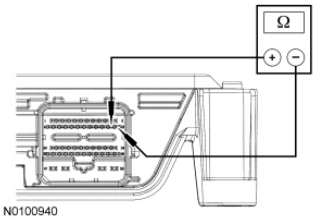
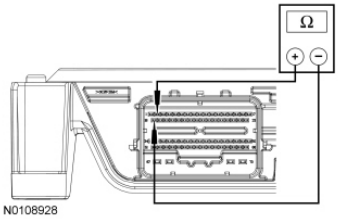
No
INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

AL4 CHECK CIRCUITS FOR SHORT TO GROUND

- With the service disconnect plug removed, measure the resistance between BECM C4237B-2, circuit J1-A02, harness side and ground; and between BECM C4237B-18, circuit J1-A18, harness side and ground.

Yes
GO to AL5 .

No
INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT

 N0103039 • **Are the resistances greater than 10,000 ohms?**	the self-test. TEST the system for normal operation.
AL5 MEASURE BPSM TERMINATION RESISTANCE	
⚠ **WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.** • Measure the resistance between BPSM C4238B pin 22 and pin 23, component side.  N0100940 • **Is the resistance between 108 and 132 ohms?**	**Yes** GO to AL6 . **No** INSTALL a new BPSM . REFER to Battery Pack Sensor Module (BPSM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AL6 MEASURE BECM TERMINATION RESISTANCE	
• Measure the resistance between BECM C4237B pin 2 and pin 18, component side.  N0108928 • **Is the resistance between 108 and 132 ohms?**	**Yes** GO to AL7 . **No** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AL7 CHECK THE BPSM	
⚠ **WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is**	**Yes** GO to AL8 . **No** Repair is complete.

present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. • Install a new BPSM and the previously removed high-voltage BEC cover. Refer to Battery Pack Sensor Module (BPSM) in this section. • Connect: BECM C4237B. • Connect: Service Disconnect Plug. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0AFC:67 ieved?**	TEST the system for normal operation.
AL8 CHECK THE BECM	
⚠ **WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Install a new BECM . Refer to Battery Energy Control Module (BECM) in this section. • Connect: BPSM C4238B (if previously disconnected). • Install the high-voltage BEC cover (if previously removed). Refer to Battery Pack Sensor Module (BPSM) in this section. • Connect: Service Disconnect Plug (if previously disconnected). • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0AFC:67 retrieved?**	**Yes** INSTALL a new HVTB (includes HV system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** Repair is complete. TEST the system for normal operation.

Pinpoint Test AM: DTC P0B1C:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Pack Sensor Module (BPSM) monitors battery pack voltage of the High Voltage Traction Battery (HVTB). Normal pack voltage should be between 179-343 volts.

- P0B1C:00 (Hybrid Battery Pack Voltage Sense C Circuit High: No Sub Type Information) - Fault is sewhen BPSM sensed higher than normal voltage.

This pinpoint test is intended to diagnose the following:

- HVTB
- BPSM

PINPOINT TEST AM: DTC P0B1C:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

Test Step	Result / Action to Take
AM1 RETRIEVE BECM DTCs	
⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Are any DTCs other than P0B1C:00 retrieved?**	**Yes** REFER to the Battery Energy Control Module (BECM) DTC Chart and diagnose all other DTCs first. **No** GO to AM2 .
AM2 CHECK THE BPSM	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions	**Yes** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

may result in serious personal injury or death. • Ignition OFF. • Install a new BPSM . Refer to Battery Pack Sensor Module (BPSM) in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0B1C:00 retrieved?**	**No** Repair is complete. TEST the system for normal operation.

Pinpoint Test AN: DTC P0B36:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The service disconnect plug completes the high-voltage circuit. It has a non-serviceable fuse to protect the high-voltage components in the event current raises above the normal operating range. The service disconnect plug also shuts off the high-voltage to the system so service to the system can be completed safely. If the service disconnect voltage becomes too high, the powertrain malfunction (wrench) warning indicator illuminates and the DTC is set.

- P0B36:00 (High Voltage Service Disconnect Circuit High: No Sub Type Information) - This fault is set when the service disconnect voltage is high for 1 second or more.

This pinpoint test is intended to diagnose the following:
- Service disconnect plug
- Battery Pack Sensor Module (BPSM)
- High Voltage Traction Battery (HVTB)

PINPOINT TEST AN: DTC P0B36:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. gh-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

Test Step	Result / Action to Take
AN1 RETRIEVE BECM DTCs	

• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Are any DTCs other than P0B36:00 retrieved?**	**Yes** REFER to the Battery Energy Control Module (BECM) DTC Chart and diagnose all other DTCs first. **No** GO to AN2 .
AN2 CHECK SERVICE DISCONNECT PLUG	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Install a new BPSM . Refer to Battery Pack Sensor Module (BPSM) in this section. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0B36:00 retrieved?**	**Yes** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** Repair is complete. TEST the system for normal operation.

Pinpoint Test AO: DTC P0B37:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The service disconnect plug completes the high-voltage circuit. It is fused to protect the high-voltage components in the event current raises above the normal operating range. The service disconnect plug also shuts off the high-voltage to the system so service to the system can be completed safely. When the service disconnect plug is open, the stop safely hazard (red triangle) warning indicator is illuminated and the vehicle will shut down and/or not start.

- P0B37:00 (High Voltage Service Disconnect Open: No Sup Type Information) - This DTC is set when the service disconnect is open for 1 second or more while the service disconnect plug is still inserted in the High Voltage Traction Battery (HVTB).

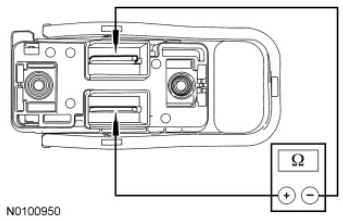
This pinpoint test is intended to diagnose the following:

- Service disconnect plug
- HVTB
- Battery Pack Sensor Module (BPSM)

PINPOINT TEST AO: DTC P0B37:00

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

Test Step	Result / Action to Take
AO1 CHECK SERVICE DISCONNECT PLUG POSITION	
• Ignition OFF. • Make sure service disconnect plug is inserted correctly and securely. • **Is the service disconnect plug seated correctly?**	**Yes** GO to AO2 . **No** REPOSITION service disconnect plug correctly. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AO2 CHECK SERVICE DISCONNECT PLUG	
⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Measure the resistance between the 2 service disconnect plug terminals, component side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to AO3 . **No** INSTALL a new service disconnect plug. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AO3 CHECK THE BPSM	
	Yes

⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Install a new BPSM . Refer to Battery Pack Sensor Module (BPSM) in this section. • Connect: Service Disconnect Plug. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . /li> • Enter the following diagnostic mode on the scan tool: Self Test - BECM . • **Is DTC P0B37:00 retrieved?**	INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** Repair is complete. TEST the system for normal operation.

Pinpoint Test AP: P0BXX:00 Hybrid Battery Voltage Sense Circuit X Low/High

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Pack Sensor Module (BPSM) monitors battery pack voltage of the High Voltage Traction Battery (HVTB). The BPSM also measures each of the 26 individual battery modules (identified as A through Z in DTC descriptions) within the battery. The BPSM communicates normal pack voltage to the Battery Energy Control Module (BECM) via a dedicated Controller Area Network (CAN).

NOTE: There are a total of 52 voltage sense circuit DTCs, 26 which indicate voltage circuit sense high and 26 which indicate voltage circuit sense low. The "X" in both the DTCs and DTC descriptions below will vary using other letters and/or numbers (DTCs) or letters only (DTC description) depending on the actual DTC that is present. Refer to the Battery Energy Control Module (BECM) DTC Chart in this section for the actual listing of all 52 DTCs.

- P0BXX:00 (Hybrid Battery Voltage Sense Circuit X High: No Sub Type Information) - Fault is set when BPSM monitors voltage in one individual battery module is more than 13.5 volts.
- P0BXX:00 (Hybrid Battery Voltage Sense Circuit X Low: No Sub Type Information) - Fault is set wh BPSM monitors voltage in one individual battery module is less than 6.8 volts.

This pinpoint test is intended to diagnose the following:

- BPSM
- HVTB

PINPOINT TEST AP: P0BXX:00 HYBRID BATTERY VOLTAGE SENSE CIRCUIT X LOW/HIGH

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

Test Step	Result / Action to Take
AP1 CHECK THE BPSM	
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Depower the HVTB system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Install a new BPSM . Refer to Battery Pack Sensor Module (BPSM) in this section. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Clear DTCs - BECM . • Enter the following diagnostic mode on the scan tool: Self Test - BECM .	**Yes** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** Repair is complete. TEST the system for normal operation.

• **Is a Hybrid Battery Voltage Sense Circuit X High or Hybrid Battery Voltage Sense Circuit X Low DTC retrieved?**	

Pinpoint Test AQ: DTC P0A0C:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Energy Control Module (BECM) checks for continuity of the high-voltage system interlock circuit. The interlock circuit must have continuity before high-voltage will be supplied to the vehicle. The interlock circuit voltage travels through each of the high-voltage components and high-voltage cables and back to the BECM . This fault will illuminate the stop safely hazard (red triangle) warning indicator and shut down the vehicle.

- DTC P0A0C:00 (High Voltage System Interlock Circuit Low: No Sub Type Information) - Fault sets when the BECM senses the interlock circuit is open or shorted to power for 5 seconds or more.

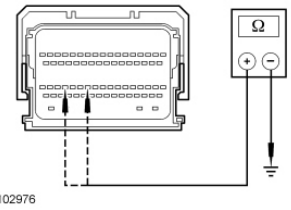
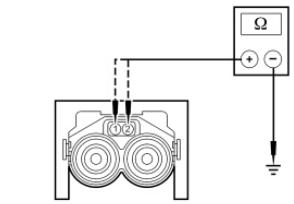
This pinpoint test is intended to diagnose the following:
- Air Conditioning Compressor Module (ACCM)
- BECM
- DC to DC Converter Control Module (DC/DC)
- Transmission Control Module (TCM) (part of Electronically Controlled Continuously Variable Transmissio(eCVT))
- High-voltage cables

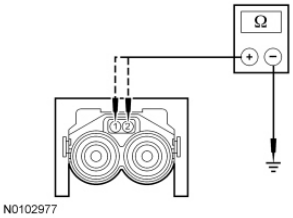
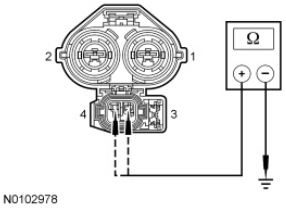
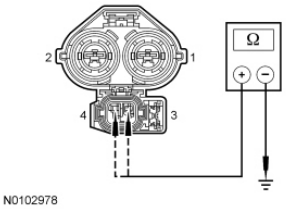
PINPOINT TEST AQ: DTC P0A0C:00

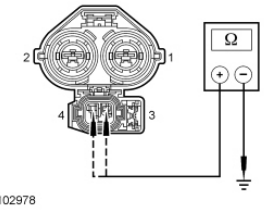
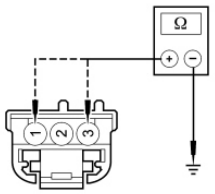
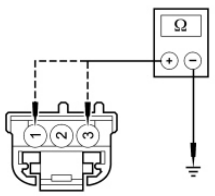
⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

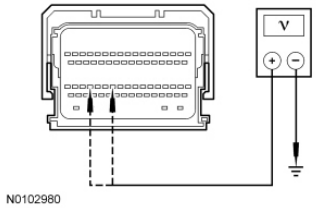
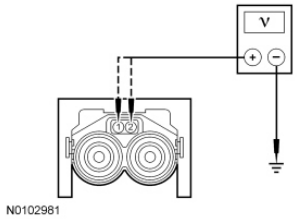
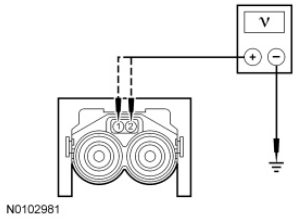
NOTICE: **Use the correct probe adapter(s) from the Flex Probe Kit when taking measurements. Failure to use the correct probe adapter(s) may damage the connector.**

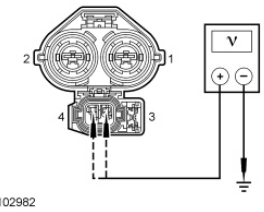
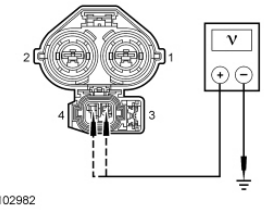
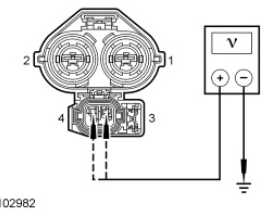
Test Step	Result / Action to Take
AQ1 CHECK FOR SHORT TO GROUND IN INTERLOCK CIRCUIT	
⚠ **WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.**	**Yes** GO to AQ8 . **No** GO to AQ2 .

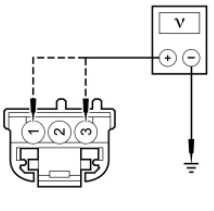
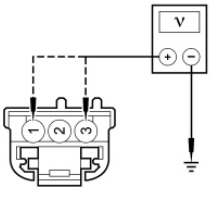
• Ignition OFF. • Depower the High Voltage Traction Battery (HVTB) system. Refer to High-Voltage Traction Battery Systems Depowering in this section. • Disconnect: BECM C4237B. • Measure the resistance between BECM C4237B-44, circuit J1-A44, harness side and ground; and between BECM C4237B-47, circuit J1-A47, harness side and ground.  N0102976 • **Are the resistances greater than 10,000 ohms?**	
AQ2 CHECK FOR SHORT TO GROUND IN HIGH-VOLTAGE CABLES IN INTERLOCK CIRCUIT	
• Disconnect: High-voltage BEC C4236B. • Measure the resistance between high-voltage BEC C4236B-1, circuit CYB04 (VT/BN), harness side and ground; and between high-voltage BEC C4236B-2, circuit CYB03 (BN/YE), harness side and ground.  N0102977 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AQ4 . **No** GO to AQ3 .
AQ3 CHECK FOR SHORT TO GROUND IN INTERLOCK CIRCUIT TO TCM	
• Disconnect: TCM C1458C. • Measure the resistance between high-voltage BEC C4236B-1, circuit CYB04 (VT/BN), harness side and ground; and between high-voltage BEC C4236B-2, circuit CYB03 (BN/YE), harness side and ground.	**Yes** INSTALL a eCVT . REFER to Section 307-01C . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL new high-voltage cables. REFER to High-Voltage Cables in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0102977 • **Are the resistances greater than 10,000 ohms?**	
AQ4 CHECK FOR SHORT TO GROUND IN INTERLOCK CIRCUIT TO ACCM AND DC/DC	
• Disconnect: High-voltage BEC C4236A. • Measure the resistance between high-voltage BEC C4236A-3, circuit CYB02 (WH/BN), harness side and ground; and between high-voltage BEC C4236A-4, circuit CYB03 (BN/YE), harness side and ground.  N0102978 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to AQ7 . **No** GO to AQ5 .
AQ5 CHECK FOR SHORT TO GROUND IN INTERLOCK CIRCUIT TO DC/DC	
• Disconnect: DC/DC C1457A. • Measure the resistance between high-voltage BEC C4236A-3, circuit CYB02 (WH/BN), harness side and ground; and between high-voltage BEC C4236A-4, circuit CYB03 (BN/YE), harness side and ground.  N0102978 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new DC/DC . REFER to Section 414-05 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to AQ6 .
AQ6 CHECK FOR SHORT TO GROUND IN INTERLOCK CIRCUIT TO ACCM	
• Connect: DC/DC C1457A. • Disconnect: ACCM C1469B. • Measure the resistance between high-voltage BEC C4236A-3, circuit CYB02 (WH/BN), harness side and ground; and between high-voltage BEC C4236A-4, circuit	**Yes** INSTALL a new ACCM and A/C compressor assembly. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal

CYB03 (BN/YE), harness side and ground.  N0102978 • **Are the resistances greater than 10,000 ohms?**	operation. **No** INSTALL new high-voltage cables. REFER to High-Voltage Cables in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AQ7 CHECK FOR SHORT TO GROUND AT HIGH-VOLTAGE BEC	
• Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: High-voltage BEC C4001. • Disconnect: High-voltage BEC C4002. • Measure the resistance between high-voltage BEC C4001-1, circuit J12-1, harness side and ground; and between high-voltage BEC C4001-3, circuit J1-A44, harness side and ground.  N0102979 • Measure the resistance between high-voltage BEC C4002-1, circuit J12-1, harness side and ground; and between high-voltage BEC C4002-3, circuit J12-A47, harness side and ground.  N0102979 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AQ8 CHECK FOR SHORT TO VOLTAGE IN INTERLOCK CIRCUIT	

• Ignition ON. • Measure the voltage between BECM C4237B-44, circuit J1-A44, harness side and ground; and between BECM C4237B-47, circuit J1-A47, harness side and ground.  N0102980 • **Is any voltage present?**	**Yes** GO to AQ9 . **No** GO to AQ15 .
AQ9 CHECK FOR VOLTAGE IN HIGH-VOLTAGE CABLES IN INTERLOCK CIRCUIT	
• Disconnect: High-voltage BEC C4236B. • Measure the voltage between high-voltage BEC C4236B-1, circuit CYB04 (VT/BN), harness side and ground; and between high-voltage BEC C4236B-2, circuit CYB03 (BN/YE), harness side and ground.  N0102981 • **Is any voltage present?**	**Yes** GO to AQ10 . **No** GO to AQ11 .
AQ10 CHECK FOR VOLTAGE IN INTERLOCK CIRCUIT TO TCM	
• Disconnect: TCM C1458C. • Measure the voltage between high-voltage BEC C4236B-1, circuit CYB04 (VT/BN), harness side and ground; and between high-voltage BEC C4236B-2, circuit CYB03 (BN/YE), harness side and ground.  N0102981 • **Is any voltage present?**	**Yes** INSTALL new high-voltage cables. REFER to High-Voltage Cables in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a eCVT . REFER to Section 307-01C . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AQ11 CHECK FOR VOLTAGE IN INTERLOCK CIRCUIT TO ACCM AND DC/DC	

• Disconnect: High-voltage BEC C4236A. • Measure the voltage between high-voltage BEC C4236A-3, circuit CYB02 (WH/BN), harness side and ground; and between high-voltage BEC C4236A-4, circuit CYB03 (BN/YE), harness side and ground.  N0102982 • **Is any voltage present?**	**Yes** GO to AQ12 . **No** GO to AQ14 .
AQ12 CHECK FOR VOLTAGE IN INTERLOCK CIRCUIT TO DC/DC	
• Disconnect: DC/DC C1457A. • Measure the voltage between high-voltage BEC C4236A-3, circuit CYB02 (WH/BN), harness side and ground; and between high-voltage BEC C4236A-4, circuit CYB03 (BN/YE), harness side and ground.  N0102982 • **Is any voltage present?**	**Yes** GO to AQ13 . **No** INSTALL a new DC/DC . REFER to Section 414-05 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AQ13 CHECK FOR VOLTAGE IN INTERLOCK CIRCUIT TO ACCM	
• Connect: DC/DC C1457A. • Disconnect: ACCM C1469B. • Measure the voltage between high-voltage BEC C4236A-3, circuit CYB02 (WH/BN), harness side and ground; and between high-voltage BEC C4236A-4, circuit CYB03 (BN/YE), harness side and ground  N0102982 • **Is any voltage present?**	**Yes** INSTALL new high-voltage cables. REFER to High-Voltage Cables in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new ACCM and A/C compressor assembly. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

AQ14 CHECK FOR VOLTAGE AT HIGH-VOLTAGE BEC	
• Remove the high-voltage BEC cover. Refer to the exploded view in Battery Pack Sensor Module (BPSM) in this section. • Disconnect: High-voltage BEC C4001. • Disconnect: High-voltage BEC C4002. • Measure the voltage between high-voltage BEC C4001-1, circuit J12-1, harness side and ground; and between high-voltage BEC C4001-3, circuit J1-A44, harness side and ground.  N0102983 • Measure the voltage between high-voltage BEC C4002-1, circuit J12-1, harness side and ground; and between high-voltage BEC C4002-3, circuit J1-A47, harness side and ground.  N0102983 • **Is any voltage present?**	**Yes** INSTALL a new HVTB (includes HVTB system wire harness). REFER to High-Voltage Traction Battery in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** INSTALL a new high-voltage BEC . REFER to High-Voltage Bussed Electrical Center in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
AQ15 CHECK FOR CORRECT BECM OPERATION	
• Ignition OFF. • Check the BECM harness and component side connectors for: ♦ corrosion. ♦ pushed-out/bent pins. • Connect: BECM C4237B . • Connect: Service Disconnect Plug. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Battery Energy Control Module (BECM) in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Rubber Insulating Gloves Testing

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

NOTE: The high-voltage insulated safety gloves must be recertified every 6 months to remain within OSHA guidelines.

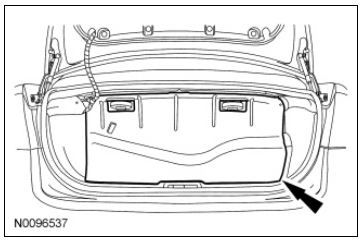
1. Leather gloves must always be worn over the rubber insulating gloves in order to protect them.
2. The gloves should not be used if they show any signs of wear and tear.
3. Roll the glove up from the open end until the lower portion of the glove begins to balloon from the resulting air pressure. If the glove leaks any air, it must not be used.
4. Rubber insulating gloves must be class "00" and meet all of the American Society for Testing and Materials standards.

High-Voltage Traction Battery Systems Depowering

⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.

1. Turn the ignition off.

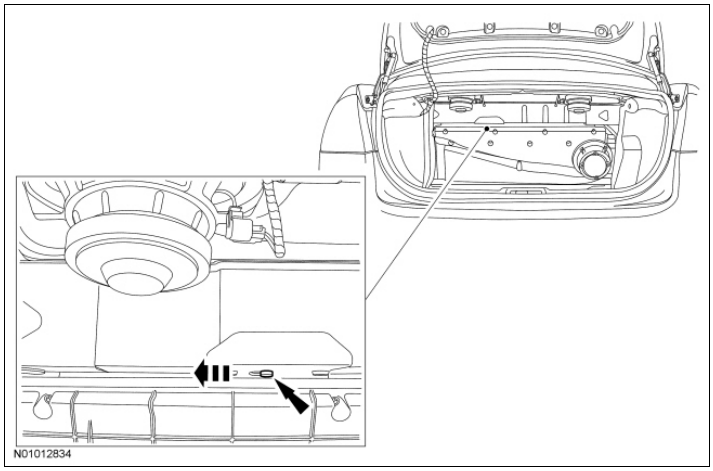
2. Remove the 4 pin-type retainers and the trunk front cover.



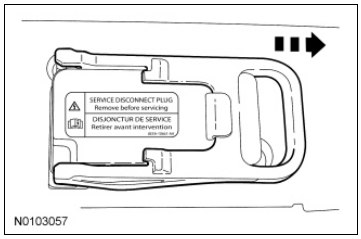
3. **NOTE:** If the center safety belt retractor locks and the safety belt webbing prevents the 60 percent backrest from lowering, raise the backrest upward to release the safety belt retractor and belt webbing.

   Fold the LH backrest down.

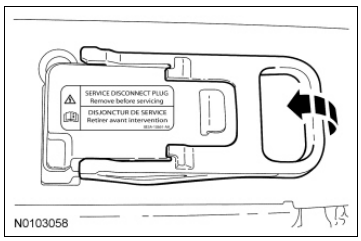
   - Between the High Voltage Traction Battery (HVTB) and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.



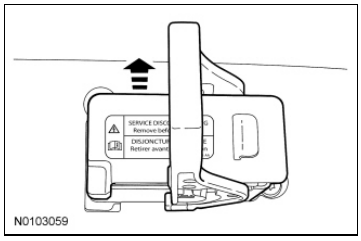
4. Slide the handle of the service disconnect plug toward the LH side of the vehicle.



5. Rotate the handle upward.



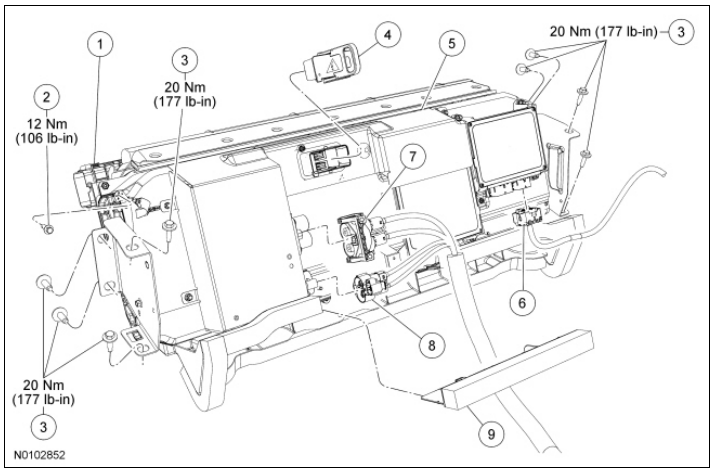
6. Pull the service disconnect plug out and away from the HVTB . Be sure to store the plug in a place where it cannot be accidentally re-installed while the vehicle is being serviced.



7. Wait 5 minutes after the service disconnect plug is removed before continuing service. This allows any residual voltage in the high-voltage system to dissipate.

8. To install, reverse the removal procedure.

High-Voltage Traction Battery



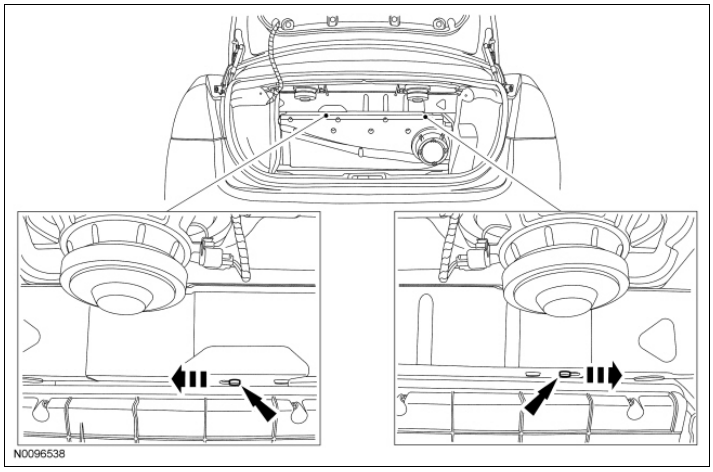
Item	Part Number	Description
1	10C665	High Voltage Traction Battery (HVTB) cooling outlet duct
2	W712524	HVTB ground strap-to-chassis bolt
3	W505435	HVTB mounting bolts (8 required)
4	10A757	HVTB service disconnect plug
5	10B759	HVTB assembly
6	-	Battery Energy Control Module (BECM) 50-pin connector (part of 14A005)
7	-	High-voltage/high-current electrical connector (part of 14300)
8	-	High-voltage/low-current electrical connector (part of 14300)
9	19B680	HVTB cooling inlet duct plate

Removal and Installation

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

1. Depower the High Voltage Traction Battery (HVTB). For additional information, refer to High-Voltage Traction Battery Systems Depowering in this section.

- Between the HVTB and the sheet metal, locate the seat backrest latch release lever.
  - Push the release lever toward the outboard side of the vehicle and fold the backrest down.



3. Remove the RH rear seat bolster. For additional information, refer to Section 501-10 .

4. Disconnect the cooling fan jumper harness electrical connector, then remove the wiring connector pushpin from the HVTB handle bracket.

5. Remove the HVTB cooling inlet duct. For additional information, refer to High-Voltage Traction Battery Cooling Inlet Duct in this section.

6. Disconnect the 50-pin connector at the Battery Energy Control Module (BECM).

7. Remove the ground strap-to-chassis bolt and position the ground strap aside.
   - To install, tighten to 12 Nm (106 lb-in).

8. Remove the 2 plastic bumpers from the back of the rear seat back by releasing the 2 pushpins.

9. **NOTE:** The attaching bolts have a conductive coating on them and are serrated under the head flange. These features ground the HVTB to the vehicle, which is required for electro-magnetic compatibility. If a bolt(s) is lost or damaged, a new identical bolt(s) must be installed.

   Remove the 4 HVTB mounting bolts from the trunk area that secure the HVTB to the brackets.

   - To install, tighten to 20 Nm (177 lb-in).

10. **NOTE:** The attaching bolts have a conductive coating on them and are serrated under the head flange. These features ground the HVTB to the vehicle, which is required for electro-magnetic compatibility. If a bolt(s) is lost or damaged, a new identical bolt(s) must be installed.

    From each rear door opening, remove the 2 HVTB mounting bolts (total of 4 bolts) that secure the HVTB to the brackets.

    - To install, tighten to 20 Nm (177 lb-in).

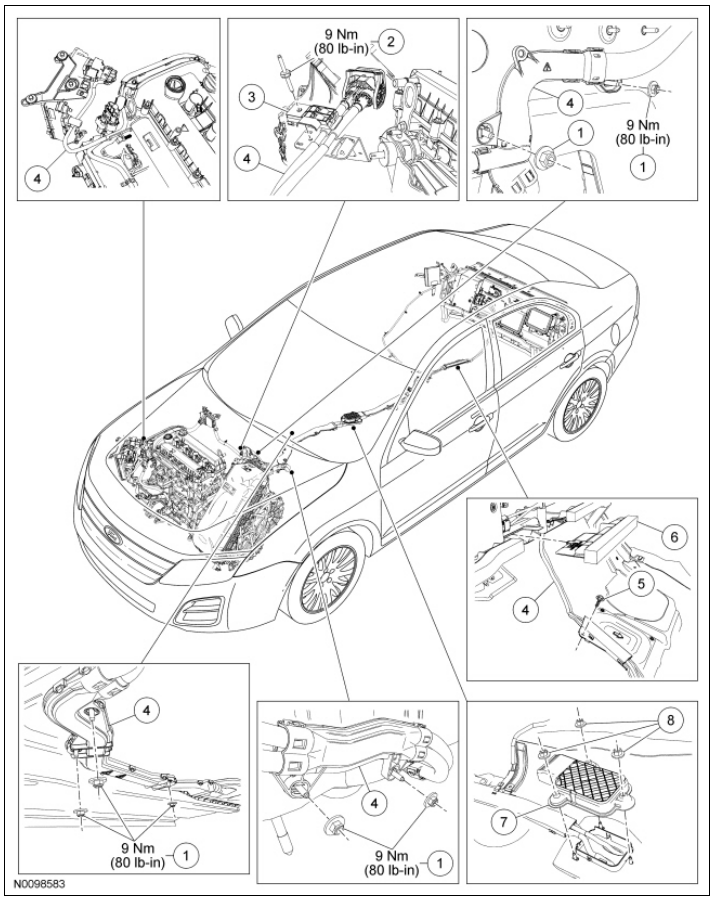
11. ***NOTICE:*** **Lay a fender cover or other protective material over the seat backs to reduce the possibility of damage when removing the battery.**

    NOTICE: **Make certain the High Voltage Traction Battery (HVTB) does not mar or damage the interior panels or seating during removal. There is very little clearance on each side.**

    With the help of an assistant inside the vehicle, grasp the handles on each side of the battery and slide the battery forward and out of the vehicle.

12. To install, reverse the removal procedure.

High-Voltage Cables



Item	Part Number	Description
1	W713475	High-voltage cable shield nuts (7 required)
2	W704683	High-voltage cable strain relief bolt
3	-	High-voltage cable strain relief clamp (part of 14300)
4	14300	High-voltage cable assembly
5	N807011	High-voltage cable shield screw
6	19B680	High Voltage Traction Battery (HVTB) cooling inlet duct plate
7	-	High-voltage cable floor pan grommet cover (part of 14300)
8	W713475	High-voltage cable floor pan grommet nuts (3 required)

Removal and Installation

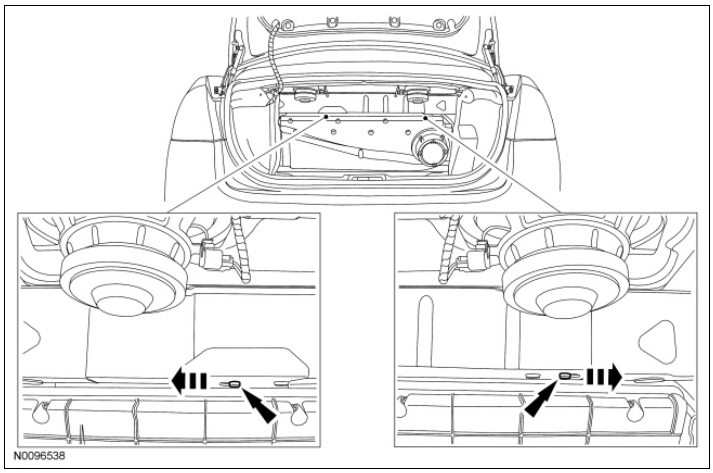
⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

1. Discharge the A/C system. For additional information, refer to Section 412-00A .

2. Discot the 12-volt battery. For additional information, refer to Section 414-01 .

3. Depower the High Voltage Traction Battery (HVTB). For additional information, refer to High-Voltage Traction Battery Systems Depowering in this section.

4. Fold the RH backrest down.
   - Between the HVTB and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.



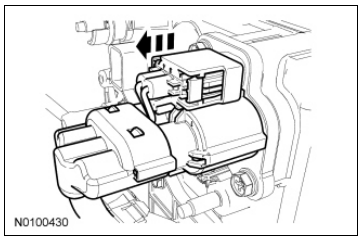
5. Remove the RH rear seat bolster. For additional information, refer to Section 501-10 .

6. ***NOTICE:*** **Failure to disconnect high-voltage cable connectors as instructed may result in damage to the connectors.**

   NOTE: DC to DC Converter Control Module (DC/DC) connector shown, high-voltage/low-current connector at high-voltage Bussed Electrical Center (BEC) similar.

   Release the locking lever and locking tabs and disconnect the interlock connector and the 2 high voltage cables at the high-voltage BEC .

   - Press the locking clip on the white interlock connector and disengage the white connector before releasing the locking clip on the orange portion of the high-voltage connector. The white interlock connector will not come completely apart until the orange portion is released.



7. Remove the HVTB cooling inlet duct plate.

8. Remove the pushpin that retains the high-voltage cables to the bracket on the HVTB case.

9. Remove the passenger side front seat. For additional information, refer to Section 501-10 .

10. Remove the front door scuff plate trim panel.

11. Remove the rear door scuff plate trim panel.

12. Remove the lower B-pillar trim panel.
    - Slide the lower B-pillar trim panel down to disengage it from the upper B-pillar trim panel.

13. Remove the rear seat cushion. For additional information, refer to Section 501-10 .

14. Remove the high-voltage cable shield retaining screw.

15. Partially raise the LR seat back and pull the high-voltage cables out from under the rear seat backrest, then position both rear seat backrests in the upright position.

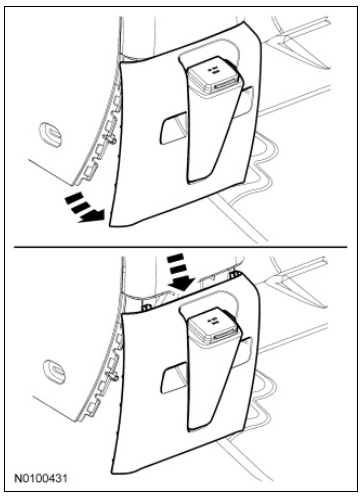
16. **NOTE:** The high-voltage cables are routed under the passenger side rear carpet.

    Disconnect the high-voltage cable from the DC/AC inverter and remove the 5 retaining clips. Position the cable aside.

17. ***NOTICE:*** **Make sure that the rear of the floor console is lifted away from the floor as specified. Failure to follow this procedure will result in damage to the floor console and the tabs at the top of the floor console end cover.**

    Remove the floor console end cover in the following sequence.

    1. Remove the floor console rear screws.
    2. Lift the floor console about 25 mm (0.984 in) away from the floor.
    3. Remove the floor console end cover by pulling the cover away at the bottom and rotating out. Lower the cover 7-13 mm (0.275-0.511 in) to clear the tabs on the top of the floor console end cover.



18. Disconnect the AC power point connector.

19. Release the 2 pushpins that hold the high-voltage cables to the floor pan and pull the high-voltage cable out from underneath the carpet and floor console.

20. Remove the 3 nuts at the floor pan grommet cover.

21. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

22. Remove the 5 nuts that retain the high-voltage cable shield to the floor pan and remove the cables from the studs.
    - To install, tighten to 9 Nm (80 lb-in).

23. Remove the 2 nuts that retain the high-voltage cable shield to the bulkhead and remove the cables from the studs.
    - To install, tighten to 9 Nm (80 lb-in).

24. Remove the pushpin that retains the high-voltage harness to the bulkhead.

25. Push the high-voltage cables through the opening of the vehicle floor pan.

26. Remove the engine cover.

27. Remove the high-voltage cable strain relief bolt and remove the strain relief clamp from the bracket.
    - To install, tighten to 9 Nm (80 lb-in).

28. Disconnect the high-voltage electrical connector from the transmission and position the cable aside.

29. Using a screwdriver or other suitable tool, release the clip that locks the high-voltage junction block to the bracket by pushing the tool between the high-voltage junction block and the bracket from the LH side. Remove the cable from the retainer on the bulkhead and position the cable aside.

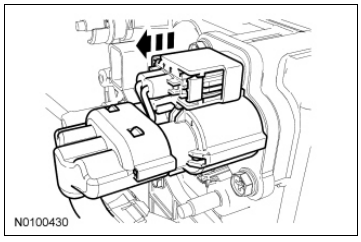
30. Lift the high-voltage cables from the 2 studs on the front of the engine and disengage the pushpin at the intake manifold.

31. ***NOTICE:*** **Failure to disconnect high-voltage cable connectors as instructed may result in damage to the connectors.**

    NOTE: DC/DC connector shown, high-voltage/low-current connector at Air Conditioning Compressor Module (ACCM) similar.

    Release the clips and locking tabs and disconnect the interlock connector and the high-voltage cable connector at the ACCM .

    - Press the locking clip on the white interlock connector and disengage the white connector before releasing the locking clip on the orange portion of the high-voltage connector. The white interlock connector will not come completely apart until the orange portion is released.

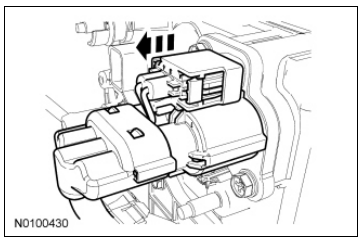


32. ***NOTICE:*** **Failure to disconnect high-voltage cable connectors as instructed may result in damage to the connectors.**

    Release the clips and locking tabs and disconnect the interlock connector and the high-voltage cable connector at the DC/DC .

    - Press the locking clip on the white interlock connector and disengage the white connector before releasing the locking clip on the orange portion of the high-voltage connector. The

white interlock connector will not come completely apart until the orange portion is released.



33. Remove the A/C evaporator inlet fitting nut from the low side and disconnect the fitting nut. Discard the gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

34. Remove the A/C compressor manifold and suction tube fitting nut (low side) and disconnect the fitting. Remove the tube and discard the gasket seal.
    - To install, tighten to 15 Nm (133 lb-in).

35. Wrap mechanic's wire around the Hydraulic Control Unit (HCU) motor from above and support the HCU .

36. Remove the 3 bolts that retain the HCU bracket to the frame.
    - To install, tighten to 23 Nm (17 lb-ft).

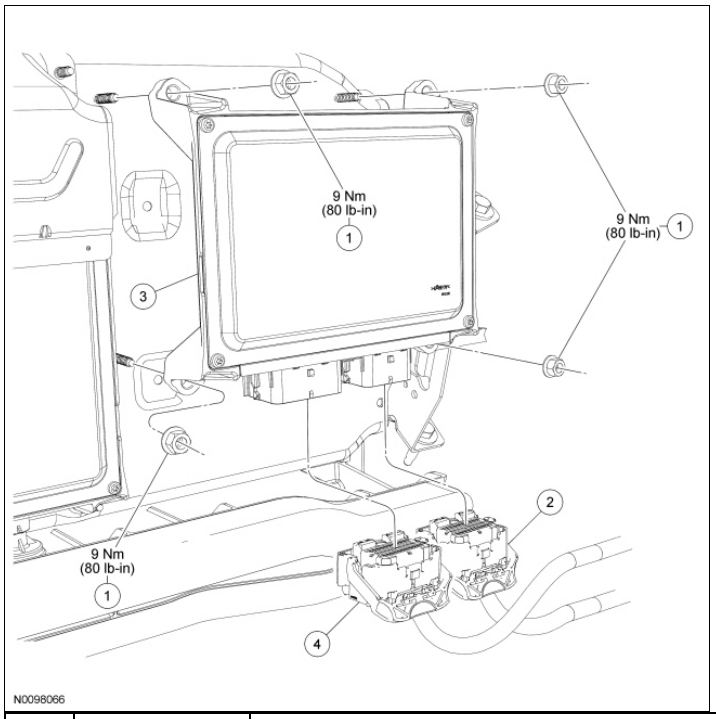
37. An assistant is needed to help feed the cable down through the engine compartment and remove the high-voltage cable assembly from the bottom of the vehicle.

38. To install, reverse removal procedure.

Battery Energy Control Module (BECM)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

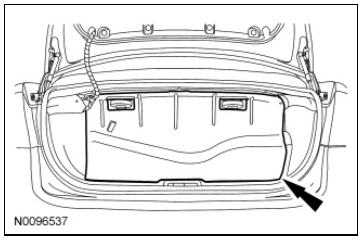


Item	Part Number	Description
1	W705790	Battery Energy Control Module (BECM) nuts (4 required)
2	-	BECM connector (part of 14A005)
3	10B687	BECM
4	-	BECM connector (part of 10B759)

Removal and Installation

1. Retrieve the module configuration. Carry out the module configuration retrieval steps of the Programmable Module Installation (PMI) procedure. For additional information, refer to Section 418-01 .

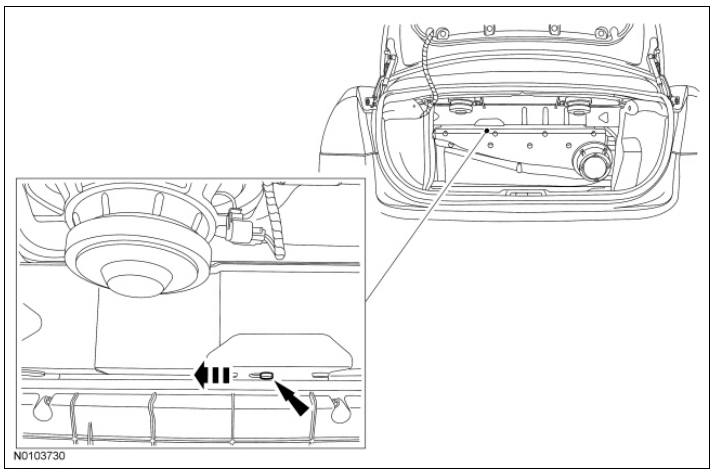
2. Remove the 4 pin-type retainers and the trunk front cover.



3. **NOTE:** If the center safety belt retractor locks and the safety belt webbing prevents the 60 percent backrest from lowering, raise the backrest upward to release the safety belt retractor and belt webbing.

   Fold the LH backrest down.

   - Between the High Voltage Tractiattery (HVTB) and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.

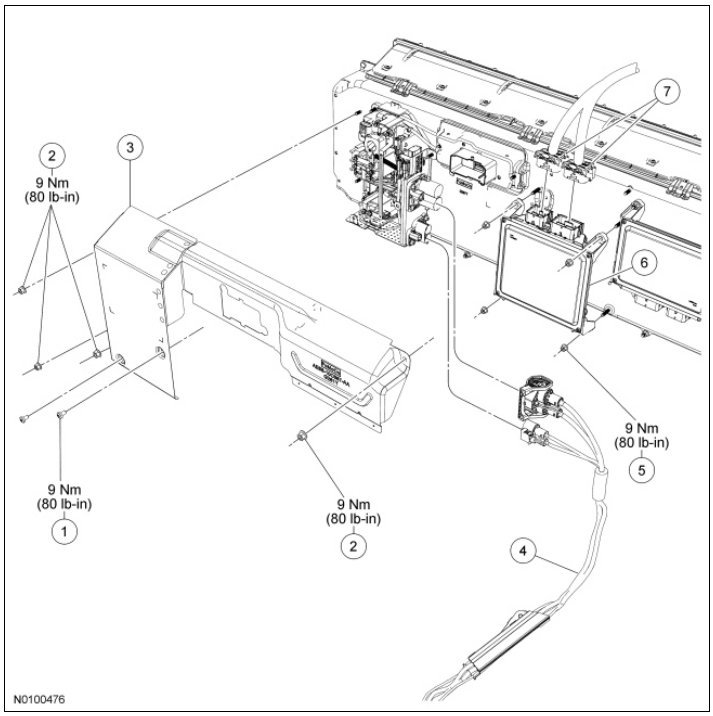


4. Release the locking levers and disconnect the 2 electrical connectors at the Battery Energy Control Module (BECM).

5. Remove the 4 nuts and the BECM .
   - To install, tighten to 9 Nm (80 lb-in).

6. To install, reverse the removal procedure.
   - When installing a new BECM , carry out the steps necessary to complete Programmable Module Installation (PMI). For additional information, refer to Section 418-01 .

Battery Pack Sensor Module (BPSM)



Item	Part Number	Description
1	W500010	High-voltage Bussed Electrical Center (BEC) cover screw (2 required)
2	W705790	High-voltage BEC cover nuts (4 required)
3	10A687	High-voltage BEC cover
4	14300	High-voltage cable assembly
5	W705790	Battery Pack Sensor Module (BPSM) nut (4 required)
6	10B830	BPSM
7	-	BPSM connectors (part of 10B759)

Removal and Installation

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

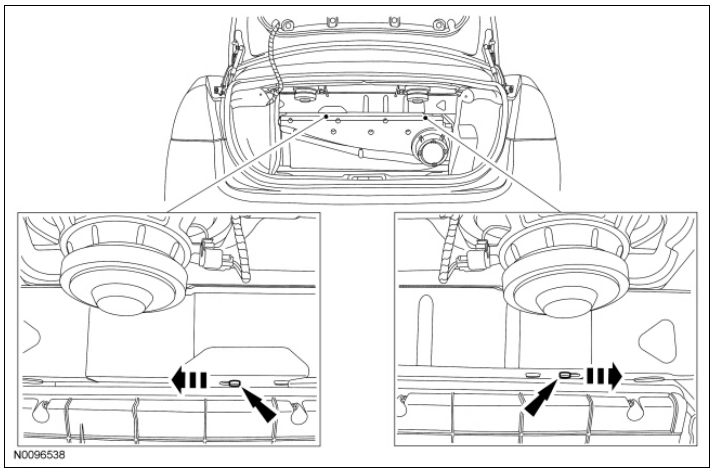
⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injuryr death.

⚠ WARNING: Always inspect gloves before each use to prevent high-voltage shock. High-voltage insulated safety gloves with a leather outer glove are required to service some components of this vehicle where specified in the service procedures. All high-voltage insulated safety gloves must meet or exceed ANSI/ASTM class 00. Refer to Rubber Insulating Gloves Testing in this section. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.

1. Depower the High Voltage Traction Battery (HVTB). For additional information, refer to High-Voltage Traction Battery Systems Depowering in this section.

2. Fold the RH backrest down.
   - Between the HVTB and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.



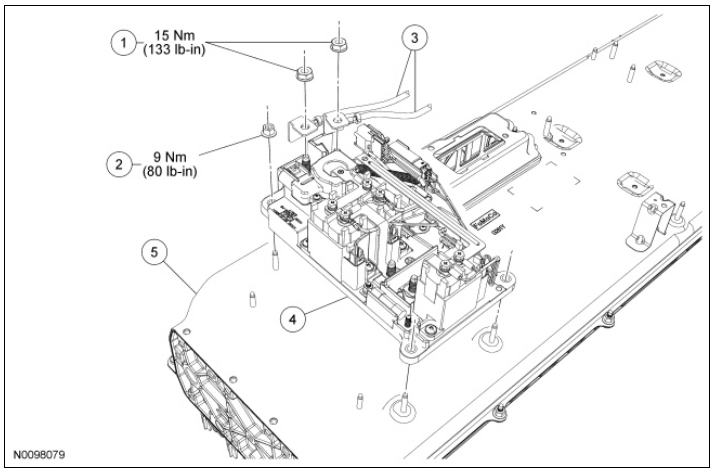
3. Remove the 4 high-voltage Bussed Electrical Center (BEC) cover nuts, the 2 high-voltage BEC cover screws and the high-voltage BEC cover.
   - To install, tighten to 9 Nm (80 lb-in).

4. Release the locking levers and disconnect the 2 connectors at the Battery Pack Sensor Module (BPSM).

5. Remove the 4 nuts and the BPSM .
   - To install, tighten to 9 Nm (80 lb-in).

6. To install, reverse the removal procedure.

High-Voltage Bussed Electrical Center



Item	Part Number	Description
1	W701596	High Voltage Traction Battery (HVTB) cable nuts (2 required)
2	W705790	High-voltage Bussed Electrical Center (BEC) nut
3	-	HVTB B+ and B- cables (part of 10B759)
4	10C666	High-voltage BEC
5	10B759	HVTB

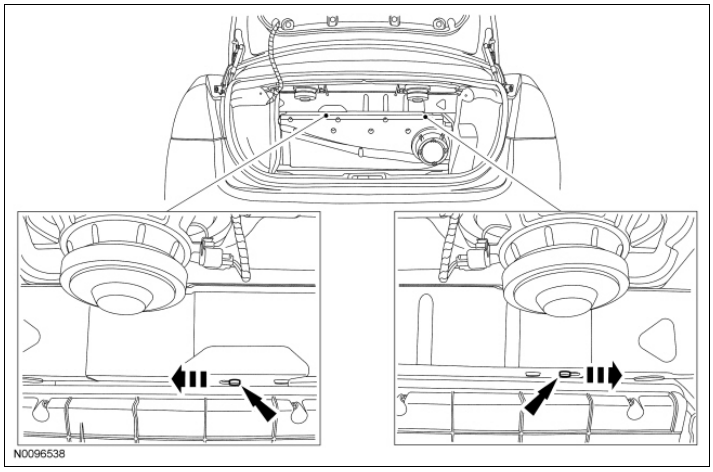
Removal and Installation

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always insta the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.

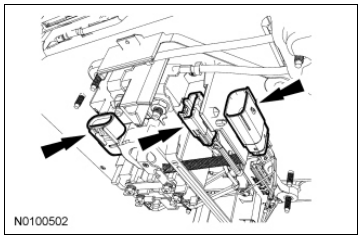
1. Depower the High Voltage Traction Battery (HVTB). For additional information, refer to High-Voltage Traction Battery Systems Depowering in this section.

2. Fold the RH backrest down.
   - Between the HVTB and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.



3. Remove the high-voltage cable connector and bracket. For additional information, refer to High-Voltage Traction Battery Connector and Bracket in this section.

4. Release the locking tabs and disconnect the 3 connectors.

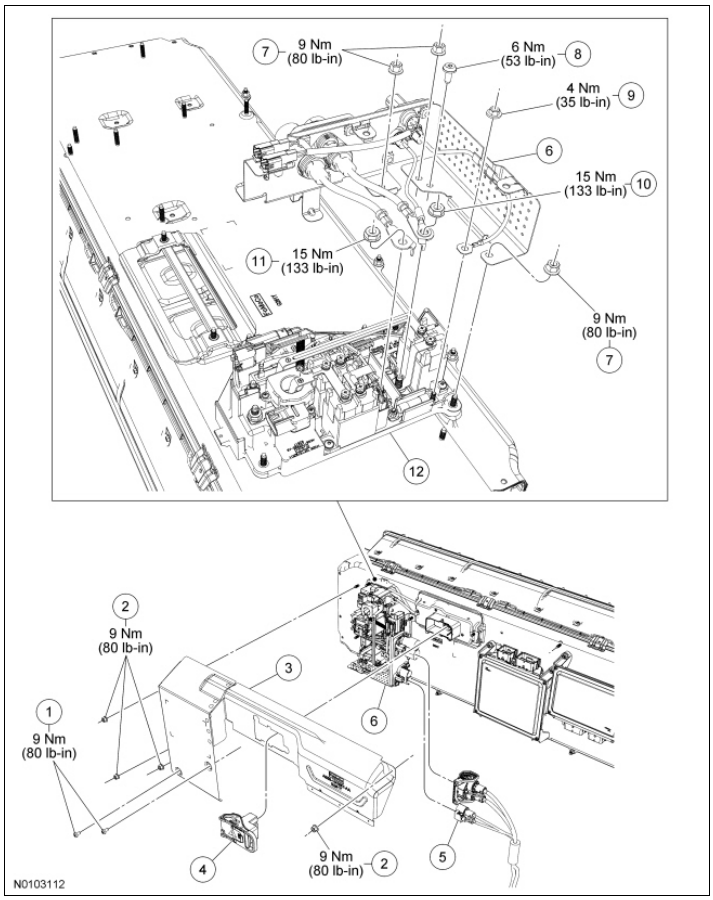


5. Remove the 2 HVTB cable nuts and detach the cables from the high-voltage Bussed Electrical Center (BEC).
    - To install, tighten to 15 Nm (133 lb-in).

6. Remove the nut at the upper LH corner and remove the high-voltage BEC .
    - To install, tighten to 9 Nm (80 lb-in).

7. To install, reverse the removal procedure.

High-Voltage Traction Battery Connector and Bracket



Item	Part Number	Description
1	W505530	High-voltage Bussed Electrical Center (BEC) cover screws (2 required)
2	W705790	High-voltage BEC cover nuts (4 required)
3	10A687	High-voltage BEC cover
4	10A757	High Voltage Traction Battery (HVTB) service disconnect plug
5	14300	High-voltage cable
6	14E049	High-voltage cable connector and bracket assembly
7	W705790	High-voltage cable connector and bracket assembly nuts (3 required)
8	W506973	High-voltage cable connector and bracket assembly screw
9	W702841	High-voltage/low-current positive cable nut
10	W701596	High-voltage/high-current and low-current negative cable nut

11	W701596	High-voltage/high-current positive cable nut
12	10C666	High-voltage BEC

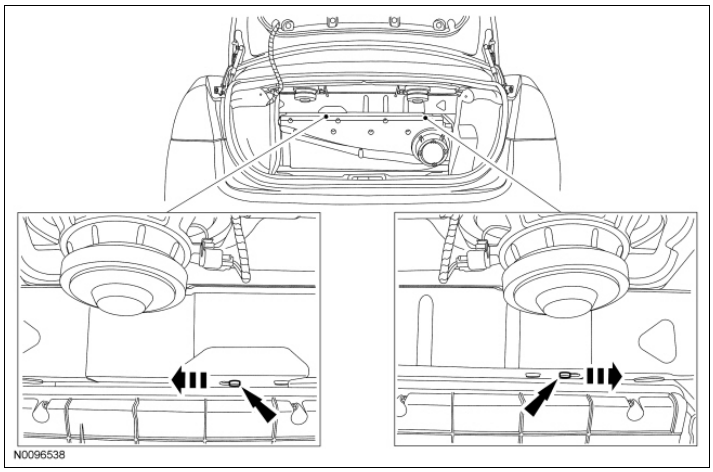
Removal and Installation

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.

1. Depower the High Voltage Traction Battery (HVTB). For additional information, refer to High-Voltage Traction Battery Systems Depowering in this section.

2. Fold the RH backrest down.
   - Between the HVTB and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.

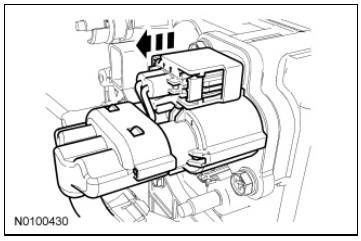


3. ***NOTICE:*** **Failure to disconnect high-voltage cable connectors as instructed may result in damage to the connectors.**

   NOTE: DC to DC Converter Control Module (DC/DC) connector shown, high-voltage/low-current connector at HVTB similar.

   Release the locking lever and locking tabs and disconnect the interlock connector and the 2 high-voltage cables.

   - Press the locking clip on the white interlock connector and disengage the white connector before releasing the locking clip on the orange portion of the high-voltage connector. The white interlock connector will not come completely apart until the orange portion is released.



4. Remove the 4 nuts and 2 screws at the HVTB Bussed Electrical Center (BEC) cover and remove the cover.
    - To install, tighten to 9 Nm (80 lb-in).

5. Disconnect the 2 interlock circuit connectors on the high-voltage cable connector and bracket.

6. Remove the high-voltage/high-current positive cable nut.
    - To install, tighten to 15 Nm (133 lb-in).

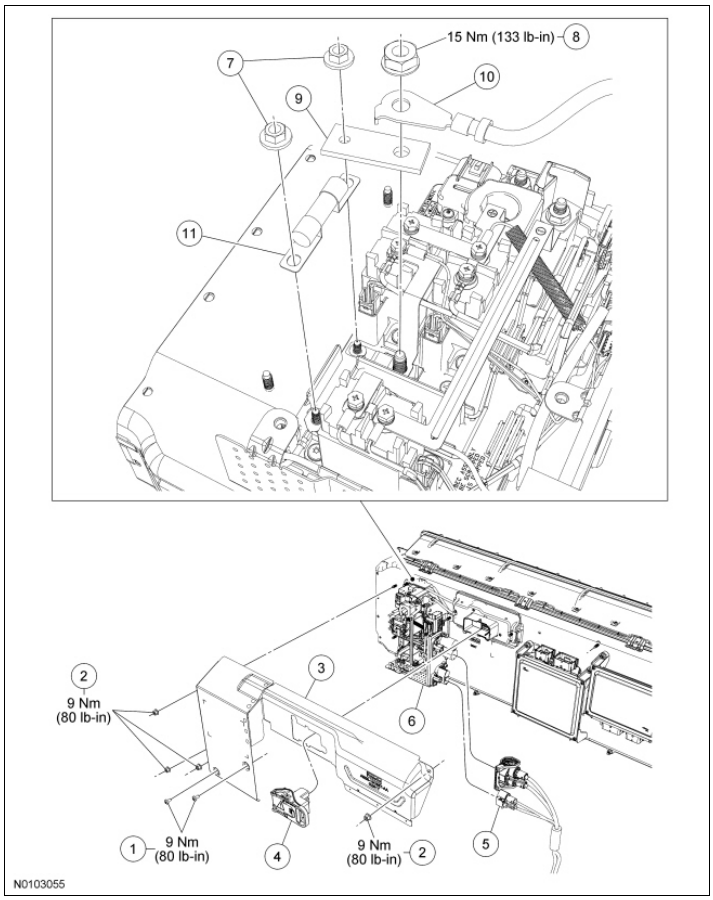
7. Remove the high-voltage/high and low-current negative cable nut.
    - To install, tighten to 15 Nm (133 lb-in).

8. Remove the high-voltage/low-current positive cable nut at the 40A fuse.
    - To install, tighten to 4 Nm (35 lb-in).

9. Remove the 3 nuts, 1 bolt and the high-voltage cable connector and bracket assembly.
    - To install, tighten the 3 nuts to 9 Nm (80 lb-in).
    - To install, tighten the bolt to 6 Nm (53 lb-in).

10. To install, reverse the removal procedure.

High-Voltage Low-Current Fuse



Item	Part Number	Description
1	W505530	High-voltage Bussed Electrical Center (BEC) cover screws (2 required)
2	W705790	High-voltage BEC cover nuts (4 required)
3	10A687	High-voltage BEC cover
4	10A757	High Voltage Traction Battery (HVTB) service disconnect plug
5	14300	High-voltage cable
6	14E049	High-voltage cable connector and bracket assembly
7	W702841	High-voltage/low-current fuse nuts (2 required)
8	W701596	High-voltage/high-current positive cable nut
9	-	High-voltage/low-current circuit bus bar (part of 10C666)
10	-	High-voltage/high-current positive cable (part of 14E049)

11	14526	High-voltage/low-current fuse (40A)

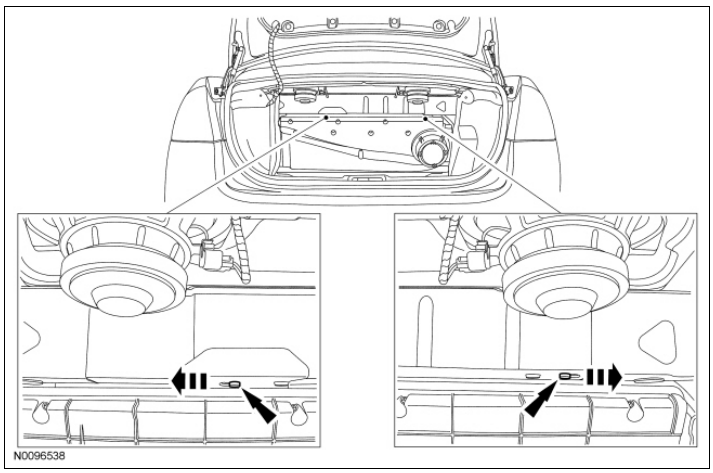
Removal and Installation

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

⚠ WARNING: Never install the service disconnect plug when a high-voltage service cover is removed. Always install the cover prior to connecting the service disconnect plug. The cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death.

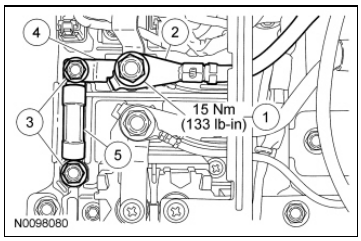
1. Depower the High Voltage Traction Battery (HVTB). For additional informn, refer to High-Voltage Traction Battery Systems Depowering in this section.

2. Fold the RH backrest down.
   - Between the HVTB and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.



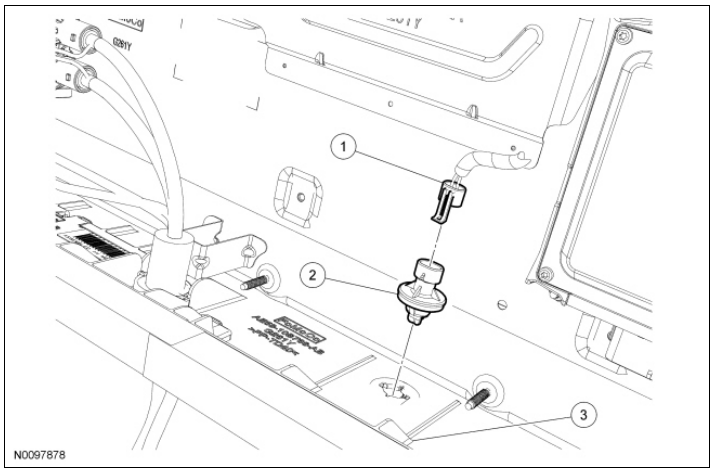
3. Remove the 4 nuts, 2 bolts and the high-voltage BEC cover.
   - To install, tighten to 9 Nm (80 lb-in).

4. Remove the high-voltage/high-current fuse.
   1. Remove the high-voltage/high-current positive cable nut.
      - ♦ To install, tighten to 15 Nm (133 lb-in).
   2. Position the high-voltage/high-current positive cable aside.
   3. Remove the 2 high-voltage/low-current fuse nuts on each end of the fuse.
      - ♦ To install, tighten to 4 Nm (35 lb-in).
   4. Remove the high-voltage/low-current circuit bus bar.
   5. Remove the high-voltage/low-current fuse (40A).



5. To install, reverse the removal procedure.

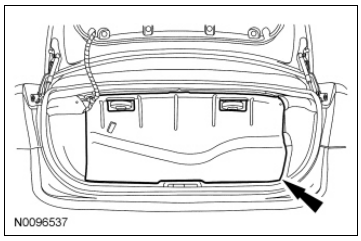
High-Voltage Traction Battery Inlet Air Temperature Sensor



Item	Part Number	Description
1	-	High Voltage Traction Battery (HVTB) inlet air temperature sensor connector (part of 10B759)
2	14A606	HVTB inlet air temperature sensor
3	10B768	HVTB inlet air duct

Removal and Installation

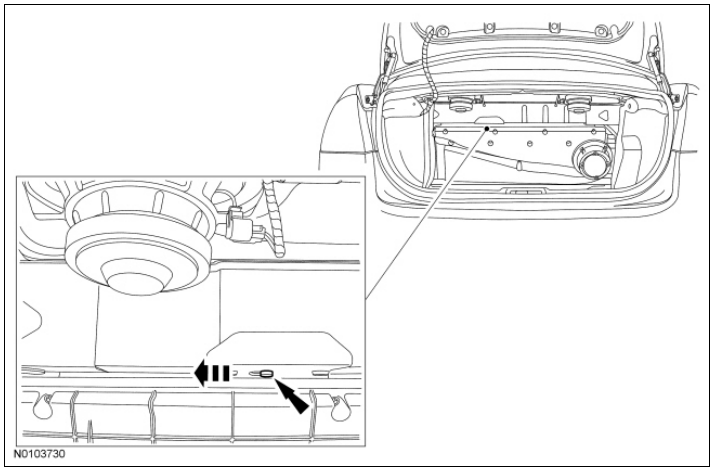
1. Remove the 4 pin-type retainers and the trunk front cover.



2. **NOTE:** If the center safety belt retractor locks and the safety belt webbing prevents the 60 percent backrest from lowering, raise the backrest upward to release the safety belt retractor and belt webbing.

   Fold the LH backrest down.

   - Between the High Voltage Traction Battery (HVTB) and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.

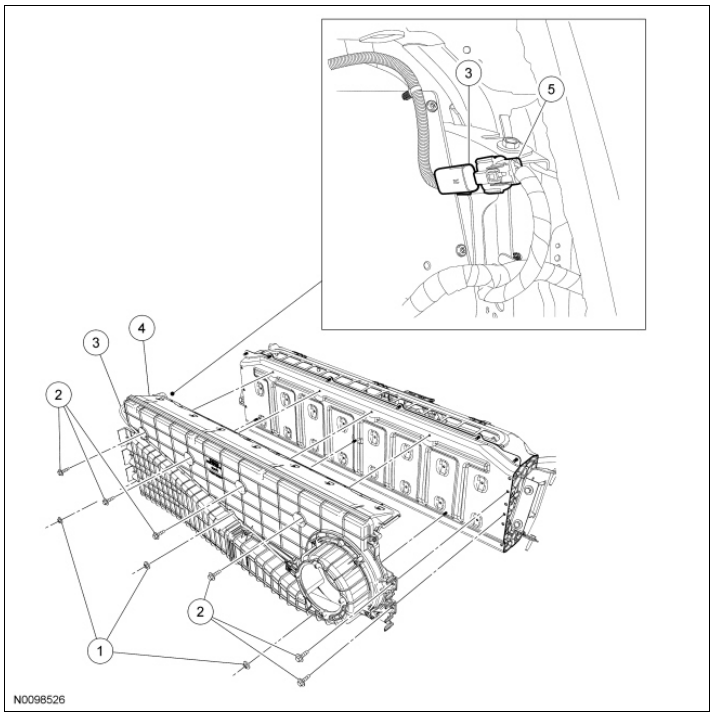


3. Release the locking tab and removthe connector from the HVTB inlet air temperature sensor.

4. Remove the HVTB inlet air temperature sensor.
    - Turn the sensor counterclockwise to unlock and release it from the plenum.

5. To install, reverse the removal procedure.

High-Voltage Traction Battery Cooling Outlet Duct



Item	Part Number	Description
1	W713475	High Voltage Traction Battery (HVTB) cooling outlet duct nuts (3 required)
2	W708703	HVTB cooling outlet duct screws (6 required)
3	14D641	HVTB cooling fan jumper wiring harness
4	10C665	HVTB cooling outlet duct
5	-	HVTB cooling fan connector (part of 14A005)

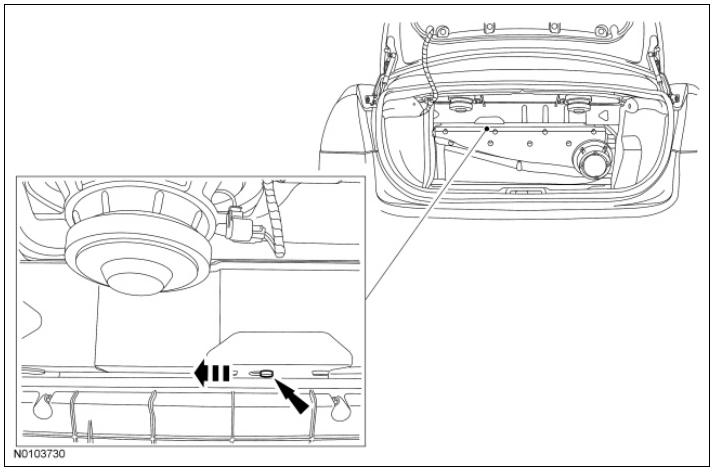
Removal and Installation

1. Remove the High Voltage Traction Battery (HVTB) cooling fan. For additional information, refer to High-Voltage Traction Battery Cooling Fan in this section.

2. **NOTE:** If the center safety belt retractor locks and the safety belt webbing prevents the 60 percent backrest from lowering, raise the backrest upward to release the safety belt retractor and belt webbing.

   Fold the LH backrest down.

   - Between the HVTB and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down



3. Release the locking tab and disconnect the HVTB cooling fan jumper harness. Rove the clips holding the harness to the HVTB mounting bracket and HVTB case.

4. Release the clips that hold the HVTB cooling fan jumper harness to the HVTB cooling outlet duct and remove the harness from the duct.

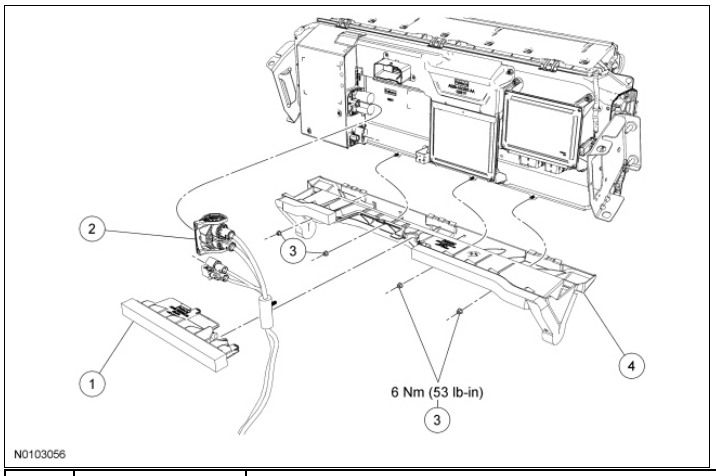
5. Remove the 6 bolts and 3 nuts and remove the HVTB cooling outlet duct.

6. To install, reverse the removal procedure.

High-Voltage Traction Battery Cooling Inlet Duct

Material

Item	Specification
Threadlock and Sealer TA-25	WSK-M2G351-A5



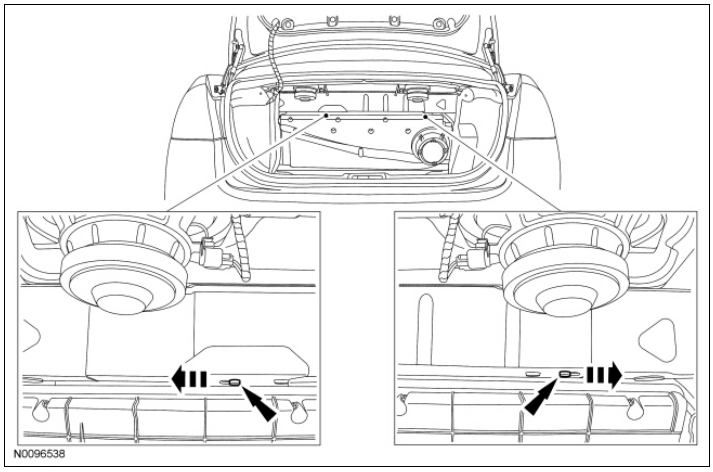
Item	Part Number	Description
1	19B680	High Voltage Traction Battery (HVTB) cooling inlet duct plate
2	14300	High-voltage cable assembly
3	W705790	HVTB cooling inlet duct nuts (4 required)
4	10B768	HVTB cooling inlet duct

Removal and Installation

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

1. Depower the High Voltage Traction Battery (HVTB). For additional information, refer to High-Voltage Traction Battery Systems Depowering in this section.

2. Fold the RH backrest down.
   - Between the HVTB and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.

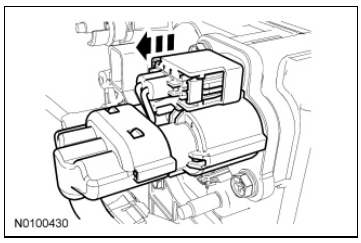


3. Pull loose and remove the cooling inlet duct plate in front of the high-voltage cables.

4. ***NOTICE:*** **Failure to disconnect high-voltage cable connectors as instructed may result in damage to the connectors.**

   Disconnect the high-voltage/high-current, high-voltage/low-current and interlock connectors.

   - Press the locking clip on the white interlock connector and disengage the white connector before releasing the locking clip on the orange portion of the high-voltage/low-current connector. The white interlock connector will not come completely apart until the orange portion is released.



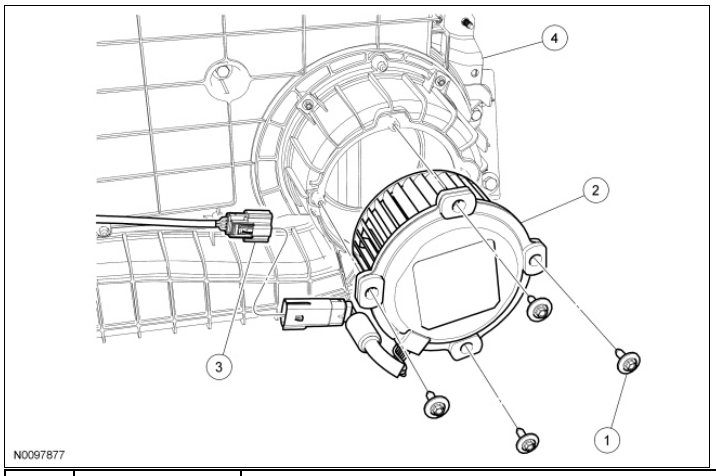
5. Remove the 4 HVTB cooling inlet duct nuts and the inlet duct.
   - To install, apply a small amount of threadlock and sealer and tighten to 6 Nm (53 lb-in).

6. To install, reverse the removal procedure.

High-Voltage Traction Battery Cooling Fan

Material

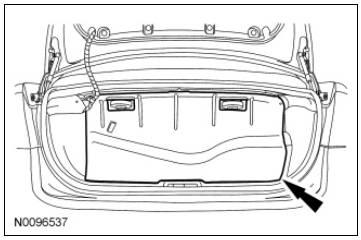
Item	Specification
Instant Gel Adhesive TA-19	WSK-M2G402-A4



Item	Part Number	Description
1	W790165	High Voltage Traction Battery (HVTB) cooling fan screw (4 required)
2	10C659	HVTB cooling fan
3	14D641	HVTB cooling fan jumper harness
4	10C665	HVTB outlet air duct

Removal and Installation

1. Open the trunk, remove the 4 pin-type retainers and the front trunk cover.



2. Release the locking tab and separate the High Voltage Traction Battery (HVTB) cooling fan connector.

3. Remove the 4 HVTB cooling fan screws.

4. Remove the HVTB cooling fan.

5. To install, add a small amount of instant gel adhesive to the HVTB cooling fan screws and reverse the removal procedure.

General Specifications

Item	Specification
DC to DC Converter Control Module (DC/DC) voltage output	13.3-14.7 volts
DC/DC output current capacity	100-145 amps

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C tube bracket bolt	6	-	53
DC/AC inverter nuts	9	-	80
DC to DC Converter Control Module (DC/DC) low-voltage battery cable nuts	17	-	150
DC/DC lower LH bracket bolts	5	-	44
DC/DC lower RH bracket nut	22	16	-
DC/DC top bracket bolts	9	-	80

High-Voltage Converter/Inverter

DC to DC Converter Control Module (DC/DC)

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage hybrid system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

The DC to DC Converter Control Module (DC/DC) is a liquid-cooled component that converts high-voltage (179-343 volts) DC power from the High Voltage Traction Battery (HVTB) to low-voltage (12 volts) DC power. This charges the 12-volt battery through the low-voltage battery cables and powers the low-voltage electrical systems, eliminating the need for a conventional engine-driven generator. It utilizes a dedicated control module, which is part of the DC/DC . The DC/DC communicates with other modules over the High Speed Controller Area Network (HS-CAN) bus, and is located on the RH frame rail, behind the radiator support.

High-Voltage Cable Assembly

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage hybrid system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

All cables that carry high voltage are integrated into a single high-voltage cable assembly that runs between the DC/DC , the Electronically Controlled Continuously Variable Transmission (eCVT), the Air Conditioning Compressor Module (ACCM) and the HVTB . The high-voltage cable assembly can be serviced separately from the rest of the high-voltage system.

DC/AC Inverter and AC Power Point

The DC/AC inverter converts low voltage (12 volts) DC to 110 volts AC to power a device that uses AC power with a rating of less than 150 watts. The DC/AC inverter is located behind the RH rear seat bolster, and is a serviceable part. The AC power point is located in the rear of the floor console and can be serviced separately from the floor console.

High-Voltage Converter/Inverter

Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation - DC to DC Converter Control Module (DC/DC)

The DC to DC Converter Control Module (DC/DC) is a liquid-cooled component that converts high voltage (179-343 volts) DC power to low voltage (12 volts) DC power, while maintaining electrical isolation between the 2 systems. The DC/DC is enabled when the High Voltage Traction Battery (HVTB) contactors have closed, providing high-voltage power to the DC/DC (for information on the HVTB system, refer to Section 414-03). The DC/DC steps the high voltage down to a low-voltage (between 12 and 15 volts, depending on vehicle needs), providing power to the vehicle low-voltage battery systems. The DC/DC also charges the 12-volt battery through the low-voltage battery cables as necessary, eliminating the need for a conventional engine-driven generator. Depending on vehicle and environmental conditions, the DC/DC is capable of outputting as many as 145 amps to the 12-volt battery.

The DC/DC is liquid-cooled and is part of the Motor Electronics Cooling System (MECS). In addition to the DC/DC , the MECS also provides cooling of the Electronically Controlled Continuously Variable Transmission (eCVT). For information on the MECS , refer to Section 307-02B .

The DC/DC communicates on the High Speed Controller Area Network (HS-CAN). When a fault is sensed by the DC/DC , a DTC is set and can be retrieved using a scan tool connected to the Data Link Connector (DLC). The PCM communicates charging needs of the 12-volt system to the DC/DC over the HS-CAN , enabling the DC/DC to control low-voltage charging operations.

The DC/DC receives the following HS-CAN messages:

- Transmission Control Module (TCM) high-voltage input, via the TCM
- Ignition status, via the Instrument Panel Cluster (IPC)
- MECS coolant temperature, via the PCM
- "Ready Indicator Light" illumination request, via the PCM
- Transaxle gear mode, via the PCM
- DC/DC enable and low-voltage set point request, via the PCM

Faults with the DC/DC system that cause low or excessively high 12-volt battery voltage will result in the DC/DC sending a HS-CAN message to the IPC requesting the CHECK CHARGING SYSTEM message be

displayed in the message center.

Principles of Operation - High-Voltage Cable Assembly

The high-voltage cable assembly contains 4 basic circuits:

- The high-voltage/high-amperage cables run between the HVTB and the eCVT .
- The high-voltage/low-amperage cables run from the HVTB to the DC/DC and the Air Conditioning Compressor Module (ACCM).
- The interlock circuit consists of small-gauge wiring wrapped around the high-voltage cables. It is a continuous, single circuit used to monitor the integrity of the high-voltage connections. The interlock connectors are part of the high-voltage cable connectors and are either disconnected at the same time as the high-voltage cable, or must be disconnecd before the high-voltage cable depending upon the type of connection being serviced.
- The AC power point high-voltage wiring and LED indicator circuits between the DC/AC inverter and the AC power point.

All high-voltage wiring utilizes orange insulation as well as orange tape and/or harness tubing.

Principles of Operation - DC/AC Inverter and AC Power Point

The DC/AC inverter converts 12 volts DC to 110 volts AC to power a device that uses AC electricity with a rating of less than 150 watts. The 110 volts AC created by the inverter will measure differently than a conventional AC outlet (utility-generated) with some multi-meters. The AC power point will automatically shut off if the load exceeds 150 watts, to help prevent damage to the inverter or load. The inverter supplies 110 volts AC power only when the ignition is in the ON/START position. This reduces the draw on the 12-volt system when the vehicle is not running. The AC power point is equipped with a green LED that indicates the system integrity.

- Green LED illuminates continuously - ignition in ON/START and system is operating normally.
- Green LED flashes continuously - ignition in ON/START and a fault is detected.
- Green LED does not illuminate - ignition is not in ON/START, fault on the RUN/START circuit input to the DC/AC inverter or the DC/AC inverter is not powered (fault with DC/AC inverter B+ or ground circuits).

Short circuits, overloads or overheating of the inverter will cause the green LED to flash and the power to be cut off to the outlet. If the LED is flashing, the problem must be corrected (short circuit or excessive load). If the DC/AC inverter is overheated, it must be allowed time to cool off (without the load connected). Refer to the Owner's Literature for a list of appropriate electrical loads/devices that can be used.

nspection and Verification - DC to DC Converter Control Module (DC/DC) System

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage hybrid system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

1. Verify the customer concern.

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

Visual Inspection Chart

Electrical
• Battery Junction Box (BJB) fuse 47 (10A) • B+ cable fuse (200A) • B+ terminal at DC to DC Converter Control Module (DC/DC) converter control module • 12-volt battery • Wiring, terminals or connectors • High-voltage cables • DC/DC

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

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

If the cause is not visually evident, connect the scan tool to the DLC .

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

   If the scan tool does not communicate with the VCM :

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power to the Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the Network Test.
   - If the scan tool responds with no communication with one or more modules, refer to Section 418-00 .
   - If the Network Test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous memory DTCs and carry out the self-test diagnostics for the DC/DC and PCM.

9. If the DTCs retrieved are related to this concern, go to the DC to DC Converter Control Module (DC/DC) DTC Chart or the PCM DTC Chart.

10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - DC/DC Converter Control Module (DC/DC) System .

Inspection and Verification - DC/AC Inverter System

1. Verify the customer concern.

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

Visual Inspection Chart

Electrical
• Smart Junction Box (SJB) fuse(s): ♦ 4 (30A) ♦ 35 (10A) • Wiring, terminals or connectors • AC power point • DC/AC inverter

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

4. If the cause is not visually evident, verify the symptom and GO to Symptom Chart - DC/AC Inverter System .

DTC Charts

DC to DC Converter Control Module (DC/DC) DTC Chart

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage hybrid system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.**

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure type code. The failure type code provides information about specific fault conditions such as opens or shorts to ground. Continuous Memory Diagnostic Trouble Codes (CMDTCs) have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
P0A12:16	DC/DC Converter Enable Circuit Low: Circuit Voltage Below Threshold	GO to Pinpoint Test A .

P0A94:4B	DC/DC Converter Performance: Over Temperature	GO to Pinpoint Test B .
P0AF7:00	14 Volt Power Module Internal Temperature Too High: No Sub Type Information	GO to Pinpoint Test C .
P0AFA:13	Hybrid Battery System Voltage Low: Circuit Open	GO to Pinpoint Test D .
P0AFA:16	Hybrid Battery System Voltage Low: Circuit Voltage Below Threshold	GO to Pinpoint Test E .
P0AFB:17	Hybrid Battery System Voltage High: Circuit Voltage Above Threshold	GO to Pinpoint Test F .
U0001:88	High Speed Controller Area Network (HS-CAN) Communication Bus: Bus Off	The DC to DC Converter Control Module (DC/DC) could not communicate on the network at a point in time. The fault is currently not present. CLEAR the DTC. REPEAT the Network Test with the scan tool. REFER to Section 418-00 for further diagnosis as needed.
U0100:00	Lost Communication With ECM/PCM "A": No Sub Type Information	REFER to Section 418-00 to diagnose lost PCM communication.
U0101:00	Lost Communication With TCM : No Sub Type Information	REFER to Section 418-00 to diagnose lost Transmission Control Module (TCM) communication.
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	REFER to Section 418-00 to diagnose lost IPC module communication.
U0300:00	Internal Control Module Software Incompatibility: No Sub Type Information	DIAGNOSE any other DC/DC DTCs first. If no other DC/DC DTCs are present, GO to Pinpoint Test G .
U0401:68	Invalid Data Received From ECM/PCM A: Event Information	**NOTE:** DTC U0401:68 indicates a HS-CAN message from the PCM is outside normal limits due to a faulty PCM input. REVIEW freeze frame data for DTC U0401:68 to determine if the fault pertains to the Motor Electronics Cooling System (MECS) coolant temperature sensor, ambient air temperature or vehicle voltage. RETRIEVE PCM DTCs and DIAGNOSE any DTCs related to MECS coolant temperature sensor, ambient air temperature or vehicle voltage. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for further diagnosis.
U0402:68	Invalid Data Received From TCM : Event Information	**NOTE:** DTC U0402:68 indicates a HS-CAN message from the TCM is outside normal limits due to a faulty TCM input.

		RETRIEVE TCM DTCs and DIAGNOSE any DTCs related to high-voltage input. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for further diagnosis.
U3000:04	Control Module: System Internal Failure	CLEAR the DTC. REPEAT the self-test. If the DTC is still present, INSTALL a new DC/DC .
U3000:41	Control Module: General Checksum Failure	DIAGNOSE any other DC/DC DTCs first. If no other DTCs are present, CLEAR the DTC. REPEAT the self-test. If the DTC is still present, INSTALL a new DC/DC . REFER to Direct Current/Direct Current (DC/DC) Converter in this section.
U3000:42	Control Module: General Memory Failure	DIAGNOSE any other DC/DC DTCs first. If no other DTCs are present, CLEAR the DTC. REPEAT the self-test. If the DTC is still present, INSTALL a new DC/DC . REFER to Direct Current/Direct Current (DC/DC) Converter in this section.
U3000:45	Control Module: Program Memory Failure	DIAGNOSE any other DC/DC DTCs first. If no other DTCs are present, CLEAR the DTC. REPEAT the self-test. If the DTC is still present, INSTALL a new DC/DC . REFER to Direct Current/Direct Current (DC/DC) Converter in this section.
U3000:49	Control Module: Internal Electronic Failure	If the 12V battery is on a charger, REMOVE the charger. CLEAR the DTC. REPEAT the self-test. If DTC U3003:49 returns, INSTALL a new DC/DC . REFER to Direct Current/Direct Current (DC/DC) Converter in this section.
U3000:96	Control Module: Component Internal Failure	CLEAR the DTC. REPEAT the self-test. REFER to Direct Current/Direct Current (DC/DC) Converter in this section. If the DTC is still present, INSTALL a new DC/DC .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test H .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test I .
U3003:62	Battery Voltage: Signal Compare Failure	GO to Pinpoint Test J .

PCM DTC Chart

DTC	Description	Action
P0562	System Voltage Low	GO to Pinpoint Test H .
P0563	System Voltage High	GO to Pinpoint Test I .

Symptom Chart - DC to DC Converter Control Module (DC/DC) System

Symptom Chart - DC to DC Converter Control Module (DC/DC) System

⚠ **WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage hybrid system**

utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

ConditionPossible SourcesAction

- CHECK CHARGING SYSTEM displayed in the message center

- Fuse(s)
- 12-volt battery
- 12-volt battery cables
- DC/DC
- Wiring, terminals or connectors

- CARRY OUT self-test of the DC/DC and REFER to the DC to DC Converter Control Module (DC/DC) DTC Chart for further diagnosis.

Symptom Chart - DC/AC Inverter System

Symptom Chart - DC/AC Inverter System

Pinpoint Tests

Pinpoint Test A: DTC P0A12:16

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

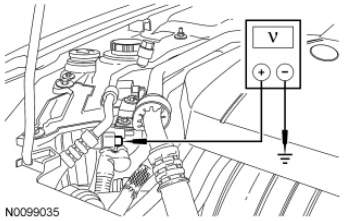
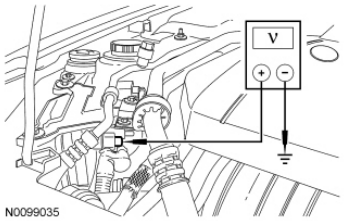
The DC to DC Converter Control Module (DC/DC) monitors the PCM relay control circuit voltage. If the PCM relay control circuit to the DC/DC becomes open or voltage is low, DTC P0A12:16 sets and the DC/DC maintains standard operation of the charging system, though a delay in vehicle start-up time may occur.

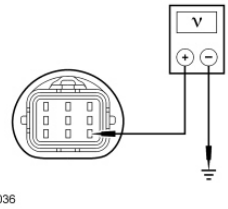
- DTC P1A12:16 (DC/DC Converter Enable Circuit Low: Circuit Voltage Below Threshold) - Sets when the PCM relay control circuit provides less than 7 volts to DC/DC C1457D-7.

This pinpoint test is intended to diagnose the following:
- Fuse
- Wiring, terminals or connectors
- 12-volt battery cables
- DC/DC

PINPOINT TEST A: DTC P0A12:16

Test Step	Result / Action to Take

A1 CHECK THE BATTERY POSITIVE CIRCUIT VOLTAGE	
• Ignition OFF. • Measure the voltage between DC/DC C1457B, B+ terminal and ground.  • START the vehicle (Ready Indicator light ON). • Measure the voltage between DC/DC C1457B, B+ terminal and ground.  • **Did the voltage increase with the ignition ON?**	**Yes** GO to A3 . **No** GO to A2 .
A2 CHECK THE DC TO DC VOLTAGE CONVERTER STATUS (EnableStat) PID	
• Connect the scan tool. • Enter the following diagnostic mode on the scan tool: DataLogger - DC/DC . • Monitor the EnableStat PID. • **Does the PID read Enable?**	**Yes** GO to A4 . **No** CARRY OUT self-test of the PCM and Battery Energy Control Module (BECM). REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual and Section 414-03 for further diagnosis.
A3 CHECK THE PCM RELAY CONTROL INPUT TO THE DC/DC	
• Ignition OFF. • Disconnect: DC/DC C1457D. • START the vehicle (Ready Indicator light ON). • Measure the voltage between DC/DC C1457D-7, circuit CBK03 (GY), harness side and ground.	**Yes** GO to A4 . **No** VERIFY the Battery Junction Box (BJB) fuse 47 (10A) is OK. If OK, REPAIR circuit CBK03 (GY). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.

 • **Is the voltage greater than 10 volts?**	
A4 CLEAR DTCs AND CARRY OUT SELF-TEST OF THE DC/DC	
• Using the scan tool, clear the DC/DC DTCs. • Wait a minimum of 65 seconds before carrying out the next step. • Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • **Is DTC P0A12:16 reported?**	**Yes** INSTALL a new DC/DC . REFER to Direct Current/Direct Current (DC/DC) Converter in this section. REPEAT the self-test. TEST the system for normal operation. **No** Concern is not present at this time. INSPECT the PCM relay control input to DC/DC C1457D-7, circuit CBK03 (GY) for intermittent faults. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test B: DTC P0A94:4B

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The DC to DC Converter Control Module (DC/DC) provides power for the low-voltage vehicle systems and charging of the 12-volt battery. The DC/DC can receive a High Speed Controller Area Network (HS-CAN) message from the PCM indicating that the Motor Electronics Cooling System (MECS) temperature exceeds 80°C (176°F). Because of this, the DC/DC may limit current output to 100 amps (maximum output is normally greater than 100 amps). When either condition is present, DTC P0A94:4B sets and the DC/DC will continue limiting current until the over-temperature condition clears. Periodic or constant heavy electrical loads of the 12-volt system may cause the 12-volt battery to become drained. Reduced functionality of 12-volt systems (headlamps, HVAC blower motor, etc.) may also be noticed.

- DTC P0A94:4B (DC/DC Performance: Over Temperature) - Sets when the MECS temperature exceeds 80°C (176°F) and/or the DC/DC is limiting current output to 100 amps.

This pinpoint test is intended to diagnose the following:
- MECS
- DC/DC

PINPOINT TEST B: DTC P0A94:4B

Test Step	Result / Action to Take		
B1 CARRY OUT SELF-TEST OF THE PCM		• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - PCM. • **Is PCM DTC P0A7C:00 reported?**	**Yes** REFER to Section 307-02B to inspect and diagnose the MECS cooling loop circuit. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation. **No** GO to B2 .
B2 CHECK FOR DC/DC DTC P0AF7:00			
• Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • **Is DTC P0AF7:00 reported?**	**Yes** GO to Pinpoint Test C . **No** GO to B3 .		
B3 CLEAR DTCs AND CARRY OUT SELF-TEST OF THE DC/DC			
• Using the scan tool, clear the DC/DC DTCs. • Enter the following diagnostic mode on the scan tool: Self Test - DC/DC .	**Yes** INSTALL a new DC/DC . REPEAT the self-test. TEST the system for normal operation. **No** Concern is not present at this time. CHECK the MECS coolant level. REFER to Section 307-02B . CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.		

• **Is DTC P0A94:4B reported?**	

Pinpoint Test C: DTC P0AF7:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The DC to DC Converter Control Module (DC/DC) is cooled by the Motor Electronics Cooling System (MECS). The DC/DC monitors its temperature internally. If the internal temperature becomes excessive, DTC P0AF7:00 sets and the DC/DC will be in standby mode (DC/DC disabled) until the over-temperature condition clears. Presence of this DTC will result in CHECK CHARGING SYSTEM being displayed in the message center and the 12-volt battery eventually becoming drained. Reduced or no functionality of 12-volt systems (headlamps, HVAC blower motor, etc.) may also be noticed.

- DTC P0AF7:00 14 (Volt Power Module Internal Temperature Too High: No Sub Type Information) - Sets when the DC/DC senses high internal temperature.

This pinpoint test is intended to diagnose the following:
- MECS
- DC/DC

PINPOINT TEST C: DTC P0AF7:00

Test Step	Result / Action to Take
C1 CHECK FOR DC/DC DTC P0A94:4B	
• Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • **Is DTC P0A94:4B reported?**	**Yes** REFER to Section 307-02B to inspect and diagnose the MECS cooling loop circuit. **No** GO to C2 .
C2 CLEAR DTCs AND CARRY OUT SELF-TEST OF THE DC/DC	
• Using the scan tool, clear the DC/DC DTCs. • Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • **Is DTC P0AF7:00 reported?**	**Yes** INSTALL a new DC/DC . CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation. **No** Concern is not present at this time. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test D: DTC P0AFA:13

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for

schematic and connector information.

Normal Operation

The DC to DC Converter Control Module (DC/DC) monitors the high voltage available from the High Voltage Traction Battery (HVTB). The DC/DC compares that high-voltage reading with the high voltage available to the Transmission Control Module (TCM), which is communicated via a High Speed Controller Area Network (HS-CAN) message. When the DC/DC compares its available high voltage to that available to the TCM and determines the difference to be 150 volts or more, it will set DTC P0AFA:13 and request the CHECK CHARGING SYSTEM message be displayed in the message center. The DC/DC will attempt to maintain operation. An open high-voltage, low-current fuse (located in the high-voltage Bussed Electrical Center (BEC)) may cause the DC/DC and Air Conditioning Compressor Module (ACCM) to be non-functional, resulting in the 12-volt battery eventually becoming drained. Reduced or no functionality of 12-volt systems (headlamps, HVAC blower motor, etc.) may also be noticed.

- DTC P0AFA:13 (Hybrid Battery System Voltage Low: Circuit Open) - Sets when the difference in high voltage between the TCM and DC/DC is greater than 150 volts.

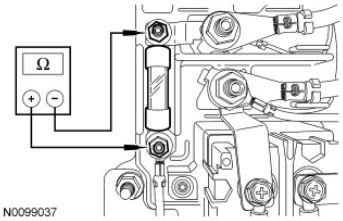
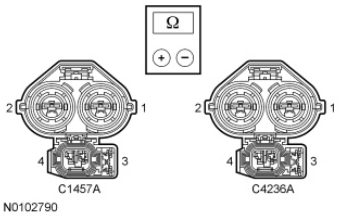
This pinpoint test is intended to diagnose the following:

- High-voltage BEC
- High-voltage low-cuent fuse
- High-voltage cables
- DC/DC

PINPOINT TEST D: DTC P0AFA:13

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage hybrid system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

Test Step	Result / Action to Take
D1 CHECK THE HIGH-VOLTAGE BEC HIGH-VOLTAGE LOW-CURRENT FUSE	
⚠ WARNING: Never install the service disconnect plug with the high-voltage bussed electrical center (BEC) cover removed. Always install the cover prior to connecting the service disconnect plug. The high-voltage BEC cover prevents inadvertent contact with the high voltage which is present at several points under the cover. Failure to follow these instructions may result in serious personal injury or death. • Ignition OFF. • Depower the HVTB . Refer to Section 414-03 . • Remove the high-voltage BEC cover. Refer to the High-Voltage Low-Current Fuse procedure in Section 414-03 .	**Yes** GO to D2 . **No** INSTALL a new high-voltage, low-current fuse. INSPECT the high-voltage BEC for signs of an obvious short condition. INSTALL a new high-voltage BEC as needed. If an obvious short condition is not identified, CARRY OUT self-test of the Battery Energy Control Module (BECM). REFER to Section 414-03 to diagnose BECM DTCs.

• Inspect and measure the resistance of the high-voltage low-current fuse.  • **Is the fuse undamaged and the resistance less than 5 ohms?**	
D2 CARRY OUT TESTING OF THE HIGH-VOLTAGE CABLES	
• Disconnect: DC/DC C1457A. • Disconnect: High-Voltage BEC C4236A. • Measure the resistance between DC/DC C1457A, harness side and high-voltage BEC C4236A, harness side as follows: **DC/DC** / **Circuit** / **High-Voltage BEC** C1457A-2 / HYT03 (OG/WH) / C4236A-2 C1457A-1 / HYT04 (OG/BK) / C4236A-1  • **Are the resistances less than 5 ohms?**	**Yes** GO to D3 . **No** INSTALL new high-voltage cables. REFER to Section 414-03 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D3 CHECK HIGH VOLTAGE TO THE TCM USING PID BATTERY VOLTAGE (TCM) RECEIVED (HVBAT_V)	
• Connect: DC/DC C1457A. • Connect: High-Voltage BEC C4236A. • Install the HVTB service disconnect. Refer to Section 414-03 . • Ignition ON. • Connect the scan tool. • Enter the following diagnostic mode on the scan tool: DataLogger - TCM . • Monitor the TCM PID HVBAT_V. • **Does the PID read greater than 150 volts?**	**Yes** GO to D4 . **No** GO to D5 .

D4 CHECK HIGH VOLTAGE TO THE DC/DC USING PID HEV HIGH VOLTAGE BUS-MEASURED (HEVHiVolt)	
• Enter the following diagnostic mode on the scan tool: DataLogger - DC/DC . • Monitor the DC/DC PID HEVHiVolt. • **Does t read greater than 150 volts?**	**Yes** GO to D5 . **No** INSTALL a new DC/DC . REFER to Direct Current/Direct Current (DC/DC) Converter in this section. REPEAT the self-test. TEST the system for normal operation.
D5 CLEAR DTCs AND CARRY OUT SELF-TEST OF THE DC/DC	
• Using the scan tool, clear the DC/DC DTCs. • Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • **Is DTC P0AFA:13 reported?**	**Yes** INSTALL a new DC/DC . REFER to Direct Current/Direct Current (DC/DC) Converter in this section. REPEAT the self-test. TEST the system for normal operation. **No** Concern is not present at this time. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test E: DTC P0AFA:16

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The DC to DC Converter Control Module (DC/DC) monitors the high voltage available from the High Voltage Traction Battery (HVTB). If the DC/DC senses high voltage of less than 150 volts, it will set DTC P0AFA:16 and request the CHECK CHARGING SYSTEM message be displayed in the message center. The DC/DC will be in standby mode (DC/DC disabled) until the low-voltage condition clears, resulting in the 12-volt battery eventually becoming drained. Reduced or no functionality of 12-volt systems (headlamps, HVAC blower motor, etc.) may also be noticed.

- DTC P0AFA:16 (Hybrid Battery System Voltage Low: Circuit Voltage Below Threshold) - Sets when the DC/DC senses HVTB voltage of less than 150 volts.

This pinpoint test is intended to diagnose the following:
- Identify subsystem which is source of HVTB system fault

PINPOINT TEST E: DTC P0AFA:16

Test Step	Result / Action to Take

E1 CHECK FOR DC/DC DTC P0AFA:13	
• Ignition ON. • Connect the scan tool. • Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • **Is DTC P0AFA:13 reported?**	**Yes** GO to Pinpoint Test D . **No** GO to E2 .
E2 CHECK HIGH VOLTAGE TO THE TCM USING PID BATTERY VOLTAGE (TCM) RECEIVED (HVBAT_V)	
• Enter the following diagnostic mode on the scan tool: DataLogger - TCM . • Monitor the TCM PID HVBAT_V. • **Does the PID read greater than 150 volts?**	**Yes** GO to Pinpoint Test D . **No** CARRY OUT self-test of the Battery Energy Control Module (BECM). REFER to Section 414-03 for diagnosis of the BECM DTCs. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test F: DTC P0AFB:17

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The DC to DC Converter Control Module (DC/DC) monitors the high voltage available from the High Voltage Traction Battery (HVTB). If the DC/DC senses high voltage of greater than 360 volts, it will set DTC P0AFB:17 and request the CHECK CHARGING SYSTEM message be displayed in the message center. The DC/DC will be in standby mode (DC/DC disabled) until the high voltage condition clears, resulting in the 12-volt battery eventually becoming drained. Reduced or no functionality of 12-volt systems (headlamps, HVAC blower motor, etc.) may also be noticed.

- DTC P0AFB:17 (Hybrid Battery System Voltage High: Circuit Voltage Above Threshold) - Sets when the DC/DC senses HVTB voltage of greater than 360 volts.

This pinpoint test is intended to diagnose the following: li>HVTB system fault
- High-voltage cables

PINPOINT TEST F: DTC P0AFB:17

Test Step	Result / Action to Take
F1 CHECK THE TCM AND AIR CONDITIONING COMPRESSOR MODULE FOR HIGH VOLTAGE OVER-VOLTAGE DTCs	

• Ignition ON. • Connect the scan tool. • Enter the following diagnostic mode on the scan tool: Self Test - TCM , and record the results. • Enter the following diagnostic mode on the scan tool: Self Test - ACCM . • **Is Transmission Control Module (TCM) DTC P0A78:17, P0A7A:17, P1A07:16, P0A07:62 and/or Air Conditioning Compressor Module (ACCM) DTC P0AFB:17 present?**	**Yes** GO to F2 . **No** DEPOWER the HVTB . REFER to Section 414-03 . INSPECT the high-voltage cable ends for arcing or terminal pull out. REPAIR as necessary. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.
F2 CHECK HIGH VOLTAGE TO THE DC/DC USING PID HEV HIGH VOLTAGE BUS-MEASURED (HEVHiVolt)	
• Enter the following diagnostic mode on the scan tool: DataLogger - DC/DC . • Monitor the DC/DC PID HEVHiVolt. • **Does the PID read less than 360 volts?**	**Yes** CARRY OUT self-test of the Battery Energy Control Module (BECM). REFER to Section 414-03 for further diagnosis of the BECM DTCs. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation. **No** DEPOWER the HVTB . REFER to Section 414-03 . INSPECT the high-voltage cable ends for arcing or terminal pull out. REPAIR as necessary. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test G: DTC U0300:00

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The DC to DC Converter Control Module (DC/DC) communicates with various modules over the High Speed Controller Area Network (HS-CAN). If the DC/DC determines a software incompatibility fault is present, it sets DTC U0300:00 and operates in offline mode (low-voltage set point and current limits at default settings). Periodic or constant heavy electrical loads of the 12-volt system may cause the 12-volt battery to become drained. Reduced functionality of 12-volt systems (headlamps, HVAC blower motor, etc.) may also be noticed.

- DTC U0300:00 (Internal Control Module Software Incompatibility: No Sub Type Information) - Sets due to a HS-CAN configuration error.

This pinpoint test is intended to diagnose the following:

- HS-CAN fault
- DC/DC

PINPOINT TEST G: DTC U0300:00

Test Step	Result / Action to Take
G1 CARRY OUT NETWORK TEST	
• Ignition ON. • Connect the scan tool. • Enter the following diagnostic mode on the scan tool: Network Test. • **Were any concerns identified by the Network Test?**	**Yes** REFER to Section 418-00 to diagnose the network concern. **No** GO to G2 .
G2 CLEAR DTCs AND CARRY OUT SELF-TEST OF THE DC/DC	
• Using the scan tool, clear the DC/DC DTCs. • Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • **Is DTC U0300:00 reported?**	**Yes** INSTALL a new DC/DC . REFER to Direct Current/Direct Current (DC/DC) Converter in this section. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation. **No** Concern is not present at this time. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test H: DTC P0562 and U3003:16

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The DC to DC Converter Control Module (DC/DC) monitors the 12-volt battery system voltage internally at the B+ terminal of the DC/DC . If the voltage drops below 10.5 volts while the ignition is ON, the DC/DC sets DTC U3003:16 and requests CHECK CHARGING SYSTEM be displayed in the message center. The DC/DC will be in standby mode (DC/DC disabled) and the 12-volt battery will eventually be drained. Reduced or no functionality of 12-volt systems (headlamps, HVAC blower motor, etc.) may also be noticed.

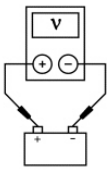
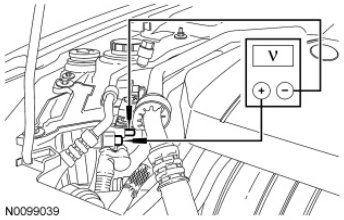
The PCM monitors the system voltage through the Battery Junction Box (BJB). If this voltage drops 1.5 volts or more below the generator voltage desired, this DTC will be set after 30 seconds.

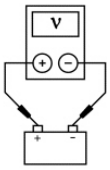
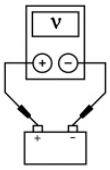
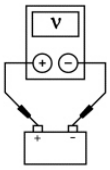
- DTC P0562 (System Voltage Low) - If the PCM detects a voltage from the charging system that is 1.5 volts lower than the DC/DC voltage desired, this DTC will be set.
- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) - Sets if the 12-volt battery system voltage is less than 10.5 volts.

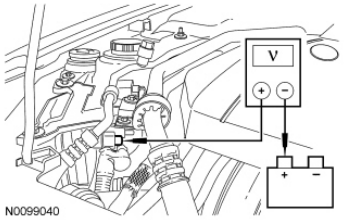
This pinpoint test is intended to diagnose the following:

- 12-volt battery
- 12-volt battery cables
- DC/DC
- Wiring, terminals or connectors

PINPOINT TEST H: DTC P0562 AND U3003:16

Test Step	Result / Action to Take
H1 CHECK THE DC/DC DTCs	
• Review the DC/DC DTCs recorded during Inspection and Verification. • **Are any DC/DC DTCs other than U3003:16 present?**	**Yes** REPAIR all other DC/DC DTCs before repairing U3003:16. GO to the DC to DC Converter Control Module (DC/DC) DTC Chart in this section. **No** GO to H2 .
H2 TEST BATTERY CONDITION	
• Ignition OFF. • Carry out the battery condition test. Refer to Section 414-01 . • **Did the battery pass the condition test?**	**Yes** GO to H3 . **No** INSTALL a new battery. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.
H3 CHECK VOLTAGE AT THE DC/DC	
• START the vehicle (Ready Indicator light ON). • Turn the headlamps on and the blower on high. • Measure the voltage of the battery.  AJ0210-A • Measure the voltage between DC/DC C1457B, circuit SDC02 (RD), harness side and DC/DC C1457C, circuit GD108 (BK/VT), harness side.  N0099039 • **Does the DC/DC voltage match battery voltage?**	**Yes** For DTC P0562, GO to H4 . For DTC U3003:16, GO to H7 . **No** GO to H6 .
H4 COMPARE PCM MODULE SUPPLY VOLTAGE (VPWR) PID	

• With the engine still running at idle, headlamps on and blower on high, measure the battery voltage at the battery and monitor the PCM VPWR PID.  AJ0210-A • **Does PCM VPWR PID display battery voltage within ±0.5 volt?**	**Yes** GO to H5 . **No** REPAIR high resistance or loose connections in the affected PCM power circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
H5 CHECK PCM GROUND FOR HIGH RESISTANCE	
• Monitor PCM VPWR PID. • With the engine still running at idle, turn off all accessory loads, measure the battery voltage at the battery and note the PCM VPWR PID.  AJ0210-A • With the engine still running at idle, turn headlamps on and blower on high, measure the battery voltage at the battery and monitor the PCM VPWR PID.  AJ0210-A • **Does the VPWR PID read within ±0.5 volt with accessory loads on as compared to accessory loads off?**	**Yes** GO to H7 . **No** REPAIR the affected PCM ground circuits. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
H6 MEASURE VOLTAGE DROP OF DC/DC B+ CIRCUIT	

• Measure the voltage between DC/DC C1457B, circuit SDC02 (RD), harness side and the positive battery terminal.  • **Is the voltage drop less than 0.5 volt?**	**Yes** REPAIR DC/DC B- circuit GD108 (BK/VT) or INSTALL a new cable, if necessary. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR DC/DC B+ circuit SDC02 (RD) or INSTALL a new cable, if necessary. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.
H7 CLEAR DTCs AND CARRY OUT SELF-TEST OF THE DC/DC	
• Connect the scan tool. • Using the scan tool, clear the DC/DC DTCs. • Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • **Is DTC U3003:16 reported?**	**Yes** INSTALL a new DC/DC . REFER to Section 414-03 . CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a discharged battery. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test I: DTC P0563 and U3003:17

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The DC to DC Converter Control Module (DC/DC) monitors the 12-volt battery system voltage internally at the B+ terminal of the DC/DC . If the voltage is greater than 16 volts, the DC/DC sets DTC U3003:17 and requests CHECK CHARGING SYSTEM be displayed in the message center. The DC/DC will be in standby mode (DC/DC disabled) and the 12-volt battery will eventually be drained. Reduced or no functionality of 12-volt systems (headlamps, HVAC blower motor, etc.) may also be noticed.

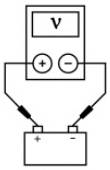
The PCM also monitors system voltage and will set a DTC if the system voltage rises above a set threshold.

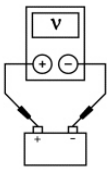
- DTC P0563 (System Voltage High) - If the PCM detects a voltage from the charging system higher than 15.2 volts with vehicle speed above 8 km/h (5 mph), this DTC will be set.
- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) - Sets if the 12-volt battery system voltage is greater than 16 volts.

This pinpoint test is intended to diagnose the following:

- 12-volt battery jump started or incorrectly charged
- Customer-installed accessory
- DC/DC

PINPOINT TEST I: DTC P0563 AND U3003:17

Test Step	Result / Action to Take
I1 CHECK VOLTAGE AT THE DC/DC	
• START the vehicle (Ready Indicator light ON). • Turn off the headlamps, blower and any other accessories. • Measure the voltage of the battery.  AJ0210-A • **Is the voltage less than 16 volts?**	**Yes** GO to I3 .
I2 TEST BATTERY CONDITION	
• Ignition OFF. • Carry out the battery condition test. Refer to Section 414-01 . • **Did the battery pass the condition test?**	**Yes** GO to I4 . **No** DTC U3003:17 or P0563 was most likely set due to the 12-volt battery being recently jump started or incorrectly charged using a battery charger. INSTALL a new battery. CLEAR the DTC. REPEAT the self-tests. TEST the system for normal operation. If DTC U3003:17 or P0563 is still present, GO to I3 .
I3 INSPECT VEHICLE ACCESSORIES	
• Ignition OFF. • Inspect the vehicle and disable any customer installed accessories. • START the vehicle (Ready Indicator light ON). • Measure the voltage of the battery.	**Yes** COMMUNICATE the accessory concern to the customer. CLEAR the DTC. REPEAT the self-tests. TEST the system for normal operation. **No** GO to I4 .

 AJ0210-A • **Is the voltage less than 16 volts?**	
I4 CLEAR DTCs AND CARRY OUT SELF-TEST OF THE DC/DC AND PCM	
• Ignition ON. • Connect the scan tool. • Using the scan tool, clear the DC/DC and PCM DTCs. • Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • Enter the following diagnostic mode on the scan tool: Self Test - PCM. • **Is DTC U3003:17 reported in the DC/DC or is DTC P0563 reported in the PCM?**	**Yes** INSTALL a new DC/DC . REFER to Direct Current/Direct Current (DC/DC) Converter in this section. REPEAT the self-tests. TEST the system for normal operation. **No** Concern is not present at this time. DTC U3003:17 or P0563 was most likely set due to the 12-volt battery being recently jump started or incorrectly charged using a battery charger. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test J: DTC U3003:62

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

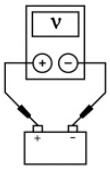
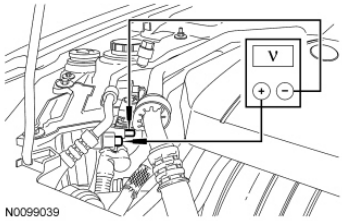
Normal Operation

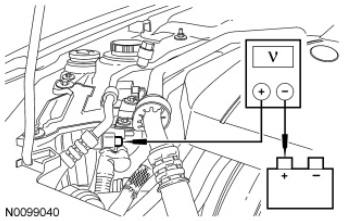
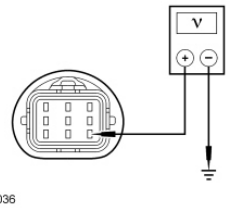
The DC to DC Converter Control Module (DC/DC) monitors the 12-volt battery system voltage internally at the B+ terminal of the DC/DC . The DC/DC also monitors the PCM relay control circuit voltage and compares that voltage to the voltage sensed internally at the B+ terminal. If the 2 voltages vary by greater than 4.3 volts, the DC/DC sets DTC U3003:62 and requests CHECK CHARGING SYSTEM be displayed in the message center. The DC/DC will be in standby mode (DC/DC disabled) and the 12-volt battery will be drained. Reduced or no functionality of 12-volt systems (headlamps, HVAC blower motor, etc.) may also be noticed.

- DTC U3003:62 (Battery Voltage: Signal Compare Failure) - Sets when the DC/DC senses greater than 4.3 volts difference between the DC/DC B+ terminal and the PCM relay control circuit.

This pinpoint test is intended to diagnose the following:
- DC/DC B+ cable mounting
- B+ cable fuse (200A)
- 12-volt battery cables
- Wiring, terminals or connectors
- DC/DC

PINPOINT TEST J: DTC U3003:62

Test Step	Result / Action to Take
J1 CHECK THE PCM MODULE SUPPLY VOLTAGE (VPWR) PID	
• Measure and record the voltage of the battery.  AJ0210-A • Connect the scan tool. • Entethe following diagnostic mode on the scan tool: DataLogger - PCM. • Monitor the VPWR PID. • **Does the VPWR PID match battery voltage?**	**Yes** GO to J2 . **No** CARRY OUT a self-test of the PCM. RECORD any DTCs and REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
J2 CHECK THE B+ CABLE	
• Measure the voltage between DC/DC C1457B, circuit SDC02 (RD), and DC/DC C1457C, circuit GD108 (BK/VT), harness side.  N0099039 • **Does the DC/DC voltage match battery voltage?**	**Yes** GO to J3 . **No** VERIFY the B+ cable fuse (200A) is OK. If OK, REPAIR the affected circuit(s). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.
J3 MEASURE VOLTAGE DROP OF DC/DC B+ CIRCUIT	
• Ignition ON. • With the headlamps ON and the blower on high, measure the voltage between DC/DC C1457B, circuit SDC02 (RD), harness side and the positive battery terminal.	**Yes** GO to J4 . **No** REPAIR DC/DC B+ circuit SDC02 (RD) or INSTALL a new cable, if necessary. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.

 • **Is the voltage drop less 0.5 volt?**	
J4 CHECK THE PCM RELAY CONTROL INPUT TO THE DC/DC	
• Ignition OFF. • Disconnect: DC/DC C1457D. • Ignition ON. • Measure the voltage between DC/DC C1457D-7, circuit CBK03 (GY), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to J5 . **No** VERIFY the Battery Junction Box (BJB) fuse 47 (10A) is OK. If OK, REPAIR circuit CBK03 (GY). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation.
J5 CLEAR DTCs AND CARRY OUT SELF-TEST OF THE DC/DC	
• Connect the scan tool. • Using the scan tool, clear the DC/DC DTCs. • Enter the following diagnostic mode on the scan tool: Self Test - DC/DC . • **Is DTC U3003:62 reported?**	**Yes** INSTALL a new DC/DC . REFER to Direct Current/Direct Current (DC/DC) Converter in this section. CLEAR the DTC. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connection. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test K: The DC/AC Inverter Does Not Operate Correctly - No Power at the AC Power Point or the AC Power Point LED Indicator Flashes With the Key in ON Position

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The DC/AC inverter receives 12 volts DC at C2293A-1 and C2293A-3 and is grounded at C2293A-6. The incoming DC power is internally converted to 60 Hz, 110 volt AC power that is output to the AC power point

from C2293B-1 (power) and C2293B-5 (neutral).

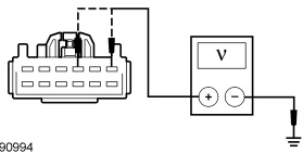
NOTE: The electrical device that is powered by the AC power point must not exceed 150 watts.

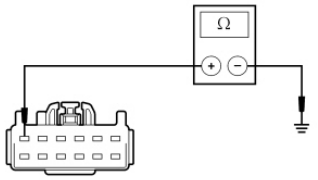
NOTE: If the green LED is flashing, the AC power point may be overloaded, overheated or shorted. Unplug the electrical device from the AC power point and cycle the key. Refer to the Owner's Literature to determine if the electrical device is appropriate for the AC power point.

This pinpoint test is intended to diagnose the following:

- Fuses
- Wiring, terminals or connectors
- DC/AC inverter
- AC power point

PINPOINT TEST K: THE DC/AC INVERTER DOES NOT OPERATE CORRECTLY - NO POWER AT THE AC POWER POINT OR THE AC POWER POINT LED INDICATOR FLASHES WITH THE KEY IN THE ON POSITION

Test Step	Result / Action to Take
K1 CHECK THE DC/AC INVERTER VOLTAGE CIRCUITS	
• Ignition OFF. • Disconnect: DC/AC Inverter C2293A. • Ignition ON. • Measure the voltage between DC/AC inverter C2293A-1, circuit SBP04 (GN/RD), harness side and ground; and between DC/AC inverter C2293A-3, circuit CBP35 (YE/GY), harness side and ground.  A0090994 • **Are the voltages greater than 10 volts?**	**Yes** GO to K2 . **No** VERIFY the Smart Junction Box (SJB) fuses 4 (30A) and 35 (10A) are OK. If OK, REPAIR the affected circuit(s). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
K2 CHECK THE DC/AC INVERTER GROUND CIRCUIT	
• Ignition OFF. • Measure the resistance between DC/AC inverter C22936, circuit GD139 (BK/YE), harness side and ground.	**Yes** GO to K3 . **No** REPAIR circuit GD139 (BK/YE). TEST the system for normal operation.

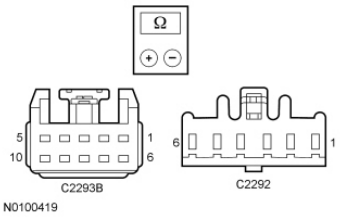


- **Is the resistance less than 5 ohms?**

K3 CHECK THE AC POWER POINT CIRCUITS FOR AN OPEN

- Disconnect: SJB Fuse 4 (30A).
- Disconnect: SJB Fuse 35 (10A).
- Disconnect: AC Power Point C2292.
- Disconnect: DC/AC Inverter C2293B.
- Measure the resistance between DC/AC inverter C2293B, harness side and AC power point C2292, harness side as follows:

DC/AC Inverter	Circuit	AC Power Point
C2293B-1	HYA01 (OG/GN)	C2292-1
C2293B-5	HYA02 (OG/WH)	C2292-3



- **Are the resistances less than 5 ohms?**

Yes
GO to K4 .

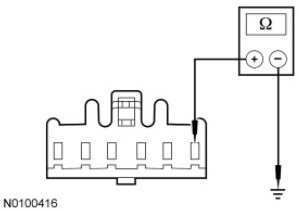
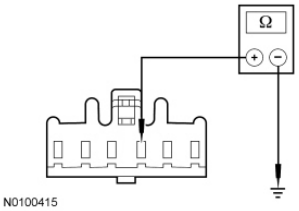
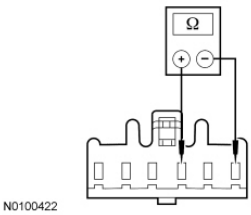
No
REPAIR the affected circuit(s). TEST the system for normal operation.

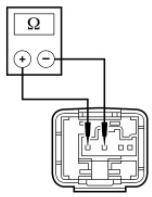
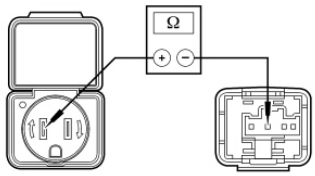
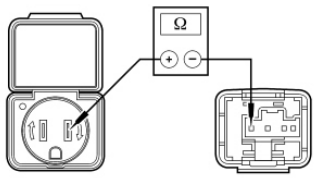
K4 CHECK THE AC POWER POINT CIRCUITS FOR A SHORT TO GROUND

- Measure the resistance between AC power point C2292-1, circuit HYA01 (OG/GN), harness side and ground.

Yes
GO to K5 .

No
REPAIR the affected circuit(s). TEST the system for normal operation.

 N0100416 • Measure the resistance between AC power point C2292-3, circuit HYA02 (OG/WH), harness side and ground.  N0100415 • **Are the resistances greater than 10,000 ohms?**	
K5 CHECK THE AC POWER POINT CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between AC power point C2292-1, circuit HYA01 (OG/GN), harness side and C2292-3, circuit HYA02 (OG/WH), harness side.  N0100422 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K6 . **No** REPAIR the affected circuit(s). TEST the system for normal operation.
K6 CHECK THE AC POWER POINT FOR A SHORT TOGETHER	
• Measure the resistance between AC power point C2292-1, circuit HYA01 (OG/GN), component side and C2292-3, circuit HYA02 (OG/WH), harness side.	**Yes** GO to K7 . **No** INSTALL a new AC power point. TEST the system for normal operation.

 N0100423 • **Is the resistance greater than 10,000 ohms?**	
K7 CHECK THE AC POWER POINT FOR AN OPEN	
• Measure the resistance between AC power point outlet side, pin 1 and AC power point C2292, pin-3, component side.  N0100418 • Measure the resistance between AC power point outlet side, pin 2 and AC power point C2292, pin-1, component side.  N0100417 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DC/AC inverter. REFER to Direct Current/Alternating Current (DC/AC) Inverter in this section. TEST the system for normal operation. **No** INSTALL a new AC power point. REFER to Alternating Current (AC) Powerpoint in this section. TEST the system for normal operation.

Pinpoint Test L: The DC/AC Inverter Does Not Operate Correctly - The AC Power Point LED Indicator is Never On

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connectoinformation.

Normal Operation

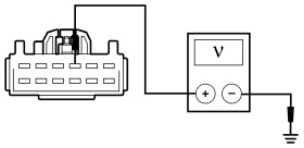
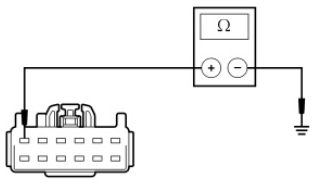
The DC/AC inverter receives 12 volts DC at C2293A-1 and C2293A-3 and is grounded at C2293A-6. The incoming DC power is internally converted to 60 Hz, 110 volt AC power that is output to the AC power point from C2293B-1 (power) and C2293B-5 (neutral). If a fault in the system is detected, the LED flashes or is off when the key is in the ON position. The LED continuously illuminates if the system is operating correctly when the key is in the ON position.

This pinpoint test is intended to diagnose the following:

- Fuses
- Wiring, terminals or connectors
- DC/AC inverter
- AC power point

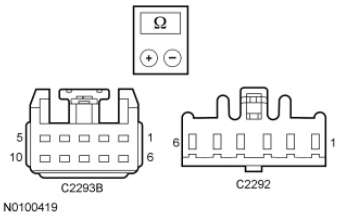
PINPOINT TEST L: THE DC/AC INVERTER DOES NOT OPERATE CORRECTLY - THE AC POWER POINT LED INDICATOR IS NEVER ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
L1 CHECK DC/AC INVERTER VOLTAGE CIRCUIT	
• Ignition OFF. • Disconnect: DC/AC Inverter C2293A. • Ignition ON. • Measure the voltage between DC/AC inverter C2293A-3, circuit CBP35 (YE/GY), harness side and ground.  A0091492 • **Is the voltage greater than 10 volts?**	**Yes** GO to L2 . **No** VERIFY Smart Junction Box (SJB) fuse 35 (10A). If OK, REPAIR circuit CBP35 (YE/GY). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. TEST the system for normal operation.
L2 CHECK DC/AC INVERTER GROUND CIRCUIT	
• Ignition OFF. • Measure the resistance between DC/AC inverter C2293A-6, circuit GD139 (BK/YE), harness side and ground.  A0096456 • **Is the resistance less than 5 ohms?**	**Yes** GO to L3 . **No** REPAIR circuit GD139 (BK/YE). TEST the system for normal operation.
L3 CHECK AC POWER POINT LED INDICATOR CIRCUITS FOR AN OPEN	

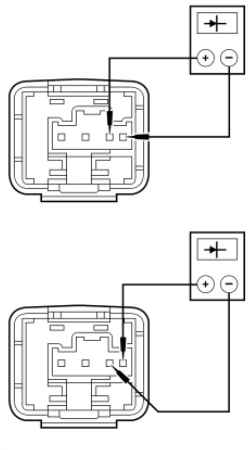
• Disconnect: SJB Fuse 4 (30A). • Disconnect: SJB Fuse 35 (10A). • Disconnect: DC/AC Inverter C2293B. • Disconnect: AC Power Point C2292. • Measure the resistance between DC/AC inverter C2293B, harness side and AC power point C2292 as follows:	**Yes** GO to L4 . **No** REPAIR the affected circuit(s). TEST the system for normal operation.

DC/AC Inverter	Circuit	AC Power Point
C2293B-9	LYA03 (YE/VT)	C2292-6
C2293B-8	RYA03 (BU/BN)	C2292-5



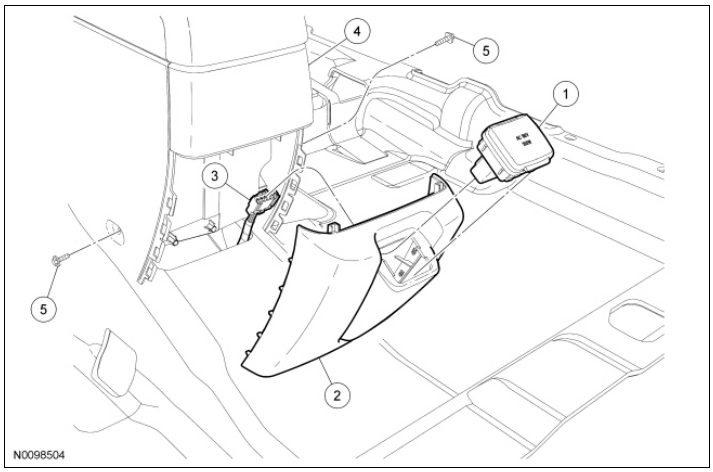
• **Are the resistances less than 5 ohms?**

L4 CHECK THE AC POWER POINT LED	
• Using the digital multimeter diode check function, test the diode between AC power point C2292, pin-5 and pin-6, component side in both directions.	**Yes** INSTALL a new DC/AC inverter. REFER to Direct Current/Alternating Current (DC/AC) Inverter in this section. TEST the system for normal operation. **No** INSTALL a new AC power point. REFER to Alternating Current (AC) Powerpoint in this section. TEST the system for normal operation.



• **Is the diode OK?**

Alternating Current (AC) Powerpoint



Item	Part Number	Description
1	19N236	AC power point
2	-	Floor console end cover
3	-	AC power point electrical connector (part of 14300)
4	-	Floor console
5	W711401	Floor console rear screws (2 required)

Removal and Installation

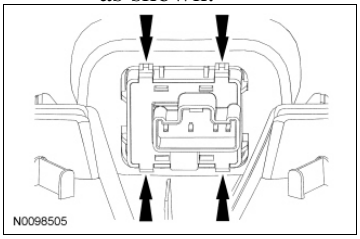
⚠ WARNING: Disconnect the battery before servicing the direct current/alternating (DC-AC) inverter or alternating current (AC) powerpoint to prevent the risk of high voltage shock. Failure to follow this instruction may result in serious personal injury.

1. Disconnect the 12-volt battery. For additional information, refer to Section 414-01 .

2. ***NOTICE:*** **Make sure that the rear of the floor console is lifted away from the floor as specified. Failure to follow this procedure will result in damage to the floor console and the tabs at the top of the floor console end cover.**

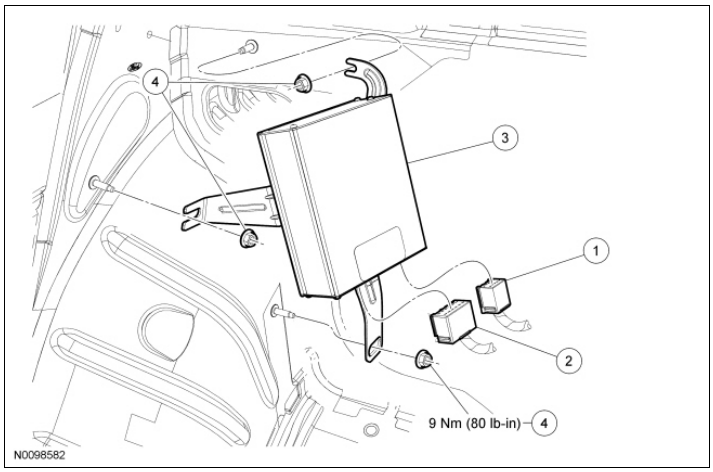
   Remove the floor console rear screws and lift the floor console about 25 mm (0.984 in) away from the floor.

3. Remove the floor console end cover by pulling the cover away at the bottom and rotating out. Lower the cover 7-13 mm (0.275-0.511 in) to clear the tabs on the top of the floor console end cover.
4. Disconnect the electrical connector and remove the AC power point by depressing the 4 tabs as shown.



5. To install, reverse the removal procedure.

Direct Current/Alternating Current (DC/AC) Inverter



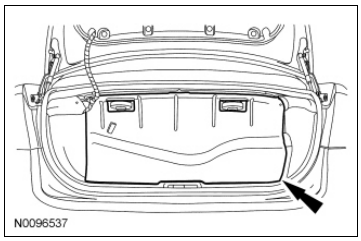
Item	Part Number	Description
1	-	DC/AC inverter wiring connector (part of 14300)
2	-	DC/AC inverter wiring connector (part of 14A005)
3	19G317	DC/AC inverter
4	W707142	DC/AC inverter nuts (3 required)

Removal and Installation

⚠ WARNING: Disconnect the battery before servicing the direct current/alternating (DC-AC) inverter or alternating current (AC) powerpoint to prevent the risk of high voltage shock. Failure to follow this instruction may result in serious personal injury.

1. Disconnect the 12-volt battery. For additional information, refer to Section 414-01 .

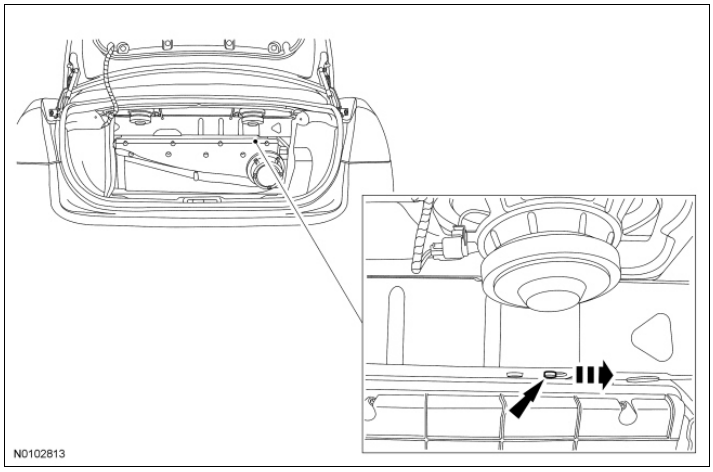
2. Remove 4 pin-type retainers and the front trunk cover.



3. **NOTE:** If the center safety belt retractor locks and the safety belt webbing prevents the 60 percent backrest from lowering, raise thekrest upward to release the safety belt retractor and belt webbing.

   Fold the RH backrest down.

   - Between the High Voltage Traction Battery (HVTB) and the sheet metal, locate the seat backrest latch release lever.
   - Push the release lever toward the outboard side of the vehicle and fold the backrest down.



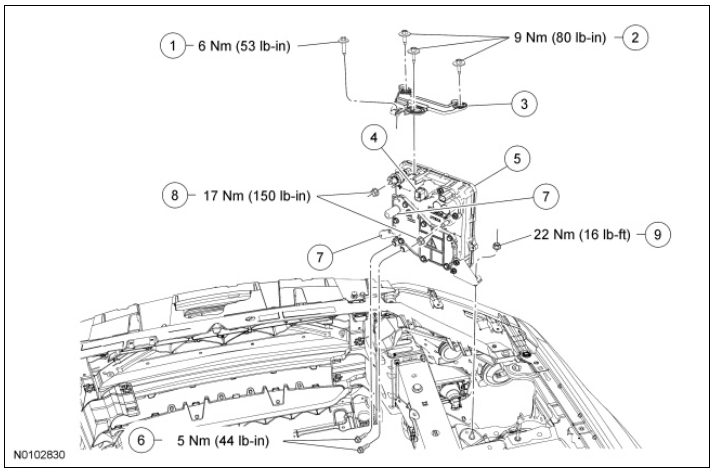
4. Remove the RH rear seat bolster. For additional information, refer to Section 501-10 .

5. Disconnect the 2 electrical connectors at the DC/AC inverter.

6. Remove the 3 nuts and the DC/AC inverter.
   - To install, tighten to 9 Nm (80 lb-in).

7. To install, reverse the removal procedure.

Direct Current/Direct Current (DC/DC) Converter



Item	Part Number	Description
1	W503924	A/C tube bracket bolt
2	W713417	DC to DC Converter Control Module (DC/DC) top bracket bolts (3 required)
3	14B303	DC/DC top bracket
4	-	DC/DC low-voltage electrical connector
5	14B227	DC/DC assembly
6	W712524	DC/DC lower LH bracket bolts (2 required)
7	-	DC/DC coolant inlet/ outlet tubes
8	W520513	DC/DC low-voltage battery cable nuts (2 required)
9	W520102	DC/DC lower RH bracket nut

Removal and Installation

⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage hybrid system utes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death.

1. Depower the High Voltage Traction Battery (HVTB). For additional information, refer to Section 414-03 .

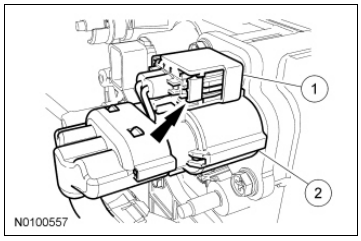
2. Disconnect the 12-volt battery. For additional information, refer to Section 414-01 .

3. Remove the A/C tube bracket bolt and the 3 DC to DC Converter Control Module (DC/DC) top bracket bolts. Remove the bracket.
   - To install, tighten the 3 DC/DC top bracket bolts to 9 Nm (80 lb-in).
   - To install, tighten the A/C tube bracket bolt to 6 Nm (53 lb-in).

4. ***NOTICE:*** **Failure to disconnect high-voltage cable connectors as instructed may result in damage to the connectors.**

   Disconnect the DC/DC high-voltage and interlock connector as follows:

   1. Press the locking tab on the white interlock connector and partially disconnect the connector from the DC/DC .
   2. Press the locking tab on the orange high-voltage connector and fully disconnect **both** connectors from the DC/DC .



5. Disconnect the DC/DC low-voltage connector.

6. ⚠ **WARNING: Always tighten the DC/DC converter low-voltage battery cable fasteners to specification. Loose connections may result in electrical arcing, which increases both the risk of fires and serious personal injury.**

   Remove the 2 DC/DC low-voltage battery cable nuts and position the low-voltage battery cables aside.

   - To install, tighten to 17 Nm (150 lb-in).

7. Clamp the Motor Electronics Cooling System (MECS) hoses to prevent coolant from leaking from the hoses during the repair.

8. Loosen the hose clamps and remove the MECS hoses from the DC/DC .

9. Remove the DC/DC lower RH bracket nut.
   - To install, tighten to 22 Nm (16 lb-ft).

10. Detach the wire harness from the lower LH side of the DC/DC .

11. ***NOTICE:*** **Do not remove the DC to DC Converter Control Module (DC/DC) LH lower bracket from the vehicle rail, as this may degrade the vehicle ground attachment and DC/DC alignment.**

    NOTE: If a new DC/DC is being installed, the new DC/DC will come with a new LH lower bracket attached. Remove the LH lower bracket from the new DC/DC and discard. Whenever possible, re-use the LH lower bracket which has been left attached to the vehicle. If the a new bracket is being installed, make sure the surfaces between the bracket and side rails are clean and free of grease, dirt and debris.

    Remove the 2 lower LH DC/DC bracket bolts and remove the DC/DC .

    - To install, tighten to 5 Nm (44 lb-in).

12. To install, reverse the removal procedure.

13. Refill the MECS after installation. Bleed any air from the system. For additional information, refer to Section 307-02B .

Torque Specifications

Description	Nm	lb-in
Antenna cable bolt	8	71
Antenna module bolt	12	106
Audio Digital Signal Processing (DSP) module bolts	9	80
Engine ground strap	9	80
Radio interference capacitor (body)	7	62
Speaker enclosure mounting bolts	8	71
Subwoofer amplifier screws	5	44

Information and Entertainment System

Functional Components

The functional components of the audio system are:

- Audio Front Control Module (ACM)
- Front Controls Interface Module (FCIM)
- Front Display Interface Module (FDIM)
- Accessory Protocol Interface Module (APIM), located toward the rear end of the floor console
- Audio Digital Signal Processing (DSP) module, located in the RH side of the luggage compartment
- Subwoofer amplifier, located in the RH side of the luggage compartment
- Audio amplifier, located in the RH side of the luggage compartment
- Global Positioning System Module (GPSM), located in the instrument panel
- Speakers (see Audio Line-Up for locations)
- AM/FM antenna (Fusion) located at the rear of the roof
- Antenna module (MKZ), located at the RH C-pillar
- AM/FM/satellite radio combination antenna (Fusion), located at the rear of the roof
- Satellite radio antenna (MKZ), located at the rear of the roof
- Global Positioning System (GPS) antenna (integral to the AM/FM/satellite radio antenna (Fusion) or the satellite radio antenna (MKZ))
- AM/FM antenna cable (must be overlaid on harness)
- Satellite radio antenna cable (must be overlaid on harness)
- Steering wheel controls
- Universal Serial Bus (USB) port and cable, located in the floor console stowage bin
- Audio input jack, located in the floor console stowage bin (vehicles with the SYNC® system) or at the front of the floor console (vehicles without the SYNC® system)
- Clockspring
- Microphone

Audio Line-Up

The vehicle is equipped with one of the following audio systems:

- Base - Fusion
  - ♦ AM/FM/CD ACM with MP3
  - ♦ Four speakers (1 in each door)
- Mid-Level - Fusion
  - ♦ AM/FM/CD with MP3
  - ♦ Six speakers (1 in each door, 1 sail-mounted tweeter in each front door)
- Premium Sound - MKZ
  - ♦ AM/FM/CD ACM with MP3 (standard)
  - ♦ Navigation ACM with HD Radio® and built-in single CD/DVD drive (optional)
  - ♦ Nine speakers (one1 speaker in each front door, 1 speaker in each rear door, 1 tweeter in each front door, 1 instrument panel speaker, 2 parcel shelf-mounted subwoofers)
  - ♦ Audio amplifier and subwoofer amplifier
- Sony® Sound - Fusion
  - ♦ AM/FM/CD ACM with MP3 (standard)
  - ♦ Navigation ACM with HD Radio® and built-in single CD/DVD drive (optional)

        - Twelve speakers (1 speaker in each front door, one 2-way speaker in each rear door, 1 tweeter in each front door, 1 instrument panel speaker, 1 parcel shelf speaker, 2 parcel shelf-mounted subwoofers)
        - Audio DSP module
    - THX® A
        - AM/FM/CD ACM with MP3 (standard)
        - Navigation ACM with HD Radio® and built-in single CD/DVD drive (optional)
        - Fourteen speakers (1 speaker in each front door, one 2-way speaker in each rear door, 1 tweeter in each front door, one 3-way instrument panel speaker, 1 parcel shelf speaker, 2 parcel shelf-mounted subwoofers)
        - Audio DSP module

All audio systems include the following features:

- Speed sensitive volume
- Accessory delay
- MP3 capability
- Audio input jack

The following options are also available:

- Steering wheel controls
- Satellite radio
    - Provides satellite broadcast audio channels
- SYNC® System
    - Provides mobile phone and media device functionality with the vehicle audio system

AM/FM Antenna - Fusion

The antenna can be either an AM/FM antenna or a combination AM/FM/satellite radio antenna if the vehicle is equipped with satellite radio.

AM/FM Antenna - MKZ

The AM/FM antenna is located in the rear glass. It cannot be replaced separate from the rear glass.

Satellite Radio

The satellite radio system is comprised of the following:

- Satellite radio receiver built-in to the ACpan>
- Combination AM/FM/satellite radio antenna (Fusion)
- Standalone satellite radio antenna (MKZ)
- Satellite radio antenna cable

The satellite radio antenna is a stand-alone antenna on the MKZ, or is a combination AM/FM/satellite antenna on the Fusion. The satellite radio antenna cable connects the satellite radio antenna to the ACM .

The satellite radio antenna cable is not removable from the wiring harnesses.

Navigation System with HD Radio®

The navigation system consists of the following:

- Navigation ACM
- GPS antenna
- Satellite radio/ GPS splitter cable (part of the front satellite radio antenna cable)
- Microphone

The ACM controls the operation of the navigation system and the audio system. The system uses a GPS antenna, a vehicle speed input, and other sensor information to accurately establish the vehicle position.

SYNC® System

The SYNC® system consists of the following:

- APIM
- SYNC®-specific steering wheel controls
- Microphone
- USB port and cable
- Audio input jack

SYNC® is a hands-free communications and entertainment system that allows the following interactions:

- Send and receive phone calls via a Bluetooth-enabled phone
- Send and receive text messages via a Bluetooth-enabled phone
- Connect media devices (such as an iPod® or USB flash device) in order to play audio files
- Play media files via a Bluetooth-enabled audio device
- Produce vehicle health reports
- Initiate an emergency call (eCall) when the air bags deploy
- Provide hands-free access to traffic reports, turn-by-turn driving directions, business listings, news, sports, and weather

The GPSM works with the SYNC® system to provide vehicle location on vehicles not equipped with navigation, as the vehicle location must be known for the traffic, directions, and information features to operate correctly.

Not all features are available with every phone.

For additional information on audio system operation, including the SYNC® system, refer to the Owner's Literature.

Information and Entertainment System

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3086-A	Multi-Media Interface Tester 105-00120
 ST3051-A	Universal Serial Bus (USB) Male-A To Male-A Cable CCMUSB2-AM-AM-10

Principles of Operation

Audio Front Control Module (ACM)

The Audio Front Control Module (ACM) can be operated with the key in RUN or ACC. The accessory delay feature allows the audio system to be operated for a preset period of time after the key is turned off and a front door has not been opened. The ACM sends AC voltage audio signals to the speakers or to the amplifiers, depending on vehicle configuration. The ACM can produce its own DTCs, which can be communicated to the scan tool through the Medium Speed Controller Area Network (MS-CAN).

Front Controls Interface Module (FCIM)

The Front Controls Interface Module (FCIM) acts as a customer interface with the audio system and the climate control system. When a switch is pressed, a message is broadcast over the MS-CAN . When a climate control switch is pressed, the HVAC module sends a message back to the FCIM to illuminate the correct switches to indicate the status of the climate control system.

Front Display Interface Module (FDIM)

For vehicles without navigation, the Front Display Interface Module (FDIM) is a stand-alone module. It receives messages for all of its displays, which include:

- Audio information
- Climate control fan speed and temperature setting
- Outside air temperature

- Compass heading

For vehicles with navigation, the FDIM is hardwired to the ACM . When the touchscreen is pressed, a signal is sent to the ACM , which acts on the signal either by changing the audio setting or by broadcasting a message via the MS-CAN to the module controlling the function that was selected. The audio system, navigation, and climate control video feed to the FDIM is provided by the ACM . If equipped with a rear view camera, the video feed for the camera is provided directly by the rear view camera.

Satellite Audio

The satellite radio antenna receives digital audio signals and sends them to the ACM through the satellite radio antenna cable.

Antenna â Fusion

The antenna receives AM/FM radio waves, and satellite radio signals (if equipped with satellite radio). All audio signals are sent to the ACM through the antenna cables.

Antenna â MKZ

The antenna receives both AM and FM radio waves. The antenna is built into the rear window glass. An antenna module is utilized to isolate the signals. The audio signals are then sent to the ACM through the AM/FM antenna cable. If equipped with satellite radio, the satellite radio antenna is mounted to the roof. It receives digital audio signals and sends them to the ACM .

SonyÂ® Sound

For vehicles with the SonyÂ® sound system, audio signals are sent from the ACM to the audio Digital Signal Processing (DSP) module, which processes the audio signals and sends them to all of the speakers. The audio DSP module uses internal software to produce an optimal sound environment. The audio DSP module communicates on the MS-CAN . Customer preference settings such as fade and balance are broadcast to the audio DSP module by the ACM .

THXÂ® Sound

For vehicles with the THXÂ® sound system, the audio DSP module provides theatre quality sound in the vehicle. Audio signals are sent from the ACM to the audio DSP module, which processes the audio signals and sends them to all of the speakers. An enable detection circuit is utilized for the amplifier (internal to the audio DSP module). The circuit turns the amplifier on. The audio DSP module communicates on the MS-CAN . Customer preference settings such as fade and balance are broadcast to the audio DSP module by the ACM .

Navigation System

The vehicle navigation system guides the user to a pre-entered destination. No navigation map DVD is needed, as the map guidance information is stored in the ACM hard-drive. The ACM calculates route information based on Global Positioning System (GPS) data. The ACM also uses vehicle speed and transmission gear selected signals received through the MS-CAN to detect vehicle speed and direction, resulting in more accurate navigation tracking.

The navigation display is shown on the FDIM . Either the FDIM touchscreen or the buttons on the FCIM can be used to interact with the navigation system.

The compass heading is derived from the GPS antenna signal. There are no serviceable parts for the compass.

A voice recognition system allows the user to interface with the system without using the touchscreen. A microphone provides the voice recognition input. The microphone is shared with the SYNCÂ® system.

Jukebox Feature

The navigation ACM contains a 10 gigabyte on-board hard drive that is capable of storing music ripped (recorded) from a music disc. The music can be loaded into the jukebox by inserting a disc (in the correct format) and following the on-screen instructions to load the music into the ACM . The jukebox cannot rip MP3 discs.

SYNCÂ® System

The SYNCÂ® system allows interaction with several types of customer devices, including mobile phones and media devices. The APIM contains an on-board Bluetooth chipset, which enables certain wireless devices to interact with the system.

The APIM consists of 2 internal modules: the Consumer Interface Processor (CIP) and the Vehicle Interface Processor (VIP). The modules are not replaceable individually, but can be flashed independently, if required.

The CIP interfaces with all of the inputs to the APIM . The CIP contains an analog-to-digital-to-analog converter, as well as the Bluetooth chipset. Any consumer-available application upgrades that are available are loaded directly to the CIP through the USB port.

The VIP provides an interface between the CIP and the vehicle. The main functions of the VIP are controlling the APIM power management and translating both inbound and outbound signals over the CAN .

The APIM can receive inputs from the following audio sources:

- USB port
- Audio input jack
- Bluetooth

The USB port can be used for connecting a media device (such as an iPodÂ®) with the device's available cable, or for directly plugging in a portable mass storage device (such as a "thumb drive"). When playing media files stored on a mass storage device, the SYNCÂ® system only plays files that do not have Digital Rights Management (DRM) protection. The USB port can also be used for uploading vehicle application upgrades.

The USB port is powered by the APIM , so no external power source is needed to power a device plugged into the USB port if the device supports this feature.

The audio input jack can be used for connecting a media device (such as an iPodÂ®) utilizing a 1/8-inch audio jack. When a device is connected through the audio input jack, only the speaker volume can be controlled by the ACM . All other functions (such as seek, fast forward, pause, etc.) must be carried out on the device itself.

The Bluetooth interface can accommodate both Bluetooth-enabled mobile phones and Bluetooth-enabled media devices. Any Bluetooth device used with the SYNCÂ® system must first be paired with the system before it is operational.

Bluetooth is a secure, short-range radio frequency that allows devices to communicate wirelessly through radio waves. The operating range of a Bluetooth signal is a maximum of 32 feet.

Only one Bluetooth phone and one Bluetooth media device can be connected to the system at any one time. If

an additional device of either type is paired with the system and made active, the APIM will disconnect any active connection and establish a connection with the new device.

It is important to understand that not all mobile phones will have the same level of features when interacting with the SYNCÂ® system. For a list of compatible phones, refer to the SyncMyRide website .

In addition to audio information, metadata may also be sent to the APIM from a device plugged into the USB port. Metadata consists of such information as artist, album title, song title, and genre. The metadata is used by the APIM to create indexes that can be used to sort for particular music, based on customer preference. Not all USB devices can send metadata to the APIM ; also, no metadata is transferred when a device is connected through the audio input jack. When a new media device is connected to the SYNCÂ® system, the APIM automatically indexes the information. This may take several minutes (depending on the amount of data on the device), and is considered normal operation. When a device that was previously connected to the SYNCÂ® system is reconnected, the APIM updates the index (rather than creating a new one), which reduces the amount of time needed to create the index.

The APIM receives both stereo and mono sound inputs, and can also transmit both stereo and mono sound. The mono function is used to receive the microphone input, and to send sound to the ACM for voice prompts, the Text-To-Speech (TTS) feature, ring tones, and any audio received through a connected mobile phone. The TTS feature speaks information so that it does not have to be read from the display.

The APIM communicates on the MS-CAN and High Speed Controller Area Network (HS-CAN). Communication with the scan tool is established through the HS-CAN .

Global Positioning System Module (GPSM)

The Global Positioning System Module (GPSM) provides vehicle location for real-time traffic reports and re-routing, and for identifying vehicle location in the event of a collision. The vehicle location information is broadcast to the APIM over the MS-CAN . The GPSM is part of the SYNCÂ® system and is only present for vehicles without navigation.

Voice Recognition For Vehicles With Navigation And The SYNCÂ® System

When the audio system enters voice recognition mode, the ACM initially controls the voice recognition feature. The microphone is wired directly to the APIM , which relays the microphone input to the ACM through dedicated wiring. If the first command spoken is part of the ACM voice recognition set, the ACM retains control of the voice recognition and takes the appropriate action(s). If the first command spoken is part of the APIM voice recognition set, the ACM shuts off its own voice recognition and broadcasts a Controller Area Network (CAN) message to the APIM , transferring the voice recognition to the SYNCÂ® system and providing the voice command that was spoken. The ACM controls the voice engine for the base audio, navigation, and climate control systems. The APIM controls the voice engine for the SYNCÂ® system (USB port, audio input jack, Bluetooth).

Steering Wheel Controls

The steering wheel controls consist of a series of resistors. Each steering wheel control switch function corresponds with a specific resistance value within the switch. When a switch is pressed, the ACM (or the APIM) monitors the change in reference voltage to determine the requested function.

Noise Suppression Equipment

The radio frequency suppression equipment reduces interference transmitted through the speakers by the engine ignition and electrical systems. When installing any new radio suppression equipment components, make sure that a good contact is made at all connections.

Audio Signals

Audio signal flow varies greatly depending on vehicle content.

Stereo signals contain left and right channel information, and are used for most audio signals.

A mono signal is used for the microphone input to the APIM . The mono signal is also used for the voice prompts, the TTS feature, ring tones, and any audio received through a connected mobile phone. These audio signals are output from the APIM to the ACM . The mono and stereo outputs from the APIM utilize separate circuits.

A digital signal is used to transmit data from a media device connected through the USB port to the APIM . The APIM then converts the signal to analog and relays the signal to the ACM .

A wireless signal is used to broadcast audio signals from a Bluetooth device to the APIM . As with a digital signal sent through the USB port, the APIM converts the wireless audio signal to analog and relays it to the ACM .

Network Communication

The following audio system components communicate via the MS-CAN :

- ACM
- Navigation ACM
- Audio DSP module (SonyÂ® sound)
- Audio DSP module (THXÂ® sound)
- FCIM
- FDIM (vehicles without navigation)
- APIM
- GPSM

There are numerous messages internal to the audio system. The functions of these messages include (but are not limited to):

- Changing the audio source
- Changing equalizer settings
- Updating the FDIM display
- Dialing phone numbers from the FCIM (if equipped with the SYNCÂ® system)

In addition, the following messages are utilized by the audio system in conjunction with systems outside of the audio system:

Audio System

Message	Transmitting Module	Receiving Module(s)	Audio System Function
Accelerometer and Yaw Sensor Data	Instrument Panel Cluster (IPC)	GPSM	Provides vehicle yaw rate to the GPSM for use in vehicle tracking.
Accessory Delay Status	SJB	ACM APIM	When active, this signal allows the audio component to be operated after the vehicle is shut off.

		FCIM FDIM	
Average Fuel Economy Data	IPC	ACM	Provides average fuel economy data to the ACM .
Belt-MinderÂ® Status	IPC	ACM	When this signal is active, the speaker output is reduced to allow the Belt-MinderÂ® tone to be more easily heard. This message only applies to vehicles with MyKey that have this feature currently enabled.
Climate Control Data (Hybrid only)	HVAC module	ACM	Provides the outside air temperature to the ACM .
Compass Display Status	IPC	FDIM	Indicates the compass heading or mode (calibration, zone). This message only applies to vehicles without navigation.
eCall Notification	Restraints Control Module (RCM)	APIM	Provides the eCall status to the APIM . This message is also used to confirm that the APIM and RCM are both configured for the eCall feature.
eCall Status	APIM	RCM	Provides the eCall status to the RCM . This message is also used to confirm that the APIM and RCM are both configured for the eCall feature.
English/Metric Mode	IPC	ACM	Indicates whether English or metric units is currently selected.
FCIM Button Press Data	FCIM	ACM APIM Audio DSP module IPC	Indicates when a button is pressed on the FCIM so the audio system can make the desired setting change.
Fuel Level (Instant)	IPC	APIM	Provides the instant fuel level to the APIM .
Historical Fuel Economy (Hybrid only)	IPC	ACM	Provides the historical fuel economy data to the ACM for display on the FDIM . This message only applies to vehicles with navigation.
HVAC Button Status (from ACM)	ACM	HVAC module	Indicates when a climate control setting is changed using the FDIM touchscreen (which is hardwired to the ACM) so the HVAC module can make the desired setting changes. This message only applies to vehicles with navigation.
HVAC Button Status (from FCIM)	FCIM	HVAC module	Indicates when a climate control button is pressed on the FCIM so the HVAC module can make the desired setting change.
HVAC Indicator Status (to ACM)	HVAC module	ACM	Indicates the mode of the HVAC module so the ACM can send the correct display information to the FDIM . This message only applies to vehicles with navigation.
HVAC Indicator Status (to FCIM)	HVAC module	FCIM	Indicates the mode of the HVAC module so the FCIM can illuminate the appropriate indicator on the bezel face.
	HVAC module		

HVAC Module Display Data		ACM (with navigation) FDIM (without navigation)	Indicates certain climate control settings such as temperature, fan speed, air distribution, and outside air temperature.
HVAC Voice Request	ACM	HVAC module	Provides climate control setting changes that are initiated through the voice recognition system. This message only applies to vehicles with navigation.
Ignition Switch Position	SJB	ACM APIM Audio DSP module FCIM FDIM GPSM	Indicates the ignition position to the audio system modules in order to control power management.
Instrument Illumination Level	SJB	ACM FCIM FDIM	Controls the backlight intensity, based on the position of the dimmer switch.
Navigation Rolling Wheel Count	IPC	ACM GPSM	Used by the ACM to more accurately track vehicle position when the GPS signal is temporarily unavailable. Used by the GPSM for vehicle tracking if the vehicle speed signal is lost.
Odometer Rolling Count	PCM	APIM	Provides the odometer reading to the APIM in order to initiate maintenance interval notifications.
Park Brake Status	SJB	ACM	Provides the park brake status to the ACM .
Parking Aid Sounder Volume Cutback Request	Parking Aid Module (PAM)	ACM	When this signal is active, the speaker output is reduced to allow the parking aid tone to be more easily heard.
Power Flow Status (Hybrid only)	IPC	ACM	Provides the approximate power flow data to the ACM for display on the FDIM . This message only applies to vehicles with navigation.
TPMS Status (Hybrid only)	SJB	APIM	Provides the current tire pressure and TPMS warning indicator status to the APIM .
Transmission Selector (PRNDL) Status	IPC	ACM GPSM	For the navigation system, this signal is used for more accurate navigation tracking. For the parking aid system, this signal is used by the ACM to determine if it should enable the speaker mute feature when a parking aid tone sounds. For vehicles with a rear view camera, this signal is used by the ACM to determine if it should allow the

			video feed from the rear view camera to be shown on the FDIM . For vehicles with the SYNCÂ® system but not navigation, this signal is used by the GPSM for more accurate vehicle tracking.
Vehicle Speed	IPC	ACM Audio DSP module GPSM	Used by the ACM (or audio DSP module) for the speed-compensated volume function. Used by the GPSM for vehicle tracking.
Vehicle Identification Number (VIN) Information	IPC	ACM APIM	Provides the VIN to verify the correct modules are installed.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Front Controls Interface Module (FCIM) • Front Display Interface Module (FDIM) • Antenna • Audio input jack • Noise suppression equipment • Speaker(s) • Steering wheel controls • Universal Serial Bus (USB) port	• Battery Junction Box (BJB) fuse(s): ♦ 20 (20A) (VBATT) ♦ 21 (20A) (VBATT) • Smart Junction Box (SJB) fuse(s): ♦ 13 (5A) (VBATT) ♦ 14 (10A) (VBATT) ♦ 19 (25A) (VBATT) ♦ 28 (5A) (START signal) ♦ 38 (20A) (VBATT) ♦ 39 (20A) (VBATT) ♦ 41 (15A) (Accessory delay) • Wiring, terminals or connectors

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. **NOTE:** Do not press any buttons on the FCIM or FDIM while the Audio Front Control Module (ACM) is carrying out the self-test.

   Clear the continuous DTCs and carry out the self-test diagnostics for the ACM .

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

10. If no DTCs related to the concern are retrieved, refer to the Symptom Charts.

DTC Charts

Audio Front Control Module (ACM) DTC Chart â Fusion Without Navigation

DTC	Description	Action
B1031	SDARS Satellite Antenna Open	GO to Pinpoint Test B .
B1032	SDARS Satellite Antenna Short	GO to Pinpoint Test B .
B1117	Audio Steering Wheel Button Stuck	GO to Pinpoint Test Q .
B1318	Battery Voltage Low	GO to Pinpoint Test AO .
B1342	ECU is Faulted	**NOTE:** DTC B1342 may set as a result of a speaker circuit fault. In this case, DTC B2965 should also be set. Be sure to repair the speaker circuit fault before diagnosing DTC B1342. CLEAR the DTCs. REPEAT the self-test. If DTC B1342 is the only DTC retrieved again, INSTALL a new Audio Front Control Module (ACM).

		REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation.
B2103	Antenna Not Connected	GO to Pinpoint Test A .
B2404	Audio Steering Wheel Switch Circuit Fault	GO to Pinpoint Test Q .
B2406	Audio Disc CD Player Internal Fault	**NOTE:** DTC B1342 may also be set. CLEAR the DTCs. REPEAT the self-test. If DTC B2406 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation.
B2477	Module Configuration Failure	REFER to Section 418-01 .
B2965	Audio System Speaker Circuit Fault	For the base or mid-level audio system, GO to Pinpoint Test C . For SonyÂ® sound, GO to Pinpoint Test E .
U0140	Lost Communication With Body Control Module (GEM)	GO to Pinpoint Test AE .
U0155	Lost Communication With Instrument Panel Cluster (IC) Control Module	GO to Pinpoint Test AG .
U0159	Lost Communication With Parking Assist Control Module (PAM)	GO to Pinpoint Test U .
U0197	Lost Communication With Telephone Control Module	GO to Pinpoint Test AK .
U0238	Lost Communication With Digital Audio Control Module "D" (DSP)	GO to Pinpoint Test AL .
U0255	Lost Communication With Front Controls Interface Module	GO to Pinpoint Test AM .
U0256	Lost Communication With Front Display Interface Module	GO to Pinpoint Test AN .
U2050	No Application Present	REFER to Section 418-01 .
U2051	One or More Calibration Files Missing/Corrupt	REFER to Section 418-01 .

Audio Front Control Module (ACM) DTC Chart â MKZ Without Navigation

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B11BA:1C	Steering Wheel Audio Switch Pack: Circuit Voltage out of Range	GO to Pinpoint Test Q .
B11BA:63	Steering Wheel Audio Switch Pack: Circuit / Component Protection Time-Out	GO to Pinpoint Test Q .
B1A01:01	Speaker #1: General Electrical Failure	For premium sound, GO to Pinpoint Test D . For THXÂ® sound, GO to Pinpoint Test F .
B1A01:11	Speaker #1: Circuit Short to Ground	For premium sound, GO to Pinpoint Test D . For THXÂ® sound, GO to Pinpoint Test F .
B1A01:12	Speaker #1: Circuit Short to Battery	For premium sound, GO to Pinpoint Test D . For THXÂ® sound, GO to Pinpoint Test F .
B1A01:13	Speaker #1: Circuit Open	For premium sound, GO to Pinpoint Test D . For THXÂ® sound, GO to Pinpoint Test F .
B1A02:01	Speaker #2: General Electrical Failure	For premium sound, GO to Pinpoint Test D . For THXÂ® sound, GO to Pinpoint Test F .
B1A02:11	Speaker #2: Circuit Short to Ground	For premium sound, GO to Pinpoint Test D . For THXÂ® sound, GO to Pinpoint Test F .
B1A02:12	Speaker #2: Circuit Short to Battery	For premium sound, GO to Pinpoint Test D . For THXÂ® sound, GO to Pinpoint Test F .
B1A02:13	Speaker #2: Circuit Open	For premium sound, GO to Pinpoint Test D . For THXÂ® sound, GO to Pinpoint Test F .
B1A03:01	Speaker #3: General Electrical Failure	GO to Pinpoint Test D .
B1A03:11	Speaker #3: Circuit Short to Ground	GO to Pinpoint Test D .
B1A03:12	Speaker #3: Circuit Short to Battery	GO to Pinpoint Test D .
B1A03:13	Speaker #3: Circuit Open	GO to Pinpoint Test D .
B1A04:01	Speaker #4: General Electrical Failure	GO to Pinpoint Test D .
B1A04:11	Speaker #4: Circuit Short to Ground	GO to Pinpoint Test D .
B1A04:12	Speaker #4: Circuit Short to Battery	GO to Pinpoint Test D .
B1A04:13	Speaker #4: Circuit Open	GO to Pinpoint Test D .
B1A05:02	Speaker #5: General Signal Failure	GO to Pinpoint Test D .
B1A06:02	Speaker #6: General Signal Failure	GO to Pinpoint Test D .
B1A56:21	Antenna: Signal Amplitude â © Minimum	GO to Pinpoint Test A .
B1A89:01		GO to Pinpoint Test B .

	Satellite Antenna: General Electrical Failure	
B1A89:13	Satellite Antenna: Circuit Open	GO to Pinpoint Test B .
B1D19:49	Compact Disc Unit: Internal Electronic Failure	CLEAR the DTCs. REPEAT the self-test. If DTC B1D19:49 is retrieved again, INSTALL a new Audio Front Control Module (ACM). REFER to Audio Control Module (ACM) â MKZ in this section. REPEAT the self-test.
B1D78:13	Auxiliary Input: Circuit Open	GO to Pinpoint Test R .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AG .
U0159:00	Lost Communication With Parking Assist Control Module "A": No Sub Type Information	GO to Pinpoint Test U .
U0197:00	Lost Communication With Telephone Control Module: No Sub Type Information	GO to Pinpoint Test AK .
U0238:00	Lost Communication With Digital Audio Control Module "D": No Sub Type Information	GO to Pinpoint Test AL .
U0255:00	Lost Communication With Front Display Interface Module: No Sub Type Information	GO to Pinpoint Test AN .
U0256:00	Lost Communication With Front Controls Interface Module: No Sub Type Information	GO to Pinpoint Test AM .
U2014:41	Control Module Hardware: General Checksum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:41 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) â MKZ in this section. REPEAT the self-test.
U2014:42	Control Module Hardware: General Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:42 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) â MKZ in this section. REPEAT the self-test.
U2014:96	Control Module Hardware: Component Internal Failure	GO to Pinpoint Test I .
U201A:51	Control Module Main Calibration Data: Not Programmed	REFER to Section 418-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	REFER to Section 418-01 .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	REFER to Section 418-01 .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AO .
U3003:17		GO to Pinpoint Test AP .

	Battery Voltage: Circuit Voltage Above Threshold	

Audio Front Control Module (ACM) DTC Chart â Navigation

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B119F:01	GPS Antenna: General Electrical Failure	GO to Pinpoint Test W .
B119F:13	GPS Antenna: Circuit Open	GO to Pinpoint Test W .
B11BA:1C	Steering Wheel Audio Switch Pack: Circuit Voltage out of Range	GO to Pinpoint Test Q .
B11BA:63	Steering Wheel Audio Switch Pack: Circuit / Component Protection Time-Out	GO to Pinpoint Test Q .
B1201:1C	Steering Wheel Audio Switch Pack 2: Circuit Voltage out of Range	GO to Pinpoint Test Q .
B1201:63	Steering Wheel Audio Switch Pack 2: Circuit / Component Protection Time-Out	GO to Pinpoint Test Q .
B121C:01	Hard Drive: General Electrical Failure	CLEAR the DTCs. REPEAT the self-test. If DTC B121C:01 is retrieved again, INSTALL a new Audio Front Control Module (ACM). REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. REPEAT the self-test.
B1A01:01	Speaker #1: General Electrical Failure	For premium sound, GO to Pinpoint Test D . For SonyÂ® sound, GO to Pinpoint Test E . For THXÂ® sound, GO to Pinpoint Test F .
B1A02:01	Speaker #2: General Electrical Failure	For premium sound, GO to Pinpoint Test D . For SonyÂ® sound, GO to Pinpoint Test E . For THXÂ® sound, GO to Pinpoint Test F .
B1A03:01	Speaker #3: General Electrical Failure	For premium sound, GO to Pinpoint Test D . For SonyÂ® sound, GO to Pinpoint Test E . For THXÂ® sound, GO to Pinpoint Test F .
B1A04:01	Speaker #4: General Electrical Failure	For premium sound, GO to Pinpoint Test D .

		For SonyÂ® sound, GO to Pinpoint Test E . For THXÂ® sound, GO to Pinpoint Test F .
B1A05:01	Speaker #5: General Electrical Failure	For premium sound, GO to Pinpoint Test D . For SonyÂ® sound, GO to Pinpoint Test E . For THXÂ® sound, GO to Pinpoint Test F .
B1A06:01	Speaker #6: General Electrical Failure	For premium sound, GO to Pinpoint Test D . For SonyÂ® sound, GO to Pinpoint Test E . For THXÂ® sound, GO to Pinpoint Test F .
B1A07:01	Speaker #7: General Electrical Failure	GO to Pinpoint Test Y .
B1A56:21	Antenna: Signal Amplitude â © Minimum	GO to Pinpoint Test A .
B1A89:01	Satellite Antenna: General Electrical Failure	GO to Pinpoint Test B .
B1A89:13	Satellite Antenna: Circuit Open	GO to Pinpoint Test B .
B1D19:49	Compact Disc Unit: Internal Electronic Failure	CLEAR the DTCs. REPEAT the self-test. If DTC B1D19:49 is retrieved again, INSTALL a new Audio Front Control Module (ACM). REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. REPEAT the self-test.
B1D19:4B	Compact Disc Unit: Over Temperature	The ACM was over-temperature. This may occur during extended use. Audio operation can resume after the ACM cools. CLEAR the DTCs. This is normal operation.
B1D79:01	Microphone Input: General Electrical Failure	GO to Pinpoint Test V .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AG .
U0159:00	Lost Communication With Parking Assist Control Module "A": No Sub Type Information	GO to Pinpoint Test U .
U0162:00	Lost Communication With Navigation Display Module: No Sub Type Information	GO to Pinpoint Test M .
U0164:00	Lost Communication With HVAC Control Module: No Sub Type Information	GO to Pinpoint Test AH .
U0197:00	Lost Communication With Telephone Control Module: No Sub Type Information	GO to Pinpoint Test AK .
U0238:00		GO to Pinpoint Test AL .

	Lost Communication With Digital Audio Control Module "D": No Sub Type Information	
U0256:00	Lost Communication With Front Controls Interface Module: No Sub Type Information	GO to Pinpoint Test AM .
U2014:09	Control Module Hardware: Component Failure	GO to Pinpoint Test X .
U2014:41	Control Module Hardware: General Checksum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:41 is retrieved again, INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. REPEAT the self-test.
U2014:96	Control Module Hardware: Component Internal Failure	GO to Pinpoint Test I .
U201A:51	Control Module Main Calibration Data: Not Programmed	REFER to Section 418-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	REFER to Section 418-01 .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	REFER to Section 418-01 .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AO .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test AP .

Audio Digital Signal Processing (DSP) Module DTC Chart â SonyÂ® Sound

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B1A01:01	Speaker #1: General Electrical Failure	GO to Pinpoint Test E .
B1A01:11	Speaker #1: Circuit Short to Ground	GO to Pinpoint Test E .
B1A01:12	Speaker #1: Circuit Short to Battery	GO to Pinpoint Test E .
B1A01:13	Speaker #1: Circuit Open	GO to Pinpoint Test E .
B1A02:01	Speaker #2: General Electrical Failure	GO to Pinpoint Test E .
B1A02:11	Speaker #2: Circuit Short to Ground	GO to Pinpoint Test E .
B1A02:12	Speaker #2: Circuit Short to Battery	GO to Pinpoint Test E .
B1A02:13	Speaker #2: Circuit Open	GO to Pinpoint Test E .
B1A03:01	Speaker #3: General Electrical Failure	GO to Pinpoint Test E .

B1A03:11	Speaker #3: Circuit Short to Ground	GO to Pinpoint Test E .
B1A03:12	Speaker #3: Circuit Short to Battery	GO to Pinpoint Test E .
B1A03:13	Speaker #3: Circuit Open	GO to Pinpoint Test E .
B1A04:01	Speaker #4: General Electrical Failure	GO to Pinpoint Test E .
B1A04:11	Speaker #4: Circuit Short to Ground	GO to Pinpoint Test E .
B1A04:12	Speaker #4: Circuit Short to Battery	GO to Pinpoint Test E .
B1A04:13	Speaker #4: Circuit Open	GO to Pinpoint Test E .
B1A05:01	Speaker #5: General Electrical Failure	GO to Pinpoint Test E .
B1A05:11	Speaker #5: Circuit Short to Ground	GO to Pinpoint Test E .
B1A05:12	Speaker #5: Circuit Short to Battery	GO to Pinpoint Test E .
B1A05:13	Speaker #5: Circuit Open	GO to Pinpoint Test E .
B1A06:01	Speaker #6: General Electrical Failure	GO to Pinpoint Test E .
B1A06:11	Speaker #6: Circuit Short to Ground	GO to Pinpoint Test E .
B1A06:12	Speaker #6: Circuit Short to Battery	GO to Pinpoint Test E .
B1A06:13	Speaker #6: Circuit Open	GO to Pinpoint Test E .
B1A07:01	Speaker #7: General Electrical Failure	GO to Pinpoint Test E .
B1A07:11	Speaker #7: Circuit Short to Ground	GO to Pinpoint Test E .
B1A07:12	Speaker #7: Circuit Short to Battery	GO to Pinpoint Test E .
B1A07:13	Speaker #7: Circuit Open	GO to Pinpoint Test E .
B1A08:01	Speaker #8: General Electrical Failure	GO to Pinpoint Test E .
B1A08:11	Speaker #8: Circuit Short to Ground	GO to Pinpoint Test E .
B1A08:12	Speaker #8: Circuit Short to Battery	GO to Pinpoint Test E .
B1A08:13	Speaker #8: Circuit Open	GO to Pinpoint Test E .
B1A09:02	Speaker #9: General Signal Failure	GO to Pinpoint Test E .
B1A09:12	Speaker #9: Circuit Short to Battery	GO to Pinpoint Test E .
B1A09:13	Speaker #9: Circuit Open	GO to Pinpoint Test E .
B1A10:11	Speaker #10: Circuit Short to Ground	GO to Pinpoint Test E .
B1A10:12	Speaker #10: Circuit Short to Battery	GO to Pinpoint Test E .
B1A10:13	Speaker #10: Circuit Open	GO to Pinpoint Test E .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AG .
U0184:00	Lost Communication With Radio: No Sub Type Information	GO to Pinpoint Test AJ .
U0197:00	Lost Communication With Telephone Control Module: No Sub Type Information	GO to Pinpoint Test AK .
U2014:01	Control Module Hardware: General Electrical Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:01 is retrieved again, INSTALL a new audio Digital Signal Processing (DSP) module. REFER to Audio Digital Signal Processing (DSP) Module in this section. REPEAT the self-test.
U2014:41		

	Control Module Hardware: General Checksum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:41 is retrieved again, INSTALL a new audio Digital Signal Processing (DSP) module. REFER to Audio Digital Signal Processing (DSP) Module in this section. REPEAT the self-test.
U201A:51	Control Module Main Calibration Data: Not Programmed	REFER to Section 418-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	REFER to Section 418-01 .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	REFER to Section 418-01 .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AS .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test AT .

Audio Digital Signal Processing (DSP) Module DTC Chart â THXÂ® Sound

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B1A01:11	Speaker #1: Circuit Short to Ground	GO to Pinpoint Test F .
B1A01:12	Speaker #1: Circuit Short to Battery	GO to Pinpoint Test F .
B1A01:13	Speaker #1: Circuit Open	GO to Pinpoint Test F .
B1A02:11	Speaker #2: Circuit Short to Ground	GO to Pinpoint Test F .
B1A02:12	Speaker #2: Circuit Short to Battery	GO to Pinpoint Test F .
B1A02:13	Speaker #2: Circuit Open	GO to Pinpoint Test F .
B1A03:11	Speaker #3: Circuit Short to Ground	GO to Pinpoint Test F .
B1A03:12	Speaker #3: Circuit Short to Battery	GO to Pinpoint Test F .
B1A03:13	Speaker #3: Circuit Open	GO to Pinpoint Test F .
B1A04:11	Speaker #4: Circuit Short to Ground	GO to Pinpoint Test F .
B1A04:12	Speaker #4: Circuit Short to Battery	GO to Pinpoint Test F .
B1A04:13	Speaker #4: Circuit Open	GO to Pinpoint Test F .
B1A05:11	Speaker #5: Circuit Short to Ground	GO to Pinpoint Test F .

B1A05:12	Speaker #5: Circuit Short to Battery	GO to Pinpoint Test F .
B1A05:13	Speaker #5: Circuit Open	GO to Pinpoint Test F .
B1A06:11	Speaker #6: Circuit Short to Ground	GO to Pinpoint Test F .
B1A06:12	Speaker #6: Circuit Short to Battery	GO to Pinpoint Test F .
B1A06:13	Speaker #6: Circuit Open	GO to Pinpoint Test F .
B1A07:11	Speaker #7: Circuit Short to Ground	GO to Pinpoint Test F .
B1A07:12	Speaker #7: Circuit Short to Battery	GO to Pinpoint Test F .
B1A07:13	Speaker #7: Circuit Open	GO to Pinpoint Test F .
B1A08:11	Speaker #8: Circuit Short to Ground	GO to Pinpoint Test F .
B1A08:12	Speaker #8: Circuit Short to Battery	GO to Pinpoint Test F .
B1A08:13	Speaker #8: Circuit Open	GO to Pinpoint Test F .
B1A09:11	Speaker #9: Circuit Short to Ground	GO to Pinpoint Test F .
B1A09:12	Speaker #9: Circuit Short to Battery	GO to Pinpoint Test F .
B1A09:13	Speaker #9: Circuit Open	GO to Pinpoint Test F .
B1A10:11	Speaker #10: Circuit Short to Ground	GO to Pinpoint Test F .
B1A10:12	Speaker #10: Circuit Short to Battery	GO to Pinpoint Test F .
B1A10:13	Speaker #10: Circuit Open	GO to Pinpoint Test F .
B1A11:11	Speaker #11: Circuit Short to Ground	GO to Pinpoint Test F .
B1A11:12	Speaker #11: Circuit Short to Battery	GO to Pinpoint Test F .
B1A11:13	Speaker #11: Circuit Open	GO to Pinpoint Test F .
B1A12:11	Speaker #12: Circuit Short to Ground	GO to Pinpoint Test F .
B1A12:12	Speaker #12: Circuit Short to Battery	GO to Pinpoint Test F .
B1A12:13	Speaker #12: Circuit Open	GO to Pinpoint Test F .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AG .
U0184:00	Lost Communication With Radio: No Sub Type Information	GO to Pinpoint Test AJ .
U0197:00		GO to Pinpoint Test AK .

	Lost Communication With Telephone Control Module: No Sub Type Information	
U2014:41	Control Module Hardware: General Checksum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:41 is retrieved again, INSTALL a new audio Digital Signal Processing (DSP) module. REFER to Audio Digital Signal Processing (DSP) Module in this section. REPEAT the self-test.
U2014:42	Control Module Hardware: General Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:42 is retrieved again, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module in this section. REPEAT the self-test.
U2014:4B	Control Module Hardware: Over Temperature	The audio DSP module was over-temperature. This may occur during extended use. Audio operation can resume after the audio DSP module cools. CLEAR the DTCs. This is normal operation.
U2014:96	Control Module Hardware: Component Internal Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:96 is retrieved again, INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module in this section. REPEAT the self-test.
U201A:51	Control Module Main Calibration Data: Not Programmed	REFER to Section 418-01 .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	REFER to Section 418-01 .
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	REFER to Section 418-01 .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AS .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test AT .

Accessory Protocol Interface Module (APIM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B1201:1C	Steering Wheel Audio Switch Pack 2: Circuit Voltage Out of Range	GO to Pinpoint Test Q .
B1201:63	Steering Wheel Audio Switch Pack 2: Circuit / Component Protection Time-Out	GO to Pinpoint Test Q .
B1252:04	USB Port: System Internal Failure	GO to Pinpoint Test AB .
B1252:11	USB Port: Circuit Short to Ground	GO to Pinpoint Test AB .

B1A16:01	Microphone Input Circuit: General Electrical Failure	GO to Pinpoint Test V .
U0100:00	Lost Communication With ECM /PCM "A": No Sub Type Information	GO to Pinpoint Test AD .
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0151:00	Lost Communication With Restraints Control Module: No Sub Type Information	GO to Pinpoint Test AF .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AG .
U016A:00	Lost Communication With Global Positioning System Module: No Sub Type Information	GO to Pinpoint Test AI .
U0184:00	Lost Communication With Radio: No Sub Type Information	GO to Pinpoint Test AJ .
U0255:00	Lost Communication With Front Display Interface Module: No Sub Type Information	GO to Pinpoint Test AN .
U0256:00	Lost Communication With Front Controls Interface Module: No Sub Type Information	GO to Pinpoint Test AM .
U0422:00	Invalid Data Received From Body Control Module: No Sub Type Information	RETRIEVE and FOLLOW other DTCs present in the Accessory Protocol Interface Module (APIM) or Smart Junction Box (SJB).
U0423:00	Invalid Data Received From Instrument Panel Control Module: No Sub Type Information	RETRIEVE and FOLLOW other DTCs present in the APIM or Instrument Panel Cluster (IPC).
U046B:00	Invalid Data Received From Global Positioning System Module: No Sub Type Information	RETRIEVE and FOLLOW other DTCs present in the APIM or Global Positioning System Module (GPSM).
U0485:00	Invalid Data Received From Radio: No Sub Type Information	RETRIEVE and FOLLOW other DTCs present in the APIM or Audio Front Control Module (ACM).
U2100:00	Initial Configuration Not Complete: No Sub Type Information	REFER to Section 418-01 .
U2101:00	Initial Configuration Not Complete: No Sub Type Information	REFER to Section 418-01 .
U3000:04	Control Module: System Internal Failure	GO to Pinpoint Test Z .
U3000:41	Control Module: General Checksum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:41 is still present, INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. REPEAT the self-test.
U3000:42	Control Module: General Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:42 is still present, INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. REPEAT the self-test.
U3000:88	Control Module: Bus Off	REFER to Section 418-00 .

U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AQ .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test AR .

Front Controls Interface Module (FCIM) DTC Chart â Fusion Without Navigation

DTC	Description	Action
B1318	Battery Voltage Low	GO to Pinpoint Test AU .
B1342	ECU is Faulted	CLEAR the DTCs. REPEAT the self-test. If DTC B1342 is still present, INSTALL a new Front Controls Interface Module (FCIM). REFER to Front Controls Interface Module (FCIM) â Fusion in this section. REPEAT the self-test.
B2924	Audio Button Stuck	GO to Pinpoint Test J .
U0140	Lost Communication With Body Control Module (GEM)	GO to Pinpoint Test AE .
U0164	Lost Communication With HVAC Control Module (EATC)	GO to Pinpoint Test AH .
U0184	Lost Communication With Radio (ACM)	GO to Pinpoint Test AJ .
U2050	No Application Present	REFER to Section 418-01 .
U2051	One or More Calibration Files Missing/Corrupt	REFER to Section 418-01 .

Front Controls Interface Module (FCIM) DTC Chart â MKZ Without Navigation, All Vehicles With Navigation

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0184:00	Lost Communication With Radio: No Sub Type Information	GO to Pinpoint Test AJ .
U2013:63	Switch Pack: Circuit / Component Protection Time-Out	GO to Pinpoint Test J .
U2014:41		

	Control Module Hardware: General Checksum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:41 is still present, INSTALL a new Front Controls Interface Module (FCIM). REFER to Front Controls Interface Module (FCIM) â MKZ in this section. REPEAT the self-test.
U2014:42	Control Module Hardware: General Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U2014:42 is still present, INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) â MKZ in this section. REPEAT the self-test.
U201A:51	Control Module Main Calibration Data: Not Programmed	REFER to Section 418-01 .
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AU .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test AV .

Front Display Interface Module (FDIM) DTC Chart â Vehicles Without Navigation

DTC	Description	Action
B1318	Battery Voltage Low	GO to Pinpoint Test AW .
B1342	ECU is Faulted	CLEAR the DTCs. REPEAT the self-test. If DTC B1342 is still present, INSTALL a new Front Display Interface Module (FDIM). REFER to Front Display Interface Module (FDIM) â Fusion or Front Display Interface Module (FDIM) â MKZ in this section. REPEAT the self-test.
B2477	Module Configuration Failure	REFER to Section 418-01 .
B2924	Audio Button Stuck	GO to Pinpoint Test AZ .
U0140	Lost Communication With Body Control Module (GEM)	GO to Pinpoint Test AE .
U0155	Lost Communication With Instrument Panel Cluster (IC) Control Module	GO to Pinpoint Test AG .
U0164	Lost Communication With HVAC Control Module (EATC)	GO to Pinpoint Test AH .
U0184	Lost Communication With Radio (ACM)	GO to Pinpoint Test AJ .
U0197	Lost Communication With Telephone Control Module	GO to Pinpoint Test AK .
U0238	Lost Communication With Digital Audio Control Module "D" (DSP)	GO to Pinpoint Test AL .
U2050	No Application Present	REFER to Section 418-01 .
U2051		REFER to Section 418-01 .

	One or More Calibration Files Missing/Corrupt	

Global Positioning System Module (GPSM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
U0140:00	Lost Communication With Body Control Module: No Sub Type Information	GO to Pinpoint Test AE .
U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test AG .
U0184:00	Lost Communication With Radio: No Sub Type Information	GO to Pinpoint Test AJ .
U0197:00	Lost Communication With Telephone Control Module: No Sub Type Information	GO to Pinpoint Test AK .
U0422:00	Invalid Data Received From Body Control Module: No Sub Type Information	RETRIEVE and FOLLOW diagnostics for other DTCs present in the Global Positioning System Module (GPSM) and Restraints Control Module (RCM).
U0423:00	Invalid Data Received From Body Control Module: No Sub Type Information	RETRIEVE and FOLLOW diagnostics for other DTCs present in the GPSM and Instrument Panel Cluster (IPC).
U3000:09	Control Module: Component Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:09 is still present, INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) â Fusion or Global Positioning System Module (GPSM) â MKZ in this section. REPEAT the self-test.
U3000:41	Control Module: General Checksum Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:41 is still present, INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) â Fusion or Global Positioning System Module (GPSM) â MKZ in this section. REPEAT the self-test.
U3000:42	Control Module: General Memory Failure	CLEAR the DTCs. REPEAT the self-test. If DTC U3000:42 is still present, INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) â Fusion or Global Positioning System Module (GPSM) â MKZ in this section. REPEAT the self-test.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AX .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test AY .

Symptom Chart â General Audio System

General Audio System

Symptom Chart â Sound Quality

Sound Quality

Symptom Chart â Satellite Radio

Satellite Radio

Symptom Chart â Navigation

Navigation

Symptom Chart â SYNCÂ® System

SYNCÂ® System

Pinpoint Tests

Pinpoint Test A: Poor Reception â AM/FM

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation â Fusion

The AM/FM antenna receives AM and FM radio waves and transmits them to the Audio Front Control Module (ACM) through the AM/FM antenna cable. The ACM powers the AM/FM antenna in order to amplify the AM signal.

MKZ

The AM/FM radio antenna, integral to the rear window, receives AM and FM radio waves. The antenna module sends the radio waves to the ACM through the AM/FM antenna cable.

All Vehicles

The noise suppression equipment reduces engine ignition and electrical systems interference transmitted through the speakers.

The RDS function allows the vehicle operator to choose which genre (category) of music to listen to. When the SCAN button is pressed, the ACM only stops at channels falling within the selected category. If no channel in the selected category is found, the ACM continues to scan without stopping. This may appear to be a reception issue, but it is actually due to the customer setting.

- DTC B1A56:21 (Antenna: Signal Amplitude â © Minimum) â sets when the signal strength is less than the pre-configured threshold value during the self-test.
- DTC B2103 (Antenna Not Connected) â sets when the signal strength is less than the pre-configured threshold value during the self-test. This DTC applies to base and mid-level sound only.

This pinpoint test is intended to diagnose the following:

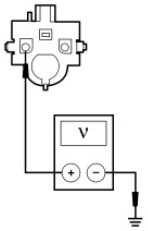
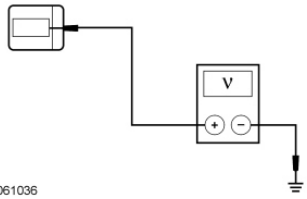
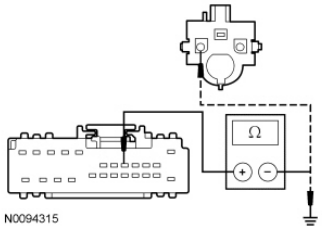
- No channel found in the selected category
- Wiring, terminals or connectors
- AM/FM antenna
- AM/FM antenna cable
- Charging system
- Ignition system
- Noise suppression equipment
- Antenna module (MKZ only)
- ACM

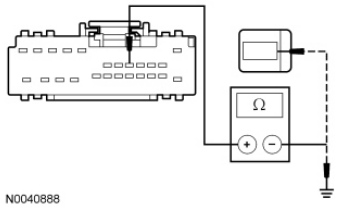
PINPOINT TEST A: POOR RECEPTION â AM/FM

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK THE RDS SETTING	
• Turn the RDS function off. Refer to the Owner's Literature. • Scan for a good channel. • **Does the audio system find a good channel with normal reception?**	**Yes** The system is operating correctly at this time. The concern was a result of no channel being found in the selected category. **No** GO to A2 .
A2 CHECK THE AUDIO SYSTEM RECEPTION	
• Check the audio system reception with the engine running, and with the engine off. • **Does the poor reception only occur with the engine running?**	**Yes** GO to A3 . **No** GO to A7 .
A3 CHECK THE NOISE SUPPRESSION EQUIPMENT	

• Check the engine ground strap for security, cleanliness, and metal-to-metal contact. • **Are the connections clean, secure, and in metal-to-metal contact?**	**Yes** GO to A4 . **No** CLEAN and SECURE the connections, or INSTALL a new engine ground strap as needed. TEST the system for normal operation.
A4 CHECK THE RADIO INTERFERENCE CAPACITOR	
• Install a new radio interference capacitor. • Start the vehicle. • Operate the audio system in radio tuner (AM/FM) mode. • **Is the reception OK?**	**Yes** The cause of the concern was an inoperative radio interference capacitor. The system is now operating correctly. **No** GO to A5 .
A5 CHECK THE GENERATOR	
• Ignition OFF. • Disconnect: Generator C102a . • Start the engine. • Operate the audio system in radio tuner (AM/FM) mode. • **Is the reception OK?**	**Yes** INSTALL a new generator. REFER to Section 414-00 . TEST the system for normal operation. **No** GO to A6 .
A6 CHECK THE IGNITION CIRCUITS	
• Ignition OFF. • Connect: Generator C102a . • Check the ignition circuits for correct routing, grounding, and integrity of the connections. • **Are the ignition components OK?**	**Yes** USE a jumper cable to ground various parts of the vehicle to the frame (for example: engine, fenders, quarter panels, stone deflectors, air cleaner, body sheet metal). When the noise is eliminated, PROVIDE a permanent ground where necessary. TEST the system for normal operation. **No** REPAIR the ignition system as necessary. TEST the system for normal operation.
A7 CHECK THE AM/FM ANTENNA ENABLE CIRCUIT	
• Ignition OFF. • Disconnect: AM/FM Antenna C9021 (Fusion) . • Disconnect: Antenna Module C4194a (MKZ) . • Operate the audio system in radio tuner (AM/FM) mode. • For Fusion measure the voltage between the AM/FM antenna C9021-1, circuit CME44 (BU), harness side and ground.	**Yes** For Fusion GO to A11 . For MKZ, GO to A9 . **No** GO to A8 .

 N0094314 • For MKZ, measure the voltage between the antenna module C4194a-1, circuit CME44 (YE/GN), harness side and ground.  A0061036 • **Is the voltage greater than 10 volts?**	
A8 CHECK THE AM/FM ANTENNA ENABLE CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Disconnect: ACM C240a . • For Fusion, measure the resistance between the ACM C240a-5, circuit CME44 (YE/GN), harness side and the AM/FM antenna C9021-1, circuit CME44 (BU), harness side; and between the ACM C240a-5, circuit CME44 (YE/GN), harness side and ground.  N0094315 • For MKZ, measure the resistance between the ACM C240a-5, circuit CME44 (YE/GN), harness side and the antenna module C4194a-1, circuit CME44 (YE/GN), harness side; and between the ACM C240a-5, circuit CME44 (YE/GN), harness side and ground.	**Yes** GO to A13 . **No** REPAIR the circuit. TEST the system for normal operation.

 • **Is the resistance less than 5 ohms between the ACM and the AM/FM antenna (or antenna module), and greater than 10,000 ohms between the ACM and ground?**	
A9 CHECK THE ANTENNA GRID	
• Ignition OFF. • Inspect the antenna grid closely for signs of damage. • **Is the antenna grid OK?**	**Yes** GO to A10 . **No** REPAIR the antenna grid as necessary. REFER to Section 501-11 . TEST the system for normal operation.
A10 ISOLATE THE ANTENNA MODULE	
• Ignition OFF. • Install a new antenna module. Refer to Antenna Module in this section. • Operate the audio system in radio tuner (AM/FM) mode. • **Is the reception OK?**	**Yes** The concern was caused by an inoperative antenna module. The system is now operating correctly. **No** GO to A12 .
A11 ISOLATE THE AM/FM ANTENNA	
• Ignition OFF. • Install a new AM/FM antenna. Refer to Antenna â AM/FM in this section. • Operate the audio system in radio tuner (AM/FM) mode. • **Is the reception OK?**	**Yes** The concern was caused by an inoperative AM/FM antenna. The system is now operating correctly. **No** GO to A12 .
A12 ISOLATE THE AM/FM ANTENNA CABLE	
• Ignition OFF. • Substitute each AM/FM antenna cable by routing a new component. Do not remove the original antenna cable at this time. • Operate the audio system in radio tuner (AM/FM) mode. • **Is the reception OK?**	**Yes** INSTALL a new AM/FM antenna cable for the inoperative cable. REFER to Antenna Cable â AM/FM in this section. TEST the system for normal operation. **No** GO to A13 .
A13 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation.

♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test B: Poor Reception/Poor Sound Quality/No Sound â Satellite Radio

Normal Operation

Digital signals are received by the satellite radio antenna and sent to the Audio Front Control Module (ACM), as the satellite radio receiver is built-in to the ACM .

A short to ground in the satellite radio antenna typically has no effect on the antenna signal. However, an open in the antenna circuit results in no sound from the satellite radio system. A short to voltage in the antenna circuit can have varying effects on the system.

Obstructions to the antenna line of sight can affect reception, but this is considered normal operation. Possible obstructions include hills, tall buildings, tunnels, and being parked inside a garage. Be sure the vehicle is in a clear area, free of obstructions, before testing satellite radio reception.

DTC Description	Fault Trigger Conditions
• B1031 â SDARS Satellite Antenna Open	Sets when an open or high resistance is detected in the satellite antenna circuit. This DTC can be either continuous or on-demand.
• B1032 â SDARS Satellite Antenna Short	Sets when a short to ground is detected in the satellite antenna circuit. This DTC can be either continuous or on-demand.
• B1A89:01 â Satellite Antenna: General Electrical Failure	May set when any fault is detected in the satellite radio antenna circuit. This DTC can be either continuous or on-demand.
• B1A89:13 â Satellite Antenna: Circuit Open	Sets when an open is detected in the satellite radio antenna circuit. This DTC can be either continuous or on-demand.

This pinpoint test is intended to diagnose the following:

- Obstructions to the antenna line of sight
- No channel found in the selected category
- Satellite radio antenna
- Satellite radio antenna cable
- ACM

PINPOINT TEST B: POOR RECEPTION/POOR SOUND QUALITY/NO SOUND â SATELLITE RADIO

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK THE RECEPTION AND CATEGORY FILTER SETTING	
• Turn the category filter function off. For additional information, refer to the Owner's Literature. • Drive the vehicle to an open location, free of obstacles. • Scan for a good channel. • **Does the satellite audio system find a good channel with normal reception?**	**Yes** The system is operating correctly at this time. The concern was a result of no channel being found in the selected category. **No** GO to B2 .
B2 CHECK THE SATELLITE SIGNAL PID (SAT_SIG_STR)	
• Enter the following diagnostic mode on the scan tool: ACM DataLogger . • Monitor the ACM PID (SAT_SIG_STR). • **Does the PID indicate "No Signal"?**	**Yes** GO to B3 . **No** GO to Pinpoint Test I .
B3 CHECK THE SATELLITE RADIO ANTENNA CABLE RESISTANCE	
• Ignition OFF. • Disconnect: Satellite Radio Antenna Connection At ACM . • Disconnect: Satellite Radio Antenna Cable In-Line Connection At RH Kick Panel . • Disconnect: Satellite Radio Antenna Connection At Satellite Radio Antenna . • Measure the resistance of the front satellite radio antenna cable core between the ACM and the satellite radio antenna in-line connection; and between the front satellite radio antenna cable core and shield. • Measure the resistance of the rear satellite radio antenna cable core between the satellite radio antenna and the satellite radio antenna in-line connection; and between the rear satellite radio antenna cable core and shield. • **Is the resistance of each satellite radio antenna cable core less than 2 ohms, and the resistance between the core and shield of each satellite radio antenna cable greater than 10,000 ohms?**	**Yes** GO to B4 . **No** INSTALL a new front or rear satellite radio antenna cable. REFER to Antenna Cable â Satellite Radio in this section. CLEAR any DTCs present. TEST the system for normal operation.
B4 ISOLATE THE SATELLITE RADIO ANTENNA	
	Yes

• Install a new satellite radio antenna. Refer to Antenna â Satellite Radio in this section. • Operate the audio system in satellite radio mode. • **Is the reception OK?**	The concern was caused by an inoperative satellite radio antenna. The system is operating correctly at this time. CLEAR any DTCs present. **No** GO to B5 .
B5 CHECK FOR CORRECT ACM MODULE OPERATION	
• Ignition OFF. • Disconnect all the ACM module connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM module connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM module. REFER to in Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: No Sound From One Or More Speakers (Not All Speakers) â Base, Mid-Level Sound

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Audio Front Control Module (ACM) directs audio signals to the speakers in the form of an AC voltage. The ACM provides internal circuit protection for shorts to ground or shorts to voltage.

A short to ground or short to voltage in the circuitry to one of the speakers can cause multiple speakers to lose sound due to the built-in overload protection feature of the ACM . In this case, a speaker fault DTC sets, and this pinpoint test should be followed to isolate the damaged circuit.

It should also be noted that when the ACM activates the built-in overload protection, DTC B1342 may also be set. The circuit failure must be repaired before DTC B1342 can be cleared.

The speaker walk test can be used to isolate a concern with a particular speaker. This can reduce the diagnostic steps necessary to isolate the concern. To carry out the speaker walk test, refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.

- DTC B2965 (Audio System Speaker Circuit Fault) â sets when a short to ground, short to voltage, or open is detected on any of the speaker circuits.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Speaker
- ACM

PINPOINT TEST C: NO SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS) â BASE, MID-LEVEL SOUND

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>C1 DETERMINE THE INOPERATIVE SPEAKER(S)</td><td></td></tr>
<tr><td>• Carry out the speaker walk test. Refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.
• Is the concern only with a tweeter speaker?</td><td>Yes
GO to C2 .

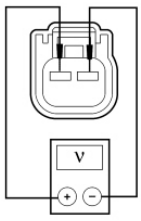
No
GO to C5 .</td></tr>
<tr><td>C2 CHECK FOR VOLTAGE TO THE SUSPECT TWEETER SPEAKER</td><td></td></tr>
<tr><td>• Ignition OFF.
• Disconnect: Suspect Tweeter Speaker .
• Operate the audio system in radio tuner (AM/FM) mode.
• Measure the AC voltage between the suspect tweeter speaker pin 1 and pin 2, harness side as follows:

<table><tr><th>Suspect Speaker</th><th>Positive Meter Lead</th><th>Negative Meter Lead</th></tr><tr><td>LH tweeter</td><td>C569-1

VME07 (WH)</td><td>C569-2

RME07 (WH/BN)</td></tr><tr><td>RH tweeter</td><td>C613-1

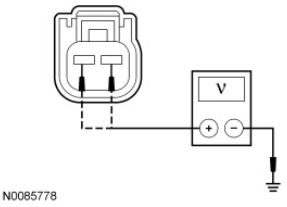
VME11 (VT/OG)</td><td>C613-2

RME11 (YE/OG)</td></tr></table>
 
N0085777
• Is a fluctuating AC voltage present?</td><td>Yes
INSTALL a new speaker for the suspect tweeter speaker. REFER to Speaker â Door in this section. CLEAR any DTCs present. TEST the system for normal operation.

No
GO to C3 .</td></tr>
<tr><td>C3 CHECK THE CIRCUITS TO THE SUSPECT TWEETER SPEAKER FOR A SHORT TO VOLTAGE</td><td></td></tr>
</table>

- Ignition OFF.
- Disconnect: LF Door Speaker C592b (LH Speaker Concern) or RF Door Speaker C692b (RH Speaker Concern) .
- Ignition ON.
- Measure the voltage between the suspect tweeter speaker, harness side and ground as follows:

Suspect Tweeter Speaker	Positive Meter Lead	Negative Meter Lead
LH tweeter	C569-1 VME07 (WH)	Ground
LH tweeter	C569-2 RME07 (WH/GN)	Ground
RH tweeter	C613-1 VME11 (VT/OG)	Ground
RH tweeter	C613-2 RME11 (YE/OG)	Ground



- **Is any voltage present?**

Yes
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

No
GO to C4 .

C4 CHECK THE CIRCUITS TO THE SUSPECT TWEETER SPEAKER FOR AN OPEN OR SHORT TO GROUND

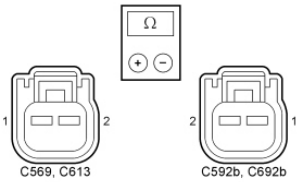
- Ignition OFF.
- Measure the resistance between the suspect tweeter speaker, harness side and the door speaker, harness side; and between the suspect tweeter speaker, harness side and ground as follows:

Suspect Tweeter Speaker	Positive Meter Lead	Negative Meter Lead	Circuit

Yes
INSTALL a new door speaker. REFER to Speaker â Door in this section. CLEAR any DTCs present. TEST the system for normal operation.

No
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

LH tweeter	C569-1	C592b-1, then ground	VME07 (WH) or VME08 (GN/OG)
LH tweeter	C569-2	C592b-2, then ground	RME07 (WH/GN) or RME08 (GY/OG)
RH tweeter	C613-1	C692b-1, then ground	VME11 (VT/OG)
RH tweeter	C613-2	C692b-2, then ground	RME11 (YE/OG)



N0102360

- **Is the resistance less than 5 ohms between the suspect tweeter speaker and the door speaker, and greater than 10,000 ohms between the suspect tweeter speaker and ground?**

C5 CHECK THE AUDIO SIGNALS TO THE SUSPECT SPEAKER

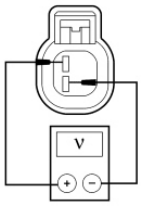
- Ignition OFF.
- Disconnect: Suspect Speaker .
- Operate the audio system in radio tuner (AM/FM) mode.
- Measure the AC voltage between the suspect speaker pins, harness side as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead
LF door	C523-1 or C592a-1 VME07 (WH)	C523-2 or C592a-2 RME07 (WH/BN)
RF door	C612-1 or C692a-1 VME10 (WH/VT)	C612-2 or C692a-2 RME10 (WH/OG)
LR door	C702-1 VME09 (WH/GN)	C702-2 RME09 (BN/YE)

Yes
INSTALL a new speaker for the suspect speaker. REFER to Speaker â Door in this section. CLEAR any DTCs present. TEST the system for normal operation.

No
GO to C6 .

RR door	C802-1 VME12 (BN/WH)	C802-2 RME12 (BN/BU)



- **Is a fluctuating AC voltage present?**

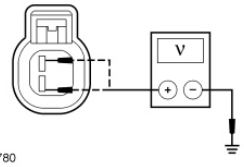
C6 CHECK THE CIRCUITS TO THE SUSPECT SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: ACM C240a .
- Ignition ON.
- Measure the voltage between the suspect speaker, harness side and ground as follows:

Yes
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

No
GO to C7 .

Suspect Speaker	Positive Meter Lead	Negative Meter Lead
LF door	C523-1 or C592a-1 VME07 (WH)	C523-2 or C592a-2 RME07 (WH/BN)
RF door	C612-1 or C692a-1 VME10 (WH/VT)	C612-2 or C692a-1 RME10 (WH/OG)
LR door	C702-1 VME09 (WH/GN)	C702-2 RME09 (BN/YE)
RR door	C802-1 VME12 (BN/WH)	C802-2 RME12 (BN/BU)

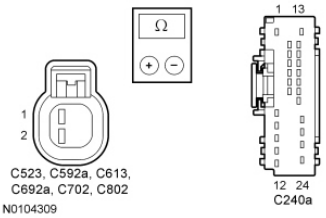


- **Is any voltage present?**

C7 CHECK THE SPEAKER CIRCUITS FOR AN OPEN OR SHORT TO GROUND

- Ignition OFF.
- Measure the resistance between suspect speaker, harness side and the ACM , harness side; and between the suspect speaker, harness side and ground as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
LH front	C523-1 or C592a-1, then ground	C240a-8	VME07 (WH)
	C523-2 or C592a-2, then ground	C240a-21	RME07 (WH/BN)
RH front	C612-1 or C692a-1, then ground	C240a-11	VME10 (WH/VT)
	C612-2 or C692a-2, then ground	C240a-12	RME10 (WH/OG)
LH rear	C702-1, then ground	C240a-9	VME09 (WH/GN)
	C702-2, then ground	C240a-22	RME09 (BN/YE)
RH rear	C802-1, then ground	C240a-10	VME12 (BN/WH)
	C802-2, then ground	C240a-23	RME12 (BN/BU)



- **Are the resistances less than 5 ohms between the ACM and the suspect speaker, and greater than 10,000 ohms between the ACM and ground?**

Yes
GO to C8 .

No
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

C8 CHECK FOR CORRECT ACM OPERATION

- Disconnect all the ACM connectors.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins

Yes
INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST

♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTC present.

Pinpoint Test D: No Sound From One Or More Speakers (Not All Speakers) â Premium Sound

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Audio Front Control Module (ACM) directs audio signals to the audio amplifier and to the subwoofer amplifier in the form of an AC voltage. The amplifiers boost the audio signals and send them to the speakers. The ACM provides internal circuit protection for shorts to ground or shorts to voltage.

A short to ground or short to voltage in the circuitry to one of the speakers may cause multiple speakers to lose sound due to the built-in overload protection feature of the ACM . In this case, a speaker fault DTC sets, and this pinpoint test should be followed to isolate the damaged circuit.

The speaker walk test can be used to isolate a concern with a particular speaker. This can reduce the diagnostic steps necessary to isolate the concern. To carry out the speaker walk test, refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.

To enable the amplifiers, the ACM sends voltage through individual enable/clip circuits. The circuits act as both an output (to enable the amplifier) and an input (to detect an overload condition). The voltage sent by the ACM passes through a variable resistor in each amplifier, then to ground. As the amplifier reaches maximum output, the resistance in the variable resistor decreases. This decreases the voltage drop, resulting in the ACM detecting a higher voltage on the enable/clip circuit. When the voltage reaches the clip threshold, the ACM clips the audio output signal to the amplifier (heard as distortion), in order to prevent damage to the amplifier and speakers.

The enable/clip status is based on the following voltages, as detected by the ACM :

- Less than 0.4 volt: amplifier disabled
- Between 3.8 and 6.7 volts (nominal): amplifier enabled
- Greater than 8.5 volts: amplifier clipped

An open in the enable/clip circuit causes the speakers powered by that particular amplifier to produce no sound because the enable signal does not reach the audio amplifier. A short to ground or short to voltage can cause severe distortion to be heard in the speakers.

Root DTC Description	Failure-Type Codes	Fault Trigger Conditions
• B1A01 â	01, 11, 12, 13	Sets when a fault is detected in the LF speaker circuits. This DTC can be continuous or on-demand.

Speaker #1		
• B1A02 â Speaker #2	01, 11, 12, 13	Sets when a fault is detected in the RF speaker circuits. This DTC can be continuous or on-demand.
• B1A03 â Speaker #3	01, 11, 12, 13	Sets when a fault is detected in the RR speaker circuits. This DTC can be continuous or on-demand.
• B1A04 â Speaker #4	01, 11, 12, 13	Sets when a fault is detected in the LR speaker circuits. This DTC can be continuous or on-demand.
• B1A05 â Speaker #5	01, 02	Sets when a fault is detected in the subwoofer speaker circuits. This DTC can be continuous or on-demand.
• B1A06 â Speaker #6	01, 02	Sets when a fault is detected in the instrument panel speaker circuits. This DTC can be continuous or on-demand.

This pinpoint test is intended to diagnose the following:

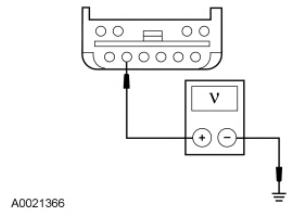
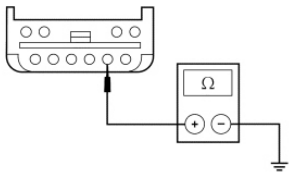
- Fuse
- Wiring, terminals or connectors
- Speaker
- Audio amplifier
- Subwoofer amplifier
- ACM

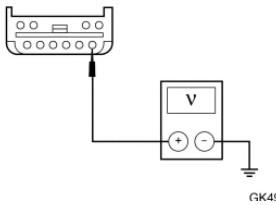
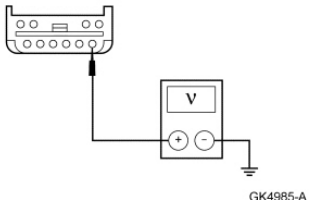
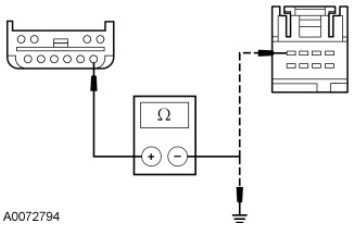
PINPOINT TEST D: NO SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS) â PREMIUM SOUND

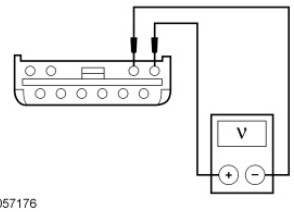
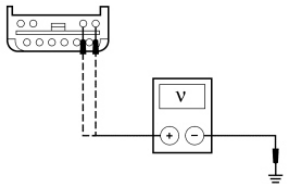
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

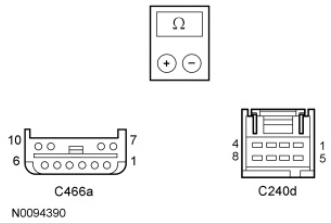
Test Step	Result / Action to Take
D1 DETERMINE THE INOPERATIVE SPEAKER(S)	
• Carry out the speaker walk test. Refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section. • **Is the concern only with the subwoofer speakers?**	**Yes** GO to D2 . **No** If the concern is only with a tweeter speaker, GO to D14 . For all other concerns, GO to

	D17 .
D2 DETERMINE THE INOPERATIVE SUBWOOFER	
• Operate the audio system in radio tuner (AM/FM) mode and observe the subwoofer operation. • **Do both of the subwoofers have a concern?**	**Yes** GO to D3 . **No** GO to D11 .
D3 CHECK THE SUBWOOFER AMPLIFIER VOLTAGE SUPPLY	
• Ignition OFF. • Disconnect: Subwoofer Amplifier C466a . • Measure the voltage between the subwoofer amplifier C466a-5, circuit SBP38 (BN/RD), harness side and ground.  A0021366 • **Is the voltage greater than 10 volts?**	**Yes** GO to D4 . **No** VERIFY the Smart Junction Box (SJB) fuse 38 (20A) is OK. If OK, REPAIR the circuit. CLEAR any DTCs present. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
D4 CHECK THE SUBWOOFER AMPLIFIER GROUND CIRCUIT FOR CONTINUITY	
• Disconnect: Negative Battery Cable . • Measure the resistance between the subwoofer amplifier C466a-2, circuit GD148 (BK/YE), harness side and ground.  GK8801-A • **Is the resistance less than 5 ohms?**	**Yes** GO to D5 . **No** REPAIR the circuit. CLEAR any DTCs present. TEST the system for normal operation.
D5 CHECK THE SUBWOOFER AMPLIFIER ENABLE CIRCUIT FOR CORRECT VOLTAGE	
• Connect: Negative Battery Cable . • Operate the audio system in radio tuner (AM/FM) mode. • Measure the voltage between the subwoofer amplifier C466a-1, circuit SME23 (VT/RD), harness side and ground.	**Yes** GO to D8 . **No** GO to D6 .

 • **Is the voltage between 3.8 and 6.7 volts?**	
D6 CHECK THE SUBWOOFER AMPLIFIER ENABLE CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240d . • Ignition ON. • Measure the voltage between the subwoofer amplifier C466a-1, circuit SME23 (VT/RD), harness side and ground.  • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to D7 .
D7 CHECK THE SUBWOOFER AMPLIFIER ENABLE CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Measure the voltage between the subwoofer amplifier C466a-1, circuit SME23 (VT/RD), harness side and the ACM C240d-4, circuit SME23 (VT/RD), harness side and ground; and between the subwoofer amplifier C466a-1, circuit SME23 (VT/RD), harness side and ground.  • **Is the resistance less than 5 ohms between the subwoofer amplifier and the ACM , and greater than 10,000 ohms between the subwoofer amplifier and ground?**	**Yes** GO to D28 . **No** REPAIR the circuit. TEST the system for normal operation.
D8 CHECK THE AUDIO SIGNAL TO THE SUBWOOFER AMPLIFIER	

• Operate the audio system in radio tuner (AM/FM) mode. • Measure the AC voltage between the subwoofer amplifier C466a-7, circuit VME22 (VT/GN), harness side and the subwoofer amplifier C466a-8, circuit RME22 (GN/WH), harness side.  A0057176 • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new subwoofer amplifier. REFER to Subwoofer Amplifier in this section. CLEAR any DTCs present. TEST the system for normal operation. **No** GO to D9 .
D9 CHECK THE AUDIO CIRCUITS TO THE SUBWOOFER AMPLIFIER FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Measure the voltage between the subwoofer amplifier C466a-7, circuit VME22 (VT/GN), harness side ground; and between the subwoofer amplifier C466a-8, circuit RME22 (GN/WH), harness side and ground.  N0035293 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation. **No** GO to D10 .
D10 CHECK THE AUDIO CIRCUITS TO THE SUBWOOFER AMPLIFIER FOR AN OPEN OR SHORT TO GROUND	
• Measure the resistance between the subwoofer amplifier, harness side and the ACM , harness side; and between the subwoofer amplifier, harness side and ground as follows:	**Yes** GO to D28 . **No** REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

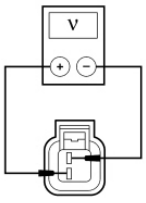
Positive Meter Lead	Negative Meter Lead	Circuit
C466a-7	C240d-1, then ground	VME22 (VT/GN)
C466a-8	C240d-2, then ground	RME22 (GN/WH)



- **Is the resistance less than 5 ohms between the subwoofer amplifier and the ACM , and greater than 10,000 ohms between the subwoofer amplifier and ground?**

D11 CHECK THE AUDIO SIGNAL TO THE SUSPECT SUBWOOFER SPEAKER

- Ignition OFF.
- Disconnect: Suspect Subwoofer Speaker .
- Ignition ON.
- Operate the audio system in radio tuner (AM/FM) mode.
- Measure the AC voltage between the LH subwoofer speaker C3120-1, circuit VME01 (GN/VT), harness side and the LH subwoofer speaker C3120-2, circuit RME01 (GY), harness side; or between the RH subwoofer speaker C3121-1, circuit VME02 (VT), harness side and the RH subwoofer speaker C3121-2, circuit RME02 (YE), harness side.



- **Is a fluctuating AC voltage present?**

Yes
INSTALL a new subwoofer speaker for the suspect speaker. REFER to Speaker â Subwoofer in this section. TEST the system for normal operation.

No
GO to D12 .

D12 CHECK THE AUDIO CIRCUITS TO THE SUSPECT SUBWOOFER SPEAKER FOR A SHORT TO VOLTAGE

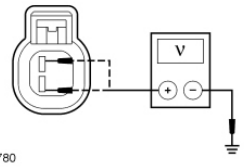
- Ignition OFF.
- Disconnect: Subwoofer Amplifier C466b .
- Ignition ON.
- Measure the voltage between the suspect subwoofer speaker, harness side and ground as follows:

Suspect Subwoofer Speaker	Positive Meter Lead	Negative Meter Lead
LH	C3120-1 VME01 (GN/VT)	C3120-2 RME01 (GY)
RH		

Yes
REPAIR the circuit in question. TEST the system for normal operation.

No
GO to D13 .

	C3121-1 VME02 (VT)	C3121-2 RME02 (YE)

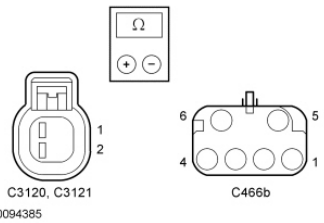


- **Is any voltage present?**

D13 CHECK THE AUDIO CIRCUITS TO THE SUSPECT SUBWOOFER SPEAKER FOR AN OPEN OR SHORT TO GROUND

- Ignition OFF.
- Measure the resistance between the suspect subwoofer speaker, harness side and the subwoofer amplifier, harness side; and between the suspect subwoofer speaker, harness side and ground as follows:

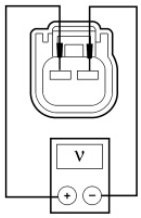
Suspect Subwoofer Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
Subwoofer #1	C3120-1 C3120-2	C466b-1, then ground C466b-2, then ground	VME01 (GN/VT) RME01 (GY)
Subwoofer #2	C3121-1 C3121-2	C466b-3, then ground C466b-4, then ground	VME02 (VT) RME02 (YE)

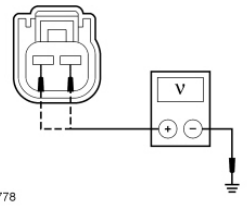


- **Is the resistance less than 5 ohms between the suspect subwoofer speaker and the subwoofer amplifier, and greater than 10,000 ohms between the suspect subwoofer**

Yes
INSTALL a new subwoofer amplifier. REFER to Subwoofer Amplifier in this section. TEST the system for normal operation.

No
REPAIR the circuit in question. TEST the system for normal operation.

speaker and ground?	
D14 CHECK FOR AN AUDIO SIGNAL TO THE SUSPECT TWEETER SPEAKER	
• Ignition OFF. • Disconnect: Suspect Tweeter Speaker . • Operate the audio system in radio tuner (AM/FM) mode. • Measure the AC voltage between the suspect tweeter speaker pin 1 and pin 2, harness side as follows: **Suspect Speaker** / **Positive Meter Lead** / **Negative Meter Lead** LH tweeter / C569-1 VME07 (WH) / C569-2 RME07 (WH/GN) RH tweeter / C613-1 VME11 (VT/OG) / C613-2 RME11 (YE/OG)  N0085777 • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new speaker for the suspect tweeter speaker. REFER to Speaker â Door in this section. CLEAR any DTCs present. TEST the system for normal operation. **No** GO to D15 .
D15 CHECK THE CIRCUITS TO THE SUSPECT TWEETER SPEAKER FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: LF Door Speaker C592b (LH Speaker Concern) or RF Door Speaker C692b (RH Speaker Concern) . • Ignition ON. • Measure the voltage between the suspect tweeter speaker, harness side and ground as follows: **Suspect Tweeter Speaker** / **Positive Meter Lead** / **Negative Meter Lead** LH tweeter / C569-1 / VME07 (WH) LH tweeter / C569-2 / RME07 (WH/GN) RH tweeter / C613-1 / VME11 (VT/OG) RH tweeter / C613-2 / RME11 (YE/OG)	**Yes** REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation. **No** GO to D16 .

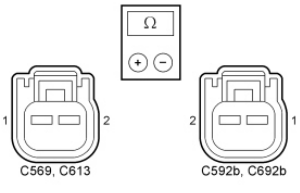


- **Is any voltage present?**

D16 CHECK THE CIRCUITS TO THE SUSPECT TWEETER SPEAKER FOR AN OPEN OR SHORT TO GROUND

- Ignition OFF.
- Measure the resistance between the suspect tweeter speaker, harness side and the door speaker, harness side; and between the suspect tweeter speaker, harness side and ground as follows:

Suspect Tweeter Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
LH tweeter	C569-1	C592b-1, then ground	VME07 (WH) or VME08 (GN/OG)
LH tweeter	C569-2	C592b-2, then ground	RME07 (WH/GN) or RME08 (GY/OG)
RH tweeter	C613-1	C692b-1, then ground	VME11 (VT/OG)
RH tweeter	C613-2	C692b-2, then ground	RME11 (YE/OG)

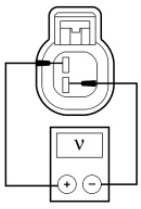


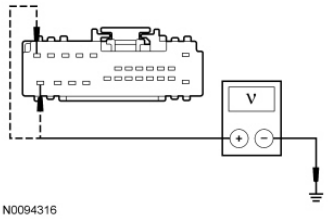
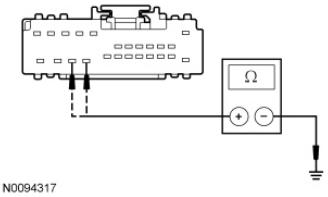
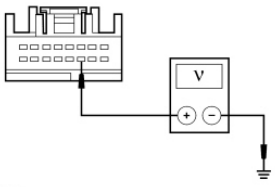
- **Is the resistance less than 5 ohms between the suspect tweeter speaker and the door speaker, and greater than 10,000 ohms between the suspect tweeter speaker and ground?**

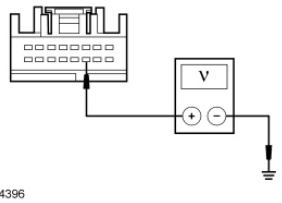
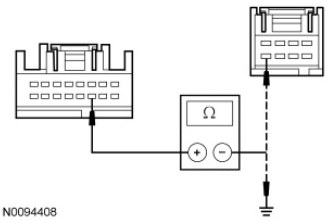
Yes
INSTALL a new door speaker. REFER to Speaker â Door in this section. CLEAR any DTCs present. TEST the system for normal operation.

No
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

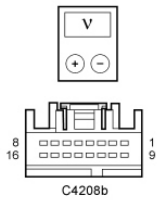
D17 CHECK THE AUDIO SIGNALS TO THE SUSPECT SPEAKER

• Ignition OFF. • Disconnect: Suspect Speaker . • Operate the audio system in radio tuner (AM/FM) mode. • Measure the AC voltage between the suspect speaker pins, harness side as follows: **Suspect Speaker** / **Positive Meter Lead** / **Negative Meter Lead** LF door: C592a-1 VME07 (WH) / C592a-2 RME07 (WH/BN) RF door: C692a-1 VME10 (WH/VT) / C692a-2 RME10 (WH/OG) LR door: C702-1 VME09 (WH/GN) / C702-2 RME09 (BN/YE) RR door: C802-1 VME12 (BN/WH) / C802-2 RME12 (BN/BU) Instrument panel: C2363-1 VME06 (GN) / C2363-2 RME06 (GY/YE)  N0085779 • **Is a fluctuating AC voltage present?**	**Yes** INSTALL a new speaker for the suspect speaker. REFER to Speaker â Door in this section. CLEAR any DTCs present. TEST the system for normal operation. **No** GO to D18 .
D18 CHECK THE AUDIO AMPLIFIER VOLTAGE	
• Ignition OFF. • Disconnect: Audio Amplifier C4208a . • Measure the voltage between the audio amplifier C4208a-12, circuit SBB20 (GN/RD), harness side and ground; and between the audio amplifier C4208a-24, circuit SBB21 (GY/RD), harness side and ground.	**Yes** GO to D19 . **No** VERIFY the Smart Junction Box (SJB) fuses 20 (20A) and 21 (20) are OK. If OK, REPAIR the circuit in question. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

 N0094316 • **Are the voltages greater than 10 volts?**	
D19 CHECK THE AUDIO AMPLIFIER GROUND CIRCUITS FOR CONTINUITY	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the audio amplifier C4208a-21, circuit GD148 (BK/YE), harness side and ground; and between the audio amplifier C4208a-22, circuit GD148 (BK/YE), harness side and ground.  N0094317 • **Are the resistances less than 5 ohms?**	**Yes** GO to D20 . **No** REPAIR the circuit in question. TEST the system for normal operation.
D20 CHECK THE AUDIO AMPLIFIER ENABLE CIRCUIT FOR CORRECT VOLTAGE	
• Ignition OFF. • Connect: Audio Amplifier C4208a . • Disconnect: Audio Amplifier C4208b . • Operate the audio system in radio tuner (AM/FM) mode. • Measure the voltage between the audio amplifier C4208b-11, circuit SME56 (BN), harness side and ground.  N0094396 • **Is the voltage between 3.8 and 6.7 volts?**	**Yes** GO to D23 . **No** GO to D21 .
D21 CHECK THE AUDIO AMPLIFIER ENABLE CIRCUIT FOR A SHORT VOLTAGE	

• Ignition OFF. • Connect: ACM C240d . • Ignition ON. • Measure the voltage between the audio amplifier C4208b-11, circuit SME56 (BN), harness side and ground.  N0094396 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to D22 .
D22 CHECK THE AUDIO AMPLIFIER ENABLE CIRCUIT FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the audio amplifier C4208b-11, circuit SME56 (BN), harness side and the ACM C240d-8, circuit SME56 (BN), harness side; and between the audio amplifier C4208b-11, circuit SME56 (BN), harness side and ground.  N0094408 • **Is the resistance less than 5 ohms between the audio amplifier and the ACM , and greater than 10,000 ohms between the audio amplifier and ground?**	**Yes** GO to D28 . **No** REPAIR the circuit. TEST the system for normal operation.
D23 CHECK THE AUDIO SIGNALS TO THE AUDIO AMPLIFIER	
• Connect: Audio Amplifier C4208a . • Disconnect: Audio Amplifier C4208b . • Ignition ON. • Operate the audio system in radio tuner (AM/FM) mode. • Measure the AC voltage between the audio amplifier pins, harness side as follows: **Suspect Speaker** / **Positive Meter Lead** / **Negative Meter Lead** LF door	**Yes** GO to D24 . **No** GO to D26 .

	C4208b-2 VME07 (WH)	C4208b-3 RME07 (WH/BN)
RF door	C4208b-1 VME10 (WH/VT)	C4208b-9 RME10 (WH/OG)
LR door	C4208b-6 VME09 (WH/GN)	C4208b-7 RME09 (BN/YE)
RR door	C4208b-5 VME12 (BN/WH)	C4208b-4 RME12 (BN/BU)
Instrument panel	C4208b-15 VME51 (BN/BU)	C4208b-14 RME51 (WH/BU)



N0104310

- **Is any voltage present?**

D24 CHECK THE SPEAKER CIRCUITS FOR A SHORT TO VOLTAGE

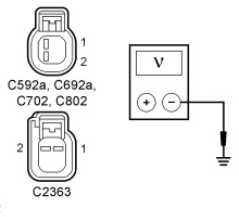
- Ignition OFF.
- Connect: Audio Amplifier C4208b .
- Disconnect: Audio Amplifier C4208a .
- Ignition ON.
- Measure the voltage between the suspect speaker, harness side and ground as follows:

Yes
REPAIR the circuit in question.
TEST the system for normal operation.

No
GO to D25 .

Suspect Speaker	Positive Meter Lead	Negative Meter Lead
LF door	C592a-1 VME07 (WH)	Ground
	C592a-2 RME07 (WH/BN)	Ground
RF door	C692a-1 VME10 (WH/VT)	Ground
	C692a-2	Ground

	RME10 (WH/OG)	
LR door	C702-1 VME09 (WH/GN)	Ground
	C702-2 RME09 (BN/YE)	Ground
RR door	C802-1 VME12 (BN/WH)	Ground
	C802-2 RME12 (BN/BU)	Ground
Instrument panel	C2363-1 VME06 (GN)	Ground
	C2363-2 RME06 (GY/YE)	Ground



- **Is any voltage present?**

D25 CHECK THE SPEAKER CIRCUITS FOR AN OPEN OR SHORT TO GROUND

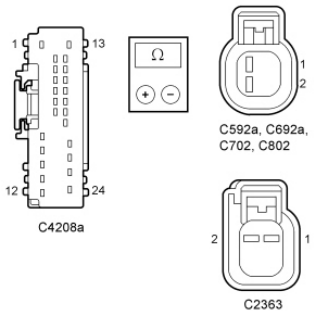
- Ignition OFF.
- Measure the resistance between the audio amplifier, harness side and the suspect speaker, harness side; and between the audio amplifier, harness side and ground as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
LF door	C4208a-7	C592a-1, then ground	VME07 (WH)
	C4208a-6	C592a-2, then ground	RME07 (WH/BN)
RF door	C4208a-5	C692a-1, then ground	VME10 (WH/VT)
	C4208a-4	C692a-2, then ground	RME10 (WH/OG)

Yes
INSTALL a new audio amplifier. REFER to Audio Amplifier in this section. TEST the system for normal operation.

No
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

LR door	C4208a-9	C702-1, then ground	VME09 (WH/GN)
	C4208a-8	C702-2, then ground	RME09 (BN/YE)
RR door	C4208a-3	C802-1, then ground	VME12 (BN/WH)
	C4208a-2	C802-2, then ground	RME12 (BN/BU)
Instrument panel	C4208a-11	C2363-1, then ground	VME06 (GN)
	C4208a-10	C2363-2, then ground	RME06 (GY/YE)



N0102363

- **Are the resistances less than 5 ohms between the audio amplifier and the suspect speaker, and greater than 10,000 ohms between the audio amplifier and ground?**

D26 CHECK THE AUDIO CIRCUITS TO THE AUDIO AMPLIFIER FOR A SHORT TO VOLTAGE

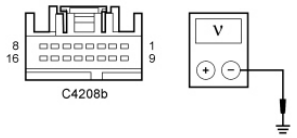
- Ignition OFF.
- Connect: ACM C240a (Except Instrument Panel Speaker Concern) or C240d (Instrument Panel Speaker Concern) .
- Ignition ON.
- Measure the voltage between the audio amplifier, harness side and ground as follows:

Yes
REPAIR the circuit in question. TEST the system for normal operation.

No
GO to D27 .

Suspect Speaker	Positive Meter Lead	Negative Meter Lead
LF door	C4208b-2 VME07 (WH)	Ground
	C4208b-3	Ground

	RME07 (WH/BN)	
RF door	C4208b-1 VME10 (WH/VT)	Ground
	C4208b-9 RME10 (WH/OG)	Ground
LR door	C4208b-6 VME09 (WH/GN)	Ground
	C4208b-7 RME09 (BN/YE)	Ground
RR door	C4208b-5 VME12 (BN/WH)	Ground
	C4208b-4 RME12 (BN/BU)	Ground
Instrument panel	C4208b-15 VME51 (BN/BU)	Ground
	C4208b-14 RME51 (WH/BU)	Ground



N0104311

- **Is any voltage present?**

D27 CHECK THE AUDIO CIRCUITS TO THE AUDIO AMPLIFIER FOR AN OPEN OR SHORT TO GROUND

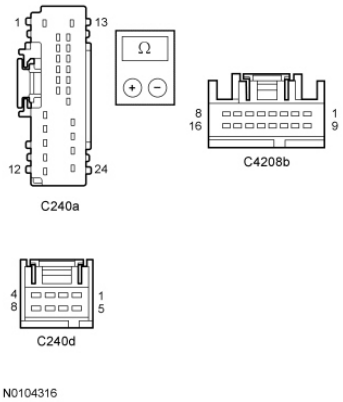
- Ignition OFF.
- Measure the resistance between the ACM , harness side and the audio amplifier, harness side; and between the ACM , harness side and ground as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
LF door	C240a-8	C4208b-2, then ground	VME07 (WH)

Yes
GO to D28 .

No
REPAIR the circuit in question.
CLEAR any DTCs present.
TEST the system for normal operation.

	C240a-21	C4208b-3, then ground	RME07 (WH/BN)
RF door	C240a-11	C4208b-1, then ground	VME10 (WH/VT)
	C240a-12	C4208b-9, then ground	RME10 (WH/OG)
LR door	C240a-9	C4208b-6, then ground	VME09 (WH/GN)
	C240a-22	C4208b-7, then ground	RME09 (BN/YE)
RR door	C240a-10	C4208b-5, then ground	VME12 (BN/WH)
	C240a-23	C4208b-4, then ground	RME12 (BN/BU)
Instrument panel	C240d-6	C4208b-15, then ground	VME51 (BN/BU)
	C2407-2	C4208b-14, then ground	RME51 (WH/BU)



- **Are the resistances less than 5 ohms between the audio amplifier and the suspect speaker, and greater than 10,000 ohms between the audio amplifier and ground?**

D28 CHECK FOR CORRECT ACM OPERATION	
• Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any

	DTCs present.

Pinpoint Test E: No Sound From One Or More Speakers (Not All Speakers) â SonyÂ® Sound

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Audio Front Control Module (ACM) directs the audio signals to the audio Digital Signal Processing (DSP) module in the form of an AC voltage. The audio DSP module boosts the audio signals and sends them to the speakers. The audio DSP module provides internal circuit protection for shorts to ground or shorts to voltage.

A short to ground or short to voltage in the circuit to one of the speakers may cause multiple speakers to lose sound due to the built-in overload protection feature of the audio DSP module. In this case, a speaker fault DTC sets, and this pinpoint test should be followed to isolate the damaged circuit.

The ACM sends the audio signals to the audio DSP module in the following banks:

Speaker Bank	Speakers
LH front (without navigation)	All LH speakers
LH front (navigation)	LF door, LF tweeter, LH instrument panel
RH front (without navigation)	All RH speakers
RH front (navigation)	RF door, RF tweeter, RH instrument panel
LH rear (navigation)	LR door
RH rear (navigation)	RR door
Center imaging (navigation)	Center instrument panel, LH parcel shelf, RH parcel shelf
Subwoofer (navigation)	Subwoofer #1, subwoofer #2

For vehicles with navigation, it is also important to note that if the navigation voice guidance setting is set too low, it may appear that the front speakers intermittently produce no sound. Make sure the voice guidance setting is set high enough to hear the voice guidance commands before addressing a concern with the front speakers.

The speaker walk test can be used to isolate a concern with a particular speaker. This can reduce the diagnostic steps necessary to isolate the concern. To carry out the speaker walk test, refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.

Root DTC Description	Failure-Type Codes	Fault Trigger Conditions
• B1A01 â	01, 11, 12, 13	Set by the audio DSP module when a failure is detected in the center front imaging speaker (part of the instrument panel speaker) circuit.

Speaker #1		
• B1A02 â Speaker #2	01, 11, 12, 13	Set by the audio DSP module when a failure is detected in the LH front door speaker circuit.
• B1A03 â Speaker #3	01, 11, 12, 13	Set by the audio DSP module when a failure is detected in the LH tweeter circuit.
• B1A04 â Speaker #4	01, 11, 12, 13	Set by the audio DSP module when a failure is detected in the LH rear door speaker circuit.
• B1A05 â Speaker #5	01, 11, 12, 13	Set by the audio DSP module when a failure is detected in the parcel shelf speaker circuit.
• B1A06 â Speaker #6	01, 11, 12, 13	Set by the audio DSP module when a failure is detected in the RH front door speaker circuit.
• B1A07 â Speaker #7	11, 12, 13	Set by the audio DSP module when a failure is detected in the RH tweeter circuit.
• B1A08 â Speaker #8	11, 12, 13	Set by the audio DSP module when a failure is detected in the RH rear door speaker circuit.
• B1A09 â Speaker #9	11, 12, 13	Set by the audio DSP module when a failure is detected in the RH subwoofer circuit.
• B1A10 â Speaker #10	11, 12, 13	Set by the audio DSP module when a failure is detected in the LH subwoofer circuit.

This pinpoint test is intended to diagnose the following:

- Fuse

- Wiring, terminals or connectors
- Speaker
- Audio DSP module
- ACM

PINPOINT TEST E: NO SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS) â SONYÂ® SOUND

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
E1 CHECK FOR AN AUDIO SIGNAL TO THE SUSPECT SPEAKER	
• Ignition OFF. • Disconnect: Suspect Speaker. • Operate the audio system in radio tuner (AM/FM) mode. • Measure the AC voltage between the suspect speaker pins, harness side as follows:	**Yes** INSTALL a new speaker for the suspect speaker. REFER to the appropriate removal and installation procedure in this section. TEST the system for normal operation. **No** GO to E2 .

Suspect Speaker	Positive Meter Lead	Negative Meter Lead
LH front door	C523-1 VME07 (WH)	C523-2 RME07 (WH/BN)
RH front door	C612-1 VME10 (WH/VT)	C612-2 RME10 (WH/OG)
LH rear door	C702-1 VME09 (WH/GN)	C702-2 RME09 (BN/YE)
RH rear door	C802-1 VME12 (BN/WH)	C802-2 RME12 (BN/BU)
Instrument panel speaker	C2359-1 VME06 (GN)	C2359-2 RME06 (GY/YE)
LH tweeter		

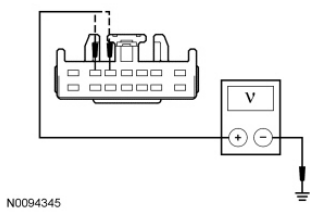
	C591-1 VME08 (GN/OG)	C591-2 RME08 (GY/OG)
RH tweeter	C691-1 VME11 (VT/OG)	C691-2 RME11 (YE/OG)
Rear center speaker	C3306-1 VME30 (GN/BN)	C3306-2 RME30 (VT/BN)
LH Subwoofer	C3120-1 VME01 (GN/VT)	C3120-2 RME01 (GY)
RH Subwoofer	C3121-1 VME02 (VT)	C3121-2 RME02 (YE)

- **Is a fluctuating AC voltage present?**

E2 CHECK THE AUDIO DSP MODULE VOLTAGE SUPPLY

- Ignition OFF.
- Disconnect: Audio DSP Module C4240a.
- Measure the voltage between the audio DSP module, harness side and ground as follows:

Positive Meter Lead	Negative Meter Lead
C4240a-5 SBP19 (BU/RD)	Ground
C4240a-6 SBP19 (BU/RD)	Ground

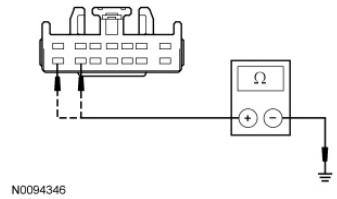


- **Are the voltages greater than 10 volts?**

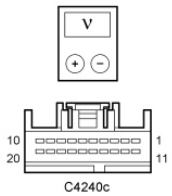
Yes
GO to E3 .

No
VERIFY the Battery Junction Box (BJB) fuse 19 (25A) is OK. If OK, REPAIR the circuit in question. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

E3 CHECK THE AUDIO DSP MODULE GROUND CIRCUITS FOR CONTINUITY

• Ignition OFF. • Disconnect: Negative Battery Cable. • Measure the resistance between the audio amplifier, harness side and ground as follows: **Positive Meter Lead** / **Negative Meter Lead** C4240a-13 GD148 (BK/YE) — Ground C4240a-14 GD148 (BK/YE) — Ground  N0094346 • **Are the resistances less than 5 ohms?**	**Yes** GO to E4 . **No** REPAIR the circuit in question. TEST the system for normal operation.
E4 CHECK FOR AN AUDIO SIGNAL AT THE AUDIO DSP MODULE	
• Ignition OFF. • Connect: Audio DSP Module C4240a. • Disconnect: Audio DSP Module C4240c. • Operate the audio system in radio tuner (AM/FM) mode. • Measure the AC voltage between the audio DSP module pins, harness side as follows: **Suspect Speaker** / **Positive Meter Lead** / **Negative Meter Lead** LH front door or LH tweeter — C4240c-7 VME07 (WH) — C4240c-17 RME07 (WH/BN) RH front door or RH tweeter — C4240c-9 VME10 (WH/VT) — C4240c-19 RME10 (WH/OG) LH rear door — C4240c-8 VME09 — C4240c-18 RME09	**Yes** GO to E5 . **No** GO to E7 .

	(WH/GN)	(BN/YE)
RH rear door	C4240c-10 VME12 (BN/WH)	C4240c-20 RME12 (BN/BU)
Instrument panel or rear center	C4240c-6 VME51 (BN/BU)	C4240c-16 RME51 (WH/BU)
Subwoofer	C4240c-5 VME22 (VT/GN)	C4240c-15 RME22 (GN/WH)



N0102366

- **Is a fluctuating AC voltage present?**

E5 CHECK THE SPEAKER CIRCUITS FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Audio DSP Module C4240c.
- Disconnect: Audio DSP Module C4240b (Except Subwoofer Concern).
- Disconnect: Audio DSP Module C4240a (Subwoofer Concern).
- Ignition ON.
- Measure the voltage between the suspect speaker, harness side and ground as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead
LH front door	C591-1 VME08 (GN/OG)	Ground
	C591-2 RME08 (GY/OG)	Ground
RH front door	C612-1	Ground

Yes
REPAIR the circuit in question. TEST the system for normal operation.

No
GO to E6 .

	VME10 (WH/VT)	
	C612-2 RME10 (WH/OG)	Ground
LH rear door	C702-1 VME09 (WH/GN)	Ground
	C702-2 RME09 (BN/YE)	Ground
RH rear door	C802-1 VME12 (BN/WH)	Ground
	C802-2 RME12 (BN/BU)	Ground
Instrument panel	C2359-1 VME06 (GN)	Ground
	C2359-2 RME06 (GY/YE)	Ground
LH tweeter	C591-1 VME08 (GN/OG)	Ground
	C591-2 RME08 (GY/OG)	Ground
RH tweeter	C691-1 VME11 (VT/OG)	Ground
	C691-2 RME11 (YE/OG)	Ground
Rear center speaker	C3306-1 VME30 (GN/BN)	Ground
	C3306-2	Ground

	RME30 (VT/BN)	
LH subwoofer	C3120-1 VME01 (GN/VT)	Ground
	C3120-2 RME01 (GY)	Ground
RH subwoofer	C3121-1 VME02 (VT)	Ground
	C3121-2 RME02 (YE)	Ground

- **Is any voltage present?**

E6 CHECK THE SPEAKER CIRCUITS FOR AN OPEN OR SHORT TO GROUND

- Ignition OFF.
- Measure the resistance between the audio DSP module, harness side and the suspect speaker, harness side; and between the audio DSP module, harness side and ground as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
LH front door	C4240b-2	C523-1, then ground	VME07 (WH)
	C4240b-10	C523-2, then ground	RME07 (WH/BN)
RH front door	C4240b-6	C612-1, then ground	VME10 (WH/VT)
	C4240b-14	C612-2, then ground	RME10 (WH/OG)
LH rear door	C4240b-4	C702-1, then ground	VME09 (WH/GN)
	C4240b-12	C702-2, then ground	RME09 (BN/YE)
RH rear door	C4240b-8		

Yes
GO to E10 .

No
REPAIR the circuit in question. TEST the system for normal operation.

		C802-1, then ground	VME12 (BN/WH)
	C4208b-16	C802-2, then ground	RME12 (BN/BU)
Instrument panel	C4240b-1	C2359-1, then ground	VME06 (GN)
	C4240b-9	C2359-2, then ground	RME06 (GY/YE)
LH tweeter	C4240b-3	C591-1, then ground	VME08 (GN/OG)
	C4240b-11	C591-2, then ground	RME08 (GY/OG)
RH tweeter	C4240b-7	C691-1, then ground	VME11 (VT/OG)
	C4240b-15	C691-2, then ground	RME11 (YE/OG)
Rear center speaker	C4240b-5	C3306-1, then ground	VME30 (GN/BN)
	C4208b-13	C3306-3, then ground	RME30 (VT/BN)
LH Subwoofer	C4240a-1	C3120-1, then ground	VME01 (GN/VT)
	C4240a-9	C3120-2, then ground	RME01 (GY)
RH Subwoofer	C4240a-2	C3121-1, then ground	VME02 (VT)
	C4240a-10	C3121-2, then ground	RME02 (YE)

- **Are the resistances less than 5 ohms between the audio DSP module and the suspect speaker, and greater than 10,000 ohms between the audio DSP module and ground?**

E7 CHECK THE AUDIO CIRCUITS TO THE AUDIO DSP MODULE FOR A SHORT TO VOLTAGE	

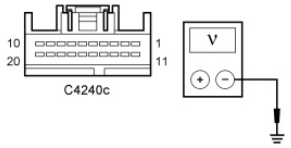
- Ignition OFF.
- Disconnect: ACM C240a (Except Subwoofer Concern).
- Disconnect: ACM C240d (Subwoofer Concern).
- Disconnect: Audio DSP Module C4240c.
- Ignition ON.
- Measure the voltage between the audio DSP module pins, harness side and ground as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead
LH front door or LH A-pillar	C4240c-7 VME07 (WH)	Ground
	C4240c-17 RME07 (WH/BN)	Ground
RH front door or RH A-pillar	C4240c-9 VME10 (WH/VT)	Ground
	C4240c-19 RME10 (WH/OG)	Ground
LH rear door or LH D-pillar	C4240c-8 VME09 (WH/GN)	Ground
	C4240c-18 RME09 (BN/YE)	Ground
RH rear door or RH D-pillar	C4240c-10 VME12 (BN/WH)	Ground
	C4240c-20 RME12 (BN/BU)	Ground
Instrument panel or rear center	C4240c-6 VME51 (BN/BU)	Ground
	C4240c-16 RME51	Ground

Yes
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

No
GO to E8 .

	(WH/BU)	
Subwoofer	C4240c-5 VME22 (VT/GN)	Ground
	C4240c-15 RME22 (GN/WH)	Ground



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- **Is any voltage present?**

E8 CHECK THE AUDIO CIRCUITS TO THE AUDIO DSP MODULE FOR AN OPEN OR SHORT TO GROUND

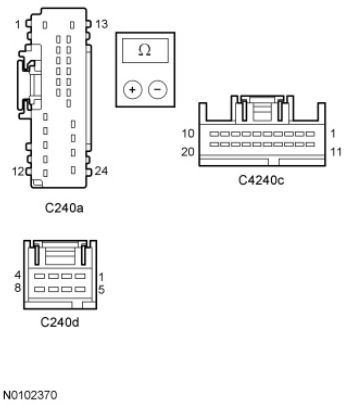
- Ignition OFF.
- Measure the resistance between the audio DSP module, harness side and the ACM , harness side; and between the audio DSP module, harness side and ground as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
LH front door or LH tweeter	C4240c-7	C240a-8, then ground	VME07 (WH)
	C4240c-17	C240a-21, then ground	RME07 (WH/BN)
RH front door or RH tweeter	C4240c-9	C240a-11, then ground	VME10 (WH/VT)
	C4240c-19	C240a-12, then ground	RME10 (WH/OG)
LH rear door	C4240c-8	C240a-9, then ground	VME09 (WH/GN)
	C4240c-18	C240a-22, then ground	RME09 (BN/YE)
RH rear door	C4240c-10	C240a-10, then ground	VME12 (BN/WH)

Yes
GO to E9 .

No
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

	C4240c-20	C240a-23, then ground	RME12 (BN/BU)
Instrument panel or rear center	C4240c-6	C240d-5, then ground	VME51 (BN/BU)
	C4240c-16	C240d-6, then ground	RME51 (WH/BU)
Subwoofer	C4240c-5	C240d-1, then ground	VME22 (VT/GN)
	C4240c-15	C240d-2, then ground	RME22 (GN/WH)



N0102370

- **Are the resistances less than 5 ohms between the audio DSP module and the ACM and greater than 10,000 ohms between the audio DSP module and ground?**

E9 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Connect: All Disconnected Connectors. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs present.
E10 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	
• Ignition OFF. • Connect: All Disconnected Connectors. • Disconnect all the audio DSP module connectors.	**Yes** INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module in this section.

• Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the audio DSP module connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs present.

Pinpoint Test F: No Sound From One Or More Speakers (Not All Speakers) â THXÂ® Sound

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Audio Front Control Module (ACM) directs the audio signals to the audio Digital Signal Processing (DSP) module in the form of an AC voltage. The audio DSP module boosts the audio signals and sends them to the speakers. The audio DSP module provides internal circuit protection for shorts to ground or shorts to voltage.

A short to ground or short to voltage in the circuit to one of the speakers may cause multiple speakers to lose sound due to the built-in overload protection feature of the audio DSP module. In this case, a speaker fault DTC sets, and this pinpoint test should be followed to isolate the damaged circuit.

The ACM sends the audio signals to the audio DSP module in the following banks:

Speaker Bank	Speakers
LH front (without navigation)	All LH speakers
LH front (navigation)	LF door, LF tweeter, LH instrument panel
RH front (without navigation)	All RH speakers
RH front (navigation)	RF door, RF tweeter, RH instrument panel
LH rear (navigation)	LR door
RH rear (navigation)	RR door
Center imaging (navigation)	Center instrument panel, LH parcel shelf, RH parcel shelf
Subwoofer (navigation)	Subwoofer #1, subwoofer #2

For vehicles with navigation, it is also important to note that if the navigation voice guidance setting is set too low, it may appear that the front speakers intermittently produce no sound. Make sure the voice guidance setting is set high enough to hear the voice guidance commands before addressing a concern with the front speakers.

The speaker walk test can be used to isolate a concern with a particular speaker. This can reduce the diagnostic steps necessary to isolate the concern. To carry out the speaker walk test, refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.

Root DTC Description	Failure-Type Codes	Fault Trigger Conditions
• B1A01 â Speaker #1	01, 11, 12, 13	Set by the ACM when a fault is detected in the LF speaker output circuits, or by the audio DSP module when a failure is detected in the LH front imaging speaker (part of the instrument panel speaker) circuit.
• B1A02 â Speaker #2	01, 11, 12, 13	Set by the ACM when a fault is detected in the RF speaker output circuits, or by the audio DSP module when a failure is detected in the center front imaging speaker (part of the instrument panel speaker) circuit.
• B1A03 â Speaker #3	01, 11, 12, 13	Set by the ACM when a fault is detected in the RR speaker output circuits, or by the audio DSP module when a failure is detected in the RH front imaging speaker (part of the instrument panel speaker) circuit.
• B1A04 â Speaker #4	01, 11, 12, 13	Set by the ACM when a fault is detected in the LR speaker output circuits, or by the audio DSP module when a failure is detected in the LH front door tweeter circuit.
• B1A05 â Speaker #5	01, 11, 12, 13	Set by the ACM when a fault is detected in the subwoofer output circuits, or by the audio DSP module when a failure is detected in the RH front door tweeter circuit.
• B1A06 â Speaker #6	01, 11, 12, 13	Set by the ACM when a fault is detected in the instrument panel speaker output circuits, or by the audio DSP module when a failure is detected in the parcel shelf speaker circuit.
• B1A07 â Speaker #7	11, 12, 13	Set by the audio DSP module when a failure is detected in the LH front door speaker circuit.
• B1A08 â Speaker #8	11, 12, 13	Set by the audio DSP module when a failure is detected in the RH front door speaker circuit.
• B1A09 â Speaker #9	11, 12, 13	Set by the audio DSP module when a failure is detected in the LH rear door speaker circuit.
• B1A10 â Speaker #10	11, 12, 13	Set by the audio DSP module when a failure is detected in the RH subwoofer circuit.
• B1A11 â Speaker #11	11, 12, 13	Set by the audio DSP module when a failure is detected in the LH subwoofer circuit.
• B1A12 â Speaker #12	11, 12, 13	Set by the audio DSP module when a failure is detected in the RH rear door speaker circuit.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Speaker

- Audio DSP module
- ACM

PINPOINT TEST F: NO SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS) â THXÂ® SOUND

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

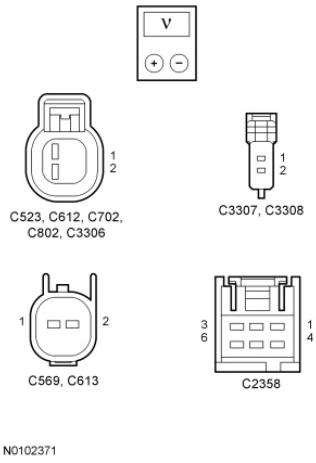
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>F1 CHECK THE AUDIO SIGNALS TO THE SUSPECT SPEAKER</td><td></td></tr>
<tr><td>

Ignition OFF.
Disconnect: Suspect Speaker .
Operate the audio system in radio tuner (AM/FM) mode.
Measure the AC voltage between the suspect speaker pins, harness side as follows:

<table>
<tr><th>Suspect Speaker</th><th>Positive Meter Lead</th><th>Negative Meter Lead</th></tr>
<tr><td>LH subwoofer</td><td>C3307-1
VME01 (GN/VT)</td><td>C3307-2
RME01 (GY)</td></tr>
<tr><td>LR door</td><td>C702-1
VME09 (WH/GN)</td><td>C702-2
RME09 (BN/YE)</td></tr>
<tr><td>LF door</td><td>C523-1
VME07 (WH)</td><td>C523-2
RME07 (WH/BN)</td></tr>
<tr><td>LH tweeter</td><td>C569-1
VME08 (GN/OG)</td><td>C569-2
RME08 (GY/OG)</td></tr>
<tr><td>LH front imaging</td><td>C2358-1
VME28 (BN/VT)</td><td>C2358-4
RME28 (BN/GN)</td></tr>
<tr><td>Center front imaging</td><td>C2358-2
VME06 (GN)</td><td>C2358-5
RME06 (GY/YE)</td></tr>
<tr><td>RH front imaging</td><td>C2358-3
VME29 (GN/WH)</td><td>C2358-6
RME29 (BU/WH)</td></tr>
<tr><td>RH tweeter</td><td>C613-1
VME11 (VT/OG)</td><td>C613-2
RME11 (YE/OG)</td></tr>
</table>
</td><td>Yes
INSTALL a new speaker for the suspect speaker. REFER to the appropriate removal and install procedure in this section. CLEAR any DTCs present. TEST the system for normal operation.

No
GO to F2 .</td></tr>
</table>

RF door	C612-1 VME10 (WH/VT)	C612-2 RME10 (WH/OG)
RR door	C802-1 VME12 (BN/WH)	C802-2 RME12 (BN/BU)
RH subwoofer	C3308-1 VME02 (VT)	C3308-2 RME02 (YE)
Rear center imaging	C3306-1 VME30 (GN/BN)	C3306-2 RME30 (VT/BN)



- **Is a fluctuating AC voltage present?**

F2 CHECK THE AUDIO SIGNALS TO THE AUDIO DSP MODULE

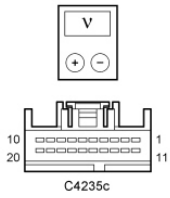
- Ignition OFF.
- Disconnect: Audio DSP Module C4235c .
- Operate the audio system in radio tuner (AM/FM) mode.
- Measure the AC voltage between the audio DSP module pins, harness side as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead
All LH speakers (without navigation), LF door or LF tweeter (with navigation)	C4235c-7 VME07 (WH)	C4235c-17 RME07 (WH/BN)
All RH speakers (without navigation), RF door or RF tweeter (with navigation)	C4235c-8 VME10 (WH/VT)	C4235c-18 RME10 (WH/OG)

Yes
GO to F3 .

No
GO to F7 .

LR door (with navigation)	C4235c-4 VME09 (WH/GN)	C4235c-14 RME09 (BN/YE)
RR door (with navigation)	C4235c-10 VME12 (BN/WH)	C4235c-20 RME12 (BN/BU)
Instrument panel or parcel shelf (with navigation)	C4235c-9 VME51 (BN/BU)	C4235c-19 RME51 (WH/BU)
Subwoofer #1 or #2	C4235c-5 VME22 (VT/GN)	C4235c-15 RME22 (GN/WH)



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- **Is a fluctuating AC voltage present?**

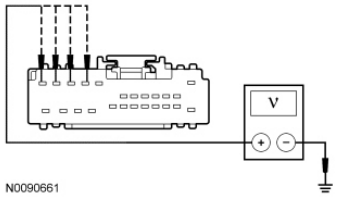
F3 CHECK THE AUDIO DSP MODULE VOLTAGE SUPPLY

- Ignition OFF.
- Disconnect: Audio DSP Module C4235a .
- Operate the audio system in radio tuner (AM/FM) mode.
- Measure the voltage between the audio DSP module, harness side and ground as follows:

Positive Meter Lead	Negative Meter Lead	Circuit
C4235a-9	Ground	SBB20 (GN/RD)
C4235a-10	Ground	SBB20 (GN/RD)
C4235a-11	Ground	SBB21 (GY/RD)
C4235a-12	Ground	SBB21 (GY/RD)

Yes
GO to F4 .

No
VERIFY the Battery Junction Box (BJB) fuse 20 (20A) or 21 (20A) is OK. If OK, REPAIR the circuit. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

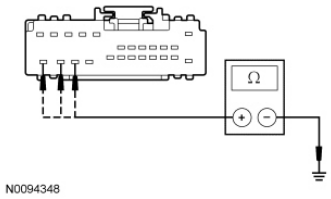


- **Are the voltages greater than 10 volts?**

F4 CHECK THE AUDIO DSP MODULE GROUND CIRCUITS FOR CONTINUITY

- Ignition OFF.
- Disconnect: Negative Battery Cable .
- Measure the voltage between the audio DSP module, harness side and ground as follows:

Positive Meter Lead	Negative Meter Lead	Circuit
C4235a-22	Ground	GD148 (BK/YE)
C4235a-23	Ground	GD148 (BK/YE)
C4235a-24	Ground	GD148 (BK/YE)



- **Are the resistances less than 5 ohms?**

Yes
GO to F5 .

No
REPAIR the circuit in question. TEST the system for normal operation.

F5 CHECK THE CIRCUITS TO THE SUSPECT SPEAKER FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: Audio DSP Module C4235a and C4235b .
- Ignition ON.
- Measure the voltage between the suspect speaker, harness side and ground as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead
LH subwoofer		Ground

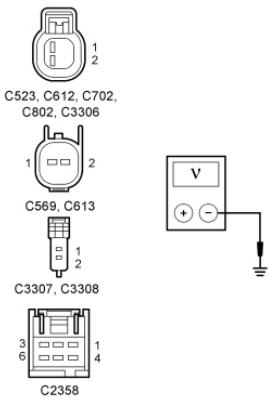
Yes
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

No
GO to F6 .

	C3307-1 VME01 (GN/VT)	
	C3307-2 RME01 (GY)	Ground
LR door	C702-1 VME09 (WH/GN)	Ground
	C702-2 RME09 (BN/YE)	Ground
LF door	C523-1 VME07 (WH)	Ground
	C523-1 RME07 (WH/BN)	Ground
LH tweeter	C569-1 VME08 (GN/OG)	Ground
	C569-2 RME08 (GY/OG)	Ground
LH front imaging	C2358-1 VME28 (BN/VT)	Ground
	C2358-4 RME28 (BN/GN)	Ground

Suspect Speaker	**Positive Meter Lead**	**Negative Meter Lead**
Center front imaging	C2358-2 VME06 (GN)	Ground
	C2358-5 RME06 (GY/YE)	Ground
RH front imaging	C2358-3 VME29 (GN/WH)	Ground
	C2358-6 RME29 (BU/WH)	Ground
RH tweeter	C613-1 VME11 (VT/OG)	Ground

	C613-2 RME11 (YE/OG)	Ground
RF door	C612-1 VME10 (WH/VT)	Ground
	C612-2 RME10 (WH/OG)	Ground
RR door	C802-1 VME12 (BN/WH)	Ground
	C802-2 RME12 (BN/BU)	Ground
Rear center imaging	C3306-1 VME30 (GN/BN)	Ground
	C3306-2 RME30 (VT/BN)	Ground
RH subwoofer	C3308-1 VME02 (VT)	Ground
	C3308-2 RME02 (YE)	Ground



- **Is any voltage present?**

F6 CHECK THE CIRCUITS TO THE SUSPECT SPEAKER FOR AN OPEN OR SHORT TO GROUND	

- Ignition OFF.
- Measure the resistance between the suspect speaker, harness side and the audio DSP module, harness side; and between the suspect speaker, harness side and ground as follows:

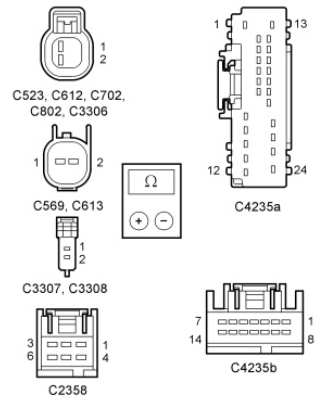
Yes
GO to F9 .

No
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

Suspect Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
LH subwoofer	C3307-1	C4235a-16, then ground	VME01 (GN/VT)
	C3307-2	C4235a-4, then ground	RME01 (GY)
LR door	C702-1	C4235a-18, then ground	VME09 (WH/GN)
	C702-2	C4235a-6, then ground	RME09 (BN/YE)
LF door	C523-1	C4235b-9, then ground	VME07 (WH)
	C523-2	C4235b-2, then ground	RME07 (WH/BN)
LH tweeter	C569-1	C4235b-11, then ground	VME08 (GN/OG)
	C569-2	C4235b-4, then ground	RME08 (GY/OG)
LH front imaging	C2358-1	C4235a-14, then ground	VME28 (BN/VT)
	C2358-4	C4235a-2, then ground	RME28 (BN/GN)

Suspect Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
Center front imaging	C2358-2	C4235b-13, then ground	VME06 (GN)
	C2358-5	C4235b-6, then ground	RME06 (GY/YE)
RH front imaging	C2358-3	C4235b-14, then ground	VME29 (GN/WH)
	C2358-6	C4235b-7, then ground	RME29 (BU/WH)
RH tweeter	C613-1	C4235b-10, then ground	VME11 (VT/OG)
	C613-2	C4235b-3, then ground	RME11 (YE/OG)
RF door	C612-1	C4235b-8, then ground	VME10 (WH/VT)

	C612-2	C4235b-1, then ground	RME10 (WH/OG)
RR door	C802-1	C4235a-17, then ground	VME12 (BN/WH)
	C802-2	C4235a-5, then ground	RME12 (BN/BU)
Rear center imaging	C3306-1	C4235b-12, then ground	VME30 (GN/BN)
	C3306-2	C4235b-5, then ground	RME30 (VT/BN)
RH subwoofer	C3308-1	C4235a-15, then ground	VME02 (VT)
	C3308-2	C4235a-3, then ground	RME02 (YE)



N0102374

- **Are the resistances less than 5 ohms between the suspect speaker and the audio DSP module, and greater than 10,000 ohms between the suspect speaker and ground?**

F7 CHECK THE AUDIO CIRCUITS TO THE AUDIO DSP MODULE FOR A SHORT TO VOLTAGE

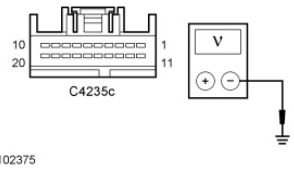
- Ignition OFF.
- Disconnect: ACM C240a or C240d .
- Ignition ON.
- Measure the voltage between the audio DSP module, harness side and ground as follows:

Suspect Speaker	Positive Meter Lead	Negative Meter Lead
All LH speakers (without navigation), LF door or LF tweeter (with navigation)	C4235c-7 VME07 (WH)	Ground

Yes
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

No
GO to F8 .

	C4235c-17 RME07 (WH/BN)	Ground
All RH speakers (without navigation), RF door or RF tweeter (with navigation)	C4235c-8 VME10 (WH/VT)	Ground
	C4235c-18 RME10 (WH/OG)	Ground
LR door (with navigation)	C4235c-4 VME09 (WH/GN)	Ground
	C4235c-14 RME09 (BN/YE)	Ground
RR door (with navigation)	C4235c-10 VME12 (BN/WH)	Ground
	C4235c-20 RME12 (BN/BU)	Ground
Instrument panel or parcel shelf (with navigation)	C4235c-9 VME51 (BN/BU)	Ground
	C4235c-19 RME51 (WH/BU)	Ground
Subwoofer #1 or #2	C4235c-5 VME22 (VT/GN)	Ground
	C4235c-15 RME22 (GN/WH)	Ground



- **Is any voltage present?**

F8 CHECK THE AUDIO CIRCUITS TO THE AUDIO DSP MODULE FOR AN OPEN OR SHORT TO GROUND

- Ignition OFF.
- Measure the resistance between the ACM , harness side and the audio DSP module, harness side; and between the ACM , harness side and ground as follows:

Without Navigation

Suspect Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
All LH speakers	C240a-8	C4235c-7, then ground	VME07 (WH)
	C240a-21	C4235c-17, then ground	RME07 (WH/BN)
All RH speakers	C240a-11	C4235c-8, then ground	VME10 (WH/VT)
	C240a-12	C4235c-18, then ground	RME10 (WH/OG)

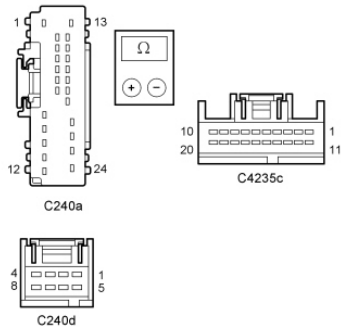
With Navigation

Suspect Speaker	Positive Meter Lead	Negative Meter Lead	Circuit
LF door, LF tweeter	C240a-8	C4235c-7, then ground	VME07 (WH)
	C240a-21	C4235c-17, then ground	RME07 (WH/BN)
RF door, RF tweeter	C240a-11	C4235c-8, then ground	VME10 (WH/VT)
	C240a-12	C4235c-18, then ground	RME10 (WH/OG)
LR door	C240a-9	C4235c-4, then ground	VME09 (WH/GN)
	C240a-22	C4235c-14, then ground	RME09 (BN/YE)

Yes
GO to F10 .

No
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

RR door	C240a-10	C4235c-10, then ground	VME12 (BN/WH)
	C240a-23	C4235c-20, then ground	RME12 (BN/BU)
Instrument panel, parcel shelf	C240d-5	C4235c-9, then ground	VME51 (BN/BU)
	C240d-6	C4235c-19, then ground	RME51 (WH/BU)
Subwoofer #1, subwoofer #2	C240d-1	C4235c-5, then ground	VME22 (VT/GN)
	C240d-2	C4235c-15, then ground	RME22 (GN/WH)



N0102376

- **Are the resistances less than 5 ohms between the ACM and the audio DSP module, and greater than 10,000 ohms between the ACM and ground?**

F9 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	
• Ignition OFF. • Connect: All Disconnected Connectors . • Disconnect all the audio DSP module connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the audio DSP module connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module in this section. CLEAR any DTCs present. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs present.
F10 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF.	**Yes** INSTALL a new ACM . REFER to

• Connect: All Disconnected Connectors . • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	Audio Control Module (ACM) â MKZ in this section. CLEAR any DTCs present. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs present.

Pinpoint Test G: No Sound From All Speakers

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation â All Vehicles

When the ignition is in the START position, voltage is supplied to the Audio Front Control Module (ACM) through the START sense circuit. When the ACM receives this voltage, it mutes the speaker output.

Vehicles With SonyÂ® Sound or THXÂ® Sound

The ACM mutes the speaker output by removing the enable voltage to the audio Digital Signal Processing (DSP) module when the ignition is in the START position to prevent popping in the speakers as a result of voltage spikes during engine cranking. However, if there is a short to voltage on the enable circuit, the ACM continuously mutes the audio output, resulting in no sound from all speakers.

To enable the audio DSP module, the ACM sends voltage through the enable circuit. The enable status is based on the following voltage, as detected by the ACM :

- Less than 0.4 volt: amplifier disabled
- Between 3.8 and battery voltage: amplifier enabled

An open in the enable circuit causes the audio system to produce no sound because the enable signal does not reach the audio DSP module.

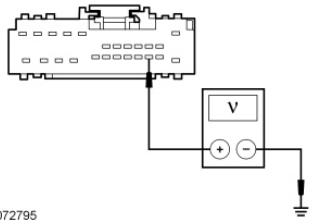
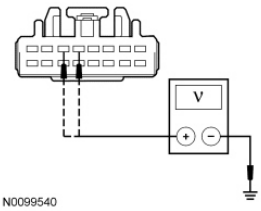
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Audio DSP module (SonyÂ® sound, THXÂ® sound)
- ACM

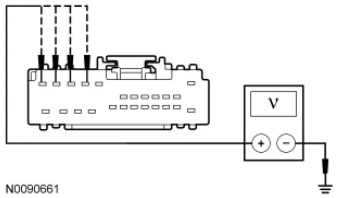
PINPOINT TEST G: NO SOUND FROM ALL SPEAKERS

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
G1 CHECK THE START SENSE CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240a . • Ignition ON. • Measure the voltage between the ACM C240a-15, circuit CBP28 (GY/VT), harness side and ground.  A0072795 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** For SonyÂ® and THXÂ® sound systems, GO to G2 . For all other sound systems, GO to G7 .
G2 CHECK THE AUDIO DSP MODULE VOLTAGE SUPPLY	
• Ignition OFF. • Disconnect: Audio DSP Module C4240a (SonyÂ® Sound) or C4235a (THXÂ® Sound) . • For SonyÂ® sound, measure the voltage between the audio DSP module C4240a-5, circuit SBP19 (BU/RD), harness side and ground; and between the audio DSP module C4240a-6, circuit SBP19 (BU/RD), harness side and ground.  N0099540 • For THXÂ® sound, measure the voltage between the audio DSP module, harness side and ground as follows: **Positive Meter Lead** / **Negative Meter Lead** / **Circuit** C4235a-9 / Ground / SBB20 (GN/RD) C4235a-10 / Ground / SBB20 (GN/RD)	**Yes** GO to G3 . **No** VERIFY the Smart Junction Box (SJB) fuse 19 (25A) (SonyÂ®), or Battery Junction Box (BJB) fuses 20 (20A) and 21 (20A) (THXÂ®) are OK. If OK, REPAIR the circuit in question. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

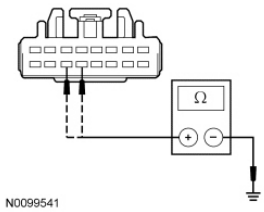
C4235a-11	Ground	SBB21 (GY/RD)
C4235a-12	Ground	SBB21 (GY/RD)



- **Are the voltages greater than 10 volts?**

G3 CHECK THE AUDIO DSP MODULE GROUND CIRCUITS FOR CONTINUITY

- Disconnect: Negative Battery Cable .
- For SonyÂ® sound, measure the resistance between the audio DSP module C4240a-13, circuit GD148 (BK/YE), harness side and ground; and between the audio DSP module C4240a-14, circuit GD148 (BK/YE), harness side and ground.

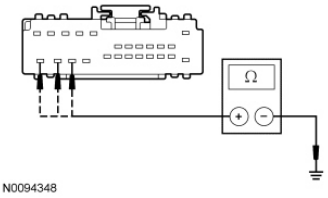
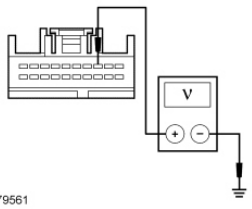
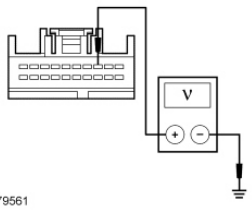


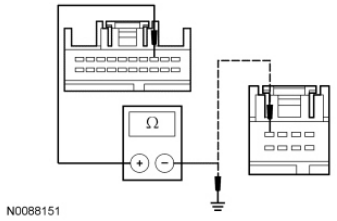
- For THXÂ® sound, measure the resistance between the audio DSP module, harness side and ground as follows:

Positive Meter Lead	Negative Meter Lead	Circuit
C4235b-22	Ground	GD148 (BK/YE)
C4235b-23	Ground	GD148 (BK/YE)
C4235b-24	Ground	GD148 (BK/YE)

Yes
GO to G4 .

No
REPAIR the circuit in question. TEST the system for normal operation.

 N0094348 • **Are the resistances less than 5 ohms?**	
G4 CHECK THE AUDIO DSP MODULE ENABLE CIRCUIT FOR CORRECT VOLTAGE	
• Connect: Negative Battery Cable . • Connect: Audio DSP Module C4240a (SonyÂ® Sound) or C4235a (THXÂ® Sound) . • Disconnect: Audio DSP Module C4240c (SonyÂ® Sound) or C4235c (THXÂ® Sound) . • Operate the audio system in radio tuner (AM/FM) mode. • Measure the voltage between the audio DSP module C4240c-3 (SonyÂ® sound) or C4235c-3 (THXÂ® sound), circuit SME23 (VT/RD), harness side and ground.  N0079561 • **Is the voltage between 3.8 and 6.7 volts?**	**Yes** GO to G8 . **No** GO to G5 .
G5 CHECK THE AUDIO DSP MODULE ENABLE CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240d . • Ignition ON. • Measure the voltage between the audio DSP module C4240c-3 (SonyÂ® sound) or C4235c-3 (THXÂ® sound), circuit SME23 (VT/RD), harness side and ground.  N0079561 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to G6 .
G6 CHECK THE AUDIO DSP MODULE ENABLE CIRCUIT FOR AN OPEN OR SHORT TO GROUND	

• Ignition OFF. • Measure the resistance between the audio DSP module C4240c-3 (SonyÂ® sound) or C4235c-3 (THXÂ® sound), circuit SME23 (VT/RD), harness side and the ACM C240d-4, circuit SME23 (VT/RD), harness side; and between the audio C4240c-3 (SonyÂ® sound) or C4235c-3 (THXÂ® sound), circuit SME23 (VT/RD), harness side and ground.  N0088151 • **Is the resistance less than 5 ohms between the audio DSP module and the ACM , and greater than 10,000 ohms between the audio DSP module and ground?**	**Yes** GO to G7 . **No** REPAIR the circuit. TEST the system for normal operation.
G7 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Connect: All Disconnected Connectors . • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
G8 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	
• Ignition OFF. • Connect: All Disconnected Connectors . • Disconnect all the audio DSP module connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the audio DSP module connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test H: Poor Quality/Distorted/No Sound â SYNCÂ® System

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Accessory Protocol Interface Module (APIM) sends left and right channel analog audio signals to the Audio Front Control Module (ACM). This includes inputs from the Universal Serial Bus (USB) port, the audio input jack, and a Bluetooth media device.

This pinpoint test is intended to diagnose the following:

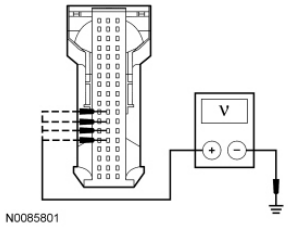
- Wiring, terminals or connectors
- APIM
- ACM

PINPOINT TEST H: POOR QUALITY/DISTORTED/NO SOUND â SYNCÂ® SYSTEM

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
H1 VERIFY THE OPERATION OF THE SYNCÂ® SYSTEM AUDIO SOURCES	
• Connect: Multi-Media Interface Tester . • Using the Multi-Media Interface Tester, test the audio output for the audio input jack, USB port, and Bluetooth connection. • **Is there poor quality/distorted/no sound from each SYNCÂ® audio source?**	**Yes** GO to H2 . **No** If the concern is only with some (but not all) of the audio sources, GO to Symptom Chart - SYNCÂ® System to diagnose the observed symptom. If all audio sources operate correctly, the concern is with the customer device.
H2 CHECK THE CIRCUITS FROM THE APIM FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240c . • Disconnect: APIM C3338 . • Measure the voltage between the APIM , harness side and ground as follows: **Connector-Pin / Circuit** C3338-23 / VME53 (VT/GN) C3338-24 / RME53 (BN/WH) C3338-25 / VME52 (BU)	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to H3 .

C3338-26	RME52 (GY/OG)

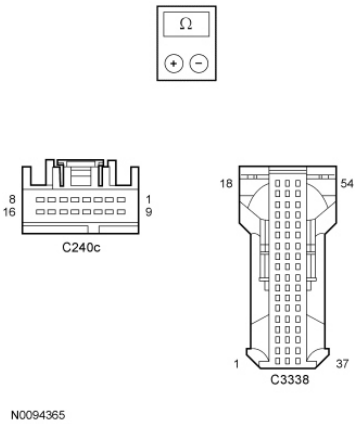


- **Is any voltage present?**

H3 CHECK THE CIRCUITS FROM THE APIM FOR AN OPEN OR SHORT TO GROUND

- Ignition OFF.
- Measure the resistance between the ACM , harness side, and the APIM , harness side; and between the ACM , harness side and ground as follows:

Positive Meter Lead	Negative Meter Lead	Circuit
C240c-9	C3338-23, then ground	VME53 (VT/GN)
C240c-10	C3338-24, then ground	RME53 (BN/WH)
C240c-1	C3338-25, then ground	VME52 (BU)
C240c-2	C3338-26, then ground	RME52 (GY/OG)



- **Is the resistance less than 5 ohms between the ACM and the APIM , and greater than 10,000 ohms between the ACM and ground?**

Yes
REPAIR the circuit in question. TEST the system for normal operation.

No
GO to H4 .

H4 CHECK FOR CORRECT APIM OPERATION	
• Connect: All Disconnected Connectors . • Disconnect the APIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the APIM connector and make sure it seats correctly. • Wait 2 minutes for the APIM to re-initalize. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation. If the concern is still present, GO to H5 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
H5 CHECK FOR CORRECT ACM OPERATION	
• Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test I: The Satellite Radio Is Inoperative/Does Not Operate Correctly

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

Digital signals are received by the satellite radio antenna and sent to the Audio Front Control Module (ACM) through the satellite radio antenna cable. The satellite radio receiver is internal to the ACM .

When a satellite radio subscription is activated, the Electronic Serial Number (ESN) of the built-in satellite radio receiver is associated with the Vehicle Identification Number (VIN). As a result, the ACM cannot be swapped from one vehicle to another.

When there is an open in the satellite radio antenna circuit, there is no satellite audio. The audio system display indicates a satellite radio antenna concern when the audio system is operated in satellite radio mode. To diagnose an open in the satellite radio antenna circuit, GO to Pinpoint Test B .

- DTC U2014:96 (Control Module Hardware: Component Internal Failure) â set by the non-navigation (MKZ) or navigation (all) ACM when a fault is detected in the internal satellite radio receiver. This results in complete loss of satellite radio functionality.

This pinpoint test is intended to diagnose the following:

- Subscription status
- Satellite radio system concern

- ACM

PINPOINT TEST I: THE SATELLITE RADIO IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
I1 CHECK THE SATELLITE RADIO DISPLAY	
• Turn the audio system on. • Operate the audio system in satellite radio mode and observe the Front Display Interface Module (FDIM) display. • **Does satellite radio information show on the FDIM display?**	**Yes** GO to I2 . **No** For vehicles without navigation, GO to Pinpoint Test K . For vehicles with navigation, GO to Pinpoint Test L .
I2 VERIFY AN ACTIVE SUBSCRIPTION	
• Operate the audio system in satellite radio mode and observe the FDIM display. • **Does the display indicate the subscription has expired?**	**Yes** The subscription has expired. INFORM the customer to contact Sirius to re-activate the subscription. **No** GO to I3 .
I3 CHECK THE SATELLITE SIGNAL PID (SAT_SIG_STR)	
• Enter the following diagnostic mode on the scan tool: ACM DataLogger . • Monitor the ACM PID (SAT_SIG_STR). • **Does the PID indicate "No Signal"?**	**Yes** GO to Pinpoint Test B . **No** For vehicles with navigation, GO to I4 . For all others, GO to I5 .
I4 CHECK THE ACM DTCs	
• Retrieve the ACM DTCs. • **Is DTC U2014:96 present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** GO to I5 .
I5 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No**

• Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test J: The Audio System Does Not Operate Correctly From The Front Controls Interface Module (FCIM)

Normal Operation

When a button is pressed on the Front Controls Interface Module (FCIM), a signal is broadcast over the Medium Speed Controller Area Network (MS-CAN) to the modules in the audio system. The FCIM is also the customer interface with the HVAC module.

If the FCIM can no longer communicate on the MS-CAN (due to loss of power, ground, etc.), the audio system remains in the operating state it was in prior to the failure. The steering wheel controls continue to operate.

- DTC B2924 (Audio Button Stuck) â set by the non-navigation (Fusion) FCIM if a switch is detected as active for greater than 3 seconds during the self-test, or for greater than 2 minutes during normal operation. When this occurs, the FCIM disables the switch until it detects it as no longer active.
- DTC U2013:63 (Switch Pack: Circuit / Component Protection Time-Out) â set by the non-navigation (MKZ) or navigation (all) FCIM if a switch is detected as active for greater than 3 seconds during the self-test, or for greater than 2 minutes during normal operation. When this occurs, the FCIM disables the switch until it detects it as no longer active.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- FCIM

PINPOINT TEST J: THE AUDIO SYSTEM DOES NOT OPERATE CORRECTLY FROM THE FCIM

Test Step	Result / Action to Take
J1 RETRIEVE ALL CONTINUOUS DTCs	
• Using the scan tool, retrieve all continuous DTCs. • **Are DTCs U0184, U0184:00, U0255, or U0255:00 present in any audio system module?**	**Yes** REFER to DTC Charts in this section. **No** GO to J2 .
J2 CHECK FOR DTC B2924 OR DTC U2013:63	
• Clear the FCIM DTCs. • Repeat the FCIM self-test,	**Yes** INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) â Fusion or Front Controls Interface Module

making sure no FCIM buttons are pressed during the test. • **Is DTC B2924 or DTC U2013:63 present?**	(FCIM) â MKZ in this section. TEST the system for normal operation. **No** GO to J3 .
J3 CHECK FOR CORRECT FCIM OPERATION	
• Disconnect the FCIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the FCIM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) â Fusion or Front Controls Interface Module (FCIM) â MKZ in this section. CLEAR any DTCs present. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs present.

Pinpoint Test K: An Individual Front Display Interface Module (FDIM) Display Is Inoperative â Vehicles Without Navigation

Normal Operation

The Front Display Interface Module (FDIM) receives inputs via the Medium Speed Controller Area Network (MS-CAN) from the following modules:

- ♦ Audio Front Control Module (ACM): audio system information
- ♦ Instrument Panel Cluster (IPC): compass heading information
- ♦ Accessory Protocol Interface Module (APIM): SYNCÂ® system information
- ♦ HVAC module: climate control system information

If the FDIM loses the signal from any of these modules, only that specific display is inoperative.

For the compass display, this pinpoint test is intended to diagnose a concern of the compass display being blank. For any other concerns with the compass display, including the compass being inaccurate, refer to Section 413-01 .

This pinpoint test is intended to diagnose the following:

- Communication network concern
- FDIM

PINPOINT TEST K: AN INDIVIDUAL FDIM DISPLAY IS INOPERATIVE â VEHICLES WITHOUT NAVIGATION

Test Step	Result / Action to Take
K1 OBSERVE THE FDIM DISPLAY	

<table>
<tr><td>• Turn the audio system on and observe the FDIM screen.
• Is the FDIM display completely inoperative?</td><td>Yes
GO to Pinpoint Test N .

No
GO to K2 .</td></tr>
<tr><td>K2 CHECK FOR LOST COMMUNICATION DTCs SET IN THE FDIM</td><td></td></tr>
<tr><td>• Using the scan tool, retrieve all continuous DTCs.
• Is DTC U0155, U0155:00, U0184, U0184:00, U0197, or U0197:00 present in the FDIM ?</td><td>Yes
REFER to DTC Charts in this section.

No
GO to K3 .</td></tr>
<tr><td>K3 CHECK THE FDIM DISPLAY SEGMENTS</td><td></td></tr>
<tr><td>• Carry out the Audio Display Test. Refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.
• Do all of the FDIM segments illuminate?</td><td>Yes
GO to K4 .

No
GO to K5 .</td></tr>
<tr><td>K4 OBSERVE THE SPECIFIC INOPERATIVE DISPLAY</td><td></td></tr>
<tr><td>• Observe the inoperative FDIM display while carrying out the indicated diagnostic method as follows:
<table>
<tr><th>Inoperative Display</th><th>Diagnostic Method</th><th>Expected Results</th></tr>
<tr><td>Compass</td><td>Drive the vehicle in an open area while observing the display.</td><td>The compass display illuminates, indicating a directional heading or a calibration error.</td></tr>
<tr><td>Audio system</td><td>Turn the audio system on, press the AM/FM button, and adjust the volume.</td><td>The FDIM display updates to show the change in audio setting.</td></tr>
<tr><td>SYNCÂ® system (if equipped)</td><td>Turn the audio system on, press the phone button, and observe the display.</td><td>The FDIM display shows information relating to the phone.</td></tr>
<tr><td>Climate control system</td><td>Turn the climate control system on, adjust the fan to high speed, and set the temperature to various settings.</td><td>The FDIM display updates to show the change in climate control setting.</td></tr>
</table></td><td>Yes
The system is operating correctly at this time. INFORM the customer on the operation of the FDIM display.

No
If the compass heading is inaccurate or indicates a calibration error, REFER to Section 413-01 to diagnose the compass.

For all other concerns, GO to K5 .</td></tr>
</table>

• **Does the inoperative display confirm the expected results?**	
K5 CHECK FOR CORRECT FDIM OPERATION	
• Ignition OFF. • Disconnect the FDIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the FDIM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) â Fusion or Front Display Interface Module (FDIM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test L: An Individual FDIM Display Is Inoperative â Vehicles With Navigation

Normal Operation

The Front Display Interface Module (FDIM) display provides information based on the video signal from the Audio Front Control Module (ACM). In addition to the information that the ACM controls for the navigation and audio system, the ACM receives inputs via the Medium Speed Controller Area Network (MS-CAN) from the following modules:

♦ Accessory Protocol Interface Module (APIM): SYNCÂ® system information (if equipped)
♦ HVAC module: climate control system information

If the ACM loses the signal from any of these modules, only that specific display becomes inoperative.

This pinpoint test is intended to diagnose the following:

• Communication network concern
• FDIM
• ACM

PINPOINT TEST L: AN INDIVIDUAL FDIM DISPLAY IS INOPERATIVE â VEHICLES WITH NAVIGATION

Test Step	Result / Action to Take
L1 OBSERVE THE FDIM DISPLAY	
• Turn the audio system on and observe the FDIM screen. • **Is the FDIM display completely inoperative?**	**Yes** GO to Pinpoint Test O . **No** GO to L2 .
L2 CHECK THE FDIM DISPLAY SEGMENTS	
• Carry out the Audio Display Test. Refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.	**Yes** GO to L3 . **No**

• **Do all of the FDIM segments illuminate?**	GO to L6 .
L3 OBSERVE THE SPECIFIC INOPERATIVE DISPLAY	
• Observe the inoperative FDIM display while carrying out the indicated diagnostic method as follows: **Inoperative Display / Diagnostic Method / Expected Results** Audio system / Turn the audio system on, press the AM/FM button, and adjust the volume. / The FDIM display updates to show the change in audio setting. SYNCÂ® system (if equipped) / Turn the audio system on, press the phone button, and observe the display. / The FDIM display shows information relating to the phone. Climate control system / Turn the climate control system on, adjust the fan to high speed, and set the temperature to various settings. / The FDIM display updates to show the change in climate control setting. • **Does the inoperative display confirm the expected results?**	**Yes** The system is operating correctly at this time. INFORM the customer on the operation of the FDIM displays. **No** GO to L4 .
L4 CHECK FOR LOST COMMUNICATION DTCs	
• Ignition ON. • Clear continuous DTCs from all modules. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Retrieve all continuous DTCs (from all modules). • **Is DTC U0164, U0164:00, U0184, U0184:00, U0197, or U0197:00 (if equipped with the SYNCÂ® system) present in any module?**	**Yes** For DTC U0164, GO to Pinpoint Test AH . For DTC U0197, GO to Pinpoint Test AK . **No** GO to L5 .
L5 CHECK FOR CORRECT FDIM OPERATION	
• Ignition OFF. • Disconnect the FDIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) â Fusion or Front Display Interface Module (FDIM) â MKZ in this section. TEST the system for normal operation. If the concern is still present, GO to L6 .

• Connect the FDIM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
L6 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test M: The Audio System Does Not Operate Correctly From The Front Display Interface Module (FDIM) â Vehicles With Navigation

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Front Display Interface Module (FDIM) touchscreen sends a voltage signal to the Audio Front Control Module (ACM) when a touch sector is pressed. The ACM then takes the appropriate action, which can be a change in the audio system setting or broadcasting the information to the appropriate module through the Medium Speed Controller Area Network (MS-CAN).

- DTC U0162:00 (Lost Communication With Navigation Display Module: No Sub Type Information) â set by the ACM if it does not detect the FDIM for greater than 5 seconds with the ignition in the RUN position. When this occurs, the touchscreen controls are inoperative and the FDIM may not display correct (if any) information.

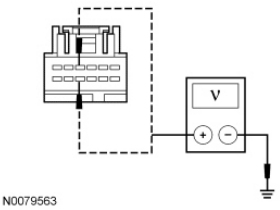
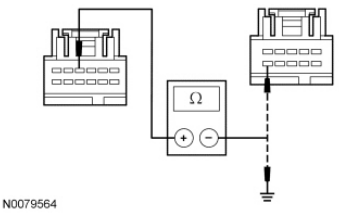
This pinpoint test is intended to diagnose the following:

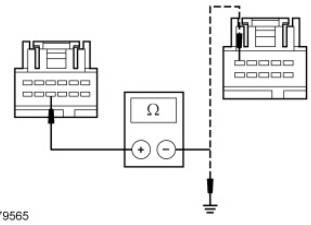
- Wiring, terminals or connectors
- FDIM
- ACM

PINPOINT TEST M: THE AUDIO SYSTEM DOES NOT OPERATE CORRECTLY FROM THE FDIM â VEHICLES WITH NAVIGATION

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
M1 OBSERVE THE FDIM DISPLAY	

• Turn the audio system on and observe the FDIM screen. • **Is the FDIM display completely inoperative?**	**Yes** GO to Pinpoint Test O . **No** GO to M2 .
M2 CHECK FOR AUDIO SYSTEM OPERATION FROM THE FCIM	
• Carry out various audio system functions using the Front Controls Interface Module (FCIM). • **Does the audio system operate correctly from the FCIM ?**	**Yes** GO to M3 . **No** GO to Pinpoint Test J .
M3 CHECK THE TOUCHSCREEN TRANSMIT AND RECEIVE CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: FDIM C2410 . • Disconnect: ACM C240b . • Ignition ON. • Measure the voltage between the FDIM C2410-4, circuit CMN26 (BU/OG), harness side and ground; and between the FDIM C2410-10, circuit CMN24 (GY/VT), harness side and ground.  N0079563 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation. **No** GO to M4 .
M4 CHECK THE TOUCHSCREEN TRANSMIT AND RECEIVE CIRCUITS FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the FDIM C2410-4, circuit CMN26 (BU/OG), harness side and the ACM C240b-10, circuit CMN26 (BU/OG), harness side; and between the FDIM C2410-4, circuit CMN26 (BU/OG), harness side and ground.  N0079564	**Yes** GO to M5 . **No** REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

• Measure the resistance between the FDIM C2410-10, circuit CMN24 (GY/VT), harness side and the ACM C240b-5, circuit CMN24 (GY/VT), harness side; and between the FDIM C2410-10, circuit CMN24 (GY/VT), harness side and ground.  • **Is the resistance less than 5 ohms between the FDIM and the ACM , and greater than 10,000 ohms between the FDIM and ground?**	
M5 ISOLATE THE FDIM	
• Connect: ACM C240b . • Install a new FDIM . Refer to Front Display Interface Module (FDIM) â Fusion or Front Display Interface Module (FDIM) â MKZ in this section. • Ignition ON. • Attempt various commands from the FDIM touchscreen. • **Does the system operate correctly?**	**Yes** The cause of the concern was an inoperative FDIM . The system is now operating correctly. **No** GO to M6 .
M6 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test N: The Front Display Interface Module (FDIM) Is Completely Inoperative â Vehicles Without Navigation

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Front Display Interface Module (FDIM) receives power at all times. The ignition switch position message is broadcast to the FDIM by the Smart Junction Box (SJB) via the Medium Speed Controller Area Network (MS-CAN).

Information from the audio system, the climate control system, the SYNCÂ® system, and the compass heading are shown on the FDIM display screen. If only one of these displays has a concern, GO to Pinpoint Test K .

This pinpoint test is intended to diagnose the following:

- Communication network concern
- FDIM

PINPOINT TEST N: THE FDIM IS COMPLETELY INOPERATIVE â VEHICLES WITHOUT NAVIGATION

Test Step	Result / Action to Take
N1 CHECK FOR SCAN TOOL COMMUNICATION WITH THE FDIM	
• Ignition ON. • Carry out the network test using the scan tool. • **Does the scan tool communicate with the FDIM ?**	**Yes** GO to N2 . **No** REFER to Section 418-00 .
N2 CHECK FOR CORRECT FDIM OPERATION	
• Ignition OFF. • Disconnect the FDIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the FDIM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) â Fusion or Front Display Interface Module (FDIM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test O: The Front Display Interface Module (FDIM) Is Completely Inoperative â Vehicles With Navigation

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Audio Front Control Module (ACM) enables the Front Display Interface Module (FDIM) by sending voltage through the enable circuit.

Video display information is sent to the FDIM from the ACM through a dedicated video cable. The video cable is only serviced by overlaying a new component.

If there is a fault in the video cable, the FDIM may illuminate very dimly and have a greyish appearance. This is because the enable circuit is still active and enables the illumination, but no video signal reaches the FDIM .

If the vehicle is equipped with a rear view camera, the video feed from the camera is hardwired to the FDIM .

For all other display information, including the climate control and SYNCÂ® system displays, messages are sent to the ACM via the Medium Speed Controller Area Network (MS-CAN). The ACM then alters the video feed to the FDIM based on the messages it receives.

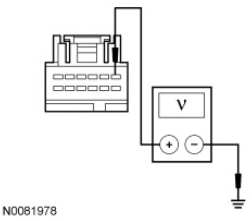
This pinpoint test is intended to diagnose the following:

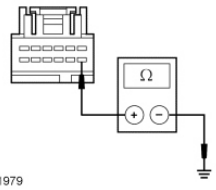
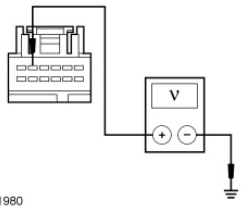
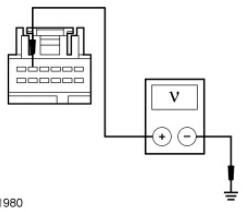
- Fuse
- Wiring, terminals or connectors
- FDIM
- ACM

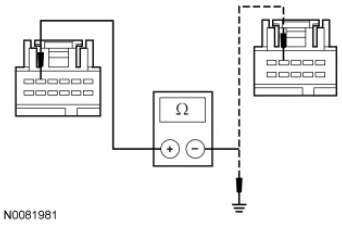
PINPOINT TEST O: THE FDIM IS COMPLETELY INOPERATIVE â VEHICLES WITH NAVIGATION

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
O1 CHECK THE FDIM VOLTAGE SUPPLY	
• Ignition OFF. • Disconnect: FDIM C2410 . • Measure the voltage between the FDIM C2410-1, circuit SBP14 (BN/RD), harness side and ground.  N0081978 • **Is the voltage greater than 10 volts?**	**Yes** GO to O2 . **No** VERIFY the Smart Junction Box (SJB) fuse 14 (10A) is OK. If OK, REPAIR the circuit. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
O2 CHECK THE FDIM GROUND CIRCUIT FOR CONTINUITY	
• Disconnect: Negative Battery Cable . • Measure the resistance between the FDIM C2410-7, circuit GD116 (BK/VT), harness side and ground.	**Yes** GO to O3 . **No** REPAIR the circuit. TEST the system for normal operation.

 N0081979 • **Is the resistance less than 5 ohms?**	
O3 CHECK THE FDIM ENABLE CIRCUIT FOR CORRECT VOLTAGE	
• Connect: Negative Battery Cable . • Ignition ON. • Turn the audio system on using the power button on the Front Controls Interface Module (FCIM). • Measure the voltage between the FDIM C2410-5, circuit CMN23 (WH/BU), harness side and ground.  N0081980 • **Is the voltage between 4.5 and 9.5 volts?**	**Yes** GO to O6 . **No** GO to O4 .
O4 CHECK THE FDIM ENABLE CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240b . • Ignition ON. • Measure the voltage between the FDIM C2410-5, circuit CMN23 (WH/BU), harness side and ground.  N0081980 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to O5 .
O5 CHECK THE FDIM ENABLE CIRCUIT FOR AN OPEN OR SHORT TO GROUND	

• Ignition OFF. • Measure the resistance between the FDIM C2410-5, circuit CMN23 (WH/BU), harness side and the ACM C240b-4, circuit CMN23 (WH/BU), harness side; and between the FDIM C2410-5, circuit CMN23 (WH/BU), harness side and ground.  • **Is the resistance less than 5 ohms between the FDIM and the ACM , and greater than 10,000 ohms between the FDIM and ground?**	**Yes** GO to O6 . **No** REPAIR the circuit. TEST the system for normal operation.
O6 ISOLATE THE VIDEO CABLE	
• Connect: ACM C240b . • Connect: FDIM C2410 . • Install a new video cable. Refer to **Video Cable** in this section. • Ignition ON. • Operate the audio system and observe the FDIM screen. • **Does the system operate correctly?**	**Yes** The cause of the concern was an inoperative video cable. The system is now operating correctly. **No** GO to O7 .
O7 ISOLATE THE FDIM	
• Install a new FDIM . Refer to Front Display Interface Module (FDIM) â Fusion or Front Display Interface Module (FDIM) â MKZ in this section. • Ignition ON. • Operate the audio system and observe the FDIM screen. • **Does the system operate correctly?**	**Yes** The cause of the concern was an inoperative FDIM . The system is now operating correctly. **No** GO to O8 .
O8 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test P: The Front Display Interface Module (FDIM) Does Not Display DVD Video Played From The Audio Front Control Module (ACM) â Vehicles With Navigation

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

Video from a DVD played in the Audio Front Control Module (ACM) is transmitted to the Front Display Interface Module (FDIM) through dedicated video circuits. This video feed is separate from all other video sources, so it is possible for the FDIM to operate correctly until a DVD video is played.

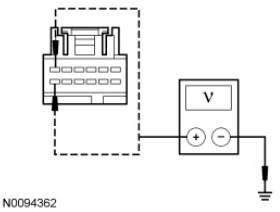
DVD video playback through the ACM is only enabled when the vehicle is in PARK. In all other gears, only the DVD audio is played. This is normal operation.

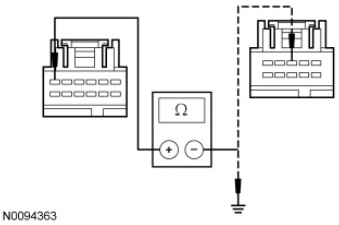
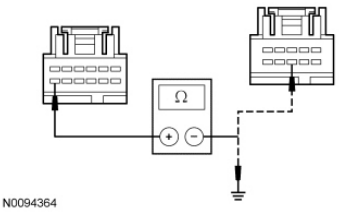
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- FDIM
- ACM

PINPOINT TEST P: THE FDIM DOES NOT DISPLAY DVD VIDEO PLAYED FROM THE ACM â VEHICLES WITH NAVIGATION

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
P1 CHECK THE FDIM VIDEO FEED CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240b . • Disconnect: FDIM C2410 . • Ignition ON. • Measure the voltage between the FDIM C2410-6, circuit VMN20 (BN/VT), harness side and ground; and between the FDIM C2410-12, circuit RMN20 (WH/GN), harness side and ground.  • **Is any voltage present?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to P2 .
P2 CHECK THE FDIM VIDEO FEED CIRCUITS FOR AN OPEN OR SHORT TO GROUND	

• Ignition OFF. • Measure the resistance between the FDIM C2410-6, circuit VMN20 (BN/VT), harness side and the ACM C240b-3, circuit VMN20 (BN/VT), harness side; and between the FDIM C2410-6, circuit VMN20 (BN/VT), harness side and ground.  N0094363 • Measure the resistance between the FDIM C2410-12, circuit RMN20 (WH/GN), harness side and the ACM C240b-8, circuit RMN20 (WH/GN), harness side; and between the FDIM C2410-12, circuit RMN20 (WH/GN), harness side and ground.  N0094364 • **Is the resistance less than 5 ohms between the FDIM and the ACM , and greater than 10,000 ohms between the FDIM and ground?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to P3 .
P3 ISOLATE THE FDIM	
• Connect: ACM C240b . • Install a new FDIM . Refer to Front Display Interface Module (FDIM) â Fusion or Front Display Interface Module (FDIM) â MKZ in this section. • Ignition ON. • Operate the audio system and observe the FDIM screen. • **Does the system operate correctly?**	**Yes** The cause of the concern was an inoperative FDIM . The system is now operating correctly. **No** GO to P4 .
P4 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present.	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may

• **Is the concern still present?**	have been caused by a loose or corroded connector.

Pinpoint Test Q: The Steering Wheel Controls Are Inoperative/Do Not Operate Correctly

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio/Navigation for schematic and connector information.

Normal Operation

There are 3different steering wheel controls configurations:

- Without the SYNCÂ® system
  - ♦ VOL-, VOL+, SEEK-, SEEK+, MEDIA
  - ♦ All switches are wired to the Audio Front Control Module (ACM)
- SYNCÂ® system without navigation
  - ♦ VOL-, VOL+, SEEK-, SEEK+, MEDIA, PHONE, OK
  - ♦ The VOL-, VOL+, SEEK-, and SEEK+ switches are wired to the ACM . The remaining switches are wired to the Accessory Protocol Interface Module (APIM).
- SYNCÂ® system with navigation
  - ♦ VOL-, VOL+, SEEK-, SEEK+, VOICE, MEDIA, PHONE
  - ♦ All switches are wired to the ACM

Voltage is sent from the ACM (or APIM) to the steering wheel controls, and the same module grounds the return circuit. The VOL-, VOL+, SEEK- and SEEK+ switches share signal and return circuits, while the VOICE, MEDIA, PHONE and OK switches share separate signal and return circuits.

For all configurations, when a switch is pressed, the voltage is routed through a specific resistor value for each function. The ACM (or APIM) then uses the reference voltage to determine which control input function has been selected.

DTC Description	Fault Trigger Conditions
• B1117 â Audio Steering Wheel Button Stuck (ACM)	Set by the non-navigation ACM when a steering wheel controls switch is detected as active for more than 120 seconds during normal operation, or for any duration during the self-test. A short to ground in the signal return circuit does not set this DTC, as the reference voltage falls out-of-range, resulting in DTC B2404 being set.
• B11BA:1C â Steering Wheel Audio Switch Pack: Circuit Voltage Out of Range	Set by the ACM when the reference voltage to the steering wheel controls is out-of-range. This can be caused by a number of different failures on the steering wheel controls circuit except for a stuck switch or a short to ground in the signal return circuit. This DTC applies to the VOL-, VOL+, SEEK-, SEEK+, and MEDIA switches.
• B11BA:63 â Steering Wheel Audio Switch Pack: Circuit /	Set by the ACM when a steering wheel control switch is detected as active for more than 120 seconds during normal operation, or for more than 3 seconds during the self-test. A short to ground in the signal return circuit should not set this DTC, as the reference voltage would fall out-of-range, resulting in DTC B11BA:1C being set. This DTC applies to the VOL-, VOL+, SEEK-, SEEK+,

Component Protection Time-Out	and MEDIA switches.
• B1201:1C â Steering Wheel Audio Switch Pack 2: Circuit Voltage Out of Range	Set by the navigation ACM when the reference voltage to the steering wheel controls is out-of-range. This can be caused by a number of different failures on the steering wheel controls circuit except for a stuck switch or a short to ground in the signal return circuit. This DTC applies to the VOICE and PHONE switches.
• B1201:1C â Steering Wheel Audio Switch Pack 2: Circuit Voltage Out of Range	Set by the APIM when the reference voltage to the steering wheel controls is out-of-range. This can be caused by a number of different failures on the steering wheel controls circuit except for a stuck switch or a short to ground in the signal return circuit. This DTC applies to vehicles without navigation.
• B1201:63 â Steering Wheel Audio Switch Pack 2: Circuit / Component Protection Time-Out	Set by the navigation ACM when a steering wheel control switch is detected as active for more than 120 seconds during normal operation, or for any duration during the self-test. A short to ground in the signal return circuit should not set this DTC, as the reference voltage would fall out-of-range, resulting in DTC B1201:1C being set. This DTC applies to the VOICE and PHONE switches.
• B1201:63 â Steering Wheel Audio Switch Pack 2: Circuit / Component Protection Time-Out	Set by the APIM when a steering wheel control switch is detected as active for more than 120 seconds during normal operation, or for any duration during the self-test. A short to ground in the signal return circuit should not set this DTC, as the reference voltage would fall out-of-range, resulting in DTC B1201:1C being set. This DTC applies to vehicles without navigation.
• B2404 â Audio Steering Wheel Switch Circuit Failure	Set by the non-navigation ACM when the reference voltage to the steering wheel controls is out-of-range. This can be caused by a number of different failures on the steering wheel controls circuit except for a stuck switch or a short to ground in the signal return circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Clockspring
- Steering wheel controls
- ACM
- APIM (without navigation only)

PINPOINT TEST Q: THE STEERING WHEEL CONTROLS ARE INOPERATIVE/DO NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: For vehicles equipped with navigation or not equipped with SYNC, start this pinpoint test at Step Q3.

Test Step	Result / Action to Take
Q1 CHECK THE SYNCÂ® SYSTEM OPERATION	
NOTE: Carrying out a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNC system. • Connect: Multi-Media Interface Tester. • Using the Multi-Media Interface Tester, test the audio output for the audio input jack, USB port, and Bluetooth connection using the VOICE switch on the steering wheel controls to enter each mode. • **Do all of the SYNCÂ® inputs function correctly?**	**Yes** The SYNCÂ® system is operating correctly at this time. CARRY OUT a SYNCÂ® system Master Reset. REFER to the Owner's Literature. REVIEW the SYNCÂ® system operation with the customer. If the customer device still does not operate correctly, the fault is with the customer device. **No** GO to Q2 .
Q2 RESET THE APIM AND RECHECK SYNCÂ® SYSTEM OPERATION	
• Carry out an APIM power reset by disconnecting the battery for 5 minutes, then reconnecting it. • Connect: Multi-Media Interface Tester. • Using the Multi-Media Interface Tester, test the audio output for the audio input jack, USB port, and Bluetooth connection using the VOICE switch on the steering wheel controls to enter each mode. • **Do all of the SYNCÂ® inputs function correctly?**	**Yes** The SYNCÂ® system is operating correctly at this time. CARRY OUT a SYNCÂ® system Master Reset. REFER to the Owner's Literature. REVIEW the SYNCÂ® system operation with the customer. If the customer device still does not operate correctly, the fault is with the customer device. **No** GO to Q3 .
Q3 DETERMINE THE INOPERATIVE STEERING WHEEL CONTROLS	
• Determine which steering wheel controls are inoperative by pressing each steering wheel control switch individually while operating the audio system in various modes (AM/FM, SYNCÂ® (if equipped), etc.). • **Is the concern with the VOL-, VOL+, SEEK-, SEEK+, or MEDIA switch?**	**Yes** GO to Q4 . **No** GO to Q5 .
Q4 MONITOR THE STEERING WHEEL CONTROL PIDs (EXCEPT NAVIGATION/SYNCÂ® SWITCHES)	

<table>
<tr><td>

- Enter the following diagnostic mode on the scan tool: ACM DataLogger.
- Monitor the steering wheel controls PIDs while pressing each steering wheel controls switch as follows:

Steering Wheel Controls Switch	PID
VOL-	SW_VOLDOWN
VOL+	SW_VOLUP
SEEK-	SW_SEEKMINUS
SEEK+	SW_SEEKPLUS
MEDIA	SW_MODE

- **Do the PID values agree with the switch positions?**

</td><td>

Yes
GO to Q11 .

No
If only one PID value is incorrect or the PID value always reads one particular switch position, INSTALL new steering wheel controls. REFER to Steering Wheel Controls in this section. CLEAR any DTCs present. TEST the system for normal operation.

Otherwise, GO to Q6 .

</td></tr>
<tr><td>

Q5 MONITOR THE STEERING WHEEL CONTROL PIDs (NAVIGATION/SYNCÂ® SWITCHES)

</td><td></td></tr>
<tr><td>

- Enter the following diagnostic mode on the scan tool: ACM DataLogger (With Navigation) or APIM DataLogger (Without Navigation).
- Monitor the steering wheel controls PIDs while pressing each steering wheel controls switch as follows:

ACM PIDs

Steering Wheel Controls Switch	ACM PID
VOICE	SW_VOICE
PHONE	SW_PHONE

APIM PIDs

Steering Wheel Controls Switch	APIM PID
VOICE	SCS_VOICE
PHONE	SCS_PHONE
OK	SCS_OK

- **Do the PID values agree with the switch positions?**

</td><td>

Yes
For vehicles with navigation, GO to Q11 .

For vehicles without navigation, GO to Q12 .

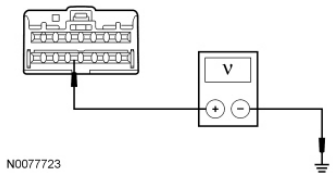
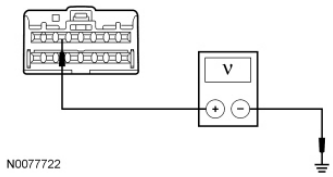
No
If only one PID value is incorrect or the PID value always reads one particular switch position, INSTALL new steering wheel controls. REFER to Steering Wheel Controls in this section. CLEAR any DTCs present. TEST the system for normal operation.

Otherwise, GO to Q6 .

</td></tr>
<tr><td>

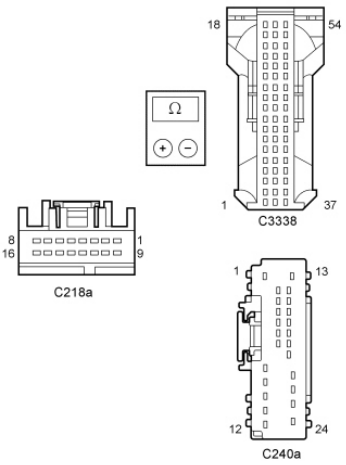
Q6 CHECK THE REFERENCE VOLTAGE CIRCUIT TO THE CLOCKSPRING FOR A SHORT TO VOLTAGE

</td><td></td></tr>
</table>

• Ignition OFF. • Disconnect: Clockspring C218a. • Disconnect: ACM C240a or APIM C3338. • Ignition ON. • For a concern with the VOL-, VOL+, SEEK-, SEEK+, or MEDIA switches, measure the voltage between the clockspring C218a-13, circuit VME14 (GY/YE), harness side and ground.  • For a concern with the VOICE, PHONE, or OK switches, measure the voltage between the clockspring C218a-6, circuit VME54 (BU/OG), harness side and ground.  • **Is any voltage present?**	**Yes** REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation. **No** GO to Q7 .
Q7 CHECK THE CIRCUITS TO THE CLOCKSPRING FOR AN OPEN OR SHORT TO GROUND	
NOTE: Circuits RME24 (BU/WH) does not need to be checked for a short to ground. • Ignition OFF. • Measure the resistance between the clockspring, harness side and the ACM (or APIM), harness side; and between the clockspring, harness side and ground as follows:	**Yes** GO to Q8 . **No** REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

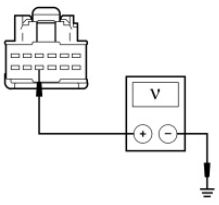
Suspect Switch	Positive Meter Lead	Negative Meter Lead	Circuit
VOL-, VOL+, SEEK-, SEEK+, or MEDIA	C218a-13 C218a-12	C240a-18, then ground C240a-19, then ground	VME14 (GY/YE) RME24 (BU/WH)

VOICE, PHONE, or OK	C218a-6 C218a-4	C240a-17 (with navigation) or C3338-14 (without navigation), then ground C240a-16 (with navigation) or C3338-15 (without navigation), then ground	VME54 (BU/OG) RME24 (BU/WH)

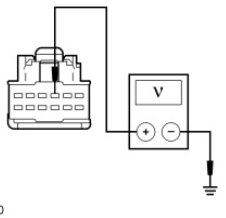


N0094358

- **Is the resistance less than 5 ohms between the ACM (or APIM) and the clockspring, and greater than 10,000 ohms between the ACM (or APIM) and ground?**

Q8 CHECK THE REFERENCE VOLTAGE CIRCUIT TO THE STEERING WHEEL CONTROLS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Clockspring C218b. • Disconnect: Steering Wheel Controls C2997.. • Ignition ON. • For a concern with the VOL-, VOL+, SEEK-, SEEK+, or MEDIA buttons, measure the voltage between the clockspring C218b-10, circuit VME14 (GY/YE), harness side and ground.  N0094359	**Yes** REPAIR the circuit. CLEAR any DTCs present. TEST the system for normal operation. **No** GO to Q9 .

- For a concern with the VOICE, PHONE, or OK buttons, measure the voltage between the clockspring C218b-3, circuit VME54 (BU/OG), harness side and ground.



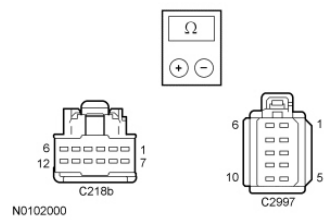
- **Is any voltage present?**

Q9 CHECK THE CIRCUITS TO THE STEERING WHEEL CONTROLS FOR AN OPEN OR SHORT TO GROUND

NOTE: Circuits RME24 (BU/WH) and RME54 (WH/VT) do not need to be checked for a short to ground.

- Ignition OFF.
- Measure the resistance between the clockspring, harness side and the steering wheel controls, harness side; and between the clockspring, harness side and ground as follows:

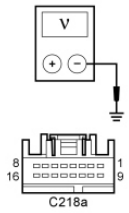
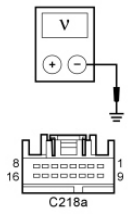
Suspect Switch	Positive Meter Lead	Negative Meter Lead	Circuit
VOL-, VOL+, SEEK-, SEEK+, or MEDIA	C218b-10 C218b-11	C2997-2, then ground C2997-4	VME14 (GY/YE) RME24 (BU/WH)
VOICE, PHONE, or OK	C218a-6 C218a-4	C2997-6, then ground C2997-7	VME54 (BU/OG) RME54 (WH/VT)



- **Is the resistance less than 5 ohms between the clockspring and the steering wheel controls, and**

Yes
GO to Q10 .

No
REPAIR the circuit in question. CLEAR any DTCs present. TEST the system for normal operation.

greater than 10,000 ohms between the clockspring and ground?	
Q10 CHECK THE REFERENCE VOLTAGE CIRCUITS TO THE CLOCKSPRING	
• Ignition OFF. • Disconnect: Clockspring C218a. • Ignition ON. • For vehicles without the SYNCÂ® system, measure the voltage between the lower clockspring C218a-6, circuit VME54 (BU/OG) and C218a-12, circuit RME24 (BU/WH); and between the lower clockspring C218a-13, circuit VME14 (GY/YE) and C218a-12, circuit RME24 (BU/WH).  N0109470 • For vehicles with the SYNCÂ® system, measure the voltage between the lower clockspring C218a-6, circuit VME54 (BU/OG) and C218a-4, circuit RME24 (BU/WH); and between the lower clockspring C218a-13, circuit VME14 (GY/YE) and C218a-12, circuit RME24 (BU/WH).  N0109470 • **Is the voltage approximately 5 volts?**	**Yes** INSTALL a new clockspring. REFER to Section 501-20B . CLEAR any DTCs present. TEST the system for normal operation. **No** INSTALL a new ACM. REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation.
Q11 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Connect: All Disconnected Connectors. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded

	connector. CLEAR any DTCs present.
Q12 CHECK FOR CORRECT APIM OPERATION	
• Connect: All Disconnected Connectors. • Disconnect the APIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the APIM connector and make sure it seats correctly. • Wait 2 minutes for the APIM to re-initalize. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs present.

Pinpoint Test R: The Audio Input Jack Is Inoperative/Does Not Operate Correctly

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation â Vehicles Without the SYNCÂ® System

Audio signals are sent from the audio input jack to the Audio Front Control Module (ACM). There are no external power or ground circuits to the audio input jack.

Vehicles With the SYNCÂ® System

Audio signals are sent from the audio input jack to the Accessory Protocol Interface Module (APIM). The signals are then sent to the ACM . There are no external power or ground circuits to the audio input jack.

- DTC B1D78:13 (Auxiliary Input: Circuit Open) â sets in continuous memory by the navigation ACM (vehicles without the SYNCÂ® system only) when an open is detected in the audio input jack circuitry for greater than 250 milliseconds.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Audio input jack
- APIM (vehicles with the SYNCÂ® system)
- ACM (vehicles without the SYNCÂ® system)

PINPOINT TEST R: THE AUDIO INPUT JACK IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Before carrying out this pinpoint test, make sure the MP3 device is operating correctly.

Test Step	Result / Action to Take
R1 CHECK THE AUDIO INPUT JACK AUDIO	

<table>
<tr><td>• Connect: Multi-Media Interface Tester .
• Using the Multi-Media Interface Tester, attempt to play an audio file using the audio input jack.
• Does the file play correctly?</td><td>Yes
The system is operating correctly at this time. The concern may be with the customer device.

No
GO to R2 .</td></tr>
<tr><td>R2 DETERMINE THE VEHICLE CONTENT</td><td></td></tr>
<tr><td>• Determine if the vehicle is equipped with the SYNCÂ® system.
• Is the vehicle equipped with the SYNCÂ® system?</td><td>Yes
GO to R3 .

No
GO to R4 .</td></tr>
<tr><td>R3 CHECK THE APIM AUDIO OUTPUT</td><td></td></tr>
<tr><td>• Using the Multi-Media Interface Tester, attempt to play an audio file using either the Universal Serial Bus (USB) port or Bluetooth.
• Is the audio output OK for the USB port or Bluetooth?</td><td>Yes
GO to R4 .

No
GO to Pinpoint Test H .</td></tr>
<tr><td>R4 CHECK THE AUDIO INPUT JACK CIRCUITS FOR A SHORT TO VOLTAGE</td><td></td></tr>
<tr><td>• Ignition OFF.
• Disconnect: Audio Input Jack C2401 (Vehicles Without the SYNCÂ® System) or C3337 (Vehicles With the SYNCÂ® System) .
• Disconnect: ACM C240c (Vehicles Without the SYNCÂ® System) or APIM C3338 (Vehicles With the SYNCÂ® System) .
• Ignition ON.
• Measure the voltage between the audio input jack, harness side and ground as follows:

<table><tr><th>Positive Meter Lead</th><th>Negative Meter Lead</th></tr><tr><td>C2401-1 or C3337-1

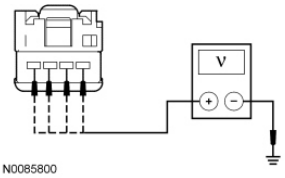
VME46 (BU/GN)</td><td>Ground</td></tr><tr><td>C2401-2 or C3337-2

RME46 (WH/GN)</td><td>Ground</td></tr><tr><td>C2401-3 or C3337-3

RME45 (YE/GN)</td><td>Ground</td></tr><tr><td>C2401-4 or C3337-4

VME45 (BU)</td><td>Ground</td></tr></table></td><td>Yes
REPAIR the circuit in question. TEST the system for normal operation.

No
GO to R5 .</td></tr>
</table>

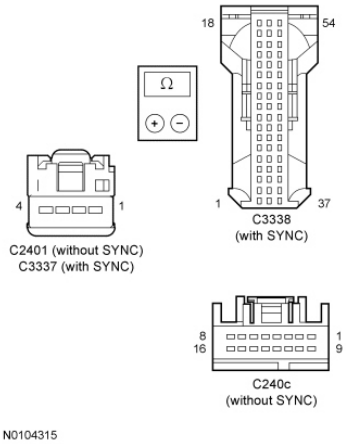


- **Is any voltage present?**

R5 CHECK THE AUDIO INPUT JACK CIRCUITS FOR AN OPEN OR SHORT TO GROUND

- Ignition OFF.
- Measure the resistance between the audio input jack, harness side and the ACM (or APIM , if equipped with the SYNCÂ® system), harness side; and between the audio input jack, harness side and ground as follows:

Positive Meter Lead	Negative Meter Lead	Circuit
C2401-1 or C3337-1	C240c-6 or C3338-47, then ground	VME46 (BU/GN)
C2401-2 or C3337-2	C240c-14 or C3338-48, then ground	RME46 (WH/GN)
C2401-3 or C3337-3	C240c-8 or C3338-46, then ground	RME45 (YE/GN)
C2401-4 or C3337-4	C240c-7 or C3338-45, then ground	VME45 (BU)



- **Is the resistance less than 5 ohms between the audio input jack and the ACM (or APIM , if equipped with the SYNCÂ® system), and greater than 10,000 ohms between the audio input jack and ground?**

Yes
GO to R6 .

No
REPAIR the circuit in question. TEST the system for normal operation.

R6 ISOLATE THE AUDIO INPUT JACK

• Connect: ACM C240c (Vehicles Without the SYNCÂ® System) or APIM C3338 (Vehicles With the SYNCÂ® System) . • Install a known good audio input jack. Refer to Audio Input Jack in this section. • Connect: Multi-Media Interface Tester . • Using the Multi-Media Interface Tester, attempt to play an audio file using the audio input jack. • **Does the file play correctly?**	**Yes** The concern was caused by an inoperative audio input jack. The system is operating correctly at this time. **No** For vehicles without the SYNCÂ® system, GO to R7 . For vehicles with the SYNCÂ® system, GO to R8 .
R7 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
R8 CHECK FOR CORRECT APIM OPERATION	
• Ignition OFF. • Disconnect the APIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the APIM connector and make sure it seats correctly. • Wait 2 minutes for the APIM to re-initialize. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test S: Loud Popping Sound When Cycling The Ignition Switch

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

Voltage is sent through the start input circuit to the Audio Front Control Module (ACM) with the ignition in the START position. Upon receiving this signal, the ACM mutes all speaker outputs to eliminate the possibility of voltage spikes producing a popping noise through the speakers.

For premium sound, the ACM disables the audio amplifier and subwoofer amplifier while the ignition is in

the START position by keeping the enable circuit voltages below 0.4 volt.

For the SonyÂ® and THXÂ® sound systems, the ACM disables the audio Digital Signal Processing (DSP) module while the ignition is in the START position by keeping the enable circuit voltage below 0.4 volt.

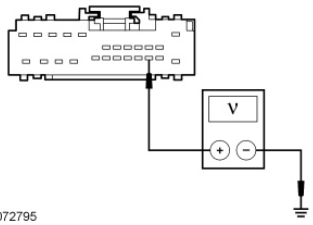
If there is a short to voltage on any of the enable circuits, distortion is heard in the speakers whenever the ACM is powered up, and that should be the primary concern addressed. If the speakers have distorted sound, GO to Symptom Chart - Sound Quality .

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- ACM

PINPOINT TEST S: LOUD POPPING SOUND WHEN CYCLING THE IGNITION SWITCH

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
S1 CHECK THE START INPUT CIRCUIT VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240a . • Disconnect: Starter Relay . • Hold the key in the START position. • Measure the voltage between the ACM C240a-15, circuit CBP28 (GY/VT), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** VERIFY the Smart Junction Box (SJB) fuse 28 (5A) is OK. If OK, REPAIR the circuit. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

Pinpoint Test T: The Speed Sensitive Volume Does Not Operate Correctly

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio/Navigation for schematic and connector information.

Normal Operation

The speed sensitive volume function adjusts the volume based on the Vehicle Speed Sensor (VSS) signal from the Instrument Panel Cluster (IPC). The IPC does not generate the VSS signal; it gateways the signal

from the PCM. The Smart Junction Box (SJB) also receives this signal and should exhibit symptoms if the signal is lost.

This pinpoint test is intended to diagnose the following:

- Speed sensitive volume setting
- VSS signal concern
- Communication network concern
- ACM

PINPOINT TEST T: THE SPEED SENSITIVE VOLUME DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
T1 CHECK THE SPEEDOMETER OPERATION	
• Drive the vehicle and observe the speedometer. • **Does the speedometer operate correctly?**	**Yes** GO to T2 . **No** REFER to Section 413-01 .
T2 CHECK THE SPEED SENSITIVE VOLUME SETTING	
• Turn the speed sensitive volume off. Refer to the Owner's Literature. • Operate the audio system in radio tuner (AM/FM) mode. • Drive the vehicle at various speeds and observe the speaker volume. • Set the speed sensitive volume to maximum compensation. Refer to the Owner's Literature. • Operate the audio system in radio tuner (AM/FM) mode. • Drive the vehicle at various speeds and observe the speaker volume. • **Does the volume remain constant with the speed sensitive volume turned off, and increase and decrease with vehicle speed with the speed sensitive volume set to maximum?**	**Yes** The system is operating correctly at this time. INSTRUCT the customer in the correct usage of the speed sensitive volume feature. **No** GO to T3 .
T3 CHECK FOR DTC U0155 OR DTC U0155:00	
• Using the scan tool, retrieve all continuous DTCs. • **Is DTC U0155 or DTC U0155:00 retrieved in any module?**	**Yes** GO to Pinpoint Test AG . **No** GO to T4 .
T4 CHECK FOR CORRECT ACM OPERATION	
• Disconnect all the ACM connectors.	**Yes** INSTALL a new ACM . REFER to Audio

• Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs present.

Pinpoint Test U: The Audio Does Not Reduce When The Parking Aid Tone Sounds

Normal Operation

The Parking Aid Module (PAM) sends the volume cutback message to the Audio Front Control Module (ACM) via the Medium Speed Controller Area Network (MS-CAN). When the PAM sounds the parking aid tone, it broadcasts an enabled message to the ACM . When the ACM receives this message, it reduces the speaker output so that the parking aid tone can be heard more clearly.

- DTC U0159 (Lost Communication With Parking Assist Control Module (PAM)) â set by the non-navigation (Fusion) ACM when the volume cutback message is missing for greater than 5 seconds. When the message is missing, the ACM defaults to no volume cutback when the parking aid tone is sounding.
- DTC U0159:00 (Lost Communication With Parking Assist Control Module "A": No Sub Type Information) â set by the non-navigation (MKZ) or the navigation (all) ACM when the volume cutback message is missing for greater than 5 seconds. When the message is missing, the ACM defaults to no volume cutback when the parking aid tone is sounding.

This pinpoint test is intended to diagnose the following:

- Parking aid system concern
- ACM

PINPOINT TEST U: THE AUDIO DOES NOT REDUCE WHEN THE PARKING AID TONE SOUNDS

Test Step	Result / Action to Take
U1 CHECK THE PARKING AID SIGNAL	
• Apply the parking brake. • Place an object behind the vehicle within the range of the parking aid sensors. Refer to Section 413-13 . • Ignition ON. • Place the transmission in REVERSE (R). • Enter the following diagnostic mode on the scan tool: ACM DataLogger . • Monitor the parking aid input status PID (RPA_STAT) while the parking aid tone is sounding.	**Yes** GO to U2 . **No** REFER to Section 413-13 to continue diagnosis of the parking aid system.

• **Does the PID read "Enabled" when the parking aid tone is sounding?**	
U2 CHECK FOR CORRECT ACM OPERATION	
• Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test V: Voice Recognition Is Inoperative/Does Not Operate Correctly

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation â Vehicles Without Navigation

When the VOICE switch is pressed, it changes a reference voltage signal, and the audio system enters voice recognition mode. The VOICE switch is wired to the Accessory Protocol Interface Module (APIM).

Vehicles With Navigation

When the VOICE switch is pressed, it changes a reference voltage signal, and the audio system enters voice recognition mode. The VOICE switch is wired to the Audio Front Control Module (ACM). The APIM receives the microphone input and also broadcasts it to the ACM . The first voice commands spoken determine which system handles the voice commands.

The microphone test is available through the scan tool or through the ACM self-diagnostic mode. Running this test causes the ACM to produce a test tone. If the system is operating correctly, the microphone detects the tone and produces a signal to the ACM indicating the tone was heard.

- DTC B1A16:01 (Microphone Input Circuit: General Electrical Failure) â set by the APIM during the on-demand self-test if it does not detect the microphone.
- DTC B1D79:01 (Microphone Input Circuit: General Electrical Failure) â set by the ACM during the microphone test when it does not receive an adequate signal from the microphone when the test tone is sounded.

This pinpoint test is intended to diagnose the following:

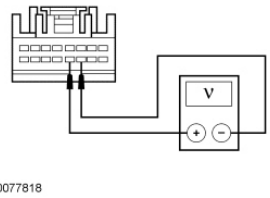
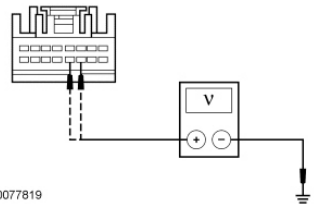
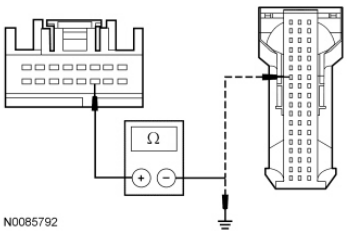
- Wiring, terminals or connectors
- Microphone
- Steering wheel controls
- ACM (if equipped with navigation)
- APIM (if equipped)

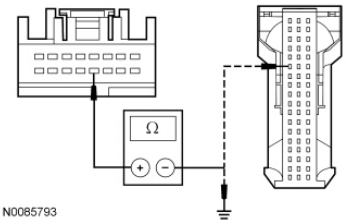
PINPOINT TEST V: VOICE RECOGNITION IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
V1 CHECK THE OPERATION OF THE STEERING WHEEL CONTROLS	
• Operate the audio system in radio tuner (AM/FM) mode. • Press the VOICE switch on the steering wheel controls. • **Does the audio system enter voice recognition mode?**	**Yes** GO to V2 . **No** GO to Pinpoint Test Q to diagnose the steering wheel controls system.
V2 CHECK THE OPERATION OF THE VOICE RECOGNITION	
• Press the VOICE switch on the steering wheel controls. • Wait for the audio system to acknowledge the VOICE switch being pressed. • While still in voice recognition mode, speak the command "PHONE", and observe the audio system. • **Does the audio system acknowledge the command "PHONE"?**	**Yes** If the vehicle is equipped with navigation, GO to V3 . Otherwise, the system is operating correctly at this time. ADVISE the customer on the correct operation of the voice recognition system. **No** GO to V6 .
V3 CHECK THE MICROPHONE SIGNAL TO THE ACM	
• Operate the audio system in radio tuner (AM/FM) mode. • Disconnect: ACM C240c. • **NOTE:** ACM C240c must be disconnected after the ACM is powered on or the ACM will not receive the RUN message over the network. • Press the VOICE switch on the steering wheel controls. • While speaking a command, measure the AC voltage between the ACM C240c-11, circuit VMM13 (YE/GN), harness side and the ACM C240c-12, circuit RMM13 (BU), harness side.	**Yes** GO to V13 . **No** GO to V4 .

 N0077818 • **Is a fluctuating AC voltage present?**	
V4 CHECK THE MICROPHONE CIRCUITS TO THE ACM FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: APIM C3338. • Ignition ON. • Measure the voltage between the ACM C240c-11, circuit VMM13 (YE/GN), harness side and ground; and between the ACM C240c-12, circuit RMM13 (BU), harness side and ground.  N0077819 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to V5 .
V5 CHECK THE MICROPHONE CIRCUITS TO THE ACM FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the ACM C240c-11, circuit VMM13 (YE/GN), harness side and the APIM C3338-12, circuit VMM13 (YE/GN), harness side; and between the ACM C240c-11, circuit VMM13 (YE/GN), harness side and ground.  N0085792 • Measure the resistance between the ACM C240c-12, circuit RMM13 (BU), harness side and the APIM C3342-13, circuit RMM13 (BU), harness side; and between the ACM C240c-12, circuit RMM13 (BU), harness side and ground.	**Yes** GO to V9 . **No** REPAIR the circuit in question. TEST the system for normal operation.

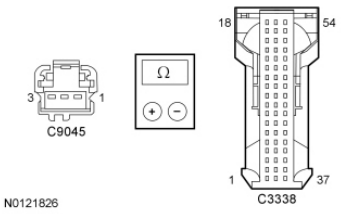


- **Is the resistance less than 5 ohms between the ACM and the APIM , and greater than 10,000 ohms between the ACM and ground?**

V6 CHECK THE MICROPHONE CIRCUITS FOR AN OPEN

- Ignition OFF.
- Disconnect: Microphone C9045.
- Disconnect: APIM C3338.
- Measure the resistance between the microphone, harness side and between the APIM , harness side as follows:

Positive Meter Lead	Negative Meter Lead	Circuit
C9045-1	C3338-18	RMM13 (BU)
C9045-2	C3338-5	VMM13 (YE/GN)
C9045-3	C3338-6	DMM13 (none)



- **Are the resistances less than 5 ohms?**

Yes
GO to V7 .

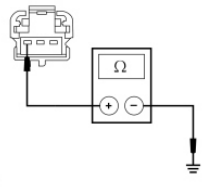
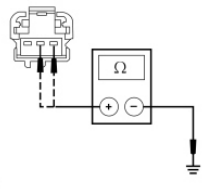
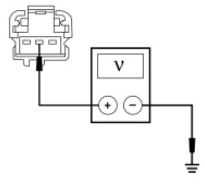
No
REPAIR the circuit in question. TEST the system for normal operation.

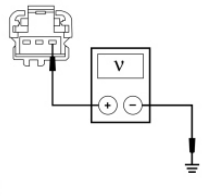
V7 CHECK THE MICROPHONE SHIELD

- Disconnect: Negative Battery Cable.
- Measure the resistance between the microphone C9045-3, circuit DMM13 (none), harness side and ground.

Yes
CONNECT the negative battery cable. GO to V8 .

No
REPAIR the circuit for an open. TEST the system for normal operation.

 N0121825 • **Is the resistance less than 5 ohms?**	
V8 CHECK THE MICROPHONE CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the microphone C9045-1, circuit RMM13 (BU), harness side and ground; and between the microphone C9045-2, circuit VMM13 (YE/GN), harness side and ground.  N0121824 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to V9 . **No** REPAIR the circuit in question. TEST the system for normal operation.
V9 CHECK THE MICROPHONE SIGNAL CIRCUIT FOR A SHORT TO VOLTAGE	
• Measure the voltage between the microphoneC9045-2, circuit VMM13 (YE/GN), harness side and ground.  N0121828 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to V10 .
V10 CHECK THE MICROPHONE VOLTAGE SUPPLY CIRCUIT	
• Connect: APIM C3338. • Ignition ON. • Measure the voltage between the microphone C9045-1, circuit RMM13 (BU), harness side and ground.	**Yes** GO to V11 . **No** GO to V12 .

 • **Is the voltage greater than 10 volts?**	
V11 ISOLATE THE MICROPHONE	
• Connect: APIM C3342. • Install a new microphone. Refer to Microphone in this section. • Operate the audio system in radio tuner (AM/FM) mode. • Press the VOICE switch on the steering wheel controls and attempt several voice commands. • **Does the voice recognition operate correctly?**	**Yes** The fault was caused by an inoperative microphone. The system is now operating correctly. **No** GO to V12 .
V12 CHECK FOR CORRECT APIM OPERATION	
• Connect: All Disconnected Connectors. • Disconnect the APIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the APIM connector and make sure it seats correctly. • Wait 2 minutes for the APIM to re-initalize. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
V13 CHECK FOR CORRECT ACM OPERATION	
• Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test W: No Global Positioning System (GPS) Antenna Signal

Normal Operation

The Global Positioning System (GPS) antenna provides information from the GPS satellite system to the Audio Front Control Module (ACM). This information is used to calculate position and direction of travel.

A splitter is used in the front satellite radio antenna cable to split the signals between the satellite radio and the

GPS . It is possible that a concern in the GPS signal line after the splitter may cause a navigation system concern without affecting the satellite radio.

- DTC B119F:01 (GPS Antenna: General Electrical Failure) â sets when any failure is detected in the GPS antenna circuit.
- DTC B119F:13 (GPS Antenna: Circuit Open) â sets when an open is detected in the GPS antenna circuit.

This pinpoint test is intended to diagnose the following:

- Satellite radio antenna cable
- AM/FM/SDARS/NAV radio antenna
- ACM

PINPOINT TEST W: NO GPS ANTENNA SIGNAL

Test Step	Result / Action to Take
W1 CHECK THE SATELLITE SIGNAL PID (SAT_SIG_STR)	
• Enter the following diagnostic mode on the scan tool: ACM DataLogger . • Monitor the ACM PID (SAT_SIG_STR). • **Does the PID indicate "No Signal"?**	**Yes** GO to Pinpoint Test B . **No** GO to W2 .
W2 CHECK FOR GPS SIGNAL-RELATED DTCs	
• Clear the ACM DTCs. • Carry out the ACM self-test. • **Is DTC B119F:01 or DTC B119F:13 retrieved?**	**Yes** INSTALL a new front satellite radio antenna cable. REFER to Antenna Cable â Satellite Radio in this section. CLEAR the DTCs. TEST the system for normal operation. **No** GO to W3 .
W3 SUBSTITUTE KNOWN GOOD ANTENNA	
• Ignition OFF. • Install a known good AM/FM/SDARS/NAV antenna. Antenna â AM/FM/Satellite Radio/Navigation . • **Is the concern still present?**	**Yes** GO to W4 . **No** INSTALL a new AM/FM/SDARS/NAV radio antenna. REFER to Antenna â AM/FM/Satellite Radio/Navigation in this section. TEST the system for normal operation.
W4 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect all the ACM	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â

connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs present.

Pinpoint Test X: The Position Cursor Is Inaccurate

Normal Operation

The primary source of vehicle location for the navigation system is the Audio Front Control Module (ACM) receiving the position signal through the Global Positioning System (GPS) antenna (integral to the satellite radio antenna).

In addition, the ACM receives the navigation rolling wheel count signal from the Instrument Panel Cluster (IPC) (which gateways the signal from the ABS module). This secondary signal is used to calculate vehicle position when the GPS signal is lost. It also supports the adaptive learning function of the ACM , whereby the ACM can compensate for long-term differences between the GPS signal location and the actual distance traveled by the vehicle.

If DTC B119F:01 or DTC B119F:13 is present, GO to Pinpoint Test W to diagnose a concern with the GPS antenna.

- DTC U2014:09 (Control Module Hardware: Component Failure) â sets when the ACM detects a fault in the internal gyroscope. The gyroscope is not serviceable.

This pinpoint test is intended to diagnose the following:

- GPS antenna concern
- Network message concern
- ACM

PINPOINT TEST X: THE POSITION CURSOR IS INACCURATE

Test Step	Result / Action to Take
X1 CHECK THE ACM FOR GPS SIGNAL-RELATED DTCs	
• Retrieve the ACM continuous DTCs. • **Is DTC B119F:01 or DTC B119F:13 present?**	**Yes** GO to Pinpoint Test W . **No** GO to X2 .
X2 CHECK FOR DTC U0155:00	
• Review the ACM continuous	**Yes** GO to Pinpoint Test AG .

DTCs. • **Is DTC U0155:00 present?**	**No** GO to X3 .
X3 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs present.

Pinpoint Test Y: The Voice Guidance Is Inoperative/Does Not Operate Correctly

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation â Premium Sound

The voice-assisted route guidance is broadcast through the front speakers. The voice guidance volume can be adjusted using the settings on the Audio Front Control Module (ACM).

SonyÂ® or THXÂ® Sound

The voice-assisted route guidance is broadcast through the instrument panel speaker. The volume can be adjusted using the settings on the ACM . The ACM sends the voice guidance audio signals to the audio Digital Signal Processing (DSP) module through a dedicated pair of circuits.

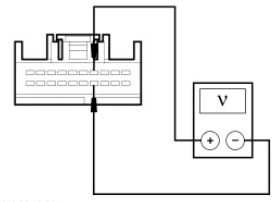
- DTC B1A07:01 (Speaker #7: General Electrical Failure) â sets when a fault is detected in the navigation audio circuits.

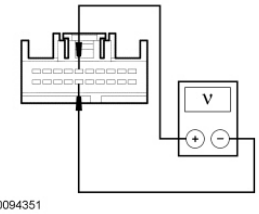
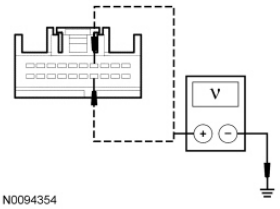
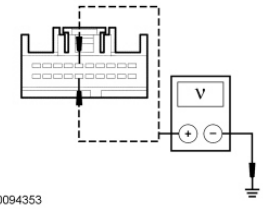
This pinpoint test is intended to diagnose the following:

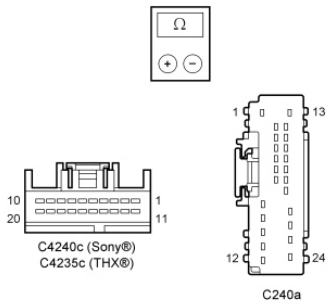
- Incorrect voice guidance setting
- Wiring, terminals or connectors (except premium sound)
- Audio DSP module (except premium sound)
- ACM

PINPOINT TEST Y: THE VOICE GUIDANCE IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
Y1 CHECK THE VOICE GUIDANCE SETTING	
• Adjust the voice volume to approximately 50%. Refer to the Owner's Literature. • Set a destination and start the route using the navigation controls. Refer to the Owner's Literature. • Observe the voice guidance. • **Does the voice guidance operate correctly?**	**Yes** The concern was caused by an incorrect customer setting. INSTRUCT the customer in the correct use of the voice guidance feature. **No** GO to Y2 .
Y2 CHECK THE SPEAKER OUTPUT	
• Carry out the speaker walk test. Refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section. • **Do the front speakers (premium sound) or instrument panel speaker (SonyÂ® or THXÂ® sound) operate correctly?**	**Yes** For premium sound, GO to Y6 . For SonyÂ® or THXÂ® sound, GO to Y3 . **No** For premium sound, GO to Pinpoint Test D . For SonyÂ® sound, GO to Pinpoint Test E . For THXÂ® sound, GO to Pinpoint Test F .
Y3 CHECK THE NAVIGATION AUDIO SIGNAL TO THE AUDIO DSP MODULE	
• Ignition OFF. • Disconnect: Audio DSP Module 4240c (SonyÂ®) Or C4235c (THXÂ®) . • Operate the audio system in navigation mode. • For SonyÂ® sound, while pressing the REPEAT button on the ACM , measure the AC voltage between the audio DSP module C4240c-4, circuit VMN07 (GY), harness side and the audio DSP module C4240c-14, circuit RMN07 (VT), harness side.  N0094352 • For THXÂ® sound, while pressing the REPEAT button on the ACM , measure the AC voltage between the audio DSP module C4235c-6, circuit VMN07 (GY), harness side and the audio DSP module C4235c-16, circuit RMN07	**Yes** GO to Y7 . **No** GO to Y4 .

(VT), harness side.  N0094351 • **Is a fluctuating AC voltage present?**	
Y4 CHECK THE NAVIGATION AUDIO SIGNAL CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240a . • Ignition ON. • For SonyÂ® sound, measure the voltage between the audio DSP module C4240c-4, circuit VMN07 (GY), harness side and ground; and between the audio DSP module C4240c-14, circuit RMN07 (VT), harness side and ground.  N0094354 • For THXÂ® sound, measure the voltage between the audio DSP module C4235c-6, circuit VMN07 (GY), harness side and ground; and between the audio DSP module C4235c-16, circuit RMN07 (VT), harness side and ground.  N0094353 • **Is any voltage present?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to Y5 .
Y5 CHECK THE NAVIGATION AUDIO SIGNAL CIRCUITS FOR AN OPEN OR SHORT TO GROUND	

• Ignition OFF. • Measure the resistance between the audio DSP module, harness side and the ACM , harness side; and between the audio DSP module, harness side and ground as follows: **Sound System / Positive Meter Lead / Negative Meter Lead / Circuit** SonyÂ® / C4240c-4, then ground / C240a-2 / VMN07 (GY) / C4240c-14, then ground / C240a-14 / RMN07 (VT) THXÂ® / C4235c-6, then ground / C240a-2 / VMN07 (GY) / C4235c-16, then ground / C240a-14 / RMN07 (VT)  N0102377 • **Is the resistance less than 5 ohms between the audio DSP module and the ACM , and greater than 10,000 ohms between the audio DSP module and ground?**	**Yes** GO to Y6 . **No** REPAIR the circuit in question. TEST the system for normal operation.
Y6 CHECK FOR CORRECT ACM OPERATION	
• Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation after the repair. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Y7 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	
• Disconnect all the audio DSP module connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the audio DSP module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test Z: The SYNCÂ® System Is Completely Inoperative

Normal Operation

When a button on the Front Controls Interface Module (FCIM) is pressed, a network message is sent to the Accessory Protocol Interface Module (APIM) via the Medium Speed Controller Area Network (MS-CAN). The APIM takes the appropriate action and sends a status message to the Front Display Interface Module (FDIM) (vehicles without navigation) or the Audio Front Control Module (ACM) (vehicles with navigation) in order to update the display screen.

- DTC U3000:04 (Control Module: System Internal Failure) â sets when the APIM detects a fault due to a device conflict or an internal failure.

This pinpoint test is intended to diagnose the following:

- Audio system concern
- Communication network concern
- Customer error
- Customer device
- APIM

PINPOINT TEST Z: THE SYNCÂ® SYSTEM IS COMPLETELY INOPERATIVE

Test Step	Result / Action to Take
Z1 CHECK FOR SCAN TOOL COMMUNICATION WITH THE APIM	
• Carry out the network test using the scan tool. • **Does the APIM pass the network test?**	**Yes** GO to Z2 . **No** REFER to Section 418-00 .
Z2 CHECK THE SYNCÂ® SYSTEM OPERATION	
	Yes The SYNCÂ® system is operating correctly at this time.

NOTE: Carrying out a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNCÂ® system. • Connect: Multi-Media Interface Tester. • Using the Multi-Media Interface Tester, test the audio output for the audio input jack, USB port, and Bluetooth connection using the VOICE switch on the steering wheel controls to enter each mode. • **Do all of the SYNCÂ® inputs function correctly?**	CARRY OUT a SYNCÂ® system Master Reset. Refer to the Owner's Literature. REVIEW the SYNCÂ® system operation with the customer. If the customer device still does not operate correctly, the fault is with the customer device. **No** GO to Z3 .
Z3 RESET THE APIM AND RECHECK SYNCÂ® SYSTEM OPERATION	
• Carry out an APIM power reset by disconnecting the battery for 5 minutes, then reconnecting it. • Connect: Multi-Media Interface Tester. • Using the Multi-Media Interface Tester, test the audio output for the audio input jack, USB port, and Bluetooth connection using the VOICE switch on the steering wheel controls to enter each mode. • **Do all of the SYNCÂ® inputs function correctly?**	**Yes** The SYNCÂ® system is operating correctly at this time. CARRY OUT a SYNCÂ® system Master Reset. REFER to the Owner's Literature. REVIEW the SYNCÂ® system operation with the customer. If the customer device still does not operate correctly, the fault is with the customer device. **No** If only some (but not all) of the inputs are inoperative, GO to Symptom Chart - SYNCÂ®System to diagnose the observed symptom. If all inputs are inoperative and/or DTC U3000:04 is present, INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section.

Pinpoint Test AA: Unable To Pair Bluetooth Device

Normal Operation

When a new Bluetooth device is added, the Accessory Protocol Interface Module (APIM) and the Bluetooth device must be paired together. Most Bluetooth devices can pair with the SYNCÂ® system, although functionality may vary. To determine if a Bluetooth device is supported, retrieve the Consumer Interface Processor (CIP) software level using the Accessory Protocol Interface Module (APIM) Software Level Check in this section, and verify the customer device is on the compatibility list for the current CIP software level.

Pairing a Bluetooth device is accomplished through the "Add Device" selection of the phone menu. When pairing a device, the SYNCÂ® system generates a unique Personal Identification Number (PIN) that must be entered on the Bluetooth device in order for the pairing process to be successful. There are also some device-specific actions that must take place. For additional information on the pairing process, refer to the Owner's Literature.

This pinpoint test is intended to diagnose the following:

- Incompatible Bluetooth device
- Customer error
- Customer Bluetooth device
- APIM

PINPOINT TEST AA: UNABLE TO PAIR BLUETOOTH DEVICE

Test Step	Result / Action to Take
AA1 CHECK THE BLUETOOTH CONNECTION	
NOTE: Carrying out a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNCÂ® system. • Connect: Multi-Media Interface Tester . • Using the Multi-Media Interface Tester, connect to the SYNCÂ® system using Bluetooth. Follow the tool instructions. • Enter the following diagnostic mode on the scan tool: APIM DataLogger . • Monitor the Bluetooth device paired PID (BT_PAIR) and the Bluetooth device connected PID (BT_CONN). • **Do the PIDs BT_PAIR and BT_CONN both read "Yes"?**	**Yes** The SYNCÂ® system is operating correctly at this time. CARRY OUT a SYNCÂ® system Master Reset. REFER to the Owner's Literature. REVIEW the pairing process with the customer. If the customer device still does not pair, the fault is with the customer device. **No** GO to AA2 .
AA2 CHECK FOR CORRECT APIM OPERATION	
• Disconnect the APIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the APIM connector and make sure it seats correctly. • Wait 2 minutes for the APIM to re-initalize. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AB: The Universal Serial Bus (USB) Port Is Inoperative/Does Not Operate Correctly

Normal Operation

The Universal Serial Bus (USB) port is connected to the Accessory Protocol Interface Module (APIM) through the USB cable. The USB port can be used to play audio files or upload software from mass storage devices, or for connecting a media device.

If supported by the user device, the USB can provide charging. Because of this feature, when a USB device is plugged into the USB port, the SYNCÂ® system does not automatically switch to the device.

If a USB mass storage device is used to play an audio file, the SYNCÂ® system only plays audio files that do not have Digital Rights Management (DRM) protection.

The USB cable and port are not serviceable separately.

- DTC B1252:04 (USB Port: System Internal Failure) â sets when the APIM detects an over-temperature condition in the USB circuit. This can be caused by a fault in the USB cable and port, or by the customer USB device.
- DTC B1252:11 (USB Port: Circuit Short to Ground) â sets when the APIM detects an over-current condition in the USB circuit. This can be caused by a fault in the USB cable and port, or by the customer USB device.

This pinpoint test is intended to diagnose the following:

- Customer USB device
- USB cable and port
- APIM

PINPOINT TEST AB: THE USB PORT IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
AB1 CHECK THE USB CONNECTION	
• Connect: Multi-Media Interface Tester. • Using the Multi-Media Interface Tester, attempt to play a file using the USB port. • **Does the audio file play successfully using the USB connection?**	**Yes** The SYNCÂ® system is operating correctly. REVIEW the operation of the USB port with the customer. If the customer device still does not operate correctly, the fault is with the customer device. **No** GO to AB2 .
AB2 INSPECT THE USB CABLE	
• Ignition OFF. • Disconnect: USB Cable At APIM . • Inspect the USB cable for damage. • Connect: USB Cable At APIM . • Ignition ON. • Connect: Multi-Media Interface Tester. • Using the Multi-Media Interface Tester, attempt to play a file using the USB port. • **Does the audio file play successfully using the USB connection?**	**Yes** The concern was caused by the USB connection not being seated correctly. The system is now operating correctly. **No** GO to AB3 .
AB3 RESET THE APIM AND RECHECK SYNCÂ® SYSTEM OPERATION	
	Yes The SYNCÂ® system is operating correctly at this time.

NOTE: Carrying out a Master Reset returns all preference settings to the factory defaults, erases all the phone book and call histories, and deletes any devices paired with the SYNCÂ® system. • Carry out an APIM power reset by disconnecting the battery for 5 minutes, then reconnecting it. • Connect: Multi-Media Interface Tester. • Using the Multi-Media Interface Tester, test the audio output for the audio input jack, USB port, and Bluetooth connection using the VOICE switch on the steering wheel controls to enter each mode. • **Do all of the SYNCÂ® inputs function correctly?**	CARRY OUT a SYNCÂ® system Master Reset. REFER to the Owner's Literature. REVIEW the SYNCÂ® system operation with the customer. If the customer device still does not operate correctly, the fault is with the customer device. **No** If only the USB port is inoperative, GO to AB4 . If additional inputs are inoperative, GO to Symptom Chart - SYNCÂ®System to diagnose the observed symptom. If all inputs are inoperative, INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section.
AB4 ISOLATE THE USB CABLE AND PORT	
• Install a new USB cable and port. Refer to Universal Serial Bus (USB) Cable and Port in this section. • Connect: Multi-Media Interface Tester. • Using the Multi-Media Interface Tester, attempt to play a file using the USB port. • **Does the audio file play successfully using the USB connection?**	**Yes** The concern was caused by an inoperative USB cable. The system is now operating correctly. **No** GO to AB5 .
AB5 CHECK FOR CORRECT APIM OPERATION	
• Disconnect the APIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the APIM connector and make sure it seats correctly. • Wait 2 minutes for the APIM to re-initalize. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs present.

Pinpoint Test AC: The SYNCÂ® System Audible Prompts Are Inoperative/Do Not Operate Correctly

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Text-To-Speech (TTS) and voice prompt features speak certain text information and interaction requests in order to minimize driver distraction while driving. The ringtone alerts the driver to an incoming call.

Audible prompts can range from a simple tone to more elaborate spoken text, based on the customer setting. When interaction mode is set to standard, detailed guidance is provided. When interaction mode is set to advanced, most prompts are tones only and minimal audible guidance is provided. Refer to the Owner's Literature for further information on voice interaction.

The audio signals for the TTS and voice prompt features, the ringtones, and audio from the outside device during a phone call, are sent from the Accessory Protocol Interface Module (APIM) to the Audio Front Control Module (ACM).

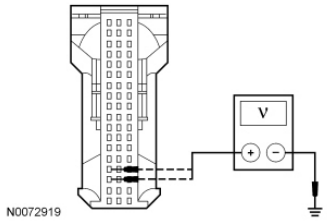
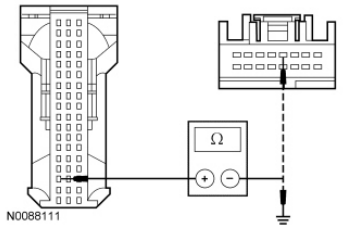
This pinpoint test is intended to diagnose the following:

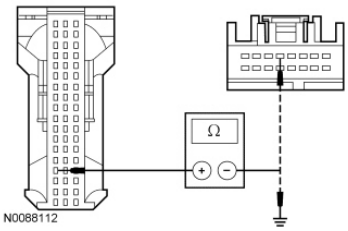
- Customer setting
- Wiring, terminals or connectors
- ACM
- APIM

PINPOINT TEST AC: THE SYNCÂ® SYSTEM AUDIBLE PROMPTS ARE INOPERATIVE/DO NOT OPERATE CORRECTLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
AC1 CHECK THE AUDIBLE PROMPT SETTING	
• Operate the audio system in SYNCÂ® mode. • Verify the audible prompts are enabled. Refer to "SYNCÂ® Voice Recognition Feature" in the Owner's Literature. • Press the VOICE switch on the steering wheel controls and observe the SYNCÂ® system audible prompt. • **Does the SYNCÂ® system produce an audible prompt correctly?**	**Yes** The system is operating correctly at this time. The concern was caused by a customer setting. INSTRUCT the customer in the correct operation of the audible prompt feature. **No** GO to AC2 .
AC2 CHECK FOR A VOLTAGE SIGNAL FROM THE APIM	
NOTICE: **This pinpoint test step directs testing circuits using a back-probe method. Use the special back-probe tool specified in the tool list in this section. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring,**	**Yes** For vehicles with navigation, GO to Pinpoint Test Y . Otherwise, GO to AC6 . **No**

terminals, or connectors and subsequent electrical faults. • Operate the audio system in SYNCÂ® mode. • While pressing the VOICE switch repeatedly, measure the AC voltage by back-probing between the ACM C240c-4, circuit VMN14 (WH/VT), harness side and the ACM C240c-5, circuit RMN14 (GY/BN), harness side. • **Is an AC voltage produced each time the VOICE switch is pressed?**	GO to AC3 .
AC3 CHECK THE AUDIBLE PROMPT CIRCUITS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: ACM C240c . • Disconnect: APIM C3338 . • Ignition ON. • Measure the voltage between the APIM C3338-3, circuit VMN14 (WH/VT), harness side and ground; and between the APIM C3338-4, circuit RMN14 (GY/BN), harness side and ground.  • **Is any voltage present?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to AC4 .
AC4 CHECK THE AUDIBLE PROMPT CIRCUITS FOR AN OPEN OR SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the APIM C3338-3, circuit VMN14 (WH/VT), harness side and the ACM 240c-4, circuit VMN14 (WH/VT), harness side; and between the APIM C3338-3, circuit VMN14 (WH/VT), harness side and ground.  • Measure the resistance between the APIM C3338-4, circuit RMN14 (GY/BN), harness side and the ACM 240c-5, circuit RMN14 (GY/BN), harness side; and between the APIM C3338-4, circuit RMN14 (GY/BN), harness side and ground.	**Yes** GO to AC5 . **No** REPAIR the circuit in question. TEST the system for normal operation.

 • **Is the resistance less than 5 ohms between the APIM and the ACM , and greater than 10,000 ohms between the APIM and ground?**	
AC5 CHECK FOR CORRECT APIM OPERATION	
• Connect: All Disconnected Connectors . • Disconnect the APIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the APIM connector and make sure it seats correctly. • Wait 2 minutes for the APIM to re-initalize. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
AC6 CHECK FOR CORRECT ACM OPERATION	
• Ignition OFF. • Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AD: DTC U0100:00

Normal Operation

The Accessory Protocol Interface Module (APIM) receives network messages from the PCM via the High Speed Controller Area Network (HS-CAN). These messages include the odometer reading and the fuel level.

As other modules outside of the audio system also receive these messages, all modules receiving a particular message should exhibit a symptom if the message is missing.

- DTC U0100:00 (Lost Communication With ECM /PCM "A": No Sub Type Information) â set by the APIM when it is missing messages from the PCM over the HS-CAN for greater than 5 seconds with the ignition in the RUN position.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- PCM

PINPOINT TEST AD: DTC U0100:00

Test Step	Result / Action to Take
AD1 CHECK FOR LOST COMMUNICATION DTCs	
• Ignition ON. • Clear continuous DTCs from all modules. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Retrieve all continuous DTCs from all modules. • **Is DTC U0100 or DTC U0100:00 set in any modules?**	**Yes** GO to AD2 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AD2 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ APIM ♦ PCM ♦ Instrument Panel Cluster (IPC) • **Is DTC B1317, B1318, U3003:16, or U3003:17 recorded in any module?**	**Yes** For the APIM , REFER to DTC Charts in this section. For all other modules, REFER to the master list in Section 419-10 . **No** GO to AD3 .
AD3 CHECK FOR DTC U0100 OR DTC U0100:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0100 or DTC U0100:00 set in more than one module?**	**Yes** GO to AD4 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, CHECK the wiring between the APIM and the PCM for an intermittent fault.
AD4 CHECK FOR CORRECT PCM OPERATION	

• Disconnect all the PCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the PCM connectors and make sure they seat correctly. • **Is the concern still present?**	**Yes** INSTALL a new PCM. Refer to the appropriate section in Group 303 for the procedure.. CLEAR all continuous DTCs. REPEAT the APIM self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all continuous DTCs. REPEAT the APIM self-test.

Pinpoint Test AE: DTC U0140 Or DTC U0140:00

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

Several audio system modules receive network messages from the Smart Junction Box (SJB) via the Medium Speed Controller Area Network (MS-CAN). The following information is included in the messages:

- Ignition switch position
- Illumination dimmer control
- Accessory delay status

As more than one module receives these messages, all modules receiving a particular message should exhibit a symptom if the message is missing.

- DTC U0140 (Lost Communication With Body Control Module (GEM)) â set by the non-navigation (Fusion) Audio Front Control Module (ACM), the Front Controls Interface Module (FCIM) (Fusion), or the Front Display Interface Module (FDIM) when network messages are missing from the SJB for greater than 5 seconds with the ignition in RUN.
- DTC U0140:00 (Lost Communication With Body Control Module: No Sub Type Information) â set by the non-navigation (MKZ) or navigation (all) ACM , the audio Digital Signal Processing (DSP) module, the Accessory Protocol Interface Module (APIM), the Global Positioning System Module (GPSM), or the FCIM (MKZ) when network messages are missing from the SJB for greater than 5 seconds with the ignition in RUN.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- Audio system concern
- SJB

PINPOINT TEST AE: DTC U0140 OR DTC U0140:00

Test Step	Result / Action to Take
AE1 CHECK FOR LOST COMMUNICATION DTCs	
• Ignition ON.	**Yes** GO to AE2 .

• Clear continuous DTCs from all modules. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Retrieve all continuous DTCs from all modules. • **Is DTC U0140 or DTC U0140:00 set in any audio system module?**	**No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AE2 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ ACM ♦ Audio DSP module (if equipped) ♦ APIM (if equipped) ♦ FCIM ♦ FDIM ♦ GPSM (if equipped) ♦ SJB • **Is DTC B1317, B1318, U3003:16, or U3003:17 recorded in any module?**	**Yes** For an audio system module, REFER to DTC Charts in this section. For the SJB , REFER to Section 419-10 . **No** GO to AE3 .
AE3 CHECK FOR DTC U0140 OR DTC U0140:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0140 or DTC U0140:00 set in more than one audio system module?**	**Yes** GO to AE4 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, CHECK the MS-CAN wiring between the SJB and the module in question for an intermittent fault.
AE4 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CLEAR all continuous DTCs. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all continuous DTCs. REPEAT the self-test for the module(s) that set DTC U0140 or DTC U0140:00.

Pinpoint Test AF: DTC U0151:00

Normal Operation

The Accessory Protocol Interface Module (APIM) receives the emergency call notification message from the Restraints Control Module (RCM) via the High Speed Controller Area Network (HS-CAN). This message indicates to the APIM the status of the emergency call system.

As other modules outside of the audio system also receive this message, all modules receiving it should exhibit a symptom if the message is missing.

- DTC U0151:00 (Lost Communication With Restraints Control Module: No Sub Type Information) â set by the APIM when it is missing the emergency call notification message from the RCM over the HS-CAN for greater than 5 seconds with the ignition in the RUN position.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- Restraints system concern

PINPOINT TEST AF: DTC U0151:00

Test Step	Result / Action to Take
AF1 CHECK FOR LOST COMMUNICATION DTCs	
• Ignition ON. • Clear continuous DTCs from all modules. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Retrieve all continuous DTCs from all modules. • **Is DTC U0151 or DTC U0151:00 set in any modules?**	**Yes** GO to AF2 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AF2 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ APIM ♦ PCM ♦ RCM ♦ Instrument Panel Cluster (IPC) • **Is DTC B1317, B1318, U3003:16, or U3003:17 recorded in any module?**	**Yes** For the APIM , REFER to DTC Charts in this section. For all other modules, REFER to the master list in Section 419-10 . **No** GO to AF3 .
AF3 CHECK FOR DTC U0151 OR DTC U0151:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test.	**Yes** GO to AF4 .

• **Is DTC U0151 or DTC U0151:00 set in more than one module?**	**No** If there is an observable audio system symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is an observable restraints system symptom, REFER to Section 501-20B to diagnose the symptom. If there is no observable symptom, CHECK the wiring between the APIM and the RCM for an intermittent fault.
AF4 CHECK FOR CORRECT RCM OPERATION	
• Disconnect all the RCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the RCM connectors and make sure they seat correctly. • **Is the concern still present?**	**Yes** INSTALL a new RCM . REFER to Section 501-20B . CLEAR all continuous DTCs. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all continuous DTCs.

Pinpoint Test AG: DTC U0155 Or DTC U0155:00

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

Several audio system modules receive network messages from the Instrument Panel Cluster (IPC) via the Medium Speed Controller Area Network (MS-CAN). The following information is included in the messages:

- English/metric units
- Vehicle Identification Number (VIN)
- Transmission gear selected
- Vehicle speed

As more than one module receives these messages, all modules receiving a particular message should exhibit a symptom if the message is missing.

- DTC U0155 (Lost Communication With Instrument Panel Cluster (IC)) â set by the non-navigation (Fusion) Audio Front Control Module (ACM) or the Front Display Interface Module (FDIM) when network messages are missing from the IPC for greater than 5 seconds with the ignition in RUN.
- DTC U0155:00 (Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information) â set by the non-navigation (MKZ) or navigation (all) ACM , the audio Digital Signal Processing (DSP) module, the Global Positioning System Module (GPSM), or the Accessory Protocol Interface Module (APIM) when network messages are missing from the IPC for greater than 5 seconds with the ignition in RUN.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- Audio system concern
- IPC

PINPOINT TEST AG: DTC U0155 OR DTC U0155:00

Test Step	Result / Action to Take
AG1 CHECK FOR LOST COMMUNICATION DTCs	
• Ignition ON. • Clear continuous DTCs from all modules. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Retrieve all continuous DTCs from all modules. • **Is DTC U0155 or DTC U0155:00 set in any audio system module?**	**Yes** GO to AG2 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AG2 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ ACM ♦ Audio DSP module (if equipped) ♦ APIM (if equipped) ♦ FDIM ♦ GPSM ♦ IPC • **Is DTC B1317, B1318, U3003:16, or U3003:17 recorded in any module?**	**Yes** For an audio system module, REFER to DTC Charts in this section. For the IPC , REFER to Section 413-01 . **No** GO to AG3 .
AG3 CHECK FOR DTC U0155 OR DTC U0155:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0155 or DTC U0155:00 set in more than one audio system module?**	**Yes** GO to AG4 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, CHECK the MS-CAN wiring between the SJB and the module in question for an intermittent fault.
AG4 CHECK FOR CORRECT IPC OPERATION	
	Yes

• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • **Is the concern still present?**	INSTALL a new IPC . REFER to Section 413-01 . CLEAR all continuous DTCs. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all continuous DTCs. REPEAT the self-test for the module(s) that set DTC U0155 or DTC U0155:00.

Pinpoint Test AH: DTC U0164 Or DTC U0164:00

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

Some audio system modules receive network messages from the HVAC module via the Medium Speed Controller Area Network (MS-CAN). The following information is included in the messages:

- HVAC indication status
- Outside temperature

As more than one module receives these messages, all modules receiving a particular message should exhibit a symptom if the message is missing.

- DTC U0164 (Lost Communication With HVAC Control Module (EATC)) â set by the non-navigation (Fusion) Front Controls Interface Module (FCIM) or the Front Display Interface Module (FDIM) when network messages are missing from the HVAC module for greater than 5 seconds with the ignition in RUN.
- DTC U0164:00 (Lost Communication With HVAC Control Module: No Sub Type Information) â set by the navigation Audio Front Control Module (ACM) when network messages are missing from the HVAC module for greater than 5 seconds with the ignition in RUN.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- Audio system concern
- HVAC module

PINPOINT TEST AH: DTC U0164 OR DTC U0164:00

Test Step	Result / Action to Take
AH1 CHECK FOR LOST COMMUNICATION DTCs	
• Ignition ON. • Clear continuous DTCs from all modules. • Ignition OFF.	**Yes** GO to AH2 . **No** The system is operating correctly at this time. The DTC

• Ignition ON. • Wait at least 10 seconds. • Retrieve all continuous DTCs from all modules. • **Is DTC U0164 or DTC U0164:00 set in any audio system module?**	may have been set due to an intermittent fault in the network wiring.
AH2 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ ACM ♦ FCIM ♦ FDIM ♦ HVAC module • **Is DTC B1317, B1318, U3003:16, or U3003:17 recorded in any module?**	**Yes** For an audio system module, REFER to DTC Charts in this section. For the HVAC module, REFER to Section 412-00A or Section 412-00B . **No** GO to AH3 .
AH3 CHECK FOR DTC U0164 OR DTC U0164:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0164 or DTC U0164:00 set in more than one audio system module?**	**Yes** GO to AH4 . **No** If there is an observable symptom, GO to Symptom Chart - General Audio System to diagnose the observed symptom. If there is no observable symptom, CHECK the MS-CAN wiring between the HVAC module and the module in question for an intermittent fault.
AH4 CHECK FOR CORRECT HVAC MODULE OPERATION	
• Disconnect all the HVAC module connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the HVAC module connectors and make sure they seat correctly. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . CLEAR all continuous DTCs. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all continuous DTCs. REPEAT the self-test for the module(s) that set DTC U0164 or DTC U0164:00.

Pinpoint Test AI: DTC U016A:00

Normal Operation

- DTC U016A:00 (Lost Communication With Global Positioning System Module: No Sub Type Information) â set by the Accessory Protocol Interface Module (APIM) when it is missing network messages from the Global Positioning System Module (GPSM) over the Medium Speed Controller Area Network (MS-CAN) for greater than 5 seconds with the ignition in the RUN position.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- GPSM
- APIM

PINPOINT TEST AI: DTC U016A:00

Test Step	Result / Action to Take
AI1 CHECK THE APIM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the APIM DTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Repeat the APIM self-test. • **Is DTC U016A:00 still present?**	**Yes** GO to AI2 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AI2 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AI3 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring. CHECK the MS-CAN wiring between the APIM and the GPSM for an intermittent fault.
AI3 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Carry out the network test using the scan tool. • **Does the GPSM pass the network test?**	**Yes** GO to AI4 . **No** REFER to Section 418-00 .
AI4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ APIM ♦ GPSM • **Is DTC U3003:16 or DTC U3003:17 recorded in either module?**	**Yes** REFER to DTC Charts in this section. **No** INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) â Fusion or Global Positioning System Module (GPSM) â MKZ in this section. CLEAR the APIM

	DTCs. REPEAT the APIM self-test. If DTC U016A:00 is still present, INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation.

Pinpoint Test AJ: DTC U0184 Or DTC U0184:00

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

Several audio system modules receive network messages from the Audio Front Control Module (ACM) via the Medium Speed Controller Area Network (MS-CAN). These messages consist of various audio system related information.

As more than one module receives these messages, all modules receiving a particular message should exhibit a symptom if the message is missing.

- DTC U0184 (Lost Communication With Radio (ACM)) â set by theFront Controls Interface Module (FCIM) (Fusion) or the Front Display Interface Module (FDIM) when network messages are missing from the ACM for greater than 5 seconds with the ignition in RUN.
- DTC U0184:00 (Lost Communication With Radio: No Sub Type Information) â set by the audio Digital Signal Processing (DSP) module, the Accessory Protocol Interface Module (APIM), the FCIM (MKZ), and the Global Positioning System Module (GPSM) when network messages are missing from the ACM for greater than 5 seconds with the ignition in RUN.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- Audio system concern
- ACM

PINPOINT TEST AJ: DTC U0184 OR DTC U0184:00

Test Step	Result / Action to Take
AJ1 CHECK FOR LOST COMMUNICATION DTCs	
• Ignition ON. • Clear continuous DTCs from all modules. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Retrieve all continuous DTCs from all modules. • **Is DTC U0184 or DTC U0184:00 set in any audio system module?**	**Yes** GO to AJ2 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.

AJ2 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ ACM ♦ Audio DSP module (if equipped) ♦ APIM (if equipped) ♦ FCIM ♦ FDIM ♦ GPSM • **Is DTC B1317, B1318, U3003:16, or U3003:17 recorded in any module?**	**Yes** REFER to DTC Charts in this section. **No** GO to AJ3 .
AJ3 CHECK FOR DTC U0184 OR DTC U0184:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test. • **Is DTC U0184 or DTC U0184:00 set in more than one audio system module?**	**Yes** GO to AJ4 . **No** If there is an observable symptom, REFER to the appropriate Symptom Chart in this section. If there is no observable symptom, CHECK the MS-CAN wiring between the ACM and the module in question for an intermittent fault.
AJ4 CHECK FOR CORRECT ACM OPERATION	
• Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. CLEAR all continuous DTCs. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all continuous DTCs. REPEAT the self-test for the module(s) that set DTC U0184 or DTC U0184:00.

Pinpoint Test AK: DTC U0197 Or DTC U0197:00

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

Several audio system modules receive network messages from the Accessory Protocol Interface Module (APIM) via the Medium Speed Controller Area Network (MS-CAN). These messages consist of various audio system related information.

As more than one module receives these messages, all modules receiving a particular message should exhibit a symptom if the message is missing.

- DTC U0197 (Lost Communication With Telephone Control Module) â set by the non-navigation (Fusion) Audio Front Control Module (ACM) or the Front Display Interface Module (FDIM) when network messages are missing from the APIM for greater than 5 seconds with the ignition in RUN.
- DTC U0197:00 (Lost Communication With Radio: No Sub Type Information) â set by the non-navigation (MKZ) ACM , the navigation (all) ACM , the audio Digital Signal Processing (DSP) module, or the Global Positioning System Module (GPSM) when network messages are missing from the APIM for greater than 5 seconds with the ignition in RUN.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- Audio system concern
- APIM

PINPOINT TEST AK: DTC U0197 OR DTC U0197:00

Test Step	Result / Action to Take
AK1 CHECK FOR LOST COMMUNICATION DTCs	
• Ignition ON. • Clear continuous DTCs from all modules. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Retrieve all continuous DTCs from all modules. • **Is DTC U0197 or DTC U0197:00 set in any audio system module?**	**Yes** GO to AK2 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AK2 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ ACM ♦ Audio DSP module (if equipped) ♦ APIM (if equipped) ♦ FDIM ♦ GPSM • **Is DTC B1317, B1318, U3003:16, or U3003:17 recorded in any module?**	**Yes** REFER to DTC Charts in this section. **No** GO to AK3 .
AK3 CHECK FOR DTC U0197 OR DTC U0197:00 SET IN MULTIPLE MODULES	
• Review the recorded results from the self-test.	**Yes** GO to AK4 .

• **Is DTC U0197 or DTC U0197:00 set in more than one audio system module?**	**No** If there is an observable symptom, REFER to the appropriate Symptom Chart in this section. If there is no observable symptom, CHECK the MS-CAN wiring between the APIM and the module in question for an intermittent fault.
AK4 CHECK FOR CORRECT APIM OPERATION	
• Disconnect the APIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the APIM connector and make sure it seats correctly. • Wait 2 minutes for the APIM to re-initialize. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. CLEAR all continuous DTCs. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all continuous DTCs. REPEAT the self-test for the module(s) that set DTC U0197 or DTC U0197:00.

Pinpoint Test AL: DTC U0238 Or DTC U0238:00

Normal Operation

- DTC U0238 (Lost Communication With Digital Audio Control Module "D" (DSP)) â set by the non-navigation Audio Front Control Module (ACM) (Fusion) or the Front Display Interface Module (FDIM) when network messages are missing from the audio Digital Signal Processing (DSP) module over the Medium Speed Controller Area Network (MS-CAN) for greater than 5 seconds with the ignition in the RUN position.
- DTC U0238:00 (Lost Communication With Digital Audio Control Module "D": No Sub Type Information) â set by the non-navigation ACM (MKZ) or the navigation ACM when network messages are missing from the audio DSP module over the MS-CAN for greater than 5 seconds with the ignition in the RUN position.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- ACM
- FDIM
- APIM

PINPOINT TEST AL: DTC U0238 OR DTC U0238:00

NOTE: Only the non-navigation FDIM can set DTC U0238. Disregard the pinpoint test steps for the FDIM if the concern is on a vehicle with navigation.

Test Step	Result / Action to Take
AL1 CHECK THE ACM AND FDIM DTCs	
	Yes GO to AL2 .

NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the APIM and FDIM DTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Repeat the APIM and FDIM self-tests. • **Is DTC U0238 or DTC U0238:00 still present?**	**No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AL2 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AL3 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring. CHECK the MS-CAN wiring between the audio DSP module and the module in question for an intermittent fault.
AL3 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Carry out the network test using the scan tool. • **Does the audio DSP module pass the network test?**	**Yes** GO to AL4 . **No** REFER to Section 418-00 .
AL4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ ACM ♦ Audio DSP module ♦ FDIM • **Is DTC B1316, B1317, U3003:16 or U3003:17 recorded in any module?**	**Yes** REFER to DTC Charts in this section. **No** INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module in this section. CLEAR the ACM and FDIM DTCs. REPEAT the ACM and FDIM self-tests. If DTC U0238:00 is still present in the ACM , INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. If DTC U0238:00 is still present in the FDIM , INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) â Fusion or Front Display Interface Module (FDIM) â MKZ in this section.

	TEST the system for normal operation.

Pinpoint Test AM: DTC U0255 Or DTC U0256:00

Normal Operation

- DTC U0255 (Lost Communication With Front Controls Interface Module) â set by the non-navigation Audio Front Control Module (ACM) (Fusion) when network messages are missing from the Front Controls Interface Module (FCIM) over the Medium Speed Controller Area Network (MS-CAN) for greater than 5 seconds with the ignition in the RUN position.
- DTC U0256:00 (Lost Communication With Front Controls Interface Module: No Sub Type Information) â set by the non-navigation ACM (MKZ), the navigation ACM (all), or the Accessory Protocol Interface Module (APIM) when network messages are missing from the FCIM over the MS-CAN for greater than 5 seconds with the ignition in the RUN position.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- ACM
- FCIM
- APIM

PINPOINT TEST AM: DTC U0255 OR DTC U0256:00

NOTE: Disregard the pinpoint test steps for the APIM if the concern is on a vehicle without the SYNCÂ® system.

Test Step	Result / Action to Take
AM1 CHECK THE ACM AND APIM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the ACM and APIM DTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Repeat the ACM and APIM self-tests. • **Is DTC U0255 or DTC U0256:00 still present?**	**Yes** GO to AM2 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AM2 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AM3 . **No** The system is operating correctly at this time. The

	DTC may have been set due to an intermittent fault in the network wiring. CHECK the MS-CAN wiring between the FCIM and the module in question for an intermittent fault.
AM3 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Carry out the network test using the scan tool. • **Does the FCIM pass the network test?**	**Yes** GO to AM4 . **No** REFER to Section 418-00 .
AM4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ ACM ♦ APIM ♦ FCIM • **Is DTC B1316, B1317, U3003:16 or U3003:17 recorded in any module?**	**Yes** REFER to DTC Charts in this section. **No** INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) â Fusion or Front Controls Interface Module (FCIM) â MKZ in this section. CLEAR the ACM and APIM DTCs. REPEAT the ACM and APIM self-tests. If DTC U0255 (Fusion without navigation) or DTC U0256:00 (all MKZ or Fusion with navigation) is still present in the ACM , INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. If DTC U0256:00 is still present in the APIM , INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation.

Pinpoint Test AN: DTC U0256 Or DTC U0255:00

Normal Operation

- DTC U0256 (Lost Communication With Front Display Interface Module) â set by the non-navigation Audio Front Control Module (ACM) (Fusion) when network messages are missing from the Front Display Interface Module (FDIM) over the Medium Speed Controller Area Network (MS-CAN) for greater than 5 seconds with the ignition in the RUN position.
- DTC U0255:00 (Lost Communication With Front Display Interface Module: No Sub Type Information) â set by the non-navigation ACM (MKZ) or the Accessory Protocol Interface Module (APIM) when network messages are missing from the FDIM over the MS-CAN for greater than 5 seconds with the ignition in the RUN position.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- ACM
- FDIM

- APIM

PINPOINT TEST AN: DTC U0256 OR DTC U0255:00

NOTE: Disregard the pinpoint test steps for the APIM if the concern is on a vehicle without the SYNCÂ® system.

Test Step	Result / Action to Take
AN1 CHECK THE ACM AND FDIM DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the ACM and APIM DTCs. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Repeat the ACM and APIM self-tests. • **Is DTC U0256 or DTC U0255:00 still present?**	**Yes** GO to AN2 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
AN2 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AN3 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring. CHECK the MS-CAN wiring between the FDIM and the module in question for an intermittent fault.
AN3 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Carry out the network test using the scan tool. • **Does the FDIM pass the network test?**	**Yes** GO to AN4 . **No** REFER to Section 418-00 .
AN4 CHECK FOR BATTERY VOLTAGE OUT-OF-RANGE DTCs	
• Carry out the self-test for the following modules: ♦ ACM ♦ APIM ♦ FDIM • **Is DTC B1316, B1317, U3003:16 or U3003:17 recorded in any module?**	**Yes** REFER to DTC Charts in this section. **No** INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) â Fusion or Front Display Interface Module (FDIM) â MKZ in this section. CLEAR

	the ACM and APIM DTCs. REPEAT the ACM and APIM self-tests. If DTC U0256 (Fusion) or DTC U0255:00 (MKZ) is still present in the ACM , INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. If DTC U0256:00 is still present in the APIM , INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation.

Pinpoint Test AO: DTC B1318 Or DTC U3003:16 (Audio Front Control Module (ACM))

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

- DTC B1318 (Battery Voltage Low) â set by the non-navigation (Fusion) Audio Front Control Module (ACM) as a continuous or on-demand DTC when the supply voltage falls below 10 volts for at least 10 seconds during normal operation.
- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) â set by the non-navigation (MKZ) or navigation (all) ACM as a continuous or on-demand DTC when the supply voltage falls below 10 volts for at least 10 seconds during normal operation, or for greater than 250 milliseconds during the self-test.

This pinpoint test is intended to diagnose the following:

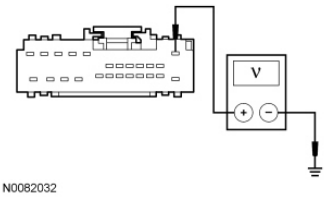
- Wiring, terminals or connectors
- High circuit resistance
- ACM

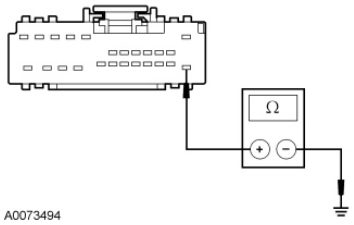
PINPOINT TEST AO: DTC B1318 Or DTC U3003:16 (ACM)

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AO1 RECHECK THE ACM DTCs	
• Clear the ACM DTCs. • Ignition OFF. • Ignition ON.	**Yes** GO to AO2 . **No**

• Wait 10 seconds. • Repeat the ACM self-test. • **Is DTC B1318 or DTC U3003:16 still present?**	The system is operating correctly at this time. The DTC may have set due to a previous low battery voltage condition.
AO2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Retrieve the continuous memory DTCs from all modules. • **Is DTC P0620, P0622, P0625, P0626, or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to AO3 .
AO3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify that the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AO4 . **No** REFER to Section 414-01 .
AO4 CHECK THE ACM VOLTAGE SUPPLY	
• Ignition OFF. • Measure and record the voltage at the battery. • Disconnect: ACM C240a . • Ignition ON. • Measure the voltage between the ACM C240a-1, circuit SBP39 (WH/RD), harness side and ground.  N0082032 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to AO5 . **No** REPAIR the circuit for high resistance. CLEAR the DTCs. REPEAT the self-test.
AO5 CHECK THE ACM GROUND CIRCUIT FOR CONTINUITY	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the ACM C240a-13, circuit GD114 (BK/BU), harness side and ground.	**Yes** GO to AO6 . **No** REPAIR the circuit for high resistance. CLEAR the DTCs. REPEAT the self-test.

 • **Is the resistance less than 5 ohms?**	
AO6 CHECK FOR CORRECT ACM OPERATION	
• Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AP: DTC U3003:17 (Audio Front Control Module (ACM))

Normal Operation

- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) â set by the Audio Front Control Module (ACM) when the supply voltage is greater than 15.8 volts for more than 250 milliseconds during normal operation or the self-test.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- ACM

PINPOINT TEST AP: DTC U3003:17 (ACM)

NOTE: DTC U3003:17 may be stored in the module memory due to past battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
AP1 CHECK FOR HIGH VOLTAGE DTCs SET IN OTHER MODULES	
• Ignition ON. • Retrieve all continuous DTCs from all modules. • **Is DTC B1317, B1676, or B0563 (PCM), or U3003:17 set in more than one module?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AP2 .
AP2 CHECK THE BATTERY VOLTAGE	

• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AP3 .
AP3 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Clear the ACM DTCs. • Repeat the ACM self-test. • **Is DTC U3003:17 still present?**	**Yes** INSTALL a new ACM . REFER to Audio Control Module (ACM) â Fusion or Audio Control Module (ACM) â MKZ in this section. TEST this system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test AQ: DTC U3003:16 (Accessory Protocol Interface Module (APIM))

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) â set by the Accessory Protocol Interface Module (APIM) when the supply voltage falls below 10 volts for at least 10 seconds during normal operation.

This pinpoint test is intended to diagnose the following:

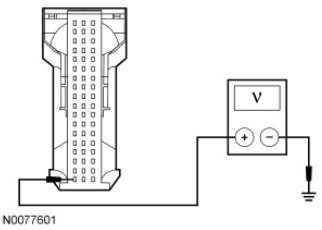
- Wiring, terminals or connectors
- High circuit resistance
- APIM

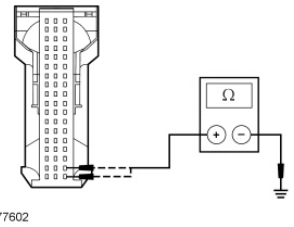
PINPOINT TEST AQ: DTC U3003:16 (APIM)

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AQ1 RECHECK THE APIM DTCs	
• Clear the APIM DTCs. • Ignition OFF. • Ignition ON. • Wait at least 15 seconds.	**Yes** GO to AQ2 . **No** The system is operating correctly at

• Repeat the APIM self-test. • **Is DTC U3003:16 still present?**	this time. The DTC may have set due to a previous low battery voltage condition.
AQ2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Retrieve the continuous memory DTCs from all modules. • **Is DTC P0620, P0622, P0625, or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to AQ3 .
AQ3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify that the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AQ4 . **No** REFER to Section 414-01 .
AQ4 CHECK THE APIM VOLTAGE SUPPLY	
• Ignition OFF. • Measure and record the voltage at the battery. • Disconnect: APIM C3338 . • Ignition ON. • Measure the voltage between the APIM C3338-1, circuit SBB13 (GY/RD), harness side and ground.  N0077601 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to AQ5 . **No** REPAIR the circuit for high resistance. CLEAR the DTCs. REPEAT the self-test.
AQ5 CHECK THE APIM GROUND CIRCUITS FOR CONTINUITY	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the APIM C3338-37, circuit GD148 (BK/YE), harness side and ground; and between the APIM C3338-38, circuit GD148 (BK/YE), harness side and ground.	**Yes** GO to AQ6 . **No** REPAIR the circuit in question for high resistance. CLEAR the DTCs. REPEAT the self-test.

 • **Are the resistances less than 5 ohms?**	
AQ6 CHECK FOR CORRECT APIM OPERATION	
• Disconnect the APIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the APIM connector and make sure it seats correctly. • Wait 2 minutes for the APIM to re-initialize. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AR: DTC U3003:17 (Accessory Protocol Interface Module (APIM))

Normal Operation

- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) â set by the Accessory Protocol Interface Module (APIM) when the supply voltage is greater than 15.8 volts for more than 250 milliseconds during normal operation.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- APIM

PINPOINT TEST AR: DTC U3003:17 (APIM)

NOTE: DTC U3003:17 may be stored in the module memory due to past battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
AR1 CHECK FOR HIGH VOLTAGE DTCs SET IN OTHER MODULES	
• Ignition ON. • Retrieve the continuous DTCs from all modules. • **Is DTC B1317, B1676, B0563 (PCM), or U3003:17 set in more than one module?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AR2 .
AR2 CHECK THE BATTERY VOLTAGE	

• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AR3 .
AR3 RECHECK FOR DTC B1317	
• Ignition OFF. • Ignition ON. • Clear the APIM DTCs. • Repeat the APIM self-test. • **Is DTC U3003:17 present?**	**Yes** INSTALL a new APIM . REFER to Accessory Protocol Interface Module (APIM) in this section. TEST this system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test AS: DTC U3003:16 (Audio Digital Signal Processing (DSP) Module)

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) â set by the audio Digital Signal Processing (DSP) module when the supply voltage falls below 10 volts for at least 10 seconds during normal operation, or for greater than 250 milliseconds during the self-test.

This pinpoint test is intended to diagnose the following:

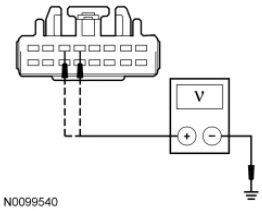
- Wiring, terminals or connectors
- High circuit resistance
- Audio DSP module

PINPOINT TEST AS: DTC U3003:16 (AUDIO DSP MODULE)

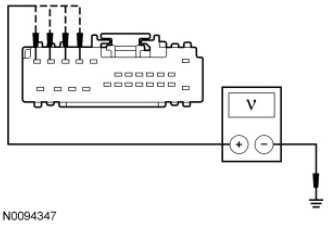
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AS1 RECHECK THE AUDIO DSP MODULE DTCs	
• Clear the audio DSP module DTCs. • Ignition OFF. • Ignition ON. • Wait at least 15 seconds.	**Yes** GO to AS2 . **No** The system is operating correctly at

• Repeat the audio DSP module self-test. • **Is DTC U3003:16 still present?**	this time. The DTC may have set due to a previous low battery voltage condition.
AS2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Retrieve the continuous memory DTCs from all modules. • **Is DTC P0620, P0622, P0625, or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to AS3 .
AS3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify that the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AS4 . **No** REFER to Section 414-01 .
AS4 CHECK THE AUDIO DSP MODULE VOLTAGE SUPPLY	
• Ignition OFF. • Measure and record the voltage at the battery. • Disconnect: Audio DSP Module C4240a (SonyÂ® Sound) or C4235a (THXÂ® Sound) . • Ignition ON. • For vehicles with SonyÂ® sound, measure the voltage between the audio DSP module C4240a-5, circuit SBP19 (BU/RD), harness side and ground; and between the audio DSP module C4240a-6, circuit SBP19 (BU/RD), harness side and ground.  • For vehicles with THXÂ® sound, measure the voltage between the audio DSP module, harness side and ground as follows: **Positive Meter Lead** / **Negative Meter Lead** C4235a-9 (SBB20 (GN/RD)) / Ground C4235a-10 / Ground	**Yes** GO to AS5 . **No** REPAIR the circuit in question for high resistance. CLEAR the DTC. REPEAT the self-test.

SBB20 (GN/RD)	
C4235a-11 SBB21 (GY/RD)	Ground
C4235a-12 SBB21 (GY/RD)	Ground

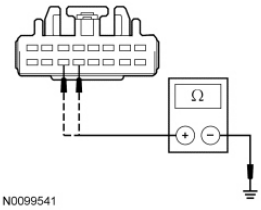


N0094347

- **Are the voltages within 0.2 volt of the recorded battery voltage?**

AS5 CHECK THE AUDIO DSP MODULE GROUND CIRCUITS FOR CONTINUITY

- Ignition OFF.
- Disconnect: Negative Battery Cable .
- For vehicles with SonyÂ® audio, measure the resistance between the audio DSP module C4240a-13, circuit GD148 (BK/YE), harness side and ground; and between the audio DSP module C4240a-14, circuit GD148 (BK/YE), harness side and ground.



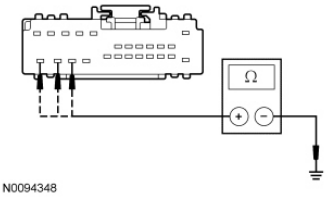
N0099541

- For vehicles with THXÂ® audio, measure the resistance between the audio DSP module, harness side and ground as follows:

Positive Meter Lead	Negative Meter Lead
C4235a-22	GD148 (BK/YE)
C4235a-23	GD148 (BK/YE)
C4235a-24	GD148 (BK/YE)

Yes
GO to AS6 .

No
REPAIR the circuit in question for high resistance. TEST the system for normal operation.

 • **Are the resistances less than 5 ohms?**	
AS6 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	
• Disconnect all the audio DSP module connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the audio DSP module connectors and make sure they seat correctly. • **Is the concern still present?**	**Yes** INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AT: DTC U3003:17 (Audio Digital Signal Processing (DSP) Module)

Normal Operation

- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) â set by the audio Digital Signal Processing (DSP) module when the supply voltage is greater than 15.8 volts for more than 250 milliseconds during normal operation or the self-test.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- Audio DSP module

PINPOINT TEST AT: DTC U3003:17 (AUDIO DSP MODULE)

NOTE: DTC U3003:17 may be stored in the module memory due to past battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
AT1 CHECK FOR HIGH VOLTAGE DTCs SET IN OTHER MODULES	
• Ignition ON. • Retrieve all continuous DTCs from all modules. • **Is DTC B1317, B1676, or B0563 (PCM), or U3003:17 set in more than one module?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AT2 .

AT2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AT3 .
AT3 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Clear the audio DSP module DTCs. • Repeat the audio DSP module self-test. • **Is DTC U3003:17 present?**	**Yes** INSTALL a new audio DSP module. REFER to Audio Digital Signal Processing (DSP) Module in this section. TEST this system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test AU: DTC B1318 Or DTC U3003:16 (Front Controls Interface Module (FCIM))

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

- DTC B1318 (Battery Voltage Low) â set by the non-navigation (Fusion) Front Controls Interface Module (FCIM) when the supply voltage falls below 10 volts for greater than 10 seconds during normal operation or during the self-test.
- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) â set by the non-navigation (MKZ) or navigation (all) FCIM when the supply voltage falls below 10 volts for greater than 10 seconds during normal operation or for greater than 250 milliseconds during the self-test.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- High circuit resistance
- FCIM

PINPOINT TEST AU: DTC B1318 OR DTC U3003:16 (FCIM)

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take

<table>
<tr><td>AU1 RECHECK THE FCIM DTCs</td><td></td></tr>
<tr><td>• Clear the FCIM DTCs.
• Ignition OFF.
• Ignition ON.
• Wait at least 15 seconds.
• Repeat the FCIM self-test.
• Is DTC B1318 or DTC U3003:16 still present?</td><td>Yes
GO to AU2 .

No
The system is operating correctly at this time. The DTC may have set due to a previous low battery voltage condition.</td></tr>
<tr><td>AU2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM</td><td></td></tr>
<tr><td>• Retrieve the continuous memory DTCs from all modules.
• Is DTC P0620, P0622, P0625, or P065B set in the PCM?</td><td>Yes
REFER to Section 414-00 .

No
GO to AU3 .</td></tr>
<tr><td>AU3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE</td><td></td></tr>
<tr><td>• Check the battery condition and verify that the battery is fully charged. Refer to Section 414-01 .
• Is the battery OK and fully charged?</td><td>Yes
GO to AU4 .

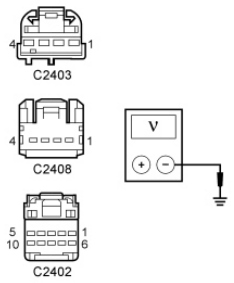
No
REFER to Section 414-01 .</td></tr>
<tr><td>AU4 CHECK THE FCIM VOLTAGE SUPPLY</td><td></td></tr>
<tr><td>• Ignition OFF.
• Measure and record the voltage at the battery.
• Disconnect: FCIM C2403 (Fusion Without Navigation), C2408 (Fusion With Navigation), or C2402 (MKZ) .
• Ignition ON.
• Measure the voltage between the FCIM , harness side and ground as follows:
<table>
<tr><th>Vehicle Equipment</th><th>Positive Meter Lead</th><th>Negative Meter Lead</th></tr>
<tr><td>Fusion without navigation</td><td>C2403-1

SBP14 (BN/RD)</td><td>Ground</td></tr>
<tr><td>Fusion with navigation</td><td>C2408-1

SBP14 (BN/RD)</td><td>Ground</td></tr>
<tr><td>MKZ</td><td>C2402-5</td><td>Ground</td></tr>
</table>
</td><td>Yes
GO to AU5 .

No
REPAIR the circuit for high resistance. CLEAR the DTC. REPEAT the self-test.</td></tr>
</table>

	SBP14 (BN/RD)	



N0102378

- **Is the voltage within 0.2 volt of the recorded battery voltage?**

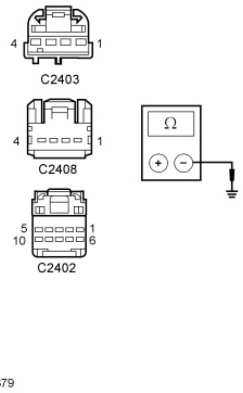
AU5 CHECK THE FCIM GROUND CIRCUIT FOR CONTINUITY

- Ignition OFF.
- Disconnect: Negative Battery Cable .
- Measure the resistance between the FCIM , harness side and ground as follows:

Vehicle Equipment	Positive Meter Lead	Negative Meter Lead
Fusion without navigation	C2403-2 GD116 (BK/VT)	Ground
Fusion with navigation	C2408-4 GD116 (BK/VT)	Ground
MKZ	C2402-8 GD116 (BK/VT)	Ground

Yes
GO to AU6 .

No
REPAIR the circuit for high resistance. TEST the system for normal operation.

 • **Is the resistance less than 5 ohms?**	
AU6 CHECK FOR CORRECT FCIM OPERATION	
• Disconnect the FCIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the FCIM connector and make sure it seats correctly. • **Is the concern still present?**	**Yes** INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) â Fusion or Front Controls Interface Module (FCIM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AV: DTC U3003:17 (Front Controls Interface Module (FCIM))

Normal Operation

- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) â set by the Front Controls Interface Module (FCIM) when the supply voltage is greater than 15.8 volts for more than 250 milliseconds during normal operation or the self-test.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- FCIM

PINPOINT TEST AV: DTC U3003:17 (FCIM)

NOTE: DTC U3003:17 may be stored in the module memory due to past battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
AV1 CHECK FOR HIGH VOLTAGE DTCs SET IN OTHER MODULES	
	Yes

• Ignition ON. • Retrieve all continuous DTCs from all modules. • **Is DTC B1317, B1676, or B0563 (PCM), or U3003:17 set in more than one module?**	REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AV2 .
AV2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AV3 .
AV3 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Clear the FCIM DTCs. • Repeat the FCIM self-test. • **Is DTC U3003:17 present?**	**Yes** INSTALL a new FCIM . REFER to Front Controls Interface Module (FCIM) â Fusion or Front Controls Interface Module (FCIM) â MKZ in this section. TEST this system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test AW: DTC B1318 (Front Display Interface Module (FDIM))

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

- DTC B1318 (Battery Voltage Low) â set by the Front Display Interface Module (FDIM) when the supply voltage falls below 10 volts for greater than 10 seconds during normal operation or during the self-test.

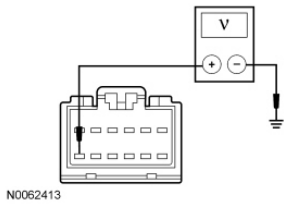
This pinpoint test is intended to diagnose the following:

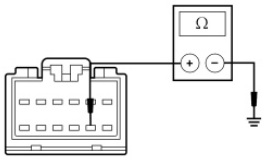
- Wiring, terminals or connectors
- High circuit resistance
- FDIM

PINPOINT TEST AW: DTC B1318 (FDIM)

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AW1 RECHECK THE FDIM DTCs	
• Clear the FDIM DTCs. • Ignition OFF. • Ignition ON. • Wait at least 15 seconds. • Repeat the FDIM self-test. • **Is DTC B1318 still present?**	**Yes** GO to AW2 . **No** The system is operating correctly at this time. The DTC may have set due to a previous low battery voltage condition.
AW2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Retrieve the continuous memory DTCs from all modules. • **Is DTC P0620, P0622, P0625, or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to AW3 .
AW3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify that the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AW4 . **No** REFER to Section 414-01 .
AW4 CHECK THE FDIM VOLTAGE SUPPLY	
• Ignition OFF. • Measure and record the voltage at the battery. • Disconnect: FDIM . • Ignition ON. • Measure the voltage between the FDIM C2407-12, circuit SBP14 (BN/RD), harness side and ground.  N0062413 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to AW5 . **No** REPAIR the circuit for high resistance. CLEAR the DTC. REPEAT the self-test.
AW5 CHECK THE FDIM GROUND CIRCUIT FOR CONTINUITY	

• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the FDIM C2407-8, circuit GD116 (BK/VT), harness side and ground.  N0077731 • **Is the resistance less than 5 ohms?**	**Yes** GO to AW6 . **No** REPAIR the circuit for high resistance. TEST the system for normal operation.
AW6 CHECK FOR CORRECT FDIM OPERATION	
• Disconnect the FDIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the FDIM connector and make sure it seats correctly. • **Is the concern still present?**	**Yes** INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) â Fusion or Front Display Interface Module (FDIM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AX: DTC U3003:16 Global Positioning System Module (GPSM))

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) â set by the Global Positioning System Module (GPSM) when the supply voltage falls below 10 volts for at least 10 seconds during normal operation, or for greater than 250 milliseconds during the self-test.

This pinpoint test is intended to diagnose the following:

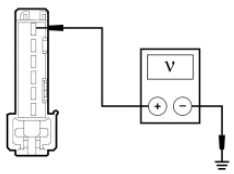
- Wiring, terminals or connectors
- High circuit resistance
- GPSM

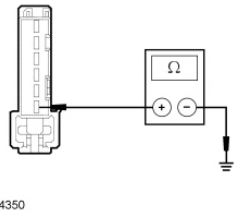
PINPOINT TEST AX: DTC U3003:16 (GPSM)

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to

Section 414-01 .

Test Step	Result / Action to Take
AX1 RECHECK THE GPSM DTCs	
• Clear the GPSM DTCs. • Ignition OFF. • Ignition ON. • Wait at least 15 seconds. • Repeat the GPSM self-test. • **Is DTC U3003:16 still present?**	**Yes** GO to AX2 . **No** The system is operating correctly at this time. The DTC may have set due to a previous low battery voltage condition.
AX2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Retrieve the continuous memory DTCs from all modules. • **Is DTC P0620, P0622, P0625, or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to AX3 .
AX3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify that the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AX4 . **No** REFER to Section 414-01 .
AX4 CHECK THE GPSM VOLTAGE SUPPLY	
• Ignition OFF. • Measure and record the voltage at the battery. • Disconnect: GPSM C2300 . • Ignition ON. • Measure the voltage between the GPSM C2300-1, circuit SBP14 (BN/RD), harness side and ground.  N0094349 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to AX5 . **No** REPAIR the circuit in question for high resistance. CLEAR the DTC. REPEAT the self-test.
AX5 CHECK THE GPSM GROUND CIRCUITS	

• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the GPSM C2300-6, circuit GD116 (BK/VT), harness side and ground.  N0094350 • **Are the resistances less than 5 ohms?**	**Yes** GO to AX6 . **No** REPAIR the circuit in question for high resistance. TEST the system for normal operation.
AX6 CHECK FOR CORRECT GPSM OPERATION	
• Disconnect the GPSM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the GPSM connector and make sure it seats correctly. • **Is the concern still present?**	**Yes** INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) â Fusion or Global Positioning System Module (GPSM) â MKZ in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AY: DTC U3003:17 (Global Positioning System Module (GPSM))

Normal Operation

- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) â set by the Global Positioning System Module (GPSM) when the supply voltage is greater than 15.8 volts for more than 250 milliseconds during normal operation or the self-test.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- GPSM

PINPOINT TEST AY: DTC U3003:17 (GPSM)

NOTE: DTC U3003:17 may be stored in the module memory due to past battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
AY1 CHECK FOR HIGH VOLTAGE DTCs SET IN OTHER MODULES	

• Ignition ON. • Retrieve all continuous DTCs from all modules. • **Is DTC B1317, B1676, or B0563 (PCM), or U3003:17 set in more than one module?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AY2 .
AY2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AY3 .
AY3 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Clear the GPSM DTCs. • Repeat the GPSM self-test. • **Is DTC U3003:17 present?**	**Yes** INSTALL a new GPSM . REFER to Global Positioning System Module (GPSM) â Fusion or Global Positioning System Module (GPSM) â MKZ in this section. TEST this system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test AZ: The Audio System Does Not Operate Correctly From The Front Display Interface Module (FDIM) â MKZ Without Navigation

Normal Operation

When a button is pressed on the Front Display Interface Module (FDIM), a message is broadcast to the Audio Front Control Module (ACM) via the Medium Speed Controller Area Network (MS-CAN). The ACM then takes the appropriate action.

- DTC B2924 (Audio Button Stuck) â sets when the FDIM detects a button as active for greater than 120 seconds during normal operation, or for any duration during the self-test. When this occurs, the FDIM disables that particular button until the fault is cleared, or until the next ignition cycle.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- FDIM

PINPOINT TEST AZ: THE AUDIO SYSTEM DOES NOT OPERATE CORRECTLY FROM THE FDIM â MKZ WITHOUT NAVIGATION

Test Step	Result / Action to Take
AZ1 CHECK the FDIM DTCs	
• Clear the FDIM DTCs. • Carry out the FDIM self-test, making sure no buttons are pressed while the self-test is running. • **Is DTC B2924 present?**	**Yes** INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) â MKZ in this section. TEST the system for normal operation. **No** GO to AZ2 .
AZ2 OBSERVE THE FDIM DISPLAY	
• Turn the audio system on and observe the FDIM screen. • **Is the FDIM display completely inoperative?**	**Yes** GO to Pinpoint Test N . **No** GO to AZ3 .
AZ3 CHECK FOR CORRECT FDIM OPERATION	
• Ignition OFF. • Disconnect the FDIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the FDIM connector and make sure it seats correctly. • Operate the system and determine if the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new FDIM . REFER to Front Display Interface Module (FDIM) â MKZ in this section. TEST this system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test BA: SYNCÂ® Traffic, Directions And Information Service Is Inoperative

Normal Operation

The SYNCÂ® traffic, directions and information service is a subscription-based service that includes precise turn-by-turn directions, personalized real-time traffic updates with text alerts, business search, entertainment, news, sports, stocks, travel and weather. The customer's mobile phone is used to access and download the SYNCÂ® services. The Global Positioning System (GPS) antenna (integral to the Global Positioning System Module (GPSM)) is used to detect the location and direction of the vehicle. For additional information on the traffic, direction and information services subscription refer to the SyncMyRide website .

This pinpoint test is intended to diagnose the following:

- Accessory Protocol Interface Module (APIM)
- GPSM
- Subscription expired

PINPOINT TEST BA: SYNCÂ® TRAFFIC, DIRECTIONS AND INFORMATION SERVICE IS INOPERATIVE

Test Step	Result / Action to Take
BA1 VERIFY THE CUSTOMER SUBSCRIPTION AND PHONE NUMBER	
• **NOTE:** Prior to performing this pinpoint test step, inquire with the customer about SYNCÂ® traffic, directions and information service registration. • Verify that the customer has an active subscription and the correct phone number that is registered on the SYNCÂ® website. REFER to the SyncMyRide website . • **Is the subscription activated and the correct phone number registered?**	**Yes** GO to BA2 . **No** If the subscription is not activated, INFORM the customer that in order for the SYNCÂ® traffic, directions and information to function the subscription needs to be activated on the SYNCÂ® website. REFER to the SyncMyRide website . If the phone number is incorrect, INFORM the customer that the correct phone number must be registered on the SYNCÂ® website. REFER to the SyncMyRide website .
BA2 CHECK FOR APIM DTCs	
• Ignition ON. • Carry out the APIM self-test. • **Are any DTCs recorded in the APIM ?**	**Yes** REFER to the APIM DTC Chart in this section. **No** GO to BA3 .
BA3 CHECK FOR GPSM DTCs	
• Carry out the GPSM self-test. • **Are any DTCs recorded in the GPSM ?**	**Yes** REFER to the GPSM DTC Chart in this section. **No** INSTALL a new GPSM . For Fusion, REFER to Global Positioning System Module (GPSM) â Fusion . For MKZ, REFER to Global Positioning System Module (GPSM) â MKZ .

Pinpoint Test BB: Poor Sound Quality Or Distorted Sound From One Or More Speakers (Not All Speakers)

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices. Refer to Diagnostic Methods in Section 100-00 for information about these practices.

Normal Operation

The Audio Front Control Module (ACM) sends audio signals to the speakers in the form of AC voltage, resulting in clear audio output.

Possible Sources

- Wiring, terminals, or connectors
- Speaker(s)
- Loose trim panel fasteners
- Loose trim panels
- Loose speaker grille
- Loose harnesses
- Loose items in storage areas
- Loose harness fasteners
- Loose door and handle lock components
- Loose component fasteners
- Watershield bonding and placement
- Subwoofer enclosure

PINPOINT TEST BB: POOR SOUND QUALITY OR DISTORTED SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS)

Test Step	Result / Action to Take
BB1 ISOLATE THE ZONE	
• Operate the audio system using digital media (CD, MP3, etc.). • Using the audio system fade and balance feature, adjust the audio sound to each of the four zones (LF, RF, LR and RR) of the vehicle to isolate the poor sound quality. • Locate and apply pressure to the trim panel(s) around the poor sound quality area in question. • **Does applying pressure to a trim panel reduce or eliminate the audible noise?**	**Yes** REPAIR or REPLACE the trim panel as needed. **No** GO to BB2 .
BB2 REMOVE AND INSPECT BEHIND/UNDERNEATH THE SUSPECT TRIM PANEL(S)	
• Remove the trim panel to access the suspect speaker. • Operate the audio system using digital media (CD, MP3, etc.). • Validate where the poor sound quality area is located. • Check: ♦ Trim panel for loose components (e.g. speaker grille) around the speaker area. ♦ Trim panel joining components for missing or broken pieces. ♦ Lock and handle mechanical parts for correct attachment. ♦ Wire harnesses for correct routing. ♦ Wire harness fasteners for correct attachment. ♦ Watershield for correct placement (speaker air path not blocked). ♦ Watershield for correct bonding to sheet metal. ♦ Storage areas for loose items. ♦ All child safety belt anchors (if equipped). ♦ All safety belt retractors. ♦ All speaker bracket fasteners and other fasteners are secured and tightened to specified torque.	**Yes** REPAIR or REPLACE any loose or broken component or fastener as needed. **No** GO to BB3 .

• **Was the source of the noise located?**	
BB3 CHECK THE SUSPECT SPEAKER FOR WATER INTRUSION	
• Inspect for watermarks. • Check the: ♦ Cone. ♦ Magnet. ♦ Basket. • **Are any watermarks present on the speaker?**	**Yes** VERIFY the water shield is in the correct location, REPAIR or REPLACE any trim, door, or speaker seal as required. DRY the speaker in question and TEST the system for normal operation. **No** GO to BB4 .
BB4 ISOLATE SPEAKER TO VERIFY NOISE	
• Remove the suspect speaker from its location and leave the speaker connected to the harness. • Hold the speaker away from any trim panel(s) and ensure the speaker is isolated from contact. • Operate the audio system using digital media (CD, MP3, etc.). • **Is the noise still present in the suspect speaker?**	**Yes** INSTALL a new speaker for the one in question. **No** LOCATE the source of the noise and REPAIR as needed.

Audio Control Module (ACM) Self-Diagnostic Mode

Audio Systems Without Navigation

NOTE: If the Audio Front Control Module (ACM) is inoperable the ACM part number may be obtained from a label affixed to the chassis.

1. Turn the ACM on.

2. Operate the audio system in radio tuner (AM/FM) mode.

3. Press and hold preset buttons 3 and 6 for 3 seconds until the speaker walk test begins.
   - The display indicates each speaker as it is tested.

4. **NOTE:** If the speaker walk test is the only test required, this procedure can be stopped after Step 3 by turning the ACM off.

   Before the speaker walk test is complete, carry out any of the following actions:

Preset Button Press	Diagnostic Function	Display	Diagnostic Function Description
1	ACM Self-Test	SELF TEST	The ACM carries out a self-test. At the end of the self-test, the display either indicates SELF PASS or scrolls through any DTCs present. Note that the self-test may not indicate all DTCs that are present. If additional DTCs are suspected, retrieve continuous and on-demand DTCs using the scan tool.
2	View DTCs	NO DTCS, or scrolls through DTCs	The ACM displays any DTCs that are present. To scroll through the DTCs, press the TUNE UP button. If no DTCs are present, the display reads NO DTCS.
3	AM/FM Antenna Signal Strength	SIGNAL ###	The ACM displays the AM/FM antenna signal strength. To run this test, the audio system should be in AM radio tuner mode before entering the ACM self-diagnostic mode.
4	Software Levels	SOFT LEVELS	The ACM displays software levels for various components of the audio system. Knowing the software levels may not aid diagnostics. Press the TUNE UP button to scroll through the software levels.
5	Display Test	DISPLAY TEST, then all segments illuminate	All of the ACM display segments illuminate.
6	Retrieve ACM Part Number	RADIO CONFIG	The ACM displays the ACM part number and various configuration levels. Press the TUNE UP button to scroll to the desired function.

5. To exit the self-diagnostic mode, turn the ACM off.

Satellite Radio Electronic Serial Number (ESN) Retrieval - Vehicles Without Navigation

NOTE: If the SDARS is inoperable the Electronic Serial Number (ESN) may be obtained from a label affixed to the chassis.

1. Operate the audio system in satellite radio mode.

2. Depending on vehicle configuration, press and hold the AUX button and preset button 1 or the SIRIUS button and preset button 1, simultaneously.
   - The Satellite Digital Audio Receiver System (SDARS) module Electronic Serial Number (ESN) displays on the screen.

3. Record the SDARS module ESN .

4. Turn the audio system off.

Audio Systems With Navigation

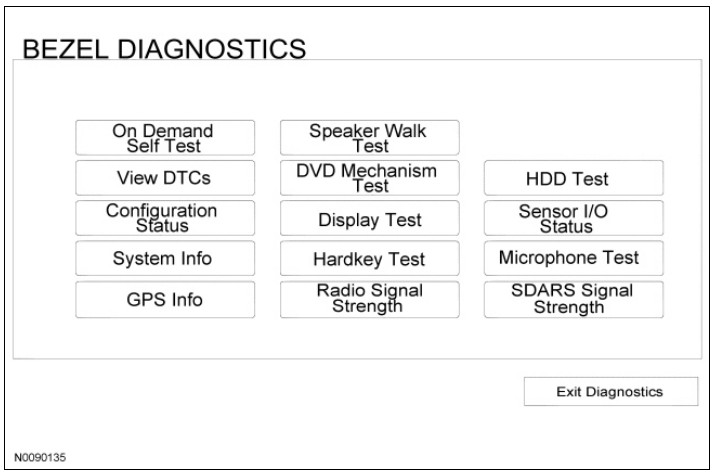
1. Turn the Audio Front Control Module (ACM) on.

2. Operate the audio system in radio tuner (AM/FM) mode.

3. Press and hold preset buttons 3 and 6 for 3 seconds until the speaker walk test begins.
   - The display indicates each speaker as it is tested.

4. **NOTE:** If the speaker walk test is the only test required, this procedure can be stopped after this step, or by allowing the speaker walk test to complete on its own.

   Before the speaker walk test is complete, press the "End Test" selection.



5. The following tests are available through the "BEZEL DIAGNOSTICS" menu:

Display Selection	Diagnostic Function Description

On Demand Self Test	The ACM carries out a self-test. At the end of the self-test, the display either indicates "Test Passed" or lists any DTCs present. Note that the self-test may not indicate all DTCs that are present. If DTCs are suspected, retrieve continuous and on-demand DTCs using the scan tool.
View DTCs	The ACM displays any DTCs that are present. If there is more than a full screen of DTCs present, to scroll through the DTCs, press the down arrow on the display. If no DTCs are present, the display reads NO DTCS. Press the "Clear DTCs" selection to clear any DTCs present.
Configuration Status	The display shows the ACM configuration. A "0" indicates the item is configured off, while a "1" indicates the item is configured on. If the ACM appears to be misconfigured, refer to Section 418-01 .
System Info	The ACM displays system information for various components of the audio system. The following items are most important for servicing the audio system: • Nav Radio Part Number - provides the ACM part number • ESN1 - provides the satellite radio Electronic Serial Number (ESN)
GPS Info	The current Global Positioning System (GPS) satellite information is shown, along with the current vehicle position. Pressing the "SV Status" selection provides additional information, if present.
Speaker Walk Test	The ACM carries out the speaker walk test.
DVD Mechanism Test	The ACM tests the internal CD/DVD drive mechanism.
Display Test	This test provides for testing of the touchscreen colors and the touchscreen sectors. Pressing any of the colors on the display causes the whole display to change to that color; pressing the display again returns to the Display Test menu. Pressing the "Touchscreen Activation Test" selection enters the touchscreen sector test. Press any area of the screen to test the touchscreen sector; press the "X" at the RH lower corner of the display to return to the Display Test menu.
Hardkey Test	This test provides for testing of the ACM buttons (not the touchscreen). When each button is pressed, the screen displays the button that is active. This test can also be used to isolate a stuck button.
Radio Signal Strength	The ACM displays the AM/FM antenna signal strength. To run this test, the audio system should be in AM radio tuner mode before entering the ACM self-diagnostic mode.
HDD Test	The ACM tests its internal hard drive.
Sensor I/O Status	The ACM displays inputs it is receiving from external sources. These inputs include: • Ignition - indicates ON (ignition in ACC or RUN) or OFF • Brake - indicates ON (vehicle in PARK) or OFF (vehicle not in PARK) • Illumination - indicates ON or OFF • ReverseGear - indicates ON (vehicle in REVERSE) or OFF (vehicle not in REVERSE)
Microphone Test	The ACM tests the microphone by supplying a test tone and monitoring the input from the microphone. If there is a concern with the microphone input, the ACM sets DTC B1D79:01. For diagnostics, refer to Diagnosis and Testing in this section.
SDARS Signal Strength	The ACM displays the satellite radio antenna signal strength.

6. To exit the self-diagnostic mode, press the "Exit Diagnostics" selection from the "BEZEL DIAGNOSTICS" menu.

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Accessory Protocol Interface Module (APIM) Software Level Check

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST3051-A	Universal Serial Bus (USB) Male-A to Male-A Cable CCMUSB2-AM-AM-10 or equivalent

NOTE: This procedure applies to checking the Accessory Protocol Interface Module (APIM) software level. To program the APIM , refer to Accessory Protocol Interface Module (APIM) Programming in Section 418-01 .

1. Turn the Audio Front Control Module (ACM) on.

2. Connect the scan tool to the Data Link Connector (DLC).

3. Connect one end of the Universal Serial Bus (USB) male-A to male-A cable to the scan tool.

4. Connect the other end of the USB male-A to male-A cable to the vehicle USB port.

5. From the technician service publication website, run On-Line Automotive Service Information System (OASIS) using Quick Start or by manually entering the Vehicle Identification Number (VIN).

6. From the OASIS tab, select the "Sync/APIM" bullet.

7. Select the "Read APIM" button to verify the current APIM software level.
   - The display shows both the Vehicle Interface Processor (VIP) and Consumer Interface Processor (CIP) software levels.

8. The scan tool displays the following information:
   - Last Recorded State - Hardware
     - VIN : vehicle identification number associated with the current APIM
     - Installed date: date the APIM was installed
     - Radio: currently identified ACM in the vehicle
     - HW Part No.: APIM hardware part number
     - Un-installed date: date (if any) the APIM was uninstalled
     - S/N: APIM serial number
   - Last Recorded State - Software
     - Date/Time: date and time of last recorded software installation
     - VIP : VIP software that was installed at that time
     - CIP : CIP software that was installed at that time
     - Description: a description of the content of the software revision
   - History - Software
     - Date/Time: date and time of any recorded software installation

- ♦ VIP : VIP software that was installed at that time
- ♦ CIP : CIP software that was installed at that time
- ♦ Description: a description of the content of the software revision

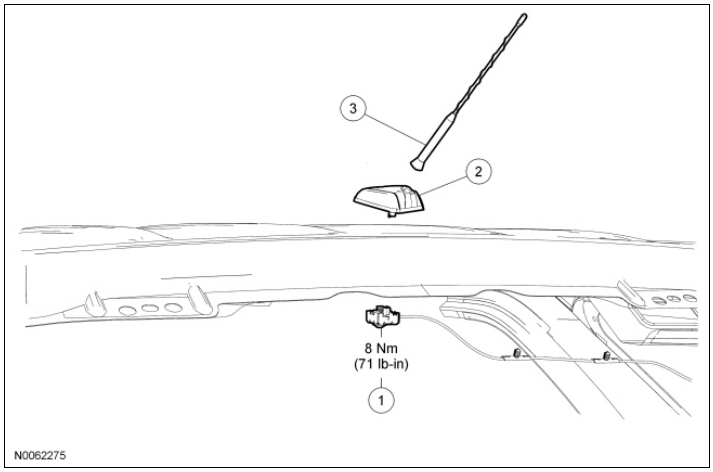
- Available Software for Programming
  - ♦ Select: allows the software package to be selected
  - ♦ Lineage: the original software release, if the software available is a revision
  - ♦ VIP : VIP software level that is available with the selection
  - ♦ CIP : CIP software level that is available with the selection
  - ♦ Description: a description of the content of the software revision

9. Click a CIP software level to view the device compatibility list associated with the CIP software level, if desired.

10. To exit the APIM software level check, disconnect the scan tool from the DLC and the USB port, or exit the OASIS screen.

Antenna - AM/FM

NOTE: Combination AM/FM/satellite antenna shown, others similar.



Item	Part Number	Description
1	-	Antenna cable bolt (part of 18812)
2	18936	Antenna
3	18813	Antenna mast

Removal and Installation

1. Remove the LH and RH assist handles. For additional information, refer to Headliner in Section 501-05 .

2. Remove the LH and RH C-pillar trim panels. For additional information, refer to Section 501-05 .

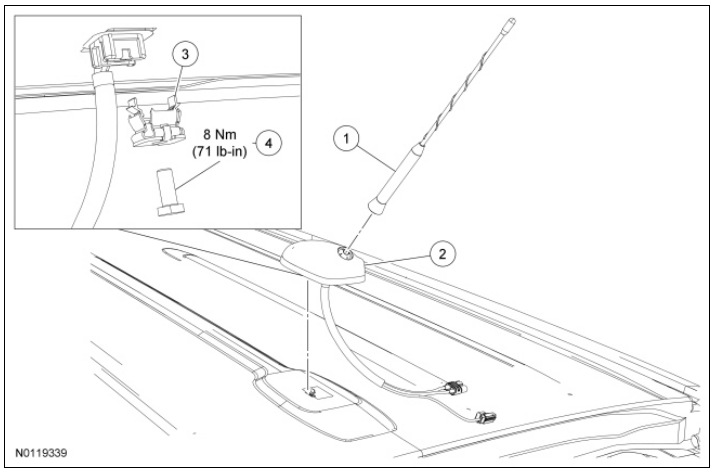
3. Carefully lower the rear of the headliner to gain access to the antenna.

4. Loosen the antenna cable bolt and disconhe cable from the antenna.
   - To install, tighten to 8 Nm (71 lb-in).

5. Remove the antenna.
   - Remove the antenna mast, if equipped.
   - Press the 2 tabs and remove the antenna.

6. To install, reverse the removal procedure.

Antenna - AM/FM/Satellite Radio/Navigation



Item	Part Number	Description
1	18813	Antenna mast
2	18936	Antenna
3	-	Antenna retaining clip
4	-	Antenna cable bolt (part of 18812)

Removal and Installation

1. Remove the LH and RH D-pillar trim panels. For additional information, refer to Section 501-05 .
2. Remove the rear dome lamp. For additional information, refer to Interior Lamp in Section 417-02 .
3. Carefully lower the rear of the headliner to gain access to the antenna.

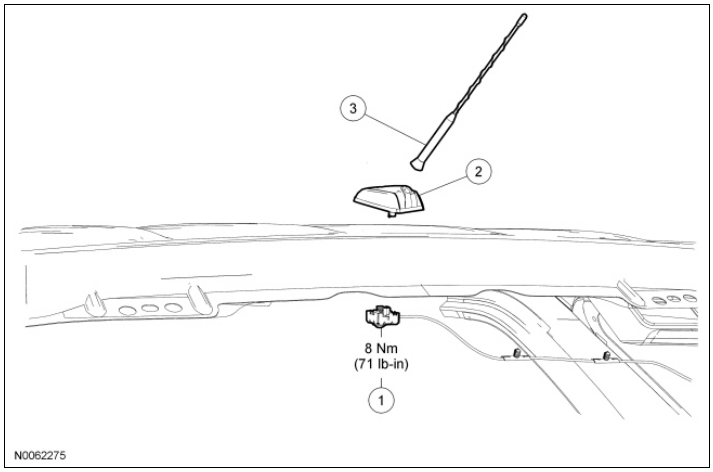
   Remove the antenna cable bolt and retaining clip from the antenna.

   - To install, tighten to 8 Nm (71 lb-in).

5. Disconnect the antenna cable connectors.
6. Remove the antenna.
   - Remove the antenna mast, if equipped.
   - Press the 2 tabs and remove the antenna.
7. To install, reverse the removal procedure.

Antenna - Satellite Radio

NOTE: Combination AM/FM/satellite antenna shown, others similar.



Item	Part Number	Description
1	-	Satellite radio antenna cable bolt (part of 18812)
2	18936	Satellite radio antenna
3	18813	Antenna mast (if equipped)

Removal and Installation

NOTE: This procedure applies to the stand-alone satellite radio antenna, the combination AM/FM/satellite radio antenna, and the combination satellite radio/Global Positioning System (GPS) antenna.

1. Remove the LH and RH assist handles. For additional information, refer to Headliner in Section 501-05 .

2. Remove the LH and RH C-pillar trim panels. For additional information, refer to Section 501-05 .

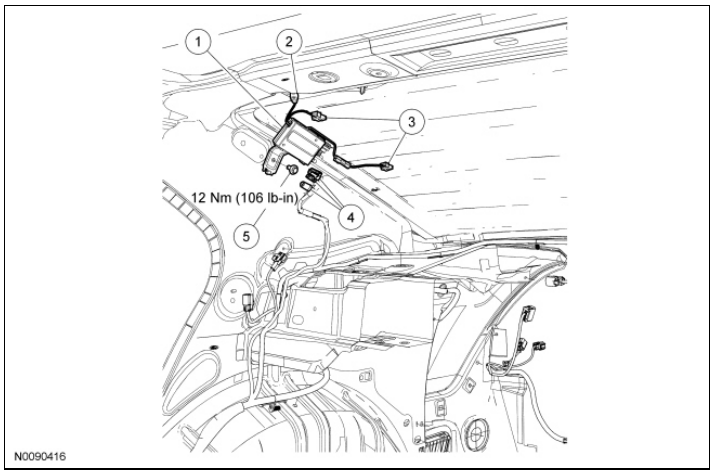
3. Carefully lower the rear of the headliner to gain access to the satellite radio antenna.

4. Loosen the satellite radio antenna cable bolt and disconnect the cable from the antenna.
   - To install, tighten to 8 Nm (71 lb-in).

5. Remove the antenna.
   - Remove the antenna mast, if equipped.
   - Press the 2 tabs and remove the satellite radio antenna.

6. To install, reverse the removal procedure.

Antenna Module



Item	Part Number	Description
1	19C029	Antenna module
2	-	Antenna module-to-antenna connector (part of 19C029)
3	-	Heated rear window connectors (part of 19C029)
4	-	Antenna module electrical connectors (part of 14A005)
5	-	Antenna module bolt

Removal and Installation

1. Remove the RH C-pillar trim panel. For additional information, refer to Section 501-05 .

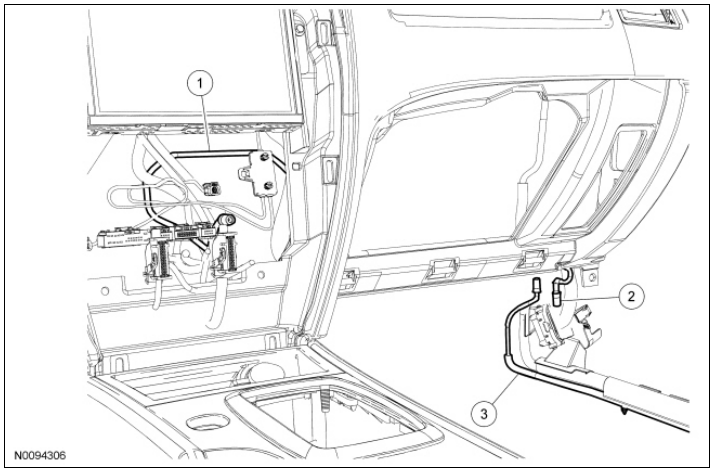
2. Disconnect the antenna module connectors.
   - Disconnect the antenna cable-to-antenna module connector.
   - Disconnect the antenna module electrical connectors.
   - Disconnect the antenna module-to-antenna connector.

3. Remove the bolt and the antenna module.
   - To install, tighten to 12 Nm (106 lb-in).

4. To install, reverse the removal procedure.

Antenna Cable - AM/FM

NOTE: Only the front AM/FM antenna cable is shown.



Item	Part Number	Description
1	18812	Front AM/FM antenna cable
2	-	Front-to-rear AM/FM antenna cable connection (part of 18812)
3	18812	Rear AM/FM antenna cable

Removal

NOTE: Both the front and rear AM/FM antenna cables are part of the vehicle wiring harness. Because the cables cannot be removed from the harness, this procedure applies to replacement of the cables only.

Front cable

1. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) - Fusion or Audio Control Module (ACM) - MKZ in this section. >

Rear cable

2. Remove the RH front and RH rear sill panels by pulling straight upward.
3. **NOTE:** For MKZ, it is only necessary to remove the RH C-pillar trim panel.

   Remove the LH and RH assist handles, and the LH and RH C-pillar trim panels. For additional information, refer to Section 501-05 .
4. **NOTE:** For Fusion, it is necessary to loosen the antenna cable bolt.

   Disconnect the rear AM/FM antenna cable from the AM/FM antenna (Fusion) or the antenna module (MKZ).
5. Remove the enable circuit.
   1. Disconnect C237 at the RH kick panel.
   2. Remove the pin retainer from the inside of the male side of the connector by pulling straight out with pliers.

3. Using a suitable tool such as a straight pick, release the locking tab and remove the enable circuit CME44 (BU) from C237-25.
4. Cut the existing circuit end and secure it with electrical tape.

Both cables

6. Disconnect the front-to-rear AM/FM antenna cable connection at the RH kick panel.
7. Cut the ends of the existing cable and tape them back to prevent NVH concerns.

Installation

Both cables

1. Overlay the new AM/FM antenna cable on the vehicle wiring harness, following the routing of the original cable.
2. Secure the new AM/FM antenna cable with tape or zip ties, as necessary.
3. Connect the front-to-rear AM/FM antenna cable connection at the RH kick panel.

Front cable

4. Connect the front AM/FM antenna cable to the ACM .
5. Install the ACM . For additional information, refer to Audio Control Module (ACM) - Fusion or Audio Control Module (ACM) - MKZ in this section.

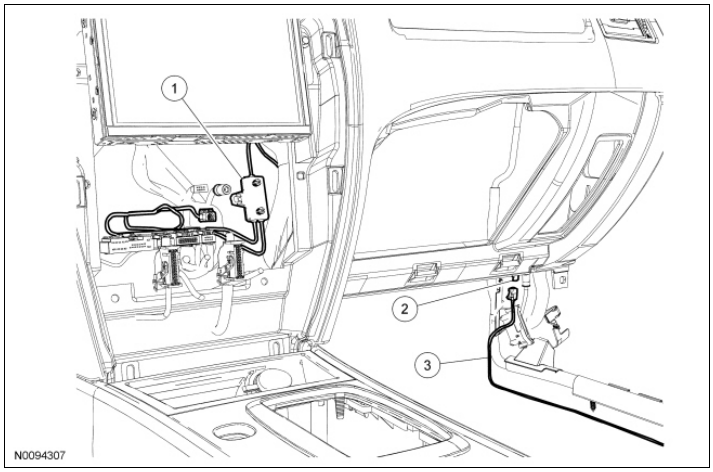
Rear cable

6. Install the enable circuit.
    1. Insert the enable circuit CME44 (BU) into C237-25.
    2. Install the pin retainer into the inside of the male side of the connector.
    3. Connect C237.
7. Connect the rear AM/FM antenna cable to the AM/FM antenna (Fusion) or the antenna module (MKZ).
    - For Fusion, tighten the bolt to 8 Nm (71 lb-in).
8. **NOTE:** For MKZ, only the RH C-pillar trim panel was removed.

   Install the LH and RH assist handles, and the LH and RH C-pillar trim panels. For additionnformation, refer to Section 501-05 .
9. Install the RH front and RH rear sill panels.

Antenna Cable - Satellite Radio

NOTE: The front satellite radio antenna cable with navigation is shown.



Item	Part Number	Description
1	18812/10E928	Front satellite radio antenna cable (without navigation/ with navigation)
2	-	Front-to-rear satellite radio antenna cable connection (part of 18812/ 10E928)
3	18812	Rear satellite radio antenna cable

Removal

NOTE: Both the front and rear satellite radio antenna cables are part of the vehicle wiring harness. Because the cables cannot be removed from the harness, this procedure applies to replacement of the cables only.

NOTE: For vehicles with navigation, a splitter is built-in to the front satellite radio antenna cable to split the satellite radio and Global Positioning System (GPS) signals.

Front cable

1. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) - Fusion or Audio Control Module (ACM) - MKZ in this section.

Rear cable

2. Remove the RH front and RH rear sill panels by pulling straight upward.

3. Remove the LH and RH assist handles, and the LH and RH C-pillar trim panels. For additional information, refer to Section 501-05 .

4. Loosen the antenna cable bolt and disconnect the cable from the antenna.

5. Remove the enable circuit.
    1. Disconnect C237 at the RH kick panel.

2. Remove the pin retainer from the inside of the male side of the connector by pulling straight out with pliers.
3. Using a suitable tool such as a straight pick, release the locking tab and remove the enable circuit CME44 (BU) from C237-25.
4. Cut the existing circuit end and secure it with electrical tape.

Both cables

6. Disconnect the front-to-rear satellite radio antenna cable connection at the RH kick panel.

7. Cut the ends of the existing cable and tape them back to prevent NVH concerns.

Installation

Both cables

1. Overlay the new satellite radio antenna cable on the vehicle wiring harness, following the routing othe original cable.

2. Secure the new AM/FM antenna cable with tape or zip ties, as necessary.
   - For the front satellite radio antenna cable on vehicles with navigation, secure the splitter using the built-in push-pins.

3. Connect the front-to-rear satellite radio antenna cable connection at the RH kick panel.

Front cable

4. Connect the front AM/FM antenna cable to the ACM .

5. Install the ACM . For additional information, refer to Audio Control Module (ACM) - Fusion or Audio Control Module (ACM) - MKZ in this section.

Rear cable

6. Install the enable circuit.
   1. Insert the enable circuit CME44 (BU) into C237-25.
   2. Install the pin retainer into the inside of the male side of the connector.
   3. Connect C237.

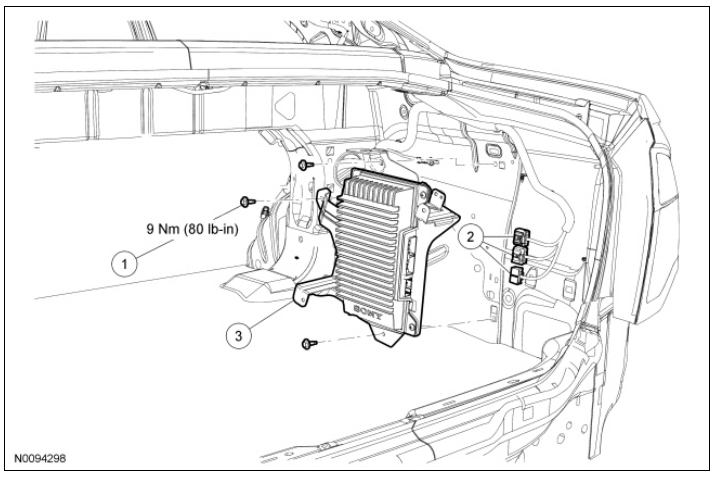
7. Connect the rear satellite radio antenna cable to the antenna.
   - Tighten the bolt to 8 Nm (71 lb-in).

8. Install the LH and RH assist handles, and the LH and RH C-pillar trim panels. For additional information, refer to Section 501-05 .

9. Install the RH front and RH rear sill panels.

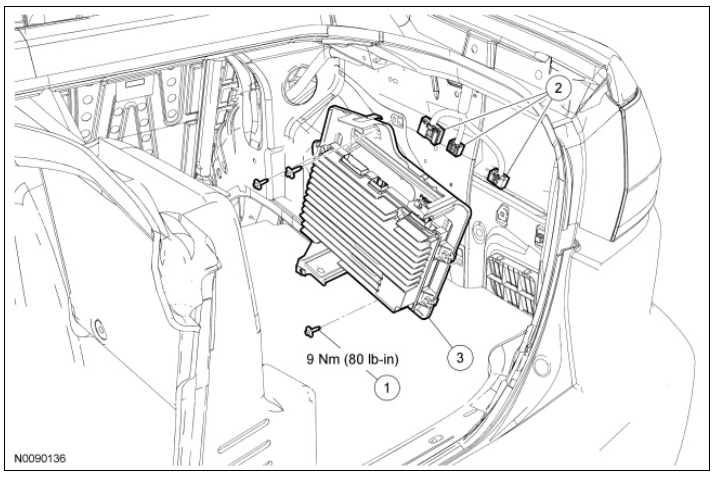
Audio Digital Signal Processing (DSP) Module

Sony® Sound



Item	Part Number	Description
1	W505423-S	Audio Digital Signal Processing (DSP) module bolts (3 required)
2	-	Audio DSP module electrical connectors (part of 14A005)
3	18B849	Audio DSP module

THX® Sound



Item	Part Number	Description
1	W505423-S	Audio Digital Signal Processing (DSP) module bolts (3 required)
2	-	Audio DSP module electrical connectors (part of

		14A005)
3	18B849	Audio DSP module
4	5445422	RH luggage compartment trim panel

Removal and Installation

NOTE: This procedure applies to Fusion with Sony® sound and MKZ with THX® sound only. For all other amplifiers, refer to the appropriate procedure in this section.

1. **NOTE:** Module configuration is required wew audio Digital Signal Processing (DSP) module is being installed.

   Upload the audio DSP module configuration information to the scan tool. For additional information, refer to Programmable Module Installation (PMI) in Section 418-01 .

2. Remove the 4 pushpins and the RH luggage compartment trim panel.

3. Disconnect the audio DSP module electrical connectors.

4. Remove the 3 bolts and the audio DSP module.
   - To install, tighten to 9 Nm (80 lb-in).

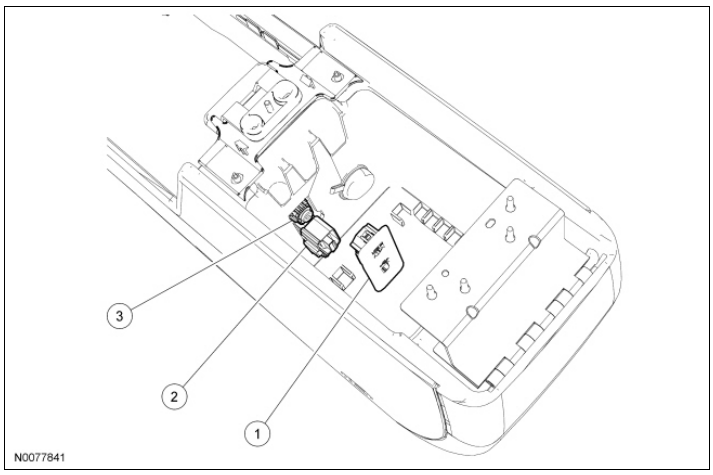
5. To install, reverse the removal procedure.
   - Download the configuration information to the audio DSP module. For additional information, refer to PMI in Section 418-01 .

Audio Input Jack

NOTE: Stowage bin door shown removed for clarity.

NOTE: Vehicle with the SYNC® system shown, others similar.

NOTE: Fusion shown, MKZ similar.



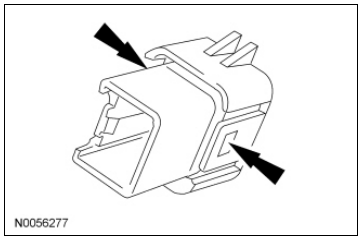
Item	Part Number	Description
1	-	Audio input jack bezel
2	-	Universal Serial Bus (USB) cable and port (if equipped) (part of 14D202)
3	19A164	Audio input jack

Removal and Installation

1. Open the floor console stowage bin door.

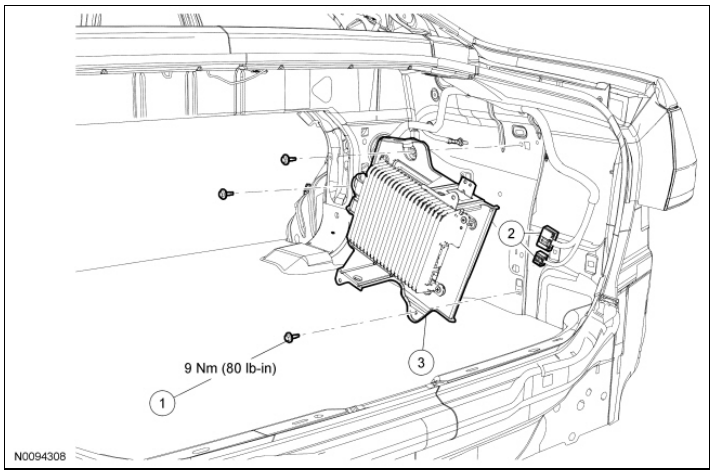
2. Using a suitable tool, remove the audio input jack bezel by prying straight back (Fusion) or straight up (MKZ).
    - Disconnect the Universal Serial Bus (USB) cable and port, if equipped.

3. Release the tabs and remove the audio input jack.



4. To install, reverse the removal procedure.

Audio Amplifier



Item	Part Number	Description
1	W505423-S	Audio amplifier bolts (3 required)
2	-	Audio amplifier electrical connectors (part of 14A005)
3	18B849	Audio amplifier

Removal and Installation

NOTE: This procedure applies to the MKZ with Premium Sound only. For all other amplifiers, refer to the appropriate procedure in this section.

1. Remove the 4 pushpins and the RH luggage compartment trim panel.

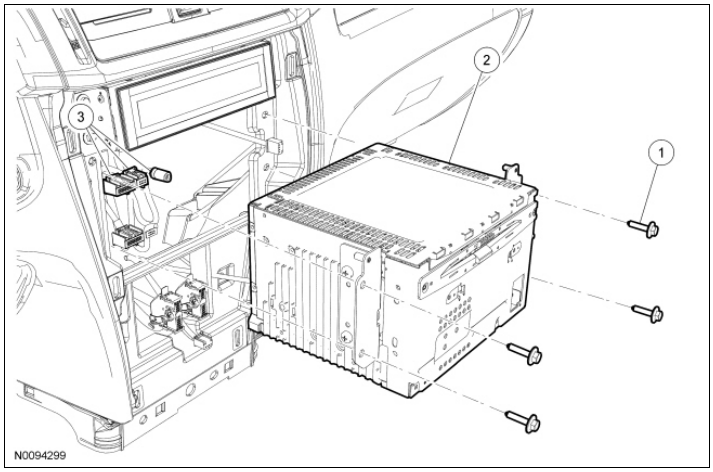
2. Disconnect the audio amplifier electrical connectors.

3. Remove the 3 bolts and the audio amplifier.
   - To install, tighten to 9 Nm (80 lb-in).

4. To install, reverse the removal procedure.

Audio Control Module (ACM) - Fusion

NOTE: Without navigation shown, with navigation similar.



Item	Part Number	Description
1	W707628	Audio Front Control Module (ACM) screws (4 required)
2	18806	ACM
3	-	ACM electrical connectors (part of 14401)

Removal and Installation

NOTE: It is not necessary to remove the Audio Front Control Module (ACM) to retrieve the part number. For additional information, refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.

All vehicles

1. **NOTE:** Module configuration is required when a new ACM is being installed.

   Upload the ACM configuration information to the scan tool. For additional information, refer to Programmable Module Installation (PMI) in Section 418-01 .

Vehicles with navigation

2. Remove the Front Display Interface Module (FDIM). For additional information, refer to Front Display Interface Module (FDIM) - Fusion in this section.

Vehicles without navigation

3. Remove the instrument panel center finish panel. For additional information, refer to Section 501-12 .

All vehicles

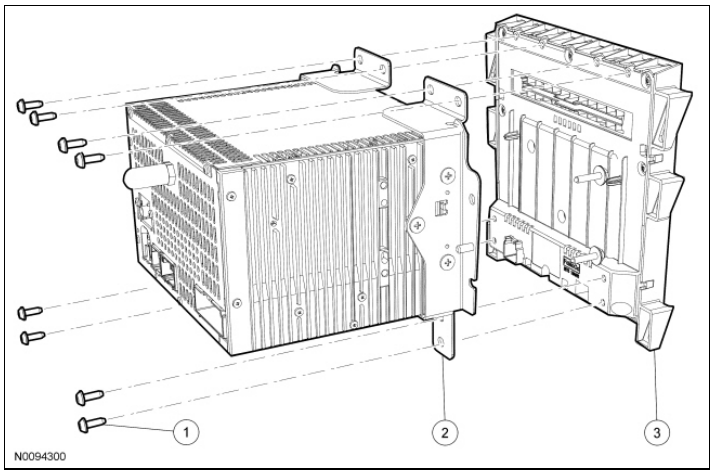
4. **NOTE:** For vehicles with navigation, the 2 upper screws were removed with the FDIM .

   Remove the 4 screws (2 for navigation) and the ACM .

- Disconnect the electrical connectors.

5. To install, reverse the removal procedure.
   - Download the ACM configuration information from the scan tool. For additional information, refer to PMI in Section 418-01 .

Audio Control Module (ACM) - MKZ



Item	Part Number	Description
1	-	Audio Front Control Module (ACM) screws (8 required)
2	18806	ACM
3	18842	Front Controls Interface Module (FCIM)

Removal and Installation

NOTE: It is not necessary to remove the Audio Front Control Module (ACM) to retrieve the part number. For additional information, refer to Audio Control Module (ACM) Self-Diagnostic Mode in this section.

1. **NOTE:** Module configuration is required when a new ACM is being installed.

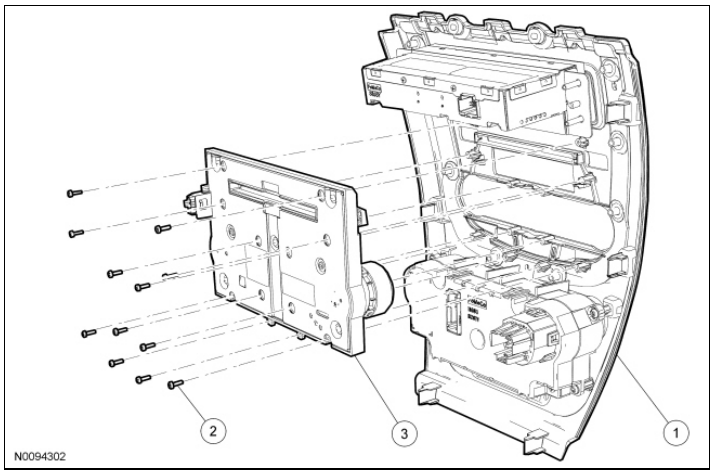
   Upload the ACM configuration infor to the scan tool. For additional information, refer to Programmable Module Installation (PMI) in Section 418-01 .

2. Remove the Front Controls Interface Module (FCIM). For additional information, refer to Front Controls Interface Module (FCIM) - MKZ in this section.

3. Remove the 8 screws and the ACM .

4. To install, reverse the removal procedure.
   - Download the ACM configuration information from the scan tool. For additional information, refer to PMI in Section 418-01 .

Front Controls Interface Module (FCIM) - Fusion



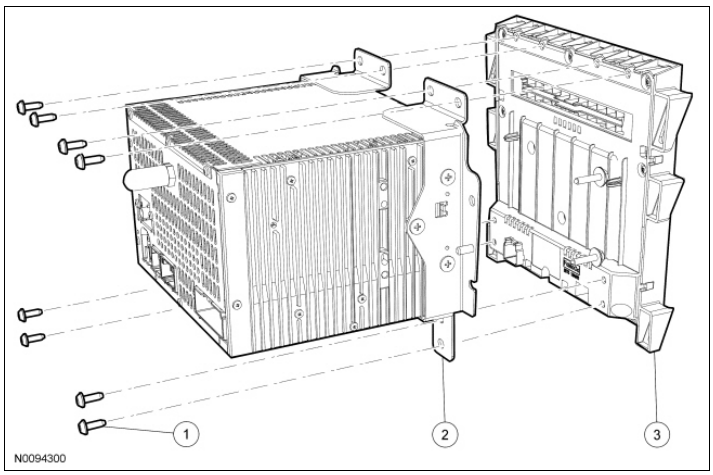
Item	Part Number	Description
1	-	Instrument panel center finish panel
3	W506943-S	Front Controls Interface Module (FCIM) screws (12 required)
3	18842	FCIM

Removal and Installation

1. Remove the instrument panel center finish panel. For additional information, refer to Section 501-12 .
2. Remove the 12 screws and the FCIM .
3. To install, reverse the removal procedure.

Front Controls Interface Module (FCIM) - MKZ

Floor Console and Instrument Panel Components



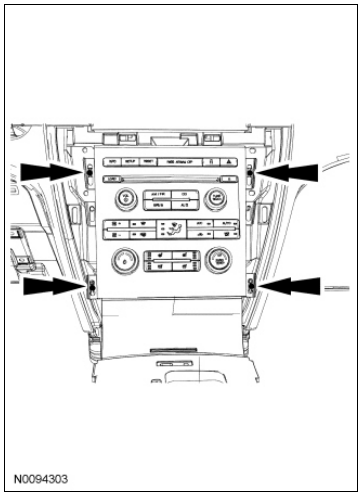
Item	Part Number	Description
1	-	Audio Front Control Module (ACM) screws (8 required)
2	18806	ACM
3	18842	Front Controls Interface Module (FCIM)

Removal and Installation

1. Remove the LH and RH floor console finish mouldings. For additional information, refer to Console - Floor, MKZ in Section 501-12 .

2. Remove the instrument panel finish moulding. For additional information, refer to Instrument Panel - Exploded View in Section 501-12 .

3. Remove the 4 screws and the Front Controls Interface Module (FCIM).
   - Disconnect the electrical connectors.

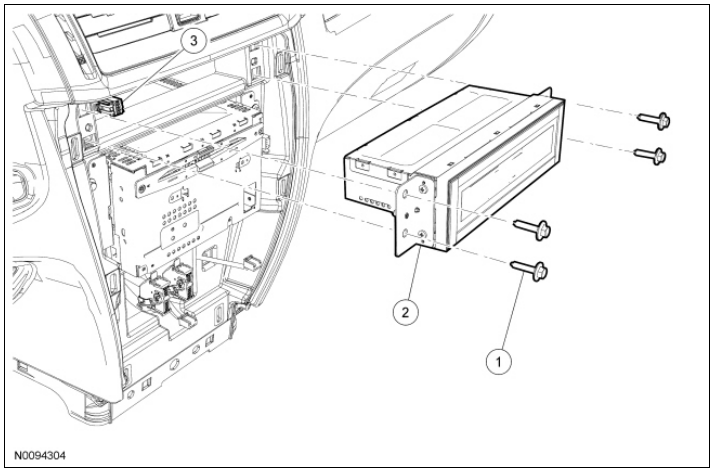


4. Remove the 8 screws and separate the Audio Front Control Module (ACM) from the FCIM .

5. To install, reverse the removal procedure.

Front Display Interface Module (FDIM) - Fusion

NOTE: Without navigation shown, with navigation similar.



Item	Part Number	Description
1	W707628-S	Front Display Interface Module (FDIM) screws (4 required)
2	10D885/10E899	FDIM (without navigation/ with navigation)
3	-	FDIM electrical connector (part of 14401)

Removal and Installation

NOTE: Vehicles without navigation require Programmable Module Installation (PMI) when a new module is being installed. For vehicles without navigation, the Front Display Interface Module (FDIM) is not a stand-alone module.

1. For vehicles without navigation, upload the FDIM configuration information to the scan tool. For additional information, refer to PMI in Section 418-01 .

2. Remove the instrument panel center finish panel. For additional information, refer to Section 501-12 .

3. ***NOTICE:*** **For vehicles with navigation, make sure not to bend the video cable when removing the FDIM .**

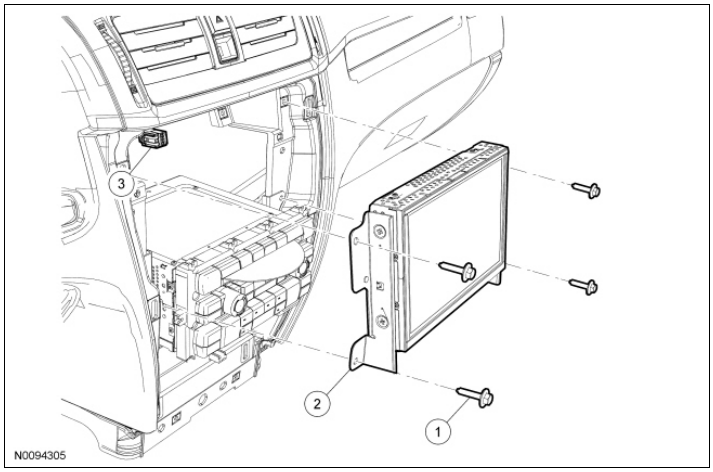
   Remove the 4 screws and the FDIM .

   - Disconnect the electrical connectors.

4. To install, reverse the removal procedure.
   - For vehicles without navigation, download the configuration information to the FDIM . For additional information, refer to PMI in Section 418-01 .

Front Display Interface Module (FDIM) - MKZ

NOTE: With navigation shown, without navigation similar.



Item	Part Number	Description
1	W707628-S	Front Display Interface Module (FDIM) screws (4 required)
2	10D885/10E899	FDIM (without navigation/ with navigation)
3	-	FDIM electrical connector (part of 14401)

Removal and Installation

NOTE: Vehicles without navigation require Programmable Module Installation (PMI) when a new module is being installed. For vehicles without navigation, the Front Display Interface Module (FDIM) is not a stand-alone module.

1. For vehicles without navigation, upload the FDIM configuration information to the scan tool. For additional information, refer to PMI in Section 418-01 .

2. Remove the instrument panel center finish panel. For additional information, refer to Section 501-12 .

3. ***NOTICE:*** **For vehicles with navigation, make sure not to bend the video cable when removing the FDIM .**

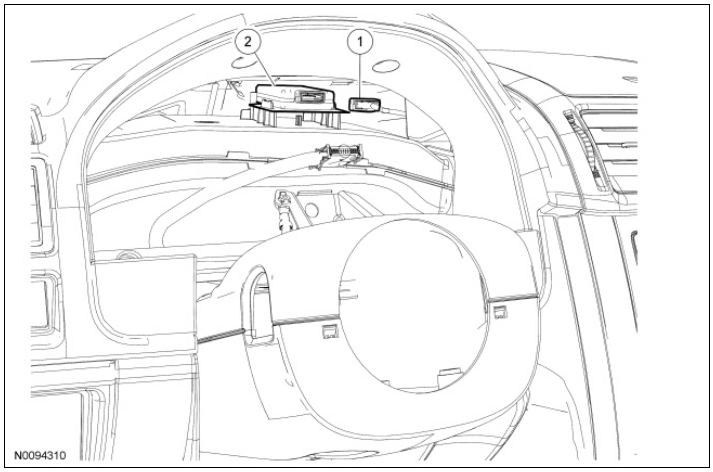
   Remove the 4 screws and the FDIM .

   - Disconnect the electrical connectors.

4. To install, reverse the removal procedure.
   - For vehicles without navigation, download the configuration information to the FDIM . For additional information, refer to PMI in Section 418-01 .

Global Positioning System Module (GPSM) - Fusion

NOTE: Steering wheel shown removed for clarity only.



Item	Part Number	Description
1	-	Global Positioning System Module (GPSM) electrical connector
2	10E893	GPSM

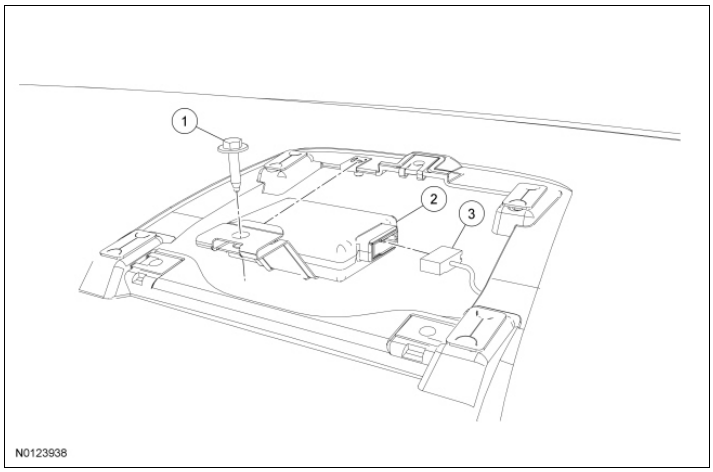
Removal and Installation

1. Remove the Instrument Panel Cluster (IPC). For additional information, refer to Section 413-01 .

2. Release the clips and remove the Global Positioning System Module (GPSM).
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

Global Positioning System Module (GPSM) - MKZ



Item	Part Number	Description
1	W707628	Bolt
2	10E893	Global Positioning System Module (GPSM)
3	-	GPSM electrical connector

Removal and Installation

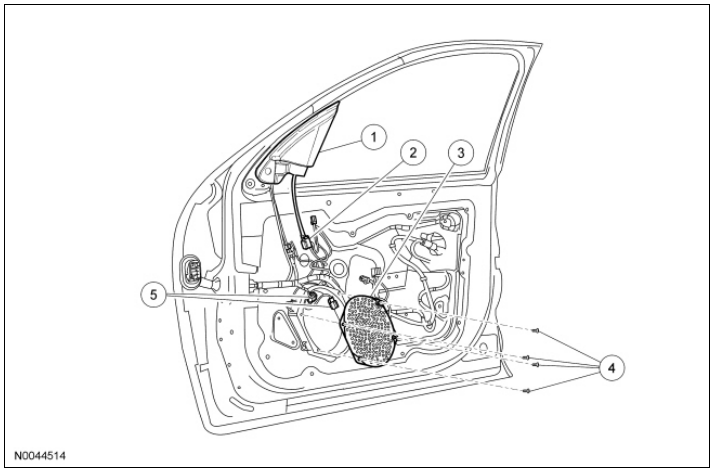
1. Remove the instrument panel speaker. For additional information, refer to Section 415-00 .
2. Remove the Global Positioning System Module (GPSM) mounting bolt.
3. Remove the GPSM .
    - Disconnect the electrical connector.
4. To install, reverse the removal procedure.

&nbP>

Speaker - Door

NOTE: Fusion shown, MKZ similar

NOTE: Front door shown, rear door similar.



Item	Part Number	Description
1	-	Sail panel
2	-	Front door tweeter speaker electrical connector (part of 18808)
3	18808	Door speaker
4	-	Door speaker screws (4 required)
5	-	Door speaker electrical connectors (part of 14630/14631)

Removal and Installation

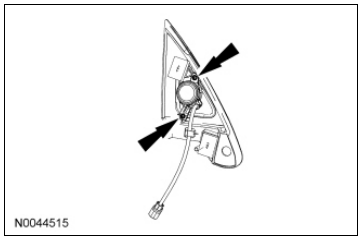
All speakers

1. Remove the door trim panel. For additional information, refer to Section 501-05 .

Front door tweeter speaker (Fusion)

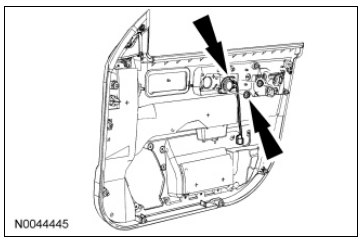
2. Remove the sail panel.
   - Disconnect the electrical connector.

3. Remove the 2 screws and the front door tweeter speaker from the sail panel.



Front door tweeter speaker (MKZ)

4. Remove the 2 nuts and the front door tweeter speaker from the door trim panel.



Front or rear door speaker

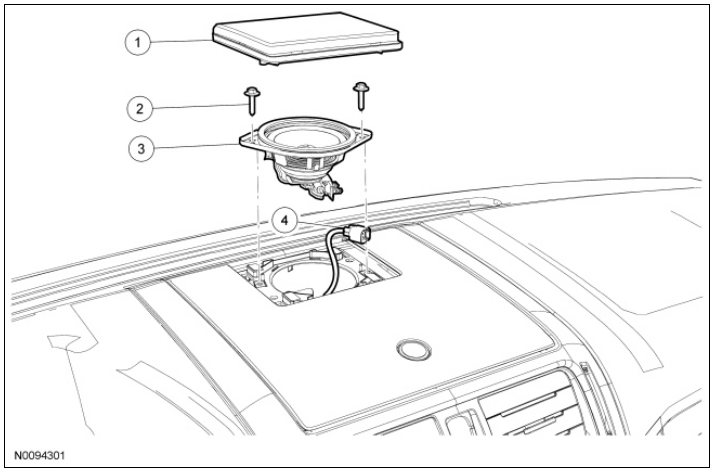
5. Remove the 4 screws and the door speaker.
    - Disconnect the electrical connectors.

All speakers

6. To install, reverse the removal procedure.

Speaker - Instrument Panel

NOTE: Vehicle without THX® shown, vehicles with THX® similar.



Item	Part Number	Description
1	5413594	Instrument panel speaker cover
2	W707628-S	Instrument panel speaker screws (Vehicles without THX® - 2 required, THX® - 3 required)
3	18978/18808	Instrument panel speaker (Sony®/THX®)
4	-	Instrument panel speaker electrical connector (part of 14401)

Removal and Installation

1. **NOTE:** For THX® sound, release the top 2 retaining clips of the center instrument panel finish panel to allow clearence for speaker cover removal.

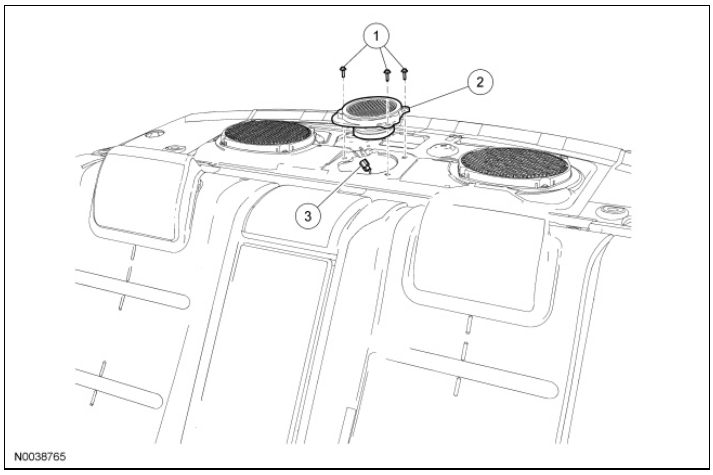
   NOTE: For THX® sound, pry the speaker cover at the front, then lift.

   Using a suitable tool such as a trim removal tool, remove the instrument panel speaker cover.

2. Remove the screws (2 for vehicles without THX® sound, 3 for THX® sound) and the instrument panel speaker.
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

Speaker - Parcel Shelf



Item	Part Number	Description
1	-	Parcel shelf speaker screws (3 required)
2	18808	Parcel shelf speaker
3	-	Parcel shelf speaker electrical connector (part of 14A005)

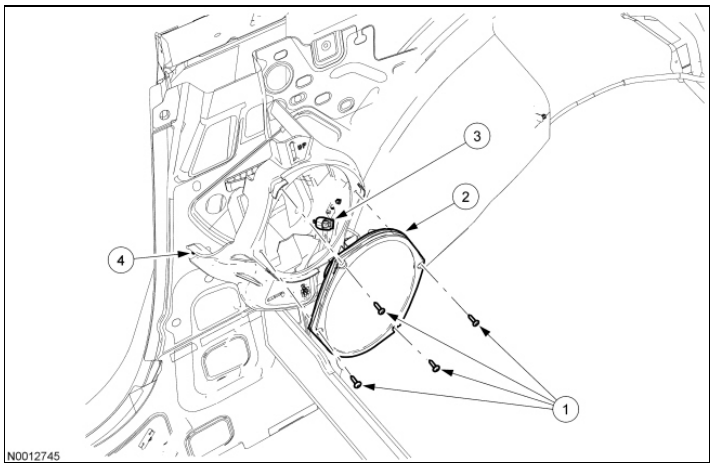
Removal and Installation

1. Remove the parcel shelf. For additional information, refer to Section 501-05 .

2. Remove the 3 screws and the parcel shelf speaker.
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

Speaker - Quarter Panel



Item	Part Number	Description
1	W709996	Quarter panel speaker screws (4 required)
2	18808	Quarter panel speaker
3	-	Quarter panel speaker electrical connector (part of 14A005)
4	W701930	Quarter panel speaker mounting bracket screws (3 required)

Removal and Installation

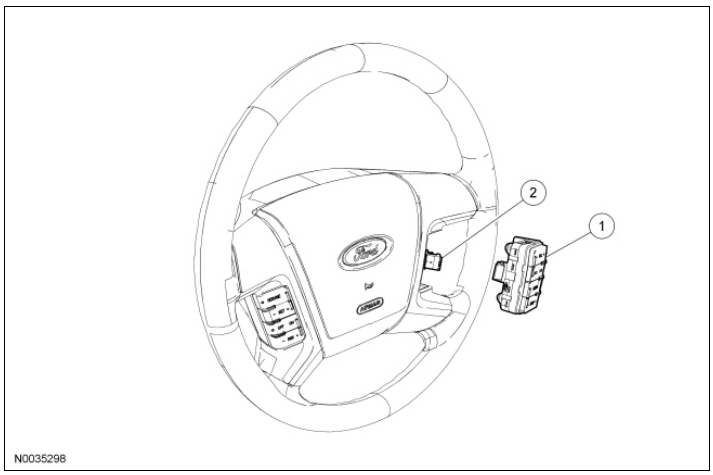
1. Remove the quarter trim panel. For additional information, refer to Section 501-05 .

2. Remove the 4 screws and the quarter panel speaker.
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

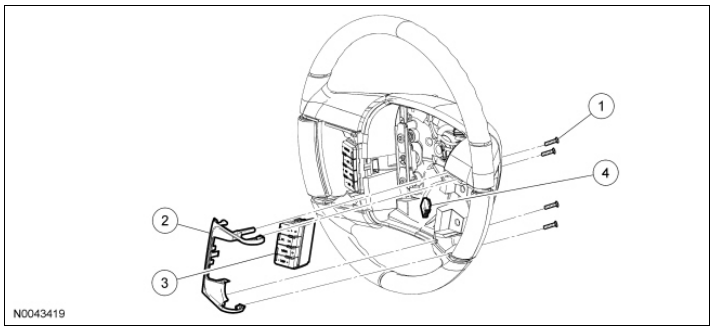
Steering Wheel Controls

Fusion



Item	Part Number	Description
1	9C888	Steering wheel controls
2	-	Steering wheel controls electrical connector (part of 14A411)

MKZ



Item	Part Number	Description
1	-	Steering wheel controls bezel screws (4 required)
2	-	Steering wheel controls bezel
3	9C888	Steering wheel controls
4	-	Steering wheel controls electrical connector (part of 14A411)

Removal and Installation

MKZ

1. Remove the driver air bag module. For additional information, refer to Section 501-20B .

2. Remove the 4 screws and the steering wheel controls bezel.

All vehicles

3. Remove the steering wheel controls by pulling the switch toward the rear of the vehicle.
   - Disconnect the electrical connector.

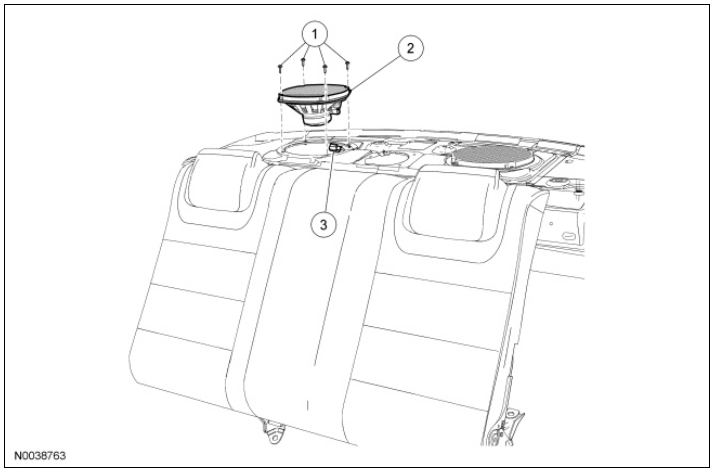
4. Remove the steering wheel controls bezel, if equipped.

5. To install, reverse the removal procedure.

;

Speaker - Subwoofer

NOTE: RH side shown, LH side similar.



Item	Part Number	Description
1	-	Subwoofer speaker screws (4 required)
2	18808	Subwoofer speaker
3	-	Subwoofer speaker electrical connector (part of 14A005)

Removal and Installation

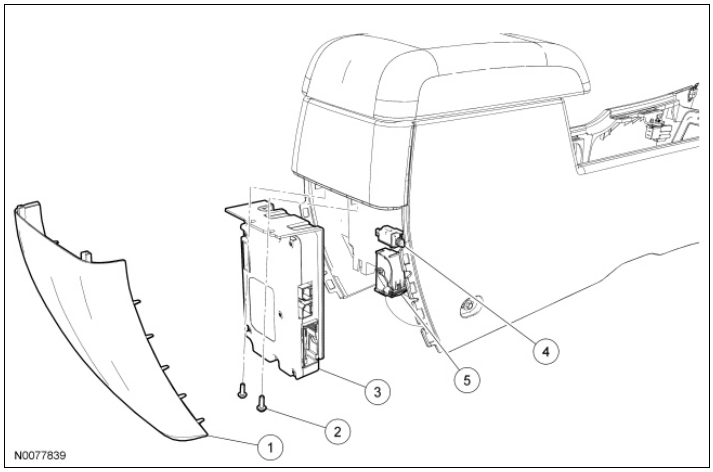
1. Remove the parcel shelf. For additional information, refer to Section 501-05 .

2. Remove the 4 screws and the subwoofer speaker.
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

Accessory Protocol Interface Module (APIM)

NOTE: Fusion shown, MKZ similar.



Item	Part Number	Description
1	-	Floor console rear trim panel (part of 045A36)
2	W505060-S	Accessory Protocol Interface Module (APIM) screws (2 required (Fusion), 4 required (MKZ))
3	14D212	APIM
4	14D202	Universal Serial Bus (USB) cable
5	-	APIM electrical connector (part of 14B079)

Removal and Installation

1. **NOTE:** It is necessary to record the current Accessory Protocol Interface Module (APIM) software and hardware level when a new APIM is being installed to make sure that the new component is the same version as the component being replaced.

   Retrieve and record the current APIM software and hardware level. For additional information, Accessory Protocol Interface Module (APIM) Software Level Check in this section.

2. Remove the floor console rear trim panel by pulling out at the botto disengage the clips then rotating the bottom of the panel out to release the upper retaining tabs.

3. **NOTE:** For Fusion, the APIM is removed as an assembly with the bracket.

   Remove the 2 screws (Fusion) or 4 screws (MKZ) and the APIM .

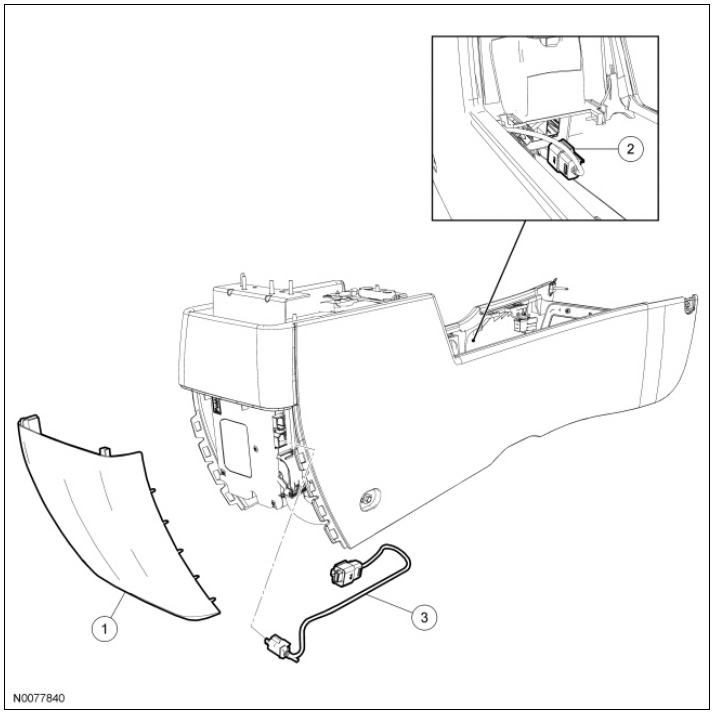
   - Disconnect the APIM electrical connector.
   - Disconnect the Universal Serial Bus (USB) cable.

4. To install, reverse the removal procedure.
   - If a new APIM is being installed, program the APIM to the correct software level. For additional information, refer to Accessory Protocol Interface Module (APIM) Programming

in Section 418-01 .

Universal Serial Bus (USB) Cable and Port

NOTE: Fusion shown, MKZ similar.



Item	Part Number	Description
1	-	Floor console rear trim panel (part of 045A36)
2	-	Universal Serial Bus (USB) cable and port-to-bezel connector (part of 14D202)
3	14D202	USB cable and port

Removal and Installation

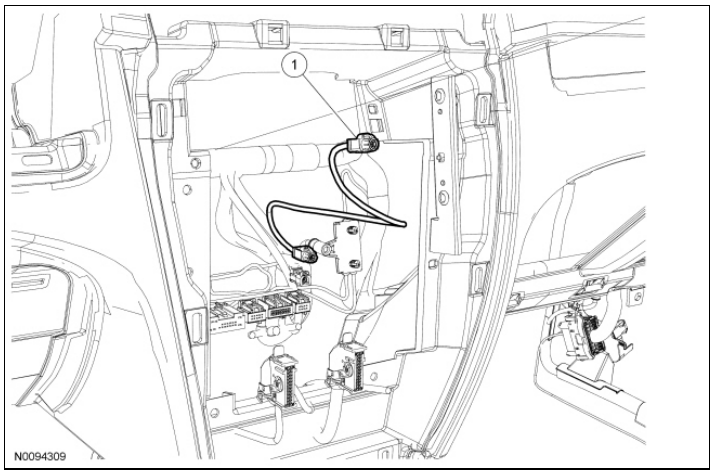
1. Remove the floor console. For additional information, refer to Section 501-12 .
2. Disconnect the Universal Serial Bus (USB) cable and port-to-bezel connector.
3. Remove the floor console rear trim panel by pulling straight back to disengage the clips.
4. ***NOTICE:*** **Be careful not to flex the floor console RH side panel too much, or damage to the floor console may occur.**

   Remove the USB cable and port.

   - Disconnect the USB cable and port-to-Accessory Protocol Interface Module (APIM) electrical connector.
   - Carefully flex the floor console RH side panel and remove the USB cable and port.
5. To install, reverse the removal procedure.

&nbs

Video Cable



Item	Part Number	Description
1	10E929	Video cable

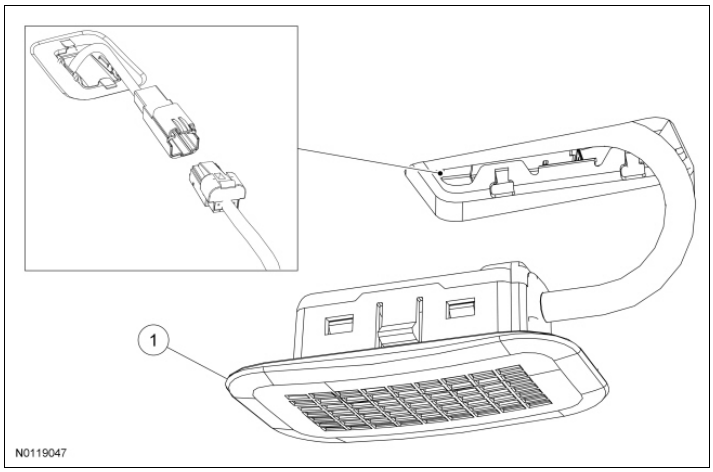
Removal and Installation

1. Remove the Audio Front Control Module (ACM). For additional information, refer to Audio Control Module (ACM) - Fusion or Audio Control Module (ACM) - MKZ in this section.

2. Remove the video cable.

3. To install, reverse the removal procedure.
    - Secure the video cable using tape or zip-ties, as necessary.

Microphone



Item	Part Number	Description
1	19A391	Microphone

Removal

NOTE: If the microphone is removed from the headliner, a new microphone must be installed.

1. Using a suitable tool, (such as a thin small flat head screwdriver) twist and pry the microphone bezel from the headliner metal mounting bracket.

2. Remove the microphone from the headliner by grasping the microphone pigtail.
   - Disconnect the microphone electrical connector.

Installation

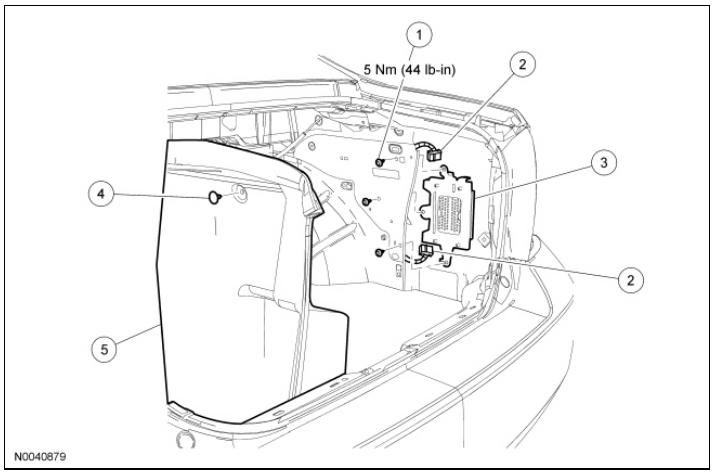
1. Reconnect the microphone electrical connector.

2. Wrap the connection with anti-rattle tape.

3. Feed the microphone pigtail into the headliner through the microphone hole.
   - Verify the microphone pigtail points towards the front of the vehicle.

4. Snap the microphone into the headliner mounting bracket.
   - Verify the mounting bracket and microphone are snug to the headliner.

Subwoofer Amplifier



Item	Part Number	Description
1	W503924	Subwoofer amplifier screws (3 required)
2	-	Subwoofer amplifier electrical connectors (part of 14A005)
3	18B849	Subwoofer amplifier
4	N802734	RH luggage compartment trim panel pushpins (4 required)
5	5445422	RH luggage compartment trim panel

Removal and Installation

NOTE: Make sure the key is in the OFF position.

1. Remove the 4 pushpins and the RH luggage compartment trim panel.

2. Disconnect the subwoofer amplifier electrical connectors.

3. Remove the 3 screws and the subwoofer amplifier.
   - To install, tighten to 5 Nm (44 lb-in).

4. To install, reverse the removal procedure.

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SECTION 501-14: Handles, Locks, Latches and Entry Systems

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SECTION 303-01B: Engine - 3.0L (4V)

SECTION 303-01C: Engine - 3.5L

SECTION 303-01D: Engine - 2.5L Hybrid

SECTION 303-03A: Engine Cooling

SECTION 303-03B: Engine Cooling - Hybrid

SECTION 303-04A: Fuel Charging and Controls - 2.5L

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SECTION 303-04C: Fuel Charging and Controls - 3.5L

SECTION 303-04D: Fuel Charging and Controls - Hybrid

SECTION 303-05A: Accessory Drive - 2.5L

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SECTION 303-05C: Accessory Drive - 3.5L

SECTION 303-05D: Accessory Drive - Hybrid

SECTION 303-06: Starting System

SECTION 303-07A: Engine Ignition - 2.5L

SECTION 303-07B: Engine Ignition - 3.0L (4V)

SECTION 303-07C: Engine Ignition - 3.5L

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SECTION 303-08B: Engine Emission Control - 3.0L (4V)

SECTION 303-08C: Engine Emission Control - 3.5L

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SECTION 303-12A: Intake Air Distribution and Filtering - 2.5L

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SECTION 303-12C: Intake Air Distribution and Filtering - 3.5L

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SECTION 303-14A: Electronic Engine Controls - 2.5L

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SECTION 303-14C: Electronic Engine Controls - 3.5L

SECTION 303-14D: Electronic Engine Controls - Hybrid

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SECTION 204-01: Front Suspension

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SECTION 307-02A: Transaxle/Transmission Cooling - Aisin AW21/6F35

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SECTION 307-05A: Automatic Transaxle/Transmission ontrols - Aisin AW21/6F35

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GROUP 08: Manual Transmission, Clutch and Transfer Case

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SECTION 308-03: Manual Transaxle/Transmission

SECTION 308-06: Manual Transaxle/Transmission External Controls

SECTION 308-07A: Four Wheel Drive (4WD) Systems

SECTION 308-07B: Transfer Case - Power Transfer Unit (PTU)

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GROUP 10: Fuel System

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SECTION 310-01A: Fuel Tank and Lines

SECTION 310-01B: Fuel Tank and Lines - Hybrid

SECTION 310-02: Acceleration Control

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SECTION 211-00B: Steering System - Hydraulic Power Assist Steering (HPAS)

SECTION 211-02: Power Steering

SECTION 211-04: Steering Column

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GROUP 14: Battery and Charging System

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SECTION 414-01: Battery, Mounting and Cables

SECTION 414-03: High Voltage Traction Battery

SECTION 414-05: High Voltage Converter/Inverter

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SECTION 419-03: Cruise Control

SECTION 419-04: Side And Rear Vision

SECTION 419-10: Multifunction Electronic Modules

Torque Specifications

Description	Nm	lb-ft	lb-in
Headlamp bolts	3.7	-	33
Rear lamp assembly nuts	6	-	53
Reversing lamp switch	24	18	-

Exterior Lighting

NOTE: If equipped, the perimeter lighting feature can be enabled or disabled. When enabled, the exterior lamps are illuminated when the UNLOCK button is pressed on the Remote Keyless Entry (RKE) transmitter. Refer to Section 501-14 for programming and diagnostics.

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

Exterior Lighting System

The exterior lighting system consists of the following components:

- Headlamps
- Ballasts (if equipped with High Intensity Discharge (HID) headlamps) (located on the underside of each headlamp)
- Front side marker lamps
- Rear side marker lamps
- Rear lamp assemblies
- High mounted stoplamp
- Reversing lamps
- Headlamp switch
- Multifunction switch
- Hazard flasher lamp switch (located in front of the instrument panel storage bin for Fusion or the lower portion of the center instrument panel finish panel for MKZ)
- Light sensor
- Stoplamp switch
- Reversing lamp switch (located on the forward side of the manual transaxle)
- SJB (located to the left of the brake pedal)
- Headlamp Control Module (HCM) (located next to the SJB)

Battery Saver

NOTE: Time-out is 1 minute if the vehicle has less than 80 km (50 miles).

The battery saver is internal to the SJB and provides automatic shut-off of the headlamps and parking lamps after 10 minutes in order to save battery voltage. A timer is started when the ignition switch is turned to the OFF position with the headlamp switch in the HEADLAMPS ON position, or the headlamp switch is placed in the HEADLAMPS ON position with the ignition switch off. When the time-out period has elapsed, the voltage is automatically shut off to the lamps by the battery saver.

The battery saver does **not** control the parking lamps if the headlamp switch is in the PARKING LAMPS ON position.

Lamp Assembly Condensation

Exterior lamps are vented to accommodate normal changes in pressure. Condensation can be a natural by-product of this design. When moist air enters the lamp assembly through the vents, there is a possibility that condensation can occur if the temperature is cold. When normal condensation occurs, a thin film of mist can form on the interior of the lens. The thin mist eventually clears and exits through the vents during normal

operation. Time to clear the lens of acceptable mist varies with ambient humidity and lamp types. Normal condensation clears from any lamp in 48 hours under dry conditions.

Do **not** replace a lamp assembly with acceptable levels of condensation such as:

- presence of thin mist (no streaks, drip marks or droplets are present)
- fine mist covers less than 50% of the lens

Examples of unacceptable moisture (usually caused by a lamp housing leak):

- water puddling inside the lamp
- large water droplets, drip marks or streaks present on the interior of the lens

Headlamps - Fusion

The headlamp system is a quad-beam pattern system. It consists of replaceable low and high beam bulbs. The headlamp assembly has the park/turn lamp integrated into the headlamp assembly.

If the headlamps are on when the ignition switch is turned off, the battery saver feature turns off the headlamps after 10 minutes have elapsed.

When the low beams are requested (based on inputs to the SJB), the low beams are illuminated.

When the high beams are requested, the high beams are illuminated with the low beams.

When the flash-to-pass feature is requested, the high beams are illuminated for as long as the multifunction switch is held in the FLASH-TO-PASS position.

Headlamps - MKZ

The headlamp system is a quad-beam pattern system. It consists of replaceable low and high beam bulbs. The headlamp assembly has the park/turn and side marker lamps integrated into the headlamp assembly.

If the headlamps are on when the ignition switch is turned off, the battery saver feature turns off the headlamps after 10 minutes have elapsed.

When the low beams are requested (based on inputs to the SJB), the low beams are illuminated.

When the high beams are requested, the high beams are illuminated with the low beams.

When the flash-to-pass feature is requested, the high beams are illuminated for as long as the multifunction switch is held in the FLASH-TO-PASS position.

High Intensity Discharge (HID) Headlamps

Each HID headlamp consists of a ballast and replaceable low and higam bulbs. The ballasts provide the higher voltage required for the HID bulbs to illuminate.

When the low beams are on, the HID ballasts provide high voltage to the HID bulbs.

Autolamps

The autolamp system provides light sensitive automatic on/off control of the exterior lamps. The autolamp system keeps the exterior lamps on for a pre-selected period of time after the ignition switch is turned to the

OFF position (20 seconds is the factory default setting). The pre-selected time lapse is adjustable up to approximately 3 minutes. To adjust the setting, refer to Autolamps Time Delay Adjustment in this section.

Headlamps On With Wipers On Feature

If the headlamp switch is in the AUTOLAMPS ON position, this feature turns the exterior lamps on when the front wipers are on for more than 10 seconds (except during a mist wipe or while the wipers are on to clear washer fluid during a wash condition). The exception to this is when the exterior lights are on because of darkness determined by the autolamp system.

Refer to Section 501-16 for diagnostics of the headlamps on with wipers on feature.

Stoplamps

NOTE: The Fusion high mounted stoplamp has 9 LEDs mounted in the center third portion of the assembly. The outer left and right portions of the high mounted stoplamp are not illuminated. The high mounted stoplamp is not designed to illuminate the full width of the lens.

The stoplamp switch is located on the brake pedal assembly. The stoplamps are supplied voltage when the brake pedal is applied.

Turn Signal/Hazard Lamps

The front turn signal lamps are located within the headlamp assemblies. Fusion utilizes combination stop/turn lamps while MKZ has dedicated rear turn lamps. When the multifunction switch is placed in the LH or RH TURN positions, the SJB routes voltage to the LH or RH turn signal lamps. The SJB then cycles the voltage on and off approximately 80 times per minute. If a front or rear turn bulb is inoperative, the SJB cycles the voltage on and off approximately 160 times per minute.

When the hazard switch is pressed, the SJB supplies voltage to all the turn lamps. The SJB cycles the voltage on and off approximately 80 times per minute.

For Fusion, the hazard flasher lamp switch is mounted to the instrument panel upper storage compartment panel.

For MKZ, the hazard flasher lamp switch is part of the Front Controls Interface Module (FCIM).

Parking Lamps

The SJB supplies voltage to the parking lamps when demanded. The parking lamps include the following:

- Front parking lamps
- Front side marker lamps
- Rear parking lamps
- Rear side marker lamps
- License plate lamps

Fog Lamps

The fog lamp switch is integrated into the headlamp switch. When the fog lamp switch is engaged, the SJB provides ground for the fog lamp relay coil (integrated into the SJB), which then energizes and routes voltage to the fog lamps. The fog lamps can be turned on when the ignition is in run or accessory, the parking lamps are on, and the high beam headlamps are off.

On vehicles equipped with HID headlamps, the fog lamps are used for the Daytime Running Lamps (DRL), if this feature is enabled.

Reversing Lamps

When the transmission is placed in REVERSE (R), the reversing lamps are illuminated. The reversing lamps are located within the rear lamp assemblies (Fusion) or mounted to the luggage compartment lid (MKZ).

Daytime Running Lamps (DRL)

On vehicles with halogen headlamps, the DRL system illuminates the low beam headlamps at a reduced intensity.

On vehicles with HID headlamps, the DRL system operates the fog lamps at full intensity by energizing the fog lamp relay.

The DRL turn on when the following conditions are met:

- The ignition switch is in the RUN position.
- The headlamps have not been turned on by the autolamp system or the headlamp switch.
- The transmission is not in PARK (P) (automatic transaxle).
- The parking brake is released (manual transaxle).

The SJB can be configured to turn the DRL on for this vehicle. Refer to Section 418-01 for additional information on this programmable parameter.

Adaptive Headlighting

Vehicles equipped with adaptive front lighting have a Headlamp Control Module (HCM) to control the left/right swiveling of the headlamp bulbs. Depending on the inputs received (steering wheel angle and vehicle speed for example), the adaptive front lighting module HCM can change the angle at which the headlamps are aimed (left or right) to improve nighttime visibility around curves.

The swiveling motor within each headlamp (used to control the angle of the headlamp beams) are part of the headlamp assembly and cannot be repaired separately.

Diagnostic Trouble Code (DTC) Chart

Smart Junction Box (SJB) DTC Chart

DTC	Description	Action
B106E	Solid State Driver Disabled Due to Short Circuit	**The module has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The SJB cannot enable the output until the cause of the short is corrected. ADDRESS all other DTCs first.** After the cause of the concern is corrected, CLEAR the DTCs. REPEAT the self-test.
B106F	Module Disabled Due to External Fault	**The module has permanently disabled an output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the SJB can withstand. The cause of the excessive current draw MUST be corrected before a new SJB is installed. ADDRESS all other DTCs first.** After the cause of the concern is corrected, INSTALL a new SJB . TEST the system for normal operation.
B1472	Lamp Headlamp Input Circuit Short to Ground	GO to Pinpoint Test D .
B1485	Brake Pedal Input Short to Battery	GO to Pinpoint Test L .
B1510	Flash To Pass Switch Circuit Short to Ground	GO to Pinpoint Test E .
B1578	Lamp Park Input Circuit Short to Ground	GO to Pinpoint Test R .
B1696	Autolamp On Circuit Short To Ground	GO to Pinpoint Test H .
B1791	Autolamp Sensor Input Circuit Open	GO to Pinpoint Test H .
B1793	Autolamp Sensor Input Circuit Short to Ground	GO to Pinpoint Test H .
B2008	Wipers On Signal Circuit Short to Ground	GO to Pinpoint Test H .
B2044	Left Rear Stop Lamp Circuit Short to Ground	GO to Pinpoint Test J .
B2045	Left Rear Stop Lamp Circuit Open	If the lamp is inoperative, GO to Pinpoint Test J . If the lamp is always on, GO to Pinpoint Test L .
B2046	Right Rear Stop Lamp Circuit Short to Ground	GO to Pinpoint Test J .
B2047	Right Rear Stop Lamp Circuit Open	If the lamp is inoperative, GO to Pinpoint Test J . If the lamp is always on, GO to Pinpoint Test L .
B2048	Left Rear Turn Lamp Circuit Short to Ground	GO to Pinpoint Test O .

B2049	Left Rear Turn Lamp Circuit Open	GO to Pinpoint Test O .
B2050	Right Rear Turn Lamp Circuit Short to Ground	GO to Pinpoint Test O .
B2051	Right Rear Turn Lamp Circuit Open	GO to Pinpoint Test O .
B2071	Hazard Switch Signal Short to Ground	GO to Pinpoint Test P .
B2254	Front Fog Lamp Switch Failure	GO to Pinpoint Test U .
B2281	Right Turn Switch Short to Ground	GO to Pinpoint Test N .
B2282	Left Turn Switch Short to Ground	GO to Pinpoint Test N .
B2498	Headlamp Switch Multiple Signals Input Active	ADDRESS any other DTCs first. GO to Pinpoint Test D .
B2A22	Headlamp Off Circuit Open	ADDRESS any other DTCs first. GO to Pinpoint Test D .
B2A23	High Beam Input Circuit Short to Ground	GO to Pinpoint Test E .
B2A24	Turn Signal Input Circuit Failure	DIAGNOSE all other DTCs and symptoms first. If no other DTCs or symptoms are present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
B2A27	Right Front Turn Lamp Circuit Open	GO to Pinpoint Test O .
B2A28	Right Front Turn Lamp Circuit Short to Ground	GO to Pinpoint Test O .
B2A29	Left Front Turn Lamp Circuit Open	GO to Pinpoint Test O .
B2A2A	Left Front Turn Lamp Circuit Short to Ground	GO to Pinpoint Test O .
B2A2B	Left Corner Lamp Output Circuit Short to Ground	DIAGNOSE all other DTCs and symptoms first. If no other DTCs or symptoms are present, INSPECT the SJB and C2280f for bent pins, loose or corroded connections. If no concerns are found, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
B2A2C	Right Corner Lamp Output Circuit Short to Ground	DIAGNOSE all other DTCs and symptoms first. If no other DTCs or symptoms are present, INSPECT the SJB and C2280f for bent pins, loose or corroded connections. If no concerns are found, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
B2A2E	Right Front Lamp Low Beam Circuit Open	If the low beam is inoperative, GO to Pinpoint Test B . If the low beam is always on, GO to Pinpoint Test D .
B2A2F	Right Front Lamp Low Beam Circuit Short to Ground	GO to Pinpoint Test B .
B2A30	Left Front Lamp Low Beam Circuit Open	If the low beam is inoperative, GO to Pinpoint Test B .

		If the low beam is always on, GO to Pinpoint Test D .
B2A31	Left Front Lamp Low Beam Circuit Short to Ground	GO to Pinpoint Test B .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Headlamp Control Module (HCM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B1A98:88	LIN Bus Circuit #1: Bus off	GO to Pinpoint Test AA .
B1D64:01	Left Headlamp Swivelling Motor: General Electrical Failure	INSTALL a new LH headlamp assembly. REFER to Headlamp Assembly in this section. CLEAR the DTCs. REPEAT the self-test.
B1D64:87	Left Headlamp Swivelling Motor: Missing Message	GO to Pinpoint Test AB .
B1D65:01	Right Headlamp Swivelling Motor: General Electrical Failure	INSTALL a new RH headlamp assembly. REFER to Headlamp Assembly in this section. CLEAR the DTCs. REPEAT the self-test.
B1D65:87	Right Headlamp Swivelling Motor: Missing Message	GO to Pinpoint Test AB .
U0001:88	High Speed CAN Communication Bus: Bus off	REFER to Section 418-00 .
U0100:87	Lost Communication With ECM/PCM "A": Missing Message	GO to Pinpoint Test AC .
U0101:87	Lost Communication With TCM: Missing Message	GO to Pinpoint Test AD .
U0121:87	Lost Communication With Anti-Lock Brake System (ABS) Control Module: Missing Message	GO to Pinpoint Test AE .
U0126:87	Lost Communication With Steering Angle Sensor Module: Missing Message	GO to Pinpoint Test AF .
U0155:87	Lost Communication with Instrument Panel Cluster (IPC) Control Module: Missing Message	GO to Pinpoint Test AG .
U0401:86	Invalid Data Received From ECM/PCM A: Signal Invalid	DTC U0401:86 is set when a module receives invalid network data from another module with a faulted input. RETRIEVE and REPAIR all non-network DTCs in the PCM and other modules on the network. REFER to Section 419-10 .
U0402:86		

	Invalid Data Received from TCM: Signal Invalid	DTC U0401:86 is set when a module receives invalid network data from another module with a faulted input. RETRIEVE and REPAIR all non-network DTCs in the TCM and other modules on the network. REFER to Section 419-10 .
U0415:86	Invalid Data Received From Anti-Lock Brake System (ABS) Control Module: Signal Invalid	DTC U0401:86 is set when a module receives invalid network data from another module with a faulted input. RETRIEVE and REPAIR all non-network DTCs in the ABS module and other modules on the network. REFER to Section 419-10 .
U0423:86	Invalid Data Received From Instrument Panel Control Module: Signal Invalid	DTC U0401:86 is set when a module receives invalid network data from another module with a faulted input. RETRIEVE and REPAIR all non-network DTCs in the Instrument Panel Cluster (IPC) and other modules on the network. REFER to Section 419-10 .
U0428:86	Invalid Data Received From Steering Angle Sensor Module: Signal Invalid	DTC U0401:86 is set when a module receives invalid network data from another module with a faulted input. RETRIEVE and REPAIR all non-network DTCs in the Power Steering Control Module (PSCM) and other modules on the network. REFER to Section 419-10 .
U3000:04	Control Module: System Internal Failure	INSTALL a new Headlamp Control Module (HCM). REFER to Headlamp Control Module (HCM) in this section.
U3000:46	Control Module: Calibration/Parameter Memory Failure	INSTALL a new Headlamp Control Module (HCM). REFER to Headlamp Control Module (HCM) in this section.
U3003:16	Battery Voltage: Circuit Voltage Below Threshold	GO to Pinpoint Test AH .
U3003:17	Battery Voltage: Circuit Voltage Above Threshold	GO to Pinpoint Test AI .

PCM DTC Chart

DTC	Description	Action
P1910	Reverse Lamp Control Circuit/Open	If the reversing lamps are inoperative, GO to Pinpoint Test W . If the reversing lamps are always on, GO to Pinpoint Test Y .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Headlamps

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

Exterior Lighting

The SJB monitors the headlamp switch position by sending voltage signals on multiple circuits to the headlamp switch. There is one circuit for each headlamp switch position. At any given time, one of the signal circuits is switched to ground.

If the SJB does not detect any of the inputs to the headlamp switch is active (switched to ground) for 5 seconds, the SJB turns on the parking lamps and headlamps and keeps them on until the battery saver feature times out.

Additionally, if the SJB detects multiple headlamp switch input circuits short to ground, the SJB turns the parking lamps and headlamps on and keeps them on until the battery saver feature times out.

Refer to Exterior Lighting for information regarding the Battery Saver feature.

If either of the above situations occur, the SJB **cannot** be ruled immediately as being at fault. This is normal behavior of the SJB design as it has detected a fault with the inputs from the headlamp switch.

The SJB also monitors the multifunction switch for a flash-to-pass or high beam request. There are 2 voltage signal circuits which monitor this. When the multifunction switch is in the FLASH-TO-PASS or HIGH BEAM position, the voltage signal is routed to ground.

NOTE: The flash-to-pass feature does not require any input from the headlamp switch.

When the SJB receives an input requesting the headlamps on, the SJB supplies voltage to the low beam and high beam bulbs as necessary.

Headlamp Functionality

When the low beams are requested (based on inputs to the SJB), the low beams are illuminated.

Vehicles equipped with High Intensity Discharge (HID) headlamps utilize a relay to provide voltage to the ballasts. When the HID relays are energized, the ballasts provide the required high voltage to illuminate the HID bulbs.

When the high beams are requested, the high beams are illuminated and the low beams turn off.

When the flash-to-pass feature is requested, the high beams are illuminated as long as the multifunction switch is held in the FLASH-TO-PASS position.

Field-Effect Transistor (FET) Protection

Field-Effect Transistor (FET) is a type of transistor that when used with module software can be used to monitor and control current flow on module outputs. The FET protection strategy is used to prevent module damage in the event of excessive current flow.

The SJB utilizes a FET protective circuit strategy for many of its outputs (for example, a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down (turns off the voltage or ground provided by the module) when a fault event is detected. A continuous DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET circuit protection to allow the circuit to function. The next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection) and the circuit remains shorted, the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When each tolerance level is reached, the continuous DTC that was stored on the first failure cannot be cleared by a command to clear the continuous DTCs. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC B106E and the associated continuous DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns.

When the first or second level is reached, the continuous DTC (associated with the short circuit) sets along with DTC B106E. These DTCs can be cleared using the module on-demand self-test, then the Clear DTC operation on the scan tool (if the on-demand test shows the fault corrected). The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs B106F and B1342 set along with the associated continuous DTC. This DTC cannot be cleared and the module must be replaced.

The SJB FET protected output circuits for the headlamps are the LH and RH low beam output circuits.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Headlamp switch • Multifunction switch • Headlamp assembly	• Battery Junction Box (BJB) fuse(s): ♦ 26 (15A) (LH ballast) ♦ 27 (15A) (RH ballast) • Smart Junction Box (SJB) fuse(s): ♦ 7 (10A) (LH low beam) ♦ 8 (10A) (RH low beam) ♦ 23 (15A) (high beams) • Bulb(s) • Headlamp relay • Wiring, terminals or connectors • SJB

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

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

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

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: Both High Beams Are Inoperative

Refer to Wiring Diagrams Cell 85 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Headlamps/Autolamps for schematic and connector information.

Normal Operation

When the headlamp switch is placed in the HEADLAMPS ON position, the Smart Junction Box (SJB) monitors the high beam request circuit from the multifunction switch. When the multifunction switch is placed in the HIGH BEAM position, the signal is switched to ground, indicating a request for the high beams. The SJB then energizes the high beam relay (integrated into the SJB) which supplies voltage to the headlamps.

The SJB communicates to the Instrument Panel Cluster (IPC) (over the communication network) to illuminate the high beam indicator.

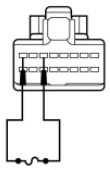
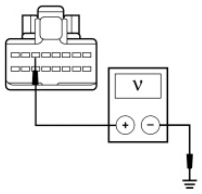
This pinpoint test is intended to diagnose the following:

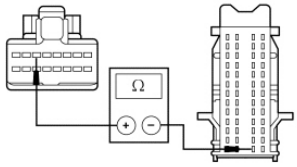
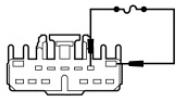
- Fuse
- Wiring, terminals or connectors
- Multifunction switch
- SJB

PINPOINT TEST A: BOTH HIGH BEAMS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK THE HIGH BEAM INDICATOR	
• Ignition OFF. • Place the headlamp switch in the HEADLAMPS ON position. • Place the multifunction switch in the HIGH BEAM position.	**Yes** VERIFY the SJB fuse 23 (15A) is OK. If OK, GO to A5 . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

• **Does the high beam indicator illuminate?**	**No** GO to A2 .
A2 BYPASS THE MULTIFUNCTION SWITCH	
• Place the headlamp switch in the OFF position. • Disconnect: Multifunction Switch C202. • Place the headlamp switch in the HEADLAMPS ON position. • Connect a fused jumper wire between the multifunction switch C202-6, circuit CLF17 (WH/OG), harness side and the multifunction switch C202-8, circuit GD116 (BK/VT), harness side.  N0057365 • **Do the high beams illuminate?**	**Yes** REMOVE the jumper wire. INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. **No** REMOVE the jumper wire. GO to A3 .
A3 CHECK FOR VOLTAGE TO THE MULTIFUNCTION SWITCH	
• Measure the voltage between the multifunction switch C202-6, circuit CLF17 (WH/OG), harness side and ground.  N0088166 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit GD116 (BK/VT) for an open. TEST the system for normal operation. **No** GO to A4 .
A4 CHECK THE HIGH BEAM REQUEST INPUT CIRCUIT FOR AN OPEN	
• Disconnect: SJB C2280b. • Measure the resistance between the multifunction switch C202-6, circuit CLF17 (WH/OG), harness side and the SJB C2280b-27, circuit CLF17 (WH/OG), harness side.	**Yes** GO to A6 . **No** REPAIR circuit CLF17 (WH/OG) for an open. TEST the system for normal operation.

 N0057366 • **Is the resistance less than 5 ohms?**	
A5 CHECK THE SJB HIGH BEAM OUTPUT CIRCUIT FOR AN OPEN	
• Place the headlamp switch in the OFF position. • Disconnect: SJB C2280e. • Connect a fused jumper wire between the SJB C2280e-1, circuit CDC34 (WH/OG), harness side and the SJB C2280e-2, circuit CLF08 (YE/VT), harness side.  N0057367 • Ignition ON. • **Do the high beams illuminate?**	**Yes** REMOVE the jumper wire. GO to A6 . **No** REMOVE the jumper wire. REPAIR circuit CLF08 (YE/VT) for an open. TEST the system for normal operation.
A6 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: One Low Beam Headlamp Is Inoperative

Refer to Wiring Diagrams Cell 85 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Headlamps/Autolamps for schematic and connector information.

Normal Operation - Fusion and MKZ With Halogen Headlamps

When the Smart Junction Box (SJB) detects the headlamp switch in the HEADLAMPS ON position and the multifunction switch in the LOW BEAM position, the SJB provides voltage to the LH and RH low beam headlamps.

MKZ with High Intensity Discharge (HID) Headlamps

When the Smart Junction Box (SJB) detects the headlamp switch in the HEADLAMPS ON position and the multifunction switch in the LOW BEAM position, the SJB provides voltage to the LH and RH headlamp relays. When the headlamp relays are energized, voltage is switched to the headlamps.

For MKZ with HID headlamps, the ballasts then provide the required high voltage to illuminate the HID headlamp bulbs.

DTC Description	Fault Trigger Conditions
• B106E - Solid State Driver Disabled Due to Short Circuit	A continuous DTC that sets when the SJB has temporarily shut down the output driver. **The module has temporarily disabled a low beam output because an excessive current draw exists (such as a short to ground). T SJB cannot enable the low beam output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.**
• B106F - Module Disabled Due to External Fault	A continuous DTC that sets when the SJB has permanently shut down the output driver. **The module has permanently disabled a low beam output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the SJB can withstand. The cause of the excessive current draw MUST be corrected before a new SJB is installed.**
• B2A2E - Right Front Lamp Low Beam Circuit Open	An on-demand DTC that sets when the SJB detects an open from the RH low beam output circuit.
• B2A2F - Right Front Lamp Low Beam Circuit Short to Ground	A continuous and on-demand DTC that sets when the SJB detects a short to ground from the beam output circuit.
• B2A30 - Left Front Lamp Low Beam Circuit Open	An on-demand DTC that sets when the SJB detects an open from the LH low beam output circuit.
• B2A31 - Left Front Lamp Low Beam Circuit Short to Ground	A continuous and on-demand DTC that sets when the SJB detects a short to ground from the LH low beam output circuit.

This pinpoint test is intended to diagnose the following:

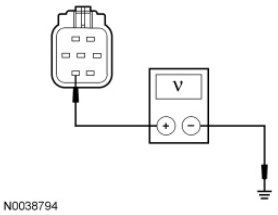
- Fuse

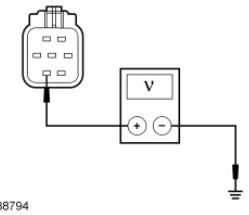
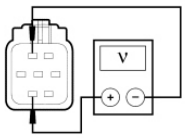
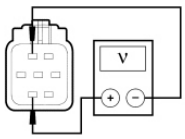
- Wiring, terminals or connectors
- Headlamp relay
- Ballast
- Bulb
- Headlamp assembly
- SJB

PINPOINT TEST B: ONE LOW BEAM HEADLAMP IS INOPERATIVE

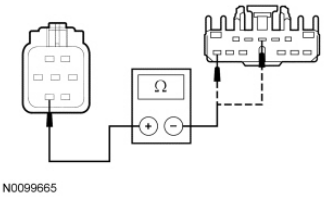
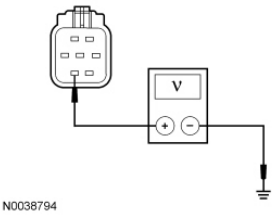
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

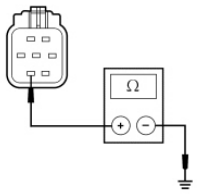
NOTE: Due to varying wattage ratings and resulting current draw of certain aftermarket headlamp bulbs, the SJB may activate its short circuit protection strategy, resulting in the low beam output circuit(s) becoming inoperative. Verify that the bulbs meet Ford specifications. If the bulbs do not meet Ford specifications, install the correct bulbs. Clear the DTCs and rhe on-demand self-test (required to reset the SJB). Correct any unresolved DTCs. Test the system for normal operation.

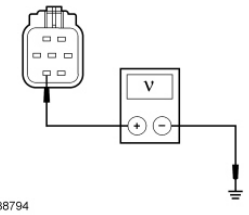
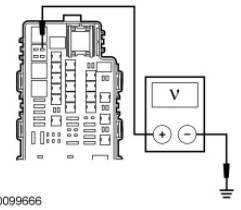
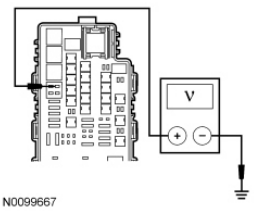
Test Step	Result / Action to Take
B1 CHECK FOR VOLTAGE TO THE HEADLAMP	
• Ignition OFF. • Disconnect: Inoperative Headlamp. • Place the headlamp switch in the HEADLAMPS ON position. • For Fusion or MKZ with halogen headlamps, measure the voltage between the LH headlamp C1021-6, circuit CLF04 (BN/BU), harness side and ground; or between the RH headlamp C1041-6, circuit CLF05 (BU/GN), harness side and ground.  N0038794 • For MKZ with HID headlamps, measure the voltage between the LH headlamp C1021-6, circuit CLF30 (VT/BN), harness side and ground; or between the RH headlamp C1041-6, circuit CLF31 (YE/GY), harness side and ground.	**Yes** GO to B2 . **No** For MKZ with halogen headlamps or Fusion, GO to B5 . For MKZ with HID headlamps, GO to B10 .

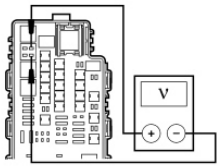
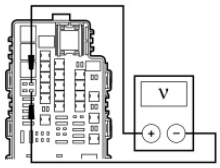
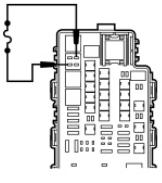
 N0038794 • **Is the voltage greater than 10 volts?**	
B2 CHECK FOR VOLTAGE TO THE HEADLAMP USING THE CONNECTOR GROUND	
• For Fusion or MKZ with halogen headlamps, measure the voltage between the LH headlamp C1021-6, circuit CLF04 (BN/BU), harness side and the LH headlamp C1021-1, circuit GD121 (BK/YE), harness side; or between the RH headlamp C1041-6, circuit CLF05 (BU/GN), harness side and the RH headlamp C1041-1, circuit GD123 (BK/GY), harness side.  N0099663 • For MKZ with HID headlamps, measure the voltage between the LH headlamp C1021-6, circuit CLF30 (VT/BN), harness side and the LH headlamp C1021-1, circuit GD121 (BK/YE), harness side; or between the RH headlamp C1041-6, circuit CLF31 (YE/GY), harness side and the RH headlamp C1041-1, circuit GD123 (BK/GY), harness side.  N0099663 • **Is the voltage greater than 10 volts?**	**Yes** For MKZ with HID headlamps, GO to B3 . For all others, REPAIR or INSTALL a new headlamp assembly. REFER to Headlamp Assembly in this section. TEST the system for normal operation. **No** REPAIR circuit GD121 (BK/YE) (LH headlamp) or circuit GD123 (BK/GY) for an open. TEST the system for normal operation.
B3 SUBSTITUTE THE HID BULB	
• Place the headlamp switch in the OFF position. • Substitute a known good HID bulb. • Place the headlamp switch in the HEADLAMPS ON position. • **Does the headlamp illuminate?**	**Yes** INSTALL a new HID headlamp bulb. REFER to Headlamp Bulb - LH, MKZ or Headlamp Bulb - RH, MKZ in this section. TEST the system for normal operation.

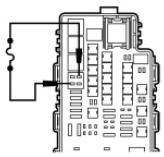
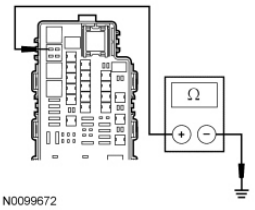
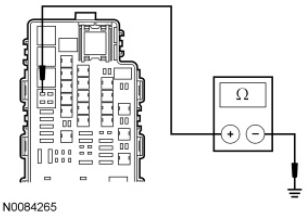
	No REINSTALL the HID bulb. GO to B4 .
B4 SUBSTITUTE THE BALLAST	
• Place the headlamp switch in the OFF position. • Substitute a known good ballast. • Place the headlamp switch in the HEADLAMPS ON position. • **Does the headlamp illuminate?**	**Yes** INSTALL a new ballast. REFER to Ballast in this section. TEST the system for normal operation. **No** INSTALL a new headlamp assembly. REFER to Headlamp Assembly in this section. TEST the system for normal operation.
B5 USE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Place the headlamp switch in the OFF position. • Check the recorded results from the SJB self-test. • **Is DTC B2A2E or DTC B2A30 present?**	**Yes** GO to B6 . **No** VERIFY the SJB fuse 7 (10A) (LH low beam) or fuse 8 (10A) (RH low beam) is OK. If OK, GO to B7 . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the low beam output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
B6 CHECK THE SJB HEADLAMP VOLTAGE SUPPLY CIRCUIT FOR AN OPEN (FUSION OR MKZ WITH HALOGEN HEADLAMPS)	
• Disconnect: SJB C2280e. • Measure the resistance between the LH headlamp C1021-6, circuit CLF04 (BN/BU), harness side and the SJB C2280e-13, circuit CLF04 (BN/BU), harness side; or between the RH headlamp C1041-6, circuit CLF05 (BU/GN), harness side and the SJB C2280e-4, circuit CLF05 (BU/GN), harness side.	**Yes** GO to B21 . **No** REPAIR circuit CLF04 (BN/BU) (LH headlamp) or circuit CLF05 (BU/GN) (RH headlamp) for an open. CLEAR the DTCs. REPEAT the self-test.

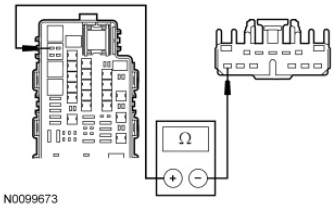
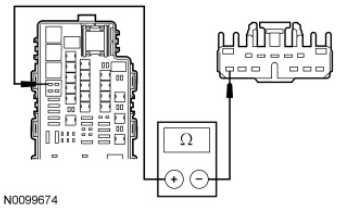
 • **Is the resistance less than 5 ohms?**	
B7 ISOLATE THE HEADLAMP AS THE CAUSE OF THE SHORT	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Clear the DTCs **and** repeat the on-demand self-test **(required to enable the low beam output driver if DTC B106E is present)** . • Place the headlamp switch in the HEADLAMPS ON position. • Measure the voltage between the LH headlamp C1021-6, circuit CLF04 (BN/BU), harness side and ground; or between the RH headlamp C1041-6, circuit CLF05 (BU/GN), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to B9 . **No** GO to B8 .
B8 CHECK THE SJB LOW BEAM OUTPUT CIRCUIT FOR A SHORT TO GROUND (FUSION OR MKZ WITH HALOGEN HEADLAMPS)	
• Ignition OFF. • Disconnect: SJB C2280e. • Measure the resistance between the LH headlamp C1021-6, circuit CLF04 (BN/BU), harness side and ground; or between the RH headlamp C1041-6, circuit CLF05 (BU/GN), harness side and ground.	**Yes** GO to B21 . **No** REPAIR circuit CLF04 (BN/BU) (LH low beam) or circuit CLF05 (BU/GN) (RH low beam) for a short to ground. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the low beam output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.

 N0068990 • **Is the resistance greater than 10,000 ohms?**	
B9 ISOLATE THE HEADLAMP AS THE CAUSE OF THE SHORT (FUSION OR MKZ WITH HID HEADLAMPS)	
• Ignition ON. • Disconnect: Headlamp Bulb. • Connect: Headlamp Assembly. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Clear the DTCs and repeat the on-demand self-test. • **Is DTC B2A31 (LH headlamp) or DTC B2A2F (RH headlamp) present?**	**Yes** INSTALL a new headlamp assembly. REFER to Headlamp Assembly in this section. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the low beam output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** INSTALL a new headlamp bulb. REFER to Headlamp Bulb - LH, Fusion or Headlamp Bulb - RH, Fusion in this section. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the low beam output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
B10 CHECK THE HEADLAMP RELAY	
• Place the headlamp switch in the OFF position. • Disconnect: Suspect Headlamp Relay. • Substitute a known good relay. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Clear the DTCs **and** repeat the on-demand self-test **(required to enable the low beam output driver if DTC B106E is present)** . • Place the headlamp switch in the HEADLAMPS ON position. • Measure the voltage between the LH headlamp C1021-6, circuit CLF30 (VT/BN), harness side	**Yes** REMOVE the known good relay. INSTALL a new headlamp relay. TEST the system for normal operation. **No** For MKZ non-Hybrid, REMOVE the known good relay. GO to B11 . For MKZ Hybrid, REMOVE the known good relay. GO to B16 .

and ground; or between the RH headlamp C1041-6, circuit CLF31 (YE/GY), harness side and ground.  N0038794 • **Is the voltage greater than 10 volts?**	
B11 CHECK FOR VOLTAGE TO THE HEADLAMP RELAY	
• Place the headlamp switch in the OFF position. • Ignition OFF. • For the LH headlamp, measure the voltage between the LH headlamp relay pin 3, circuit SBB26 (YE/RD), BJB face side and ground.  N0099666 • For the RH headlamp, measure the voltage between the RH headlamp relay pin 3, circuit SBB27 (BU/RD), BJB face side and ground.  N0099667 • **Is the voltage greater than 10 volts?**	**Yes** GO to B12 . **No** VERIFY the BJB fuse 26 (15A) (LH headlamp) or fuse 27 (15A) (RH headlamp) is OK. If OK, REPAIR circuit SBB26 (YE/RD) (LH headlamp) or circuit SBB27 (BU/RD) (RH headlamp) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
B12 CHECK FOR VOLTAGE TO THE HEADLAMP RELAY USING THE RELAY GROUND	

• For the LH headlamp, measure the voltage between the LH headlamp relay pin 3, circuit SBB26 (YE/RD), BJB face side and the LH headlamp relay pin 2, circuit GD121 (BK/YE), BJB face side.  N0099668 • For the RH headlamp, measure the voltage between the RH headlamp relay pin 3, circuit SBB27 (BU/RD), BJB face side and the RH headlamp relay pin 2, circuit GD121 (BK/YE), BJB face side.  N0099669 • **Is the voltage greater than 10 volts?**	**Yes** GO to B13 . **No** REPAIR circuit GD121 (BK/YE) for an open. TEST the system for normal operation
B13 BYPASS THE HEADLAMP RELAY	
• Connect: Headlamp Assembly. • For the LH headlamp, connect a fused jumper wire between the LH headlamp relay pin 3, circuit SBB26 (YE/RD), BJB face side and the LH headlamp relay pin 5, circuit CLF30 (VT/BN), BJB face side.  N0099670 • For the RH headlamp, connect a fused jumper wire between the RH headlamp relay pin 3, circuit SBB27 (BU/RD), BJB face side and the RH headlamp relay pin 5, circuit CLF31 (YE/GY), BJB face side.	**Yes** REMOVE the jumper wire. GO to B14 . **No** REMOVE the jumper wire. REPAIR circuit CLF30 (VT/BN) (LH headlamp) or circuit CLF31 (YE/GY) (RH headlamp) for an open. TEST the system for normal operation.

 N0099671 • **Does the headlamp illuminate?**	
B14 CHECK THE SJB LOW BEAM OUTPUT CIRCUIT FOR A SHORT TO GROUND (MKZ NON-HYBRID HID HEADLAMPS)	
• Disconnect: SJB C2280e. • For the LH headlamp, measure the resistance between the LH headlamp relay pin 1, circuit CLF04 (BN/BU), BJB face side and ground.  N0099672 • For the RH headlamp, measure the resistance between the RH headlamp relay pin 1, circuit CLF05 (BU/GN), BJB face side and ground.  N0084265 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B15 . **No** REPAIR circuit CLF04 (BN/BU) (LH low beam) or circuit CLF05 (BU/GN) (RH low beam) for a short to ground. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the low beam output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
B15 CHECK THE SJB HEADLAMP VOLTAGE SUPPLY CIRCUIT FOR AN OPEN (MKZ NON-HYBRID HID HEADLAMPS)	
• For the LH headlamp, measure the resistance between the LH headlamp relay pin 1, circuit CLF04 (BN/BU), BJB face side and the SJB C2280e-13, circuit CLF04 (BN/BU), harness side.	**Yes** GO to B21 . **No** REPAIR circuit CLF04 (BN/BU) (LH headlamp) or circuit CLF05 (BU/GN) (RH headlamp) for an open. TEST the system for normal operation.

 N0099673 • For the RH headlamp, measure the resistance between the RH headlamp relay pin 1, circuit CLF05 (BU/GN), BJB face side and the SJB C2280e-4, circuit CLF05 (BU/GN), harness side.  N0099674 • **Is the resistance less than 5 ohms?**	
B16 CHECK FOR VOLTAGE TO THE HEADLAMP RELAY (MKZ HYBRID)	
• Place the headlamp switch in the OFF position. • Ignition OFF. • For the LH headlamp, measure the voltage between the LH headlamp relay pin 3, circuit SBB26 (YE/RD), BJB face side and ground. • For the RH headlamp, measure the voltage between the RH headlamp relay pin 3, circuit SBB27 (BU/RD), BJB face side and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to B17 . **No** VERIFY the BJB fuse 26 (15A) (LH headlamp) or fuse 27 (15A) (RH headlamp) is OK. If OK, REPAIR circuit SBB26 (YE/RD) (LH headlamp) or circuit SBB27 (BU/RD) (RH headlamp) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
B17 CHECK FOR VOLTAGE TO THE HEADLAMP RELAY USING THE RELAY GROUND (MKZ HYBRID)	
• For the LH headlamp, measure the voltage between the LH headlamp relay pin 3, circuit SBB26 (YE/RD), BJB face side and the LH headlamp relay pin 1, circuit GD123 (BK/GY), BJB face side. • For the RH headlamp, measure the voltage between the RH headlamp relay pin 3, circuit SBB27 (BU/RD), BJB face side and the RH headlamp relay pin 1 circuit GD123 (BK/GY) BJB face side. • **Is the voltage greater than 10 volts?**	**Yes** GO to B18 . **No** REPAIR circuit GD121 (BK/YE) for an open. TEST the system for normal operation
B18 BYPASS THE HEADLAMP RELAY (MKZ HYBRID)	

• Connect: Headlamp Assembly. • For the LH headlamp, connect a fused jumper wire between the LH headlamp relay pin 3, circuit SBB26 (YE/RD), BJB face side and the LH headlamp relay pin 5, circuit CLF30 (VT/BN), BJB face side. • For the RH headlamp, connect a fused jumper wire between the RH headlamp relay pin 3, circuit SBB27 (BU/RD), BJB face side and the RH headlamp relay pin 5, circuit CLF31 (YE/GY), BJB face side. • **Does the headlamp illuminate?**	**Yes** REMOVE the jumper wire. GO to B19 . **No** REMOVE the jumper wire. REPAIR circuit CLF30 (VT/BN) (LH headlamp) or circuit CLF31 (YE/GY) (RH headlamp) for an open. TEST the system for normal operation.
B19 CHECK THE SJB LOW BEAM OUTPUT CIRCUIT FOR A SHORT TO GROUND (MKZ HYBRID)	
• Disconnect: SJB C2280e. • For the LH headlamp, measure the resistance between the LH headlamp relay pin 2 circuit CLF04 (BN/BU), BJB face side and ground. • For the RH headlamp, measure the resistance between the RH headlamp relay pin 2 circuit CLF05 (BU/GN), BJB face side and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B20 . **No** REPAIR circuit CLF04 (BN/BU) (LH low beam) or circuit CLF05 (BU/GN) (RH low beam) for a short to ground. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the low beam output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
B20 CHECK THE SJB HEADLAMP VOLTAGE SUPPLY CIRCUIT FOR AN OPEN (MKZ HYBRID)	
• For the LH headlamp, measure the resistance between the LH headlamp relay pin 2 circuit CLF04 (BN/BU), BJB face side and the SJB C2280e-13, circuit CLF04 (BN/BU), harness side. • For the RH headlamp, measure the resistance between the RH headlamp relay pin 2 circuit CLF05 (BU/GN), BJB face side and the SJB C2280e-4, circuit CLF05 (BU/GN), harness side. • **Is the resistance less than 5 ohms?**	**Yes** GO to B16 . **No** REPAIR circuit CLF04 (BN/BU) (LH headlamp) or circuit CLF05 (BU/GN) (RH headlamp) for an open. TEST the system for normal operation.
B21 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly.	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

• Operate the system and verify the concern is still present. • **Is the concern still present?**	

Pinpoint Test C: One High Beam Headlamp Is Inoperative

Refer to Wiring Diagrams Cell 85 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Headlamps/Autolamps for schematic and connector information.

Normal Operation

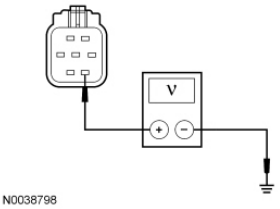
When low beams are on and the Smart Junction Box (SJB) detects the multifunction switch in the HIGH BEAM position, the SJB energizes an internal relay. When the relay is energized, the relay routes voltage to the headlamps.

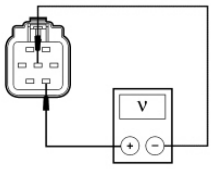
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Headlamp assembly

PINPOINT TEST C: ONE HIGH BEAM HEADLAMP IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 CHECK FOR VOLTAGE TO THE HEADLAMP	
• Ignition OFF. • Disconnect: Inoperative Headlamp. • Place the headlamp switch in the HEADLAMPS ON position. • Place the multifunction switch in the HIGH BEAM position. • Measure the voltage between the LH headlamp C1021-7, circuit CLF08 (YE/VT), harness side and ground; or between the RH headlamp C1041-7, circuit CLF08 (YE/VT), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to C2 . **No** REPAIR circuit CLF08 (YE/VT) for an open. TEST the system for normal operation.
C2 CHECK FOR VOLTAGE TO THE HEADLAMP USING THE HIGH BEAM GROUND PIN	

• Measure the voltage between the LH headlamp C1021-7, circuit CLF08 (YE/VT), harness side and the LH headlamp C1021-4, circuit GD121 (BK/YE), harness side; or between the RH headlamp C1041-7, circuit CLF08 (YE/VT), harness side and the RH headlamp C1041-4, circuit GD123 (BK/GY), harness side.  N0090414 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR or INSTALL a new headlamp assembly. REFER to Headlamp Assembly in this section. TEST the system for normal operation. **No** REPAIR circuit GD121 (BK/YE) (LH headlamp) or circuit GD123 (BK/GY) (RH headlamp) for an open. TEST the system for normal operation.

Pinpoint Test D: The Low Beam(s) Are Always On

Refer to Wiring Diagrams Cell 85 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Headlamps/Autolamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends voltage signals to the headlamp switch through individual circuits (OFF, PARKING LAMPS and HEADLAMPS). At any given time, the headlamp switch routes one of the input circuits to ground.

When the SJB detects the headlamp switch in the HEADLAMPS ON position (or a fault with one of the headlamp switch input circuits for more than 5 seconds) and the multifunction switch in the LOW BEAM position, the SJB provides voltage to the headlamps.

For MKZ equipped with High Intensity Discharge (HID) headlamps, a relay is utilized to provide voltage for the low beam headlamps.

DTC Description	Fault Trigger Conditions
• B1472 - Lamp Headlamp Input Circuit Short to Ground	An on-demand DTC that may set when the SJB detects the headlamps on input circuit is short to ground.
• B2498 - Headlamp Switch Multiple Signals Input Active	An on-demand DTC that may set when the SJB detects multiple headlamp switch inputs active at the same time.
• B2A22 - Headlamp OFF Circuit Open	An on-demand DTC that sets when the SJB detects the headlamp switch off input circuit open.
• B2A2E - Right Front Lamp Low Beam Circuit Open	An on-demand DTC that sets when the SJB detects the RH low beam output circuit shorted to voltage.

• B2A30 - Left Front Lamp Low Beam Circuit Open	An on-demand DTC that sets when the SJB detects the LH low beam output circuit shorted to volta

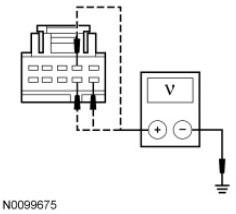
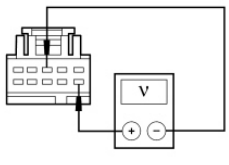
This pinpoint test is intended to diagnose the following:

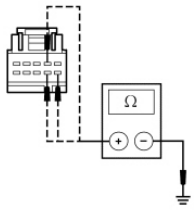
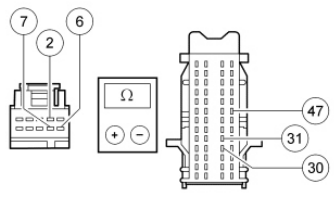
- Wiring, terminals or connectors
- Headlamp relay
- Headlamp switch
- SJB

PINPOINT TEST D: THE LOW BEAM(S) ARE ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 CHECK FOR AUTOLAMP DTCs	
• Review the DTCs retrieved from the SJB self-test. • **Is DTC B1696, B1791, B1793 or B2008 present?**	**Yes** REFER to Autolamps in this section. **No** If equipped with autolamps, GO to D2 . If not equipped with autolamps, GO to D3 .
D2 CHECK THE SJB AUTOLAMP ON REQUEST PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger. • While placing the headlamp switch in the AUTOLAMPS ON and then OFF position, monitor the SJB headlamp switch PID (HDLMP_AUT_CKT). • **Does the PID indicate ON with the headlamp switch in the AUTOLAMPS ON position and OFF when the headlamp switch is in the OFF position?**	**Yes** GO to D3 . **No** GO to Pinpoint Test H .
D3 CHECK THE SJB HEADLAMP SWITCH PIDs	
NOTE: Make sure the headlamp switch is lined up in the correct position when monitoring the PIDs. • Enter the following diagnostic mode on the scan tool: SJB DataLogger. • **NOTE:** Only one PID should indicate ON at each headlamp switch position. • While moving the headlamp switch through all positions, monitor the SJB headlamp switch input PIDs (HDLMP_OFF_CKT, HDLMP_PRK_CKT, HDLMP_ON_CKT).	**Yes** GO to D8 . **No** GO to D4 .

• **Do the headlamp switch positions agree with the PIDs (with only one PID indicating ON in each position)?**	
D4 CHECK FOR VOLTAGE SIGNALS TO THE HEADLAMP SWITCH	
• Ignition OFF. • Disconnect: Headlamp Switch C205. • Measure the voltage between the headlamp switch, harness side and ground as follows: **Headlamp Switch Connector-Pin / Circuit** C205-6 — CLF23 (WH/VT) C205-2 — CLS34 (GY) C205-7 — CLF18 (BU/WH)  N0099675 • **Are the voltages greater than 10 volts?**	**Yes** GO to D5 . **No** GO to D6 .
D5 CHECK FOR VOLTAGE TO THE HEADLAMP SWITCH USING THE CONNECTOR GROUND	
• Measure the voltage between the headlamp switch C205-6, circuit CLF23 (WH/VT), harness side and the headlamp switch C205-3, circuit GD116 (BK/VT), harness side.  N0099676 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation. **No** REPAIR circuit GD116 (BK/VT) for an open. TEST the system for normal operation.
D6 CHECK THE HEADLAMP SWITCH INPUT CIRCUITS FOR A SHORT TO GROUND	

• Disconnect: SJB C2280b. • Measure the resistance between the headlamp switch, harness side and ground as follows: | Headlamp Switch Connector-Pin	Circuit | |---|---| | C205-6 | CLF23 (WH/VT) | | C205-2 | CLS34 (GY) | | C205-7 | CLF18 (BU/WH) |  N0090404 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to D7 . **No** REPAIR the circuit in question for a short to ground. TEST the system for normal operation.
D7 CHECK THE HEADLAMP SWITCH INPUT CIRCUITS FOR AN OPEN	
• Measure the resistance between the headlamp switch, harness side and the SJB , harness side as follows: | Headlamp Switch Connector-Pin	SJB Connector-Pin	Circuit | |---|---|---| | C205-6 | C2280b-47 | CLF23 (WH/VT) | | C205-2 | C2280b-31 | CLF34 (YE/OG) | | C205-7 | C2280b-30 | CLF18 (BU/WH) |  N0090405 • **Are the resistances less than 5 ohms?**	**Yes** GO to D11 . **No** REPAIR the circuit in question for an open. TEST the system for normal operation.

D8 CHECK THE SJB OUTPUT	
• Disconnect: SJB C2280e. • **Does the LH or RH headlamp continue to illuminate?**	**Yes** For MKZ with halogen headlamps or Fusion, REPAIR circuit CLF04 (BN/BU) (LH headlamp) or circuit CLF05 (BU/GN) (RH headlamp) for a short to voltage. TEST the system for normal operation. For MKZ with HID headlamps, GO to D9 . **No** GO to D11 .
D9 CHECK THE HEADLAMP RELAY OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Suspect Headlamp Relay. • **Does the LH or RH headlamp continue to illuminate?**	**Yes** REPAIR circuit CLF30 (VT/BN) (LH headlamp) or circuit CLF31 (YE/GY) (RH headlamp) for a short to voltage. TEST the system for normal operation. **No** GO to D10 .
D10 CHECK HEADLAMP RELAY	
• Substitute a known good relay. • **Does the LH or RH headlamp continue to illuminate?**	**Yes** REPAIR circuit CLF04 (BN/BU) (LH headlamp) or circuit CLF05 (BU/GN) (RH headlamp) for a short to voltage. TEST the system for normal operation. **No** REMOVE the known good relay. INSTALL a new headlamp relay. TEST the system for normal operation.
D11 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test E: The High Beam(s) Are Always On

Refer to Wiring Diagrams Cell 85 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Headlamps/Autolamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends a voltage signal to the multifunction switch for the high beam and flash-to-pass requests. When the multifunction switch is placed in the FLASH-TO-PASS or HIGH BEAM position, the voltage signal is routed to ground. When the SJB detects a request for flash-to-pass or high beams (when the low beams are on), the SJB energizes the high beam relay (integrated into the SJB), which routes voltage to the headlamps.

- DTC B1510 (Flash To Pass Switch Circuit Short to Ground) - an on-demand DTC that sets when the SJB detects the flash-to-pass request input circuit is short to ground.
- DTC B2A23 (High Beam Input Circuit Short to Ground) - an on-demand DTC that sets when the SJB detects a short to ground on the high beam request input circuit.

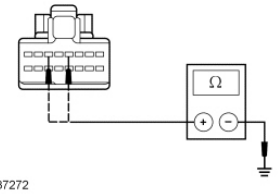
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Multifunction switch
- SJB

PINPOINT TEST E: THE HIGH BEAM(S) ARE ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 CHECK FOR DTC B1510 OR DTC B2A23	
• Review the DTCs retrieved from the SJB self-test. • **Is DTC B1510 or DTC B2A23 present?**	**Yes** GO to E2 . **No** For Fusion or MKZ, GO to E4 .
E2 CHECK THE MULTIFUNCTION SWITCH	
• Ignition OFF. • Disconnect: Multifunction Switch C202. • Ignition ON. • **Do the high beams continue to illuminate?**	**Yes** GO to E3 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 . CLEAR the DTCs. REPEAT the self-test.
E3 CHECK THE HIGH BEAM AND FLASH-TO-PASS REQUEST INPUT CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280b. • Measure the resistance between the multifunction switch C202-6, circuit CLF17 (WH/OG), harness side and ground; and between the multifunction switch C202-4, circuit CLF27 (GN/BN), harness side and ground.	**Yes** GO to E5 . **No** REPAIR the circuit in question for a short to ground. CLEAR the DTCs. REPEAT the self-test.

 N0037272 • **Are the resistances greater than 10,000 ohms?**	
E4 CHECK THE SJB HIGH BEAM OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE (FUSION OR MKZ)	
• Ignition OFF. • Disconnect: SJB C2280e. • Ignition ON. • **Do the high beams continue to illuminate?**	**Yes** REPAIR circuit CLF08 (YE/VT) for a short to voltage. TEST the system for normal operation. **No** GO to E5 .
E5 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test F: The Flash-To-Pass Feature Is Inoperative

Refer to Wiring Diagrams Cell 85 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Headlamps/Autolamps for schematic and connector information.

Normal Operation

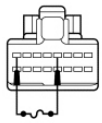
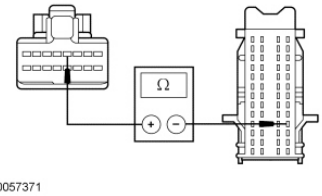
The Smart Junction Box (SJB) sends a voltage signal to the multifunction switch for the flash-to-pass request. When the multifunction switch is placed in the FLASH-TO-PASS position, the voltage signal is routed to ground. When the SJB detects a request for the flash-to-pass, the SJB provides voltage to the high beam headlamps.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Multifunction switch
- SJB

PINPOINT TEST F: THE FLASH-TO-PASS FEATURE IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 VERIFY THE HIGH BEAM HEADLAMP OPERATION	
• Ignition ON. • Place the headlamp switch in the HEADLAMPS ON position. • Place the multifunction switch in the HIGH BEAM position while observing the headlamps. • **Do the high beam headlamps illuminate?**	**Yes** GO to F2 . **No** GO to Pinpoint Test A .
F2 CHECK THE MULTIFUNCTION SWITCH	
• Ignition OFF. • Disconnect: Multifunction Switch C202. • Connect a fused jumper wire between the multifunction switch C202-4, circuit CLF27 (GN/BN), harness side and the multifunction switch C202-8, circuit GD116 (BK/VT), harness side.  N0037273 • **Do the high beams illuminate?**	**Yes** REMOVE the jumper wire. INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. **No** REMOVE the jumper wire. GO to F3 .
F3 CHECK THE FLASH-TO-PASS REQUEST INPUT CIRCUIT FOR AN OPEN	
• Disconnect: SJB C2280b. • Measure the resistance between the multifunction switch C202-4, circuit CLF27 (GN/BN), harness side and the SJB C2280b-43, circuit CLF27 (GN/BN), harness side.  N0057371 • **Is the resistance less than 5 ohms?**	**Yes** GO to F4 . **No** REPAIR circuit CLF27 (GN/BN) for an open. TEST the system for normal operation.
F4 CHECK FOR CORRECT SJB OPERATION	

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

Autolamps

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

Exterior Lighting

The SJB monitors the headlamp switch position by sending voltage signals on multiple circuits to the headlamp switch. There is one circuit for each headlamp switch position. At any given time, one of the signal circuits is switched to ground.

If the SJB does not detect any of the inputs to the headlamp switch is active (switched to ground) for 5 seconds, the SJB turns on the parking lamps and headlamps and keeps them on until the battery saver feature times out.

Additionally, if the SJB detects multiple headlamp switch input circuits short to ground, the SJB turns the parking lamps and headlamps on and keeps them on until the battery saver feature times out.

Refer to Exterior Lighting for information regarding the Battery Saver feature.

If either of the above situations occur, the SJB **cannot** be ruled immediately as being at fault. This is normal behavior of the SJB design as it has detected a fault with the inputs from the headlamp switch.

Autolamps Feature

The SJB monitors the light sensor with a voltage reference signal. The light sensor input to the SJB varies with the ambient light conditions.

When the SJB receives an input from the headlamp switch indicating a request for the autolamps, the SJB monitors the light sensor for the ambient light condition. If the SJB determines the ambient light level is dark, the SJB supplies voltage to the exterior lamps.

If the ignition switch is already in the RUN position and the vehicle enters a dark/lighted area (such as when entering/exiting a non-lighted tunnel during the daytime), the transition from light to dark (or dark to light) needs to last 15 seconds before the SJB turns the exterior lamps on or off. This strategy is to prevent the exterior lamps from unnecessarily flashing on and off.

The SJB reacts quicker under extreme changes of ambient light conditions. If the SJB has detected a very dark condition, the exterior lamps are turned on after 1.5 seconds. If the SJB has detected a very high ambient light level, the exterior lamps are turned off after 4 seconds.

Headlamps On With Wipers On Feature

If the headlamp switch is in the AUTOLAMPS ON position and the front wipers are on for more than 10 seconds (except during a mist wipe or while the wipers are on to clear washer fluid during a wash condition), the exterior lamps turn on. The exterior lamps turn off when the ignition switch is changed to the OFF or ACC position, the headlamp switch is placed in the OFF position, or the front wipers are off for more than 30 seconds. The exception to this is when the exterior lights are on because of darkness determined by the light sensor.

For diagnostics regarding the headlamps on with wipers on feature, refer to Section 501-16 .

Inspection and Verification

1. Verify the customer concern.

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

   Visual Inspection Chart

Mechanical	Electrical
• Headlamp switch	• Wiring, terminals or connectors • Light sensor • Smart Junction Box (SJB)

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
    - Verify the ignition key is in the ON position.
    - Verify the scan tool operation with a known good vehicle.
    - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
    - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
    - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

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

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test G: The Autolamps Are Inoperative

Refer to Wiring Diagrams Cell 85 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Headlamps/Autolamps for schematic and connector information.

Normal Operation

When the Smart Junction Box (SJB) detects the headlamp switch in the AUTOLAMPS ON position, the SJB monitors the light sensor input. The light sensor determines the amount of light based on the input received from the ambient lighting conditions. When the ambient level has reached a point (determined by the internal programming of the SJB), the SJB provides voltage to the headlamps, parking and license plate lamps.

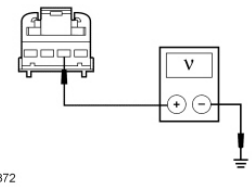
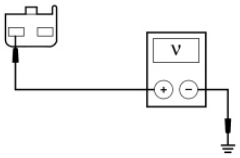
This pinpoint test is intended to diagnose the following:

- Light sensor
- SJB

PINPOINT TEST G: THE AUTOLAMPS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
G1 CHECK THE MANUAL HEADLAMP OPERATION	

• Place the headlamp switch in the HEADLAMPS ON position. • **Do the headlamps and parking lamps operate correctly?**	**Yes** GO to G2 . **No** REFER to Headlamps or Parking, Rear and License Plate Lamps in this section.
G2 CHECK FOR VOLTAGE TO THE LIGHT SENSOR	
• Ignition OFF. • Disconnect: Light Sensor C286 or C287. • Ignition ON. • Place the headlamp switch in the AUTOLAMPS ON position. • For vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU/BN), harness side and ground.  N0057372 • For vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.  N0057373 • **Is the voltage approximately 5 volts?**	**Yes** INSTALL a new light sensor. REFER to Light Sensor in this section. TEST the system for normal operation. **No** GO to G3 .
G3 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test H: The Autolamps Are On Continuously

Refer to Wiring Diagrams Cell 85 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Headlamps/Autolamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends a voltage signal to the headlamp switch to monitor the request for autolamps and a voltage signal to the light sensor to determine the ambient light level.

When the headlamp switch is placed in the AUTOLAMPS ON position, the voltage signal is routed to ground. When the SJB detects the headlamp switch in the AUTOLAMPS ON position, the SJB monitors the light sensor input. The light sensor determines the amount of light based on the input received from the ambient lighting conditions. When the ambient level has reached a point (determined by the internal programming of the SJB), the SJB provides voltage to the headlamps, parking and license plate lamps.

The SJB also monitors the windshield wiper motor status by sending a voltage signal to the wiper/washer module. When the windshield wiper is on (except during a mist wipe or while the wipers are on to clear washer fluid during a wash condition), the wiper/washer module grounds the circuit to indicate to the SJB that the wipers are on.

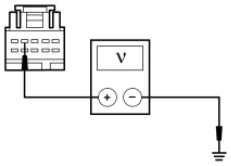
DTC Description	Fault Trigger Conditions
• B1696 - Autolamp On Circuit Short To Ground	An on-demand DTC that may set when the SJB detects a short to ground from the autolamps on input circuit.
• B1791 - Autolamp Sensor Input Circuit Open	An on-demand DTC that sets when the SJB detects an open or short to voltage from the light sensor input circuit.
• B1793 - Autolamp Sensor Input Circuit Short to Ground	A continuous and on-demand DTC that sets when the SJB detects a short to ground from the light sensor input circuit.
• B2008 - Wipers On Signal Circuit Short to Ground	An on-demand DTC that sets when the SJB detects a short to ground from the wipers on input circuit.

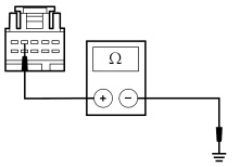
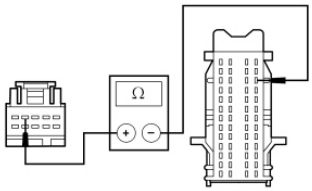
This pinpoint test is intended to diagnose the following:

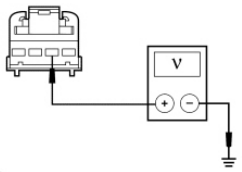
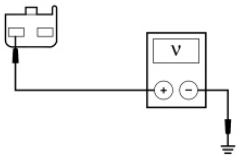
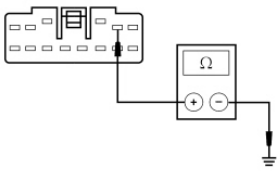
- Wiring, terminals or connectors
- Light sensor
- Headlamp switch
- Wiper/washer module
- SJB

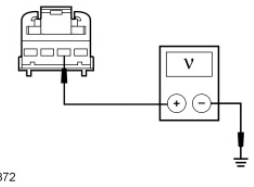
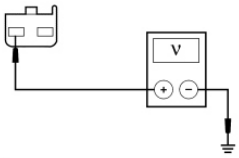
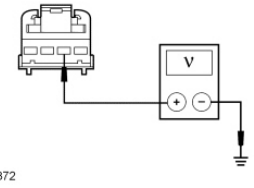
PINPOINT TEST H: THE AUTOLAMPS ARE ON CONTINU

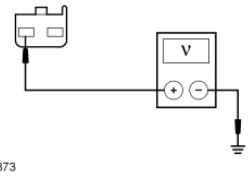
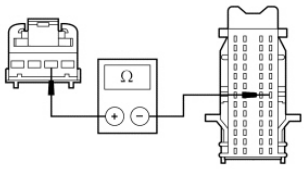
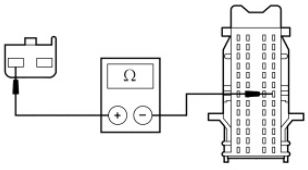
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

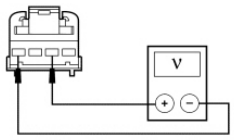
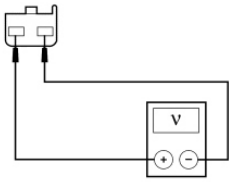
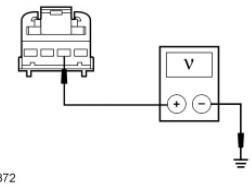
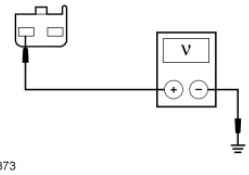
Test Step	Result / Action to Take
H1 CHECK THE SJB AUTOLAMP ON REQUEST PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger. • **NOTE:** Make sure the headlamp switch is in the OFF position. • While placing the headlamp switch in the AUTOLAMPS ON and then OFF position, monitor the SJB headlamp switch PID (HDLMP_AUT_CKT). • **Does the PID indicate ON with the headlamp switch in the AUTOLAMPS ON position and OFF when the headlamp switch is in the OFF position?**	**Yes** GO to H5 . **No** GO to H2 .
H2 CHECK FOR A VOLTAGE SIGNAL TO THE HEADLAMP SWITCH	
• Ignition OFF. • Disconnect: Headlamp Switch C205. • Measure the voltage between the headlamp switch C205-4, circuit CLF19 (VT/GN), harness side and ground.  N0099677 • **Is voltage greater than 10 volts?**	**Yes** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation. **No** GO to H3 .
H3 CHECK THE AUTOLAMPS REQUEST INPUT CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: SJB C2280b. • Measure the resistance between the headlamp switch C205-4, circuit CLF19 (VT/GN), harness side and ground.	**Yes** GO to H4 . **No** REPAIR circuit CLF19 (VT/GN) for a short to ground. TEST the system for normal operation.

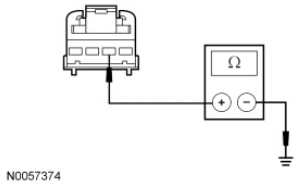
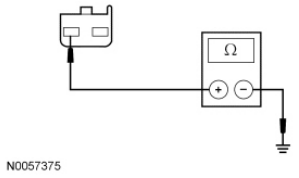
 N0083964 • **Is the resistance greater than 10,000 ohms?**	
H4 CHECK THE AUTOLAMPS REQUEST INPUT CIRCUIT FOR AN OPEN	
• Measure the resistance between the headlamp switch C205-4, circuit CLF19 (VT/GN), harness side and the SJB C2280b-50, circuit CLF19 (VT/GN), harness side.  N0083965 • **Is the resistance less than 5 ohms?**	**Yes** GO to H15 . **No** REPAIR circuit CLF19 (VT/GN) for an open. TEST the system for normal operation.
H5 USE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check the recorded results from the SJB self-test. • **Was DTC B2008, B1791 or B1793 recorded?**	**Yes** For DTC B2008, GO to H7 . For DTC B1791, GO to H9 . For DTC B1793, GO to H13 . **No** GO to H6 .
H6 CHECK FOR VOLTAGE TO THE LIGHT SENSOR (NO DTCs)	
• Ignition OFF. • Disconnect: Light Sensor C286 or C287. • Ignition ON. • Place the headlamp switch in the AUTOLAMPS ON position. • For vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU/BN), harness side and ground.	**Yes** INSTALL a new light sensor. REFER to Light Sensor in this section. TEST the system for normal operation. **No** GO to H15 .

 N0057372 • For vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.  N0057373 • **Is the voltage approximately 5 volts?**	
H7 CHECK THE WIPER/WASHER MODULE	
• Ignition OFF. • Disconnect: Wiper/Washer Module C2157. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Repeat the SJB self-test. • **Is DTC B2008 still present?**	**Yes** GO to H8 . **No** INSTALL a new wiper/washer module. REFER to Section 501-16 . CLEAR the DTCs. REPEAT the self-test.
H8 CHECK THE WIPERS ON INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280f. • Measure the resistance between the wiper/washer module C2157-2, circuit CRW01 (WH), harness side and ground.  N0099678 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to H15 . **No** REPAIR circuit CRW01 (WH) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
H9 CHECK FOR VOLTAGE TO THE LIGHT SENSOR (DTC B1791)	

• Ignition OFF. • Disconnect: Light Sensor C286. • Ignition ON. • Place the headlamp switch in the AUTOLAMPS ON position. • For vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU/BN), harness side and ground.  N0057372 • For vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.  N0057373 • **Is the voltage approximately 5 volts?**	**Yes** GO to H12 . **No** GO to H10 .
H10 CHECK THE LIGHT SENSOR INPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Place the headlamp switch in the OFF position. • Disconnect: SJB C2280b. • Ignition ON. • For vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU/BN), harness side and ground.  N0057372 • For vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.	**Yes** REPAIR circuit VLF14 (BU/BN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to H11 .

 N0057373 • **Is any voltage present?**	
H11 CHECK THE LIGHT SENSOR INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • For vehicles with automatic temperature control, measure the resistance between the light sensor C286-2, circuit VLF14 (BU/BN), harness side and the SJB C2280b-46, circuit VLF14 (BU/BN), harness side.  N0057378 • For vehicles with manual temperature control, measure the resistance between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and the SJB C2280b-46, circuit VLF14 (BU/BN), harness side.  N0057379 • **Is the resistance less than 5 ohms?**	**Yes** GO to H15 . **No** REPAIR circuit VLF14 (BU/BN) for an open. CLEAR the DTCs. REPEAT the self-test.
H12 CHECK FOR VOLTAGE TO THE LIGHT SENSOR USING THE CONNECTOR GROUND	
• For vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU/BN), harness side and the light sensor C286-4, circuit GD116 (BK/VT), harness side.	**Yes** INSTALL a new light sensor. REFER to Light Sensor in this section. CLEAR the DTCs. REPEAT the self-test. **No** REPAIR circuit GD116 (BK/VT) for an open. CLEAR the DTCs. REPEAT the

 N0084276 • For vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and the light sensor C287-B, circuit GD116 (BK/VT), harness side.  N0085766 • **Is the voltage approximately 5 volts?**	self-test.
H13 CHECK FOR VOLTAGE TO THE LIGHT SENSOR (DTC B1793)	
• Disconnect: Light Sensor C286. • Ignition ON. • Place the headlamp switch in the AUTOLAMPS ON position. • For vehicles with automatic temperature control, measure the voltage between the light sensor C286-2, circuit VLF14 (BU/BN), harness side and ground.  N0057372 • For vehicles with manual temperature control, measure the voltage between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.  N0057373 • **Is the voltage approximately 5 volts?**	**Yes** INSTALL a new light sensor. REFER to Light Sensor in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to H14 .

H14 CHECK THE LIGHT SENSOR INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280b. • For vehicles with automatic temperature control, measure the resistance between the light sensor C286-2, circuit VLF14 (BU/BN), harness side and ground.  N0057374 • For vehicles with manual temperature control, measure the resistance between the light sensor C287-A, circuit VLF14 (BU/BN), harness side and ground.  N0057375 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to H15 . **No** REPAIR circuit VLF14 (BU/BN) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
H15 CHECK FOR CORRECT SJB OPERATION	
• Ignition OFF. • Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Stoplamps

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

Fusion

When the brake pedal is applied, voltage is routed to the SJB and the high mounted stoplamp. The SJB then supplies voltage to the rear stoplamps. The rear stoplamps are combination stop/turn lamps. The turn and hazard lamp functions override the rear stoplamp function.

NOTE: The Fusion high mounted stoplamp has 9 LEDs mounted in the center third portion of the assembly. The outer left and right portions of the high mounted stoplamp are not illuminated. The high mounted stoplamp is not designed to illuminate the full width of the lens.

MKZ

When the brake pedal is applied, voltage is routed to the high mounted stoplamp, the rear stoplamps and the SJB .

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect the following for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Stoplamp switch	• Smart Junction Box (SJB) fuse 2 (15A) (stoplamp switch)

	• Bulb(s) • Wiring, terminals or connectors • Rear lamp assembly • SJB

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

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

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test I: All The Stoplamps Are Inoperative

Refer to Wiring Diagrams Cell 90 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

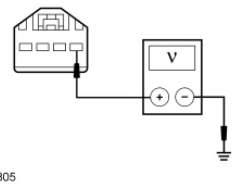
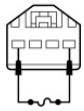
The stoplamp switch is supplied voltage from the Smart Junction Box (SJB) fuse 2 (15A). When the brake pedal is applied, the stoplamp switch routes voltage to the stoplamps and the SJB .

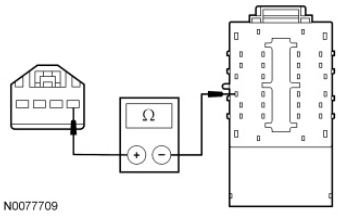
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Stoplamp switch
- SJB

PINPOINT TEST I: ALL THE STOPLAMPS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
I1 CHECK FOR VOLTAGE TO THE STOPLAMP SWITCH	
• Ignition OFF. • Disconnect: Stoplamp Switch C278. • Measure the voltage between the stoplamp switch C278-1, circuit SBP02 (YE/RD), harness side and ground.  N0038805 • **Is the voltage greater than 10 volts?**	**Yes** GO to I2 . **No** VERIFY the SJB fuse 2 (15A) is OK. If OK, GO to I3 . TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
I2 BYPASS THE STOPLAMP SWITCH	
• Connect a fused jumper wire between the stoplamp switch C278-1, circuit SBP02 (YE/RD), harness side and the stoplamp switch C278-4, circuit CCB08 (VT/WH), harness side.  N0038807	**Yes** REMOVE the jumper wire. INSTALL a new stoplamp switch. REFER to Stoplamp Switch in this section. TEST the system for normal operation. **No** REMOVE the jumper wire. REPAIR circuit CCB08 (VT/WH) for an open. TEST the system for normal operation.

• **Do the stoplamps illuminate?**	
I3 CHECK CIRCUIT SBP02 (YE/RD) FOR AN OPEN	
• Disconnect: SJB C2280d. • Measure the resistance between the stoplamp switch C278-1, circuit SBP02 (YE/RD), harness side and the SJB C2280d-13, circuit SBP02 (YE/RD), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to I4 . **No** REPAIR SBP02 (YE/RD) for an open. TEST the system for normal operation.
I4 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test J: One Or More Stoplamps Are Inoperative - Fusion

Refer to Wiring Diagrams Cell 90 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

When the brake pedal is applied, the stoplamp switch routes voltage to the high moted stoplamp and the Smart Junction Box (SJB). When the SJB detects the brake pedal is applied, the SJB provides voltage to the LH and RH rear stoplamps. Each stoplamp has an independent ground circuit.

NOTE: The Fusion high mounted stoplamp has 9 LEDs mounted in the center third portion of the assembly. The outer left and right portions of the high mounted stoplamp are not illuminated. The high mounted stoplamp is not designed to illuminate the full width of the lens.

NOTE: SJB fuse 6 (20A) supplies voltage for both combination rear stop/turn lamps and both front turn lamps.

DTC Description	Fault Trigger Conditions

• B106E - Solid State Driver Disabled Due to Short Circuit	A continuous DTC that sets when the SJB has temporarily shut down the output driver. **The module has temporarily disabled a stoplamp output because an excessive current draw exists (such as a short to ground). The SJB cannot enable the stoplamp output until the cause of the short is corrected, the DTCs have been cleared and a successful lf-test is run.**
• B106F - Module Disabled Due to External Fault	A continuous DTC that sets when the SJB has permanently shut down the output driver. **The module has permanently disabled a stoplamp output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the SJB can withstand. The cause of the excessive current draw MUST be corrected before a new SJB is installed.**
• B2044 - Left Rear Stop Lamp Circuit Short to Ground	A continuous and on-demand DTC that may set when the SJB detects a short to ground from the LH rear stop/turn lamp voltage supply circuit.
• B2045 - Left Rear Stop Lamp Circuit Open	An on-demand DTC that sets when the SJB detects an open from the LH rear stop/turn lamp voltage supply circuit.
• B2046 - Right Rear Stop Lamp Circuit Short to Ground	A continuous and on-demand DTC that may set when tan title="Smart Junction Box" class="popup" onmouseover="this.className='popupnounderline';" onmouseout="this.className='popup';">SJB detects a short to ground from the RH rear stop/turn lamp voltage supply circuit.
• B2047 - Right Rear Stop Lamp Circuit Open	An on-demand DTC that sets when the SJB detects an open from the RH rear stop/turn lamp voltage supply circuit.

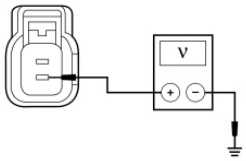
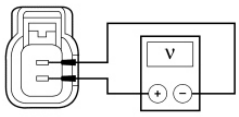
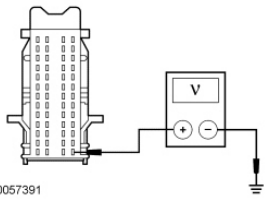
This pinpoint test is intended to diagnose the following:

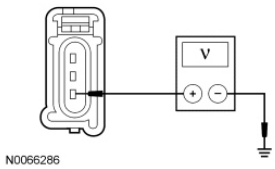
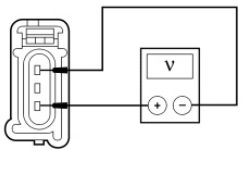
- Wiring, terminals or connectors
- Bulb holder
- High mounted stoplamp
- SJB

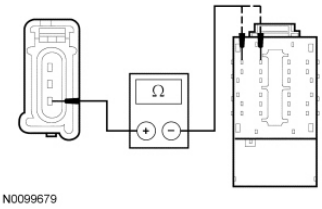
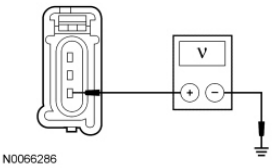
PINPOINT TEST J: ONE OR MORE STOPLAMPS ARE INOPERATIVE - FUSION

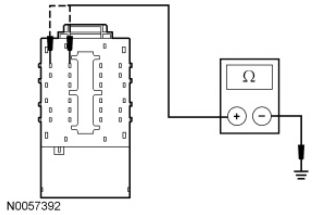
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
J1 DETERMINE THE INOPERATIVE STOPLAMP	
• Ignition OFF. • Apply the brake pedal and observe the stoplamps. • **Are all the stoplamps inoperative?**	**Yes** G Pinpoint Test I . **No** For the high mounted stoplamp, GO to J2 . If only one side (the LH or RH rear stoplamp) is inoperative, GO to J5 . If both sides (LH and RH rear stoplamps) are inoperative, VERIFY the SJB fuse 6 (20A) is OK. If OK, GO to J4 . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the stoplamp output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
J2 CHECK FOR VOLTAGE TO THE HIGH MOUNTED STOPLAMP	

NOTE: The Fusion high mounted stoplamp has 9 LEDs mounted in the center third portion of the assembly. The outer left and right portions of the high mounted stoplamp are not illuminated. The high mounted stoplamp is not designed to illuminate the full width of the lens. • Disconnect: High Mounted Stoplamp C4233. • While applying the brake pedal, measure the voltage between the high mounted stoplamp C4233-2, circuit CCB08 (VT/WH), harness side and ground.  N0077757 • **Is the voltage greater than 10 volts?**	**Yes** GO to J3 . **No** REPAIR circuit CCB08 (VT/WH) for an open. TEST the system for normal operation.
J3 CHECK FOR VOLTAGE TO THE HIGH MOUNTED STOPLAMP USING THE CONNECTOR GROUND	
• While applying the brake pedal, measure the voltage between the high mounted stoplamp C4233-2, circuit CCB08 (VT/WH), harness side and the high mounted stoplamp C4233-1, circuit GD171 (BK/GY), harness side.  N0090428 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new high mounted stoplamp. TEST the system for normal operation. **No** REPAIR circuit GD171 (BK/GY) for an open. TEST the system for normal operation.
J4 CHECK FOR VOLTAGE TO THE SJB	
• Disconnect: SJB C2280b. • While applying the brake pedal, measure the voltage between the SJB C2280b-40, circuit CCB08 (VT/WH), harness side and ground.  N0057391	**Yes** GO to J11 . **No** REPAIR circuit CCB08 (VT/WH) for an open. CLEAR the DTCs. REPEAT the self-test.

• **Is the voltage greater than 10 volts?**	
J5 USE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check the recorded results from the SJB on-demand self-test. • **Is DTC B2045 or DTC B2047 present?**	**Yes** GO to J6 . **No** GO to J9 .
J6 CHECK FOR VOLTAGE TO THE INOPERATIVE STOPLAMP	
• Disconnect: Inoperative Rear Lamp. • While applying the brake pedal, measure the voltage between the LH rear lamp C412-3, circuit CLS18 (GY/BN), harness side and ground; or between the RH rear lamp C415-3, circuit CLS19 (VT/OG), harness side and ground.  N0066286 • **Is the voltage greater than 10 volts?**	**Yes** GO to J7 . **No** GO to J8 .
J7 CHECK FOR VOLTAGE TO THE INOPERATIVE STOPLAMP USING THE CONNECTOR GROUND	
• While applying the brake pedal, measure the voltage between the LH rear lamp C412-3, circuit CLS18 (GY/BN), harness side and the LH rear lamp C412-1, circuit GD171 (BK/GY), harness side; or between the RH rear lamp C415-3, circuit CLS19 (VT/OG), harness side and the RH rear lamp C415-3, circuit GD171 (BK/GY), harness side.  N0088174 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new bulb holder. CLEAR the DTCs. REPEAT the self-test. **No** REPAIR circuit GD171 (BK/GY) for an open. CLEAR the DTCs. REPEAT the self-test.
J8 CHECK THE SJB STOPLAMP OUTPUT CIRCUIT FOR AN OPEN	

• Disconnect: SJB C2280d. • Measure the resistance between the LH rear lamp C412-3, circuit CLS18 (GY/BN), harness side and the SJB C2280d-25, circuit CLS18 (GY/BN), harness side; or between the RH rear lamp C415-3, circuit CLS19 (VT/OG), harness side and the SJB C2280d-26, circuit CLS18 (GY/BN), harness side.  N0099679 • **Is the resistance less than 5 ohms?**	**Yes** GO to J11 . **No** REPAIR circuit CLS18 (GY/BN) (LH rear stoplamp) or circuit CLS19 (VT/OG) (RH rear stoplamp) for an open. CLEAR the DTCs. REPEAT the self-test.
J9 CHECK THE BULB HOLDER FOR A SHORT TO GROUND	
• Disconnect: Inoperative Rear Lamp. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Clear the DTCs **and** repeat the self-test **(required to enable the turn lamp output driver if DTC B106E is present)** . • While applying the brake pedal, measure the voltage between the LH rear lamp C412-3, circuit CLS18 (GY/BN), harness side and ground; or between the RH rear lamp C415-3, circuit CLS19 (VT/OG), harness side and ground.  N0066286 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new bulb holder. TEST the system for normal operation. **No** GO to J10 .
J10 CHECK THE SJB STOPLAMP OUTPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280d. • Measure the resistance between the SJB C2280d-25, circuit CLS18 (GY/BN), harness side and ground; or between the SJB C2280d-26, circuit CLS19 (VT/OG), harness side and ground.	**Yes** GO to J11 . **No** REPAIR circuit CLS18 (GY/BN) (LH rear stoplamp) or circuit CLS19 (VT/OG) (RH rear stoplamp) for a short to ground. After the repair: If no DTCs are present, TEST the system for normal

 • **Is the resistance greater than 10,000 ohms?**	operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the turn lamp output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
J11 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test K: One Or More Stoplamps Are Inoperative - MKZ

Refer to Wiring Diagrams Cell 90 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

When the brake pedal is applied, the stoplamp switch routes voltage to the high mounted stoplamp and both rear stoplamps. Each stoplp has an independent ground circuit.

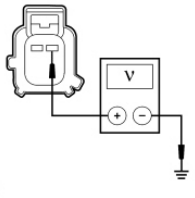
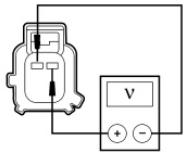
This pinpoint test is intended to diagnose the following:

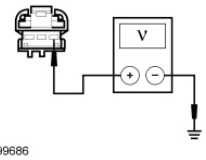
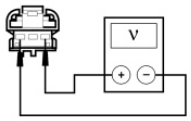
- Wiring, terminals or connectors
- High mounted stoplamp
- Rear lamp assembly

PINPOINT TEST K: ONE OR MORE STOPLAMPS ARE INOPERATIVE - MKZ

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
K1 DETERMINE THE INOPERATIVE STOPLAMP	

• Ignition OFF. • Apply the brake pedal and observe the stoplamps. • **Are all the stoplamps inoperative?**	**Yes** GO to Pinpoint Test I . **No** For the high mounted stoplamp, GO to K2 . For a LH or RH rear stoplamp, GO to K4 . /td>
K2 CHECK FOR VOLTAGE TO THE HIGH MOUNTED STOPLAMP	
• Disconnect: High Mounted Stoplamp. • While applying the brake pedal, measure the voltage between the high mounted stoplamp C475-1, circuit CCB08 (VT/WH), harness side and ground.  N0099682 • **Is the voltage greater than 10 volts?**	**Yes** GO to K3 . **No** REPAIR circuit CCB08 (VT/WH) for an open. TEST the system for normal operation.
K3 CHECK FOR VOLTAGE TO THE HIGH MOUNTED STOPLAMP USING THE CONNECTOR GROUND	
• While applying the brake pedal, measure the voltage between the high mounted stoplamp C475-1, circuit CCB08 (VT/WH), harness side and the high mounted stoplamp C475-2, circuit GD171 (BK/GY), harness side.  N0099685 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new high mounted stoplamp. REFER to High Mounted Stoplamp in this section. TEST the system for normal operation. **No** REPAIR circuit GD171 (BK/GY) for an open. TEST the system for normal operation.
K4 CHECK FOR VOLTAGE TO THE LH STOPLAMP	
• Disconnect: Inoperative Rear Stoplamp. • While applying the brake pedal, measure the voltage between the LH rear lamp C419-1, circuit CCB08 (VT/WH), harness side and ground; or between the RH rear lamp C418-1, circuit CCB08 (VT/WH), harness side and ground.	**Yes** GO to K5 . **No** REPAIR circuit CCB08 (VT/WH) for an open. TEST the system for normal operation.

 N0099686 • **Is the voltage greater than 10 volts?**	
K5 CHECK FOR VOLTAGE TO THE INOPERATIVE STOPLAMP USING THE CONNECTOR GROUND	
• While applying the brake pedal, measure the voltage between the LH rear lamp C419-1, circuit CCB08 (VT/WH), harness side and the LH rear lamp C419-3, circuit GD171 (BK/GY), harness side; or between the RH rear lamp C418-1, circuit CCB08 (VT/WH), harness side and the RH rear lamp C418-3, circuit GD171 (BK/GY), harness side.  N0099687 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new rear lamp assembly. REFER to Rear Lamp Assembly in this section. TEST the system for normal operation. **No** REPAIR circuit GD171 (BK/GY) for an open. TEST the system for normal operation.

Pinpoint Test L: The Stoplamps Are On Continuously

Refer to Wiring Diagrams Cell 90 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

When the brake pedal is applied, the stoplamp switch routes voltage to the LH and RH rear stoplamps (MKZ), the Smart Junction Box (SJB), the high mounted stoplamp and the PCM.

For Fusion, when the SJB detects the brake pedal is applied, the SJB provides voltage to the LH and RH rear stoplamps.

- DTC B1485 (Brake Pedal Input Short to Battery) - an on-demand DTC that sets when the SJB detects a short to voltage from the stoplamp switch input circuit.
- DTC B2045 (Left Rear Stop Lamp Circuit Open) - an on-demand DTC that sets when the SJB detects a short to voltage from the LH rear stop/turn lamp output circuit.
- DTC B2047 (Right Rear Stop Lamp Circuit Open) - an on-demand DTC that sets when the SJB detects a short to voltage from the RH rear stop/turn lamp output circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors

- Stoplamp switch
- PCM
- SJB

PINPOINT TEST L: THE STOPLAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
L1 DETERMINE IF ALL THE STOPLAMPS ARE ILLUMINATED	
• Ignition OFF. • Observe the stoplamps with the brake pedal released. • **Are all of the stoplamps illuminated?**	**Yes** GO to L3 . **No** GO to L2 .
L2 CHECK THE SJB STOPLAMP OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: SJB C2280d. • **Do the stoplamps continue to illuminate?**	**Yes** If the LH rear lamp continues to illuminate, REPAIR circuit CLS18 (GY/BN) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. If the RH rear lamp continues to illuminate, REPAIR circuit CLS19 (VT/OG) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to L7 .
L3 CHECK THE STOPLAMP SWITCH	
• Disconnect: Stoplamp Switch C278. • **Do the stoplamps continue to illuminate?**	**Yes** GO to L4 . **No** INSTALL a new stoplamp switch. REFER to Stoplamp Switch in this section. CLEAR the DTCs. REPEAT the self-test.
L4 CHECK THE PCM	
• Disconnect: PCM C175b. • **Do the stoplamps continue to illuminate?**	**Yes** GO to L5 . **No** GO to L6 .
L5 CHECK THE STOPLAMP SWITCH OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: SJB C2280b. • **Does the high mounted stoplamp continue to illuminate?**	**Yes** REPAIR circuit CCB08 (VT/WH) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No**

	GO to L7 .
L6 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B , Section 303-14C or Section 303-14D . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
L7 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Turn Signal and Hazard Lamps

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The Smart Junction Box (SJB) monitors the multifunction switch position by sending voltage signals (for the LH and RH turn input) to the multifunction switch. When the multifunction switch is in the LH or RH TURN positions that input signal is switched to ground.

The SJB monitors the request for the hazard lamps by sending a voltage signal to the hazard flasher lamp switch. For MKZ, the hazard flasher lamp switch is integrated into the Front Controls Interface Module (FCIM).

When the SJB receives a request for a turn signal or hazard lamps, the SJB supplies voltage to the appropriate turn lamps.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Multifunction switch	• Smart Junction Box (SJB) fuse 6 (20A) • Wiring, terminals or connectors

• Hazard flasher lamp switch	• Bulbs • SJB

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

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

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test M: The Turn Signal Lamps Are Inoperative

Refer to Wiring Diagrams Cell 90 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends voltage signals to the multifunction switch. When the multifunction switch is switched to the LH or RH TURN positions, the voltage signal is switched to ground. When the SJB detects the multifunction switch in the LH or RH TURN position, the SJB sends voltage to the appropriate turn lamps.

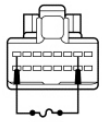
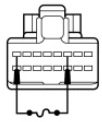
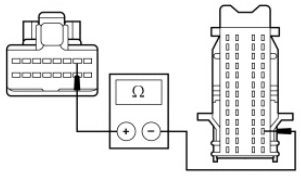
This pinpoint test is intended to diagnose the following:

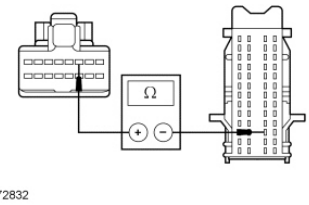
- Fuse
- Wiring, terminals or connectors
- Multifunction switch
- SJB

PINPOINT TEST M: THE TURN SIGNAL LAMPS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
M1 CHECK FOR CORRECT HIGH BEAM OPERATION	
• Place the headlamp switch in the HEADLAMPS ON position. • Place the multifunction switch in the HIGH BEAM position while observing the high beam headlamps. • **Do the high beams illuminate?**	**Yes** PLACE the headlamp switch in the OFF position. For Fusion, GO to M2 . For MKZ, VERIFY the SJB fuse 6 (20A) is OK. If OK, GO to M3 . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. **No** PLACE the headlamp switch in the OFF position. GO to Pinpoint Test A .
M2 CHECK FOR CORRECT STOPLAMP OPERATION	
• Apply and release the brake pedal. • **Do the stoplamps operate correctly?**	**Yes** GO to M3 . **No** REFER to Stoplamps in this section.
M3 BYPASS THE MULTIFUNCTION SWITCH	
• Ignition OFF. • Disconnect: Multifunction Switch C202. • For an inoperative LH turn signal, connect a fused jumper wire between the multifunction switch C202-2, circuit CLS39 (VT/WH), harness side and the multifunction switch C202-8, circuit GD116 (BK/VT), harness side.	**Yes** REMOVE the jumper wire. INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. **No** REMOVE the jumper wire. GO to M4 .

 N0069012 • For an inoperative RH turn signal, connect a fused jumper wire between the multifunction switch C202-3, circuit CLS41 (GY/YE), harness side and the multifunction switch C202-8, circuit GD116 (BK/VT), harness side.  N0069013 • Ignition ON. • **Do the turn signals in question flash on and off?**	
M4 CHECK THE TURN SIGNAL REQUEST INPUT CIRCUIT FOR AN OPEN	
• Disconnect: SJB C2280b. • For an inoperative LH turn signal, measure the resistance between the multifunction switch C202-2, circuit CLS39 (VT/WH), harness side and the SJB C2280b-42, circuit CLS39 (VT/WH), harness side.  N0072831 • For an inoperative RH turn signal, measure the resistance between the multifunction switch C202-3, circuit CLS41 (GY/YE), harness side and the SJB C2280b-29, circuit CLS41 (GY/YE), harness side.	**Yes** GO to M5 . **No** REPAIR circuit CLS39 (VT/WH) (LH turn signal) or circuit CLS41 (GY/YE) (RH turn signal) for an open. TEST the system for normal operation.

 N0072832 • **Is the resistance less than 5 ohms?**	
M5 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test N: The Turn Signal Lamps Are Always On

Refer to Wiring Diagrams Cell 90 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends voltage signals to the multifunction switch. When the multifunction switch is switched to the LH or RH TURN positions, the voltage signal is switched to ground. When the SJB detects the multifunction switch is in the LH or RH TURN position, the SJB sends voltage to the appropriate turn lamps.

- DTC B2281 (Right Turn Switch Short to Ground) - an on-demand DTC that sets when the SJB detects a short to ground from the RH turn signal input circuit.
- DTC B2282 (Left Turn Switch Short to Ground) - an on-demand DTC that sets when the SJB detects a short to ground from the LH turn signal switch input circuit.

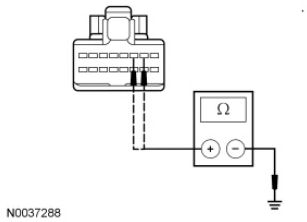
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Multifunction switch
- SJB

PINPOINT TEST N: THE TURN SIGNAL LAMPS ARE ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
N1 CHECK THE MULTIFUNCTION SWITCH	

• Ignition OFF. • Disconnect: Multifunction Switch C202. • Ignition ON. • **Do the turn lamps continue to flash on and off?**	**Yes** GO to N2 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 . CLEAR the DTCs. REPEAT the self-test.
N2 CHECK THE TURN SIGNAL REQUEST INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280b. • Measure the resistance between the multifunction switch C202-2, (LH turn lamps), circuit CLS39 (VT/WH), harness side and ground; or between the multifunction switch C202-3, (RH turn lamps), circuit CLS41 (GY/YE), harness side and ground.  N0037288 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to N3 . **No** REPAIR circuit CLS39 (VT/WH) (LH turn signal) or circuit CLS41 (GY/YE) (RH turn signal) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
N3 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs. REPEAT the self-test.

Pinpoint Test O: One Turn Signal/Hazard Lamp Is Inoperative/Always On

Refer to Wiring Diagrams Cell 90 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

When the Smart Junction Box (SJB) detects the multifunction switch is in the LH TURN position, the SJB provides voltage to the LH front turn lamp and LH rear turn lamp. When the SJB detects the multifunction switch is in the RH TURN position, the SJB provides voltage to the RH front turn lamp and the RH rear turn lamp.

DTC Description	Fault Trigger Conditions
• B106E - Solid State Driver Disabled Due to Short Circuit	A contious DTC that sets when the SJB has temporarily shut down the output driver. **The module has temporarily disabled a turn lamp output because an excessive current draw exists (such as a short to ground). The SJB cannot enable the turn lamp output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.**
• B106F - Module Disabled Due to External Fault	A continuous DTC that sets when the SJB has permanently shut down the output driver. **The module has permanently disabled a turn lamp output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the SJB can withstand. The cause of the excessive current draw MUST be corrected before a new SJB is installed.**
• B2048 - Left Rear Turn Lamp Circuit Short to Ground	A continuous and on-demand DTC that sets when the SJB detects a short to ground from the LH rear turn lamp voltage supply circuit. >
• B2049 - Left Rear Turn Lamp Circuit Open	An on-demand DTC that sets when the SJB detects an open from the LH rear turn lamp voltage supply circuit.
• B2050 - Right Rear Turn Lamp Circuit Short to Ground	A continuous and on-demand DTC that sets when the SJB detects a short to ground from the RH rear turn lamp voltage supply circuit.
• B2051 - Right Rear Turn Lamp Circuit Open	An on-demand DTC that sets when the SJB detects an open from the RH rear turn lamp voltage supply circuit.
• B2A27 - Right Front Turn Lamp Circuit Open	An on-demand DTC that sets when the SJB detects an open or short to voltage from the RH front turn lamp voltage supply circuit.
• B2A28 - Right Front Turn Lamp Circuit Short to Ground	A continuous and on-demand DTC that sets when the SJB detects ground from the RH front turn lamp voltage supply circuit.
	An on-demand DTC that sets when the SJB detects an open or short to voltage from the LH front turn lamp voltage supply circuit.

• B2A29 - Left Front Turn Lamp Circuit Open	
• B2A2A - Left Front Turn Lamp Circuit Short to Ground	A continuous and on-demand DTC that sets when the SJB detects a short to ground from the LH front turn lamp voltage supply circuit.

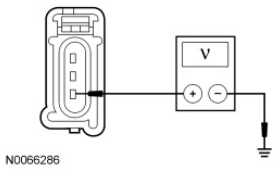
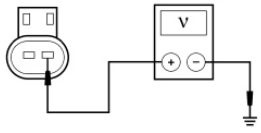
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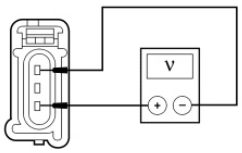
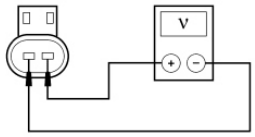
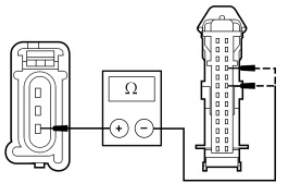
- Wiring, terminals or connectors
- Bulb holder
- Rear lamp assembly
- SJB

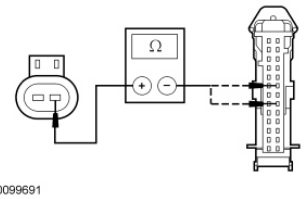
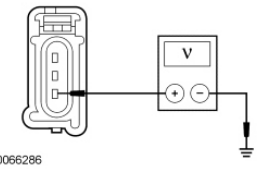
PINPOINT TEST O: ONE TURN SIGNAL/HAZARD LAMP IS INOPERATIVE/ALWAYS ON

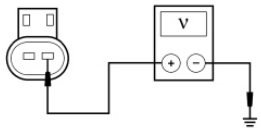
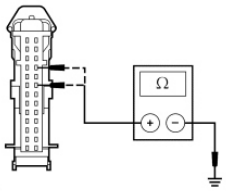
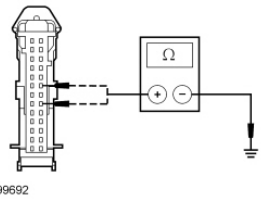
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
O1 CHECK THE STOPLAMPS	
• Apply and release the brake pedal while observing the stoplamps. • **Do the stoplamps operate correctly?**	**Yes** GO to O2 . **No** REFER to Stoplamps in this section.
O2 DETERMINE IF A TURN LAMP IS ALWAYS ON	
• Ignition ON. • Monitor the turn lamps while placing the multifunction switch in the RH TURN and then LH TURN positions. • **Is any turn lamp always on?**	**Yes** GO to O3 . **No** GO to O4 .
O3 CHECK THE SJB TURN LAMP OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280f (Front Turn Lamp). • Disconnect: SJB C2280c (Rear Turn Lamp). • Ignition ON. • **Does the turn lamp in question continue to illuminate?**	**Yes** REPAIR circuit CLS21 (BU/GN) (LH front), circuit CLS25 (YE/VT) (RH front), circuit CLS23 (GY/OG) (LH rear) or circuit CLS24 (BN/WH) (RH rear) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to O10 .

O4 USE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check the recorded results from the SJB on-demand self-test. • **Is DTC B2049, B2051, B2A27 or B2A29 present?**	**Yes** GO to O5 . **No** GO to O8 .
O5 CHECK FOR VOLTAGE TO THE TURN LAMP (OPEN DTC PRESENT)	
• Ignition OFF. • Disconnect: Inoperative Turn Lamp. • Activate the hazard flasher lamp function. • For a front lamp, measure the voltage between the LH front turn lamp C1023-3, circuit CLS21 (BU/GN), harness side and ground; or between the RH front turn lamp C1043-3, circuit CLS25 (YE/VT), harness side and ground.  N0066286 • For an MKZ rear turn lamp, measure the voltage between the LH rear turn lamp C4139-1, circuit CLS23 (GY/OG), harness side and ground; or between the RH front turn lamp C4140-1, circuit CLS24 (BN/WH), harness side and ground.  N0099688 • **Does the voltage alternate from 0 volts to greater than 10 volts?**	**Yes** GO to O6 . **No** GO to O7 .
O6 CHECK FOR VOLTAGE TO THE FRONT TURN LAMP USING THE CONNECTOR GROUND	
• For a front lamp, measure the voltage between the LH front turn lamp C1023-3, circuit CLS21 (BU/GN), harness side and the LH front turn lamp C1023-1, circuit GD123 (BK/GY), harness side; or between the RH front turn lamp C1043-3, circuit CLS25 (YE/VT), harness side and the RH front turn lamp C1043-1, circuit GD121 (BK/YE), harness	**Yes** For a front lamp, INSTALL a new bulb holder. TEST the system for normal operation. For an MKZ rear lamp, INSTALL a new rear lamp assembly. REFER to Rear Lamp Assembly in this section. TEST the

side.  N0088174 • For an MKZ rear turn lamp, measure the voltage between the LH rear turn lamp C4139-1, circuit CLS23 (GY/OG), harness side and the LH rear turn lamp C4139-2, circuit GD171 (BK/GY), harness side; or between the RH front turn lamp C4140-1, circuit CLS24 (BN/WH), harness side and the RH front turn lamp C4140-2, circuit GD171 (BK/GY), harness side.  N0099689 • **Does the voltage alternate from 0 volts to greater than 10 volts?**	system for normal operation. **No** REPAIR circuit GD123 (BK/GY) (LH front), circuit GD121 (BK/YE) (RH front) or circuit GD171 (BK/GY) (LH or RH rear) for an open. TEST the system for normal operation.
O7 CHECK THE SJB TURN LAMP OUTPUT CIRCUIT FOR AN OPEN	
• Turn the hazard lamp function off. • Disconnect: SJB C2280f (Front Turn Lamp). • Disconnect: SJB C2280c (Rear Turn Lamp). • For a front lamp, measure the resistance between the LH front turn lamp C1023-3, circuit CLS21 (BU/GN), harness side and the SJB C2280f-21, circuit CLS21 (BU/GN), harness side; or between the RH front turn lamp C1043-3, circuit CLS21 (BU/GN), harness side and the SJB C2280f-23, circuit CLS25 (YE/VT), harness side.  N0077710 • For an MKZ rear turn lamp, measure the voltage between the LH rear turn lamp C4139-1, circuit CLS23 (GY/OG), harness side and the SJB C2280c-21, circuit CLS23	**Yes** GO to O10 . **No** REPAIR circuit CLS21 (BU/GN) (LH front), circuit CLS25 (YE/VT) (RH front), circuit CLS23 (GY/OG) (LH rear) or circuit CLS24 (BN/WH) (RH rear) for an open. TEST the system for normal operation.

(GY/OG), harness side; or between the RH front turn lamp C4140-1, circuit CLS24 (BN/WH), harness side and the SJB C2280c-19, circuit CLS24 (BN/WH), harness side.  N0099691 • **Is the resistance less than 5 ohms?**	
O8 ISOLATE THE BULB HOLDER OR REAR LAMP ASSEMBLY AS THE CAUSE OF THE SHORT TO GROUND	
• Ignition OFF. • Disconnect: Inoperative Turn Lamp. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Clear the DTCs **and** repeat the self-test **(required to enable the turn lamp output driver if DTC B106E is present)** . • Activate the hazard flasher lamp function. • For a front lamp, measure the voltage between the LH front turn lamp C1023-3, circuit CLS21 (BU/GN), harness side and ground; or between the RH front turn lamp C1043-3, circuit CLS25 (YE/VT), harness side and ground.  N0066286 • For an MKZ rear turn lamp, measure the voltage between the LH rear turn lamp C4139-1, circuit CLS23 (GY/OG), harness side and ground; or between the RH front turn lamp C4140-1, circuit CLS24 (BN/WH), harness side and ground.	**Yes** INSTALL a new bulb holder or rear lamp assembly in question. TEST the system for normal operation. **No** GO to O9 .

 N0099688 • **Does the voltage alternate from 0 to greater than 10 volts?**	
O9 CHECK THE SJB TURN LAMP OUTPUT CIRCUIT FOR A SHORT TO GROUND	
• Turn the hazard lamp function off. • Ignition OFF. • Disconnect: SJB C2280f (Front Turn Lamp). • Disconnect: SJB C2280c (Rear Turn Lamp). • For a front turn lamp, measure the resistance between the SJB C2280f-21 (LH turn lamp), circuit CLS21 (BU/GN), harness side and ground; or between the SJB C2280f-23 (RH turn lamp), circuit CLS25 (YE/VT), harness side and ground.  N0058672 • For a rear turn lamp, measure the resistance between the SJB C2280c-21 (LH turn lamp), circuit CLS23 (GY/OG), harness side and ground; or between the SJB C2280c-19 (RH turn lamp), circuit CLS24 (BN/WH), harness side and ground.  N0099692 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to O10 . **No** REPAIR circuit CLS21 (BU/GN) (LH front), circuit CLS25 (YE/VT) (RH front), circuit CLS23 (GY/OG) (LH rear) or circuit CLS24 (BN/WH) (RH rear) for a short to ground. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the turn lamp output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
O10 CHECK FOR CORRECT SJB OPERATION	
• Ignition OFF. • Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at

• Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test P: The Hazard Lamps Are Inoperative/Always On

Refer to Wiring Diagrams Cell 90 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Turn Signal/Stop/Hazard Lamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends a voltage signal to the hazard flasher lamp switch. When the hazard flasher lamp switch is pressed, the voltage signal is routed to ground. When the SJB detects a request for the hazard lamps, the SJB provides voltage to the appropriate turn lamps.

The hazard flasher lamp switch is a momentary contact switch.

The hazard flasher lamp switch for MKZ is integrated into the Front Controls Interface Module (FCIM).

- DTC B2071 (Hazard Switch Signal Short to Ground) - an on-demand DTC that sets when the SJB detects a short to ground from the hazard flasher lamp switch input circuit.

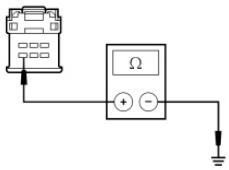
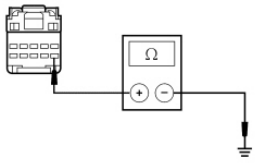
This pinpoint test is intended to diagnose the following:

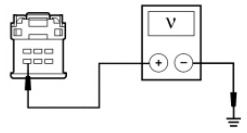
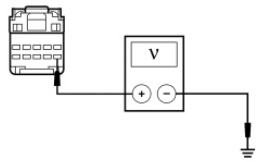
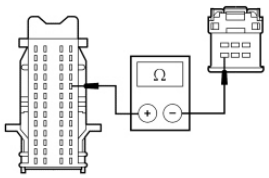
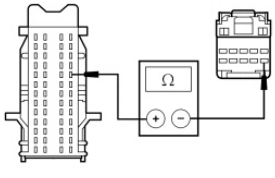
- Wiring, terminals or connectors
- Hazard flasher lamp switch (Fusion)
- FCIM (MKZ)
- SJB

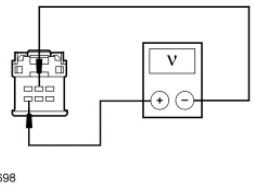
PINPOINT TEST P: THE HAZARD LAMPS ARE INOPERATIVE/ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
P1 CHECK THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check the recorded DTCs from the SJB self-test. • **Is DTC B2071 present?**	**Yes** GO to P2 . **No** GO to P4 .
P2 CHECK THE HAZARD FLASHER LAMP SWITCH	
• Disconnect: Hazard Flasher Lamp Switch C2039 (Fusion). • Disconnect: FCIM C2402 (MKZ). • Ignition ON.	**Yes** GO to P3 . **No** For Fusion, INSTALL a new hazard flasher lamp

• Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Repeat the SJB self-test. • **Is DTC B2071 still present?**	switch. REFER to Hazard Flasher Lamp Switch in this section. TEST the system for normal operation. For MKZ, INSTALL a new FCIM . REFER to Section 415-00 TEST the system for normal operation.
P3 CHECK THE HAZARD LAMP REQUEST INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: SJB C2280b. • For Fusion, measure the resistance between the hazard flasher lamp switch C2039-6, circuit CLS32 (BN/YE), harness side and ground.  N0099693 • For MKZ, measure the resistance between the FCIM C2402-6, circuit CLS32 (BN/YE), harness side and ground.  N0099694 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P7 . **No** REPAIR circuit CLS32 (BN/YE) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
P4 CHECK FOR A VOLTAGE SIGNAL TO THE HAZARD FLASHER LAMP SWITCH OR THE FCIM	
• Ignition OFF. • Disconnect: Hazard Flasher Lamp Switch C2039 (Fusion). • Disconnect: FCIM C2402 (MKZ). • For Fusion, measure the voltage between the hazard flasher lamp switch C2039-6, circuit CLS32 (BN/YE), harness side and ground.	**Yes** For Fusion, GO to P6 . For MKZ, INSTALL a new FCIM . REFER to Section 415-00 . TEST the system for normal operation. **No** GO to P5 .

 N0099695 • For MKZ, measure the voltage between the FCIM C2402-6, circuit CLS32 (BN/YE), harness side and ground.  N0104286 • **Is the voltage greater than 10 volts?**	
P5 CHECK THE HAZARD LAMP REQUEST INPUT CIRCUIT FOR AN OPEN	
• For Fusion, measure the resistance between the SJB C2280b-48, circuit CLS32 (BN/YE), harness side and the hazard flasher lamp switch C2039-6, circuit CLS32 (BN/YE), harness side.  N0099696 • For MKZ, measure the resistance between the SJB C2280b-48, circuit CLS32 (BN/YE), harness side and the FCIM C2402-6, circuit CLS32 (BN/YE), harness side.  N0099697 • **Is the resistance less than 5 ohms?**	**Yes** GO to P7 . **No** REPAIR circuit CLS32 (BN/YE) for an open. TEST the system for normal operation.
P6 CHECK FOR VOLTAGE TO THE HAZARD FLASHER LAMP SWITCH USING THE	

CONNECTOR GROUND	
• Measure the voltage between the hazard flasher lamp switch C2039-6, circuit CLS32 (BN/YE), harness side and the hazard lamp switch C2039-2, circuit GD116 (BK/VT), harness side.  N0099698 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new hazard flasher lamp switch. REFER to Hazard Flasher Lamp Switch in this section. TEST the system for normal operation. **No** REPAIR circuit GD116 (BK/VT) for an open. TEST the system for normal operation.
P7 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Parking, Rear and License Plate Lamps

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The SJB monitors the headlamp switch position by sending voltage signals on multiple circuits to the headlamp switch. There is one circuit for each headlamp switch position. At any given time, one of the signal circuits is switched to ground.

If the SJB does not detect any of the inputs to the headlamp switch is active (switched to ground) for 5 seconds, the SJB turns on the parking lamps and headlamps and keeps them on until the battery saver feature times out.

Additionally, if the SJB detects multiple headlamp switch input circuits short to ground, the SJB turns the parking lamps and headlamps on and keeps them on until the battery saver feature times out.

Refer to Exterior Lighting for information regarding the Battery Saver feature.

If either of the above situations occur, the SJB **cannot** be ruled immediately as being at fault. This is normal behavior of the SJB design as it has detected a fault with the inputs from the headlamp switch.

When the SJB receives an input from the headlamp switch indicating a request for the parking lamps, the SJB energizes the parking lamp relay, which supplies voltage to the exterior lamps.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Headlamp switch	• Smart Junction Box (SJB) fuse 22 (15A) • Rear lamp assembly • Bulb(s) • Wiring, terminals, connectors • SJB

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

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

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test Q: One Or More Parking, Rear or License Plate Lamps Is Inoperative

Refer to Wiring Diagrams Cell 92 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Parking, Rear and License Lamps for schematic and connector information.

Normal Operation

When the headlamp switch is placed in the PARKING LAMPS ON position, the Smart Junction Box (SJB) provides a ground for the parking lamp relay coil (integrated into the SJB). When the parking lamp relay is energized, voltage is routed to the front and rear parking lamps.

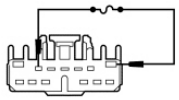
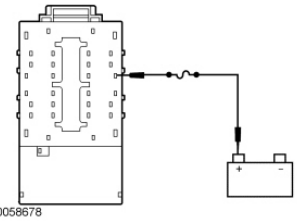
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Bulb holder
- Rear lamp assembly
- SJB

PINPOINT TEST Q: ONE OR MORE PARKING, REAR OR LICENSE PLATE LAMPS IS INOPERATIVE

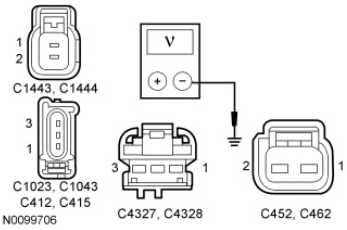
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
Q1 DETERMINE IF ALL THE PARKING LAMPS ARE INOPERATIVE	
• Ignition OFF. • Place the headlamp switch in the PARKING LAMPS ON position. • **Are all the parking lamps inoperative?**	**Yes** VERIFY the SJB fuse 22 (15A) is OK. If OK, GO to Q6 . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. **No** If all the front parking lamps are inoperative, GO to Q2 . If all the rear parking and license plate lamps are inoperative, GO to Q3 . For all others, GO to Q4 .
Q2 CHECK THE SJB PARKING LAMP OUTPUT CIRCUIT FOR AN OPEN (FRONT LAMPS)	
• PLACE the headlamp switch in the OFF position. • Disconnect: SJB C2280e. • Connect a fused jumper wire between the SJB C2280e-1, circuit CDC34 (WH/OG), harness side and the SJB C2280e-6, circuit CLS30 (VT/WH), harness side.	**Yes** REMOVE the jumper wire. GO to Q6 . **No** REMOVE the jumper wire. REPAIR circuit CLS30 (VT/WH) for an open. TEST the system for normal

 N0058677 • Ignition ON. • **Do the front parking lamps illuminate?**	operation.
Q3 CHECK THE SJB PARKING LAMP OUTPUT CIRCUIT FOR AN OPEN (REAR LAMPS)	
• PLACE the headlamp switch in the OFF position. • Disconnect: SJB C2280d. • Connect a fused jumper wire between the positive battery terminal and the SJB C2280d-20, circuit CLS30 (VT/WH), harness side.  N0058678 • **Do the rear parking lamps illuminate?**	**Yes** REMOVE the jumper wire. GO to Q6 . **No** REMOVE the jumper wire. REPAIR circuit CLS30 (VT/WH) for an open. TEST the system for normal operation.
Q4 CHECK FOR VOLTAGE TO THE INOPERATIVE LAMP	
• PLACE the headlamp switch in the OFF position. • Disconnect: Inoperative Lamp. • Place the headlamp switch in the PARKING LAMPS ON position. • For Fusion, measure the voltage between the inoperative lamp, harness side and ground as follows:	**Yes** GO to Q5 . **No** REPAIR circuit CLS30 (VT/WH) for an open. TEST the system for normal operation.

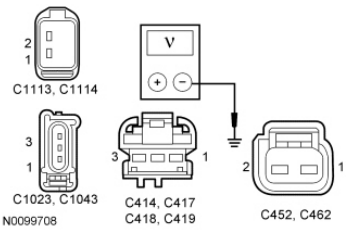
Inoperative Lamp	Connector-Pin	Circuit
LH front	C1023-2	CLS30 (VT/WH)
RH front	C1043-2	CLS30 (VT/WH)
LH front side marker	C1443-1	CLS30 (VT/WH)
RH front side marker	C1444-1	CLS30 (VT/WH)
LH rear	C412-2	

		CLS30 (VT/WH)
RH rear	C415-2	CLS30 (VT/WH)
LH rear side marker	C4328-1	CLS30 (VT/WH)
RH rear side marker	C4327-1	CLS30 (VT/WH)
LH license plate	C452-1	CLS30 (VT/WH)
RH license plate	C462-1	CLS30 (VT/WH)



- For MKZ, measure the voltage between the inoperative lamp, harness side and ground as follows:

Inoperative Lamp	Connector-Pin	Circuit
LH front	C1023-2	CLS30 (VT/WH)
RH front	C1043-2	CLS30 (VT/WH)
LH front side marker	C1113-1	CLS30 (VT/WH)
RH front side marker	C1114-1	CLS30 (VT/WH)
LH rear	C419-2	CLS30 (VT/WH)
RH rear	C418-2	CLS30 (VT/WH)
LH rear (luggage compartment lid)	C414-1	CLS30 (VT/WH)
RH rear (luggage compartment lid)	C417-1	CLS30 (VT/WH)
LH license plate	C452-1	CLS30 (VT/WH)
RH license plate	C462-1	CLS30 (VT/WH)



- **Is the voltage greater than 10 volts?**

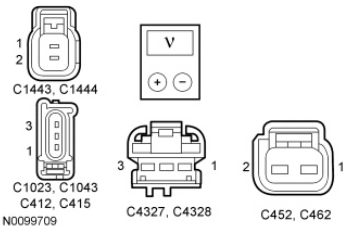
Q5 CHECK FOR VOLTAGE TO THE INOPERATIVE LAMP USING THE CONNECTOR GROUND

- For Fusion, measure the voltage between the inoperative lamp connector, harness side as follows:

Inoperative Lamp	Connector-Pin/ Circuit	Connector-Pin/ Circuit
LH front	C1023-2 CLS30 (VT/WH)	C1023-1 GD123 (BK/GY)
RH front	C1043-2 CLS30 (VT/WH)	C1043-1 GD121 (BK/YE)
LH front side marker	C1443-1 CLS30 (VT/WH)	C1443-2 GD121 (BK/YE)
RH front side marker	C1444-1 CLS30 (VT/WH)	C1444-2 GD123 (BK/GY)
LH rear	C412-2 CLS30 (VT/WH)	C412-1 GD171 (BK/GY)
RH rear	C415-2 CLS30 (VT/WH)	C415-1 GD171 (BK/GY)
LH rear side marker	C4328-1 CLS30 (VT/WH)	C4328-3 GD171 (BK/GY)
RH rear side marker	C4327-1 CLS30 (VT/WH)	C4327-3 GD171 (BK/GY)
LH license plate	C452-1 CLS30 (VT/WH)	C452-2 GD171 (BK/GY)
RH license plate	C462-1 CLS30 (VT/WH)	C462-2 GD171 (BK/GY)

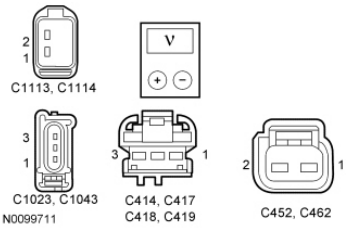
Yes
For a Fusion rear lamp, any front or license plate lamp, INSTALL a new bulb holder. TEST the system for normal operation. For a Fusion rear side marker, or an MKZ rear lamp, INSTALL a new lamp assembly. REFER to Rear Lamp Assembly or Reversing Lamp in this section. TEST the system for normal operation.

No
REPAIR the ground circuit in question for an open. TEST the system for normal operation.



- For MKZ, measure the voltage between the inoperative lamp connector, harness side as follows:

Inoperative Lamp	Connector-Pin/ Circuit	Connector-Pin/ Circuit
LH front	C1023-2 CLS30 (VT/WH)	C1023-1 GD123 (BK/GY)
RH front	C1043-2 CLS30 (VT/WH)	C1043-1 GD121 (BK/YE)
LH front side marker	C1113-1 CLS30 (VT/WH)	C1113-2 GD121 (BK/YE)
RH front side marker	C1114-1 CLS30 (VT/WH)	C1114-2 GD123 (BK/GY)
LH rear	C419-2 CLS30 (VT/WH)	C419-3 GD171 (BK/GY)
RH rear	C418-2 CLS30 (VT/WH)	C418-3 GD171 (BK/GY)
LH rear (luggage compartment lid)	C414-1 CLS30 (VT/WH)	C414-3 GD171 (BK/GY)
RH rear (luggage compartment lid)	C417-1 CLS30 (VT/WH)	C417-3 GD171 (BK/GY)
LH license plate	C452-1 CLS30 (VT/WH)	C452-2 GD171 (BK/GY)
RH license plate	C462-1 CLS30 (VT/WH)	C462-2 GD171 (BK/GY)

 • **Is the voltage greater than 10 volts?**	
Q6 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test R: The Parking, Rear Or License Plate Lamps Are On Continuously

Refer to Wiring Diagrams Cell 92 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Parking, Rear and License Lamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) monitors the parking lamp request input from the headlamp switch. The SJB provides a ground for the parking lamp relay coil (integrated into the SJB) when a request for the parking lamps is received. When the parking lamp relay is energized, voltage is routed to the front and rear parking lamps.

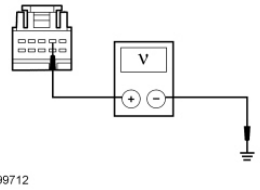
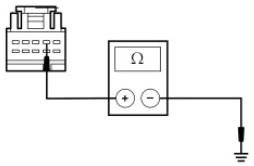
- DTC B1578 (Lamp Park Input Circuit Short to Ground) - an on-demand DTC that may set when the SJB detects a short to ground from the parking lamps on input circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Headlamp switch
- SJB

PINPOINT TEST R: THE PARKING, REAR OR LICENSE PLATE LAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
R1 USE THE RECORDED DTCs FROM THE SJB SELF-TEST	
• Check the recorded results from the SJB self-test. • **Is DTC B1578 present?**	**Yes** GO to R2 . **No** GO to R4 .

R2 CHECK FOR A VOLTAGE SIGNAL TO THE HEADLAMP SWITCH	
• Ignition OFF. • Disconnect: Headlamp Switch C205. • Measure the voltage between the headlamp switch C205-2, circuit CLS34 (GY), harness side and ground.  N0099712 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to R3 .
R3 CHECK CIRCUIT CLS34 (YE/OG) FOR A SHORT TO GROUND	
• Disconnect: SJB C2280b. • Measure the resistance between the headlamp switch C205-2, circuit CLS34 (GY), harness side and ground.  N0083974 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to R5 . **No** REPAIR circuit CLS34 (GY) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
R4 CHECK THE SJB PARKING LAMPS OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280e. • Ignition ON. • **Do the parking lamps continue to illuminate?**	**Yes** REPAIR circuit CLS30 (VT/WH) for a short to voltage. TEST the system for normal operation. **No** GO to R5 .
R5 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No**

♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Fog Lamps

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The SJB monitors the headlamp switch position by sending a voltage signal to the headlamp switch. When the fog lamp switch is engaged, the voltage signal is routed to ground.

The fog lamps can be turned on when the following conditions are met:

- The ignition switch is in the RUN or START position.
- The low beam headlamps or the parking lamps are on.
- The high beams are not on.

When the SJB receives an input from the headlamp switch indicating a request for the fog lamps, the SJB provides voltage to the fog lamp relay. When the fog lamp relay is energized, voltage is routed to the fog lamps.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect the following for obvious signs of electrical damage.

Visual Inspection Chart

Electrical

- Battery Junction Box (BJB) fuse 21 (15A) (fog lamp relay)
- Wiring, terminals or connectors
- Bulb(s)
- Headlamp switch
- Smart Junction Box (SJB)

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

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

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test S: Both Fog Lamps Are Inoperative

Refer to Wiring Diagrams Cell 86 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Fog Lamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends a voltage signal to the headlamp switch to monitor the fog lamp request. When the fog lamp switch is engaged, the voltage signal is routed to ground.

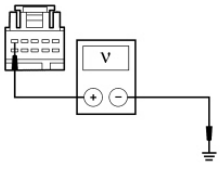
When the SJB detects the fog lamps on request, the SJB energizes the fog lamp relay (integrated into the SJB). When the fog lamp relay is energized, voltage is routed to the fog lamps.

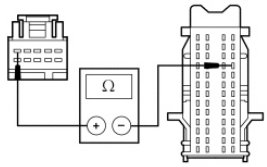
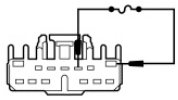
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Headlamp switch
- SJB

PINPOINT TEST S: BOTH FOG LAMPS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
S1 CHECK THE SJB FOG LAMP SWITCH PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Data Logger. • Monitor the SJB fog lamp PID (FOG SW) while engaging the fog lamp switch. • **Does the PID indicate the fog lamp switch is on?**	**Yes** VERIFY the SJB fuse 21 (15A) is OK. If OK, GO to S4 . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. **No** GO to S2 .
S2 CHECK FOR A VOLTAGE SIGNAL TO THE HEADLAMP SWITCH	
• Ignition OFF. • Disconnect: Headlamp Switch C205. • Measure the voltage between the headlamp switch C205-5, circuit CLF21 (GY/VT), harness side and ground.  N0099713 • Ignition ON.	**Yes** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation. **No** GO to S3 .

• **Is the voltage greater than 10 volts?**	
S3 CHECK THE FOG LAMPS ON REQUEST INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: SJB C2280b. • Measure the resistance between the headlamp switch C205-5, circuit CLF21 (GY/VT), harness side and the SJB C2280b-49, circuit CLF21 (GY/VT), harness side.  N0083975 • **Is the resistance less than 5 ohms?**	**Yes** GO to S5 . **No** REPAIR circuit CLF21 (GY/VT) for an open. TEST the system for normal operation.
S4 BYPASS THE SJB	
• Ignition OFF. • Disconnect: SJB C2280e. • Connect a fused jumper wire between the SJB C2280e-1, circuit CDC34 (WH/OG), harness side and the SJB C2280e-3, circuit CLF12 (BN/YE), harness side.  N0058681 • Ignition ON. • **Do the fog lamps illuminate?**	**Yes** REMOVE the jumper wire. GO to S5 . **No** REMOVE the jumper wire. REPAIR circuit CLF12 (BN/YE) for an open. TEST the system for normal operation.
S5 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test T: An Individual Fog Lamp Is Inoperative

Refer to Wiring Diagrams Cell 86 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Fog Lamps for schematic and connector information.

Normal Operation

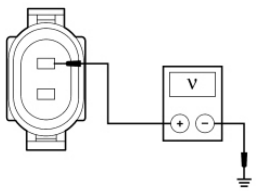
When the fog lamp relay is energized, voltage is routed to the fog lamps. A separate ground circuit is supplied to each fog lamp.

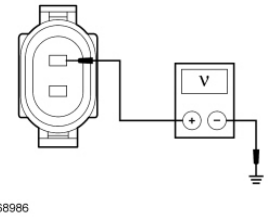
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors

PINPOINT TEST T: AN INDIVIDUAL FOG LAMP IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
T1 CHECK FOR VOLTAGE TO THE FOG LAMP	
• Ignition OFF. • Disconnect: Inoperative Fog Lamp. • Ignition ON. • Place the headlamp switch in the PARKING LAMPS ON position and engage the fog lamp switch. • For Fusion, measure the voltage between the LH fog lamp C152-A, circuit CLF12 (BN/YE), harness side and ground; or between the RH fog lamp C162-A, circuit CLF12 (BN/YE), harness side and ground.  N0068986 • For MKZ, measure the voltage between the LH fog lamp C152-1, circuit CLF12 (BN/YE), harness side and ground; or between the RH fog lamp C162-1, circuit CLF12 (BN/YE), harness side and ground.	**Yes** REPAIR circuit GD121 (BK/YE) (LH fog lamp) or circuit GD123 (BK/GY) (RH fog lamp) for an open. TEST the system for normal operation. **No** REPAIR circuit CLF12 (BN/YE) for an open. TEST the system for normal operation.

 • **Is the voltage greater than 10 volts?**	

Pinpoint Test U: The Fog Lamps Are On Continuously

Refer to Wiring Diagrams Cell 86 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Fog Lamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) sends a voltage signal to the headlamp switch to monitor the fog lamp request. When the fog lamp switch is engaged, the voltage signal is routed to ground.

When the SJB detects the fog lamps on request, the SJB energizes the fog lamp relay (integrated into the SJB). When the fog lamp relay is energized, voltage is routed through 2 output circuits from the SJB . One output is to the fog lamps and the other output is to the headlamp switch (for the fog lamps on indicator).

- DTC B2254 (Front Fog Lamp Switch Failure) - an on-demand DTC that sets when the SJB detects a short to ground from the fog lamp on input circuit.

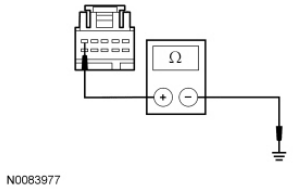
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Headlamp switch
- SJB

PINPOINT TEST U: THE FOG LAMPS ARE ON CONTINUOUSLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
U1 CHECK FOR RECORDED SJB DTCs	
• Check the recorded results from the SJB self-test. • **Is DTC B2254 present?**	**Yes** GO to U2 . **No** GO to U4 .
U2 CHECK THE HEADLAMP SWITCH	
• Ignition OFF. • Disconnect: Headlamp Switch C205. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test.	**Yes** GO to U3 . **No** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. CLEAR the

• **NOTE:** Other DTCs will be present with the headlamp switch disconnected and should be ignored. • Repeat the SJB self-test. • **Is DTC B2254 still present?**	DTCs. REPEAT the self-test.
U3 CHECK THE FOG LAMPS ON REQUEST INPUT CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: SJB C2280b. • Measure the resistance between the headlamp switch C205-5, circuit CLF21 (GY/VT), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to U6 . **No** REPAIR circuit CLF21 (GY/VT) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
U4 CHECK THE SJB FOG LAMPS OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE (TO HEADLAMP SWITCH)	
• Ignition OFF. • Disconnect: SJB C2280a. • Ignition ON. • **Do the fog lamps continue to illuminate?**	**Yes** GO to U5 . **No** REPAIR circuit CLF12 (BN/YE) to the headlamp switch for a short to voltage. TEST the system for normal operation.
U5 CHECK THE SJB FOG LAMPS OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE (TO THE FOG LAMPS)	
• Ignition OFF. • Disconnect: SJB C2280e. • Ignition ON. • **Do the fog lamps continue to illuminate?**	**Yes** REPAIR circuit CLF12 (BN/YE) for a short to voltage. TEST the system for normal operation. **No** GO to U6 .
U6 CHECK FOR CORRECT SJB OPERATION	
• Ignition OFF. • Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly.	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs. REPEAT the self-test.

• Operate the system and verify the concern is still present. • **Is the concern still present?**	

Pinpoint Test V: The Fog Lamps On Indicator Is Inoperative

Refer to Wiring Diagrams Cell 86 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Fog Lamps for schematic and connector information.

Normal Operation

When the Smart Junction Box (SJB) detects the fog lamps on request, the SJB energizes the fog lamp relay (integrated into the SJB). When the fog lamp relay is energized, voltage is routed through 2 output circuits from the SJB . One output is to the fog lamps and the other output is to the headlamp switch (for the fog lamps on indicator).

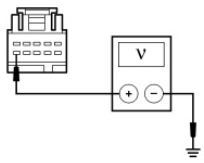
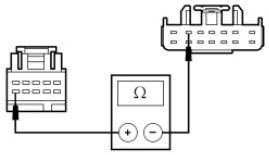
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Headlamp switch
- SJB

PINPOINT TEST V: THE FOG LAMPS ON INDICATOR IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
V1 CHECK THE HEADLAMP SWITCH	
• Ignition OFF. • Disconnect: Headlamp Switch C205. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger. • Select the SJB fog lamps (FOG_LMP) active command. Command the fog lamps on. • **NOTE:** Make sure the fog lamps are illuminated when taking a reading. • Measure the voltage between the headlamp switch C205-10, circuit CLF12 (BN/YE), harness side and ground.	**Yes** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation. **No** GO to V2 .

 N0083978 • **Is the voltage greater than 10 volts?**	
V2 CHECK THE SJB FOG LAMPS OUTPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: SJB C2280a. • Measure the resistance between the headlamp switch C205-10, circuit CLF12 (BN/YE), harness side and the SJB C2280a-6, circuit CLF12 (BN/YE), harness side.  N0083979 • **Is the resistance less than 5 ohms?**	**Yes** GO to V3 . **No** REPAIR circuit CLF12 (BN/YE) for an open. CLEAR the DTCs. REPEAT the self-test.
V3 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs. REPEAT the self-test.

Reversing Lamps

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

For vehicles equipped with an automatic transaxle, the PCM (2.5L or 3.0L engine) or the Transmission Control Module (TCM) (3.5L engine) controls the coil ground side of the reversing lamps relay. When the vehicle is in reverse, the PCM or TCM energizes the reversing lamps relay to provide voltage to the reversing lamps.

For vehicles equipped with a manual transaxle, the reversing lamp switch controls the coil ground side of the reversing lamps relay. When the vehicle is in reverse, the reversing lamp switch contacts close to ground, energizing the reversing lamps relay to provide voltage to the reversing lamps.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Reversing lamp switch (manual transaxle)	• Battery Junction Box (BJB) fuse 47 (10A) • Bulb(s) • Wiring, terminals or connectors • Reversing lamps relay

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the PCM or TCM .

9. If the DTCs retrieved are related to the concern, refer to Diagnostic Trouble Code (DTC) Chart in this section. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

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

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test W: Both Reversing Lamps Are Inoperative

Refer to Wiring Diagrams Cell 11 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Fuse and Relay Information for schematic and connector information.

Refer to Wiring Diagrams Cell 93 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Reversing Lamps for schematic and connector information.

Normal Operation

Voltage is supplied from the Battery Junction Box (BJB) fuse 47 (10A) to the coil and switched sides of the reversing lamps relay. When the reversing lamps relay is energized, voltage is routed to the reversing lamps.

Automatic Transaxle

The PCM (2.5L or 3.0L engines) or the Transmission Control Module (TCM) (3.5L engine) monitors the transaxle gear status. When the PCM detects the transaxle in REVERSE (R), the PCM or TCM provides ground for the reversing lamps relay coil.

Manual Transaxle

The reversing lamp switch controls the coil ground side of the reversing lamps relay. When the transaxle is in REVERSE (R), the reversing lamp switch contacts close, completing the path to ground for the reversing lamps relay coil.

- DTC P1910 (Reverse Lamp Control Circuit/Open) - sets when the PCM detects no voltage on the reversing lamp relay coil ground control circuit (if the coil voltage supply circuit or the coil ground control circuit is open).

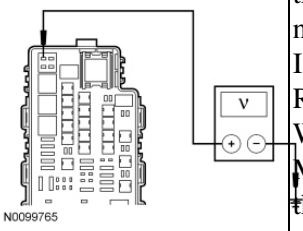
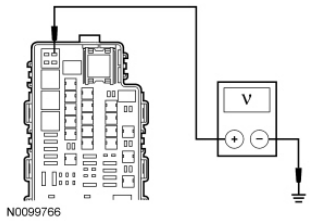
This pinpoint test is intended to diagnose the following:

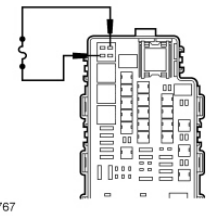
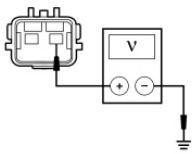
- Fuse
- Wiring, terminals or connectors
- Reversing lamps relay
- Reversing lamp switch
- PCM
- TCM

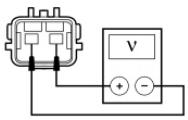
PINPOINT TEST W: BOTH REVERSING LAMPS ARE INOPERATIVE

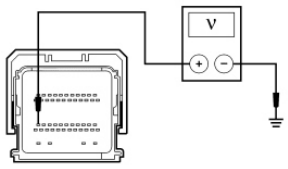
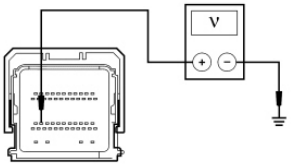
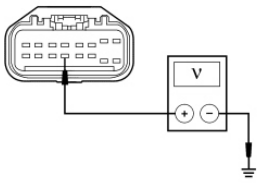
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

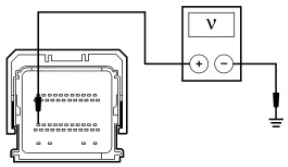
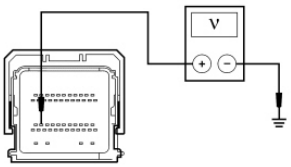
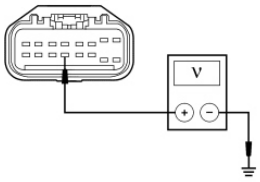
Test Step	Result / Action to Take
W1 CHECK THE REVERSING LAMPS RELAY	
• Ignition OFF. • Disconnect: Reversing Lamps Relay. • Ignition ON. • Substitute a known good relay and recheck the reversing lamps operation. • **Do the reversing lamps operate correctly?**	**Yes** REMOVE the known good relay. INSTALL a new reversing lamps relay. TEST the system for normal operation. **No**

	REMOVE the known good relay. GO to W2 .		
W2 CHECK FOR VOLTAGE TO THE REVERSING LAMPS RELAY COIL		• Ignition ON. • Measure the voltage between the reversing lamps relay pin 1, circuit CBK03 (GY), BJB face side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to W3 . **No** VERIFY the BJB fuse 47 (10A) is OK. If OK, REPAIR circuit CBK03 (GY) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
W3 CHECK FOR VOLTAGE TO THE REVERSING LAMPS RELAY SWITCH			
• Measure the voltage between the reversing lamps relay pin 3, circuit CBK03 (GY), BJB face side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to W4 . **No** REPAIR circuit CBK03 (GY) for an open. TEST the system for normal operation.		
W4 BYPASS THE REVERSING LAMPS RELAY			
• Connect a fused jumper wire between the reversing lamps relay pin 3, circuit CBK03 (GY), BJB face side and the reversing lamps relay pin 5, circuit	**Yes** REMOVE the jumper wire. For vehicles with a manual transaxle, GO to W5 . For		

CLS10 (GN/BN), BJB face side.  N0099767 • **Do the reversing lamps illuminate?**	vehicles with an automatic transaxle, GO to W7 . **No** REMOVE the jumper wire. REPAIR circuit CLS10 (GN/BN) for an open. TEST the system for normal operation.
W5 CHECK FOR VOLTAGE TO THE REVERSING LAMP SWITCH	
• Ignition OFF. • Connect: Reversing Lamps Relay. • Disconnect: Reversing Lamp Switch C169. • Ignition ON. • Measure the voltage between the reversing lamp switch C169-1, circuit CLS28 (BU/WH), harness side and ground.  N0099768 • **Is the voltage greater than 10 volts?**	**Yes** GO to W6 . **No** REPAIR circuit CLS28 (BU/WH) for an open. TEST the system for normal operation.
W6 CHECK FOR VOLTAGE TO THE REVERSING LAMP SWITCH USING THE CONNECTOR GROUND	
• Measure the voltage between the reversing lamp switch C169-1, circuit CLS28 (BU/WH), harness side and the reversing lamp switch C169-2, circuit GD121	**Yes** INSTALL a new reversing lamp switch. REFER to Reversing Lamp Switch in this section.

(BK/YE), harness side.  N0099769 • **Is the voltage greater than 10 volts?**	TEST the system for normal operation. **No** REPAIR circuit GD121 (BK/YE) for an open. TEST the system for normal operation.
W7 CHECK FOR PCM OR TCM TR SENSOR DTCs FROM THE SELF-TEST	
• Review the DTCs from the PCM (2.5L or 3.0L engine) or the TCM (3.5L engine) Key ON Engine OFF (KOEO) self-test. • **Are any TR sensor DTCs present?**	**Yes** REFER to Section 307-01A , Section 307-01B or Section 307-01C . **No** GO to W8 .
W8 CHECK THE REVERSING LAMPS RELAY COIL GROUND CONTROLLED CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PCM C175t (2.5L or 3.0L Engine). • Disconnect: TCM C1533 (3.5L Engine). • Ignition ON. • For Hybrid vehicles, measure the voltage between the PCM C175t-34, circuit CLS28 (BU/WH), harness side and ground.	**Yes** REPAIR circuit CLS28 (BU/WH) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to W9 .

 N0077711 • For non-Hybrid vehicles with a 2.5L or 3.0L engine, measure the voltage between the PCM C175t-33, circuit CLS28 (BU/WH), harness side and ground.  N0099770 • For vehicles with a 3.5L engine, measure the voltage between the TCM C1533-13, circuit CLS28 (BU/WH), harness side and ground.  N0099771 • **Is any voltage present?**	
W9 CHECK FOR VOLTAGE TO THE PCM OR THE TCM WITH THE REVERSING LAMP RELAY CONNECTED	
• Ignition OFF. • Connect: Reversing Lamps Relay. • Ignition ON. • For Hybrid vehicles, measure the voltage between the PCM C175t-34, circuit CLS28 (BU/WH), harness side	**Yes** For vehicles with a 3.5L engine, GO to W10 . For all other vehicles, GO to W11 .

and ground.  N0077711 • For non-Hybrid vehicles with a 2.5L or 3.0L engine, measure the voltage between the PCM C175t-33, circuit CLS28 (BU/WH), harness side and ground.  N0099770 • For vehicles with a 3.5L engine, measure the voltage between the TCM C1533-13, circuit CLS28 (BU/WH), harness side and ground.  N0099771 • **Is the voltage greater than 10 volts?**	**No** REPAIR circuit CLS28 (BU/WH) for an open. CLEAR the DTCs. REPEAT the self-test.
W10 CHECK FOR CORRECT TCM OPERATION	
• Disconnect the TCM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new TCM . REFER to Section 307-01A . TEST the

• Connect the TCM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
W11 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B , Section 303-14C or Section 303-14D . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test X: The Individual Reversing Lamp Is Inoperative

Refer to Wiring Diagrams Cell 93 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Reversing Lamps for schematic and connector information.

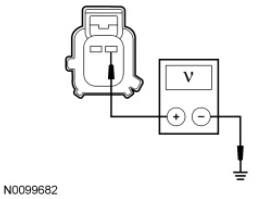
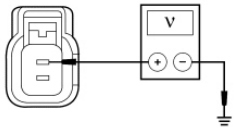
When the reversing lamps relay is energized, voltage is routed to the reversing lamps.

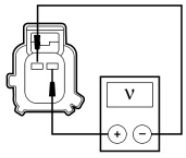
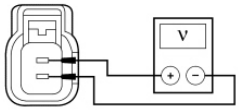
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Bulb holder

PINPOINT TEST X: THE INDIVIDUAL REVERSING LAMP IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
X1 CHECK FOR VOLTAGE TO THE REVERSING LAMP	
• Ignition OFF. • Disconnect: Inoperative Reversing Lamp. • Apply the parking brake. • Ignition ON. • Select REVERSE. • For Fusion, measure the voltage between the LH rear lamp C487-1, circuit CLS10 (GN/BN), harness side and ground, or between the RH rear lamp C488-1, circuit CLS10 (GN/BN), harness side and ground.  N0099682 • For MKZ, measure the voltage between the LH rear lamp C451-1, circuit CLS10 (GN/BN), harness side and ground, or between the RH rear lamp C461-1, circuit CLS10 (GN/BN), harness side and ground.  N0099772 • **Is the voltage greater than 10 volts?**	**Yes** GO to X2 . **No** REPAIR circuit CLS10 (GN/BN) for an open. TEST the system for normal operation.
X2 CHECK FOR VOLTAGE TO THE REVERSING LAMP USING THE CONNECTOR GROUND	

• For Fusion, measure the voltage between the LH rear lamp C487-1, circuit CLS10 (GN/BN), harness side and the LH rear lamp C487-2, circuit GD171 (BK/GY), harness side, or between the RH rear lamp C488-1, circuit CLS10 (GN/BN), harness side and the RH rear lamp C488-2, circuit GD171 (BK/GY), harness side.  N0099685 • For MKZ, measure the voltage between the LH rear lamp C451-1, circuit CLS10 (GN/BN), harness side and the LH rear lamp C451-2, circuit GD171 (BK/GY), harness side, or between the RH rear lamp C461-1, circuit CLS10 (GN/BN), harness side and the RH rear lamp C461-2, circuit GD171 (BK/GY), harness side.  N0099773 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new bulb holder. TEST the system for normal operation. **No** REPAIR circuit GD171 (BK/GY) for an open. TEST the system for normal operation.

Pinpoint Test Y: The Reversing Lamps Are On Continuously

Refer to Wiring Diagrams Cell 93 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Reversing Lamps for schematic and connector information.

Normal Operation

Voltage is supplied from the Battery Junction Box (BJB) fuse 47 (10A) to the coil and switched sides of the reversing lamps relay. When the reversing lamps relay is energized, voltage is routed to the reversing lamps.

Automatic Transaxle

The PCM (2.5L or 3.0L engines) or the Transmission Control Module (TCM) (3.5L engine) monitors the transaxle gear status. When the PCM detects the transaxle is in REVERSE (R), the PCM or TCM provides ground for the reversing lamps relay coil.

Manual Transaxle

The reversing lamp switch controls the coil ground side of the reversing lamps relay. When the transaxle is in REVERSE (R), the reversing lamp switch contacts close, completing the path to ground for the reversing lamps relay coil.

- DTC P1910 (Reverse Lamp Control Circuit/Open) - sets when the PCM detects no voltage on the reversing lamp relay coil ground control circuit (if the coil ground control circuit is short to ground).

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Reversing lamps relay
- Reversing lamp switch
- Auto-dimming interior mirror
- PCM
- TCM

PINPOINT TEST Y: THE REVERSING LAMPS ARE ON CONTINUOUSLY

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
Y1 CHECK THE REVERSING LAMPS RELAY	
• Ignition OFF. • Substitute a known good relay. • Ignition ON. • **Do the reversing lamps continue to illuminate?**	**Yes** REMOVE the known good relay. GO to Y2 . **No** REMOVE the known good relay. INSTALL a new reversing lamps relay. TEST the system for normal operation.
Y2 CHECK THE REVERSING LAMPS RELAY OUTPUT	
• Ignition OFF. • Disconnect: Reversing Lamps Relay. • Ignition ON. • **Do the reversing lamps continue to illuminate?**	**Yes** If equipped with an auto-dimming interior mirror, GO to Y3 . If not equipped with an auto-dimming interior mirror, REPAIR circuit CLS10 (GN/BN) for a short to voltage. TEST the system for normal operation. **No** For vehicles with a manual transaxle, GO to Y4 . For vehicles with an automatic transaxle, GO to Y5 .
Y3 ISOLATE THE SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Auto-Dimming Interior Mirror C911 or C9039. • Ignition ON. • **Do the reversing lamps continue to illuminate?**	**Yes** REPAIR circuit CLS10 (GN/BN) for a short to voltage. TEST the system for normal operation. **No** INSTALL a new auto-dimming interior mirror. REFER to Section 501-09 . TEST the system for normal operation.
Y4 CHECK THE REVERSING LAMP SWITCH	
• Ignition OFF.	**Yes** REPAIR circuit CLS28 (BU/WH) for a short to ground. TEST

• Connect: Reversing Lamps Relay. • Disconnect: Reversing Lamp Switch C169. • Ignition ON. • **Do the reversing lamps continue to illuminate?**	the system for normal operation. **No** INSTALL a new reversing lamp switch. REFER to Reversing Lamp Switch in this section. TEST the system for normal operation.
Y5 CHECK FOR PCM OR TCM TR SENSOR DTCs FROM THE SELF-TEST	
• Review the DTCs from the PCM (2.5L or 3.0L engine) or the TCM (3.5L engine) Key ON Engine OFF (KOEO) self-test. • **Are any TR sensor DTCs present?**	**Yes** REFER to Section 307-01A , Section 307-01B or Section 307-01C . **No** GO to Y6 .
Y6 CHECK THE REVERSING LAMPS RELAY CONTROL CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Connect: Reversing Lamps Relay. • Disconnect: PCM C175t (2.5L or 3.0L Engine,). • Disconnect: TCM C1533 (3.5L Engine). • Ignition ON. • **Do the reversing lamps continue to illuminate?**	**Yes** REPAIR circuit CLS28 (BU/WH) for a short to ground. TEST the system for normal operation. **No** For vehicles with a 3.5L engine, GO to Y7 . For all other vehicles, GO to Y8 .
Y7 CHECK FOR CORRECT TCM OPERATION	
• Disconnect the TCM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the TCM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new TCM . REFER to Section 307-01A . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
Y8 CHECK FOR CORRECT PCM OPERATION	
• Disconnect the PCM connector. • Check for: ♦ corrosion ♦ damaged pins	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14D . TEST the system for normal operation.

♦ pushed-out pins • Connect the PCM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR any DTCs. REPEAT the self-test.

Daytime Running Lamps (DRL)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The SJB controls the Daytime Running Lamps (DRL) by using various inputs to determine whether or not the DRL should be illuminated. These inputs include:

- Ignition switch position
- Headlamp switch position
- Headlamps on or off
- Transmission gear selection (automatic transaxle)
- Parking brake applied or released (manual transaxle)

When the DRL is active, the SJB provides a pulse-width modulated voltage to the low beam headlamps. This illuminates the headlamps at a reduced intensity.

The DRL is not a programmable parameter for this vehicle.

Inspection and Verification

1. Verify the customer concern.

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

5. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the RUN position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

6. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

7. Clear the continuous DTCs and carry out the self-test diagnostics for the PCM, the SJB , and the IPC .

8. If the DTCs retrieved are related to the concern, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual or the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

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

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test Z: The Daytime Running Lamps (DRL) Are Inoperative

Normal Operation

When the ignition switch is in the RUN position, the headlamps are not on, the transaxle is not in PARK (P) (automatic transaxle) or the parking brake is not applied (manual transaxle), the Smart Junction Box (SJB) provides a pulse-width modulated voltage to the low beam headlamps. This illuminates the headlamps at a reduced intensity.

This pinpoint test is intended to diagnose the following:

- Exterior lighting system input/output
- Ignition switch input
- Transaxle gear input (automatic transaxle)
- Parking brake switch input (manual transaxle)
- SJB

PINPOINT TEST Z: THE DRL ARE INOPERATIVE

Test Step	Result / Action to Take
Z1 VERIFY THE DRL OPERATION	
• Ignition ON. • Place the headlamp switch in the OFF position.	**Yes** The system is operating correctly. INFORM the customer of the

• If equipped with an automatic transaxle, place the gear selector lever in any gear other than PARK (P). • If equipped with a manual transaxle, release the parking brake. • **Do the DRL illuminate?**	conditions required for the DRL to operate correctly. **No** GO to Z2 .
Z2 CHECK THE OPERATION OF THE HEADLAMPS (VEHICLES WITH HALOGEN HEADLAMPS) OR FOG LAMPS (VEHICLES WITH HID HEADLAMPS)	
• Place the headlamp switch in the HEADLAMPS ON position (and engage the fog lamp switch for vehicles with HID headlamps) and observe the headlamps/fog lamps. • **Do the headlamps/fog lamps operate correctly?**	**Yes** GO to Z3 . **No** REFER to Headlamps or Fog Lamps in this section.
Z3 CHECK THE IGNITION SWITCH INPUT	
• Place the headlamp switch in the OFF position. • Enter the following diagnostic mode on the scan tool: SJB DataLogger. • Monitor the SJB ignition switch PIDs (IGN_A_ECU, IGN_O_ECU, IGN_R_ECU, IGN_S_ECU) while cycling the ignition switch through all its positions. • **Does the PID agree with the ignition switch positions?**	**Yes** For vehicles with an automatic transaxle, GO to Z4 . For vehicles with a manual transaxle, GO to Z5 . **No** REFER to Section 211-05 to diagnose the ignition switch input.
Z4 CHECK THE TRANSAXLE GEAR INPUT	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: PCM DataLogger. • Monitor the PCM transmission gear status PID (TR) while placing the gear selector lever through all its positions. • **Does the PID agree with the gear selection?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** REFER to Section 307-01A , Section 307-01B or Section 307-01C to diagnose the digital Transmission Range (TR) sensor input.
Z5 CHECK THE BRAKE WARNING INDICATOR OPERATION	
• Ignition ON. • Apply and release the parking brake while observing the brake warning indicator. • **Does the brake warning indicator operate correctly?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** REFER to Section 413-01 to diagnose the brake warning indicator.

Adaptive Headlighting

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit 105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The Headlamp Control Module (HCM) receives information from the communication network such as vehicle speed, steering wheel angle and headlamps on status. Based on the information received, the HCM determines if the headlamps need to be angled left or right as well as the degree of angle.

The HCM does not operate the adaptive headlamps until the vehicle speed is above 5 km/h (3 mph).

When the ignition is placed in the RUN/START position, the HCM runs an initialization check to determine the straight-ahead position of the headlamps. If the HCM does not receive the required information over the communication network or determines that there is a fault with the circuitry to the sensors or control motors, it defaults the headlamps to the straight-ahead position and sets DTC(s).

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Headlamp assembly	• Smart Junction Box (SJB) fuse 42 (10A) • Wiring, terminals or connectors • Headlamp Control Module (HCM)

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the HCM .

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

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

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test AA: DTC B1A98:88

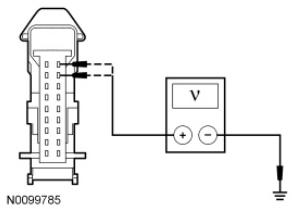
- DTC B1A98:88 (LIN Bus Circuit #1: Bus off) - sets continuous and on-demand by the Headlamp Control Module (HCM) if communication is lost to the headlamps due to a circuit fault on the communication circuit between the HCM and the headlamps.

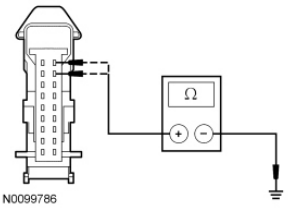
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Headlamp assembly

- HCM

PINPOINT TEST AA: DTC B1A98:88

Test Step	Result / Action to Take
AA1 ISOLATE THE LH HEADLAMP ASSEMBLY AS THE CAUSE OF THE DTC	
• Ignition OFF. • Disconnect: LH Headlamp Assembly C1021. • Ignition ON. • Enter the following diagnostic mode on the scan tool: HCM Self-Test. • **NOTE:** Other DTCs can be present with the headlamp assembly disconnected and should be ignored. • Clear the DTCs and repeat the HCM self-test. • **Is DTC B1A98:88 still present?**	**Yes** GO to AA2 . **No** INSTALL a new LH headlamp assembly. REFER to Headlamp Assembly in this section. CLEAR the DTCs. REPEAT the self-test.
AA2 ISOLATE THE RH HEADLAMP ASSEMBLY AS THE CAUSE OF THE DTC	
• Ignition OFF. • Disconnect: RH Headlamp Assembly C1041. • Ignition ON. • Enter the following diagnostic mode on the scan tool: HCM Self-Test. • **NOTE:** Other DTCs can be present with the headlamp assembly disconnected and should be ignored. • Clear the DTCs and repeat the HCM self-test. • **Is DTC B1A98:88 still present?**	**Yes** GO to AA3 . **No** INSTALL a new RH headlamp assembly. REFER to Headlamp Assembly in this section. CLEAR the DTCs. REPEAT the self-test.
AA3 CHECK THE COMMUNICATION CIRCUITS TO THE HEADLAMPS FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: HCM C1600. • Ignition ON. • Measure the voltage between the HCM C1600-17, circuit VLF32 (YE), harness side, and ground; and the HCM C1600-18, circuit VLF33 (BU), harness side, and ground.  	**Yes** REPAIR circuit VLF32 (YE) (LH headlamp) or circuit VLF33 (BU) (RH headlamp) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to AA4 .

• **Is any voltage present?**	
AA4 CHECK THE COMMUNICATION CIRCUITS TO THE HEADLAMPS FOR A SHORT TO GROUND	
• Ignition OFF. • Measure the resistance between the HCM C1600-17, circuit VLF32 (YE), harness side, and ground; and the HCM C1600-18, circuit VLF33 (BU), harness side, and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to AA5 . **No** REPAIR circuit VLF32 (YE) (LH headlamp) or circuit VLF33 (BU) (RH headlamp) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
AA5 CHECK FOR CORRECT HCM OPERATION	
• Disconnect all the HCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the HCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HCM . REFER to Headlamp Control Module (HCM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AB: DTC B1D64:87, B1D65:87

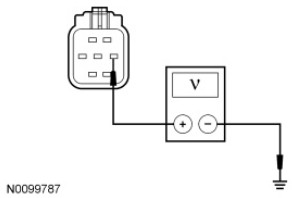
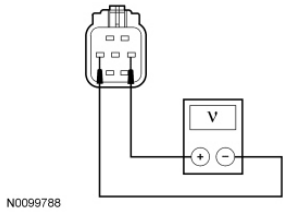
- DTC B1D64:87 (Left Headlamp Swivelling Motor: Missing Message) - sets continuous and on-demand in the Headlamp Control Module (HCM) if data messages from the LH headlamp are missing.
- DTC B1D65:87 (Right Headlamp Swivelling Motor: Missing Message) - sets continuous and on-demand in the HCM if data messages from the RH headlamp are missing.

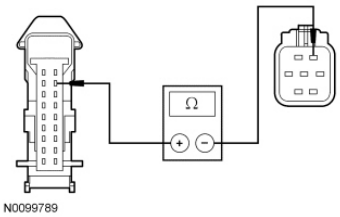
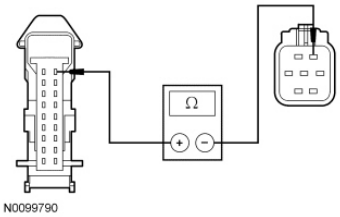
This pinpoint test is intended to diae the following:

- Wiring, terminals or connectors
- Headlamp assembly
- HCM

PINPOINT TEST AB: DTC B1D64:87, B1D65:87

Test Step	Result / Action to Take

AB1 CHECK FOR VOLTAGE TO THE HEADLAMP	
• Ignition OFF. • Disconnect: LH Headlamp Assembly C1021 (DTC B1D64:87). • Disconnect: RH Headlamp Assembly C1041 (DTC B1D65:87). • Ignition ON. • Measure the voltage between the LH headlamp C1021-5, circuit CBP42 (GN), harness side and ground; or between the RH headlamp C1041-5, circuit CBP42 (GN), harness side and ground.  N0099787 • **Is the voltage greater than 10 volts?**	**Yes** GO to AB2 . **No** REPAIR circuit CBP42 (GN) for an open. CLEAR the DTCs. REPEAT the self-test.
AB2 CHECK FOR VOLTAGE TO THE HEADLAMP USING THE CONNECTOR GROUND	
• Measure the voltage between the LH headlamp C1021-5, circuit CBP42 (GN), harness side and the LH headlamp C1021-3, circuit GD121 (BK/YE), harness side; or between the RH headlamp C1041-5, circuit CBP42 (GN), harness side and the RH headlamp C1041-3, circuit GD123 (BK/GY), harness side.  N0099788 • **Is the voltage greater than 10 volts?**	**Yes** GO to AB3 . **No** REPAIR circuit GD121 (BK/YE) (LH headlamp) or circuit GD123 (BK/GY) (RH headlamp) for an open. CLEAR the DTCs. REPEAT the self-test.
AB3 CHECK THE COMMUNICATION CIRCUIT BETWEEN THE HCM AND THE HEADLAMP FOR AN OPEN	
• Ignition OFF. • Disconnect: HCM C1600. • For the LH headlamp, measure the resistance between the HCM C1600-17, circuit VLF32 (YE), harness side and the LH headlamp C1021-2, circuit VLF32 (YE), harness side.	**Yes** GO to AB4 . **No** REPAIR circuit VLF32 (YE) (LH headlamp) or circuit VLF33 (BU) (RH headlamp) for an open. CLEAR the DTCs. REPEAT the self-test.

 N0099789 • For the RH headlamp, measure the resistance between the HCM C1600-18, circuit VLF33 (BU), harness side and the RH headlamp C1041-2, circuit VLF33 (BU), harness side.  N0099790 • **Is the resistance less than 5 ohms?**	
AB4 CHECK FOR CORRECT HCM OPERATION	
• Disconnect all the HCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the HCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HCM . REFER to Headlamp Control Module (HCM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test AC: DTC U0100:87

- DTC U0100:87 (Lost Communication With ECM/PCM "A": Missing Message) - sets continuous in the Headlamp Control Module (HCM) if data messages received from the PCM over the High Speed Controller Area Network (HS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- HCM
- PCM

PINPOINT TEST AC: DTC U0100:87

NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out.

Test Step	Result / Action to Take
AC1 VERIFY THAT THE SCAN TOOL CAN COMMUNICATE WITH THE PCM	
• Ignition ON. • Check that a vehicle session can be established using the scan tool. • **Can a vehicle session be established?**	**Yes** GO to AC2 . **No** REFER to Section 418-00 to diagnose no communication with the PCM.
AC2 CHECK THE IPC CONTINUOUS MEMORY DTCs	
• Enter the following diagnostic mode on the scan tool: HCM Self-Test. • Clear the DTCs. Repeat the HCM self-test. • **Is DTC U0100:87 retrieved again?**	**Yes** GO to AC3 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AC3 RETRIEVE THE RECORDED DTCs FROM THE HCM SELF-TEST	
• Check for recorded DTCs from the HCM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AH . For DTC U3003:17 GO to Pinpoint Test AI . **No** GO to AC4 .
AC4 CHECK FOR DTC U0100 SET IN OTHER MODULES	
• Enter the following diagnostic mode on the scan tool: Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0100 set in the Instrument Panel Cluster (IPC) or the Restraints Control Module (RCM)?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B , Section 303-14C or Section 303-14D . TEST the system for normal operation. **No** INSTALL a new HCM . REFER to Headlamp Control Module (HCM) in this section. TEST the system for normal operation.

Pinpoint Test AD: DTC U0101:87

- DTC U0101:87 (Lost Communication With TCM : No Sub-Type Information) - sets continuous in the Headlamp Control Module (HCM) if data messages received from the Transmission Control dule (TCM) over the High Speed Controller Area Network (HS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- HCM
- TCM

PINPOINT TEST AD: DTC U0101:87

NOTE: If other new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out.

Test Step	Result / Action to Take
AD1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AD2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AD2 CHECK THE COMMUNICATION NETWORK	
• Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the TCM pass the network test?**	**Yes** GO to AD3 . **No** REFER to Section 418-00 .
AD3 CHECK THE RECORDED DTCs FROM THE HCM SELF-TEST	
• Check for recorded DTCs from the IPC self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AH . For DTC U3003:17 GO to Pinpoint Test AI . **No** GO to AD4 .
AD4 RECHECK THE HCM DTCs	
• Enter the following diagnostic mode on the scan tool: HCM Self-Test. • Clear the DTCs. Repeat the IPC self-test. • **Is DTC U0101:87 still present?**	**Yes** INSTALL a new TCM . REFER to Section 307-01A . CLEAR the DTCs. REPEAT the self-test. If DTC U0101:87 is still present, INSTALL a new HCM . REFER to Headlamp Control Module (HCM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test AE: DTC U0121:87

Normal Operation

- DTC U0121:87 (Lost Communication With Anti-Lock Brake System (ABS) Control Module:

Missing Message) - sets continuous by the Headlamp Control Module (HCM) if data messages received from the ABS module over the High Speed Controller Area Network (HS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

This pinpoint test is intended to diagnose the following:

- HCM
- ABS module

PINPOINT TEST AE: DTC U0121:87

NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out.

Test Step	Result / Action to Take
AE1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AE2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AE2 CHECK THE COMMUNICATION NETWORK	
• Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the ABS module pass the network test?**	**Yes** GO to AE3 . **No** REFER to Section 418-00 .
AE3 RETRIEVE THE RECORDED DTCs FROM THE HCM SELF-TEST	
• Check for recorded DTCs from the HCM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AH . For DTC U3003:17 GO to Pinpoint Test AI . **No** GO to AE4 .
AE4 RECHECK THE HCM DTCs	
• Enter the following diagnostic mode on the scan tool: HCM Self-Test. • Clear the DTCs. Repeat the HCM self-test. • **Is DTC U0121:87 still present?**	**Yes** INSTALL a new ABS module. REFER to Section 206-09 . CLEAR the DTCs. REPEAT the self-test. If DTC U0121:87 is still present, INSTALL a new HCM . REFER to Headlamp Control Module (HCM) in this section. TEST the system for normal operation.

	No The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test AF: DTC U0126:87

- DTC U0126:87 (Lost Communication With Steering Wheel Angle Sensor Module: Missing Message) - sets continuous in the Headlamp Control Module (HCM) if data messages received from the Power Steering Control Module (PSCM) over the High Speed Controller Area Network (HS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

The PSCM is integrated into the steering gear.

This pinpoint test is intended to diagnose the following:

- HCM
- PSCM

PINPOINT TEST AF: U0126:87

If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out.

Test Step	Result / Action to Take
AF1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AF2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AF2 CHECK THE COMMUNICATION NETWORK	
• Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the PSCM pass the network test?**	**Yes** GO to AF3 . **No** REFER to Section 418-00 .
AF3 RETRIEVE THE RECORDED DTCs FROM THE HCM SELF-TEST	
• Check for recorded DTCs from the HCM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AH . For DTC U3003:17 GO to Pinpoint Test AI . **No**

	GO to AF4 .
AF4 RECHECK THE HCM DTCs	
• Enter the following diagnostic mode on the scan tool: HCM Self-Test. • Clear the DTCs. Repeat the HCM self-test. • **Is DTC U0126:87 still present?**	**Yes** INSTALL a new steering gear. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the self-test. If DTC U0126:87 is still present, INSTALL a new HCM . REFER to Headlamp Control Module (HCM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test AG: DTC U0155:87

- DTC U0155:87 (Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information) - sets continuous by the HCM if data messages (ignition switch status, headlamps on status) received from the IPC over the HS-CAN are missing. For a complete list of all network messages, refer to Section 418-00 .

The Smart Junction Box (SJB) communicates the headlamps on status to the IPC over the Medium Speed Controller Area Network (MS-CAN). The IPC acts as a gateway module and relays the information through the High Speed Controller Area Network (HS-CAN) to the HCM .

This pinpoint test is intended to diagnose the following:

- HCM
- IPC

PINPOINT TEST AG: U0155:87

NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during the Programmable Module Installation (PMI) or the PMI may not have been carried out.

Test Step	Result / Action to Take
AG1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to AG2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
AG2 CHECK THE COMMUNICATION NETWORK	
	Yes GO to AG3 .

• Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the IPC pass the network test?**	**No** REFER to Section 418-00 .
AG3 RETRIEVE THE RECORDED DTCs FROM THE IPC SELF-TEST	
• Check for recorded DTCs from the HCM self-test. • **Is DTC U3003:16 or DTC U3003:17 recorded?**	**Yes** For DTC U3003:16, GO to Pinpoint Test AH . For DTC U3003:17 GO to Pinpoint Test AI . **No** GO to AG4 .
AG4 RECHECK THE HCM DTCs	
• Enter the following diagnostic mode on the scan tool: HCM Self-Test. • Clear the DTCs. Repeat the HCM self-test. • **Is DTC U0155:87 still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . CLEAR the DTCs. REPEAT the self-test. If DTC U0155:87 is still present, INSTALL a new HCM . REFER to Headlamp Control Module (HCM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.

Pinpoint Test AH: DTC U3003:16

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

- DTC U3003:16 (Battery Voltage: Circuit Voltage Below Threshold) - sets continuous and on-demand in the Headlamp Control Module (HCM) if the HCM detects battery voltage below 9 volts from the HCM voltage supply circuit.

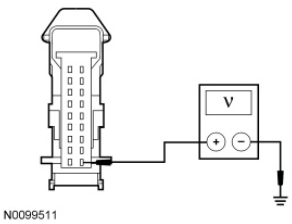
This pinpoint test is intended to diagnose the following:

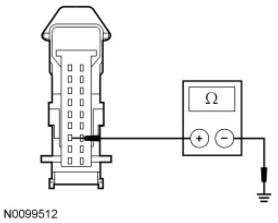
- Wiring, terminals or connectors
- HCM

PINPOINT TEST AH: DTC U3003:16

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AH1 RECHECK THE HCM DTCs	&sp;
• Ignition ON. • Enter the following diagnostic mode on the scan tool: HCM Self-Test. • Clear the DTCs. Repeat the HCM self-test. • **Is DTC U3003:16 still present?**	**Yes** GO to AH2 . **No** The system is operating correctly at this time. The DTC may have been set due to a previous low battery voltage condition.
AH2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Enter the following diagnostic mode on the scan tool: PCM Self-Test. • Carry out the PCM Key ON Engine OFF (KOEO) self-test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC P0620, P0622, P0625, P0626 or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to AH3 .
AH3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Check the battery condition and verify that the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to AH4 . **No** REFER to Section 414-01 .
AH4 CHECK THE HCM VOLTAGE SUPPLY	
• Ignition OFF. • Disconnect: HCM C1600. • Ignition ON. • Measure and record the voltage at the battery. • Measure the voltage between the HCM C1600-10, circuit CBP42 (GN), harness side and ground.  N0099511 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	**Yes** GO to AH5 . **No** REPAIR the circuit for high resistance. CLEAR the DTC. REPEAT the self-test.
AH5 CHECK THE HCM GROUND CIRCUIT	

• Ignition OFF. • Disconnect: Negative Battery Cable. • Measure the resistance between the HCM C1600-3, circuit GD121 (BK/YE), harness side and ground.  N0099512 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new HCM . REFER to Headlamp Control Module (HCM) in this section. TEST the system for normal operation. **No** REPAIR the circuit for high resistance. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test AI: DTC U3003:17

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

- DTC U3003:17 (Battery Voltage: Circuit Voltage Above Threshold) - sets continuous and on-demand in the Headlamp Control Module (HCM) if the HCM detects battery voltage above 16 volts on the voltage input circuit.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- HCM

PINPOINT TEST AI: DTC U3003:17

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: DTC U3003:17 may be stored in the module memory due to past battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
AI1 CHECK FOR DTC B1317, B1676, P0563 (PCM) OR U3003:17 SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Self-Test. • Retrieve the continuous memory DTCs from all modules.	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AI2 .

• **Is DTC B1317, B1676, P0563 (PCM) or U3003:17 set in more than one module?**	
AI2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to AI3 .
AI3 RECHECK FOR DTC U3003:17	
• Turn the engine off. • Ignition ON. • Enter the following diagnostic mode on the scan tool: HCM Self-Test. • Clear the DTCs and repeat the HCM on-demand self-test.. • **Is DTC U3003:17 present?**	**Yes** INSTALL a new HCM . REFER to Headlamp Control Module (HCM) in this section. TEST the system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Headlamp Adjustment

Special Tool(s)

 ST3041-A	Vision 100 Headlamp Aimer 196-00005 or equivalent

Headlamp Aiming

1. The headlamp aiming procedure depends on what type of beam pattern the headlamp is equipped with. Vehicles may come equipped with VOL, VOR or SAE only (includes sealed beam type) headlamps. To identify the headlamp beam pattern, look on the headlamp lens. Molded in small letters on the headlamp lens is one of the following:
    - SAE
    - VOL and SAE
    - VOR and SAE

2. Once the headlamp beam pattern is identified, aim the headlamps using one of the following methods as applicable.
    - Photometric aimers can aim VOL-, VOR- and SAE-type headlamps only. This is the preferred method of headlamp aiming.
    - Visual or screen method aiming can be used to aim VOL-, VOR- and SAE-type headlamps only.
    - Mechanical aimers cannot be used with VOR- or VOL-type headlamps. Aerodynamic lamps that can be aimed mechanically have 3 nibs molded into the lens of the lamp.

Photometric Aiming

1. For the photometric aiming procedure, refer to the appropriate photometric headlamp aimer instruction manual.

Screen Method Aiming

All headlamp types

NOTE: Horizontal aim is not adjustable for VOL or VOR headlamps.

NOTE: Consult your state vehicle inspection manual for recommended tolerance ranges for visual aiming.

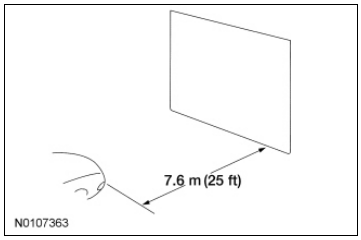
NOTE: The sight shield may need to be positioned or removed for access to the adjusters.

1. Before starting headlamp adjustment:
    - check the tire inflation.
    - check that no other load is in the vehicle other than a half tank of fuel.

- check that the headlamps are clean.
- check for correct headlamp operation.
- check that the vehicle is on level ground.
- if the vehicle is equipped with air suspension, make sure that the switch is on.

2. **NOTE:** The vertical wall or screen must be a minimum of 2.4 m (8 ft) wide.

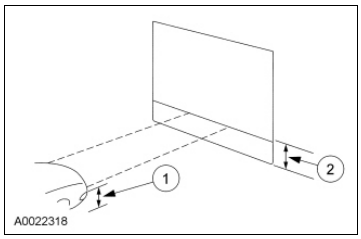
   Park the vehicle on a level surface approximately 7.6 m (25 ft) from the vertical wall or screen directly in front of it.



3. **NOTE:** The center of the lamp is marked either on the lens (circle, crosshair or other mark) or on the bulb shield internal to the lamp (crosshair or other mark).

   Mark a horizontal reference line on the vertical wall or screen.

   1. Measure the center of the headlamp height to ground and record the measurement.
   2. Make a 2.4 m (8 ft) horizontal mark (using masking tape) on the vertical wall or screen at the same distance from the ground as previously recorded.



4. **NOTE:** This procedure should be done in a dark environment to effectively see the headlamp beam pattern.

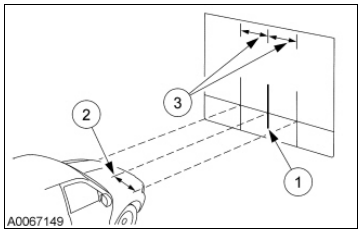
   Turn on the low beam headlamps to illuminate the wall or screen and open the hood.

5. **NOTE:** For SAE-type headlamps, the appearance of the beam pattern may vary between vehicles.

   On the wall or screen, locate the high intensity area of the beam pattern. Place the top edge of the high intensity zone even with the horizontal reference line.

SAE-type headlamps

6. In addition to the horizontal line marked in Step 3, a pair of vertical lines must be marked at the center line of the headlamps on the wall or screen.
   1. Mark the center line of the vehicle on the wall or screen.
   2. Measure from the center of the headlamp to the center line of the vehicle.
   3. Make two 1.5 m (5 ft) vertical marks (using masking tape) on the wall or screen at the same distance from the vehicle center line as previously recorded.

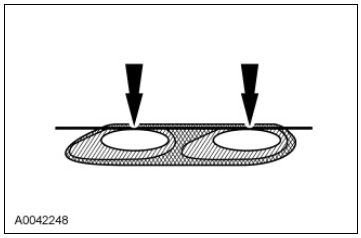


7. On the wall or screen, locate the high intensity area of the beam pattern. Place the left edge of the high intensity zone even with the vertical line corresponding to the headlamp being adjusted.

VOR-type headlamps

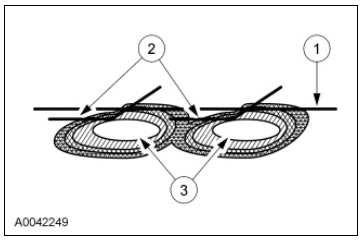
8. **NOTE:** The appearance of the VOR beam pattern may vary between vehicles.

   Identify at the top edge of this high intensity area a distinct horizontal cutoff in the beam pattern. If the top edge of this cutoff is not even with the horizontal reference line, the headlamp beam needs to be adjusted.



VOL-type headlamps

9. For VOL-type headlamps, there is a distinct cutoff in the left portion of the beam pattern. The edge of this cutoff should be positioned 50.2 mm (2 in) below the horizontal reference line.
   1. Horizontal reference line.
   2. Top edge of the beam pattern.
   3. High intensity zone.

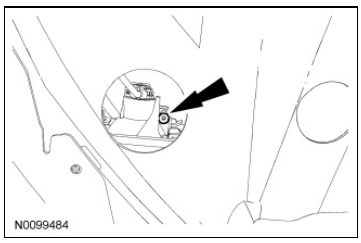


Mechanical Aiming

1. For the mechanical aiming procedure, refer to the appropriate mechanical headlamp aimer instruction manual.

Front Fog Lamp Adjustment

Front Fog Lamp Adjustment Screw Location



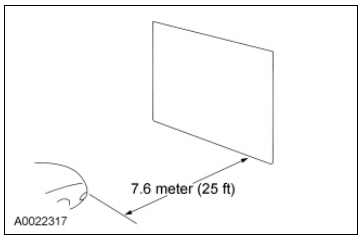
1. **NOTE:** Horizontal aim is not required for this vehicle and is not adjustable. Consult your state vehicle inspection center for recommended tolerance ranges for visual aiming.

   Before starting the fog lamp assembly adjustment:

   - make sure the vehicle is on level ground.
   - check the tire inflation.
   - make sure there are no other loads in the vehicle other than a half tank of fuel.
   - make sure the fog lamps and headlamps are clean.
   - make sure the headlamps are operating and are correctly aimed.

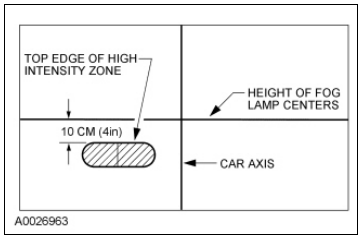
2. **NOTE:** The vertical wall screen must be a minimum of 2.4 m (8 ft) wide.

   Park the vehicle on a level surface approximately 7.6 m (25 ft) from the vertical wall or screen directly in front of it.



3. Measure the distance from the floor to the center of the fog lamp.

4. The correct visual aim for the fog lamps is with the top edge of the high-intensity zone 10 cm (4 in) below the horizontal center of the fog lamps.
   - Rotate the adjustment screw until the fog lamp beam is within specification.



Autolamps Time Delay Adjustment

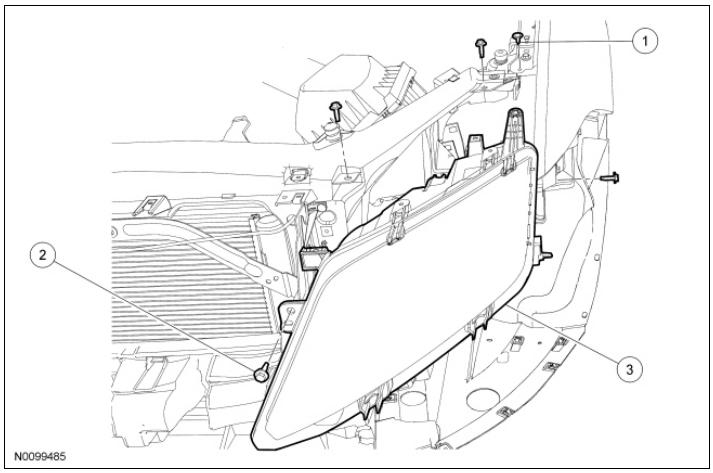
NOTE: The time delay can be programmed through the message center using the message center buttons (if equipped) or using the following steps.

NOTE: Steps 2 through 5 must be carried out within a 10-second period.

1. Start with the ignition switch off and the headlamp switch in the AUTOLAMPS ON position.
2. Place the headlamp switch in the OFF position.
3. Place the ignition switch in the RUN position.
4. Place the ignition switch in the OFF position.
5. Place the headlamp switch in the AUTOLAMPS ON position. The exterior lamps turn on at this point.
6. Wait the desired amount of time and place the headlamp switch in the OFF position (maximum of 3 minutes). The exterior lamps turn off and the autolamp time delay is now set.

Headlamp Assembly

NOTE: Fusion shown, MKZ similar.



Item	Part Number	Description
1	-	Headlamp assembly pin-type retainer (part of 13005)
2	W711676	Headlamp assembly bolts (4 required)
3	13008	Headlamp assembly

Removal and Installation

NOTE: Make sure the headlamp switch and the ignition switch are in the OFF position.

1. Remove the front bumper cover. For additional information, refer to Section 501-19 .

2. Remove the headlamp assembly pin-type retainer.

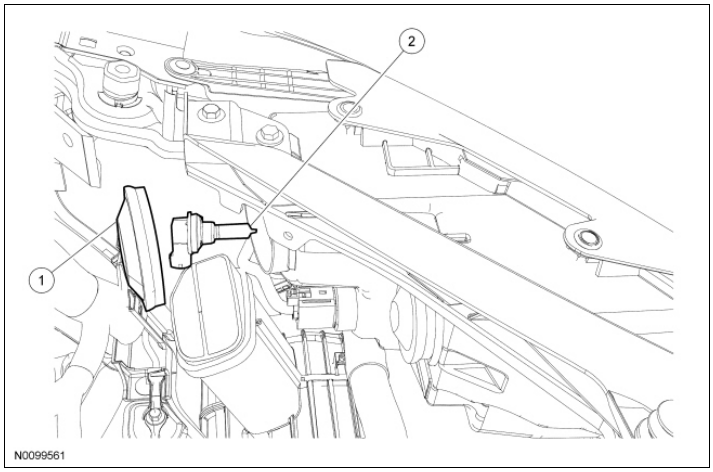
3. Remove the 4 bolts and the headlamp assembly.
   - Disconnect the electrical connectors.

4. To install, reverse the removal procedure.

Headlamp Bulb - LH, Fusion

Low Beam

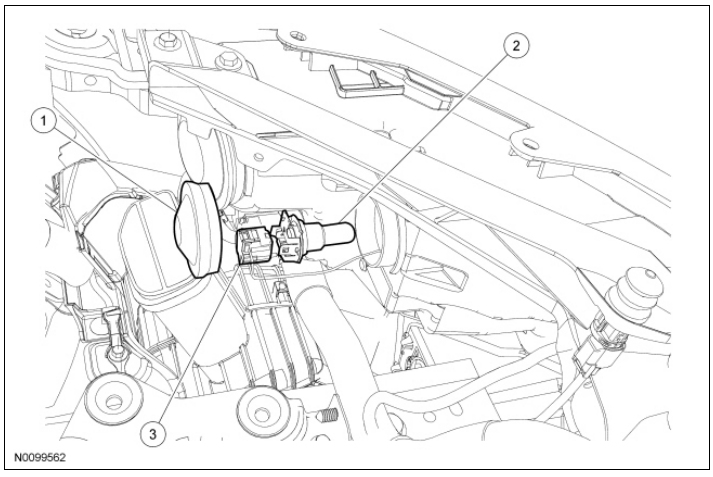
NOTE: Non-Hybrid shown, Hybrid similar.



Item	Part Number	Description
1	13N019	Headlamp bulb protective cover
2	13N021	Headlamp low beam bulb

High Beam

NOTE: Non-Hybrid shown, Hybrid similar.



Item	Part Number	Description
1	13N019	Headlamp bulb protective cover
2	13N021	Headlamp high beam bulb

3	-	Headlamp high beam bulb electrical connector (part of 13008)

Removal and Installation

⚠ WARNING: The bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope. Failure to follow these instructions may result in personal injury.

NOTE: The headlamp bulb should not be removed from the headlamp until just before a new bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn on the headlamps with the bulb removed from the headlamp.

NOTE: Make sure the headlamp switch and the ignition switch are in the OFF position.

Low beam bulb

1. For vehicles equipped with a 3.0L engine, remove the air cleaner. For additional information, refer to Section 303-12B .

High beam bulb

2. For Hybrid vehicles, remove the battery. For additional information, refer to Section 414-01 .

Low beam or high beam bulb

3. For non-Hybrid vehicles, if equipped remove the pin-type retainer and separate the small splash shield from the core support.

4. For Hybrid vehicles, remove the air cleaner ACL outlet pipe. For additional information, refer to Section 303-12D .

5. Remove the headlamp bulb protective cover.

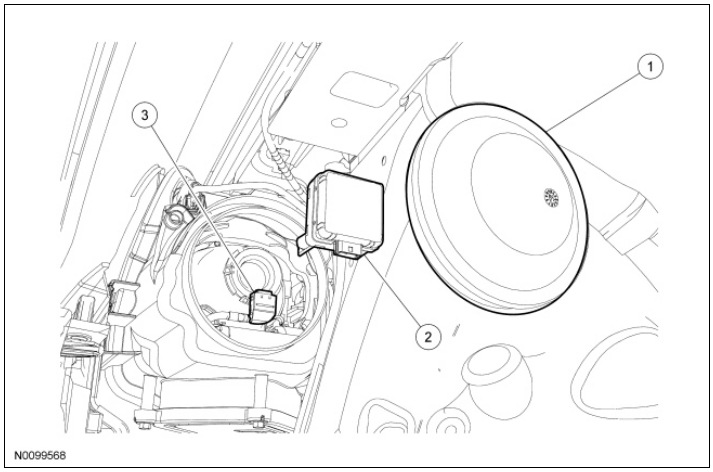
6. Remove the headlamp bulb.
    - Disconnect the electrical connector.

7. To install, reverse the removal procedure.
    - Make sure the headlamp bulb protective cover is completely sealed.

Headlamp Bulb - LH, MKZ

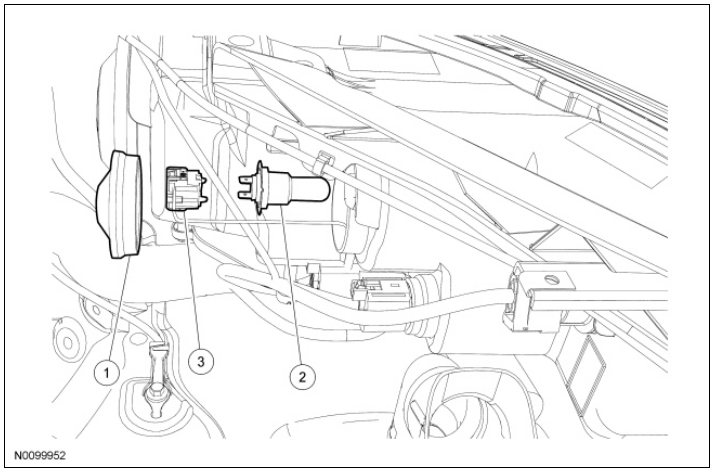
Low Beam

NOTE: High Intensity Discharge (HID) bulb shown, halogen bulb similar.



Item	Part Number	Description
1	13N019	Headlamp bulb protective cover
2	13N021	Headlamp low beam bulb
3	-	Headlamp low beam bulb electrical connector (part of 13008)

High Beam



Item	Part Number	Description
1	13N019	Headlamp bulb protective cover

2	13N021	Headlamp high beam bulb
3	-	Headlamp high beam bulb electrical connector (part of 13008)

Removal and Installation

⚠ WARNING: The bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope. Failure to follow these instructions may result in personal injury.

NOTE: The headlamp bulb should not be removed from the headlamp until just before a new bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn on the headlamps with the bulb removed from the headlamp.

NOTE: Make sure the headlamp switch and the ignition switch are in the OFF position.

High beam bulb

1. Remove the Air Cleaner ACL . For additional information, refer to Section 303-12C

Low beam or high beam bulb

2. Remove the headlamp bulb protective cover.

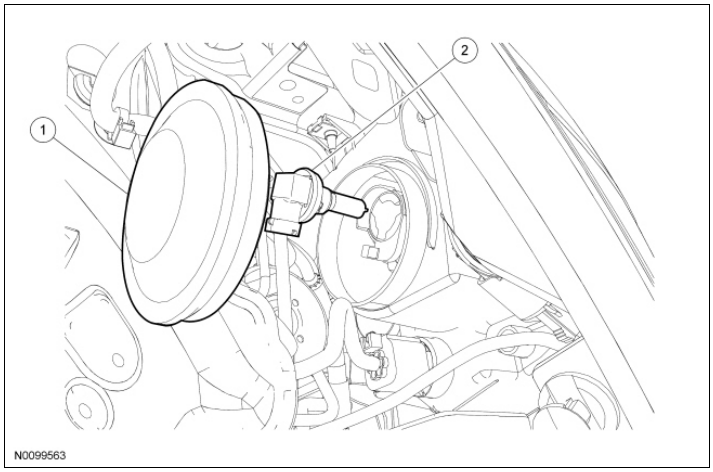
3. Remove the headlamp bulb.
   - Disconnect the electrical connector.

4. To install, reverse the removal procedure.
   - Make sure the headlamp bulb protective cover is completely sealed.

Headlamp Bulb - RH, Fusion

Low Beam

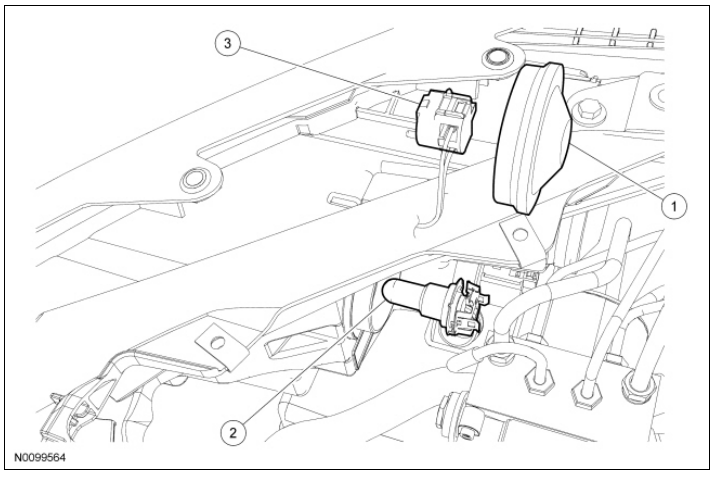
NOTE: Non-Hybrid shown, Hybrid similar.



Item	Part Number	Description
1	13N019	Headlamp bulb protective cover
2	13N021	Headlamp low beam bulb

High Beam

NOTE: Non-Hybrid shown, Hybrid similar.



Item	Part Number	Description
1	13N019	Headlamp bulb protective cover
2	13N021	Headlamp high beam bulb

3	-	Headlamp high beam bulb electrical connector (part of 13008)

Removal and Installation

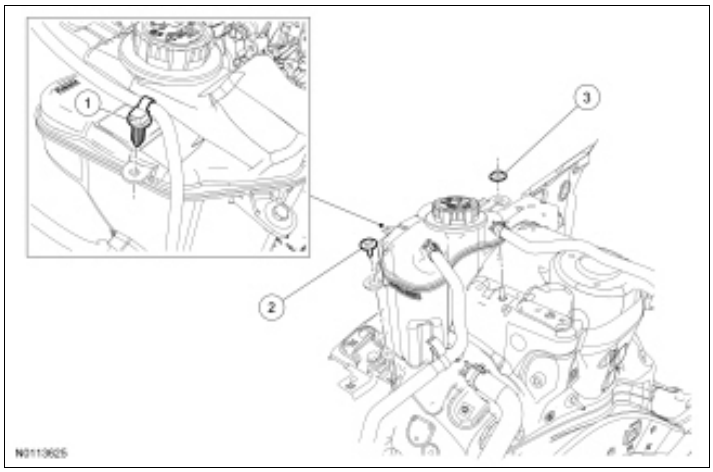
⚠ WARNING: The bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope. Failure to follow these instructions may result in personal injury.

NOTE: The headlamp bulb should not be removed from the headlamp until just before a new bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn on the headlamps with the bulb removed from the headlamp.

NOTE: Make sure the headlamp switch and the ignition switch are in the OFF position.

Low beam bulb, all vehicles and High beam bulb, Hybrid vehicles

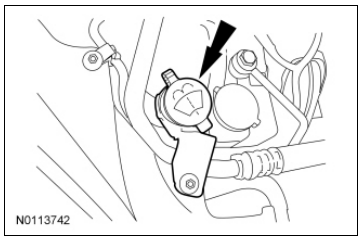
1. Position the engine coolant degas bottle aside.
    1. If equipped detach the wiring harness retainer from the degas bottle.
    2. Remove the bolt.
        - ♦ To install, tighten to 9 Nm (80 lb-in).
    3. Remove the nut.
        - ♦ To install, tighten to 9 Nm (80 lb-in).



High beam bulb

2. For non Hybrid vehicles, remove the headlamp assembly. For additional information, refer to Headlamp Assembly in this section.

3. For Hybrid vehicles, position aside the windshield washer reservoir filler tube.



Low beam or high beam bulb

4. Remove the headlamp bulb protective cover.

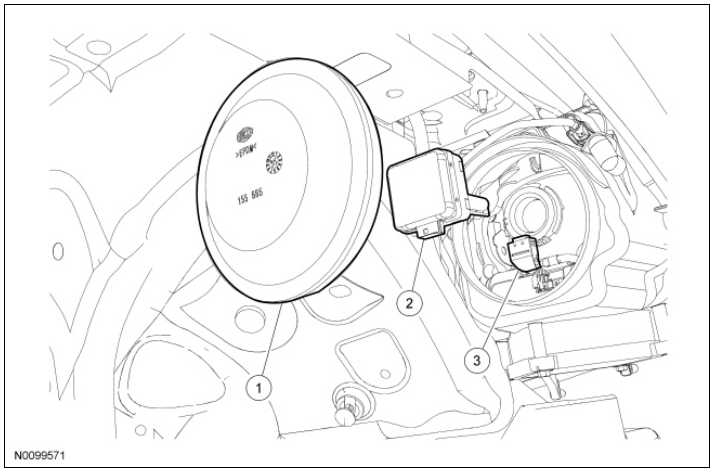
5. Remove the headlamp bulb.
    - Disconnect the electrical connector.

6. To install, reverse the removal procedure.
    - Make sure the headlamp bulb protective cover is completely sealed.

Headlamp Bulb - RH, MKZ

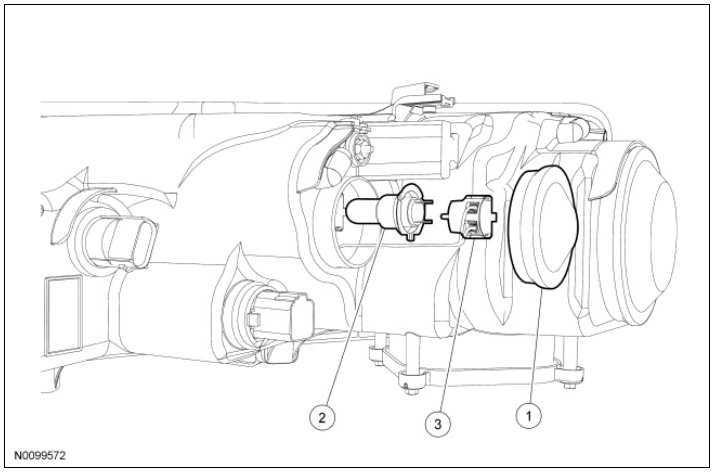
Low Beam

NOTE: High Intensity Discharge (HID) bulb shown, halogen bulb similar.



Item	Part Number	Description
1	13N019	Headlamp bulb protective cover
2	13N021	Headlamp low beam bulb
3	-	Headlamp low beam bulb electrical connector (part of 13008)

High Beam



Item	Part Number	Description
1	13N019	Headlamp bulb protective cover

2	13N021	Headlamp high beam bulb
3	-	Headlamp high beam bulb electrical connector (part of 13008)

Removal and Installation

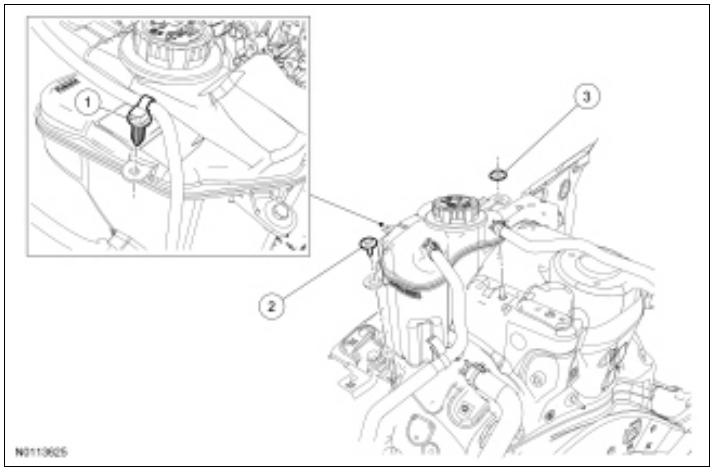
⚠ WARNING: The bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope. Failure to follow these instructions may result in personal injury.

NOTE: The headlamp bulb should not be removed from the headlamp until just before a new bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn on the headlamps with the bulb removed from the headlamp.

NOTE: Make sure the headlamp switch and the ignition switch are in the OFF position.

Low beam bulb

1. Position the engine coolant degas bottle aside.
    1. Detach the wiring harness retainer from the degas bottle.
    2. Remove the bolt.
        - ♦ To install, tighten to 9 Nm (80 lb-in).
    3. Remove the nut.
        - ♦ To install, tighten to 9 Nm (80 lb-in).



High beam bulb

2. Remove the headlamp assembly. For additional information, refer to Headlamp Assembly in this section.

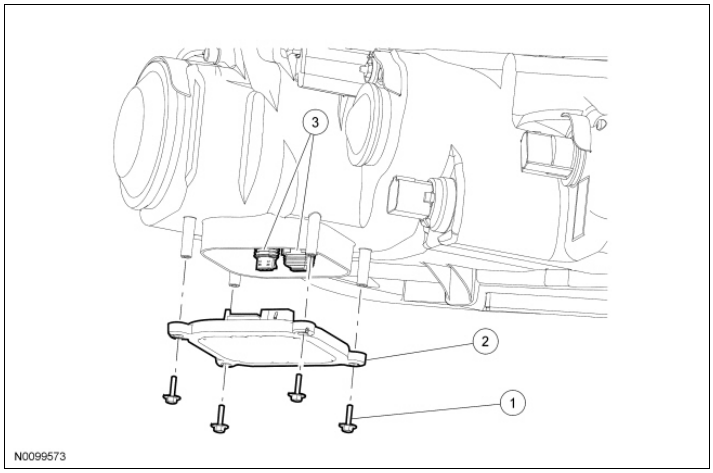
Low beam or high beam bulb

3. Remove the headlamp bulb protective cover.

4. Remove the headlamp bulb.
    - Disconnect the electrical connector.

5. To install, reverse the removal procedure.
    - Make sure the headlamp bulb protective cover is completely sealed.

Ballast



Item	Part Number	Description
1	-	Ballast screws (4 required) (part of 13008)
2	13C170	Ballast
3	-	Ballast electrical connectors (part of 13008)

Removal and Installation

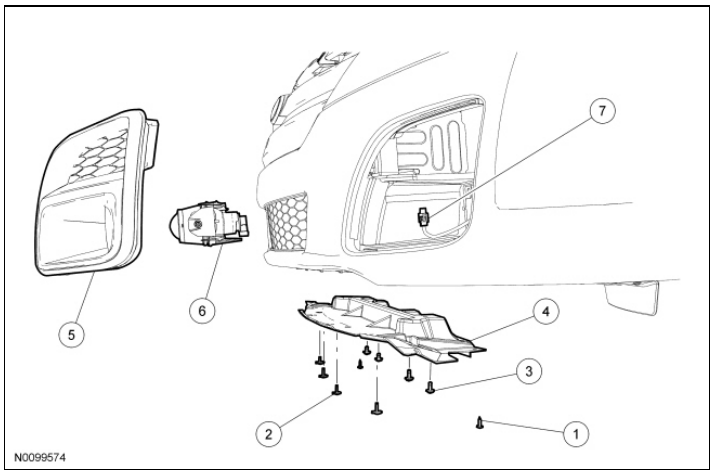
1. Remove the headlamp assembly. For additional information, refer to Headlamp Assembly in this section.

2. Remove the 4 screws and the ballast.
   - Disconnect the electrical connectors.

3. To install, reverse the removal procedure.

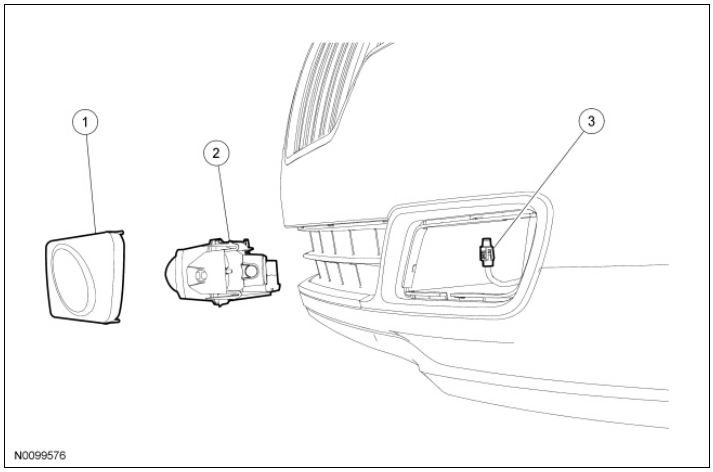
Fog Lamp

Fusion



Item	Part Number	Description
1	W706805	Lower radiator air deflector outer screws (2 required)
2	W709976	Lower radiator air deflector front screws (4 required)
3	N807389	Lower radiator air deflector pin-type retainers (4 required)
4	8327	Lower radiator air deflector
5	17E811/17E810	Fog lamp bezel (LH/RH)
6	15K200	Fog lamp
7	-	Fog lamp electrical connector (part of 14290)

MKZ



Item	Part Number	Description

1	17E811/17E810	Fog lamp bezel LH/RH
2	15K200	Fog lamp
3	-	Fog lamp electrical connector (part of 14290)

Removal and Installation

NOTE: Make sure the headlamp switch and the ignition switch are in the OFF position.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

Fusion

2. Remove the 2 outer screws and the 4 front screws from the lower radiator air deflector.

3. Remove the 4 pin-type retainers and the lower radiator air deflector.

All vehicles

4. **NOTE:** For MKZ, the fog lamp bezel tabs are located along the upper and lower edge close to each corner. They are released from the front using a thin flat-bladed tool (such as a pocket screwdriver). Usre not to damage the painted surface when releasing the tabs.

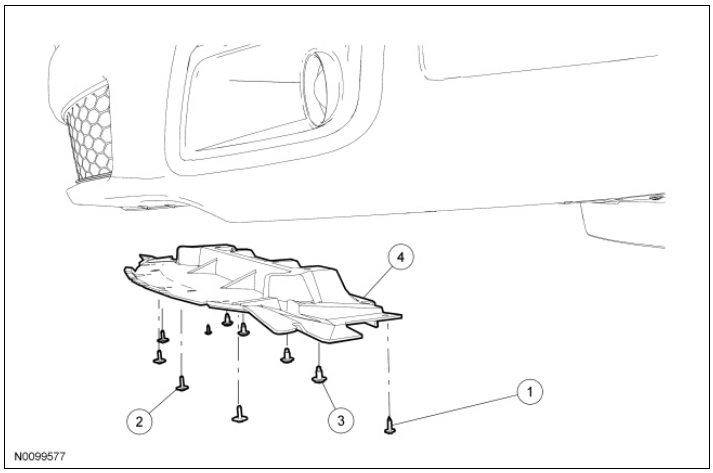
   Release the 4 tabs and remove the fog lamp bezel.

5. Release the locking tabs and remove the fog lamp.
   - Disconnect the electrical connector.

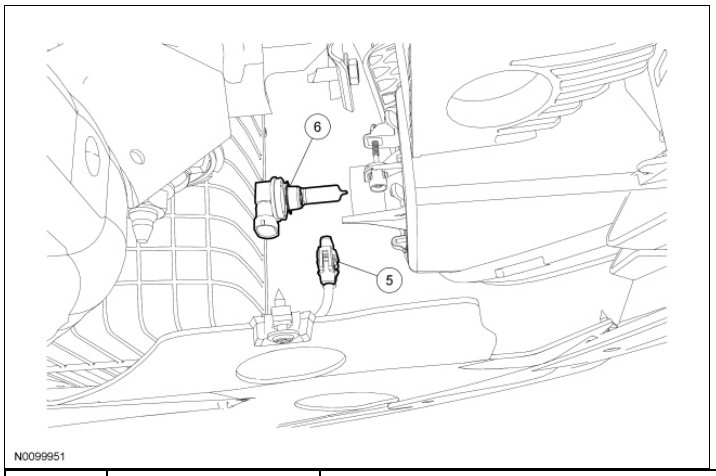
6. To install, reverse the removal procedure.

Fog Lamp Bulb

NOTE: Fusion shown, MKZ similar.



Item	Part Number	Description
1	W706805	Lower radiator air deflector outer screws (2 required)
2	W709976	Lower radiator air deflector front screws (4 required)
3	N807389	Lower radiator air deflector pin-type retainers (4 required)
4	8327	Lower radiator air deflector



Item	Part Number	Description
5	-	Fog lamp electrical connector (part of 14290)
6	13N021	Fog lamp bulb

Removal and Installation

⚠ WARNING: The bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope. Failure to follow these instructions may result in personal injury.

NOTE: The fog lamp bulb should not be removed from the fog lamp until just before a new bulb is installed. Removing the bulb for an extended period of time may affect fog lamp bulb performance. Contaminants may enter the fog lamp where they can settle on the lens and reflector. Never turn on the fog lamps with the bulb removed.

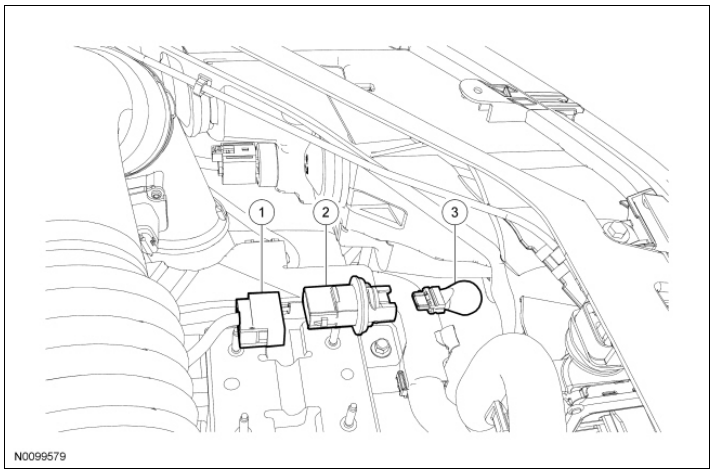
NOTE: Make sure the headlamp switch and the ignition switch are in the OFF position.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .
2. Remove the 2 outer screws and the 4 front screws from the lower radiator air deflector.
3. Remove the 4 pin-type retainers and the lower radiator air deflector.
4. Disconnect the electrical connector and remove the fog lamp bulb.

- To install, reverse the removal procedure.

Parking Lamp Bulb - LH, Fusion

NOTE: Hybrid shown, non-Hybrid similar.



Item	Part Number	Description
1	-	Front parking/turn lamp electrical connector (part of 14290)
2	13411	Front parking/turn lamp bulb socket
3	13466	Front parking/turn lamp bulb

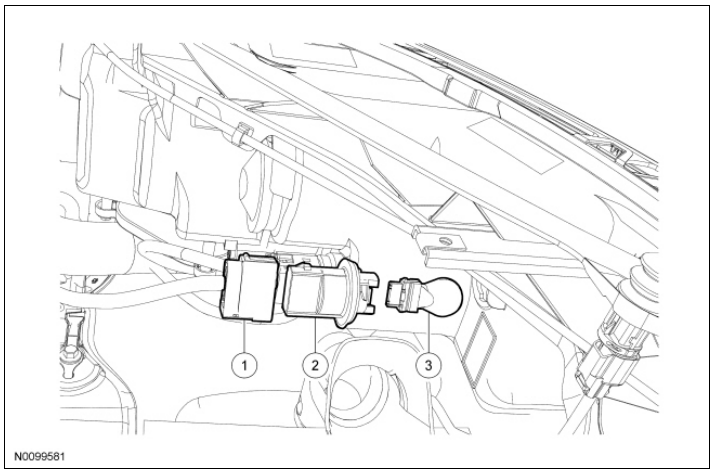
Removal and Installation

NOTE: The front parking/turn lamp on non-Hybrid vehicles equipped with a 2.5L or 3.0L engine can be accessed without removing any components.

1. For Hybrid vehicles, remove the battery tray. For additional information, refer to Section 414-01 .
2. For vehicles equipped with a 3.5L engine, remove the air cleaner. For additional information, refer to Section 303-12C .
3. Disconnect the parking/turn lamp electrical connector.
4. Remove the front parking/turn lamp socket from the headlamp assembly.
    - Remove the front parking/turn lamp bulb.
5. To install, reverse the removal procedure.

Parking Lamp Bulb - LH, MKZ

NOTE: The air cleaner is shown removed for clarity.



Item	Part Number	Description
1	-	Front parking/turn lamp electrical connector (part of 14290)
2	13411	Front parking/turn lamp bulb socket
3	13466	Front parking/turn lamp bulb

Removal and Installation

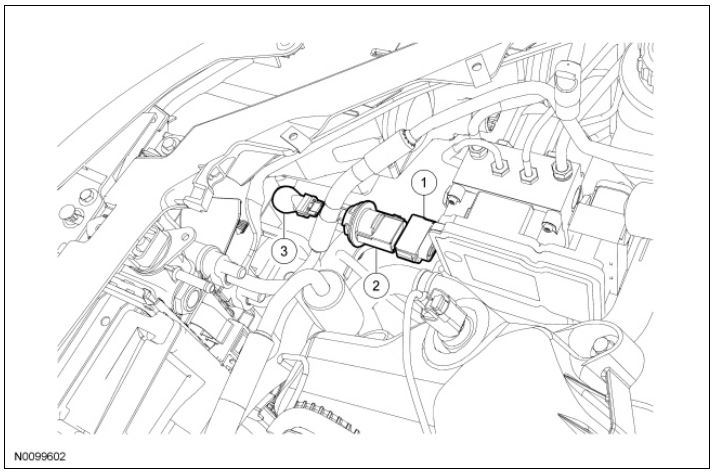
NOTE: The front parking/turn lamp can be accessed without removing any components.

1. Disconnect the electrical connector and remove the front parking lamp socket from the headlamp assembly.
    - Remove the front parking lamp bulb.

2. To install, reverse the removal procedure.

Parking Lamp Bulb - RH, Fusion

NOTE: Hybrid shown, non-Hybrid similar.



Item	Part Number	Description
1	-	Front parking/turn lamp electrical connector (part of 14290)
2	13411	Front parking/turn lamp bulb socket
3	13466	Front parking/turn lamp bulb

Removal and Installation

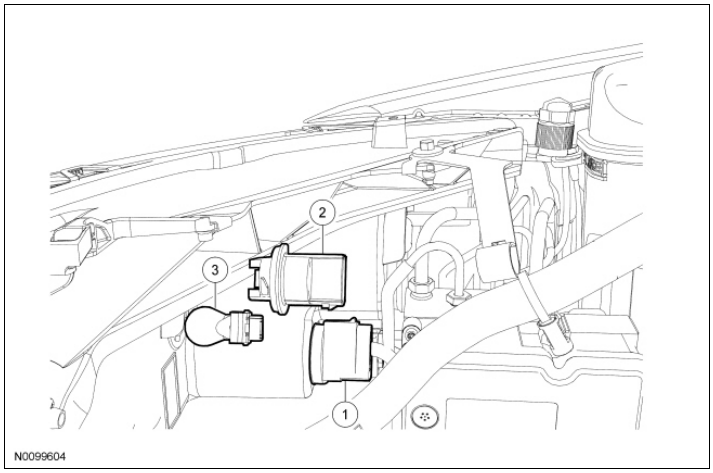
NOTE: The front parking/turn lamp on non-Hybrid vehicles can be accessed without removing any components.

1. Remove the headlamp assembly. For additional information, refer to Headlamp Assembly in this section.

2. Remove the front parking/turn lamp socket from the headlamp assembly.
   - Remove the front parking/turn lamp bulb.

3. To install, reverse the removal procedure.

Parking Lamp Bulb - RH, MKZ

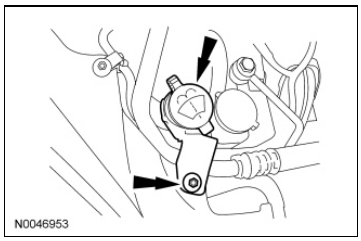


Item	Part Number	Description
1	-	Front parking/turn lamp electrical connector (part of 14290)
2	13411	Front parking/turn lamp bulb socket
3	13466	Front parking/turn lamp bulb

Removal and Installation

NOTE: The engine appearance cover can be removed for additional clearance.

1. Remove the bolt and the position aside the windshield washer reservoir filler tube.

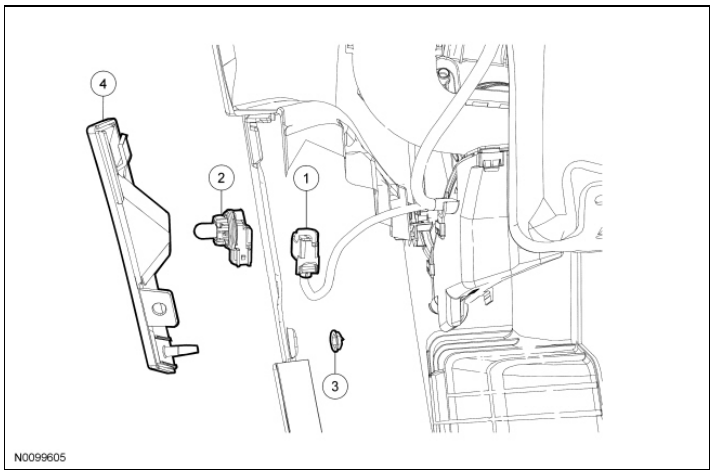


2. Disconnect the electrical connector and remove the front parking lamp socket from the headlamp assembly.
    - Remove the front parking lamp bulb.

3. To install, reverse the removal procedure.

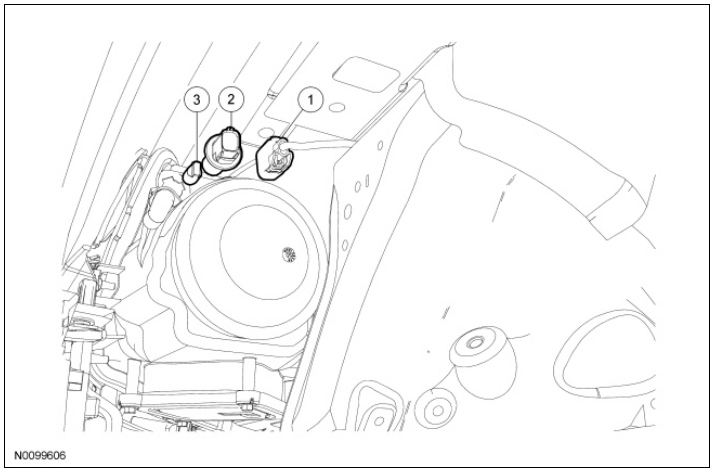
Side Marker Lamp - Front

Fusion



Item	Part Number	Description
1	-	Side marker lamp electrical connector (part of 14290)
2	-	Side marker lamp bulb socket (part of 13200)
3	W707501	Side marker lamp nut
4	13200	Side marker lamp

MKZ



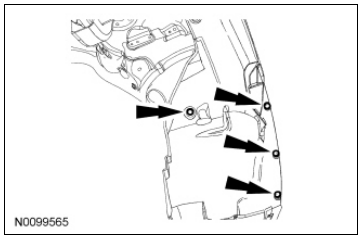
Item	Part Number	Description
1	-	Side marker lamp electrical connector (part of 14290)
2	13411	Side marker lamp bulb socket
3	13466	Side marker lamp bulb

Removal and Installation

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 4 pin-type retainers and position the fender splash shield aside.



3. Disconnect the side marker lamp electrical connector.

Fusion

4. Remove the nut and remove the side marker lamp.

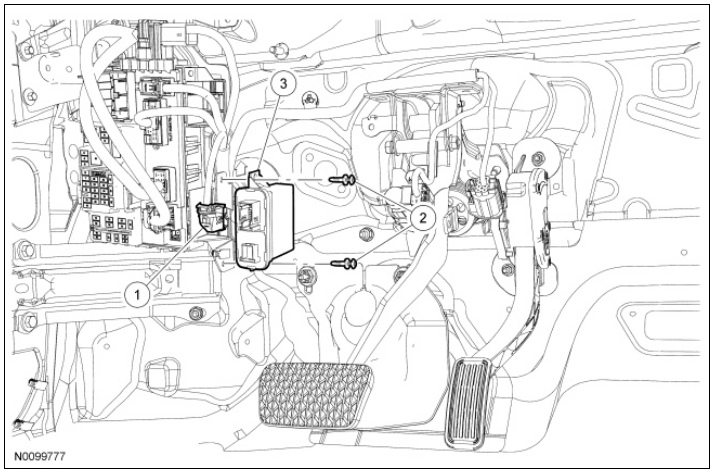
MKZ

5. Remove the side marker lamp from the headlamp assembly.

All vehicles

6. To install, reverse the removal procedure.

Headlamp Control Module (HCM)



Item	Part Number	Description
1	-	Headlamp Control Module (HCM) electrical connector (part of 14290)
2	W713134	HCM pin-type retainers (2 required)
3	13K198	HCM

Removal and Installation

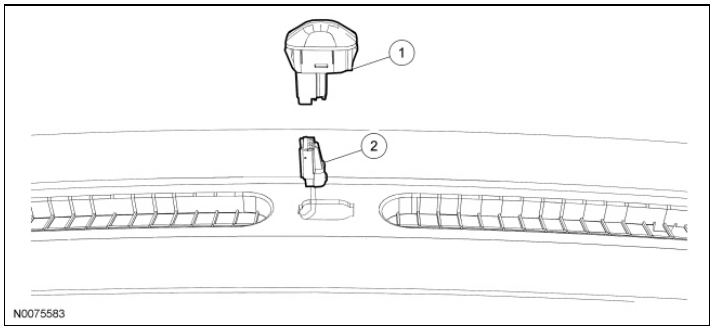
1. If installing a new Headlamp Control Module (HCM), upload the module configuration information to the scan tool. For additional information, refer to Section 418-01 .

2. Disconnect the HCM electrical connector.

3. Remove the 2 pin-type retainers and the HCM .

4. To install, reverse the removal procedure.
   - If installing a new HCM , download the HCM configuration information from the sn tool into the new HCM . For additional information, refer to Programmable Module Installation (PMI) Section 418-01 .

Light Sensor



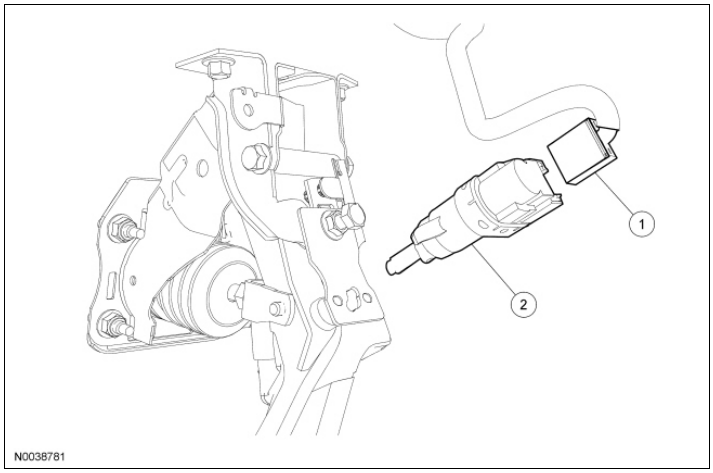
Item	Part Number	Description
1	13A018	Light sensor
2	-	Light sensor electrical connector (part of 14401)

Removal and Installation

1. Using a suitable tool, remove the light sensor from the defroster grille.
    - Disconnect the electrical connector.

2. To install, reverse the removal procedure.

Stoplamp Switch



Item	Part Number	Description
1	-	Stoplamp switch electrical connector (part of 14290)
2	13480	Stoplamp switch

Removal and Installation

NOTICE: **Do not press, pull or otherwise move the brake pedal while removing or installing the stoplamp switch. The switch must be installed with the booster push rod attached to the brake pedal and with the brake pedal in the at-rest position. Installing the switch with the brake pedal in any other position results in incorrect adjustment and damage to the switch.**

1. ***NOTICE:*** **The switch plunger must be compressed for the switch to rotate in the bracket. Attempting to remove the switch with the plunger extended (during brake pedal apply) results in damage to the switch.**

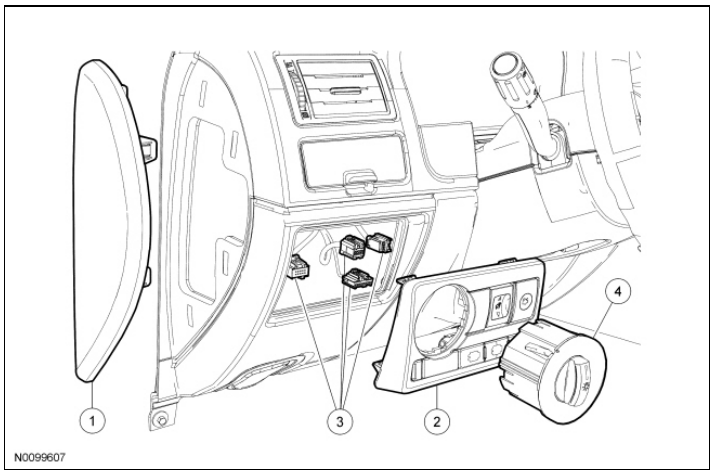
   Rotate the stoplamp switch clockwise approximately one-eighth turn and remove the stoplamp switch.

   - Disconnect the electrical connector.

2. To install, reverse the removal procedure.

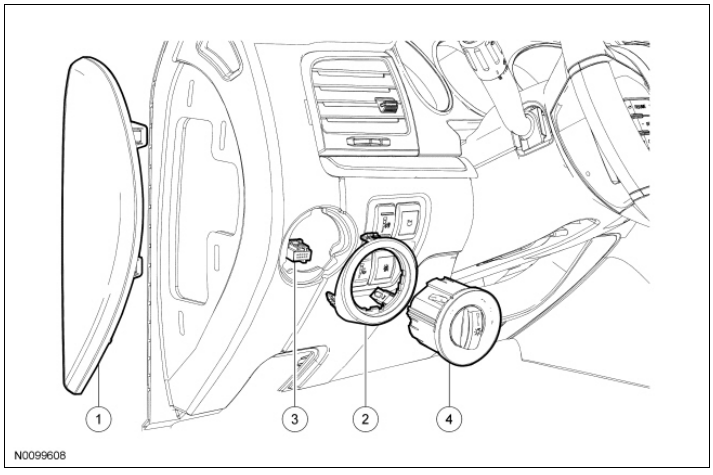
Headlamp Switch

Fusion



Item	Part Number	Description
1	5404481	Instrument panel side finish panel
2	5404338	Headlamp switch bezel
3	-	Headlamp switch electrical connectors (part of 14401)
4	11654	Headlamp switch

MKZ



Item	Part Number	Description
1	5404481	Instrument panel side finish panel
2	-	Headlamp switch bezel
3	-	Headlamp switch electrical connector (part of 14401)
4	11654	Headlamp switch

Removal and Installation

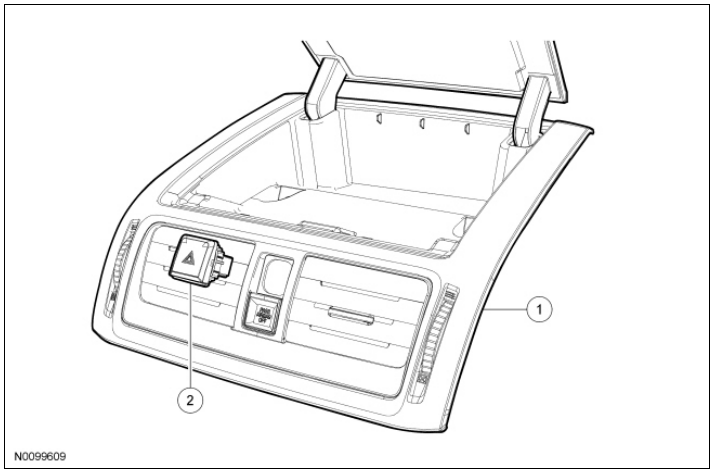
1. Remove the instrument panel side finish panel.
2. **NOTE:** The headlamp switch bezel is removed by pushing from behind.

   Release the tabs and remove the headlamp switch and bezel assembly.

   - Disconnect the electrical connector.
3. **NOTE:** The 3 retaining tabs on the headlamp switch are located at approximately the 3, 6 and 11 o'clock positions when viewed from the front.

   Release the tabs and separate the headlamp switch from the bezel.
4. To install, reverse the removal procedure.

Hazard Flasher Lamp Switch

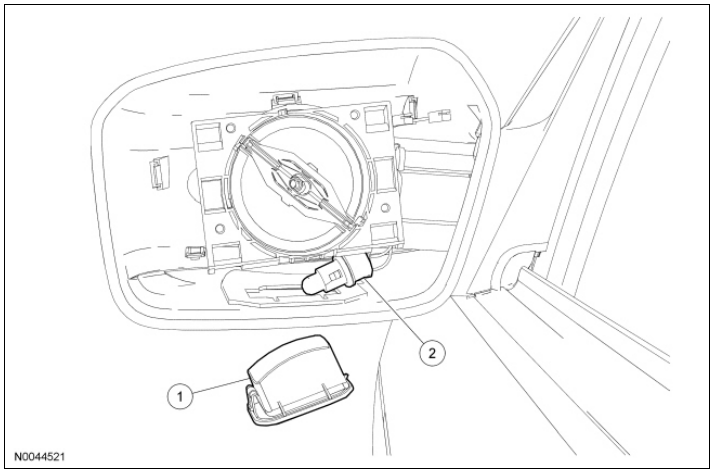


Item	Part Number	Description
1	5413594	Instrument panel upper storage compartment
2	13A350	Hazard flasher lamp switch

Removal and Installation

1. Remove the instrument panel upper storage compartment. For additional information, refer to Section 501-12 .
2. Release the tabs and remove the hazard flasher lamp switch.
3. To install, reverse the removal procedure.

Puddle Lamp

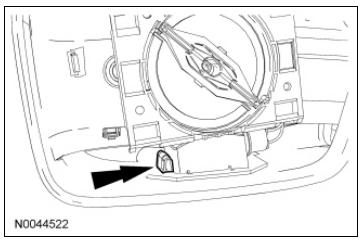


Item	Part Number	Description
1	13B375	Puddle lamp
2	-	Puddle lamp bulb socket (part of 17683)

Removal and Installation

1. Remove the exterior mirror glass. For additional information, refer to Section 501-09 .

2. Release the tab to remove the puddle lamp from the mirror housing.



3. **NOTE:** The LH puddle lamp bulb socket is rotated clockwise to remove and the RH puddle lamp bulb socket is rotated counterclockwise to remove.

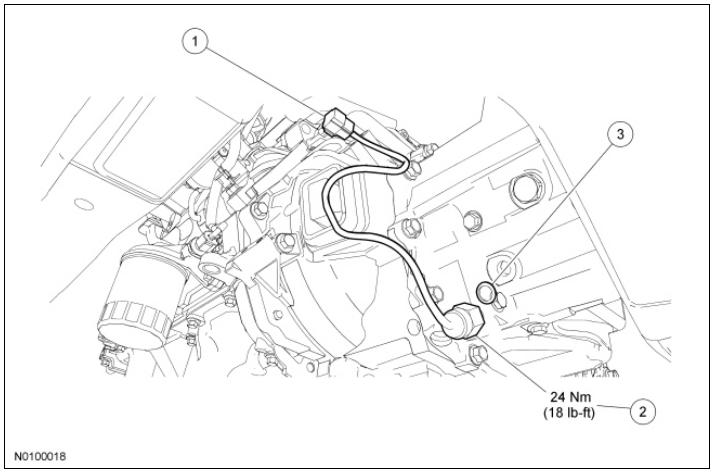
   Rotate the puddle lamp bulb socket approximately one-quarter turn and remove it from the puddle lamp.

4. **NOTE:** When rotating the bulb socket in the puddle lamp, the socket should come to a stop indicating it is completely installed.

   NOTE: An audible click can be heard when the puddle lamp is fully seated.

   To install, reverse the removal procedure.

Reversing Lamp Switch



Item	Part Number	Description
1	-	Reversing lamp switch electrical connector (part of 7B229)
2	7B229	Reversing lamp switch
3	S995621	Reversing lamp switch gasket

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the fasteners and the lower engine splash shield.

3. **NOTE:** Discard the reversing lamp switch gasket.

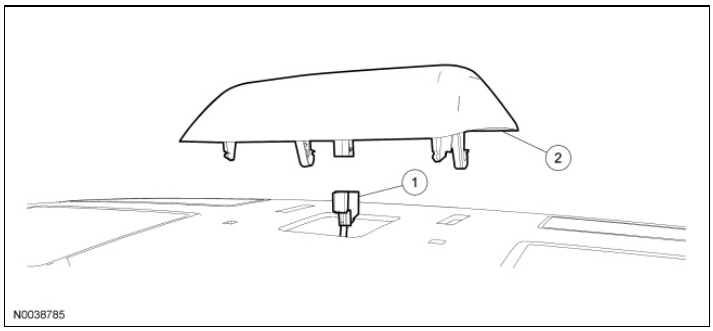
   Disconnect the electrical connector and remove the reversing lamp switch.

   - To install, tighten to 24 Nm (18 lb-ft).

4. To install, reverse the removal procedure.
   - Install a new reversing lamp switch gasket.
   - Check the transmission fluid and fill as necessary. For additional information, refer to Section 308-03 .

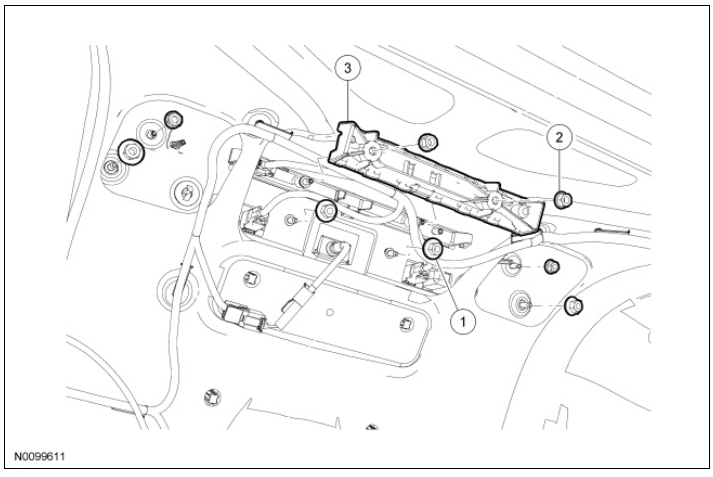
High Mounted Stoplamp

Parcel Shelf Mounted



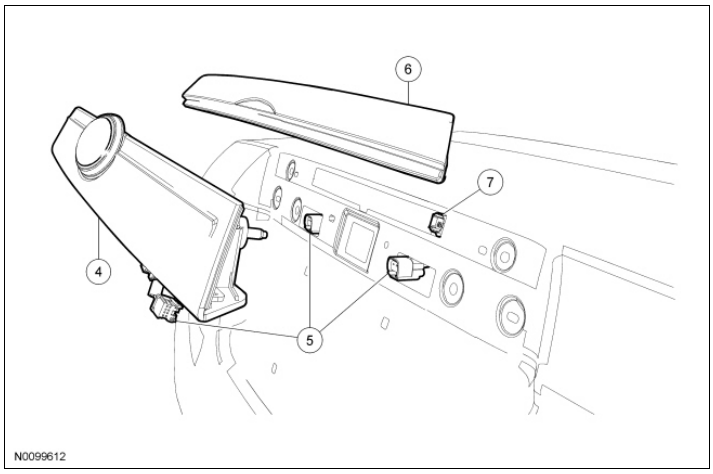
Item	Part Number	Description
1	-	High mounted stoplamp electrical connector (part of 14A005)
2	13A613	High mounted stoplamp

Luggage Compartment Lid Mounted



Item	Part Number	Description
1	W709764	Luggage compartment lid moulding nuts (4 required)
2	W704141	High mounted stoplamp nuts (4 required)
3	13A417	High mounted stoplamp bracket

Luggage Compartment Lid Mounted (Continued)



Item	Part Number	Description
4	5442512	Luggage compartment lid moulding
5	-	Electrical connectors (part of 13A412)
6	13A613	High mounted stoplamp
7	-	High mounted stoplamp electrical connector

Removal and Installation /p>

Parcel shelf mounted

1. Disconnect the high mounted stoplamp electrical connector from within the luggage compartment.

2. Push the high mounted stoplamp rearward to disengage the forward tabs and remove the high mounted stoplamp.

Luggage compartment lid mounted

3. Remove the luggage compartment lid trim panel.

4. Remove the 4 nuts and the luggage compartment lid moulding.
   - Disconnect the electrical connectors.

5. Remove the 4 nuts and the high mounted stoplamp bracket.

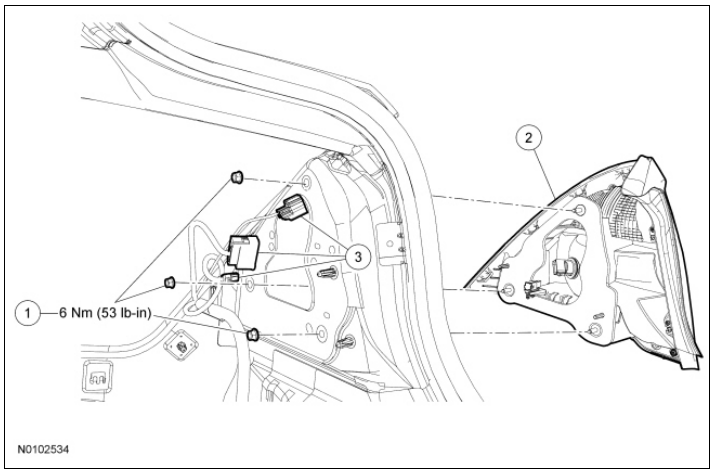
6. Release the 2 tabs and remove the high mounted stoplamp.
   - Disconnect the electrical connector.

All vehicles

7. To install, reverse the removal procedure.

Rear Lamp Assembly

NOTE: Fusion shown, MKZ similar.



Item	Part Number	Description
1	W704141	Rear lamp assembly nuts (3 required)
2	13A505/13A504	Rear lamp assembly (LH/RH)
3	-	Rear lamp assembly electrical connectors (part of 14A005)

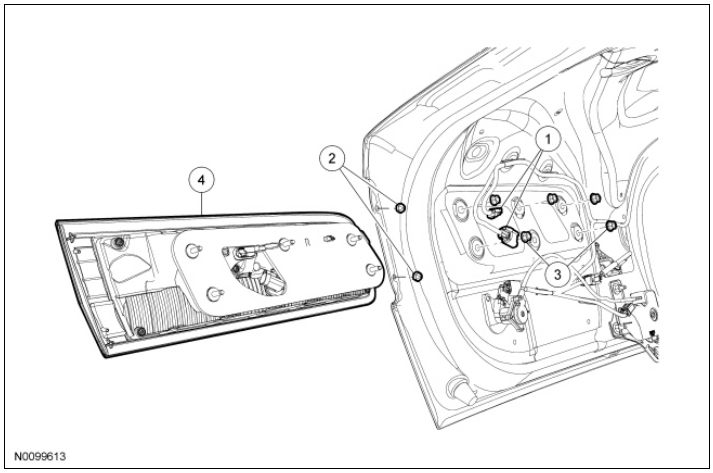
Removal and Installation

1. Remove the pin-type retainer and position the luggage compartment trim panel aside.

2. Remove the 3 nuts and the rear lamp assembly.
   - Disconnect the electrical connectors.
   - To install, tighten the nuts to 6 Nm (53 lb-in).

3. To install, reverse the removal procedure.

Reversing Lamp



Item	Part Number	Description
1	-	Electrical connectors (part of 14A005)
2	-	Reversing lamp outboard nuts (2 required)
3	W704141	Reversing lamp inboard nuts (5 required)
4	13405\13404	Reversing lamp (LH/RH)

Removal and Installation

1. Remove the pin-type retainers and the luggage compartment trim panel.
2. Disconnect the electrical connector(s).
3. Remove the 7 nuts and the reversing lamp.
4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Interior Lighting Control Module (ILCM) bolts	1.6	14

Interior Lighting

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The SJB controls all of the interior lighting functions. The interior lighting system consists of the following components:

- SJB
- Instrument panel dimmer switch
- Interior/map lamps
- Luggage compartment lamp
- Vanity mirror lamps
- Puddle lamps (if equipped)
- Scuff plate lamps (if equipped)
- Door ajar switches
- Luggage compartment lid ajar switch
- Ambient lighting module (Fusion) (if equipped)
- Ambient lighting switch (part of the traction control switch for Fusion) (if equipped)
- Ambient lighting select switch (MKZ (if equipped))
- Ambient lighting dimmer switch (MKZ (if equipped))
- Interior Lighting Control Module (ILCM) (MKZ)

The interior lighting system consists of up to 3 subsystems:

- Courtesy lamps
- Demand lamps
- Ambient lighting (if equipped)

Courtesy Lamps

The courtesy lamp subsystem consists of the interior dome lamps, the instrument panel dimmer switch, the overhead console lamps, scuff plate lamps (if equipped) and the puddle lamps (if equipped). The SJB supplies voltage to the courtesy lamps when the SJB receives the required input.

Demand Lamps

The demand lamps subsystem consists of the front map lamps, and the left and right vanity mirror lamps. The demand lamps are provided voltage from the battery saver relay (integrated into the SJB) when the battery saver relay is energized.

Ambient Lighting - Fusion

The ambient lighting subsystem consists of the ambient lighting module, ambient lighting select switch, and LEDs located throughout the vehicle. The LEDs are located on the center console cupholders, the storage bin, and the front and rear footwells. The ambient lighting system is powered through the accessory delay relay. The ambient lighting only illuminates when the key is in the on position.

Ambient Lighting - MKZ

The ambient lighting feature provides illumination to the center console cup holders, the storage bin, door map pockets and the front and rear footwells.

There are 4 different color LEDs (red, blue, green and white) housed within each LED assembly. By illuminating various color combinations, the LEDs are able to produce 7 different colors of ambient light. With each press of the ambient lighting select switch, the ILCM cycles through a different color variation. With each press of the ambient lighting dimmer switch, the ILCM changes the brightness setting of the ambient lighting or turns the ambient lighting feature off. The module retains the last color and brightness setting between uses.

Interior Lighting Delay

The interior lighting delay feature provides temporary illumination of the courtesy lamps after the doors are opened and then closed. The interior lighting delay feature keeps the courtesy lamps on for a period of 25 seconds after all the doors are closed. If during the 25-second delay time, the SJB detects that the ignition has been turned out of off if the vehicle is locked using the Remote Keyless Entry (RKE) or the keypad, the courtesy lamps are turned off.

Illuminated Entry

The illuminated entry requests the courtesy lamps to illuminate when the ignition is OFF and either the RKE transmitter UNLOCK button is pressed, or the vehicle is unlocked using the keypad. The illuminated entry requests the courtesy lamps off:

- after 25 seconds have elapsed.
- when the ignition is switched to the OFF position.
- when the RKE transmitter LOCK button is pressed.
- when the vehicle is locked using the keypad

Illuminated Exit

NOTE: The puddle lamps are not illuminated for the illuminated exit feature.

The illuminated exit requests the courtesy lamps to illuminate for 25 second when all doors are closed and the ignition key is removed from the ignition lock cylinder. The illuminated exit deactivates:

- when the ignition key is inserted into the ignition lock cylinder.
- when a door becomes ajar.
- after 25 seconds have elapsed.

Theater Lighting

The theater lighting feature ramps-up the courtesy lamps intensity over 0.7 second when courtesy lamp activation is requested. The theater lighting feature ramps-down the courtesy lamps intensity over 1.7 seconds when interior lighting deactivation is requested by any feature other than the panic alarm or battery saver.

Battery Saver

NOTE: Time-out is 1 minute if the vehicle has less than 80 km (50 miles).

The SJB provides automatic shut-off of the demand lamps and courtesy lamps after a 10-minute time-out period in order to save battery voltage. A timer in the SJB is started when the ignition is turned to the OFF position and all the doors and liftgate are closed. When 10 minutes have elapsed, voltage is automatically shut off to the lamps by the SJB .

Interior Lighting

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit 300-NUD105-R025DE or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

When a vehicle door is ajar with the vehicle speed less than 15 km/h (9 mph) or 5 km/h (3 mph) for puddle lamps, or a request from the instrument panel dimmer switch is received, the SJB provides voltage to the interior courtesy and puddle lamp circuits. The SJB controls all interior lighting functions and timing by monitoring inputs from the door ajar switches, the instrument panel dimmer switch, the Remote Keyless Entry (RKE) transmitter and vehicle speed.

Interior Lamp Arbitrator

The SJB chooses between the interior lighting, dome defeat, interior lighting delay, illuminated entry, illuminated exit and battery saver to determine which feature has precedence of activating and deactivating the interior lamps.

Ambient Lighting - Fusion

The ambient lighting feature provides illumination to the center console cup holders, the storage bin, and the front and rear footwells The ambient lighting feature is powered by the accessory delay relay, which allows the ambient lighting feature to be used independent of the parking lamps status.

The ambient lighting module provides voltage and ground to the LEDs. There are 3 different color (red, blue and green) LEDs housed within each LED assembly. By illuminating various color combinations, the LEDs are able to produce 7 different colors of ambient light. The ambient lighting switch is an input to the ambient lighting module. With each press of the ambient lighting switch, the ambient lighting module cycles through a different color variation or turns the ambient lighting feature off. The module retains the last color setting between uses.

Ambient Lighting - MKZ

The Interior Lighting Control Module (ILCM) provides voltage to the LEDs. There are 4 different color LEDs (red, blue, green and white) housed within each LED assembly. By illuminating various color combinations, the LEDs are able to produce 7 different colors of ambient light. The ambient lighting select switch and ambient lighting dimmer switch are inputs to the ILCM . With each press of the ambient lighting select switch, the ILCM cycles through a different color variation. With each press of the ambient lighting dimmer switch, the ILCM changes the brightness setting of the ambient lighting or turns the ambient lightieature off. The module retains the last color and brightness setting between uses.

Battery Saver

NOTE: Time-out is 1 minute if the vehicle has less than 80 km (50 miles).

The SJB provides automatic shut-off of the demand lamps and courtesy lamps after a 10-minute time-out period in order to save battery voltage. A timer in the SJB is started when the ignition is turned to the OFF position and all the doors are closed. When the 10-minute time-out period has elapsed, the voltage is automatically shut off to the lamps by the SJB .

To activate the battery saver feature, one of the following events must occur:

- The ignition is turned to any position other than OFF.
- Any door becomes ajar.
- The UNLOCK button of the RKE transmitter is pressed.
- A key is inserted into the ignition lock cylinder.
- A valid keypad code is entered.
- The luggage compartment lid is opened.
- The instrument panel dimmer switch is placed in the DOME LAMP position.
- The headlamp switch is placed in the PARKING LAMPS or HEADLAMPS ON position.
- The multifunction switch is placed in the FLASH-TO-PASS position.
- The key is inserted into the ignition lock cylinder.

Field-Effect Transistor (FET) Protection

Field-Effect Transistor (FET) is a type of transistor that when used with module software can be used to monitor and control current flow on module outputs. The FET protection strategy is used to prevent module damage in the event of excessive current flow.

The SJB utilizes a FET protective circuit strategy for many of its outputs (for example, a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down (turns off the voltage or ground provided by the module) when a fault event is detected. A continuous DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET circuit protection to allow the circuit to function. The next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection) and the circuit remains shorted, the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When each tolerance level is reached, the continuous DTC that was stored on the first failure cannot be cleared by a command to clear the continuous DTCs. The module does not allow this code to be cleared or the

circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC B106E and the associated continuous DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns.

When the first or second level is reached, the continuous DTC (associated with the short circuit) sets along with DTC B106E. These DTCs can be cleared using the module on-demand self-test, then the Clear DTC operation on the scan tool (if the on-demand test shows the fault corrected). The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs B106F and B1342 set along with the associated continuous DTC. This DTC cannot be cleared and the module must be replaced.

The SJB FET protected output circuits for the interior lighting system are the interior courtesy lamp and puddle lamp output circuits.

The Interior Lighting Control Module (ILCM) operates in a similar manner. The ILCM FET protected output circuits for the ambient lighting system are the ambient lighting output circuits.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Smart Junction Box (SJB) fuse(s): ♦ 9 (15A) ♦ 10 (15A) ♦ 25 (10A) • Wiring, terminals or connectors • Bulb(s) • Courtesy lamps • Map lamps • Puddle lamp(s) • Scuff plate lamp(s) (if equipped) • Luggage compartment lamp • Vanity lamps • Instrument panel dimmer switch • Glove compartment lamp • Ambient lighting switch (if equipped)

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication with the SJB , refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

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

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

DTC Charts

Smart Junction Box (SJB) DTC Chart

DTC	Description	Action
B106E	Solid State Driver Disabled Due to Short Circuit	**The module has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The Smart Junction Box (SJB) cannot enable the output until the cause of the short is corrected. ADDRESS all other DTCs first.** After the cause of the concern is corrected, CLEAR the DTCs. REPEAT the self-test.
B106F	Module Disabled Due to External Fault	**The module has permanently disabled an output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the SJB can withstand. The cause of the excessive current draw MUST be corrected before a new SJB is installed. ADDRESS all other DTCs first.** After the cause of the concern is corrected, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
B1320	Driver Door Ajar Circuit Open	GO to Pinpoint Test F .
B1328		GO to Pinpoint Test F .

	Passenger Door Ajar Circuit Open	
B1331	Decklid Ajar Rear Door Circuit Failure	GO to Pinpoint Test E .
B1336	Door Ajar RR Circuit Open	GO to Pinpoint Test F .
B1572	Door Ajar LR Circuit Open	GO to Pinpoint Test F .
B213A	Digital Dimmer Switch Input Circuit Failure	REFER to Section 413-00 .
B2A35	Interior Lighting Output Circuit Open	If the interior courtesy lamps are inoperative, GO to Pinpoint Test C . If the interior courtesy lamps stay on continuously, GO to Pinpoint Test F .
B2A36	Interior Lighting Output Circuit Short to Ground	GO to Pinpoint Test C .
B2A38	Floor Lamp Circuit Short to Ground	DIAGNOSE all other DTCs and symptoms first. If no other DTCs or symptoms are present, INSPECT the SJB and C2280a for bent pins, loose or corroded connections. If no concerns are found, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.
B2A39	Puddle Lamp Output Circuit Open	If the puddle lamps are inoperative, GO to Pinpoint Test D . If the puddle lamps are always on, GO to Pinpoint Test G .
B2A3A	Puddle Lamp Output Circuit Short to Ground	GO to Pinpoint Test D .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Interiorighting Control Module (ILCM) DTC Chart

DTC	Description	Action
B106E	Solid State Driver Disabled Due to Short Circuit	**The module has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The Interior Lighting Control Module (ILCM) cannot enable the output until the cause of the short is corrected. ADDRESS all other DTCs first.** After the cause of the concern is corrected, CLEAR the DTCs. REPEAT the self-test.
B106F	Module Disabled Due to External Fault	**The module has permanently disabled an output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the SJB can withstand. The cause of the excessive current draw MUST be corrected before a new ILCM is installed. ADDRESS all other DTCs first.** After the cause of the concern is corrected, INSTALL a new ILCM . REFER to Interior Lighting Control Module (ILCM) in this section.

		TEST the system for normal operation.
B1342	ECU Is Faulted	INSTALL a new ILCM . REFER to Interior Lighting Control Module (ILCM) in this section. TEST the system for normal operation.
B2477	Module Configuration Failure	REFER to Section 418-01 .
B2A21	One Or More Configuration Files Missing Or Corrupt	REFER to Section 418-01 .
B2B00	Ambient Light Zone 1 Red Circuit Open	GO to Pinpoint Test N .
B2B01	Ambient Light Zone 1 Red Circuit Short to Ground	GO to Pinpoint Test N .
B2B02	Ambient Light Zone 1 Green Circuit Open	GO to Pinpoint Test N .
B2B03	Ambient Light Zone 1 Green Circuit Short to Ground	GO to Pinpoint Test N .
B2B04	Ambient Light Zone 1 Blue Circuit Open	GO to Pinpoint Test N .
B2B05	Ambient Light Zone 1 Blue Circuit Short to Ground	GO to Pinpoint Test N .
B2B06	Ambient Light Zone 1 Signature Circuit Open	GO to Pinpoint Test N .
B2B07	Ambient Light Zone 1 Signature Circuit Short to Ground	GO to Pinpoint Test N .
B2B18	Ambient Light Switch Input Fault	If the ambient lighting is inoperative or does not cycle through the color combinations, GO to Pinpoint Test M . If the ambient lighting does not cycle through the brightness settings, GO to Pinpoint Test O .
U0140	Lost Communication With Body Control Module (GEM)	GO to Pinpoint Test P .
U2050	No Application Present	CARRY OUT Programmable Module Installation (PMI). REFER to Section 418-01 .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The Courtesy Lamps Do Not Illuminate With A Door Open

Refer to Wiring Diagrams Cell 110 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Door Locks for schematic and connector information.

Refer to Wiring Diagrams Cell 113 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Luggage Compartment Lid Release for schematic and connector information.

Normal Operation

When any door is open, the ajar switch opens the circuit to the Smart Junction Box (SJB). The SJB monitors the ajar circuits, and based on the ajar status, the SJB supplies voltage to the courtesy lamps.

When any door is opened, a correct unlock code from the keyless entry keypad or an unlock request from a programmed Remote Keyless Entry (RKE) transmitter is detected, the SJB provides voltage to the courtesy lamps.

This pinpoint test is intended to diagnose the following:

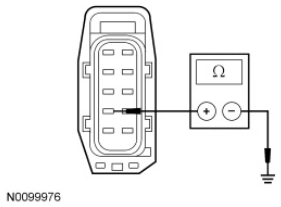
- Wiring, terminals or connectors
- Door ajar switch
- SJB

PINPOINT TEST A: THE COURTESY LAMPS DO NOT ILLUMINATE WITH A DOOR OPEN

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CHECK THE COURTESY LAMP OPERATION USING THE INSTRUMENT PANEL DIMMER SWITCH	
• Operate the courtesy lamps using the instrument panel dimmer switch. • **Do the interior courtesy lamps illuminate using the instrument panel dimmer switch?**	**Yes** GO to A2 . **No** GO to Pinpoint Test C .
A2 CHECK THE DOOR AJAR SWITCH OPERATION	
• Ignition OFF. • Disconnect: Suspect Door Ajar Switch. • **Do the interior lamps illuminate?**	**Yes** INSTALL a new door latch in question. REFER to Section 501-14 . TEST the system for normal operation. **No** GO to A3 .
A3 CHECK THE AJAR SWITCH CIRCUIT FOR A SHORT TO GROUND	

<table>
<tr><td>
• Disconnect: SJB C2280c.
• Measure the resistance between the suspect ajar switch, harness side and ground as follows:

<table>
<tr><th>Location</th><th>Connector-Pin</th><th>Circuit</th></tr>
<tr><td>LH front door</td><td>C525-8</td><td>CPL26 (GN/VT)</td></tr>
<tr><td>RH front door</td><td>C603-8</td><td>CPL31 (WH)</td></tr>
<tr><td>LH rear door</td><td>C704-8</td><td>CPL36 (GN)</td></tr>
<tr><td>RH rear door</td><td>C804-8</td><td>CPL39 (YE)</td></tr>
</table>

N0099976
• Is the resistance greater than 10,000 ohms?
</td><td>
Yes
GO to A4 .

No
REPAIR the circuit in question for a short to ground. TEST the system for normal operation.
</td></tr>
<tr><td>A4 CHECK FOR CORRECT SJB OPERATION</td><td></td></tr>
<tr><td>
• Disconnect all the SJB connectors.
• Check for:
♦ corrosion
♦ damaged pins
♦ pushed-out pins
• Connect all the SJB connectors and make sure they seat correctly.
• Operate the system and verify the concern is still present.
• Is the concern still present?
</td><td>
Yes
INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
</td></tr>
</table>

Pinpoint Test B: The Courtesy Lamps Do Not Illuminate From The Instrument Panel Dimmer Switch

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

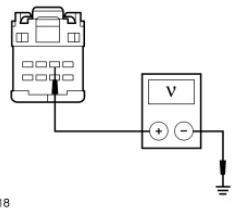
The Smart Junction Box (SJB) turns the courtesy lamps on and off by monitoring the dimmer switch input and the dome lamp request input circuits. When the instrument panel dimmer switch is pushed to the second detent up, the backlighting dim up circuit and the dome request circuit are both requested to indicate a request to turn the courtesy lamps on. When the instrument panel dimmer switch is pushed to the second detent down, the backlighting dim down circuit and the dome request circuit are both requested to indicate a request to turn the courtesy lamps off.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Instrument panel dimmer switch
- SJB

PINPOINT TEST B: THE COURTESY LAMPS DO NOT ILLUMINATE FROM THE INSTRUMENT PANEL DIMMER SWITCH

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK THE DIMMABLE BACKLIGHTING ILLUMINATION	
• Ignition OFF. • Turn the headlamps switch to the PARKING LAMPS ON position. • Monitor the instrument panel dimmable backlighting while pushing the instrument panel dimmer switch from full on to full off. • **Does the instrument cluster illumination intensity change with the instrument panel dimmer switch position?**	**Yes** GO to B2 . **No** REFER to Section 413-00 to continue diagnosis of the dimmable backlighting illumination.
B2 CHECK THE INSTRUMENT PANEL DIMMER SWITCH	
• Turn the headlamps switch to the OFF position. • Disconnect: Instrument Panel Dimmer Switch C2065. • Measure the voltage between the instrument panel dimmer switch C2065-2, circuit CLN28 (GN/BU), harness side and ground.  N0104218 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new instrument panel dimmer switch. REFER to Section 413-00 . TEST the system for normal operation. **No** GO to B3 .
B3 CHECK THE DOME LAMP REQUEST INPUT CIRCUIT FOR AN OPEN	
• Disconnect: SJB C2280b. • Measure the resistance between the SJB C2280b-51, circuit CLN28 (GN/BU), harness side and the instrument panel dimmer switch C2065-2, circuit CLN28 (GN/BU), harness side. • **Is the resistance less than 5 ohms?**	**Yes** GO to B4 . **No** REPAIR the circuit. TEST the system for normal operation.
B4 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors.	**Yes** INSTALL a new SJB . REFER

• Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: The Interior Courtesy Lamp(s) Are Inoperative

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

Power is supplied to the interior courtesy lamps and cargo lamp by the Smart Junction Box (SJB) fuse 9 (15A). Based on the input status, the SJB supplies voltage to the interior courtesy lamps.

DTC Description	Fault Trigger Conditions
• B106E - Solid State Driver Disabled Due to Short Circuit	A continuous DTC that sets when the SJB has temporarily shut down the output driver. **The module has temporarily disabled the interior courtesy lamp output because an excessive current draw exists (such as a short to ground). The SJB cannot enable the interior courtesy lamp output until the cause of the short is corrected, the DTCs have been cleared and a successful self-test is run.**
• B106F - Module Disabled Due to External Fault	A continuous DTC that sets when the SJB has permanently shut down the output driver. **The module has permanently disabled the interior courtesy lamp output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the SJB can withstand. The cause of the excessive current draw MUST be corrected before a new SJB is installed.**
• B2A35 - Interior Lighting Output Circuit Open	An on-demand DTC that sets when the SJB detects an open from the courtesy lighting output circuit.
• B2A36 - Interior Lighting Output Circuit Short To Ground	A continuous and on-demand DTC that sets when the SJB detects a short to ground from the courtesy lighting output circuit.

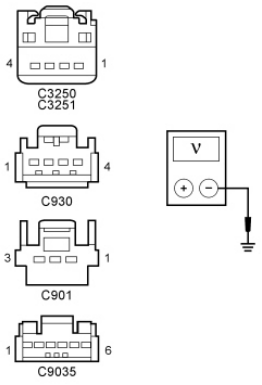
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Interior lamp
- SJB

PINPOINT TEST C: THE INTERIOR COURTESY LAMP(S) ARE INOPERATIVE

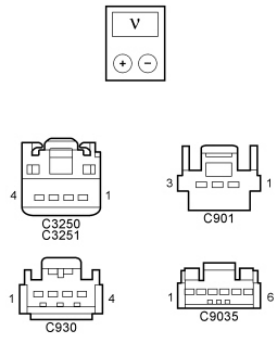
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 CHECK THE OPERATION OF ALL THE INTERIOR COURTESY LAMPS	
• Ignition OFF. • Push up the instrument panel dimmer switch to the second up detent and observe the interior courtesy lamps. • **Are the interior courtesy lamps inoperative?**	**Yes** VERIFY the SJB fuse 9 (15A) is OK. If OK, GO to C4 . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the interior courtesy lamp output driver if DTC B106E is present)** . TEST the system for normal operation. If DTC B106F is present, INSTALL a new SJB .

	REFER to Section 419-10 . TEST the system for normal operation. **No** GO to C2 .
C2 CHECK FOR VOLTAGE TO THE INTERIOR LAMP	
• Push the instrument panel dimmer switch down out of the DOME LAMP position. • Disconnect: Inoperative Lamp. • Push up the instrument panel dimmer switch to the second up detent. • Measure the voltage between the inoperative lamp, harness side and ground as follows: **Inoperative Lamp / Connector-Pin / Circuit** Front — C930-3 — VLN33 (GY/VT) Front (MKZ with ambient lighting) — C9035-3 — VLN33 (GY/VT) Rear — C901-1 — VLN33 (GY/VT) LH scuff plate — C3251-1 — VLN33 (GY/VT) RH scuff plate — C3250-1 — VLN33 (GY/VT)  N0104219 • **Is the voltage greater than 10 volts?**	**Yes** GO to C3 . **No** REPAIR circuit VLN33 (GY/VT) for an open. TEST the system for normal operation.
C3 CHECK FOR VOLTAGE TO THE INTERIOR LAMP USING THE CONNECTOR GROUND	

- Measure the voltage between the inoperative interior lamp connector, harness side as follows:

Inoperative Lamp	Connector-Pin/ Circuit	Connector-Pin/ Circuit
Front	C930-3 VLN33 (GY/VT)	C930-1 GD139 (BK/YE)
Front (MKZ with ambient lighting)	C9035-3 VLN33 (GY/VT)	C9035-1 GD139 (BK/YE)
Rear	C901-1 VLN33 (GY/VT)	C901-2 GD139 (BK/YE)
LH scuff plate	C3251-1 VLN33 (GY/VT)	C3251-3 GD126 (BK/WH)
RH scuff plate	C3250-1 VLN33 (GY/VT)	C3250-3 GD126 (BK/WH)



N0104220

- **Is the voltage greater than 10 volts?**

Yes
INSTALL a new interior lamp for the lamp in question. REFER to Interior Lamp - Front or Interior Lamp - Rear in this section. TEST the system for normal operation.

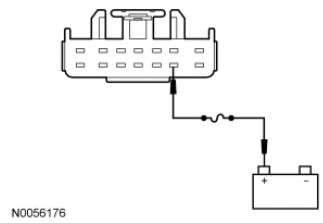
No
REPAIR the ground circuit in question for an open. TEST the system for normal operation.

C4 BYPASS THE SJB

- Ignition OFF.
- Disconnect: SJB C2280a.
- **NOTE:** If the jumper wire fails, refer to the Wiring Diagrams Manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, test the system for normal operation. If DTC B106E is present, clear the DTCs **and** repeat the self-test **(required to enable the courtesy lamp output driver if DTC B is present).** Test the system for normal operation. If DTC B106F is present, install a new SJB . Refer to Section 419-10 . Test the system for normal operation.

Yes
REMOVE the jumper wire. GO to C5 .

No
REMOVE the jumper wire. REPAIR circuit VLN33 (GY/VT) for an open.

• Connect a fused jumper wire between the SJB C2280a-9, circuit VLN33 (GY/VT), harness side and battery positive.  N0056176 • **Do the courtesy lamps illuminate?**	CLEAR the DTCs. REPEAT the self-test.
C5 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: The Puddle Lamp(s) Are Inoperative

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

Power is supplied to the puddle lamps through the Smart Junction Box (SJB) fuse 10 (15A). Based on the input status, the SJB supplies voltage to the puddle lamps. The puddle lamps have separate ground circuits.

DTC Description	Fault Trigger Conditions
• B106E - Solid State Driver Disabled Due to Short Circuit	A continuous DTC that sets when the SJB has temporarily shut down the output driver. **The module has temporarily disabled the puddle lamp output because an excessive current draw exists (such as a short to ground). The SJB cannot enable the puddle lamp output until the cause of the short is corrected, the DTCs have been cleared an a successful self-test is run.**

• B106F - Module Disabled Due to External Fault	A continuous DTC that sets when the SJB has permanently shut down the output driver. **The module has permanently disabled the puddle lamp output because an excessive current draw fault (such as a short to ground) has exceeded the limits that the SJB can withstand. The cause of the excessive current draw MUST be corrected before a new SJB is installed.**
• B2A39 - Puddle Lamp Output Circuit Open	An on-demand DTC that sets when the SJB detects an open on the puddle lamp output circuit.
• B2A3A - Puddle Lamp Output Circuit Short To Ground	A continuous and on-demand DTC that sets when the SJB detects a short to ground on the puddle lamp output circuit. This DTC may also set as a result when the SJB fuse 10 (15A) has failed or is removed.

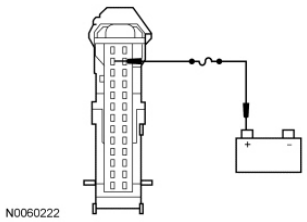
This pinpoint test is intended to diagnose the following:

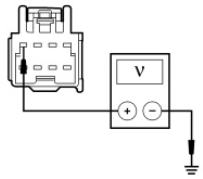
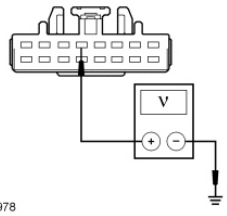
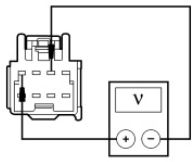
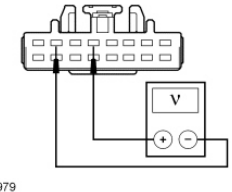
- Fuse
- Wiring, terminals or connectors
- Exterior mirror

PINPOINT TEST D: THE PUDDLE LAMP(S) ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 CHECK THE PUDDLE LAMP OPERATION	
• Ignition OFF. • Operate the instrument panel dimmer switch to the DOME LAMP position. • **Are both the puddle lamps inoperative?**	**Yes** VERIFY the SJB fuse 10 (15A) is OK. If OK, GO to D2 . If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. After the repair: if no DTCs are present, TEST the system for normal operation. If DTC B106E is present, CLEAR the DTCs **and** REPEAT the self-test **(required to enable the puddle lamp output driver if DTC B106E is present)** . TEST the system for normal operation.

	If DTC B106F is present, INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** GO to D3 .
D2 BYPASS THE SJB	
• Operate the instrument panel dimmer switch out of the DOME LAMP position. • Disconnect: SJB C2280c. • **NOTE:** If the jumper wire fails, refer to the Wiring Diagrams Manual to identify the possible causes of the circuit short. After the repair: If no DTCs are present, test the system for normal operation. If DTC B106E is present, clear the DTCs **and** repeat the self-test **(required to enable the courtesy lamp output driver if DTC B106E is present).** Test the system for normal operation. If DTC B106F is present, install a new SJB . Refer to Section 419-10 . Test the system for normal operation. • Connect a fused jumper wire between the SJB C2280c-12, circuit CLN25 (VT), harness side and battery positive.  N0060222 • **Do the puddle lamps illuminate?**	**Yes** REMOVE the jumper wire. GO to D3 . **No** REMOVE the jumper wire. REPAIR circuit CLN25 (VT) for an open. CLEAR the DTCs. REPEAT the self-test.
D3 CHECK FOR VOLTAGE TO THE EXTERIOR MIRROR	
• Operate the instrument panel dimmer switch out of the DOME LAMP position. • Disconnect: Suspect Exterior Mirror. • Operate the instrument panel dimmer switch to the DOME LAMP position. • For Fusion, measure the voltage between the LH exterior mirror C517-4, circuit CLN25 (VT), harness side and ground; or between the RH exterior mirror C625-4, circuit CLN25 (VT), harness side and ground.	**Yes** GO to D4 . **No** REPAIR circuit CLN25 (VT) for an open. TEST the system for normal operation.

 N0099743 • For MKZ, measure the voltage between the LH exterior mirror C522-5, circuit CLN25 (VT), harness side and ground; or between the RH exterior mirror C626-5, circuit CLN25 (VT), harness side and ground.  N0099978 • **Is the voltage greater than 10 volts?**	
D4 CHECK FOR VOLTAGE TO THE EXTERIOR MIRROR USING THE CONNECTOR GROUND	
• For Fusion, measure the voltage between the LH exterior mirror C517-4, circuit CLN25 (VT), harness side and the LH exterior mirror C517-6, circuit GD126 (BK/WH), harness side; or between the RH exterior mirror C625-4, circuit CLN25 (VT), harness side and the RH exterior mirror C625-6, circuit GD139 (BK/YE), harness side.  N0099744 • For MKZ, measure the voltage between the LH exterior mirror C522-5, circuit CLN25 (VT), harness side and LH exterior mirror C522-7, circuit GD126 (BK/WH), harness side; or between the RH exterior mirror C626-5, circuit CLN25 (VT), harness side and the RH exterior mirror C626-7, circuit GD139 (BK/YE), harness side.  N0099979	**Yes** INSTALL a new exterior mirror in question. REFER to Section 501-09 . TEST the system for normal operation. **No** REPAIR the ground circuit in question for an open. TEST the system for normal operation.

• **Is the voltage greater than 10 volts?**	

Pinpoint Test E: The Luggage Compartment Lamp Is Inoperative/Always On

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

Power is supplied to the luggage compartment lamp from the demand lighting circuit. Ground for the luggage compartment lamp is controlled by the luggage compartment latch. When the luggage compartment lid is opened, a switch inside the latch closes and completes the path to ground.

- DTC B1331 (Decklid Ajar Rear Door Circuit Failure) - an on-demand DTC that sets when the SJB detects an open from the luggage compartment lid ajar input circuit.

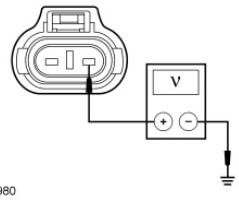
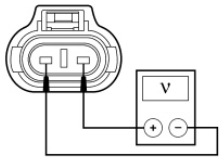
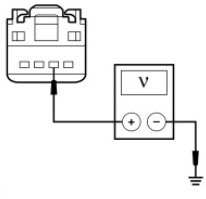
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Luggage compartment lamp
- Luggage compartment lid latch

PINPOINT TEST E: THE LUGGAGE COMPARTMENT LAMP IS INOPERATIVE/ALWAYS ON

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
E1 DETERMINE IF THE LAMP IS INOPERATIVE OR ALWAYS ON	
• Open the luggage compartment lid and observe the luggage compartment lamp. • **Is the luggage compartment lamp illuminated?**	**Yes** GO to E2 . **No** GO to E3 .
E2 CHECK THE LUGGAGE COMPARTMENT LAMP GROUND CONTROLLED CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: Luggage Compartment Lid Latch C429. • **Does the luggage compartment lamp continue to illuminate?**	**Yes** REPAIR circuit CLN13 (WH/BU) for a short to ground. TEST the system for normal operation. **No** INSTALL a new luggage compartment lid latch. REFER to Section 501-14 . TEST the system for normal operation.
E3 CHECK FOR VOLTAGE TO THE LUGGAGE COMPARTMENT LAMP	

• Disconnect: Luggage Compartment Lamp C4198. • Ignition ON. • Measure the voltage between the luggage compartment lamp C4198-1, circuit CLN09 (YE/GN), harness side and ground.  N0099980 • **Is the voltage greater than 10 volts?**	**Yes** GO to E4 . **No** REPAIR circuit CLN09 (YE/GN) for an open. TEST the system for normal operation.
E4 CHECK FOR VOLTAGE TO THE LUGGAGE COMPARTMENT LAMP USING THE CONNECTOR GROUND	
• Measure the voltage between the luggage compartment lamp C4198-1, circuit CLN09 (YE/GN), harness side and the luggage compartment lamp C4198-2, circuit CLN13 (WH/BU), harness side.  N0099981 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new luggage compartment lamp. TEST the system for normal operation. **No** GO to E5 .
E5 CHECK FOR VOLTAGE TO THE LUGGAGE COMPARTMENT LID LATCH	
• Connect: Luggage Compartment Lamp C4198. • Disconnect: Luggage Compartment Lid Latch C429. • Measure the voltage between the luggage compartment lid latch C429-2, circuit CLN13 (WH/BU), harness side and ground.  N0099982 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new luggage compartment lid latch. REFER to Section 501-14 . TEST the system for normal operation. **No** REPAIR circuit CLN13 (WH/BU) for an open. TEST the system for normal operation.

Pinpoint Test F: The Interior Courtesy Lamps Stay On Continuously

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 110 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Door Locks for schematic and connector information.

Refer to Wiring Diagrams Cell 113 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Luggage Compartment Lid Release for schematic and connector information.

Normal Operation

When any door or liftgate is opened, a correct unlock code from the keyless entry keypad or an unlock request from a programmed Remote Keyless Entry (RKE) transmitter is detected, the Smart Junction Box (SJB) supplies voltage to the interior courtesy lamps.

DTC Description	Fault Trigger Conditions
• B1320 - Driver Door Ajar Circuit Open	An on-demand DTC that sets when the SJB detects an open from the LH front door ajar input circuit.
• B1328 - Passenger Door Ajar Circuit Open	An on-demand DTC that sets when the SJB detects an open from the RH front door ajar input circuit.
• B1336 - Door Ajar RR Circuit Open	An on-demand DTC that sets when the SJB detects an open from the RH rear door ajar input circuit.
• B1572 - Door Ajar LR Circuit Open	An on-demand DTC that sets when the SJB detects an open from the LH rear door ajar input circuit.
• B2A35 - Interior Lighting Output Circuit Open	An on-demand DTC that sets when the SJB detects a short to voltage from the courtesy lamp output circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Door ajar switch
- SJB

PINPOINT TEST F: THE INTERIOR COURTESY LAMPS STAY ON CONTINUOUSLY

NOTICE: **Use the correct probe a) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 CHECK THE SJB DTCs	

NOTE: Make sure all doors are closed before running the SJB on-demand self-test.

- Carry out the SJB on-demand self-test.
- **Is DTC B1320, B1328, B1336 or B1572 recorded?**

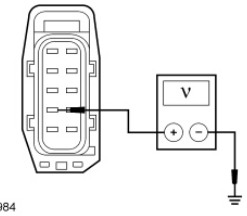
Yes
GO to F2 .

No
GO to F5 .

F2 CHECK FOR VOLTAGE TO THE DOOR AJAR SWITCH

- Ignition OFF.
- Disconnect: Suspect Door Ajar Switch.
- Measure the voltage between the suspect door ajar switch, harness side and ground as follows:

Suspect Door Ajar Switch	Connector-Pin	Circuit
LH front	C525-8	CPL26 (GN/VT)
RH front	C603-8	CPL31 (WH)
LH rear	C704-8	CPL36 (GN)
RH rear	C804-8	CPL39 (YE)



- **Is the voltage greater than 10 volts?**

Yes
GO to F3 .

No
GO to F4 .

F3 CHECK FOR VOLTAGE TO THE DOOR AJAR SWITCH USING THE CONNECTOR GROUND

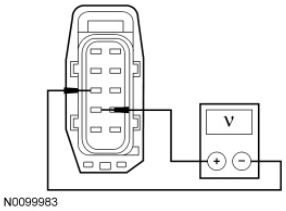
- Measure the voltage between the suspect door ajar switch, harness side and ground as follows:

Suspect Door Ajar Switch	Connector-Pin	Circuit
LH front	C525-8 CPL26 (GN/VT)	C525-6 GD126 (BK/WH)
RH front	C603-8 CPL31 (WH)	C603-6 GD139

Yes
INSTALL a new door latch for the ajar switch in question. REFER to Section 501-14 . CLEAR the DTCs. REPEAT the self-test.

No
REPAIR the ground circuit in question for an open. CLEAR the DTCs. REPEAT the self-test.

		(BK/YE)
LH rear	C704-8 CPL36 (GN)	C704-6 GD126 (BK/WH)
RH rear	C804-8 CPL39 (YE)	C804-6 GD139 (BK/YE)

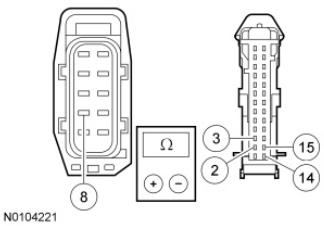


- **Is the voltage greater than 10 volts?**

F4 CHECK THE DOOR AJAR SWITCH INPUT CIRCUIT FOR AN OPEN

- Disconnect: SJB C2280c.
- Measure the resistance between the suspect door ajar switch, harness side and the SJB , harness side as follows:

Suspect Door Ajar Switch Connector-Pin	SJB Connector-Pin	Circuit
LH front C525-8	C2280c-14	CPL26 (GN/VT)
RH front C603-8	C2280c-2	CPL31 (WH)
LH rear C704-8	C2280c-3	CPL36 (GN)
RH rear C804-8	C2280c-15	CPL39 (YE)



- **Is the resistance less than 5 ohms?**

Yes
GO to F5 .

No
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

F5 CHECK THE SJB INTERIOR COURTESY LAMP OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE

NOTE: Make sure the doors are closed for correct test results. • Ignition OFF. • Disconnect: SJB C2280a. • Ignition ON. • Observe the interior courtesy lamps. • **Do the interior courtesy lamps continue to illuminate?**	**Yes** REPAIR circuit VLN33 (GY/VT) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to F6 .
F6 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test G: The Puddle Lamps Stay On Continuously

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

When the request from the instrument panel dimmer switch is detected, any door is opened, a correct unlock code from the keyless entry keypad or an unlock request from a programmed Remote Keyless Entry (RKE) transmitter is detected, the Smart Junction Box (SJB) supplies voltage to the puddle lamps.

- DTC B2A39 (Puddle Lamp Output Circuit Open) - an on-demand DTC that sets when the SJB detects a short to voltage from the puddle lamp output circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- SJB

PINPOINT TEST G: THE PUDDLE LAMPS STAY ON CONTINUOUSLY

NOTICE: **Use the correct probe adapt(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
G1 CHECK THE INTERIOR COURTESY LAMPS	
• Ignition OFF. • **Are the interior courtesy lamps illuminated?**	**Yes** GO to Pinpoint Test F .

	No GO to G2 .
G2 CHECK THE SJB PUDDLE LAMP OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: SJB C2280c. • Ignition ON. • **Do the puddle lamps continue to illuminate?**	**Yes** REPAIR circuit CLN25 (VT) for a short to voltage. CLEAR the DTCs. REPEAT the self-test. **No** GO to G3 .
G3 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test H: All The Demand Lamps Are Inoperative

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) supplies voltage to the demand lamps. The demand lamps are ground through one circuit. The glove compartment lamp (MKZ only) is case grounded.

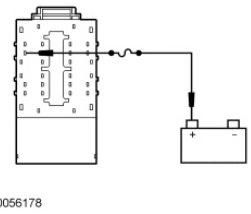
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- SJB

PINPOINT TEST H: ALL THE DEMAND LAMPS ARE INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
H1 CHECK THE OPERATION OF THE INTERIOR COURTESY LAMPS	
• Ignition OFF.	**Yes** GO to H2 .

• Operate the courtesy lamps by opening the LH front door. • **Do the courtesy lamps illuminate?**	**No** GO to Pinpoint Test A .
H2 CHECK CIRCUIT CLN09 (YE/GN) FOR AN OPEN	
• Disconnect: SJB C2280d. • Connect a fused jumper wire between the SJB C2280d-21, circuit CLN09 (YE/GN), harness side and battery positive.  N0056178 • **Do the demand lamps illuminate?**	**Yes** REMOVE the jumper wire. GO to H3 . **No** REMOVE the jumper wire. REPAIR the circuit. TEST the system for normal operation.
H3 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test I: An Individual Demand Lamp Is Inoperative

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

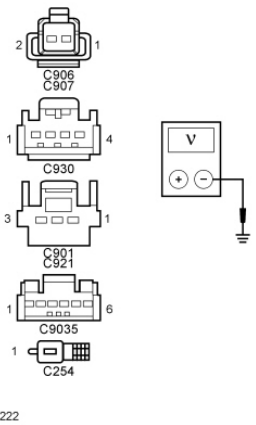
The Smart Junction Box (SJB) supplies voltage to the demand lamps. The demand lamps are grounded through one circuit. The glove compartment lamp (MKZ only) is case grounded.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Demand lamp

PINPOINT TEST I: AN INDIVIDUAL DEMAND LAMP IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

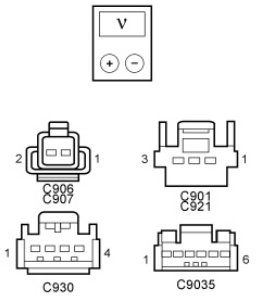
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>I1 CHECK FOR VOLTAGE TO THE DEMAND LAMP</td><td></td></tr>
<tr><td>
• Ignition OFF.
• Disconnect: Suspect Demand Lamp.
• Ignition ON.
• Measure the voltage between the suspect demand lamp, harness side and ground as follows:
<table>
<tr><th>Location</th><th>Connector-Pin</th><th>Circuit</th></tr>
<tr><td>RH vanity mirror lamp</td><td>C906-1</td><td>CLN09 (YE/GN)</td></tr>
<tr><td>LH vanity mirror lamp</td><td>C907-1</td><td>CLN09 (YE/GN)</td></tr>
<tr><td>Front</td><td>C930-2</td><td>CLN09 (YE/GN)</td></tr>
<tr><td>Front (MKZ only)</td><td>C9035-2</td><td>CLN09 (YE/GN)</td></tr>
<tr><td>Rear (with moonroof)</td><td>C921-3</td><td>CLN09 (YE/GN)</td></tr>
<tr><td>Rear (without moonroof)</td><td>C901-3</td><td>CLN09 (YE/GN)</td></tr>
<tr><td>Glove compartment lamp</td><td>C254-1</td><td>CLN09 (YE/GN)</td></tr>
</table>


N0104222
• Is the voltage greater than 10 volts?
</td><td>Yes
GO to I2 .

No
REPAIR the circuit in question. TEST the system for normal operation.</td></tr>
<tr><td>I2 CHECK FOR VOLTAGE TO THE DEMAND LAMP USING THE CONNECTOR GROUND</td><td></td></tr>
</table>

- Measure the voltage between the inoperative demand lamp, harness side and ground as follows:

Inoperative Lamp	Connector-Pin/ Circuit	Connector-Pin/ Circuit
LH vanity mirror lamp	C907-1 CLN09 (YE/GN)	C907-2 GD139 (BK/YE)
RH vanity mirror lamp	C906-1 CLN09 (YE/GN)	C906-2 GD139 (BK/YE)
Front	C930-2 CLN09 (YE/GN)	C930-1 GD139 (BK/YE)
Front (MKZ only)	C9035-2 CLN09 (YE/GN)	C9035-6 GD139 (BK/YE)
Rear (with moonroof)	C921-3 CLN09 (YE/GN)	C921-2 GD139 (BK/YE)
Rear (without moonroof)	C901-3 CLN09 (YE/GN)	C901-2 GD139 (BK/YE)



N0104223

- **Is the voltage greater than 10 volts?**

Yes
INSTALL a new demand lamp for the suspect lamp. TEST the system for normal operation.

No
REPAIR the circuit in question. TEST the system for normal operation.

Pinpoint Test J: The Battery Saver Does Not Deactivate After Time-Out

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) controls the battery saver function. The battery saver function provides automatic shutoff of the interior lamps (courtesy lamps and demand lamps) after 10 minutes have elapsed in order to save battery power.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- SJB

PINPOINT TEST J: THE BATTERY SAVER DOES NOT DEACTIVATE AFTER TIME-OUT

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
J1 CHECK THE SJB IGNITION SWITCH PIDs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB DataLogger. • Monitor the SJB ignition switch PIDs (IGN_A_ECU, IGN_O_ECU, IGN_R_ECU and IGN_S_ECU) while rotating the ignition switch through all positions. • **Do the ignition switch PIDs agree with the ignition switch positions?**	**Yes** GO to J2 . **No** REFER to Section 211-05 .
J2 CHECK THE DEMAND LAMP VOLTAGE SUPPLY CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SJB C2280e. • Ignition ON. • Operate the demand lamps. • **Do the demand lamps illuminate?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to J3 .
J3 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test K: The Ambient Lighting Is Inoperative - Fusion

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

When the ignition key is in the RUN or ACC position, the ambient lighting module supplies voltage and ground to the LEDs located in the floor console cup holders, storage tray, storage bin, door map pockets and the front and rear footwells. The ambient lighting switch is used to cycle through the 8 color combinations or to turn the ambient lighting feature off. There are 4 different color (red, blue, green and white) LEDs housed within each LED assembly.

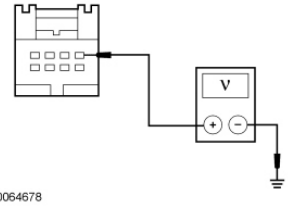
When the ignition key is in the RUN or ACC position, the ambient lighting switch and the ambient lighting module receive voltage. When the ambient lighting switch (a momentary contact switch) is pressed, voltage is routed to the ambient lighting module indicating a request for the module to cycle the ambient lighting to the next setting.

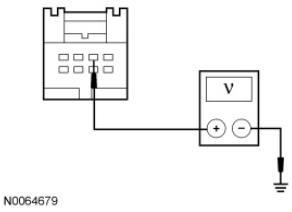
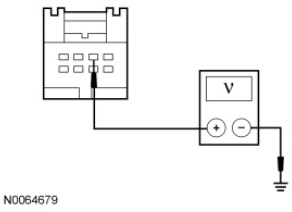
This pinpoint test is intended to diagnose the following:

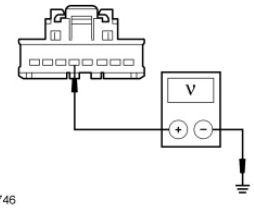
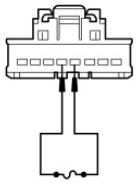
- Fuse
- Wiring, terminals or connectors
- Ambient lighting harness
- Ambient lighting switch
- Ambient lighting module

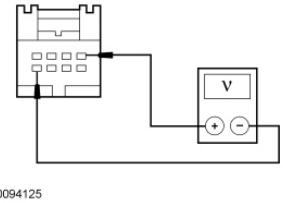
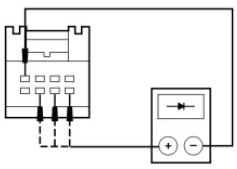
PINPOINT TEST K: THE AMBIENT LIGHTING IS INOPERATIVE - FUSION

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
K1 CHECK FOR VOLTAGE TO THE AMBIENT LIGHTING MODULE	
• Ignition OFF. • Disconnect: Ambient Lighting Module C3256. • Ignition ON. • Measure the voltage between the ambient lighting module C3256-1, circuit CBX07 (GN/RD), harness side and ground.  N0064678 • **Is the voltage greater than 10 volts?**	**Yes** GO to K2 . **No** VERIFY the Smart Junction Box (SJB) fuse 41 (15A) is OK. If OK, REPAIR the circuit CBX07 (GN/RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams

	Manual to identify the possible causes of the circuit short.
K2 CHECK THE INPUT FROM THE AMBIENT LIGHTING SWITCH	
• While pressing and releasing the ambient lighting switch, measure the voltage between the ambient lighting module C3256-2, circuit CLN54 (BN/YE), harness side and ground.  N0064679 • **Is the voltage greater than 10 volts with the switch pressed and 0 volts with the switch released?**	**Yes** GO to K6 . **No** If voltage is always present, GO to K3 . If no voltage is present, GO to K4 .
K3 CHECK THE AMBIENT LIGHTING SWITCH INPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Traction Control/Ambient Lighting Switch C2304. • Ignition ON. • Measure the voltage between the ambient lighting module C3256-2, circuit CLN54 (BN/YE), harness side and ground.  N0064679 • **Is any voltage present?**	**Yes** REPAIR the circuit for a short to voltage. TEST the system for normal operation. **No** INSTALL a new traction control/ambient lighting switch. REFER to Section 206-09 . TEST the system for normal operation.
K4 CHECK FOR VOLTAGE TO THE AMBIENT LIGHTING SWITCH	

• Ignition OFF. • Connect: Ambient Lighting Module C3256. • Disconnect: Traction Control/Ambient Lighting Switch C2304. • Ignition ON. • Measure the voltage between the ambient lighting switch C2304-5, circuit CBP41 (BU), harness side and ground.  N0099746 • **Is the voltage greater than 10 volts?**	**Yes** GO to K5 . **No** VERIFY the SJB fuse 41 (15A) is OK. If OK, REPAIR the circuit for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
K5 BYPASS THE AMBIENT LIGHTING SWITCH	
• Connect and remove a fused jumper wire between the ambient lighting switch C2304-5, circuit CBP41 (BU), harness side and the ambient lighting switch C2304-4, circuit CLN54 (BN/YE), harness side.  N0099748 • **Do the ambient LEDs illuminate and cycle through a color change each time the jumper wire is connected and removed?**	**Yes** INSTALL a new traction control/ambient lighting switch. REFER to Section 206-09 . TEST the system for normal operation. **No** REPAIR the circuit for an open. TEST the system for normal operation.
K6 CHECK FOR VOLTAGE TO THE AMBIENT LIGHTING MODULE USING THE CONNECTOR GROUND	
• Measure the voltage between the ambient lighting module C3256-1, circuit CBX07 (GN/RD), harness side and the ambient lighting module C3256-8, circuit GD908 (BK), harness side.	**Yes** GO to K7 . **No** REPAIR the circuit for an open. TEST the

 N0094125 • **Is the voltage greater than 10 volts?**	system for normal operation.
K7 CHECK THE AMBIENT LIGHTING HARNESS	
• Ignition OFF. • Check any of the diode circuits between the ambient lighting module, harness side as follows: **Connector-Pin/Circuit** / **Connector-Pin/Circuit** C3256-5 CLN45 (GN) — C3256-4 RLN44 (BN) C3256-6 CLN46 (BU) — C3256-4 RLN44 (BN) C3256-7 CLN44 (OG) — C3256-4 RLN44 (BN)  N0064681 • **Does the meter indicate the circuit is good?**	**Yes** GO to K8 . **No** REPAIR or INSTALL a new ambient lighting harness. TEST the system for normal operation.
K8 CHECK FOR CORRECT AMBIENT LIGHTING MODULE OPERATION	
• Disconnect the ambient lighting module connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new ambient lighting module. REFER to Ambient Lighting Module in this

• Connect the ambient lighting module connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test L: The Ambient Lighting Does Not Cycle Through All Color Combinations - Fusion

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

When the ignition key is in the RUN or ACC position, the ambient lighting module supplies voltage and ground to the LEDs located in the floor console cup holders, storage tray, storage bin, door map pockets and the front and rear footwells. The ambient lighting switch is used to cycle through the 8 color combinations or to turn the ambient lighting feature off. There are 4 different color (red, blue, green and white) LEDs housed within each LED assembly.

When the ignition key is in the RUN or ACC position, the ambient lighting switch and the ambient lighting module receive voltage. When the ambient lighting switch (a momentary contact switch) is pressed, voltage is routed to the ambie lighting module indicating a request for the module to cycle the ambient lighting to the next setting.

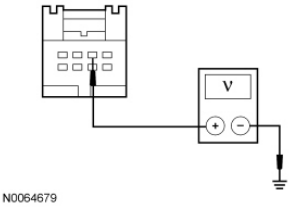
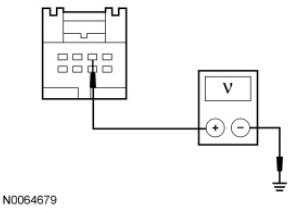
This pinpoint test is intended to diagnose the following:

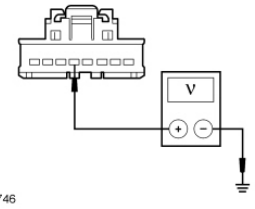
- Wiring, terminals or connectors
- Ambient lighting harness
- Ambient lighting switch
- Ambient lighting module

PINPOINT TEST L: THE AMBIENT LIGHTING DOES NOT CYCLE THROUGH ALL COLOR COMBINATIONS - FUSION

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
L1 CHECK THE INPUT FROM THE AMBIENT LIGHTING SWITCH	

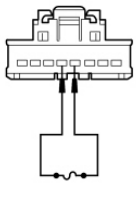
• Ignition OFF. • Disconnect: Ambient Lighting Module C3256. • Ignition ON. • While pressing and releasing the ambient lighting switch, measure the voltage between the ambient lighting module C3256-2, circuit CLN54 (BN/YE), harness side and ground.  N0064679 • **Is the voltage greater than 10 volts with the switch pressed, and 0 volts with the switch released?**	**Yes** GO to L . **No** If voltage is always present, GO to L2 . If no voltage is present, GO to L3 .
L2 CHECK THE AMBIENT LIGHTING SWITCH INPUT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: Traction Control/Ambient Lighting Switch C2304. • Ignition ON. • Measure the voltage between the ambient lighting module C3256-2, circuit CLN54 (BN/YE), harness side and ground.  N0064679 • **Is any voltage present?**	**Yes** REPAIR the circuit for a short to voltage. TEST the system for normal operation. **No** INSTALL a new traction control/ambient lighting switch. REFER to Section 206-09 . TEST the system for normal operation.
L3 CHECK FOR VOLTAGE TO THE AMBIENT LIGHTING SWITCH	
• Ignition OFF. • Disconnect: Traction Control/Ambient Lighting Switch C2304. • Connect: Ambient Lighting Module C3256. • Ignition ON. • Measure the voltage between the ambient lighting switch C2304-5, circuit CBP41 (BU), harness side and ground.	**Yes** GO to L4 . **No** VERIFY the Smart Junction Box (SJB) fuse 41 (15A) is OK. If OK, REPAIR the circuit for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.



- **Is the voltage greater than 10 volts?**

L4 BYPASS THE AMBIENT LIGHTING SWITCH

- Connect and remove a fused jumper wire between the ambient lighting switch C2304-5, circuit CBP41 (BU), harness side and the ambient lighting switch C2304-4, circuit CLN54 (BN/YE), harness side.



- **Do the ambient LEDs illuminate and cycle through a color change each time the jumper wire is connected and removed?**

Yes
INSTALL a new traction control/ambient lighting switch. REFER to Section 206-09 . TEST the system for normal operation.

No
REPAIR the circuit for an open. TEST the system for normal operation.

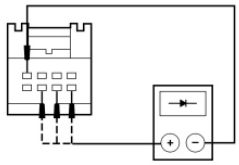
L5 CHECK THE AMBIENT LIGHTING HARNESS

- Ignition OFF.
- Check any of the diode circuits between the ambient lighting module, harness side as follows:

Connector-Pin/Circuit	Connector-Pin/Circuit
C3256-5 CLN45 (GN)	C3256-4 RLN44 (BN)
C3256-6 CLN46 (BU)	C3256-4 RLN44 (BN)
C3256-7 CLN44 (OG)	C3256-4 RLN44 (BN)

Yes
GO to L6 .

No
REPAIR or INSTALL a new ambient lighting harness. TEST the system for normal operation.

 N0064681 • **Does the meter indicate the circuit is good?**	
L6 CHECK FOR CORRECT AMBIENT LIGHTING MODULE OPERATION	
• Disconnect the ambient lighting module connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the ambient lighting module connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ambient lighting module. REFER to Ambient Lighting Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test M: The Ambient Lighting Is Inoperative - MKZ

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

The Interior Lighting Control Module (ILCM) supplies voltage and ground to the LEDs located in the floor console cup holders, storage tray, storage bin, door map pockets and the front and rear footwells. The ambient lighting select switch is used to cycle through the 7 color combinations or to turn the ambient lighting feature off. There are 4 different color (red, blue, green and white) LEDs housed within each LED assembly.

The ILCM sends a voltage signal to the ambient lighting select switch. When the ambient lighting switch (a momentary contact switch) is pressed, the voltage signal is routed toround indicating a request for the module to cycle the ambient lighting to the next color setting.

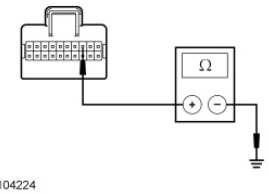
- DTC B2B18 (Ambient Light Switch Input Fault) - a continuous and on-demand DTC that sets when the ILCM detects a short to ground from the ambient lighting select switch input circuit.

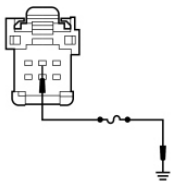
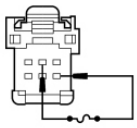
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Ambient lighting harness
- Ambient lighting select switch
- ILCM

PINPOINT TEST M: THE AMBIENT LIGHTING IS INOPERATIVE - MKZ

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
M1 CHECK FOR COMMUNICATION TO THE ILCM	
• Enter the following diagnostic mode on the scan tool: ILCM DataLogger. • Carry out the network test using the scan tool. • **Does the scan tool communicate with the ILCM ?**	**Yes** GO to M2 . **No** REFER to Section 418-00 .
M2 CHECK THE INPUT FROM THE AMBIENT LIGHTING SWITCH	
• Enter the following diagnostic mode on the scan tool: ILCM DataLogger. • While pressing and releasing the ambient lighting switch, monitor the ILCM ambient lighting select switch PID (AmbiColor). • **Does the PID read active with the switch pressed and idle with the switch released?**	**Yes** GO to M8 . **No** If the PID always reads active, GO to M3 . If the PID always reads idle, GO to M4 .
M3 CHECK THE AMBIENT LIGHTING SWITCH FOR A SHORT TO GROUND	
• Disconnect: Ambient Lighting Switch C2306. • Enter the following diagnostic mode on the scan tool: ILCM DataLogger. • Monitor the ILCM ambient lighting select switch PID (AmbiColor). • **Does the PID still read active?**	**Yes** GO to M4 . **No** INSTALL a new ambient lighting select switch. REFER to Ambient Lighting Switch in this section. TEST the system for normal operation.
M4 CHECK THE AMBIENT LIGHTING SELECT SWITCH INPUT CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: ILCM C2301. • Measure the resistance between the ILCM C2301-8, circuit CPL60 (WH/BN), harness side and ground.  N0104224 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to M5 . **No** REPAIR circuit CPL60 (WH/BN) for a short to ground. CLEAR the DTCs. REPEAT the self-test.
M5 BYPASS THE AMBIENT LIGHTING SELECT SWITCH	

• Ignition OFF. • Disconnect: Ambient Lighting Select Switch C2306. • Ignition ON. • Enter the following diagnostic mode on the scan tool: ILCM DataLogger. • Monitor the ILCM ambient lighting select switch PID (AmbiColor). • Connect a fused jumper wire between the ambient lighting select switch C2306-2, circuit CPL60 (WH/BN), harness side and ground.  N0104225 • **Does the PID read active?**	**Yes** GO to M6 . **No** GO to M7 .
M6 BYPASS THE AMBIENT LIGHTING SELECT SWITCH USING THE CONNECTOR GROUND	
• Enter the following diagnostic mode on the scan tool: ILCM DataLogger. • Monitor the ILCM ambient lighting select switch PID (AmbiColor). • Connect and remove a fused jumper wire between the ambient lighting switch C2306-2, circuit CLN60 (BN/YE), harness side and the ambient lighting switch C2306-6, circuit GD908 (BK), harness side.  N0104226 • **Does the PID read active?**	**Yes** REMOVE the jumper wire. INSTALL a new ambient lighting switch. REFER to Ambient Lighting Switch in this section. TEST the system for normal operation. **No** REMOVE the jumper wire. REPAIR circuit GD908 (BK) for an open. TEST the system for normal operation.
M7 CHECK THE AMBIENT LIGHTING SELECT SWITCH INPUT CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: ILCM C2301. • Measure the resistance between the ILCM C2301-8, circuit CLN60 (BN/YE), harness side and the ambient lighting select switch C2306-2, circuit CLN60 (BN/YE), harness side. • **Is the resistance less than 5 ohms?**	**Yes** GO to M8 . **No** REPAIR circuit CLN60 (BN/YE) for an open. TEST the system for normal operation.
M8 CHECK THE AMBIENT LIGHTING RETURN CIRCUIT	

<table>
<tr>
<td>
• Ignition OFF.
• Check the diode circuits between the ILCM , harness side as follows:

<table>
<tr><th>Connector-Pin/Circuit</th><th>Connector-Pin/Circuit</th></tr>
<tr><td>C2301-4

CLN44 (OG)</td><td>C2301-20

RLN44 (BN)</td></tr>
<tr><td>C2301-3

CLN45 (GN)</td><td>C2301-20

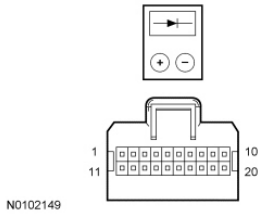
RLN44 (BN)</td></tr>
<tr><td>C2301-6

CLN46 (BU)</td><td>C2301-20

RLN44 (BN)</td></tr>
<tr><td>C2301-5

CLN57 (WH)</td><td>C2301-20

RLN44 (BN)</td></tr>
</table>



• Does the meter indicate the circuit is good?
</td>
<td>
Yes
GO to M9 .

No
REPAIR circuit RLN44 (BU) for an open. TEST the system for normal operation.
</td>
</tr>
<tr>
<td>M9 CHECK FOR CORRECT ILCM OPERATION</td>
<td></td>
</tr>
<tr>
<td>
• Disconnect the ILCM connector.
• Check for:
♦ corrosion
♦ damaged pins
♦ pushed-out pins
• Connect the ILCM connector and make sure it seats correctly.
• Operate the system and verify the concern is still present.
• Is the concern still present?
</td>
<td>
Yes
INSTALL a new ILCM . REFER to Interior Lighting Control Module (ILCM) in this section. TEST the system for normal operation.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
</td>
</tr>
</table>

Pinpoint Test N: The Ambient Lighting Does Not Cycle Through All Color Combinations - MKZ

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

The Interior Lighting Control Module (ILCM) supplies voltagend ground to the LEDs located in the floor console cup holders, storage tray, storage bin, door map pockets and the front and rear footwells. The ambient lighting select switch is used to cycle through the 7 color combinations or to turn the ambient lighting feature off. There are 4 different color (red, blue, green and white) LEDs housed within each LED assembly.

The ILCM sends a voltage signal to the ambient lighting select switch. When the ambient lighting switch (a momentary contact switch) is pressed, the voltage signal is routed to ground indicating a request for the module to cycle the ambient lighting to the next color setting.

DTC Description	Fault Trigger Conditions
• B2B00 - Ambient Light Zone 1 Red Circuit Open	A continuous and on-demand DTC that sets when the ILCM detects an open from the ambient lighting zone 1 red circuit.
• B2B01 - Ambient Light Zone 1 Red Circuit Short to Ground	A continuous and on-demand DTC that sets when the ILCM detects a short to ground from the ambient lighting zone 1 red circuit.
• B2B02 - Ambient Light Zone 1 Green Circuit Open	inuous and on-demand DTC that sets when the ILCM detects an open from the ambient lighting zone 1 green circuit.
• B2B03 - Ambient Light Zone 1 Green Circuit Short to Ground	A continuous and on-demand DTC that sets when the ILCM detects a short to ground from the ambient lighting zone 1 green circuit.
• B2B04 - Ambient Light Zone 1 Blue Circuit Open	A continuous and on-demand DTC that sets when the ILCM detects an open from the ambient lighting zone 1 blue circuit.
• B2B05 - Ambient Light Zone 1 Blue Circuit Short to Ground	A continuous and on-demand DTC that sets when the ILCM detects a short to ground from the ambient lighting zone 1 blue circuit.
• B2B06 - Ambient Light Zone 1 Signature Circuit Open	A continuous and on-demand DTC that sets when the ILCM detects an open from the ambient lighting zone ure circuit.
• B2B07 - Ambient Light Zone 1 Signature Circuit Short to Ground	A continuous and on-demand DTC that sets when the ILCM detects a short to ground from the ambient lighting zone 1 signature circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Ambient lighting harness
- Ambient lighting select switch
- ILCM

PINPOINT TEST N: THE AMBIENT LIGHTING DOES NOT CYCLE THROUGH ALL COLOR COMBINATIONS - MKZ

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>N1 CHECK THE INPUT FROM THE AMBIENT LIGHTING SWITCH</td><td></td></tr>
<tr><td>• Enter the following diagnostic mode on the scan tool: ILCM DataLogger.
• While pressing and releasing the ambient lighting switch, monitor the ILCM ambient lighting select switch PID (AmbiColor).
• Does the PID read active with thetch pressed and idle with the switch released?</td><td>Yes
GO to N2 .

No
GO to Pinpoint Test M .</td></tr>
<tr><td>N2 CHECK THE AMBIENT LIGHTING HARNESS</td><td></td></tr>
<tr><td>• Ignition OFF.
• Check the diode circuits between the ILCM , harness side as follows:

<table><tr><th>Connector-Pin/Circuit</th><th>Connector-Pin/Circuit</th></tr><tr><td>C2301-4

CLN44 (OG)</td><td>C2301-20

RLN44 (BN)</td></tr><tr><td>C2301-3

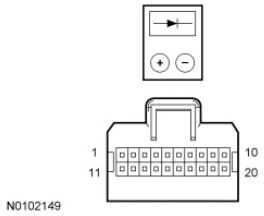
CLN45 (GN)</td><td>C2301-20

RLN44 (BN)</td></tr><tr><td>C2301-6

CLN46 (BU)</td><td>C2301-20

RLN44 (BN)</td></tr><tr><td>C2301-5

CLN57 (WH)</td><td>C2301-20

RLN44 (BN)</td></tr></table>
 

• Does the meter indicate the circuit is good?</td><td>Yes
GO to N3 .

No
REPAIR the circuit in question or INSTALL a new ambient lighting harness. TEST the system for normal operation.</td></tr>
<tr><td>N3 CHECK FOR CORRECT ILCM OPERATION</td><td></td></tr>
</table>

• Disconnect the ILCM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the ILCM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ILCM . REFER to Interior Lighting Control Module (ILCM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test O: The Ambient Lighting Does Not Cycle Through Brightness Settings - MKZ

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

The Interior Lighting Control Module (ILCM) sends 2 voltage reference signals to the ambient lighting dimmer switch (dim up or didown). When the ambient lighting dimmer switch (a momentary contact switch) is pressed (dim up or dim down), the voltage signal is routed to the ground indicating a request for the module to cycle the ambient lighting to the next dim up or dim down setting.

- DTC B2B18 (Ambient Light Switch Input Fault) - a continuous and on-demand DTC that sets when the ILCM detects a short to ground from the ambient lighting dim up or dim down input circuit.

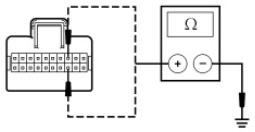
This pinpoint test is intended to diagnose the following:

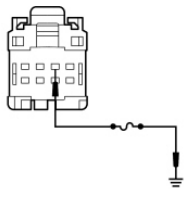
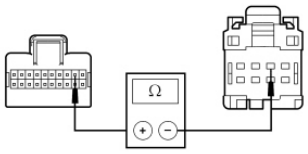
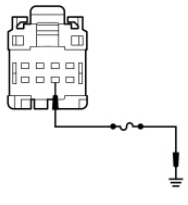
- Wiring, terminals or connectors
- Ambient lighting harness
- Ambient lighting dimmer switch
- ILCM

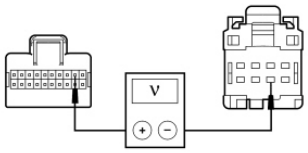
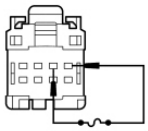
PINPOINT TEST O: THE AMBIENT LIGHTING DOES NOT CYCLE THROUGH BRIGHTNESS SETTINGS - MKZ

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
O1 CHECK THE INPUT FROM THE AMBIENT LIGHTING SWITCH	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: ILCM DataLogger. • While pressing and releasing the ambient lighting dimmer switch up and down, monitor the ILCM ambient lighting dimmer switch PID (AmbiDim). • **Does the PID agree with the switch positions?**	**Yes** GO to O9 . **No** If the PID indicates up or down with the switch not pressed, GO to O2 . If the PID indicates idle when

	the switch is pressed up or down, GO to O4 .
O2 CHECK THE AMBIENT LIGHTING DIMMER SWITCH FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Ambient Lighting Dimmer Switch C2305. • Ignition ON. • Enter the following diagnostic mode on the scan tool: ILCM DataLogger. • Monitor the ILCM ambient lighting dimmer switch PID (AmbiDim). • **Does the PID still indicate up or down?**	**Yes** GO to O3 . **No** INSTALL a new ambient lighting dimmer switch. REFER to Ambient Lighting Switch in this section. TEST the system for normal operation.
O3 CHECK THE AMBIENT LIGHTING DIMMER SWITCH INPUT CIRCUITS FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: ILCM C2301. • Measure the resistance between the ILCM C2301-9, circuit CLN61 (WH/VT), harness side and ground; and between the ILCM C2301-19, circuit CLN62 (BN/BU), harness side and ground.  N0104227 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to O9 . **No** REPAIR the circuit in question for a short to ground. CLEAR the DTCs. REPEAT the self-test.
O4 CHECK THE INPUT FROM THE AMBIENT LIGHTING DIMMER SWITCH DIM DOWN CIRCUIT	
• Ignition OFF. • Disconnect: Ambient Lighting Dimmer Switch C2305. • Ignition ON. • Enter the following diagnostic mode on the scan tool: ILCM DataLogger. • Monitor the ILCM ambient lighting dimmer switch PID (AmbiDim). • Connect and remove a fused jumper wire between the ambient lighting switch C2305-3, circuit CLN61 (WH/VT), harness side and ground.	**Yes** GO to O6 . **No** GO to O5 .

 N0104228 • **Does the PID indicate down?**	
O5 CHECK THE AMBIENT LIGHTING DIMMER SWITCH DIM DOWN CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: ILCM C2301. • Measure the resistance between the ILCM C2301-19, circuit CLN61 (WH/VT), harness side and the ambient lighting dimmer switch C2305-3, circuit CLN61 (WH/VT), harness side.  N0104229 • **Is the resistance less than 5 ohms?**	**Yes** GO to O9 . **No** REPAIR circuit CLN62 (BN/BU) for an open. TEST the system for normal operation.
O6 CHECK THE INPUT FROM THE AMBIENT LIGHTING DIMMER SWITCH DIM UP CIRCUIT	
• Enter the following diagnostic mode on the scan tool: ILCM DataLogger. • Monitor the ILCM ambient lighting dimmer switch PID (AmbiDim). • Connect a fused jumper wire between the ambient lighting dimmer switch C2305-7, circuit CLN62 (BN/BU), harness side and ground.  N0104230 • **Does the PID indicate up?**	**Yes** REMOVE the jumper wire. GO to O8 . **No** REMOVE the jumper wire. GO to O7 .
O7 CHECK THE AMBIENT LIGHTING DIMMER SWITCH DIM UP CIRCUIT FOR AN OPEN	

• Ignition OFF. • Disconnect: ILCM C2301. • Measure the resistance between the ILCM C2301-9, circuit CLN62 (BN/BU), harness side and the ambient lighting dimmer switch C2305-7, circuit CLN62 (BN/BU), harness side.  N0104231 • **Is the resistance less than 5 ohms?**	**Yes** GO to O9 . **No** REPAIR circuit CLN61 (WH/VT) for an open. TEST the system for normal operation.
O8 BYPASS THE AMBIENT LIGHTING DIMMER SWITCH	
• Enter the following diagnostic mode on the scan tool: ILCM DataLogger. • Monitor the ILCM ambient lighting dimmer switch PID (AmbiDim). • Connect a fused jumper wire between the ambient lighting dimmer switch C2305-3, circuit CLN61 (WH/VT), harness side and the ambient lighting switch C2305-4, circuit GD908 (BK), harness side.  N0104232 • **Does the PID indicate down?**	**Yes** INSTALL a new ambient lighting dimmer. REFER to Ambient Lighting Switch in this section. TEST the system for normal operation. **No** GO to O9 .
O9 CHECK FOR CORRECT ILCM OPERATION	
• Disconnect the ILCM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the ILCM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ILCM . REFER to Interior Lighting Control Module (ILCM) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test P: DTC U0140 - Lost Communication With Smart Junction Box (SJB)

Normal Operation

- DTC U0140 (Lost Communication With SJB) - set by the Interior Lighting Control Module (ILCM) if data messages received from the SJB over the Medium Speed Controller Area Network (MS-CAN) are missing. For a complete list of all network messages, refer to Section 418-00 .

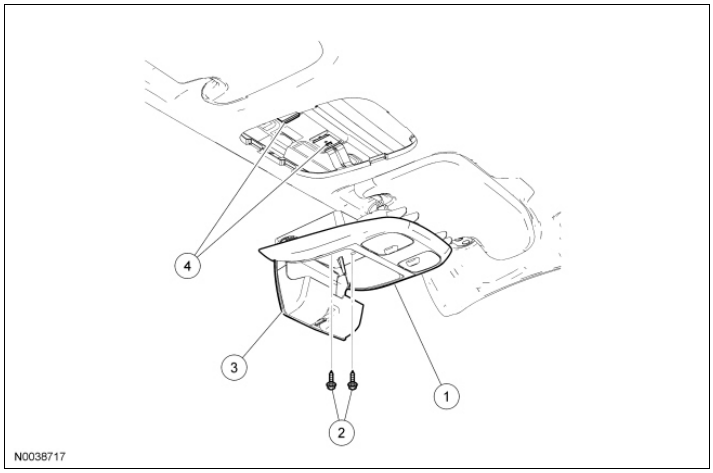
This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- ILCM

PINPOINT TEST P: DTC U0140 - LOST COMMUNICATION WITH SJB

Test Step	Result / Action to Take
P1 VERIFY CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to P2 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
P2 CHECK THE COMMUNICATION NETWORK	
• Enter the following diagnostic mode on the scan tool: Network Test. • Carry out the network test. • **Does the SJB pass the network test?**	**Yes** GO to P3 . **No** REFER to Section 418-00 .
P3 RECHECK THE ILCM DTCs	
• Clear the DTCs. Repeat the ILCM self-test. • **Is DTC U0140 still present?**	**Yes** GO to P4 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
P4 CHECK FOR DTC U0140 or U0140:00 SET IN OTHER MODULES	
• Clear all DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds. • Enter the following diagnostic mode on the scan tool: Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0140 set in the Driver Seat Module (DSM) or the Driver Door Module (DDM)?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new ILCM . REFER to Interior Lighting Control Module (ILCM) in this section. TEST the system for normal operation.

Interior Lamp - Front



Item	Part Number	Description
1	54519A70	Overhead console
2	-	Overhead console screws (2 required)
3	-	Overhead console storage door (part of 54519A70)
4	-	Overhead console retainer brackets

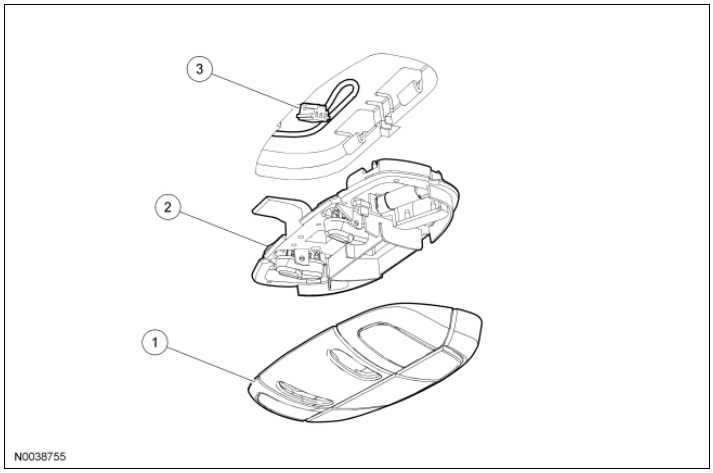
Removal and Installation

1. Open the overhead console storage door to access the screws.
   - Remove the 2 screws.

2. Pull the overhead console down and remove the console from the headliner retainer.
   - Disconnect the electrical connector.

3. To install, reverse the removal procedure.

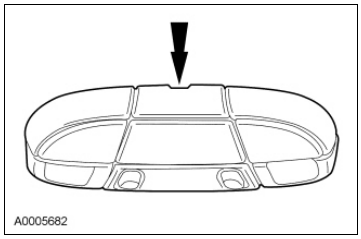
Interior Lamp - Rear



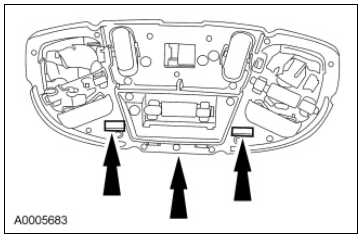
Item	Part Number	Description
1	13783	Rear interior lamp lens
2	13776	Rear interior lamp
3	-	Rear interior lamp electrical connector (part of 14334)

Removal and Installation

1. Remove the rear interior lamp lens.

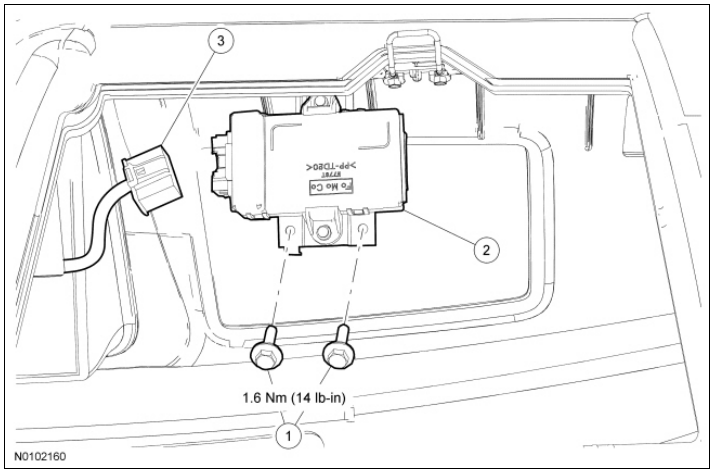


2. Release the 2 retaining clips (through the access holes) and remove the rear interior lamp assembly.
   - Disconnect the electrical connector.



3. To install, reverse the removal procedure.

Interior Lighting Control Module (ILCM)



Item	Part Number	Description
1	-	Interior Lighting Control Module (ILCM) bolts (2 required)
2	13E702	ILCM
3	-	ILCM electrical connector (part of 13E720)

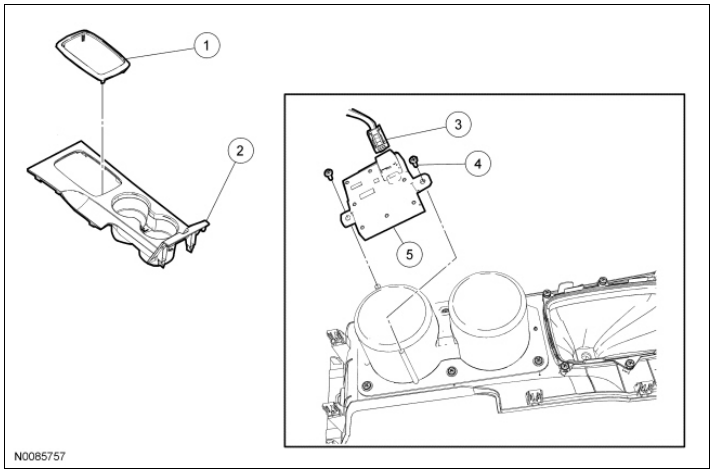
Removal and Installation

1. Remove the passenger air bag module. For additional information, refer to Section 501-20B .

2. Remove the 2 bolts and the Interior Lighting Control Module (ILCM).
   - To install, tighten to 1.6 Nm (14 lb-in).

3. To install, reverse the removal procedure.

Ambient Lighting Module



Item	Part Number	Description
1	061A16	Selector lever trim ring
2	045A76	Floor console finish panel
3	-	Ambient lighting module electrical connector (part of 14D375)
4	W701679	Ambient lighting module screws (2 required)
5	13C788	Ambient lighting module

Removal and Installation

1. If equipped with an automatic transaxle, remove the selector lever trim ring.

2. If equipped with a manual transaxle, remove the gearshift knob.

3. Open the storage compartment door.

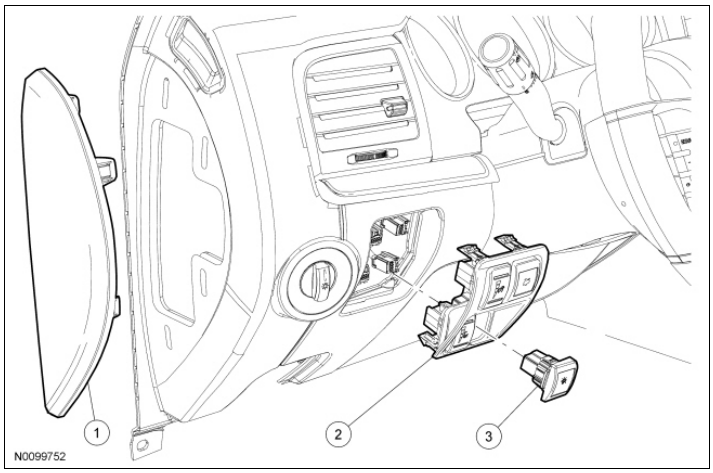
4. Pull the floor console finish panel straight up to release the retainer clips and remove the finish panel.
   - Disconnect the ambient lighting module electrical connector.

5. Remove the 2 screws and the ambient lighting module.

6. To install, reverse the removal procedure.

Ambient Lighting Switch

NOTE: Ambient select switch shown, ambient dimmer switch similar.



Item	Part Number	Description
1	5404481	Instrument panel side finish panel
2	5404338	Switch bezel
3	13D806	Ambient lighting select switch

Removal and Installation

1. Remove the instrument panel side finish panel.
2. **NOTE:** The switch bezel is removed by pushing from behind.

   Remove the switch bezel.

   - Disconnect the electrical connectors.
3. Release the tabs and remove the ambient lighting switch.
4. To install, reverse the removal procedure.

Communications Network

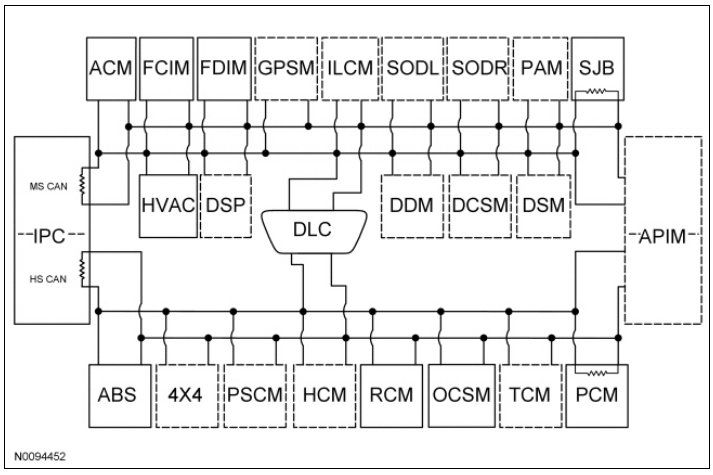
NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

Multiplexing is a method of sending 2 or more signals simultaneously over a single circuit. Multiplexing is used to allow 2 or more electronic modules (nodes) to communicate simultaneously over a twisted-wire pair [data (+) and data (-)] network. The information or messages that can be communicated on these wires consists of commands, status or data. The advantage of using multiplexing is to reduce the weight of the vehicle by reducing the number of redundant components and electrical wiring.

The vehicle has 2 module communication networks which are connected to the Data Link Connector (DLC), located under the instrument panel:

- High Speed Controller Area Network (HS-CAN)
- Medium Speed Controller Area Network (MS-CAN)

Network Topology



Module Name	Network Type	Termination Module
4X4 control module (if equipped)	HS-CAN	No
ABS module	HS-CAN	No
Accessory Protocol Interface Module (APIM) (if equipped)	HS-CAN MS-CAN	No No
Audio Front Control Module (ACM)	MS-CAN	No
Audio Digital Signal Processing (DSP) module (if equipped)	MS-CAN	No
Driver Door Module (DDM) (if equipped)	MS-CAN	No
Driver Seat Module (DSM) (if equipped)	MS-CAN	No
Dual Climate Controlled Seat Module (DCSM) (if equipped)	MS-CAN	No
Front Controls Interface Module (FCIM)	MS-CAN	No
Front Display Interface Module (FDIM)	MS-CAN	No

Global Positioning System Module (GPSM) (if equipped)	MS-CAN	No
Headlamp Control Module (HCM) (if equipped)	HS-CAN	No
HVAC module (if equipped)	MS-CAN	No
Interior Lighting Control Module (ILCM) (if equipped)	MS-CAN	No
Instrument Panel Cluster (IPC) (gateway module)	HS-CAN MS-CAN	Yes Yes
Occupant Classification System Module (OCSM)	HS-CAN	No
Parking Aid Module (PAM) (if equipped)	MS-CAN	No
Power Steering Control Module (PSCM) (if equipped)	HS-CAN	No
PCM	HS-CAN	Yes
Restraints Control Module (RCM)	HS-CAN	No
Smart Junction Box (SJB)	MS-CAN	Yes
Side Obstacle Detection Control Module - Left (SOD-L) (if equipped)	MS-CAN	No
Side Obstacle Detection Control Module - Right (SOD-R) (if equipped)	MS-CAN	No
Transmission Control Module (TCM) (if equipped)	HS-CAN	No

Network Termination

The CAN uses network termination to improve communication reliability. Termination modules are located at both ends of the network. As network messages are broadcast in the form of voltage signals, the network voltage signals are stabilized by the termination resistors.

Each termination module has an internal 120 ohm resistor that bridges across the positive and negative bus connection. With two 120 ohm resistors located in a parallel circuit configuration, the total network impedance, or total resistance, is 60 ohms.

Network termination improves bus message reliability by:

- stabilizing bus voltage.
- eliminating electrical interference.

Gateway Module

The IPC is the gateway module, translating messages on the HS-CAN to MS-CAN and vice versa. This allows a message to be distributed throughout both networks. The IPC is the only module on this vehicle that has this ability.

Communications Network - Hybrid

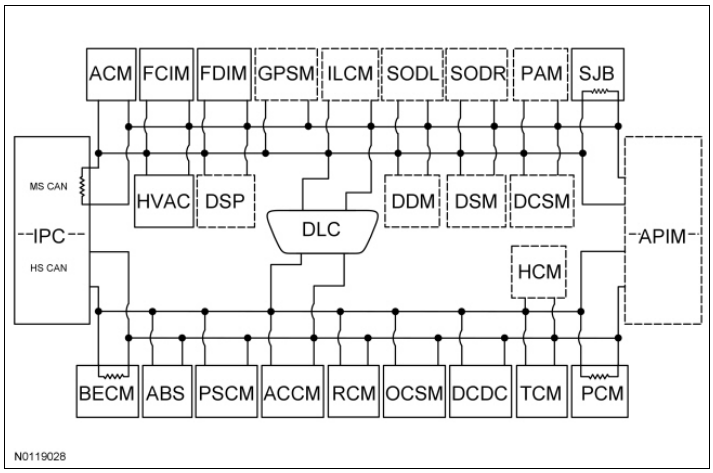
NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

Multiplexing is a method of sending 2 or more signals simultaneously over a single circuit. Multiplexing is used to allow 2 or more electronic modules (nodes) to communicate simultaneously over a twisted-wire pair [data (+) and data (-)] network. The information or messages that can be communicated on these wires consists of commands, status or data. The advantage of using multiplexing is to reduce the weight of the vehicle by reducing the number of redundant components and electrical wiring.

The vehicle has 2 module communication networks which are connected to the Data Link Connector (DLC), located under the instrument panel:

- High Speed Controller Area Network (HS-CAN)
- Medium Speed Controller Area Network (MS-CAN)

Network Topology



Module Name	Network Type	Termination Module
ABS module	HS-CAN	No
Accessory Protocol Interface Module (APIM) (if equipped)	HS-CAN MS-CAN	No/No
Air Conditioning Compressor Module (ACCM)	HS-CAN	No
Audio Front Control Module (ACM)	MS-CAN	No
Audio Digital Signal Processing (DSP) module (if equipped)	MS-CAN	No
Battery Energy Control Module (BECM)	HS-CAN	Yes
DC to DC Converter Control Module (DC/DC)	HS-CAN	No
Driver Door Module (DDM) (if equipped)	MS-CAN	No
Dual Climate Controlled Seat Module (DCSM) (if equipped)	MS-CAN	No
Driver Seat Module (DSM) (if equipped)	MS-CAN	No

Front Controls Interface Module (FCIM)	MS-CAN	No
Front Display Interface Module (FDIM)	MS-CAN	No
Global Positioning System Module (GPSM) (if equipped)	MS-CAN	No
Headlamp Control Module (HCM) (if equipped)	HS-CAN	No
HVAC module (if equipped)	MS-CAN	No
Interior Lighting Control Module (ILCM) (if equipped)	MS-CAN	No
Instrument Panel Cluster (IPC) (gateway module)	HS-CAN MS-CAN	No/Yes
Occupant Classification System Module (OCSM)	HS-CAN	No
Parking Aid Module (PAM) (if equipped)	MS-CAN	No
Power Steering Control Module (PSCM)	HS-CAN	No
PCM	HS-CAN	Yes
Restraints Control Module (RCM)	HS-CAN	No
Smart Junction Box (SJB)	MS-CAN	Yes
Side Obstacle Detection Control Module - Left (SOD-L) (if equipped)	MS-CAN	No
Side Obstacle Detection Control Module - Right (SOD-R) (if equipped)	MS-CAN	No
Transmission Control Module (TCM)	HS-CAN	No

Network Termination

The CAN uses network termination to improve communication reliability. Termination modules are located at both ends of the network. Each termination module has an internal 120 ohm resistor that bridges across the positive and negative network circuit. With two 120 ohm resistors located in a parallel circuit configuration, the total network impedance, or total resistance, is 60 ohms.

Network termination improves bus message reliability by:

- stabilizing bus voltage.
- eliminating electrical interference.

Gateway Module

The IPC is the gateway module, translating messages on the HS-CAN to MS-CAN and vice versa. This allows a message to be distributed throughout both networks. The IPC is the only module on this vehicle that has this ability.

Communications Network

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit 105-R025D or equivalent

Principles of Operation

Both the High Speed Controller Area Network (HS-CAN) and the Medium Speed Controller Area Network (MS-CAN) use an unshielded twisted-pair cable of data (+) and data (-) circuits. The HS-CAN operates at a maximum data transfer speed of 500 Kbps and is designed for applications in which modules must respond as rapidly as required by the driver or needed by the process being controlled. The MS-CAN operates at a maximum data transfer speed of 125 Kbps for bus messages and is designed for general information transfer.

High Speed Controller Area Network (HS-CAN) Modules

The following modules are on the HS-CAN :

- 4X4 control module (if equipped)
- ABS module
- Accessory Protocol Interface Module (APIM) (if equipped)
- Air Conditioning Compressor Module (ACCM) (Hybrid only)
- Battery Energy Control Module (BECM) (Hybrid only)
- DC to DC Converter Control Module (DC/DC) (Hybrid only)
- Headlamp Control Module (HCM) (if equipped)
- Instrument Panel Cluster (IPC) (gateway module)
- Occupant Classification System Module (OCSM)
- PCM
- Power Steering Control Module (PSCM) (if equipped)
- Restraints Control Module (RCM)
- Transmission Control Module (TCM) (if equipped)

Medium Speed Controller Area Network (MS-CAN) Modules

The following modules are on the MS-CAN :

- Accessory Protocol Interface Module (APIM) (if equipped)
- Audio Front Control Module (ACM)

- Audio Digital Signal Processing (DSP) module (if equipped)
- Driver Door Module (DDM) (if equipped)
- Driver Seat Module (DSM) (if equipped)
- Dual Climate Controlled Seat Module (DCSM) (if equipped)
- Front Controls Interface Module (FCIM)
- Front Display Interface Module (FDIM)
- Global Positioning System Module (GPSM) (if equipped)
- HVAC module (if equipped)
- Interior Lighting Control Module (ILCM) (if equipped)
- Instrument Panel Cluster (IPC) (gateway module)
- Parking Aid Module (PAM) (if equipped)
- Smart Junction Box (SJB)
- Side Obstacle Detection Control Module - Left (SOD-L) (if equipped)
- Side Obstacle Detection Control Module - Right (SOD-R) (if equipped)

Controller Area Network (CAN) Fault Tolerance

NOTE: The oscilloscope traces below are from the IDS oscilloscope taken using the IDS pre-configured CAN settings. The traces are for both data (+) and data (-) taken simultaneously (2-channel) at a sample rate of 1 mega-sample per second (1MS/s) or greater.

Traces below are viewed at 500mV per division (vertical axis) and 20 microseconds (20µ) per division (horizontal axis). Readings taken with a different oscilloscope vary from those shown. Compare any suspect readings to a known good vehicle.

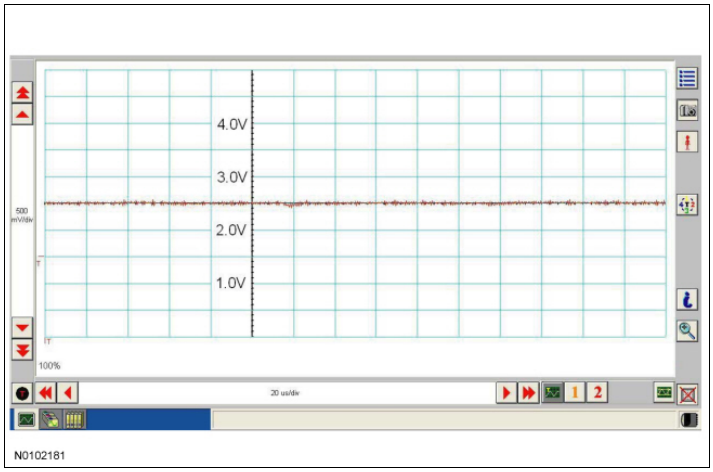
Normal CAN Operation



The data (+) and data (-) circuits are each regulated to approximately 2.5 volts during neutral or rested network traffic. As messages ae sent on the data (+) circuit, voltage is increased by approximately 1.0 volt. Inversely, the data (-) circuit is reduced by approximately 1.0 volt when a message is sent.

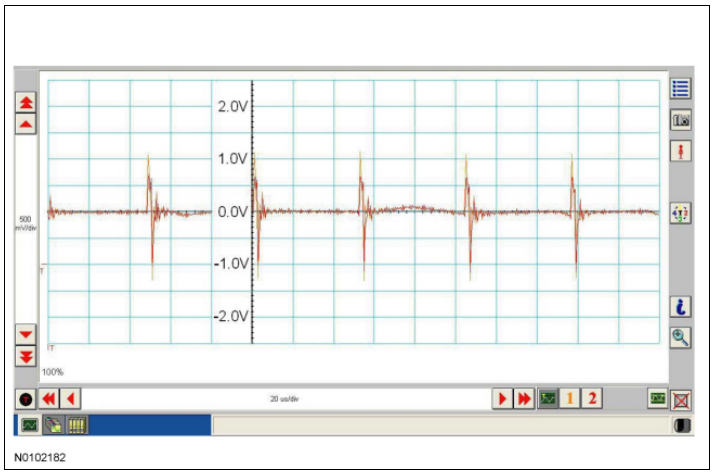
Successful communication of a message can usually be identified by the slight spike at the end of a message transmission. Any signals that are significantly different than the normal CAN waveform may cause network DTCs (U-codes) to set or may cause a complete network outage.

CAN Circuits Shorted Together



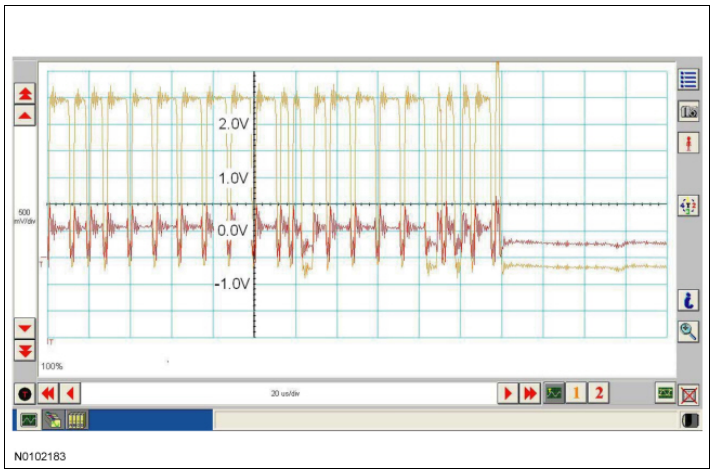
In the event that the data (+) and data (-) circuits become shorted together, the signal stays at base voltage (2.5V) continuously and all communication capabilities are lost.

CAN (+) Circuit Shorted To Ground



In the event that the data (+) circuit becomes shorted to ground, both the data (+) and data (-) circuits are pulled low (0V) and all communication capabilities are lost.

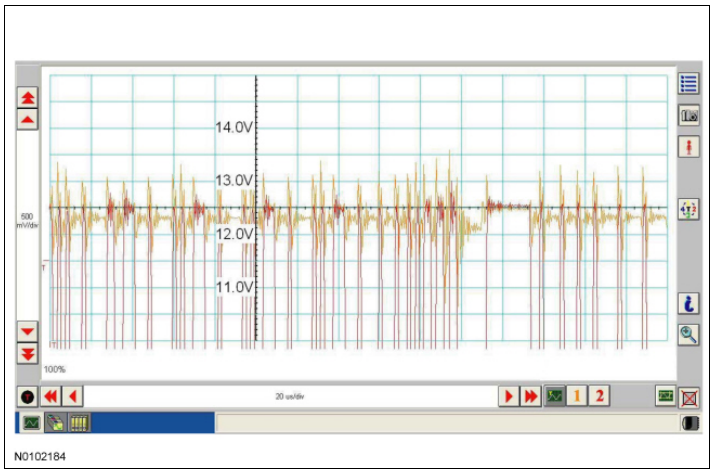
CAN (-) Circuit Shorted To Ground



In the event that the data (-) circuit becomes shorted to ground, the data (-) circuit is pulled low (0V) and the data (+) circuit reaches near-normal peak voltage (3.0V) during communication but falls to 0V instead of

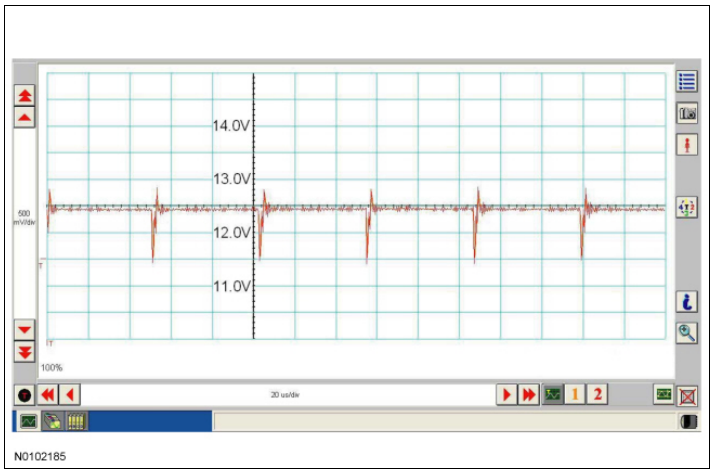
normal base voltage (2.5V). Communication may continue but at a degraded level.

CAN (+) Circuit Shorted To Battery Voltage



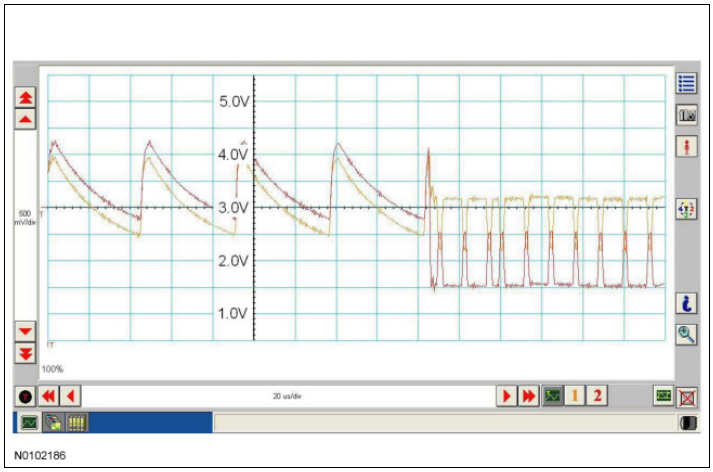
In the event that the data (+) circuit becomes shorted to battery voltage, the data (+) circuit is pulled high (12V) and the data (-) circuit falls to abnormally high voltage (above 5V) during communication and reaches battery voltage (12V) for peak voltage. Communication may continue but at a degraded level.

CAN (-) Circuit Shorted To Battery Voltage



In the event that the data (-) circuit becomes shorted to battery voltage, both the data (+) and data (-) circuits are pulled high (12V) and all communication capabilities are lost.

CAN Circuit Signal Corruption



Rhythmic oscillations, inductive spikes or random interference can disrupt the network communications. The corruption signal source may be outside electrical interference such as motors or solenoids or internal interference generated from a module on the network. In some cases, an open in either the data (+) or data (-) circuit to a network module may cause the module to emit interference on the one circuit which is still connected. The trace shown is an example of a "sawtooth" pattern transmitted from a module with one open network circuit.

Other corruptions may be present when a module is intermittently powered up and down. The module on power up may initiate communication out of sync with other modules on the network causing momentary communication outages.

Controller Area Network (CAN) Multiplex Messages

Modules on the CAN utilize simultaneous communication of 2 or more messages on the same network circuits. The following chart summarizes the messages sent and received on the network.

CAN Module Communication Message Chart - Gasoline Engine

NOTE: This chart describes the specific HS-CAN and MS-CAN messages broadcast by each module, and the module(s) that receive the message.

Broadcast Message	Originating Module	Network Type	Receiving Module(s)
4X4 indicator status	4X4 control module	HS-CAN	• IPC
4X4 mode	4X4 control module	HS-CAN	• ABS module
4X4 warning indicator request	4X4 control module	HS-CAN	• IPC
A/C clutch engagement request	HVAC module	MS-CAN	• IPC
A/C clutch engagement request (gateway)	IPC	HS-CAN	• PCM
A/C clutch engagement status	PCM	HS-CAN	

			• IPC
A/C clutch engagement status (gateway)	IPC	HS-CAN	• HVAC module
A/C recirculation mode request	PCM	HS-CAN	• IPC
A/C recirculation mode request (gateway)	IPC	MS-CAN	• HVAC module
ABS event in progress	ABS module	HS-CAN	• PCM • RCM • TCM
ABS Roll Stability Control (RSC®) chime malfunction status	ABS module	HS-CAN	• IPC
ABS warning indicator request	ABS module	HS-CAN	• IPC • RCM
Accelerator pedal position	PCM	HS-CAN	• 4X4 control module • ABS module • TCM
Accelerometer and yaw sensor data	ABS module	HS-CAN	• HCM • IPC • PSCM
Accelerometer and yaw sensor data (gateway)	IPC	MS-CAN	• ACM • GPSM • HCM
Accessory delay status	SJB	MS-CAN	• APIM • ACM • FCIM • FDIM • ILCM
Airbag deployment eCall confirmation	APIM	HS-CAN	• RCM
Airbag deployment eCall notification	RCM	HS-CAN	• APIM
Airbag deployment event data record	PCM	HS-CAN	• RCM
Airbag deployment status	RCM	HS-CAN	• IPC • OCSM • PCM
Airbag deployment status (gateway)	IPC	MS-CAN	• SJB

Airbag warning indicator request	RCM	HS-CAN	• IPC
Airbag warning indicator status	IPC	HS-CAN	• RCM
Ambient temperature, inferred	PCM	HS-CAN	• IPC
Ambient temperature, inferred (gateway)	IPC	MS-CAN	• SJB
Autolamp delay command	IPC	MS-CAN	• SJB
Autolamp delay status	SJB	MS-CAN	• IPC
Autolock command	IPC	MS-CAN	• SJB
Autolock status	SJB	MS-CAN	• IPC
Auto-unlock command	IPC	MS-CAN	• SJB
Auto-unlock status	SJB	MS-CAN	• IPC
Average fuel economy data	IPC	MS-CAN	• ACM
Average fuel economy reset request (with navigation ACM)	ACM	MS-CAN	• IPC
Axle ratio	PCM	HS-CAN	• ABS module • IPC
Axle ratio (gateway)	IPC	MS-CAN	• SJB
Barometric pressure	PCM	HS-CAN	• IPC • TCM
Barometric pressure (gateway)	IPC	MS-CAN	• SJB
Belt-Minder® warning status	RCM	HS-CAN	• IPC
Belt-Minder® warning status (gateway)	IPC	MS-CAN	• ACM
Belt-Minder® programming request	RCM	HS-CAN	• IPC
Brake (red) warning indicator request	ABS module	HS-CAN	• IPC • RCM
Brake fluid level low	SJB	MS-CAN	• IPC
Brake lamp switch status	PCM	HS-CAN	• 4X4 control module

			• ABS module • TCM
Charging system status	PCM	HS-CAN	• IPC
Charging system warning indicator request	PCM	HS-CAN	• IPC • PSCM
Climate controlled seat command	HVAC module	MS-CAN	• DCSM
Climate controlled seat status	DCSM	MS-CAN	• HVAC module
Compass display data	IPC	MS-CAN	• FDIM
Compass zone and calibration status	IPC	MS-CAN	• FDIM
Door ajar status	SJB	MS-CAN	• IPC
Driver door lock command	SJB	MS-CAN	• DDM
Driver door lock cylinder status	DDM	MS-CAN	• SJB
Driver door lock switch status	DDM	MS-CAN	• SJB
Easy entry/exit command	IPC	MS-CAN	• DSM
Easy entry/exit status	DSM	MS-CAN	• IPC
Engine coolant temperature	PCM	HS-CAN	• 4X4 control module • IPC • TCM
Engine coolant temperature (gateway)	IPC	MS-CAN	• HVAC module
Engine fail-safe cooling mode status	PCM	HS-CAN	• IPC
Engine fail-safe Electronic Throttle Control (ETC) status	PCM	HS-CAN	• TCM
Engine fail-safe ETC warning indicator request	PCM	HS-CAN	• IPC
Engine load percentage	PCM	HS-CAN	• TCM
Engine MIL request	PCM	HS-CAN	• IPC
Engine off timer	PCM	HS-CAN	

			• 4X4 control module • IPC
Engine off timer (gateway)	IPC	MS-CAN	• HVAC module
Engine RPM	PCM	HS-CAN	• 4X4 control module • ABS module • IPC • PSCM • TCM
Engine RPM (gateway)	IPC	MS-CAN	• DCSM • HVAC module
Engine RPM minimum request	PCM	HS-CAN	• TCM
Engine throttle position	PCM	HS-CAN	• TCM
Engine torque data	PCM	HS-CAN	• TCM
Engine torque data	PCM	HS-CAN	• ABS module • APIM • TCM
Engine torque reduction request	TCM	HS-CAN	• PCM
Engine torque reduction request	ABS module	HS-CAN	• PCM
Engine torque transfer request	ABS module	HS-CAN	• 4X4 control module
Engine type	PCM	HS-CAN	• ABS module • IPC
Engine type (gateway)	IPC	MS-CAN	• SJB
English/metric display (with navigation ACM)	ACM	MS-CAN	• IPC
English/metric mode	IPC	MS-CAN	• ACM • HVAC module

ePRNDL mode	IPC	HS-CAN	• PCM • TCM
FCIM button press data	FCIM	MS-CAN	• ACM • APIM • Audio DSP module • IPC
Fuel cap off indicator request	PCM	HS-CAN	• IPC
Fuel flow data	PCM	HS-CAN	• APIM • IPC
Fuel level (instant)	IPC	HS-CAN	• PCM
Fuel level status	IPC	MS-CAN	• ACM
Fuel level status	IPC	HS-CAN	• APIM
Fuel pump cutoff request	RCM	HS-CAN	• PCM
Headlamp high beam indicator request	SJB	MS-CAN	• IPC
Headlamp high beam indicator request (gateway)	IPC	HS-CAN	• HCM
Headlamp low beam status	SJB	MS-CAN	• IPC
Headlamp low beam status (gateway)	IPC	HS-CAN	• HCM
Headlamps on warning chime command	SJB	MS-CAN	• IPC
HVAC button status	FCIM	MS-CAN	• ACM • HVAC module
HVAC button status, navigation ACM	ACM	MS-CAN	• HVAC module
HVAC indicator status	HVAC module	MS-CAN	• ACM • FCIM
HVAC module display data	HVAC module	MS-CAN	• ACM • FDIM
HVAC voice request	ACM	MS-CAN	• HVAC module
Ignition key type	IPC	HS-CAN	• PCM

			• ABS module • RCM
Ignition key type	IPC	MS-CAN	• ACM
Ignition switch position	SJB	MS-CAN	• ACM • APIM • Audio DSP module • DCSM • DDM • DSM • FCIM • FDIM • GPSM • HVAC module • ILCM • IPC • PAM • SOD-R • SOD-L
Ignition switch position (gateway)	IPC	HS-CAN	• 4X4 control module • ABS module • HCM • PCM • TCM
IKT programming request	IPC	MS-CAN	• SJB
IKT programming status	SJB	MS-CAN	• IPC
Instrument illumination level	SJB	MS-CAN	• ACM • APIM • FCIM • FDIM • HVAC module • ILCM • IPC • SOD-L • SOD-R
Interior courtesy lamp battery saver status	SJB	MS-CAN	• ILCM
Interior courtesy lamp delay status	SJB	MS-CAN	• ILCM
Interior courtesy lamp door status	SJB	MS-CAN	

			• ILCM
Interior courtesy lamp illuminated entry status	SJB	MS-CAN	• ILCM
Key fob or Integrated Keyhead Transmitter (IKT) button status	SJB	MS-CAN	• DSM
Key fob or IKT ID	SJB	MS-CAN	• DSM
Key-in-ignition status	SJB	MS-CAN	• APIM • DCSM • DSM • ILCM • IPC
Key-in-ignition warning chime command	SJB	MS-CAN	• IPC
Keypad button status	SJB	MS-CAN	• DSM
Keypad ID	SJB	MS-CAN	• DSM
Low odometer status	IPC	MS-CAN	• HVAC module • SJB
Memory cancel command	DSM	MS-CAN	• DDM
Memory command	DSM	MS-CAN	• DDM
Memory set switch status	DDM	MS-CAN	• DSM
Mirror manual override	DDM	MS-CAN	• DSM
Navigation rolling wheel count	ABS module	HS-CAN	• IPC
Navigation rolling wheel count (gateway)	IPC	MS-CAN	• ACM • APIM • GPSM
Occupant Classification System (OCS) calibration data	OCSM	HS-CAN	• RCM
OCS fault status	OCSM	HS-CAN	• RCM
OCS object entrapped message request	OCSM	HS-CAN	• IPC
OCS sensor data	OCSM	HS-CAN	• IPC • RCM
OCS sensor data (gateway)	IPC	MS-CAN	• SJB
OCS serial number	OCSM	HS-CAN	

			• RCM
Odometer rolling count	PCM	HS-CAN	• APIM • IPC
Output Shaft Speed (OSS)	TCM	HS-CAN	• PCM
Park brake chime request	SJB	MS-CAN	• IPC
Park brake status	SJB	MS-CAN	• ACM • IPC
Park brake status (gateway)	IPC	HS-CAN	• 4X4 control module • PCM
Park lamp status	SJB	MS-CAN	• ACM • FCIM • HVAC module • ILCM • IPC • SOD-L • SOD-R
Parking aid enabled command	IPC	MS-CAN	• PAM
Parking aid enabled status	PAM	MS-CAN	• IPC
Parking aid fault status	PAM	MS-CAN	• IPC
Parking aid front warning command	IPC	MS-CAN	• PAM
Parking aid front warning status	PAM	MS-CAN	• IPC
Parking aid sounder volume cutback request	PAM	MS-CAN	• ACM
Passenger mirror switch status	DDM	MS-CAN	• DSM
Passenger seat belt buckle status	RCM	HS-CAN	• OCSM
Passive Anti-Theft System (PATS) security data	IPC	HS-CAN	• PCM
PATS security data	PCM	HS-CAN	• IPC
PATS security data	IPC	MS-CAN	• SJB
Perimeter alarm chime request	SJB	MS-CAN	• IPC
PSCM fault status	PSCM	HS-CAN	

			• IPC
RCM serial number	RCM	HS-CAN	• ABS module • OCSM
Reverse mirror command	IPC	MS-CAN	• DSM
Reverse mirror status	DSM	MS-CAN	• IPC
Seat belt indicator request	RCM	HS-CAN	• IPC
Seat belt warning chime request	RCM	HS-CAN	• IPC
Seat belt warning chime status	IPC	HS-CAN	• RCM
Side obstacle detection cross traffic alert	SOD-L	MS-CAN	• IPC • PAM
Side obstacle detection cross traffic alert	SOD-R	MS-CAN	• IPC • PAM
Side obstacle detection cross traffic command	IPC	MS-CAN	• SOD-L • SOD-R
Side obstacle detection cross traffic status	SOD-L	MS-CAN	• IPC
Side obstacle detection cross traffic status	SOD-R	MS-CAN	• IPC
Side obstacle detection enabled status	IPC	MS-CAN	• SOD-L • SOD-R
Side obstacle detection system status	SOD-L	MS-CAN	• IPC
Side obstacle detection system status	SOD-R	MS-CAN	• IPC
Speed control deactivation request	ABS module	HS-CAN	• PCM
Speed control indicator status	PCM	HS-CAN	• 4X4 control module • IPC
Speed control status	PCM	HS-CAN	• TCM
Stability control disable switch status	IPC	HS-CAN	• ABS module • PCM
Stability control event in progress	ABS module	HS-CAN	• PCM

			• RCM
Stability control indicator status	ABS module	HS-CAN	• IPC • RCM
Stability control present	ABS module	HS-CAN	• TCM
Steering wheel angle	PSCM	HS-CAN	• 4X4 control module • ABS module • HCM • RCM
Steering wheel angle offset	ABS module	HS-CAN	• PSCM
Target RPM request	TCM	HS-CAN	• PCM
TCM desired converter clutch mode	PCM	HS-CAN	• TCM
TCM desired gear	PCM	HS-CAN	• TCM
Tire revolutions per mile	PCM	HS-CAN	• ABS module • IPC • TCM
Tire revolutions per mile (gateway)	IPC	MS-CAN	• SJB
Tire size information	ABS module	HS-CAN	• IPC • PCM
Tire size information (gateway)	IPC	MS-CAN	• APIM
Torque transfer percent command	4X4 control module	HS-CAN	• ABS module
TPMS indicator command	SJB	MS-CAN	• APIM • IPC
TPMS sensor status	SJB	MS-CAN	• APIM
TPMS system status	SJB	MS-CAN	• APIM • IPC
Traction control event in progress	ABS module	HS-CAN	• PCM • RCM
Transmission ePRNDL display	PCM	HS-CAN	• IPC

Transmission ePRNDL display	TCM	HS-CAN	• IPC
Transmission forward clutch neutral idle status	TCM	HS-CAN	• PCM
Transmission gear actual	PCM	HS-CAN	• 4X4 control module • ABS module
Transmission gear actual	TCM	HS-CAN	• 4X4 control module • ABS module
Transmission malfunction indicator request	TCM	HS-CAN	• PCM
Transmission overdrive cancel status	PCM	HS-CAN	• IPC
Transmission overdrive cancel status	TCM	HS-CAN	• IPC
Transmission select shift present	IPC	HS-CAN	• TCM
Transmission selector (PRNDL) status	PCM	HS-CAN	• ABS module • HCM • IPC • RCM
Transmission selector (PRNDL) status	TCM	HS-CAN	• ABS module • HCM • IPC • RCM
Transmission selector (PRNDL) status (gateway)	IPC	MS-CAN	• ACM • APIM • DSM • GPSM • PAM • SJB • SOD-L • SOD-R
Transmission shift in progress	TCM	HS-CAN	• ABS • PCM
Transmission shift mode	PCM	HS-CAN	• IPC
Transmission shift mode	TCM	HS-CAN	• IPC

Transmission temperature	TCM	HS-CAN	• PCM
Turbine Shaft Speed (TSS)	TCM	HS-CAN	• PCM
Turn signal command	SJB	MS-CAN	• IPC
Vehicle speed	PCM	HS-CAN	• HCM • IPC • TCM
Vehicle speed (gateway)	IPC	MS-CAN	• ACM • Audio DSP module • GPSM • HVAC module • PAM • SJB • SOD-L • SOD-R
VIN information	PCM	HS-CAN	• 4X4 control module • ABS module • IPC • RCM • TCM
VIN information (gateway)	IPC	MS-CAN	• APIM • ACM • HVAC module • SJB
Wheel speed data	ABS module	HS-CAN	• 4X4 control module • PCM • TCM

CAN Module Communication Message Chart - Hybrid

NOTE: This chart describes the specific HS-CAN and MS-CAN messages broadcast by each module, and the module(s) that receive the message.

Broadcast Message	Originating Module	Network Type	Receiving Module(s)

A/C cabin air temperature	HVAC module	MS-CAN	• IPC
A/C cabin air temperature (gateway)	IPC	HS-CAN	• BECM • PCM
A/C compressor enabled status	ACCM	HS-CAN	• PCM
A/C compressor engagement request	HVAC module	MS-CAN	• IPC
A/C compressor engagement request (gateway)	IPC	HS-CAN	• PCM
A/C compressor maximum power consumption allowed	PCM	HS-CAN	• ACCM
A/C compressor power consumption	ACCM	HS-CAN	• PCM
A/C compressor speed	ACCM	HS-CAN	• PCM
A/C compressor status	PCM	HS-CAN	• ACCM • IPC
A/C compressor status (gateway)	IPC	MS-CAN	• HVAC module
A/C compressor target speed	PCM	HS-CAN	• ACCM
A/C evaporator temperature	HVAC module	MS-CAN	• IPC
A/C evaporator temperature (gateway)	IPC	HS-CAN	• PCM
A/C recirculation door status	HVAC module	MS-CAN	• IPC
A/C recirculation door status (gateway)	IPC	HS-CAN	• BECM • PCM
ABS braking active status	ABS module	HS-CAN	• PCM • TCM
ABS event in progress	ABS module	HS-CAN	• PCM • RCM
ABS fault status	ABS module	HS-CAN	• PCM
ABS Roll Stability Control (RSC®) chime malfunction status	ABS module	HS-CAN	• IPC
ABS self-test in operation status	ABS module	HS-CAN	• PCM
ABS warning indicator request	ABS module	HS-CAN	

- IPC
- RCM

Accelerometer and yaw sensor dataABS moduleHS-CAN

- IPC
- PSCM

Accelerometer and yaw sensor data (gateway)IPCMS-CAN

- ACM
- GPSM

Accessory delay statusSJBMS-CAN

- APIM
- ACM
- FCIM
- FDIM
- ILCM

Airbag deployment eCall confirmationAPIMHS-CAN

- RCM

Airbag deployment eCall notificationRCMHS-CAN

- APIM

Airbag deployment event data recordPCMHS-CAN

- RCM

Airbag deployment statusRCMHS-CAN

- IPC
- OCSM
- PCM

Airbag deployment status (gateway)IPCMS-CAN

- SJB

Airbag warning indicator requestRCMHS-CAN

- IPC

Airbag warning indicator statusIPCHS-CAN

- RCM

Ambient temperatureHVAC moduleMS-CAN

- ACM
- IPC

Ambient temperature (gateway)IPCHS-CAN

- PCM

Ambient temperature, inferredPCMHS-CAN

- ABS module
- ACCM
- BECM
- DC/DC
- IPC
- TCM

Autolamp delay commandIPCMS-CAN

- SJB

Autolamp delay statusSJBMS-CAN

- IPC

Autolock commandIPCMS-CAN

- SJB

Autolock statusSJBMS-CAN

- IPC

Auto-unlock commandIPCMS-CAN

- SJB

Auto-unlock statusSJBMS-CAN

- IPC

Average fuel economy dataIPCMS-CAN

- ACM

Average fuel economy reset request (navigation)ACMMS-CAN

- IPC

Barometric pressurePCMHS-CAN

- IPC

Barometric pressure (gateway)IPCMS-CAN

- HVAC module
- SJB

Belt-Minder® warning statusRCMHS-CAN

- IPC

Belt-Minder® warning status (gateway)IPCMS-CAN

- ACM

Belt-Minder® programming requestRCMHS-CAN

- IPC

Brake (red) warning indicator requestABS moduleHS-CAN

- IPC
- RCM

Brake fluid level lowSJBMS-CAN

- IPC

Brake lamp illuminated statusABS moduleHS-CAN

- IPC

Brake pedal positionABS moduleHS-CAN

- PCM

Brake system type configurationABS moduleHS-CAN

- IPC

Brake vacuum requestABS moduleHS-CAN

- PCM

Climate control mode statusHVAC moduleMS-CAN

- IPC

Climate control mode status (gateway)IPCHS-CAN

- PCM

Compass display dataIPCMS-CAN

- FDIM

Compass zone and calibration statusIPCMS-CAN

- FDIM

Door ajar statusSJBMS-CAN

- IPC

Door lock statusSJBMS-CAN

- IPC

Engine air inlet temperaturePCMHS-CAN

- BECM

Engine coolant temperaturePCMHS-CAN

- BECM
- IPC
- TCM

Engine coolant temperature (gateway)IPCMS-CAN

- HVAC module

Engine fail-safe cooling mode statusPCMHS-CAN

- IPC

Engine Malfunction Indicator Lamp (MIL) requestTCMHS-CAN

- PCM

Engine MIL requestPCMHS-CAN

- IPC

Engine MIL requestBECMHS-CAN

- PCM

Engine off timerPCMHS-CAN

- IPC

Engine off timer (gateway)IPCMS-CAN

- HVAC module

Engine RPMPCMHS-CAN

- ABS module
- BECM
- IPC

Engine RPM (gateway)IPCMS-CAN

- APIM
- HVAC module

Engine RPM desiredPCMHS-CAN

- TCM

Engine run/stop statusPCMHS-CAN

- TCM

Engine throttle positionPCMHS-CAN

- BECM
- TCM

Engine torque dataPCMHS-CAN

- ABS
- IPC
- TCM

Engine torque desiredPCMHS-CAN

- IPC
- TCM

Engine torque reduction requestABS moduleHS-CAN

- PCM

Engine typePCMHS-CAN

- IPC

Engine type (gateway)IPCMS-CAN

- SJB

English/metric display (navigation)ACMMS-CAN

- IPC

English/metric modeIPCMS-CAN

- ACM
- HVAC module

English/metric modeIPCHS-CAN

- PCM

FCIM button press dataFCIMMS-CAN

- ACM
- APIM
- Audio DSP module
- IPC

Fuel cap off indicator requestPCMHS-CAN

- IPC

Fuel cutoff requestTCMHS-CAN

- PCM

Fuel door open statusPCMHS-CAN

- IPC

Fuel economy historyIPCMS-CAN

- ACM

Fuel level (instant)IPCHS-CAN

- PCM

Fuel level statusIPCMS-CAN

- ACM

Fuel level statusIPCHS-CAN

- APIM

Fuel pump cutoff requestRCMHS-CAN

- BECM
- PCM

Headlamp high beam indicator requestSJBMS-CAN

- IPC

Headlamp low beam statusSJBMS-CAN

- IPC

Headlamps on warning chime commandSJBMS-CAN

- IPC

HVAC button statusFCIMMS-CAN

- ACM
- HVAC module

HVAC button status, navigation ACMACMMS-CAN

- HVAC module

HVAC indicator statusHVAC moduleMS-CAN

- ACM
- FCIM

HVAC module display dataHVAC moduleMS-CAN

- ACM
- FDIM

HVAC recirculation door overrideBECMHS-CAN

- IPC

HVAC recirculation door override (gateway)IPCMS-CAN

- HVAC module

HVAC recirculation door override (gateway)IPCMS-CAN

- HVAC module

HVAC voice requestACMMS-CAN

- HVAC module

Hybrid battery airflow volumeBECMHS-CAN

- IPC

Hybrid battery airflow volume (gateway)IPCMS-CAN

- HVAC module

Hybrid battery currentBECMHS-CAN

- IPC
- PCM
- TCM

Hybrid battery fault statusBECMHS-CAN

- PCM

Hybrid battery fault statusBECMHS-CAN

- PCM

Hybrid battery jumpstart active statusBECMHS-CAN

- PCM

Hybrid battery regeneration mode requestBECMHS-CAN

- PCM

Hybrid battery regeneration power dataBECMHS-CAN

- PCM

Hybrid battery state of charge dataBECMHS-CAN

- PCM

Hybrid battery state of charge display levelPCMHS-CAN

- IPC

Hybrid battery state of charge display level (gateway)IPCMS-CAN

- ACM
- HVAC module

Hybrid battery temperatureBECMHS-CAN

- IPC
- PCM
- TCM

Hybrid battery temperature (gateway)IPCMS-CAN

- HVAC module

Hybrid battery voltageBECMHS-CAN

- IPC
- PCM
- TCM

Hybrid brake regeneration faultABS moduleHS-CAN

- PCM

Hybrid brake torque requestABS moduleHS-CAN

- PCM

Hybrid charging system indicator requestDC/DCHS-CAN

- IPC
- PCM
- PSCM

Hybrid contactor control requestPCMHS-CAN

- TCM

Hybrid contactor statusBECMHS-CAN

- PCM
- TCM

Hybrid DC/DC system statusDC/DCHS-CAN

- BECM
- PCM

Hybrid DC/DC voltage statusDC/DCHS-CAN

- BECM
- IPC
- PCM

Hybrid engine load percentagePCMHS-CAN

- BECM
- TCM

Hybrid engine sync counter cylinder IDPCMHS-CAN

- TCM

Hybrid generator coil temperatureTCMHS-CAN

- PCM

Hybrid generator error statusTCMHS-CAN

- PCM

Hybrid generator inverter temperatureTCMHS-CAN

- PCM

Hybrid generator modePCMHS-CAN

- TCM

Hybrid generator speedTCMHS-CAN

- IPC
- PCM

Hybrid generator torque commandTCMHS-CAN

- IPC
- PCM

Hybrid global snapshot timerBECMHS-CAN

- ACCM
- ABS module
- DC/DC

- IPC
- PCM
- TCM

Hybrid hazard warning indicator requestBECMHS-CAN

- IPC

Hybrid hazard warning indicator requestTCMHS-CAN

- IPC

Hybrid hazard warning indicator requestPCMHS-CAN

- IPC

Hybrid heater pump requestHVAC moduleMS-CAN

- IPC

Hybrid heater pump request (gateway)IPCHS-CAN

- PCM

Hybrid heater pump statusPCMHS-CAN

- IPC

Hybrid heater pump status (gateway)IPCMS-CAN

- HVAC module

Hybrid inverter voltageTCMHS-CAN

- BECM
- PCM

Hybrid minimum engine speed requestTCMHS-CAN

- PCM

Hybrid motor coil temperatureTCMHS-CAN

- PCM

Hybrid motor coolant over temperature warningPCMHS-CAN

- IPC

Hybrid motor coolant temperaturePCMHS-CAN

- DC/DC
- TCM

Hybrid motor error statusTCMHS-CAN

- PCM

Hybrid motor inverter temperatureTCMHS-CAN

- PCM

Hybrid motor torque commandTCMHS-CAN

- IPC
- PCM

Hybrid motor torque dataTCMHS-CAN

- PCM

Hybrid odometer countTCMHS-CAN

- PCM

Hybrid operating modePCMHS-CAN

- BECM
- TCM

Hybrid powertrain efficiency glow percentagePCMHS-CAN

- IPC

Hybrid powertrain malfunction indicator requestBECMHS-CAN

- IPC

Hybrid powertrain malfunction indicator requestTCMHS-CAN

- IPC

Hybrid powertrain malfunction indicator requestPCMHS-CAN

- IPC

Hybrid powertrain powerflow display dataPCMHS-CAN

- IPC

Hybrid powertrain powerflow display data (gateway)IPCMS-CAN

- ACM
- HVAC module

Hybrid powertrain powerflow display textPCMHS-CAN

- IPC

Hybrid powertrain powerflow display text (gateway)IPCMS-CAN

- ACM
- HVAC module

Hybrid powertrain status engine activePCMHS-CAN

- IPC

Hybrid powertrain status engine active (gateway)IPCMS-CAN

- ACM
- HVAC module

Hybrid powertrain status front axle activePCMHS-CAN

- IPC

Hybrid powertrain status front axle active (gateway)IPCMS-CAN

- ACM
- HVAC module

Hybrid powertrain status high voltage battery activePCMHS-CAN

- IPC

Hybrid powertrain status high voltage battery active (gateway)IPCMS-CAN

- ACM
- HVAC module

Hybrid powertrain status motor/generator activePCMHS-CAN

- IPC

Hybrid powertrain status motor/generator active (gateway)IPCMS-CAN

- ACM
- HVAC module

Hybrid ready light statusPCMHS-CAN

- ABS
- BECM
- DC/DC
- IPC
- PSCM

Hybrid transmission temperatureTCMHS-CAN

- PCM

Ignition key typeIPCHS-CAN

- PCM
- ABS module
- RCM

Ignition key typeIPCMS-CAN

- ACM

Ignition switch positionSJBMS-CAN

- ACM
- APIM
- Audio DSP module
- FCIM
- FDIM
- GPSM
- HVAC module

Ignition switch position (gateway)IPCHS-CAN

- ABS module
- PCM
- TCM
- ACCM
- BECM
- DC/DC

Ignition switch positionSJBMS-CAN

- ILCM
- IPC
- PAM
- SOD-R
- SOD-L

IKT programming requestIPCMS-CAN

- SJB

IKT programming statusSJBMS-CAN

- IPC

Instrument illumination levelSJBMS-CAN

- ACM
- APIM
- FCIM
- FDIM
- HVAC module
- ILCM
- IPC
- SOD-L
- SOD-R

Interior courtesy lamp battery saver statusSJBMS-CAN

- ILCM

Interior courtesy lamp delay statusSJBMS-CAN

- ILCM

Interior courtesy lamp door statusSJBMS-CAN

- ILCM

Interior courtesy lamp illuminated entry statusSJBMS-CAN

- ILCM

Key-in-ignition statusSJBMS-CAN

- APIM
- ILCM
- IPC

Key-in-ignition warning chime commandSJBMS-CAN

- IPC

Low odometer statusIPCMS-CAN

- HVAC module
- SJB

MyKey maximum speed commandIPCHS-CAN

- PCM

MyKey volume commandIPCMS-CAN

- ACM

Navigation rolling wheel countABS moduleHS-CAN

- IPC

Navigation rolling wheel count (gateway)IPCMS-CAN

- ACM
- APIM
- GPSM

OCS calibration dataOCSMHS-CAN

- RCM

OCS fault statusOCSMHS-CAN

- RCM

OCS object entrapped message requestOCSMHS-CAN

- IPC

OCS sensor dataOCSMHS-CAN

- IPC
- RCM

OCS sensor data (gateway)IPCMS-CAN

- SJB

OCS serial numberOCSMHS-CAN

- RCM

Odometer rolling countPCMHS-CAN

- IPC

Park brake chime requestSJBMS-CAN

- IPC

Park brake statusSJBMS-CAN

- ACM
- IPC

Park brake status (gateway)IPCHS-CAN

- PCM
- ABS module
- IPC

Park lamp statusSJBMS-CAN

- FCIM
- HVAC module
- ILCM
- IPC
- SOD-L
- SOD-R

Parking aid enabled commandIPCMS-CAN

- PAM

Parking aid enabled statusPAMMS-CAN

- IPC

Parking aid fault statusPAMMS-CAN

- IPC

Parking aid front warning commandIPCMS-CAN

- PAM

Parking aid front warning statusPAMMS-CAN

- IPC

Parking aid sounder volume cutback requestPAMMS-CAN

- ACM

Passenger seat belt buckle statusRCMHS-CAN

- OCSM

Passive Anti-Theft System (PATS) security dataIPCHS-CAN

- TCM

PATS security dataTCMHS-CAN

- IPC

PATS security dataIPCMS-CAN

- SJB

Perimeter alarm chime requestSJBMS-CAN

- IPC

PSCM fault statusPSCMHS-CAN

- IPC

RCM serial numberRCMHS-CAN

- ABS module
- OCSM

Seat belt indicator requestRCMHS-CAN

- IPC

Seat belt warning chime requestRCMHS-CAN

- IPC

Seat belt warning chime statusIPCHS-CAN

- RCM

Side obstacle detection cross traffic alertSOD-LMS-CAN

- IPC
- PAM

Side obstacle detection cross traffic alertSOD-RMS-CAN

- IPC
- PAM

Side obstacle detection cross traffic commandIPCMS-CAN

- SOD-L
- SOD-R

Side obstacle detection cross traffic statusSOD-LMS-CAN

- IPC

Side obstacle detection cross traffic statusSOD-RMS-CAN

- IPC

Side obstacle detection enabled statusIPCMS-CAN

- SOD-L
- SOD-R

Side obstacle detection system statusSOD-LMS-CAN

- IPC

Side obstacle detection system statusSOD-RMS-CAN

- IPC

Speed control deactivation requestABS moduleHS-CAN

- PCM

Speed control indicator statusPCMHS-CAN

- IPC

Stability control event in progressABS moduleHS-CAN

- PCM
- RCM

Stability control indicator statusABS moduleHS-CAN

- IPC

- RCM

Stability control presentABS moduleHS-CAN

- IPC

Steering column torquePSCMHS-CAN

- IPC

Steering wheel anglePSCMHS-CAN

- ABS module
- RCM

Steering wheel angle offsetABS moduleHS-CAN

- PSCM

TCM error statusTCMHS-CAN

- PCM

Tire revolutions per milePCMHS-CAN

- ABS module
- IPC
- TCM

Tire size informationABS moduleHS-CAN

- IPC

Tire size information (gateway)IPCMS-CAN

- APIM
- GPSM

TPMS indicator commandSJBMS-CAN

- APIM
- IPC

TPMS sensor statusSJBMS-CAN

- APIM

TPMS system statusSJBMS-CAN

- APIM
- IPC

Traction control event in progressABS moduleHS-CAN

- IPC
- PCM
- RCM

Transmission selector (PRNDL) statusPCMHS-CAN

- ABS module
- BECM
- DC/DC
- IPC
- TCM

Transmission selector (PRNDL) status (gateway)IPCMS-CAN

- ACM
- APIM
- GPSM
- PAM
- SJB
- SOD-L
- SOD-R

Turn signal commandSJBMS-CAN

- IPC

Vehicle rolling directionPCMHS-CAN

- ABS module

Vehicle rolling direction confirmationABS moduleHS-CAN

- PCM

Vehicle speedTCMHS-CAN

- BECM
- IPC
- PCM
- PSCM

Vehicle speed (gateway)IPCMS-CAN

- ACM
- APIM
- Audio DSP module
- GPSM
- HVAC module
- PAM
- SJB
- SOD-L
- SOD-R

VIN informationPCMHS-CAN

- ABS module
- IPC
- RCM
- TCM
- ACCM
- BECM
- DC/DC

VIN information (gateway)IPCMS-CAN

- APIM
- ACM
- HVAC module
- SJB

Wheel speed dataABS moduleHS-CAN

- PCM
- TCM

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.
   - If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

Visual Inspection Chart

Electrical
• BJB fuse(s): ♦ 12 (30A) (no communication with the DCSM) ♦ 16 (5A) (no communication with the TCM (3.5L only)) ♦ 17 (10A) (no communication with the BECM (hybrid only)) ♦ 19 (25A) (no communication with audio Digital Signal Processing (DSP) module ♦ 20 (20A) (no communication with the audio DSP module) ♦ 21 (20A) (no communication with the audio DSP module) ♦ 23 (10A) (no communication with the PCM, TCM (hybrid only)) ♦ 32 (30A) (no communication with the DSM) ♦ 39 (10A) (no communication with the TCM (hybrid only)) ♦ 40 (10A) (no communication with the PCM (hybrid only)) ♦ 42 (10A) (no communication with the ABS module (gasoline engine only)) ♦ 44 (10A) (no communication with the TCM (3.5L only)) ♦ 46 (15A) (no communication with the PCM (gasoline engine only)) ♦ 47 (10A) (no communication with the ABS module (hybrid only), ACCM (hybrid only), DC/DC (hybrid only))

- ♦ 48 (20A) (no communication with the BECM (hybrid only))
- SJB fuse(s):
  - ♦ 5 (10A) (no communication with the SJB)
  - ♦ 11 (10A) (no communication with the 4X4 control module)
  - ♦ 12 (7.5A) (no communication with the DDM)
  - ♦ 13 (5A) (no communication with the APIM)
  - ♦ 14 (10A) (no communication with the FCIM , FDIM , ILCM , GPSM)
  - ♦ 15 (10A) (no communication with the HVAC module)
  - ♦ 20 (15A) (no power to the scan tool)
  - ♦ 26 (15A) (no communication with the IPC)
  - ♦ 29 (5A) (no communication with the IPC)
  - ♦ 32 (10A) (no communication with the RCM)
  - ♦ 35 (10A) (no communication with the 4X4 control module, PAM , SOD-L , SOD-R)
  - ♦ 39 (20A) (no communication with the ACM)
  - ♦ 42 (10A) (no communication with the HCM , PSCM)
  - ♦ 46 (7.5A) (no communication with the OCSM)
- DLC
- Wiring harness
- Wiring, terminals or connectors

3. Connect the scan tool to the Data Link Connector (DLC).
   - **NOTE:** Make sure to use the latest scan tool software release.

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

     If the Integrated Diagnostic System (IDS) does not communicate with the VCM :

     - ♦ Check the VCM connection to the vehicle.
     - ♦ Check the scan tool connection to the VCM .
     - ♦ GO to Pinpoint Test AF , to diagnose No Power To The Scan Tool.

4. Establish a scan tool session.
   - **NOTE:** The scan tool will first attempt to communicate with the PCM, after establishing communication with the PCM, the scan tool will then attempt to communicate with all other modules on the vehicle.

     If an IDS session cannot be established with the vehicle, (IDS may state "No communication can be established with the PCM"):

     - ♦ Choose "NO" when the scan tool prompts whether or not to retry communication.
     - ♦ Enter either a PCM part number, tear tag or calibration number to identify the vehicle and start a session (the PCM part number and 4-character tear tag are printed on the PCM label).
     - ♦ GO to Pinpoint Test A , to diagnose The PCM Does Not Respond To The Scan Tool.

5. Carry out the network test.
   - If the network test passes, retrieve and record the continuous memory DTCs and proceed to Step 6.
   - If the network test fails, GO to Symptom Chart to diagnose the failed communication network.
   - If a module fails to communicate during the network test, GO to Symptom Chart .

6. Retrieve and review the DTCs.
    - If the DTCs retrieved are related to the concern, go to DTC Charts. Follow the non-network DTC diagnostics (B-codes, C-codes, P-codes) prior to the network DTC diagnostics (U-codes). For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .
    - If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

NOTE: Network DTCs (U-codes) are often a result of intermittent concerns such as damaged wiring or low battery voltage occurrences. Additionally, vehicle service procedures such as module reprogramming will often set network DTCs. Replacing a module to resolve a network DTC is unlikely to resolve the concern. To prevent repeat network DTC concerns, inspect all network wiring, especially connectors. Test the vehicle battery, refer to Section 414-01 .

Communication Network DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Source	Action
U0001	High Speed CAN Communication Bus	ABS module	The module could not communicate on the network at a point in time. The fault is currently not present. CLEAR the DTC. REPEAT the network test with the scan tool.
U0001:88	High Speed CAN Communication Bus: Bus Off	ABS module DC/DC HCM PSCM	The module could not communicate on the network at a point in time. The fault is currently not present. CLEAR the DTC. REPEAT the network test with the scan tool.
U0002:88	High Speed CAN Communication Bus Performance: Bus Off	IPC	The module could not communicate on the network at a point in time. The fault is currently not present. CLEAR the DTC. REPEAT the network test with the scan tool.
U0011:88	Medium Speed CAN Communication Bus Performance: Bus Off	IPC	The module could not communicate on the network at a point in time. The fault is currently not present. CLEAR the DTC. REPEAT the network test with the scan tool.
U0028:08	Vehicle Communication Bus A: Bus Signal / Message Failures	RCM	The module could not communicate on the network at a point in time. The fault is currently not present. CLEAR the DTC. REPEAT the network test with the scan tool.
U0028:88	Vehicle Communication Bus A: Bus Off	OCSM RCM	The module could not communicate on the network at a point in time. The fault is currently not present. CLEAR the DTC. REPEAT the

			network test with the scan tool.
U0073	Control Module Communication Bus A Off	TCM	The module could not communicate on the network at a point in time. The fault is currently not present. CLEAR the DTC. REPEAT the network test with the scan tool.
U0074:00	Control Module Communication Bus B Off: No Sub Type Information	BECM	Refer to Section 100-01 .
U0100	Lost Communication With ECM /PCM	4X4 control module ABS module TCM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test A .
U0100:00	Lost Communication With ECM /PCM "A": No Sub Type Information	ABS module ACCM APIM BECM DC/DC IPC PSCM RCM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test A .
U0100:87	Lost Communication With ECM /PCM "A": Missing Message	HCM OCSM TCM (Hybrid)	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test A .
U0101	Lost Communication With TCM	ABS module	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test G .
U0101:00	Lost Communication With TCM : No Sub Type Information	BECM DC/DC IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test G .
U0101:87	Lost Communication With TCM : Missing Message	HCM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test G .
U0102:00	Lost Communication With Transfer Case Control Module: No Sub Type Information	IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test H .

U010F:00	Lost Communication With Air Conditioning Control Module: No Sub Type Information	IPC (Hybrid)	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test K .
U0111:00	Lost Communication With Battery Energy Control Module "A": No Sub Type Information	IPC (Hybrid)	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test J .
U0111:87	Lost Communication With Battery Energy Control Module "A": Missing Message	TCM (Hybrid)	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test J .
U0114	Lost Communication With Four-Wheel Drive Clutch Control Module	ABS module	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test H .
U0114:00	Lost Communication With Four-Wheel Drive Clutch Control Module: No Sub Type Information	ABS module	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test H .
U0121	Lost Communication With Anti-Lock Brake System (ABS) Control Module	4X4 control module	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test B .
U0121:00	Lost Communication With Anti-Lock Brake System (ABS) Control Module: No Sub Type Information	IPC PSCM RCM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test B .
U0121:87	Lost Communication With Anti-Lock Brake System (ABS) Control Module: Missing Message	HCM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test B .
U0126:87	Lost Communication With Steering Angle Sensor Module: Missing Message	HCM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test D .
U0129:87	Lost Communication With Brake System Control Module: Missing Message	TCM (Hybrid)	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test B .
U0131:00	Lost Communication With Power Steering Control Module: No Sub Type Information	IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test D .
U0131:87	Lost Communication With Power Steering Control Module: Missing Message	ABS module	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test D .
U0140	Lost Communication With Body Control Module (GEM)	ABS module ACM DDM DSM FCIM FDIM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test U .

		PAM ILCM	
U0140:00	Lost Communication With Body Control Module (GEM): No Sub Type Information	ACM APIM Audio DSP module FCIM GPSM HVAC module IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test U .
U0151:00	Lost Communication With Restraints Control Module: No Sub Type Information	APIM BECM IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test E .
U0151:87	Lost Communication With Restraints Control Module: Missing Message	ABS module OCSM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test E .
U0151:88	Lost Communication With Restraints Control Module: Bus Off	ABS module	The module could not communicate on the network at a point in time. The fault is currently not present. CLEAR the DTC. REPEAT the network test with the scan tool.
U0154:00	Lost Communication With Restraints Occupant Classification System Module: No Sub Type Information	RCM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test F .
U0155	Lost Communication With Instrument Panel Cluster (IPC) Module	4X4 control module ABS module ACM DSM FDIM GPSM PAM SJB	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test C .

U0155:00	Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	ACCM ACM APIM Audio DSP module BECM DC/DC HVAC module RCM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test C .
U0155:87	Lost Communication With Instrument Panel Cluster (IPC) Control Module: Missing Message	ABS module HCM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test C .
U0159	Lost Communication With Parking Assist Control Module (PAM)	ACM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test T .
U0159:00	Lost Communication With Parking Assist Control Module (PAM): No Sub Type Information	ACM IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test T .
U0161:00	Lost Communication With Compass Module: No Sub Type Information	IPC	REFER to Section 413-01 .
U0162:00	Lost Communication With Navigation Display Module: No Sub Type Information	ACM	REFER to Section 415-00 .
U0163:00	Lost Communication With Navigation Control Module: No Sub Type Information	IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test N .
U0164	Lost Communication With HVAC Control Module	FCIM FDIM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test V .
U0164:00	Lost Communication With HVAC Control Module: No Sub Type Information	ACM IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test V .
U016A:00	Lost Communication With Global Positioning System Module: No Sub Type Information	APIM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test P .
U0184	Lost Communication With Radio (ACM)	FCIM FDIM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test M .
U0184:00	Lost Communication With Radio: No Sub Type Information	APIM Audio DSP module	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test M .

		FCIM IPC	
U0193	Lost Communication With Digital Audio Control Module (SDARS)	ACM FDIM	REFER to Section 415-00 .
U0193:00	Lost Communication With Digital Audio Control Module (SDARS): No Sub Type Information	ACM	REFER to Section 415-00 .
U0196	Lost Communication With Entertainment Control Module - Rear (AUX)	ACM FDIM	REFER to Section 415-00 .
U0196:00	Lost Communication With Entertainment Control Module - Rear "A": No Sub Type Information	ACM Audio DSP module	REFER to Section 415-00 .
U0197	Lost Communication With Telephone Control Module	ACM FDIM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test AA .
U0197:00	Lost Communication With Telephone Control Module: No Sub Type Information	ACM Audio DSP module	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test AA .
U0208:00	Lost Communication With Seat Control Module "A": No Sub Type Information	IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test Z .
U0232:00	Lost Communication With Side Obstacle Detection Control Module - Left: No Sub Type Information	IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test R .
U0233:00	Lost Communication With Side Obstacle Detection Control Module - Right: No Sub Type Information	IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test S .
U0238	Lost Communication With Digital Audio Control Module "D" (DSP)	ACM FDIM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test W .
U0238:00	Lost Communication With Digital Audio Control Module "D" (DSP): No Sub Type Information	ACM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test W .
U0241:00	Lost Communication With Headlamp Control Module "A": No Sub Type Information	IPC	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test I .
U0249	Lost Communication With Entertainment Control Module - Rear "B" (RCU)	ACM FDIM	REFER to Section 415-00 .
U0249:00	Lost Communication With Entertainment Control Module - Rear "B" (RCU): No Sub Type Information	ACM	REFER to Section 415-00 .
U0253:00	Lost Communication With Accessory Protocol Interface	RCM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to

	Module: No Sub Type Information		Pinpoint Test AA .
U0255	Lost Communication With Front Controls Interface Module	ACM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test N .
U0255:00	Lost Communication With Front Display Interface Module: No Sub Type Information	ACM APIM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test O .
U0256	Lost Communication With Front Display Interface Module	ACM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test O .
U0256:00	Lost Communication With Front Controls Interface Module: No Sub Type Information	ACM APIM	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test N .
U0294:87	Lost Communication With Powertrain Control Monitor Module: Missing Message	TCM (Hybrid)	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test A .
U0298:00	Lost Communication With DC to DC Converter Control Module "A": No Sub Type Information	BECM IPC (Hybrid)	CLEAR the DTC. REPEAT the network test with the scan tool. If the DTC returns, GO to Pinpoint Test L .
U029A:00	Lost Communication With Hybrid Battery Pack Sensor Module: No Sub Type Information	BECM	REFER to Section 414-03 .
U0401	Invalid Data Received from ECM /PCM A	4X4 control module ABS module	RETRIEVE and FOLLOW the DTCs from the PCM.
U0401:00	Invalid Data Received from ECM /PCM "A": No Sub Type Information	ABS module PSCM RCM	RETRIEVE and FOLLOW the DTCs from the PCM.
U0401:66	Invalid Data Received from ECM /PCM "A": Signal Has Too Many Transitions / Events	BECM	RETRIEVE and FOLLOW the DTCs from the PCM.
U0401:68	Invalid Data Received from ECM /PCM "A": Event Information	ACCM BECM DC/DC IPC	RETRIEVE and FOLLOW the DTCs from the PCM.
U0401:86	Invalid Data Received from ECM /PCM "A": Signal Invalid	HCM	RETRIEVE and FOLLOW the DTCs from the PCM.
U0402	Invalid Data Received from TCM	ABS module	RETRIEVE and FOLLOW the DTCs from the TCM .

U0402:68	Invalid Data Received from TCM : Event Information	BECM IPC	RETRIEVE and FOLLOW the DTCs from the TCM .
U0402:86	Invalid Data Received from TCM : Signal Invalid	HCM	RETRIEVE and FOLLOW the DTCs from the TCM .
U040A:68	Invalid Data Received from Air Conditioning Control Module: Event Information	IPC	RETRIEVE and FOLLOW the DTCs from the ACCM .
U0412:68	Invalid Data Received from Battery Energy Control Module A: Event Information	IPC (Hybrid)	RETRIEVE and FOLLOW the DTCs from the BECM .
U0412:81	Invalid Data Received from Battery Energy Control Module A: Invalid Serial Data Received	TCM (Hybrid)	RETRIEVE and FOLLOW the DTCs from the BECM .
U0414	Invalid Data Received From Four-Wheel Drive Clutch Control Module	ABS module	RETRIEVE and FOLLOW the DTCs from the 4X4 control module.
U0415	Invalid Data Received From Anti-Lock Brake System (ABS) Control Module	4X4 control module	RETRIEVE and FOLLOW the DTCs from the ABS module.
U0415:00	Invalid Data Received From Anti-Lock Brake System (ABS) Control Module: No Sub Type Information	PSCM	RETRIEVE and FOLLOW the DTCs from the ABS module.
U0415:68	Invalid Data Received from Anti-Lock Brake System (ABS) Control Module: Event Information	IPC	RETRIEVE and FOLLOW the DTCs from the ABS module.
U0415:86	Invalid Data Received from Anti-Lock Brake System (ABS) Control Module: Signal Invalid	HCM	RETRIEVE and FOLLOW the DTCs from the ABS module.
U0420:87	Invalid Data Received From Power Steering Control Module: Missing Message	ABS module	RETRIEVE and FOLLOW the DTCs from the PSCM .
U0422:00	Invalid Data Received From Body Control Module: No Sub Type Information	GPSM	RETRIEVE and FOLLOW the DTCs from the SJB .
U0422:68	Invalid Data Received From Body Control Module: Event Information	HVAC module IPC	RETRIEVE and FOLLOW the DTCs from the SJB .
U0423:00	Invalid Data Received From Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	APIM GPSM	RETRIEVE and FOLLOW the DTCs from the IPC .
U0423:64	Invalid Data Received From Instrument Panel Cluster (IPC) Control Module: Signal Plausibility Failure	ABS module	RETRIEVE and FOLLOW the DTCs from the IPC .
U0423:68	Invalid Data Received From Instrument Panel Cluster (IPC) Control Module: Event Information	ACCM HVAC	RETRIEVE and FOLLOW the DTCs from the IPC .

		module	
U0423:86	Invalid Data Received From Instrument Panel Cluster (IPC) Control Module: Signal Invalid	HCM	RETRIEVE and FOLLOW the DTCs from the IPC .
U0424:68	Invalid Data Received From HVAC Control Module: Event Information	BECM	RETRIEVE and FOLLOW the DTCs from the HVAC module.
U0428:86	Invalid Data Received From Steering Angle Sensor Module: Signal Invalid	HCM	RETRIEVE and FOLLOW the DTCs from the PSCM .
U0430:68	Invalid Data Received From Tire Pressure Monitor Module: Event Information	HVAC module	RETRIEVE and FOLLOW the DTCs from the SJB .
U0442:86	Invalid Data Received From ECM /PCM "B": Signal Invalid	OCSM	RETRIEVE and FOLLOW the DTCs from the PCM.
U0452:00	Invalid Data Received from Restraints Control Module A: No Sub Type Information	BECM	RETRIEVE and FOLLOW the DTCs from the RCM .
U0452:29	Invalid Data Received from Restraints Control Module A: Signal Invalid	ABS module	RETRIEVE and FOLLOW the DTCs from the RCM .
U0452:68	Invalid Data Received from Restraints Control Module A: Event Information	IPC	RETRIEVE and FOLLOW the DTCs from the RCM .
U0452:86	Invalid Data Received From Restraints Control Module A: Signal Invalid	OCSM	RETRIEVE and FOLLOW the DTCs from the RCM .
U0462:00	Invalid Data Received From Compass Module: No Sub Type Information	IPC	REFER to Section 413-01 .
U0462:68	Invalid Data Received From Compass Module: Event Information	IPC	REFER to Section 413-01 .
U046B:00	Invalid Data Received From Global Positioning System Module: No Sub Type Information	APIM	RETRIEVE and FOLLOW the DTCs from the GPSM .
U0485:00	Invalid Data Received From Radio: No Sub Type Information	APIM	RETRIEVE and FOLLOW the DTCs from the ACM .
U0533:68	Invalid Data Received from Side Obstacle Detection Control Module - Left: Event Information	IPC	RETRIEVE and FOLLOW the DTCs from the SOD-L .
U0534:68	Invalid Data Received from Side Obstacle Detection Control Module - Right: Event Information	IPC	RETRIEVE and FOLLOW the DTCs from the SOD-R .
U0599:68	Invalid Data Received from DC to DC Converter Control Module "A": Event Information	BECM IPC (Hybrid)	RETRIEVE and FOLLOW the DTCs from the DC/DC .
U1900			

	CAN Communication Bus Fault-Receive Error	ABS module	GO to Symptom Chart for module that failed network test.
U2023	Fault Received From External Node	ABS module	The module had an invalid network input/message from another module. RETRIEVE and FOLLOW the non-network DTCs from other modules. REFER to Section 419-10 .
U2472	Unexpected Ignition State	SJB	REFER to Section 419-10 .
U2473	Unexpected Vehicle Speed	SJB	REFER to Section 419-10 .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The PCM Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 23 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Electronic Engine Controls - 2.5L for schematic and connector information.

Refer to Wiring Diagrams Cell 24 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Electronic Engine Controls - 3.0L for schematic and connector information.

Refer to Wiring Diagrams Cell 25 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Electronic Engine Controls - 3.5L for schematic and connector information.

Normal Operation

The PCM communicates with the scan tool through the High Speed Controller Area Network (HS-CAN). Circuits VDB04 (WH/BU) (HS-CAN +) and VDB05 (WH) (HS-CAN -) provide the network connection to the PCM. An Integrated Diagnostic System (IDS) session cannot be established if the PCM communication fails when attempting to identify the vehicle.

This pinpoint test is intended to diagnose the following:

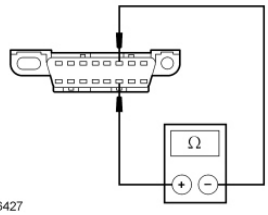
- Wiring, terminals or connectors

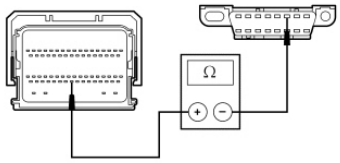
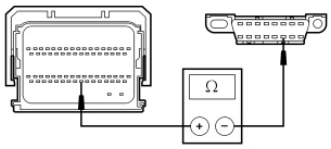
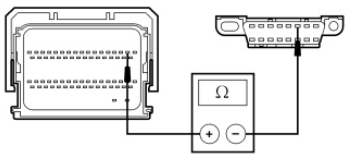
PCM

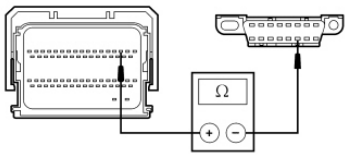
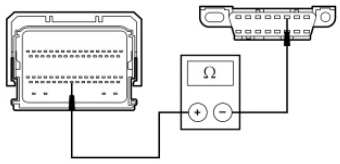
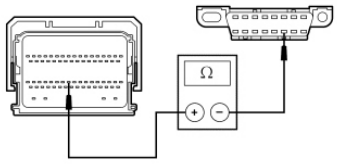
PINPOINT TEST A: THE PCM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
A1 VERIFY WHETHER OTHER HS-CAN MODULES PASS THE NETWORK TEST	
• Enter the following diagnostic mode on the scan tool: Network Test . • In the LH pane of the IDS network test display screen, verify whether any HS-CAN modules passed the network test. • **Is the text "pass" or a DTC listed next to any of the following modules (if equipped): 4X4 control module, ABS module, ACCM (Hybrid only), Accessory Protocol Interface Module (APIM), Battery Energy Control Module (BECM) (Hybrid only), DC/DC (Hybrid only), Headlamp Control Module (HCM), Instrument Panel Cluster (IPC), Power Steering Control Module (PSCM), Restraints Control Module (RCM), Occupant Classification System Module (OCSM), PCM or Transmission Control Module (TCM)?**	**Yes** If "pass" or a DTC was listed next to the PCM, a network fault is not currently present. GO to Pinpoint Test AE to diagnose an intermittent HS-CAN fault condition. If "pass" or a DTC was listed next to one or more modules other than the PCM, GO to A2 . **No** No modules are currently communicating on the HS-CAN . GO to Pinpoint Test AD to diagnose no HS-CAN communication.
A2 VERIFY THE PC/ED MANUAL PINPOINT TEST QA HAS BEEN CARRIED OUT	
• Verify that the Powertrain Control/Emissions Diagnosis (PC/ED) manual pinpoint test QA has been carried out. • **Has pinpoint test QA been carried out?**	**Yes** GO to A3 . **No** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, Section 5, pinpoint test QA to diagnose no communication with the PCM.
A3 CHECK THE HS-CAN TERMINATION RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  • **Is the resistance between 54 and 66 ohms?**	**Yes** CONNECT the negative battery cable. GO to A7 . **No** For 2.5L gasoline and 3.0L engines, GO to A4 . For 3.5L engine, GO to A5 . For 2.5L hybrid engine, GO to A6 .

A4 CHECK THE HS-CAN CIRCUITS BETWEEN THE PCM AND THE DLC FOR AN OPEN - 2.5L GAS AND 3.0L	
• Disconnect: PCM C175b . • Measure the resistance between the PCM C175b-59, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0077607 • Measure the resistance between the PCM C175b-58, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0099486 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to A7 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
A5 CHECK THE HS-CAN CIRCUITS BETWEEN THE PCM AND THE DLC FOR AN OPEN - 3.5L	
• Disconnect: PCM C175b . • Measure the resistance between the PCM C175b-2, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0026577 • Measure the resistance between the PCM C175b-3, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** CONNECT the negative battery cable. GO to A7 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0026578 • **Are the resistances less than 5 ohms?**	
A6 CHECK THE HS-CAN CIRCUITS BETWEEN THE PCM AND THE DLC FOR AN OPEN - 2.5L HYBRID	
• Disconnect: PCM C175b . • Measure the resistance between the PCM C175b-59, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0077607 • Measure e resistance between the PCM C175b-43, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0077608 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to A7 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
A7 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to the appropriate section in Section 303-14A , Section 303-14B or Section 303-14C . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with

	the scan tool.

Pinpoint Test B: The ABS Module Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 42 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The ABS module communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

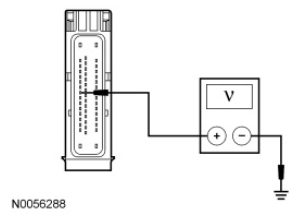
This pinpoint test is intended to diagnose the following:

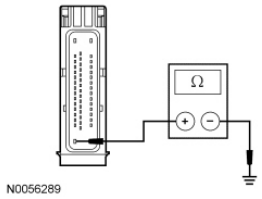
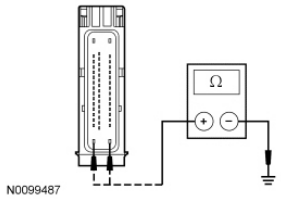
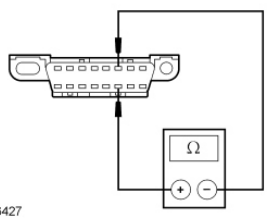
- Fuse
- Wiring, terminals or connectors
- ABS module

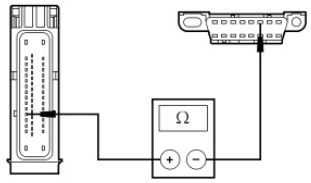
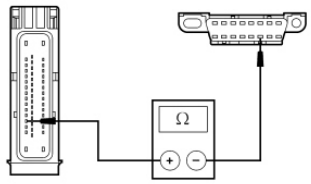
PINPOINT TEST B: THE ABS MODULE DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
B1 CHECK THE ABS MODULE VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: ABS Module C135 . • Ignition ON. • Measure the voltage between the ABS module C135-8, circuit CBP42 (GN) (gasoline engine) or C135-8, circuit CBK03 (GY), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to B2 . **No** VERIFY the SJB fuse 42 (10A) (gasoline engine) or BJB fuse 47 (10A) (hybrid) is OK. If OK, REPAIR the circuit in question. If not OK, refer to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.

B2 CHECK THE ABS MODULE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • For gasoline engine, measure the resistance between the ABS module C135-16, circuit GD123 (BK/GY), harness side and ground.  • For hybrid engine, measure the resistance between the ABS module C135-16, circuit GD121 (BK/YE), harness side and ground; and between the ABS module C135-47, circuit GD121 (BK/YE), harness side and ground.  • **Are the resistances less than 5 ohms?**	**Yes** For gasoline engine, GO to B3 . For hybrid engine, GO to B5 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the network test with the scan tool.
B3 CHECK THE HS-CAN TERMINATION RESISTANCE	
• Disconnect the scan tool cable from the Data Link Connector (DLC). • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  • **Is the resistance between 54 and 66 ohms?**	**Yes** GO to B5 . **No** GO to B4 .

B4 CHECK THE HS-CAN CIRCUITS BETWEEN THE ABS MODULE AND THE DLC FOR AN OPEN	
• Measure the resistance between the ABS module C135-12, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0026664 • Measure the resistance between the ABS module C135-13, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026665 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to B5 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
B5 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect the ABS module connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the ABS module connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Section 206-09 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test C: The Instrument Panel Cluster (IPC) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 60 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Instrument Cluster for schematic and connector information.

Normal Operation

The Instrument Panel Cluster (IPC) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

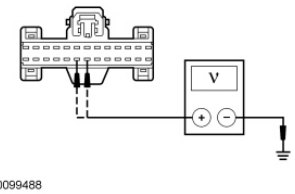
This pinpoint test is intended to diagnose the following:

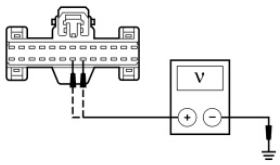
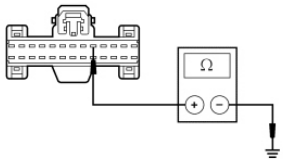
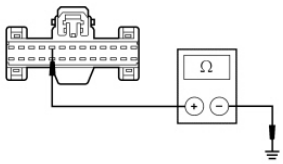
- Fuse
- Wiring, terminals or connectors
- IPC

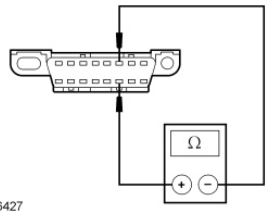
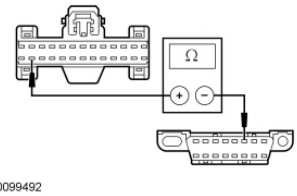
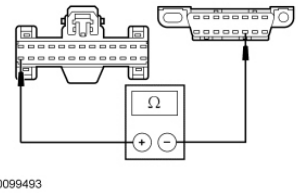
PINPOINT TEST C: THE IPC DOES NOT RESPOND TO THE SCAN TOOL

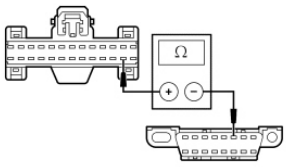
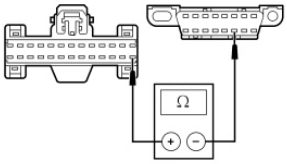
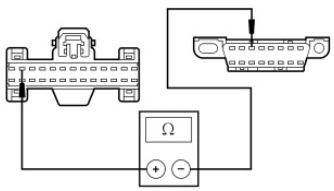
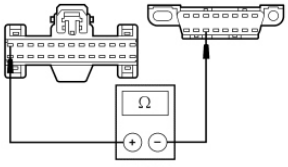
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

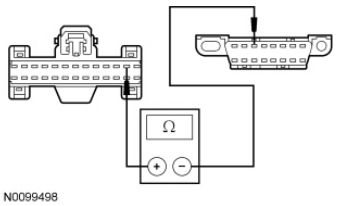
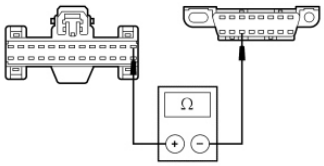
NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
C1 CHECK THE IPC VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Disconnect: Instrument Panel Cluster (IPC) C220 . • Ignition ON. • For gasoline engine, measure the voltage between the IPC C220-20, circuit CBP29 (WH/VT), harness side and ground; and between the IPC C220-21, circuit SBP26 (YE/RD), harness side and ground.  N0099488 • For hybrid engine, measure the voltage between the IPC C220-20, circuit CBP29 (WH/VT), harness side and ground; and between the IPC C220-19, circuit SBP26 (YE/RD), harness side and ground.	**Yes** GO to C2 . **No** VERIFY the Smart Junction Box (SJB) fuses 29 (5A) or 26 (15A) are OK. If OK, REPAIR the circuit in question. CLEAR the DTCs. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. REPEAT the network test with the scan tool.

 N0099489 • **Are the voltages greater than 10 volts?**	
C2 CHECK THE IPC GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • For gasoline engine, measure the resistance between the IPC C220-5, circuit GD116 (BK/VT) harness side and ground.  N0099490 • For hybrid engine, measure the resistance between the IPC C220-9, circuit GD116 (BK/VT) harness side and ground.  N0099491 • **Is the resistance less than 5 ohms?**	**Yes** For gasoline engine, GO to C3 . For hybrid engine, GO to C5 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the network test with the scan tool.
C3 CHECK THE HS-CAN TERMINATION RESISTANCE	
• Disconnect the scan tool cable from the Data Link Connector (DLC). • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** GO to C6 . **No** GO to C4 .

 N0026427 • **Is the resistance between 54 and 66 ohms?**	
C4 CHECK THE HS-CAN CIRCUITS BETWEEN THE DLC AND THE IPC FOR AN OPEN - GASOLINE	
• Measure the resistance between the IPC C220-25, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0099492 • Measure the resistance between the IPC C220-26, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0099493 • **Are the resistances less than 5 ohms?**	**Yes** GO to C6 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
C5 CHECK THE HS-CAN CIRCUITS BETWEEN THE DLC AND THE IPC FOR AN OPEN - HYBRID	
• Measure the resistance between the IPC C220-15, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.	**Yes** GO to C7 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0099494 • Measure the resistance between the IPC C220-14, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0099495 • **Are the resistances less than 5 ohms?**	
C6 CHECK THE MS-CAN CIRCUITS BETWEEN THE DLC AND THE IPC FOR AN OPEN - GASOLINE	
• Measure the resistance between the IPC C220-12, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0099496 • Measure the resistance between the IPC C220-13, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0099497 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to C8 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
C7 CHECK THE MS-CAN CIRCUITS BETWEEN THE DLC AND THE IPC FOR AN OPEN - HYBRID	

• Measure the resistance between the IPC C220-2, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0099498 • Measure the resistance between the IPC C220-1, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0099499 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to C8 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
C8 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test D: The Power Steering Control Module (PSCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 43 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Steering Controls for schematic and connector information.

Normal Operation

The Power Steering Control Module (PSCM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

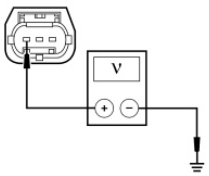
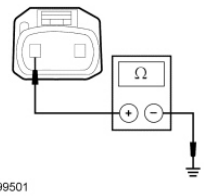
This pinpoint test is intended to diagnose the following:

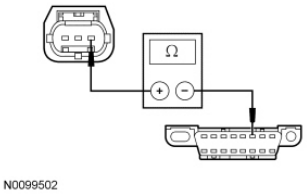
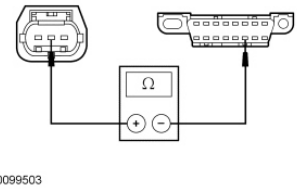
- Fuse
- Wiring, terminals or connectors
- PSCM

PINPOINT TEST D: THE PSCM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
D1 CHECK THE PSCM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Disconnect: PSCM C1467b . • Ignition ON. • Measure the voltage between the PSCM C1467b-3, circuit CBP42 (GN), harness side and ground.  N0099500 • **Is the voltage greater than 10 volts?**	**Yes** GO to D2 . **No** VERIFY the Smart Junction Box (SJB) fuse 42 (10A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
D2 CHECK THE PSCM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PSCM C1467a . • Disconnect: Negative Battery Cable . • Measure the resistance between the PSCM C1467a-2, circuit GD104 (BK/GN), harness side and ground.  N0099501 • **Is the resistance less than 5 ohms?**	**Yes** GO to D3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

D3 CHECK THE HS-CAN CIRCUITS BETWEEN THE PSCM AND THE DLC FOR AN OPEN	
• Measure the resistance between the PSCM C1467b-1, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0099502 • Measure the resistance between the PSCM C1467b-2, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0099503 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to D4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
D4 CHECK FOR CORRECT PSCM OPERATION	
• Disconnect all the PSCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the PSCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PSCM . REFER to Section 211-04 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test E: The Restraints Control Module (RCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 46 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Supplemental Restraint System for schematic and connector information.

Normal Operation

The Restraints Control Module (RCM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Case ground open
- RCM

PINPOINT TEST E: THE RCM DOES NOT RESPOND TO THE SCAN TOOL

⚠ WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

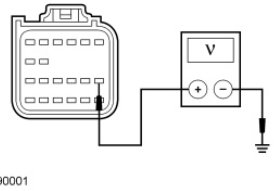
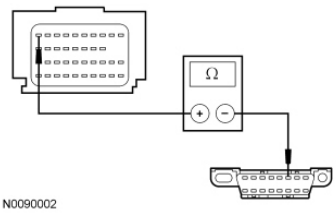
⚠ WARNING: Never probe the electrical connectors on airbag, Safety Canopy® or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these assemblies, which increases the risk of serious personal injury or death.

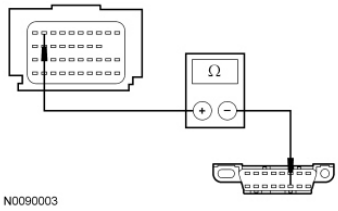
NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verificaton before proceeding with the pinpoint test.

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
E1 CHECK THE RCM CONNECTION	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: RCM C310a . • Disconnect: RCM C310b . • Inspect the RCM connector for damaged, pushed out or corroded pins. • **Are RCM C310a pin 13 and RCM C310b pins 9 and 10 OK?**	**Yes** GO to E2 . **No** REPAIR the RCM connector pins as necessary. REPOWER the SRS . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool.
E2 CHECK THE RCM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	

• Repower the SRS . Refer to Section 501-20B . • Ignition ON. • Measure the voltage between the RCM C310a-13, circuit CBP32 (GN/VT), harness side and ground.  N0090001 • **Is the voltage greater than 10 volts?**	**Yes** GO to E3 . **No** VERIFY the Smart Junction Box (SJB) fuse 32 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
E3 CHECK THE RCM CASE GROUND	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the RCM case and a good chassis ground. • **Is the resistance less than 5 ohms?**	**Yes** GO to E4 . **No** REPAIR the RCM case ground as necessary. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
E4 CHECK THE HS-CAN CIRCUITS BETWEEN THE RCM AND THE DLC FOR AN OPEN	
• Measure the resistance between the RCM C310b-10, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0090002 • Measure the resistance between the RCM C310b-9, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** CONNECT the negative battery cable. GO to E5 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 • **Are the resistances less than 5 ohms?**	
E5 CHECK FOR CORRECT RCM OPERATION	
• Disconnect all the RCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the RCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new RCM . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test F: The Occupant Classification System Module (OCSM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 46 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Supplemental Restraint System for schematic and connector information.

Normal Operation

The Occupant Classification System Module (OCSM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- OCSM

PINPOINT TEST F: THE OCSM DOES NOT RESPOND TO THE SCAN TOOL

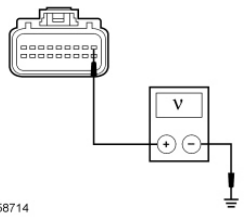
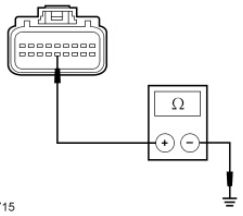
⚠ **WARNING: Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.**

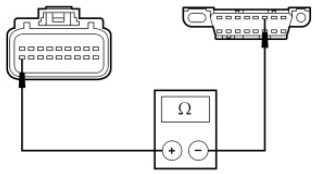
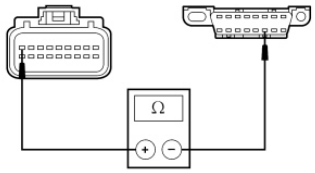
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: The Supplemental Restraint System (SRS) must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
F1 CHECK THE OCSM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Depower the SRS . Refer to Section 501-20B . • Disconnect: OCSM C3159 . • Deactivate the SRS . Refer to Section 501-20B . • Repower the SRS . Refer to Section 501-20B . • Ignition ON. • Measure the voltage between the OCSM C3159-1, circuit CBP46 (WH/BU), harness side and ground.  N0058714 • **Is the voltage greater than 10 volts?**	**Yes** GO to F2 . **No** VERIFY the Smart Junction Box (SJB) fuse 46 (7.5A) is OK. If OK, REPAIR the circuit. REACTIVATE the SRS . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool.
F2 CHECK THE OCSM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the OCSM C3159-14, circuit GD127 (BK/BU), harness side and ground.  N0058715 • **Is the resistance less than 5 ohms?**	**Yes** GO to F3 . **No** REPAIR the circuit. REACTIVATE the SRS . CONNECT the negative battery cable. REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool.
F3 CHECK THE HS-CAN CIRCUITS BETWEEN THE OCSM AND THE DLC FOR AN OPEN	

• Measure the resistance between the OCSM C3159-18, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0026670 • Measure the resistance between the OCSM C3159-9, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026671 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to F4 . **No** REPAIR the circuit. REACTIVATE the SRS . CONNECT the negative battery cable. REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool.
F4 CHECK FOR CORRECT OCSM OPERATION	
• Disconnect the OCSM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the OCSM connector and make sure it seats correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new OCSM . REFER to Section 501-20B . REACTIVATE the SRS . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. REACTIVATE the SRS . REFER to Section 501-20B . CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test G: The Transmission Control Module (TCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 29 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Transmission Controls for schematic and connector information.

Normal Operation

The Transmission Control Module (TCM) is present on hybrid vehicles only. The TCM communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

NOTE: Only vehicles with a 3.5L gasoline engine or 2.5L hybrid engine are equipped with a TCM . The PCM controls the transmission on 2.5L gasoline and 3.0L gasoline engine vehicles.

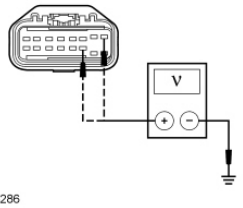
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- TCM

PINPOINT TEST G: THE TCM DOES NOT RESPOND TO THE SCAN TOOL

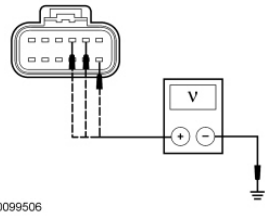
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
G1 CHECK THE TCM VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: TCM C1458a (2.5L Hybrid) . • Disconnect: TCM C1533 (3.5L) . • Ignition ON. • For 3.5L, measure the voltage between the TCM C1533-1, circuit SBB16 (VT/RD), harness side and ground; and between the TCM C1533-11, circuit CBP44 (VT), harness side and ground.  N0056286 • For 2.5L hybrid, measure the voltage between the TCM , harness side and ground as follows:	**Yes** GO to G2 . **No** For 3.5L gasoline, VERIFY the Battery Junction Box (BJB) fuse 16 (15A) or Smart Junction Box (SJB) fuse 44 (10A) is OK. For 2.5L hybrid, VERIFY the BJB fuse 23 (10A) or fuse 39 (10A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.

Connector-Pin	Circuit

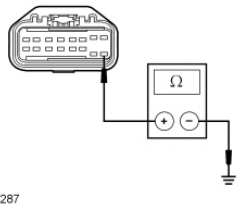
C1458a-4	CBB39 (VT/WH)
C1458a-5	CBB39 (VT/WH)
C1458a-12	SBB23 (RD)



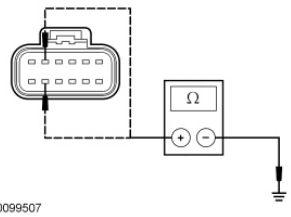
- **Are the voltages greater than 10 volts?**

G2 CHECK THE TCM GROUND CIRCUITS FOR AN OPEN

- Ignition OFF.
- Disconnect: Negative Battery Cable .
- For 3.5L gasoline, measure the resistance between the TCM C1533-9, circuit GD120 (BK/GN), harness side and ground.



- For 2.5L hybrid measure the resistance between the TCM C1458a-2, circuit GD121 (BK/YE), harness side and ground; and between the TCM C1458a-8, circuit GD121 (BK/YE), harness side and ground.



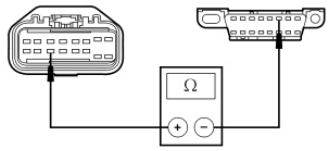
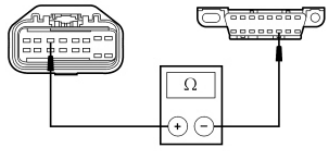
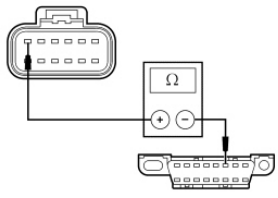
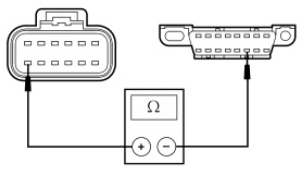
- **Are the resistances less than 5 ohms?**

Yes
For 3.5L engine, GO to G3 .

For 2.5L hybrid engine, GO to G4 .

No
REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

G3 CHECK THE HS-CAN CIRCUITS BETWEEN THE TCM AND THE DLC FOR AN OPEN - 3.5L ENGINE

• Measure the resistance between the TCM C1533-14, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0026662 • Measure the resistance between t TCM C1533-6, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026663 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to G5 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
G4 CHECK THE HS-CAN CIRCUITS BETWEEN THE TCM AND THE DLC FOR AN OPEN - 2.5L HYBRID ENGINE	
Measure the resistance between the TCM C1458a-1, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0099508 • Measure the resistance between the TCM C1458a-7, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0099509	**Yes** CONNECT the negative battery cable. GO to G5 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

• **Are the resistances less than 5 ohms?**	
G5 CHECK FOR CORRECT TCM OPERATION	
• Disconnect all the TCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the TCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new TCM . REFER to Section 307-01B . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test H: The 4X4 Control Module Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 34 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), All-Wheel Drive (AWD) for schematic and connector information.

Normal Operation

The 4X4 control module communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

This pinpoint test is intended to diagnose the following:

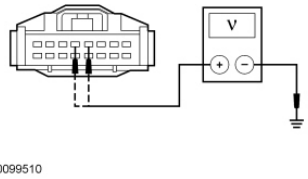
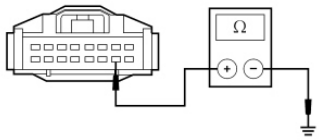
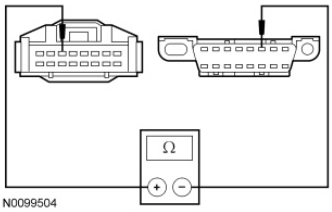
- Fuse
- Wiring, terminals or connectors
- 4X4 control module

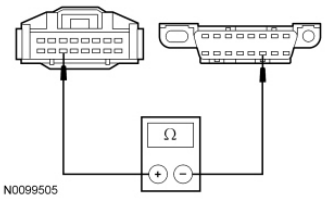
PINPOINT TEST H: THE 4X4 CONTROL MODULE DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
H1 CHECK THE 4X4 CONTROL MODULE VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: 4X4 Control Module C3253 . • Ignition ON. • Measure the voltage between the 4X4 control module C3253-4, circuit CBP35 (YE/GY), harness side and ground;	**Yes** GO to H2 . **No** VERIFY the Smart Junction Box (SJB) fuse 11 (10A) or 35 (10A) is

and between the 4X4 control module C3253-5, circuit SBP11 (BU/RD), harness side and ground.  N0099510 • **Are the voltages greater than 10 volts?**	OK. If OK, REPAIR the circuit in question. CLEAR the DTCs. REPEAT the network test with the scan tool.
H2 CHECK THE 4X4 CONTROL MODULE GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the 4X4 control module C3253-15, circuit GD126 (BK/WH), harness side and ground.  A0088928 • **Is the resistance less than 5 ohms?**	**Yes** GO to H3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the network test with the scan tool.
H3 CHECK THE HS-CAN CIRCUITS BETWEEN THE 4X4 CONTROL MODULE AND THE DLC FOR AN OPEN	
• Measure the resistance between the 4X4 control module C3253-3, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0099504 • Measure the resistance between the 4X4 control module C3253-11, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** CONNECT the negative battery cable. GO to H4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 • **Are the resistances less than 5 ohms?**	
H4 CHECK FOR CORRECT 4X4 CONTROL MODULE OPERATION	
• Disconnect the 4X4 control module connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the 4X4 control module connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new 4X4 control module. REFER to Section 308-07A . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test I: The Headlamp Control Module (HCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 85 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Headlamps/Autolamps for schematic and connector information.

Normal Operation

The Headlamp Control Module (HCM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

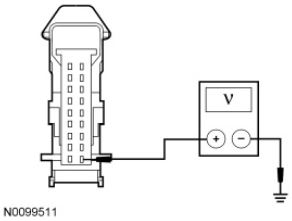
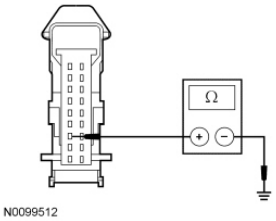
This pinpoint test is intended to diagnose the following:

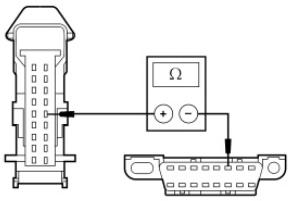
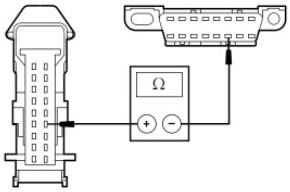
- Fuse
- Wiring, terminals or connectors
- HCM

PINPOINT TEST I: THE HCM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
I1 CHECK THE HCM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: HCM C1600 . • Ignition ON. • Measure the voltage between the HCM C1600-10, circuit CBP42 (GN), harness side and ground.  N0099511 • **Is the voltage greater than 10 volts?**	**Yes** GO to I2 . **No** VERIFY the Smart Junction Box (SJB) fuse 42 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the short circuit. CLEAR the DTCs. REPEAT the network test with the scan tool.
I2 CHECK THE HCM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the HCM C1600-3, circuit GD121 (BK/YE), harness side and ground.  N0099512 • **Is the resistance less than 5 ohms?**	**Yes** GO to I3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
I3 CHECK THE HS-CAN CIRCUITS BETWEEN THE HCM AND THE DLC FOR AN OPEN	
• Measure the resistance between the HCM C1600-14, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.	**Yes** CONNECT the negative battery cable. GO to I4 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0099513 • Measure the resistance between the HCM C1600-13, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0099514 • **Are the resistances less than 5 ohms?**	
I4 CHECK FOR CORRECT HCM OPERATION	
• Disconnect the HCM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the HCM connector and make sure it seats correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HCM . REFER to Section 417-01 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test J: The Battery Energy Control Module (BECM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

The Battery Energy Control Module (BECM) is present on hybrid vehicles only. The BECM communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

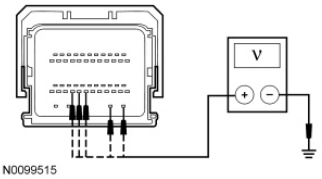
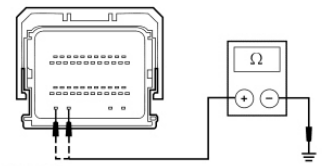
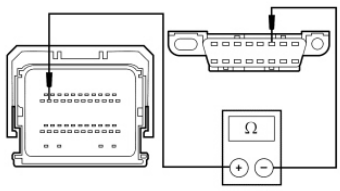
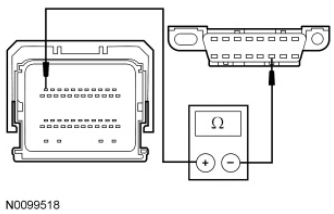
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- BECM

PINPOINT TEST J: THE BECM DOES NOT RESPOND TO THE SCAN TOOL

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
J1 CHECK THE POWER TO THE BECM	
⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Disconnect: BECM C4237a . • Ignition ON. • Measure the voltage between the BECM , harness side and ground as follows: **Connector-Pin / Circuit** C4237a-41 CBB48 (GY/YE) C4237a-42 CBB48 (GY/YE) C4237a-43 CBB48 (GY/YE) C4237a-47 SBB17 (RD) C4237a-48 SBB17 (RD)	**Yes** GO to J2 . **No** VERIFY the Battery Junction Box (BJB) fuse 17 (10A) or 48 (20A) are OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0099515 • **Are the voltages greater than 10 volts?**	
J2 CHECK THE BECM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the BECM C4237a-49, circuit GD126 (BK/WH), harness side and ground; and between the BECM C4237a-50, circuit GD126 (BK/WH), harness side and ground  N0099516 • **Are the resistances less than 5 ohms?**	**Yes** GO to J3 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
J3 CHECK THE HS-CAN CIRCUITS BETWEEN THE BECM AND THE DLC FOR AN OPEN	
• Measure the resistance between the BECM C4237a-22, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0099517 • Measure the resistance between the BECM C4237a-11, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0099518	**Yes** CONNECT the negative battery cable. GO to J4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

• **Are the resistances less than 5 ohms?**	
J4 CHECK FOR CORRECT BECM OPERATION	
NOTE: Do not disconnect the high voltage cables or connectors in the following step. • Disconnect the BECM **LOW VOLTAGE** connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the BECM **LOW VOLTAGE** connectors and make they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Section 414-03 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test K: The Air Conditioning Compressor Module (ACCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

The Air Conditioning Compressor Module (ACCM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

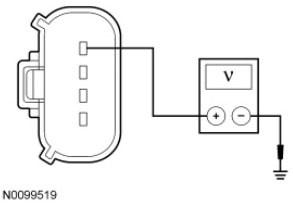
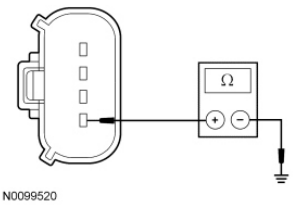
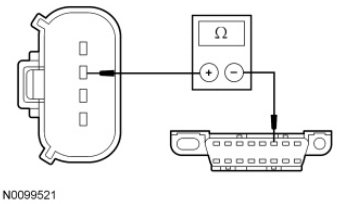
- Fuse
- Wiring, terminals or connectors
- ACCM

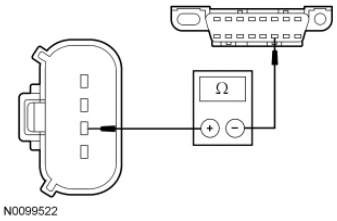
PINPOINT TEST K: THE ACCM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
K1 CHECK THE ACCM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	

• Ignition OFF. • Disconnect: ACCM C1469a . • Ignition ON. • Measure the voltage between the ACCM C1469a-1, circuit CBK03 (GY), harness side and ground.  N0099519 • **Is the voltage greater than 10 volts?**	**Yes** GO to K2 . **No** VERIFY theBattery Junction Box (BJB) fuse 47 (10A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
K2 CHECK THE ACCM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the ACCM C1469a-4, circuit GD123 (BK/GY), harness side and ground.  N0099520 • **Is the resistance less than 5 ohms?**	**Yes** GO to K3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
K3 CHECK THE HS-CAN CIRCUITS BETWEEN THE ACCM AND THE DLC FOR AN OPEN	
• Measure the resistance between the ACCM C1469a-2, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0099521 • Measure the resistance between the ACCM C1469a-3, circuit VDB05 (WH), harness side and	**Yes** CONNECT the negative battery cable. GO to K4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

the DLC C251-14, circuit VDB05 (WH), harness side.  • **Are the resistances less than 5 ohms?**	
K4 CHECK FOR CORRECT ACCM OPERATION	
• Disconnect the ACCM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the ACCM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACCM . REFER to Section 412-01 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test L: The DC to DC Converter Control Module (DC/DC) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 12 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Charging System for schematic and connector information.

Normal Operation

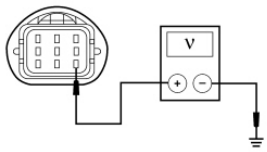
The DC to DC Converter Control Module (DC/DC) is present on hybrid vehicles only. The DC/DC communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

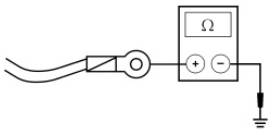
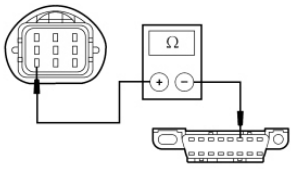
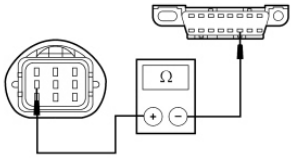
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- DC/DC

PINPOINT TEST L: THE DC/DC DOES NOT RESPOND TO THE SCAN TOOL

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
L1 CHECK THE DC/DC VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
⚠ WARNING: To prevent the risk of high-voltage shock, always follow precisely all warnings and service instructions, including instructions to depower the system. The high-voltage system utilizes approximately 300 volts DC, provided through high-voltage cables to its components and modules. The high-voltage cables and wiring are identified by orange harness tape or orange wire covering. All high-voltage components are marked with high-voltage warning labels with a high-voltage symbol. Failure to follow these instructions may result in serious personal injury or death. **⚠ WARNING: Always wear high-voltage insulated safety gloves with leather outer gloves and a face shield when servicing the battery pack sensor module (BPSM) and never remove the high-voltage BPSM connector unless directed by a service procedure. High voltage is present at the BPSM at all times, even with service disconnect plug removal . Depowering the system will not remove voltage from the BPSM connector with the orange harness. Follow all service instructions. Failure to follow these instructions may result in serious personal injury or death.** • Ignition OFF. • Disconnect: DC/DC C1457d . • Ignition ON. • Measure the voltage between the DC/DC C1457d-7, circuit CBK03 (GY), harness side and ground.  N0099523 • **Are the voltages greater than 10 volts?**	**Yes** GO to L2 . **No** VERIFY the Battery Junction Box (BJB) fuse 47 (10A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
L2 CHECK THE DC/DC GROUNDS	
• Ignition OFF. • Disconnect: Negative Battery Cable . • **NOTE:** Do not disconnect the DC/DC ground eyelet C1457c. The measurement is taken between the negative battery eyelet and chassis ground. • Measure the resistance between the DC/DC C1457c-1, circuit GD108 (BK/VT), harness side and ground.	**Yes** GO to L3 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0099524 • **Is the resistance less than 5 ohms?**	
L3 CHECK THE HS-CAN CIRCUITS BETWEEN THE DC/DC AND THE DLC FOR AN OPEN	
• Measure the resistance between the DC/DC C1457d-9, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0099525 • Measure the resistance between the DC/DC C1457d-6, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0099526 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to L4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
L4 CHECK FOR CORRECT DC/DC OPERATION	
NOTE: Do not disconnect the high voltage cables or connectors in the following step. • Disconnect the DC/DC **LOW VOLTAGE** connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the DC/DC **LOW VOLTAGE** connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DC/DC . REFER to Section 414-05 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network

	test with the scan tool.

Pinpoint Test M: The Audio Front Control Module (ACM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Audio Front Control Module (ACM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

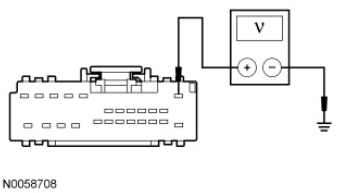
This pinpoint test is intended to diagnose the following:

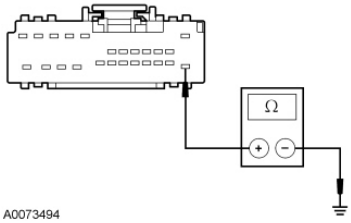
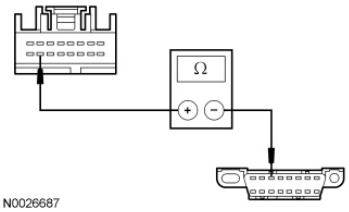
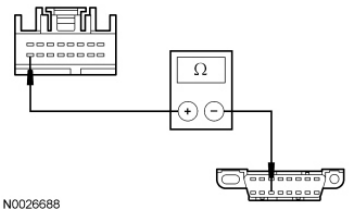
- Fuse
- Wiring, terminals or connectors
- ACM

PINPOINT TEST M: THE ACM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
M1 CHECK THE ACM VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: ACM C240a . • Ignition ON. • Measure the voltage between the ACM C240a-1, circuit SBP39 (WH/RD), harness side and ground.  N0058708 • **Is the voltage greater than 10 volts?**	**Yes** GO to M2 . **No** VERIFY the Smart Junction Box (SJB) fuse 39 (20A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.

M2 CHECK THE ACM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the ACM C240a-13, circuit GD114 (BK/BU), harness side and ground.  A0073494 • **Is the resistance less than 5 ohms?**	**Yes** GO to M3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
M3 CHECK THE MS-CAN CIRCUITS BETWEEN THE ACM AND THE DLC FOR AN OPEN	
• Disconnect: ACM C240c . • Measure the resistance between the ACM C240c-15, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0026687 • Measure the resistance between the ACM C240c-16, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0026688 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to M4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
M4 CHECK FOR CORRECT ACM OPERATION	

• Disconnect all the ACM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the ACM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ACM . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the network test with the scan tool. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test N: The Front Controls Interface Module (FCIM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Front Controls Interface Module (FCIM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- FCIM

PINPOINT TEST N: THE FCIM DOES NOT RESPOND TO THE SCAN TOOL

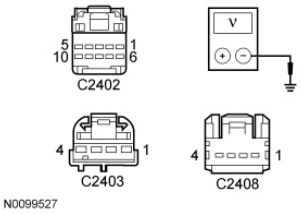
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
N1 CHECK THE FCIM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: FCIM C2403 (Without Navigation), FCIM C2408 (With Navigation, Except MKZ) or FCIM C2402 (With Navigation, MKZ) . • Ignition ON. • Measure the voltage between the FCIM , harness side and ground as follows:	**Yes** GO to N2 . **No** VERIFY the Smart Junction Box (SJB) fuse 14 (10A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

	CLEAR the DTCs. REPEAT the network test with the scan tool.

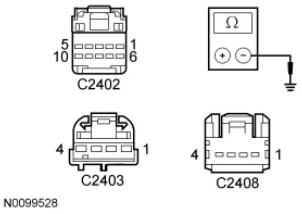
FCIM Connector-Pin	Circuit
C2402-5	SBP14 (BN/RD)
C2403-1	SBP14 (BN/RD)
C2408-1	SBP14 (BN/RD)



- **Is the voltage greater than 10 volts?**

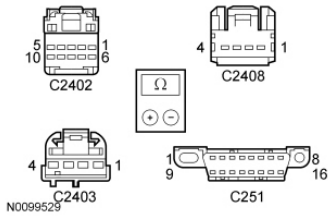
N2 CHECK THE FCIM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the FCIM , harness side and ground as follows:	**Yes** GO to N3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

FCIM Connector-Pin	Circuit
C2402-8	GD116 (BK/VT)
C2403-2	GD116 (BK/VT)
C2408-4	GD116 (BK/VT)



- **Is the resistance less than 5 ohms?**

N3 CHECK THE MS-CAN CIRCUITS BETWEEN THE FCIM AND THE DLC FOR AN OPEN	

• Measure the resistance between the FCIM , harness side and the Data Link Connector (DLC) harness side as follows: **FCIM Connector-Pin** / **Circuit** / **DLC Connector-Pin** / **Circuit** C2402-1 / VDB06 (GY/OG) / C251-3 / VDB06 (GY/OG) C2402-2 / VDB07 (VT/OG) / C251-11 / VDB07 (VT/OG) C2403-3 / VDB06 (GY/OG) / C251-3 / VDB06 (GY/OG) C2403-4 / VDB07 (VT/OG) / C251-11 / VDB07 (VT/OG) C2408-2 / VDB06 (GY/OG) / C251-3 / VDB06 (GY/OG) C2408-3 / VDB07 (VT/OG) / C251-11 / VDB07 (VT/OG)  • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to N4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
N4 CHECK FOR CORRECT FCIM OPERATION	
• Disconnect the FCIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the FCIM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new FCIM . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test O: The Front Display Interface Module (FDIM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Front Display Interface Module (FDIM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

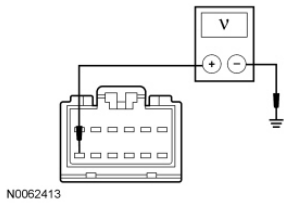
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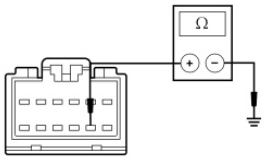
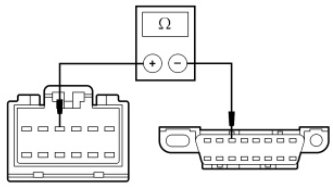
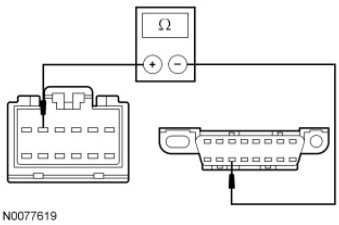
- Fuse
- Wiring, terminals or connectors
- FDIM

PINPOINT TEST O: THE FDIM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
O1 CHECK THE FDIM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: FDIM C2407 . • Ignition ON. • Measure the voltage between the FDIM C2407-12, circuit SBP14 (BN/RD), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to O2 . **No** VERIFY the Smart Junction Box (SJB) fuse 14 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
O2 CHECK THE FDIM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the FDIM C2407-8, circuit GD116 (BK/VT), harness side and ground.	**Yes** GO to O3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0077731 • **Is the resistance less than 5 ohms?**	
O3 CHECK THE MS-CAN CIRCUITS BETWEEN THE FDIM AND THE DLC FOR AN OPEN	
• Measure the resistance between the FDIM C2407-4, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0077618 • Measure the resistance between the FDIM C2407-5, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0077619 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to O4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
O4 CHECK FOR CORRECT FDIM OPERATION	
• Disconnect the FDIM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the FDIM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new FDIM . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test P: The Global Positioning System Module (GPSM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Global Positioning System Module (GPSM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

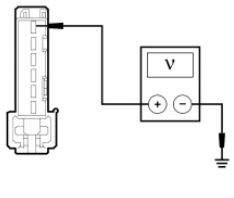
This pinpoint test is intended to diagnose the following:

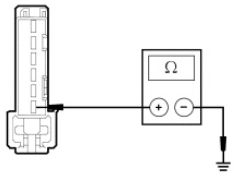
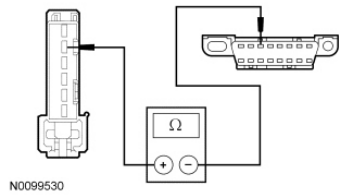
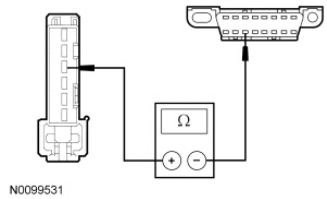
- Fuse
- Wiring, terminals or connectors
- GPSM

PINPOINT TEST P: THE GPSM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
P1 CHECK THE GPSM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: GPSM C2300 . • Ignition ON. • Measure the voltage between the GPSM C2300-1, circuit SBP14 (BN/RD), harness side and ground.  N0094349 • **Is the voltage greater than 10 volts?**	**Yes** GO to P2 . **No** VERIFY the Smart Junction Box (SJB) fuse 14 (10A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
P2 CHECK THE GPSM GROUND CIRCUIT FOR AN OPEN	

• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the GPSM C2300-6, circuit GD116 (BK/VT), harness side and ground.  N0094350 • **Is the resistance less than 5 ohms?**	**Yes** GO to P3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
P3 CHECK THE MS-CAN CIRCUITS BETWEEN THE GPSM AND THE DLC FOR AN OPEN	
• Measure the resistance between the GPSM C2300-2, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.  N0099530 • Measure the resistance between the GPSM C2300-3, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0099531 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to P4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
P4 CHECK FOR CORRECT GPSM OPERATION	
• Disconnect the GPSM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new GPSM . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No**

• Connect the GPSM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test Q: The Interior Lighting Control Module (ILCM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

The Interior Lighting Control Module (ILCM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

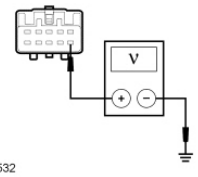
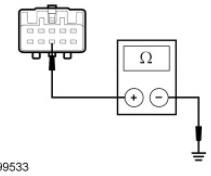
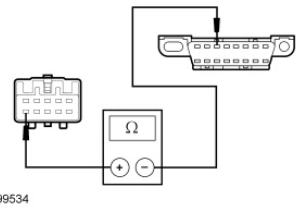
- Fuse
- Wiring, terminals or connectors
- ILCM

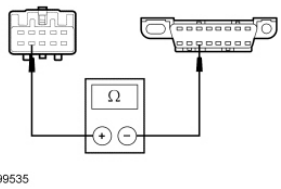
PINPOINT TEST Q: THE ILCM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
Q1 CHECK THE ILCM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: In-Line ILCM C2238 . • Ignition ON. • Measure the voltage between the in-line ILCM C2238-10, circuit SBP14 (BN/RD), harness side (male) and ground.	**Yes** GO to Q2 . **No** VERIFY the Smart Junction Box (SJB) fuse 14 (10A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0099532 • **Is the voltage greater than 10 volts?**	
Q2 CHECK THE ILCM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the in-line ILCM C2238-8, circuit GD116 (BK/VT), harness side (male) and ground.  N0099533 • **Is the resistance less than 5 ohms?**	**Yes** GO to Q3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
Q3 CHECK THE MS-CAN CIRCUITS BETWEEN THE ILCM AND THE DLC FOR AN OPEN	
• Measure the resistance between the in-line ILCM C2238-6, circuit VDB06 (GY/OG), harness side (male) and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.  N0099534 • Measure the resistance between the in-line ILCM C2238-7, circuit VDB07 (VT/OG), harness side (male) and the DLC C251-11, circuit VDB07 (VT/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to Q4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 • **Are the resistances less than 5 ohms?**	
Q4 CHECK FOR CORRECT ILCM OPERATION	
• Disconnect the ILCM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the ILCM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ILCM . REFER to Section 417-02 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test R: The Side Obstacle Detection Control Module - Left (SOD-L) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 131 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Parking Aid for schematic and connector information.

Normal Operation

The Side Obstacle Detection Control Module - Left (SOD-L) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

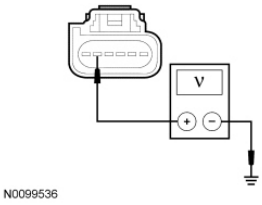
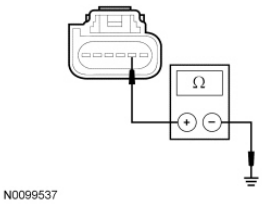
- Fuse
- Wiring, terminals or connectors
- SOD-L

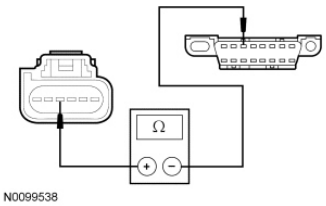
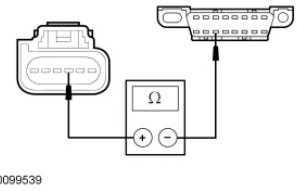
PINPOINT TEST R: THE SOD-L DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take

R1 CHECK THE SOD-L VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: SOD-L C4230 . • Ignition ON. • Measure the voltage between the SOD-L C4230-5, circuit CBP35 (YE/GY), harness side and ground.  N0099536 • **Is the voltage greater than 10 volts?**	**Yes** GO to R2 . **No** VERIFY the Smart Junction Box (SJB) fuse 35 (10A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
R2 CHECK THE SOD-L GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the SOD-L C4230-2, circuit GD171 (BK/GY), harness side and ground.  N0099537 • **Is the resistance less than 5 ohms?**	**Yes** GO to R3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
R3 CHECK THE MS-CAN CIRCUITS BETWEEN THE SOD-L AND THE DLC FOR AN OPEN	
• Measure the resistance between the SOD-L C4230-4, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to R4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0099538 • Measure the resistance between the SOD-L C4230-3, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0099539 • **Are the resistances less than 5 ohms?**	
R4 CHECK FOR CORRECT SOD-L OPERATION	
• Disconnect the SOD-L connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SOD-L connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SOD-L . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test S: The Side Obstacle Detection Control Module - Right (SOD-R) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 131 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Parking Aid for schematic and connector information.

Normal Operation

The Side Obstacle Detection Control Module - Right (SOD-R) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

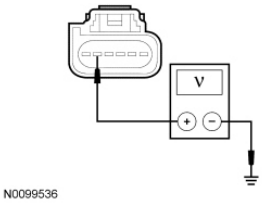
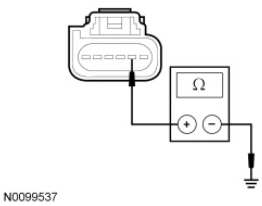
- Fuse
- Wiring, terminals or connectors

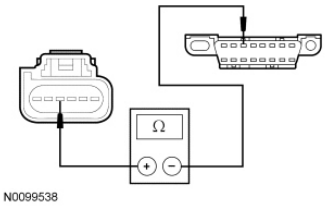
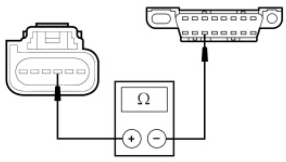
- SOD-R

PINPOINT TEST S: THE SOD-R DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
S1 CHECK THE SOD-R VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: SOD-R C4229 . • Ignition ON. • Measure the voltage between the SOD-R C4229-5, circuit CBP35 (YE/GY), harness side and ground.  N0099536 • **Is the voltage greater than 10 volts?**	**Yes** GO to S2 . **No** VERIFY the Smart Junction Box (SJB) fuse 35 (10A) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the network test with the scan tool.
S2 CHECK THE SOD-R GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the SOD-R C4229-2, circuit GD171 (BK/GY), harness side and ground.  N0099537 • **Is the resistance less than 5 ohms?**	**Yes** GO to S3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
S3 CHECK THE MS-CAN CIRCUITS BETWEEN THE SOD-R AND THE DLC FOR AN OPEN	

• Measure the resistance between the SOD-R C4229-4, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.  N0099538 • Measure the resistance between the SOD-R C4229-3, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0099539 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to S4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
S4 CHECK FOR CORRECT SOD-R OPERATION	
• Disconnect the SOD-R connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SOD-R connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SOD-R . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test T: The Parking Aid Module (PAM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 131 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Parking Aid for schematic and connector information.

Normal Operation

The Parking Aid Module (PAM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

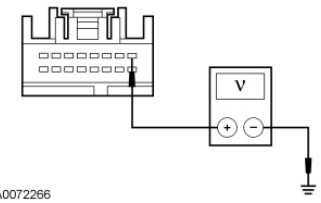
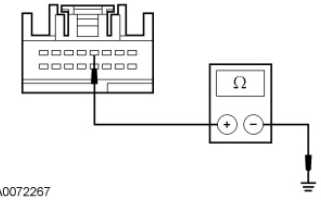
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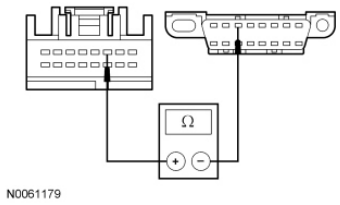
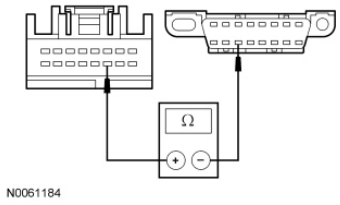
- Fuse
- Wiring, terminals or connectors
- PAM

PINPOINT TEST T: THE PAM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
T1 CHECK THE PAM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PAM C4014 . • Ignition ON. • Measure the voltage between the PAM C4014-1, circuit CBP35 (YE/GY), harness side and ground.  A0072266 • **Is the voltage greater than 10 volts?**	**Yes** GO to T2 . **No** VERIFY the Smart Junction Box (SJB) fuse 35 (10A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the short circuit. TEST the system for normal operation.
T2 CHECK THE PAM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the PAM C4014-4, circuit GD171 (BK/GY), harness side and ground.  A0072267 • **Is the resistance less than 5 ohms?**	**Yes** GO to T3 . **No** REPAIR the circuit. CONNECT the negative battery cable. TEST the system for normal operation.

T3 CHECK THE MS-CAN CIRCUITS BETWEEN THE PAM AND THE DLC FOR AN OPEN	
• Measure the resistance between the PAM C4014-3, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0061179 • Measure the resistance between the PAM C4014-11, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0061184 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to T4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
T4 CHECK FOR CORRECT PAM OPERATION	
• Disconnect the PAM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the PAM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PAM . REFER to Section 413-13 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test U: The Smart Junction Box (SJB) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 10 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Grounds for schematic and connector information.

Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

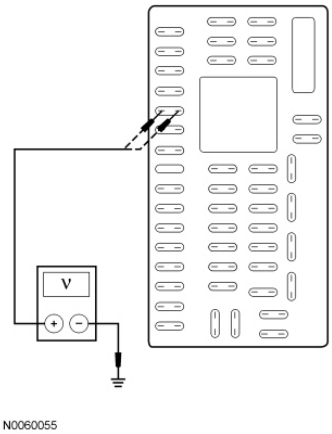
This pinpoint test is intended to diagnose the following:

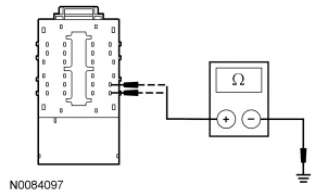
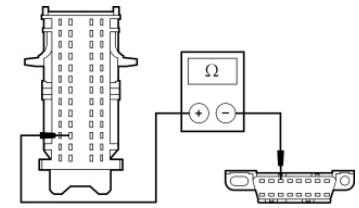
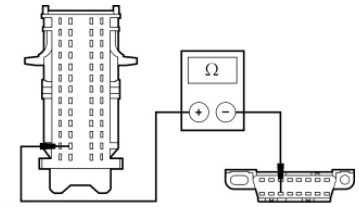
- Fuse
- Wiring, terminals or connectors
- SJB

PINPOINT TEST U: THE SJB DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
U1 CHECK THE SJB VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition ON. • **NOTE:** Measurements are taken with the fuses installed. • Measure the voltage between the SJB fuse 5 (10A) and ground.  N0060055 • **Is the voltage greater than 10 volts?**	**Yes** GO to U2 . **No** VERIFY the SJB fuse 5 (10A) is OK. If OK, REPAIR the circuit. CLEAR the DTCs. REPEAT the network test with the scan tool. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
U2 CHECK THE SJB GROUND CIRCUIT FOR AN OPEN	

• Ignition OFF. • Disconnect: Negative Battery Cable . • Disconnect: SJB C2280d . • Measure the resistance between the SJB C2280d-8, circuit GD126 (BK/WH), harness side and ground; and between the SJB C2280d-12, circuit GD126 (BK/WH), harness side and ground.  N0084097 • **Are the resistances less than 5 ohms?**	**Yes** GO to U3 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
U3 CHECK THE MS-CAN CIRCUITS BETWEEN THE SJB AND THE DLC FOR AN OPEN	
• Disconnect: SJB C2280b . • Measure the resistance between the SJB C2280b-37, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0064664 • Measure the resistance between the SJB C2280b-38, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0064665 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to U4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
U4 CHECK FOR CORRECT SJB OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No**

• Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test V: The HVAC Module Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 54 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Manual Climate Control for schematic and connector information.

Refer to Wiring Diagrams Cell 55 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Automatic Climate Control System for schematic and connector information.

Normal Operation

The HVAC module communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

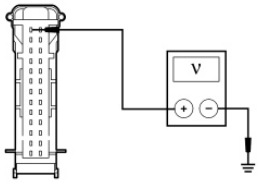
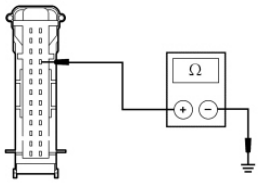
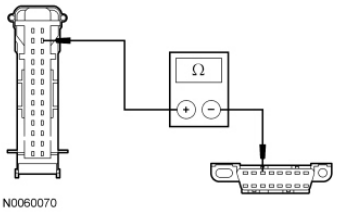
- Fuse
- Wiring, terminals or connectors
- HVAC module

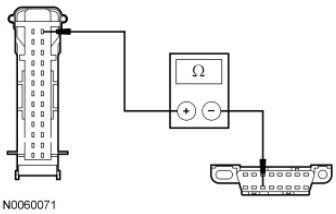
PINPOINT TEST V: THE HVAC MODULE DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
V1 CHECK THE HVAC VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: HVAC Module C2357a (Manual A/C) . • Disconnect: HVAC Module C2356a (Dual Automatic Temperature Control (DATC)) . • Ignition ON. • Measure the voltage between the HVAC module C2357a-13 (manual), C228a-13 or C2356a-13 (DATC), circuit SBP15 (WH/RD), harness side and ground.	**Yes** GO to V2 . **No** VERIFY Smart Junction Box (SJB) fuse 15 (10A) is OK. If OK, REPAIR the circuit in question. CLEAR the DTCs. REPEAT the network test with the scan tool. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

 N0084098 • **Is the voltage greater than 10 volts?**	
V2 CHECK THE HVAC GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the HVAC module C2357a-23 (manual), C228a-23 or C2356a-23 (DATC), circuit GD116 (BK/VT), harness side and ground.  N0057261 • **Is the resistance less than 5 ohms?**	**Yes** GO to V3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
V3 CHECK THE MS-CAN CIRCUITS BETWEEN THE HVAC MODULE AND THE DLC FOR AN OPEN	
• Measure the resistance between the HVAC module C2357a-25 (manual), C228a-25 or C2356a-25 (DATC), circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.  N0060070 • Measure the resistance between the HVAC module C2357a-26 (manual), C228a-26 or C2356a-26 (DATC), circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to V4 . **No** REPAIR the circuit as necessary. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 • **Are the resistances less than 5 ohms?**	
V4 CHECK FOR CORRECT HVAC MODULE OPERATION	
• Disconnect all the HVAC module connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the HVAC module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HVAC module. REFER to Section 412-01 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test W: The Audio Digital Signal Processing (DSP) Module Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The audio Digital Signal Processing (DSP) module communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Audio DSP module

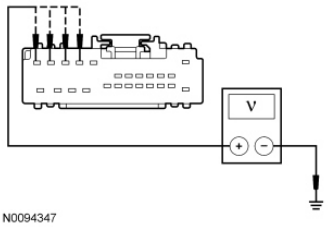
PINPOINT TEST W: THE AUDIO DSP MODULE DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

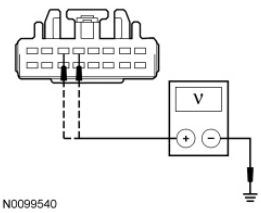
NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>W1 CHECK THE AUDIO DSP MODULE VOLTAGE SUPPLY CIRCUITS FOR AN OPEN</td><td></td></tr>
<tr><td>

Ignition OFF.
Disconnect: Audio DSP Module C4235a (THX®) or C4240a (Sony®) .
Ignition ON.
For THX® sound, measure the voltage between the audio DSP module, harness side and ground as follows:

<table>
<tr><th>Connector-Pin</th><th>Circuit</th></tr>
<tr><td>C4235a-9</td><td>SBB20 (GN/RD)</td></tr>
<tr><td>C4235a-10</td><td>SBB20 (GN/</td></tr>
<tr><td>C4235a-11</td><td>SBB21 (GY/RD)</td></tr>
<tr><td>C4235a-12</td><td>SBB21 (GY/RD)</td></tr>
</table>


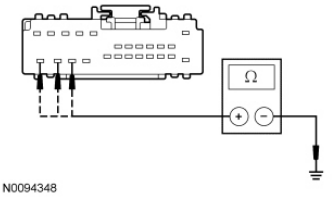
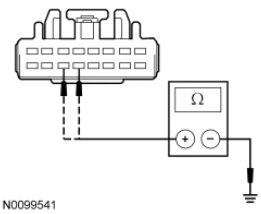
For Sony® sound, measure the voltage between the audio DSP module, harness side and ground as follows:

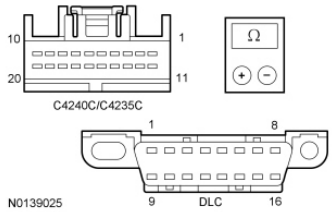
<table>
<tr><th>Connector-Pin</th><th>Circuit</th></tr>
<tr><td>C4240a-5</td><td>SBP19 (BU/RD)</td></tr>
<tr><td>C4240a-6</td><td>SBP19 (BU/RD)</td></tr>
</table>


Are the voltages greater than 10 volts?

</td><td>Yes
GO to W2 .

No
VERIFY the Smart Junction Box (SJB) fuse 19 (25A) (Sony® sound), or Battery Junction Box (BJB) fuse 20 (20A) or 21 (20A) (THX® sound) is OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the short circuit. CLEAR the DTCs. REPEAT the network test with the scan tool.</td></tr>
<tr><td></td><td></td></tr>
</table>

W2 CHECK THE AUDIO DSP MODULE GROUND CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • For THX® sound, measure the resistance between the audio DSP module, harness side and ground as follows: **Connector-Pin / Circuit** C4235a-22 GD148 (BK/YE) C4235a-23 GD148 (BK/YE) C4235a-24 GD148 (BK/YE)  N0094348 • For Sony® sound, measure the resistance between the audio DSP module, harness side and ground as follows: **Connector-Pin / Circuit** C4240a-13 GD148 (BK/YE) C4240a-14 GD148 (BK/YE)  N0099541 • **Are the resistances less than 5 ohms?**	**Yes** GO to W3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
W3 CHECK THE MS-CAN CIRCUITS BETWEEN THE AUDIO DSP MODULE AND THE DLC FOR AN OPEN	

• Disconnect: Audio DSP Module C4235c (THX®) or C4240c (Sony®) . • Measure the resistance between the Medium Speed CAN circuits: ♦ For THX® sound, audio DSP module C4235c-11 and the DLC C251-3, circuit VDB06 (GY/OG), harness side. ♦ For THX® sound, audio DSP module C4235c-1 and the DLC C251-11, circuit VDB07 (VT/OG), harness side. ♦ For Sony® sound, audio DSP module C4240c-1 and the DLC C251-3, circuit VDB06 (GY/OG), harness side. ♦ For Sony® sound, audio DSP module C4240c-11 and the DLC C251-11, circuit VDB07 (VT/OG), h side.  • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable.GO to W4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
W4 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION	
• Disconnect all the audio DSP module connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the audio DSP module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new audio DSP module. REFER to Section 415-00 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test X: The Driver Door Module (DDM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 123 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Memory Seats for schematic and connector information.

Normal Operation

The Driver Door Module (DDM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

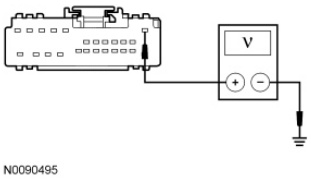
This pinpoint test is intended to diagnose the following:

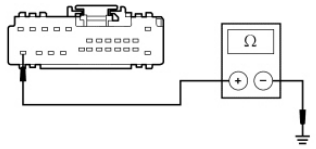
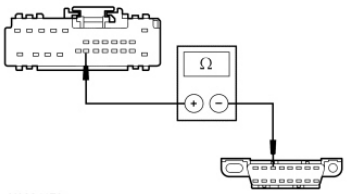
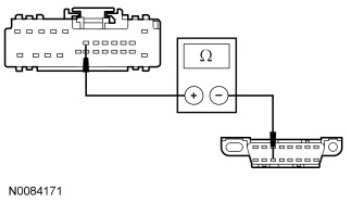
- Fuse
- Wiring, terminals or connectors
- DDM

PINPOINT TEST X: THE DRIVER DOOR MODULE (DDM) DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
X1 CHECK THE DDM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: DDM C568b . • Ignition ON. • Measure the voltage between the DDM C568b-1, circuit SBP12 (GN/RD), harness side and ground.  N0090495 • **Is the voltage greater than 10 volts?**	**Yes** GO to X2 . **No** VERIFY the Smart Junction Box (SJB) fuse 12 (7.5A) is OK. If OK, REPAIR the circuit. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the short circuit. CLEAR the DTCs. REPEAT the network test with the scan tool.
X2 CHECK THE DDM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the DDM C568b-24, circuit GD126 (BK/WH), harness side and ground.	**Yes** GO to X3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0090496 • **Is the resistance less than 5 ohms?**	
X3 CHECK THE MS-CAN CIRCUITS BETWEEN THE DDM AND THE DLC FOR AN OPEN	
• Measure the resistance between the DDM C568b-19, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0084170 • Measure the resistance between the DDM C568b-7, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0084171 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to X4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
X4 CHECK FOR CORRECT DDM OPERATION	
• Disconnect all the DDM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the DDM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DDM . REFER to Section 501-14 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test Y: The Dual Climate Controlled Seat Module (DCSM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 119 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Climate Controlled Seats for schematic and connector information.

Normal Operation

The Dual Climate Controlled Seat Module (DCSM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- DCSM

PINPOINT TEST Y: THE DCSM DOES NOT RESPOND TO THE SCAN TOOL

⚠ **WARNING: Remove restraint system diagnostic tools from the vehicle prior to road testing. If tools are not removed, the supplemental restraint system (SRS) device may not deploy in a crash. Failure to follow this instruction may result in serious personal injury or death in a crash and possibly violate vehicle safety standards.**

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

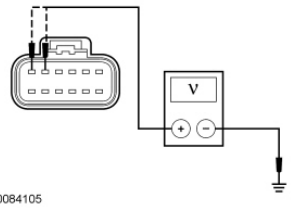
NOTE: If a seat equipped with a Supplemental Restraint System (SRS) component is being serviced, **the SRS must be depowered.** Refer to Section 501-20B .

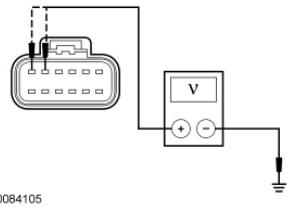
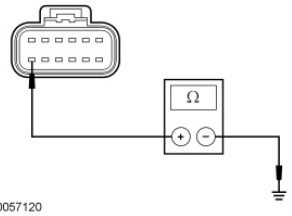
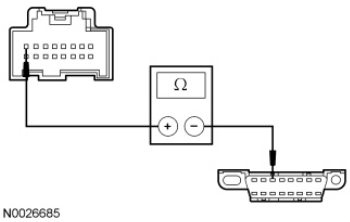
NOTE: The air bag warning lamp illuminates when the Restraints Control Module (RCM) fuse is removed and the ignition switch is ON. This is normal operation and does not indicate an SRS fault.

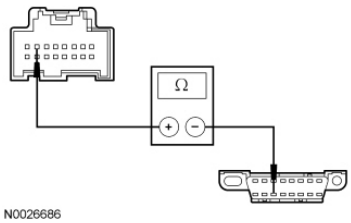
NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
Y1 VERIFY VEHICLE EQUIPMENT - SEAT SIDE AIR BAGS	
• Inspect the vehicle for seat side air bags. • **Is the vehicle equipped with seat side air bags?**	**Yes** GO to Y2 . **No** GO to Y3 .
Y2 CHECK THE DCSM VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	

• Ignition OFF. • For vehicles with seat side air bags, carry out the following: ♦ Depower the SRS . Refer to Section 501-20B . ♦ Disconnect the driver seat side air bag module C3226. ♦ Connect the restraint system diagnostic tool (418-133) to the driver seat side air bag module C3226. ♦ Disconnect the passenger seat side air bag module C3227. ♦ Connect the restraint system diagnostic tool (418-133) to the passenger seat side air bag module C3227. ♦ Connect the negative battery cable. • Disconnect: DCSM C3305a . • Ignition ON. • Measure the voltage between the DCSM C3305a-E, circuit SBB12 (GN/RD) harness side and ground; and between the DCSM C3305a-F, circuit SBB12 (GN/RD) harness side and ground.  N0084105 • **Are the voltages greater than 10 volts?**	**Yes** GO to Y4 . **No** VERIFY the Battery Junction Box (BJB) fuse 12 (30A) is OK. If OK, REPAIR the circuit in question. CLEAR the DTCs. REPEAT the network test with the scan tool. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
Y3 CHECK THE DCSM VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: DCSM C3305a . • Ignition ON. • Measure the voltage between the DCSM C3305a-E, circuit SBB12 (GN/RD) harness side and ground; and between the DCSM C3305a-F, circuit SBB12 (GN/RD) harness side and ground.	**Yes** GO to Y4 . **No** VERIFY the Battery Junction Box (BJB) fuse 12 (30A) is OK. If OK, REPAIR the circuit in question. CLEAR the DTCs. REPEAT the network test with the scan tool. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

 N0084105 • **Are the voltages greater than 10 volts?**	
Y4 CHECK THE DCSM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the DCSM C3305a-M, circuit GD139 (BK/YE), harness side and ground.  N0057120 • **Is the resistance less than 5 ohms?**	**Yes** GO to Y5 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
Y5 CHECK THE MS-CAN CIRCUITS BETWEEN THE DCSM AND THE DLC FOR AN OPEN	
• Disconnect: DCSM C3305c . • Measure the resistance between the DCSM C3305c-1, circuit VDB06 (GY/OG), harness side and the Data Link Connector (DLC) C251-3, circuit VDB06 (GY/OG), harness side.  N0026685 • Measure the resistance between the DCSM C3305c-2, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to Y6 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 • **Are the resistances less than 5 ohms?**	
Y6 CHECK FOR CORRECT DCSM OPERATION	
• Disconnect all the DCSM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the DCSM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DCSM . REFER to Section 501-10 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test Z: The Driver Seat Module (DSM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 123 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Memory Seats for schematic and connector information.

Normal Operation

The Driver Seat Module (DSM) communicates with the scan tool through the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

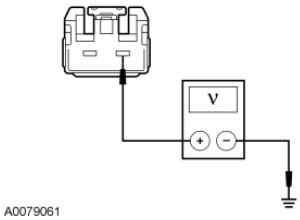
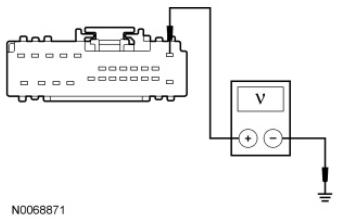
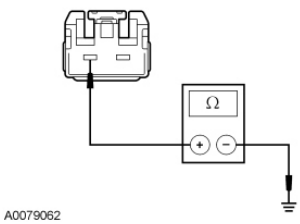
- Fuse
- Wiring, terminals or connectors
- DSM

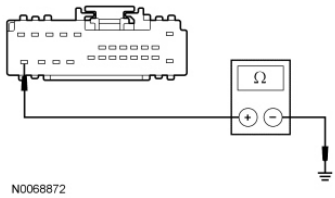
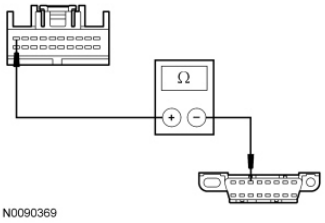
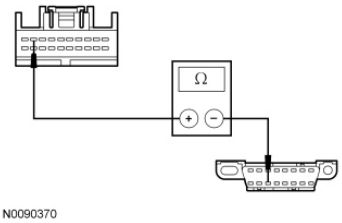
PINPOINT TEST Z: THE DSM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take

Z1 CHECK THE DSM VOLTAGE SUPPLY CIRCUITS FOR AN OPEN	
• Ignition OFF. • Disconnect: DSM C3299a . • Disconnect: DSM C3299b . • Measure the voltage between the DSM C3299a-1, circuit SBB32 (VT/RD), harness side and ground.  A0079061 • Measure the voltage between the DSM C3299b-1, circuit SBP12 (GN/RD), harness side and ground.  N0068871 • **Are the voltages greater than 10 volts?**	**Yes** GO to Z2 . **No** VERIFY the Battery Junction Box (BJB) fuse 32 (30A) or the Smart Junction Box (SJB) fuse 12 (7.5) are OK. If OK, REPAIR the circuit in question. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the short circuit. CLEAR the DTCs. REPEAT the network test with the scan tool.
Z2 CHECK THE DSM GROUND CIRCUITS FOR AN OPEN	
• Disconnect: Negative Battery Cable . • Measure the resistance between the DSM C3299a-2, circuit GD126 (BK/WH), harness side and ground.  A0079062 • Measure the resistance between the DSM C3299b-24, circuit GD126 (BK/WH), harness side and ground.	**Yes** GO to Z3 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

 N0068872 • **Are the resistances less than 5 ohms?**	
Z3 CHECK THE MS-CAN CIRCUITS BETWEEN THE DSM AND THE DLC FOR AN OPEN	
• Disconnect: DSM C3299d . • Measure the resistance between the DSM C3299d-10, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0090369 • Measure the resistance between the DSM C3299d-9, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0090370 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to Z4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
Z4 CHECK FOR CORRECT DSM OPERATION	
• Disconnect all the DSM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the DSM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present.	**Yes** INSTALL a new DSM . REFER to Section 501-10 . REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

• **Is the concern still present?**	

Pinpoint Test AA: The Accessory Protocol Interface Module (APIM) Does Not Respond To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Refer to Wiring Diagrams Cell 130 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Audio System/Navigation for schematic and connector information.

Normal Operation

The Accessory Protocol Interface Module (APIM) communicates with the scan tool through the High Speed Controller Area Network (HS-CAN).

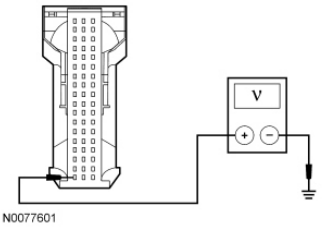
This pinpoint test is intended to diagnose the following:

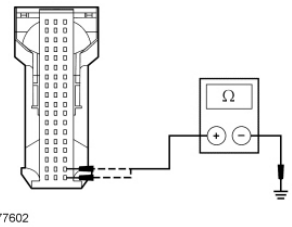
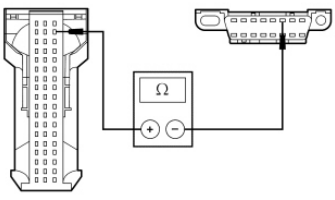
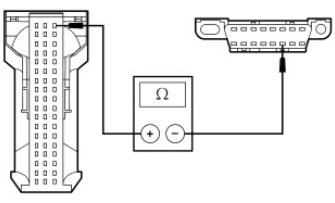
- Fuse
- Wiring, terminals or connectors
- APIM

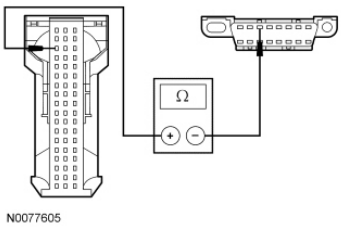
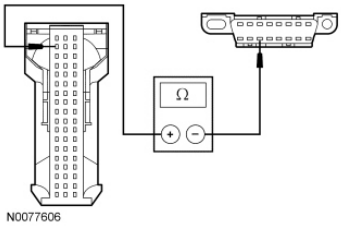
PINPOINT TEST AA: THE APIM DOES NOT RESPOND TO THE SCAN TOOL

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AA1 CHECK THE APIM VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Disconnect: APIM C3338 . • Ignition ON. • Measure the voltage between the APIM C3338-1, circuit SBP13 (GY/RD), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to AA2 . **No** VERIFY the Smart Junction Box (SJB) fuse 13 (5A) is OK. If OK, REPAIR the circuit. CLEAR the DTCs. REPEAT the network test with the scan tool. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.

AA2 CHECK THE APIM GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the APIM C3338-37, circuit GD148 (BK/YE), harness side and ground; and between the APIM C3338-38, circuit GD148 (BK/YE), harness side and ground.  N0077602 • **Are the resistances less than 5 ohms?**	**Yes** GO to AA3 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
AA3 CHECK THE HS-CAN CIRCUITS BETWEEN THE APIM AND THE DLC FOR AN OPEN	
• Measure the resistance between the APIM C3338-53, circuit VDB04 (WH/BU), harness side and the Data Link Connector (DLC) C251-6, circuit VDB04 (WH/BU), harness side.  N0077603 • Measure the resistance between the APIM C3338-54, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0077604 • **Are the resistances less than 5 ohms?**	**Yes** GO to AA4 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

AA4 CHECK THE MS-CAN CIRCUITS BETWEEN THE APIM AND THE DLC FOR AN OPEN	
• Measure the resistance between the APIM C3338-16, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0077605 • Measure the resistance between the APIM C3338-17, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0077606 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to AA5 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
AA5 CHECK FOR CORRECT APIM OPERATION	
• Disconnect all the APIM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the APIM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Section 415-00 . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test AB: Intermittent No Medium Speed Controller Area Network (MS-CAN) Communication, One Or More Modules Are Not Responding During Network Test

Normal Operation

When one of the 2 Medium Speed Controller Area Network (MS-CAN) circuits becomes open to a module on the network, intermittent or unreliable communication to all modules on the MS-CAN may result.

The following modules communicate on the MS-CAN :

- Accessory Protocol Interface Module (APIM) (if equipped)
- Audio Front Control Module (ACM)
- Audio Digital Signal Processing (DSP) module (if equipped)
- Driver Seat Module (DSM) (if equipped)
- Driver Door Module (DDM) (if equipped)
- Dual Climate Controlled Seat Module (DCSM) (if equipped)
- Front Controls Interface Module (FCIM)
- Front Display Interface Module (FDIM)
- Global Positioning System Module (GPSM) (if equipped)
- HVAC module
- Instrument Panel Cluster (IPC)
- Interior Lighting Control Module (ILCM) (if equipped)
- Parking Aid Module (PAM) (if equipped)
- Side Obstacle Detection Control Module - Left (SOD-L) (if equipped)
- Side Obstacle Detection Control Module - Right (SOD-R) (if equipped)
- Smart Junction Box (SJB)

This pinpoint test is intended to diagnose the following:

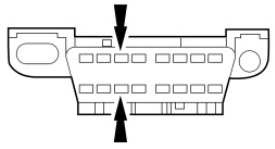
- Circuit VDB06 (GY/OG) (MS-CAN +) open
- Circuit VDB07 (VT/OG) (MS-CAN -) open

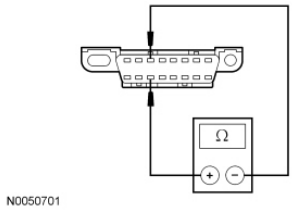
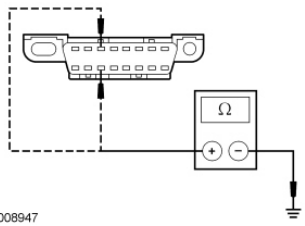
PINPOINT TEST AB: INTERMITTENT NO MEDIUM SPEED CONTROLLER AREA NETWORK (MS-CAN) COMMUNICATION, ONE OR MORE MODULES ARE NOT RESPONDING DURING NETWORK TEST

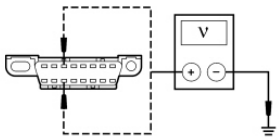
NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Various network DTCs will set while disabling modules in this test procedure which will need to be cleared after the diagnostic procedure is completed.

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AB1 CHECK THE DLC PINS FOR DAMAGE	
• Ignition OFF. • Disconnect the scan tool cable from the Data Link Connector (DLC). • Inspect DLC pins 3 and 11 for damage.  N0053178	**Yes** GO to AB2 . **No** REPAIR the DLC as necessary. CLEAR the DTCs. REPEAT the network test with the scan tool.

• **Are DLC pins 3 and 11 OK?**	
AB2 CHECK THE MS-CAN TERMINATION RESISTANCE	
• Disconnect: Negative Battery Cable. • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance between 54 and 66 ohms?**	**Yes** GO to AB3 . **No** GO to Pinpoint Test AC .
AB3 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.  N0008947 • **Are the resistances greater than 1,000 ohms?**	**Yes** GO to AB4 . **No** GO to Pinpoint Test AC .
AB4 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO VOLTAGE	
• Connect: Negative Battery Cable. • Ignition ON. • Measure the voltage between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** GO to AB5 .

 N0050702 • **Is the voltage greater than 6 volts?**	
AB5 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE SJB DISABLED	
• Disconnect: Smart Junction Box (SJB) Fuse 5 (10A). • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test U . **No** INSTALL the removed fuse. If the vehicle is equipped with a Dual Climate Controlled Seat Module (DCSM), GO to AB6 . If the vehicle is not equipped with a DCSM , GO to AB7 .
AB6 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE DCSM DISABLED	
• Disconnect: SJB Fuse 16 (15A). • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test Y . **No** INSTALL the removed fuse. GO to AB7 .
AB7 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE ACM DISABLED	
• Disconnect: SJB Fuse 39 (20A). • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test M . **No** INSTALL the removed fuse. If the vehicle is equipped with an audio Digital Signal Processing (DSP) module, GO to AB8 . If the vehicle is not equipped with an audio DSP module, GO to AB9 .
AB8 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE AUDIO DSP MODULE DISABLED	
• Disconnect: BJB Fuses 20 (20A) and 21 (20A) (THX®) or Fuse 19 (25A) (Sony®). • Enter the following diagnostic mode on the scan tool: Networkest.	**Yes** INSTALL the removed fuses. GO to Pinpoint Test W . **No**

• Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	INSTALL the removed fuses. GO to AB9 .
AB9 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE HVAC MODULE DISABLED	
• Disconnect: SJB Fuse 15 (10A). • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test V . **No** INSTALL the removed fuse. If the vehicle is equipped with an Accessory Protocol Interface Module (APIM), GO to AB10 . If the vehicle is not equipped with an APIM , GO to AB11 .
AB10 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE APIM DISCONNECTED	
• Disconnect: APIM C3342. • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test AA . **No** INSTALL the removed fuses. GO to AB11 .
AB11 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE FCIM , FDIM , ILCM (IF EQUIPPED), AND GPSM (IF EQUIPPED) DISABLED	
• Disconnect: SJB Fuse 14 (10A). • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to AB12 . **No** INSTALL the removed fuse. If the vehicle is equipped with a Driver Door Module (DDM) and/or a Driver Seat Module (DSM), GO to AB16 . If the vehicle is not equipped with a DDM and/or a DSM , GO to AB18 .
AB12 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE FCIM DISCONNECTED	
• Disconnect: Front Controls Interface Module (FCIM) C2402 (With Navigation, MKZ), C2403 (Without Navigation) or C2408 (With Navigation, except MKZ).	**Yes** CONNECT the FCIM . GO to Pinpoint Test N . **No**

• Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	CONNECT the FCIM . If the vehicle is equipped with an Interior Lighting Control Module (ILCM), GO to AB13 . If the vehicle is not equipped with an ILCM , GO to AB14 .
AB13 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE ILCM DISCONNECTED	
• Disconnect: In-Line ILCM C2238. • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** CONNECT the ILCM . GO to Pinpoint Test Q . **No** CONNECT the ILCM . GO to AB14 .
AB14 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE FDIM DISCONNECTED	
• Disconnect: Front Display Interface Module (FDIM) C2407. • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** CONNECT the FDIM . GO to Pinpoint Test O . **No** CONNECT the FDIM . If the vehicle is equipped with a Global Positioning System Module (GPSM), GO to AB15 . If the vehicle is not equipped with a GPSM , an intermittent fault is not present. GO to Pinpoint Test AC .
AB15 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE GPSM DISCONNECTED	
• Disconnect: GPSM C2300. • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** CONNECT the GPSM . GO to Pinpoint Test P . **No** An intermittent fault is not present. GO to Pinpoint Test AC .
AB16 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE DDM (IF EQUIPPED) AND DSM (IF EQUIPPED) DISABLED	
• Disconnect: SJB Fuse 12 (7.5A). • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** If the vehicle is equipped with only a DDM , INSTALL the removed fuse. GO to Pinpoint Test X . If the vehicle is equipped with only a DSM , INSTALL the removed fuse. GO to Pinpoint Test Z . If the vehicle is

	equipped with both a DDM and DSM , INSTALL the removed fuse. GO to AB17 . **No** INSTALL the removed fuse. GO to AB18 .
AB17 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE DDM DISCONNECTED	
• Disconnect: DDM C568b. • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** CONNECT the DDM . GO to Pinpoint Test X . **No** CONNECT the DDM . GO to Pinpoint Test Z .
AB18 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE IPC DISABLED	
• Disconnect: SJB Fuses 26 (15A) and 29 (5A). • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuses. GO to Pinpoint Test C . **No** INSTALL the removed fuses. If the vehicle is equipped with a Parking Aid Module (PAM) and/or side obstacle detection, GO to AB19 . If the vehicle is not equipped with a PAM and/or side obstacle detection, an intermittent fault is not present. GO to Pinpoint Test AC .
AB19 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE PAM (IF EQUIPPED), SOD-L (IF EQUIPPED) AND SOD-R (IF EQUIPPED) DISABLED	
• Disconnect: SJB Fuse 35 (10A). • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** If the vehicle is equipped with only a PAM , INSTALL the removed fuse. GO to Pinpoint Test T . If the vehicle is equipped with only side obstacle detection, INSTALL the removed fuse. GO to AB21 . If the vehicle is equipped with both a PAM and side obstacle detection, INSTALL the removed fuse. GO to AB20 . **No** INSTALL the removed fuse. An intermittent fault is not present. GO to Pinpoint Test AC .

AB20 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE PAM DISCONNECTED	
• Disconnect: PAM C4014. • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** CONNECT the PAM . GO to Pinpoint Test T . **No** CONNECT the DDM . GO to AB21 .
AB21 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE SOD-L DISCONNECTED	
• Disconnect: SOD-L C4230. • Enter the following diagnostic mode on the scan tool: Network Test. • Repeat the network test. • **Do all other MS-CAN modules pass the network test?**	**Yes** CONNECT the SOD-L . GO to Pinpoint Test R . **No** CONNECT the SOD-L . GO to Pinpoint Test S .

Pinpoint Test AC: No Medium Speed Controller Area Network (MS-CAN) Communication, All Modules Are Not Responding

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

The Medium Speed Controller Area Network (MS-CAN) uses an unshielded twisted pair cable, circuits VDB06 (GY/OG) and VDB07 (VT/OG).

This pinpoint test is intended to diagnose the following:

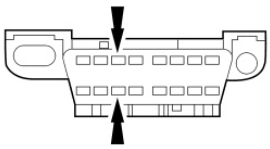
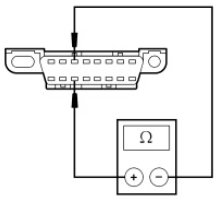
- Wiring, terminals or connectors
- Accessory Protocol Interface Module (APIM) (if equipped)
- Audio Front Control Module (ACM)
- Audio Digital Signal Processing (DSP) module (if equipped)
- Driver Door Module (DDM) (if equipped)
- Driver Seat Module (DSM) (if equipped)
- Dual Climate Controlled Seat Module (DCSM) (if equipped)
- Front Controls Interface Module (FCIM)
- Front Display Interface Module (FDIM)
- Global Positioning System Module (GPSM) (if equipped)
- HVAC module (if equipped)
- Interior Lighting Control Module (ILCM) (if equipped)
- Instrument Panel Cluster (IPC) (gateway module)
- Parking Aid Module (PAM) (if equipped)
- Smart Junction Box (SJB)
- Side Obstacle Detection Control Module - Left (SOD-L) (if equipped)
- Side Obstacle Detection Control Module - Right (SOD-R) (if equipped)

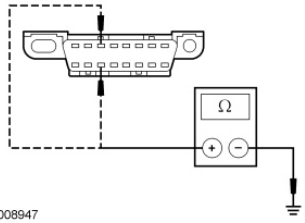
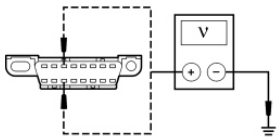
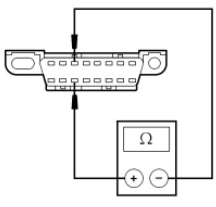
PINPOINT TEST AC: NO MS-CAN COMMUNICATION, ALL MODULES ARE NOT RESPONDING

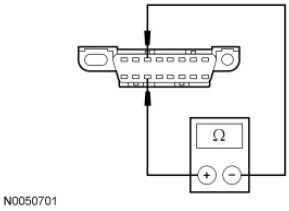
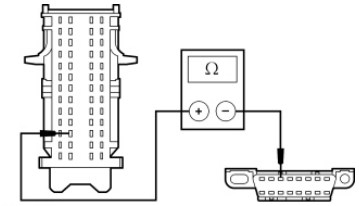
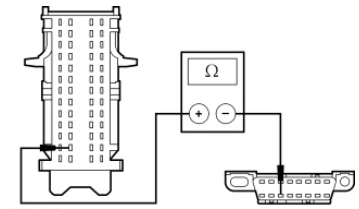
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

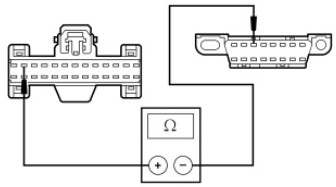
NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AC1 CHECK THE DLC PINS FOR DAMAGE	
• Ignition OFF. • Disconnect the scan tool cable from the Data Link Connector (DLC). • Inspect DLC pins 3 and 11 for damage.  N0053178 • **Are DLC pins 3 and 11 OK?**	**Yes** GO to AC2 . **No** REPAIR the DLC as necessary. CLEAR the DTCs. REPEAT the network test with the scan tool.
AC2 CHECK THE MS-CAN TERMINATION RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance between 54 and 66 ohms?**	**Yes** GO to AC3 . **No** GO to AC5 .
AC3 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND	

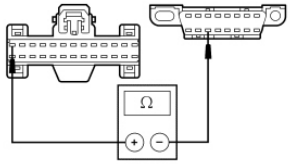
• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.  N0008947 • **Are the resistances greater than 1,000 ohms?**	**Yes** GO to AC4 . **No** GO to AC32 .
AC4 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO VOLTAGE	
• Connect: Negative Battery Cable . • Ignition ON. • Measure the voltage between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.  N0050702 • **Is the voltage greater than 6 volts?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The MS-CAN has tested within specifications. GO to Pinpoint Test AB to diagnose the intermittent MS-CAN fault.
AC5 CHECK THE MS-CAN TERMINATION RESISTOR	
• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance between 108 and 132 ohms?**	**Yes** GO to AC6 . **No** GO to AC9 .
AC6 CHECK THE MS-CAN TERMINATION RESISTOR WITH THE SJB DISCONNECTED	

• Disconnect: Smart Junction Box (SJB) C2280b . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance between 108 and 132 ohms?**	**Yes** GO to AC7 . **No** GO to AC8 .
AC7 CHECK THE MS-CAN CIRCUITS BETWEEN THE SJB AND THE DLC FOR AN OPEN	
• Measure the resistance between the SJB C2280b-37, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0064664 • Measure the resistance between the SJB C2280b-38, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0064665 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to AC53 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
AC8 CHECK THE MS-CAN CIRCUITS BETWEEN THE IPC AND THE DLC FOR AN OPEN	
• Disconnect: Instrument Panel Cluster (IPC) C220 . • For gasoline engine, measure the resistance between the IPC C220-12, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to AC61 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.



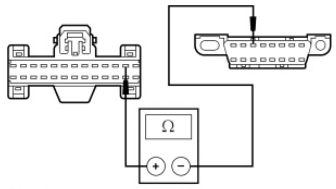
N0099496

- For gasoline engine, measure the resistance between the IPC C220-13, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.



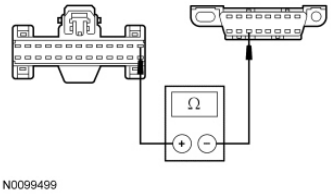
N0099497

- For hybrid engine, measure the resistance between the IPC C220-2, circuit VDB06 (GY/OG), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.



N0099498

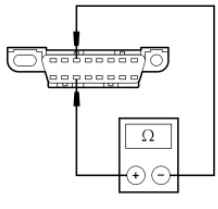
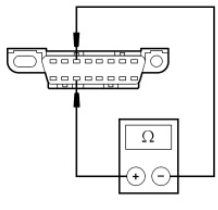
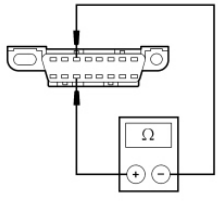
- For hybrid engine, measure the resistance between the IPC C220-1, circuit VDB07 (VT/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.

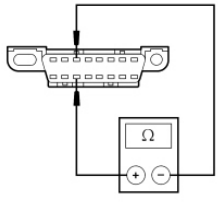
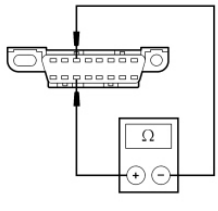
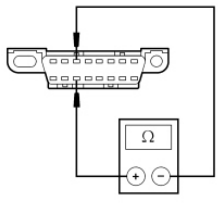


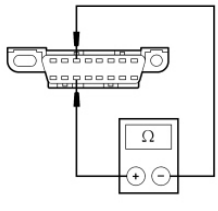
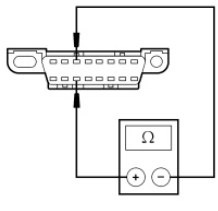
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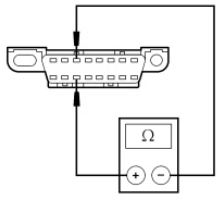
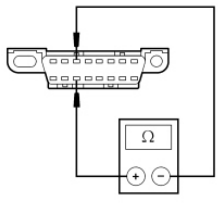
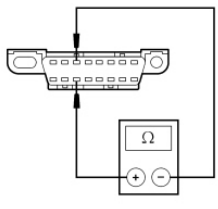
- **Are the resistances less than 5 ohms?**

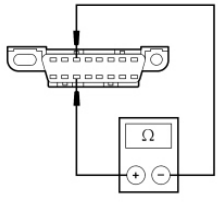
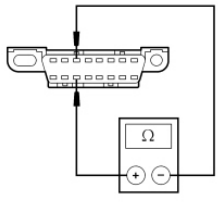
AC9 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER	

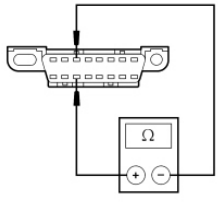
• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** GO to AC11 . **No** GO to AC10 .
AC10 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR AN OPEN	
• Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** A capacitor internal to a module may still be draining, causing irregular resistance readings. WAIT 5 minutes. REPEAT this pinpoint test.
AC11 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE SJB DISCONNECTED	
• Disconnect: SJB C2280b . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** If the vehicle is equipped with a Parking Aid Module (PAM), GO to AC12 . If the vehicle is not equipped with a PAM , GO to AC13 . **No** CONNECT the negative battery cable. GO to AC53 .
AC12 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE PAM DISCONNECTED	

• Disconnect: PAM C4014 . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** GO to AC13 . **No** CONNECT the negative battery cable. GO to AC54 .
AC13 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE ACM DISCONNECTED	
• Disconnect: Audio Front Control Module (ACM) C240c . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** If the vehicle is equipped with an audio Digital Signal Processing (DSP) module, GO to AC14 . If the vehicle is not equipped with an audio DSP module, GO to AC15 . **No** CONNECT the negative battery cable. GO to AC55 .
AC14 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE AUDIO DSP MODULE DISCONNECTED	
• Disconnect: Audio DSP Module C4235a . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** GO to AC15 . **No** CONNECT the negative battery cable. GO to AC56 .

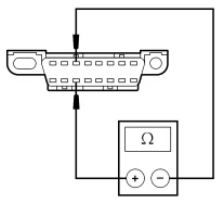
AC15 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE FCIM DISCONNECTED	
• Disconnect: Front Controls Interface Module (FCIM) C2402 (With Navigation, MKZ), C2403 (Without Navigation) or C2408 (With Navigation, Except MKZ) . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** If the vehicle is equipped with a Front Display Interface Module (FDIM), GO to AC16 . If the vehicle is not equipped with an FDIM , GO to AC17 . **No** CONNECT the negative battery cable. GO to AC57 .
AC16 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE FDIM DISCONNECTED	
• Disconnect: FDIM C2407 . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** GO to AC17 . **No** CONNECT the negative battery cable. GO to AC58 .
AC17 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE HVAC MODULE DISCONNECTED	
• Disconnect: HVAC Module C2357a (Manual) or C2356a (Dual Automatic Temperature Control (DATC)) . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.	**Yes** If the vehicle is equipped with a Global Positioning System Module (GPSM), GO to AC18 . If the vehicle is not equipped with a GPSM , GO to AC19 . **No** CONNECT the negative battery cable.

 N0050701 • **Is the resistance less than 5 ohms?**	GO to AC59 .
AC18 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE GPSM DISCONNECTED	
• Disconnect: GPSM C2300 . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** GO to AC19 . **No** CONNECT the negative battery cable. GO to AC60 .
AC19 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE IPC DISCONNECTED	
• Disconnect: Instrument Panel Cluster (IPC) C220 . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** If the vehicle is equipped with an Interior Lighting Control Module (ILCM), GO to AC20 . If the vehicle is not equipped with an ILCM , GO to AC21 . **No** CONNECT the negative battery cable. GO to AC61 .
AC20 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE ILCM DISCONNECTED	

• Disconnect: ILCM C2301 . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** GO to AC21 . **No** CONNECT the negative battery cable. GO to AC62 .
AC21 VERIFY VEHICLE EQUIPMENT - DSM	
• Verify whether the vehicle is equipped with a Driver Seat Module (DSM). • **Is the vehicle equipped with a DSM ?**	**Yes** GO to AC22 . **No** GO to AC23 .
AC22 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE DSM DISCONNECTED	
• Disconnect: DSM C3299d . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** GO to AC23 . **No** CONNECT the negative battery cable. GO to AC63 .
AC23 VERIFY VEHICLE EQUIPMENT - DCSM	
• Verify whether the vehicle is equipped with a Dual Climate Controlled Seat Module (DCSM). • **Is the vehicle equipped with a DCSM ?**	**Yes** GO to AC24 . **No** GO to AC25 .
AC24 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE DCSM DISCONNECTED	

• Disconnect: DCSM C3305c . • Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0050701 • **Is the resistance less than 5 ohms?**	**Yes** GO to AC25 . **No** CONNECT the negative battery cable. GO to AC64 .
AC25 VERIFY VEHICLE EQUIPMENT - APIM	
• Verify whether the vehicle is equipped with anAccessory Protocol Interface Module (APIM). • **Is the vehicle equipped with an APIM ?**	**Yes** GO to AC26 . **No** GO to AC27 .
AC26 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE APIM DISCONNECTED	

- Disconnect: APIM C3338 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.


N0050701

- **Is the resistance less than 5 ohms?**

Yes
GO to AC27 .

No
CONNECT the negative battery cable. GO to AC65 . **AC27 VERIFY VEHICLE EQUIPMENT - DDM**

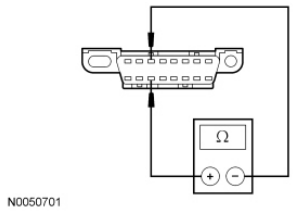
- Verify whether the vehicle is equipped with a Driver Door Module (DDM).
- **Is the vehicle equipped with a DDM ?**

Yes
GO to AC28 .

No
GO to AC29 . **AC28 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT**

TOGETHER WITH THE DDM DISCONNECTED

- Disconnect: DDM C568b .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.



- **Is the resistance less than 5 ohms?**

Yes
GO to AC29 .

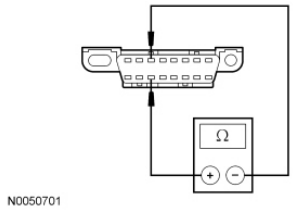
No
CONNECT the negative battery cable. GO to AC66 . **AC29 VERIFY VEHICLE EQUIPMENT - SIDE OBSTACLE DETECTION**

- Verify whether the vehicle is equipped with side obstacle detection.
- **Is the vehicle equipped with side obstacle detection?**

Yes
GO to AC30 .

No
REPAIR the circuits. CONNECT all modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC30 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE SOD-L DISCONNECTED**

- Disconnect: Side Obstacle Detection Control Module - Left (SOD-L) C4230 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.

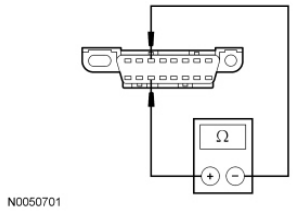


- **Is the resistance less than 5 ohms?**

Yes
GO to AC31 .

No
CONNECT the negative battery cable. GO to AC67 . **AC31 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE SOD-R DISCONNECTED**

- Disconnect: Side Obstacle Detection Control Module - Right (SOD-R) C4229 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.

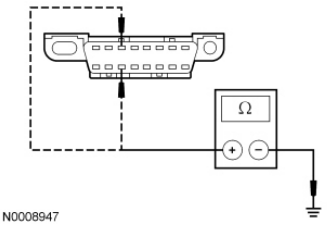


- **Is the resistance less than 5 ohms?**

Yes
REPAIR the circuit. CONNECT all modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
CONNECT the negative battery cable. GO to AC68 . **AC32 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE SJB DISCONNECTED**

- Disconnect: SJB C2280b .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



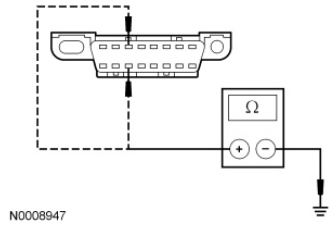
- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC53 .

No
If the vehicle is equipped with a Parking Aid Module (PAM), GO to AC33 .

If the vehicle is not equipped with a PAM , GO to AC34 . **AC33 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE PAM DISCONNECTED**

- Disconnect: PAM C4014 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.

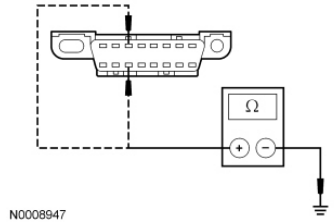


- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC54 .

No
GO to AC34 . **AC34 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE ACM DISCONNECTED**

- Disconnect: Audio Front Control Module (ACM) C240c .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



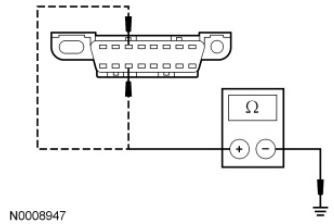
- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC55 .

No
If the vehicle is equipped with an audio Digital Signal Processing (DSP) module, GO to AC35 .

If the vehicle is not equipped with an audio DSP module, GO to AC36 . **AC35 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE AUDIO DSP MODULE DISCONNECTED**

- Disconnect: Audio DSP Module C4235a .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.

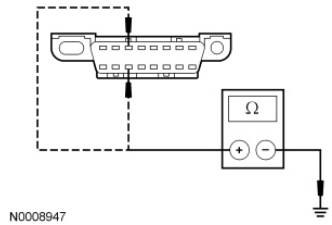


- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC56 .

No
GO to AC37 . **AC36 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE FCIM DISCONNECTED**

- Disconnect: Front Controls Interface Module (FCIM) C2402 (With Navigation, MKZ), C2403 (Without Navigation) or C2408 (With Navigation, Except MKZ) .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



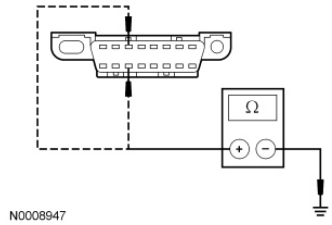
- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC57 .

No
If the vehicle is equipped with a Front Display Interface Module (FDIM), GO to AC37 .

If the vehicle is not equipped with an FDIM , GO to AC38 . **AC37 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE FDIM DISCONNECTED**

- Disconnect: FDIM C2407 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



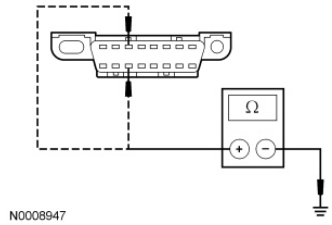
- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC58 .

No
GO to AC38 . **AC38 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE HVAC MODULE DISCONNECTED**

- Disconnect: HVAC Module C2357a (Manual) or C2356a (Dual Automatic Temperature Control (DATC)) .

- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



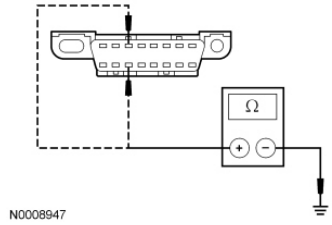
- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC59 .

No
If the vehicle is equipped with a Global Positioning System Module (GPSM), GO to AC39 .

If the vehicle is not equipped with a GPSM , GO to AC40 . **AC39 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE GPSM DISCONNECTED**

- Disconnect: GPSM C2300 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.

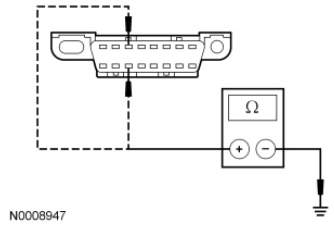


- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC60 .

No
GO to AC40 . **AC40 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE IPC DISCONNECTED**

- Disconnect: Instrument Panel Cluster (IPC) C220 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



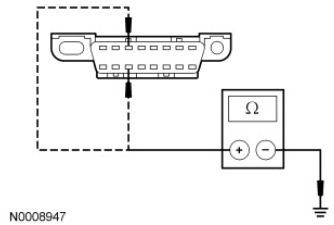
- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC61 .

No
If the vehicle is equipped with anInterior Lighting Control Module (ILCM), GO to AC41 .

If the vehicle is not equipped with an ILCM , GO to AC42 . **AC41 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE ILCM DISCONNECTED**

- Disconnect: ILCM C2301 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC62 .

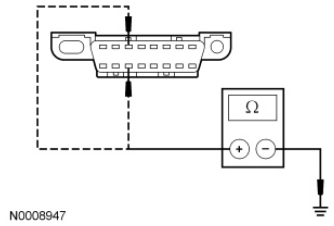
No
GO to AC42 . **AC42 VERIFY VEHICLE EQUIPMENT - DSM**

- Verify whether the vehicle is equipped with a Driver Seat Module (DSM).
- **Is the vehicle equipped with a DSM ?**

Yes
GO to AC43 .

No
GO to AC44 . **AC43 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE DSM DISCONNECTED**

- Disconnect: DSM C3299d .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC63 .

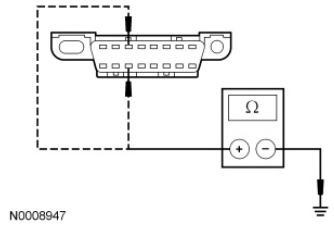
No
GO to AC44 . **AC44 VERIFY VEHICLE EQUIPMENT - DCSM**

- Verify whether the vehicle is equipped with a Dual Climate Controlled Seat Module (DCSM).
- **Is the vehicle equipped with a DCSM ?**

Yes
GO to AC45 .

No
GO to AC46 . **AC45 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE DCSM DISCONNECTED**

- Disconnect: DCSM C3305c .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC64 .

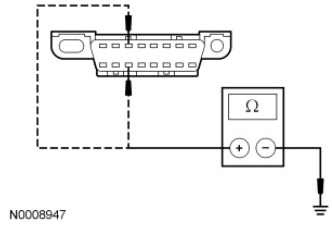
No
GO to AC46 . **AC46 VERIFY VEHICLE EQUIPMENT - APIM**

- Verify whether the vehicle is equipped with anAccessory Protocol Interface Module (APIM).
- **Is the vehicle equipped with an APIM ?**

Yes
GO to AC47 .

No
GO to AC48 . **AC47 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE APIM DISCONNECTED**

- Disconnect: APIM C3338 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC65 .

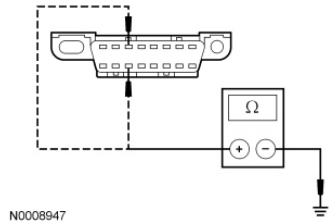
No
GO to AC48 . **AC48 VERIFY VEHICLE EQUIPMENT - DDM**

- Verify whether the vehicle is equipped with a Driver Door Module (DDM).
- **Is the vehicle equipped with a DDM ?**

Yes
GO to AC49 .

No
GO to AC50 . **AC49 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE DDM DISCONNECTED**

- Disconnect: DDM C568b .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC66 .

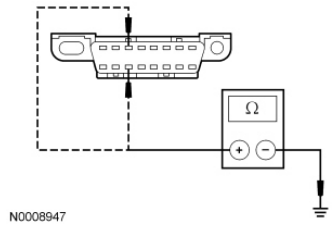
No
GO to AC50 . **AC50 VERIFY VEHICLE EQUIPMENT - SIDE OBSTACLE DETECTION**

- Verify whether the vehicle is equipped with side obstacle detection.
- **Is the vehicle equipped with side obstacle detection?**

Yes
GO to AC51 .

No
REPAIR the circuits. CONNECT all modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC51 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE SOD-L DISCONNECTED**

- Disconnect: Side Obstacle Detection Control Module - Left (SOD-L) C4230 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.

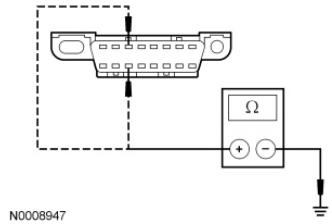


- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC67 .

No
GO to AC52 . **AC52 CHECK THE MS-CAN (+) AND MS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE SOD-R DISCONNECTED**

- Disconnect: Side Obstacle Detection Control Module - Right (SOD-R) C4229 .
- Measure the resistance between the DLC C251-3, circuit VDB06 (GY/OG), harness side and ground; and between the DLC C251-11, circuit VDB07 (VT/OG), harness side and ground.



- **Are the resistances greater than 1,000 ohms?**

Yes
CONNECT the negative battery cable. GO to AC68 .

No
REPAIR the circuit. CONNECT all modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC53 CHECK FOR CORRECT SJB OPERATION**

- Disconnect all the SJB connectors.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins

- ♦ pushed-out pins
- Connect all the SJB connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new SJB . REFER to Section 419-10 . CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC54 CHECK FOR CORRECT PAM OPERATION**

- Disconnect the PAM connector.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect the PAM connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new PAM . REFER to Section 413-13 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC55 CHECK FOR CORRECT ACM OPERATION**

- Disconnect all the ACM connectors.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect all the ACM connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new ACM . REFER to Section 415-00 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC56 CHECK FOR CORRECT AUDIO DSP MODULE OPERATION**

- Disconnect all the audio DSP module connectors.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins

- ♦ pushed-out pins
- Connect all the audio DSP module connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new audio DSP module. REFER to Section 415-00 . CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool. **AC57**
CHECK FOR CORRECT FCIM OPERATION

- Disconnect the FCIM connector.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect the FCIM connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new FCIM . REFER to Section 415-00 . CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool. **AC58**
CHECK FOR CORRECT FDIM OPERATION

- Disconnect the FDIM connector.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect the FDIM connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new FDIM . REFER to Section 415-00 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC59**
CHECK FOR CORRECT HVAC MODULE OPERATION

- Disconnect all the HVAC module connectors.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins

- ♦ pushed-out pins
- Connect all the HVAC module connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new HVAC module. REFER to Section 412-01 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC60 CHECK FOR CORRECT GPSM OPERATION**

- Disconnect the GPSM connector.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect the GPSM connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new GPSM . REFER to Section 415-00 . CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool. **AC61 CHECK FOR CORRECT IPC OPERATION**

- Disconnect the IPC connector.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect the IPC connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new IPC . REFER to Section 413-01 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC62 CHECK FOR CORRECT ILCM OPERATION**

- Disconnect the ILCM connector.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins

- ♦ pushed-out pins
- Connect the ILCM connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new ILCM . REFER to Section 417-02 . CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool. **AC63 CHECK FOR CORRECT DSM OPERATION**

- Disconnect all the DSM connectors.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect all the DSM connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new DSM . REFER to Section 501-10 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC64 CHECK FOR CORRECT DCSM OPERATION**

- Disconnect all the DCSM connectors.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect all the DCSM connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new DCSM . REFER to Section 501-10 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC65 CHECK FOR CORRECT APIM OPERATION**

- Disconnect the APIM connector.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins

- ♦ pushed-out pins
- Connect the APIM connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new APIM . REFER to Section 415-00 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC66 CHECK FOR CORRECT DDM OPERATION**

- Disconnect all the DDM connectors.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect all the DDM connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new DDM . REFER to Section 501-14 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **AC67 CHECK FOR CORRECT SOD-L OPERATION**

- Disconnect the SOD-L connector.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins
  - ♦ pushed-out pins
- Connect the SOD-L connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new SOD-L . REFER to Section 419-03 . CONNECT all modules. CLEAR the DTCs. CONNECT all modules. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. REPEAT the network test with the scan tool. **AC68 CHECK FOR CORRECT SOD-R OPERATION**

- Disconnect the SOD-R connector.
- Check for:
  - ♦ corrosion
  - ♦ damaged pins

- ♦ pushed-out pins
- Connect the SOD-R connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new SOD-R . REFER to Section 419-03 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

No
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test AD: Intermittent No High Speed Controller Area Network (HS-CAN) Communication, One Or More Modules Are Not Responding During Network Test

Normal Operation

When one of the 2 High Speed Controller Area Network (HS-CAN) circuits becomes open to a module on the network, intermittent or unreliable communication to all modules on the HS-CAN may result.

The following modules communicate on the HS-CAN :

- 4X4 control module (if equipped)
- ABS module
- Accessory Protocol Interface Module (APIM) (if equipped)
- Air Conditioning Compressor Module (ACCM) (Hybrid only)
- Battery Energy Control Module (BECM) (Hybrid only)
- DC/DC (Hybrid only)
- Headlamp Control Module (HCM) (if equipped)
- Instrument Panel Cluster (IPC)
- Occupant Classification System Module (OCSM)
- PCM
- Power Steering Control Module (PSCM) (if equipped)
- Restraints Control Module (RCM)
- Transmission Control Module (TCM) (if equipped)

This pinpoint test is intended to diagnose the following:

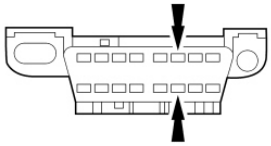
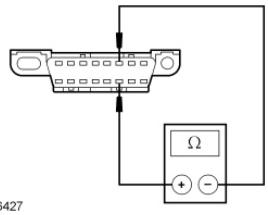
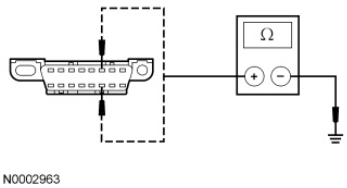
- Circuit VDB04 (WH/BU) (HS-CAN +) open
- Circuit VDB05 (WH) (HS-CAN -) open

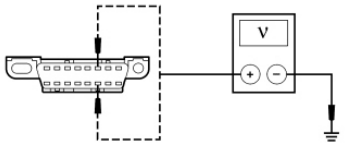
PINPOINT TEST AD: INTERMITTENT NO HS-CAN COMMUNICATION, ONE OR MORE MODULES ARE NOT RESPONDING DURING NETWORK TEST

NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

NOTE: Various network DTCs will set while disabling modules in this test procedure which will need to be cleared after the diagnostic procedure is completed.

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AD1 CHECK THE DLC PINS FOR DAMAGE	
• Ignition OFF. • Disconnect the scan tool cable from the DLC . • Inspect DLC pins 6 and 14 for damage.  A0093867 • **Are DLC pins 6 and 14 OK?**	**Yes** GO to AD2 . **No** REPAIR the DLC as necessary. CLEAR the DTCs. REPEAT the network test with the scan tool.
AD2 CHECK THE HS-CAN TERMINATION RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance between 54 and 66 ohms?**	**Yes** GO to AD3 . **No** GO to Pinpoint Test AE .
AD3 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963	**Yes** GO to AD4 . **No** GO to Pinpoint Test W .

• **Are the resistances greater than 1,000 ohms?**	
AD4 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO VOLTAGE	
• Connect: Negative Battery Cable . • Ignition ON. • Measure the voltage between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002964 • **Is the voltage greater than 6 volts?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** GO to AD5 .
AD5 CHECK FOR RESTORED COMMUNICATION WITH THE PCM DISABLED	
• Disconnect: Gasoline Engine - Battery Junction Box (BJB) Fuses 23 (10A) and 46 (15A) . • Disconnect: Hybrid - PCM C175b . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed s (gasoline engine) or CONNECT the PCM (hybrid). GO to Pinpoint Test A . **No** INSTALL the removed fuses (gasoline engine) or CONNECT the PCM (hybrid). If the vehicle is equipped with an Headlamp Control Module (HCM) and/or a Power Steering Control Module (PSCM), GO to AD6 . If the vehicle is not equipped with a HCM , GO to AD8 .
AD6 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE HCM (IF EQUIPPED) AND PSCM (IF EQUIPPED) DISABLED	
• Disconnect: Smart Junction Box (SJB) Fuse 33 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. If the vehicle is equipped with only a HCM , GO to Pinpoint Test I . If the vehicle is equipped with only a PSCM , GO to Pinpoint Test D . If the vehicle is equipped with both a HCM and PSCM , GO to AD7 .

	No INSTALL the removed fuse. GO to AD8 .
AD7 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE HCM DISCONNECTED	
• Disconnect: HCM C1600 . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** CONNECT the HCM . GO to Pinpoint Test I . **No** CONNECT the HCM . GO to Pinpoint Test D .
AD8 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE RCM DISABLED	
• Disconnect: SJB Fuse 32 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test E . **No** INSTALL the removed fuse. For gasoline engine, GO to AD9 . For hybrid, GO to AD10 .
AD9 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE ABS MODULE DISABLED - GASOLINE ENGINE	
• Disconnect: Battery Junction Box (BJB) Fuse 42 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test B . **No** INSTALL the removed fuse. If the vehicle is equipped with a 4X4 control module, GO to AD13 . If the vehicle is not equipped with a 4X4 control module, GO to AD14 .
AD10 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE ACCM , DC/DC AND ABS MODULE DISABLED - HYBRID	
• Disconnect: Battery Junction Box (BJB) Fuse 47 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to AD11 . **No** INSTALL the removed fuse. If the vehicle is equipped with a 4X4 control module, GO to AD13 . AD14 .
AD11 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE ACCM DISCONNECTED	

• Disconnect: ACCM C1469a . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuses. GO to Pinpoint Test K . **No** INSTALL the removed fuses. GO to AD12 .
AD12 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE DC/DC DISCONNECTED	
• Disconnect: DC/DC C1457d . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuses. GO to Pinpoint Test L . **No** INSTALL the removed fuses. GO to Pinpoint Test B .
AD13 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE 4X4 MODULE DISABLED	
• Disconnect: SJB Fuses 11 (10A) and 35 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuses. GO to Pinpoint Test H . **No** INSTALL the removed fuses. GO to AD9 .
AD14 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE IPC DISABLED	
• Disconnect: SJB Fuses 26 (15A) and 29 (5A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuses. GO to Pinpoint Test C . **No** INSTALL the removed fuses. If the vehicle is equipped with an Accessory Protocol Interface Module (APIM) , GO to AD15 . If the vehicle is not equipped with an APIM ,GO to AD16 .
AD15 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE APIM DISABLED	
• Disconnect: SJB Fuse 13 (5A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test AA . **No** INSTALL the removed fuse. GO to AD16 .
AD16 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE OCSM	

DISABLED	
• Disconnect: SJB Fuse 46 (7.5A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test F . **No** INSTALL the removed fuse. If the vehicle is equipped with a Transmission Control Module (TCM), GO to AD17 . If the vehicle is not equipped with a TCM , GO to AD18 .
AD17 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE TCM DISABLED	
• Disconnect: Gasoline Engine - SJB Fuse 44 (10A) and BJB Fuse 16 (5A) . • Disconnect: Hybrid - TCM C1458a . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuses (gasoline engine) or CONNECT the TCM (hybrid). GO to Pinpoint Test G . **No** INSTALL the removed fuses (gasoline engine) or CONNECT the TCM (hybrid). GO to AD18 .
AD18 CHECK FOR RESTORED NETWORK COMMUNICATION WITH THE RCM DISABLED	
• Disconnect: SJB Fuse 32 (10A) . • Enter the following diagnostic mode on the scan tool: Network Test . • Repeat the network test. • **Do all other HS-CAN modules pass the network test?**	**Yes** INSTALL the removed fuse. GO to Pinpoint Test E . **No** INSTALL the removed fuse. An intermittent fault is not present. GO to Pinpoint Test AC .

Pinpoint Test AE: No High Speed Controller Area Network (HS-CAN) Communication, All Modules Are Not Responding

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

The High Speed Controller Area Network (HS-CAN) uses an unshielded twisted pair cable, circuits VDB04 (WH/BU) and VDB05 (WH).

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- 4X4 control module (if equipped)
- ABS module
- Accessory Protocol Interface Module (APIM) (if equipped)

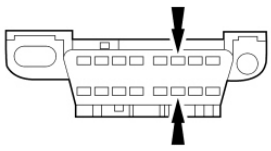
- Air Conditioning Compressor Module (ACCM) (Hybrid only)
- Battery Energy Control Module (BECM) (Hybrid only)
- DC to DC Converter Control Module (DC/DC) (Hybrid only)
- Headlamp Control Module (HCM) (if equipped)
- Instrument Panel Cluster (IPC) (gateway module)
- Occupant Classification System Module (OCSM)
- PCM
- Power Steering Control Module (PSCM) (if equipped)
- Restraints Control Module (RCM)
- Transmission Control Module (TCM) (if equipped)

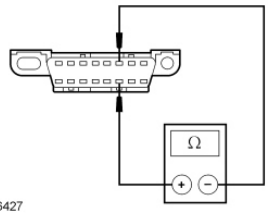
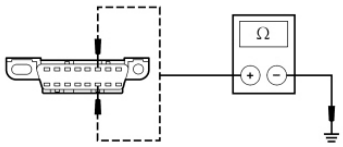
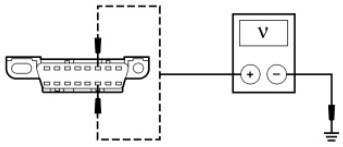
PINPOINT TEST AE: NO HS-CAN COMMUNICATION, ALL MODULES ARE NOT RESPONDING

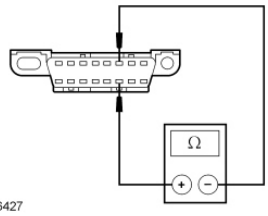
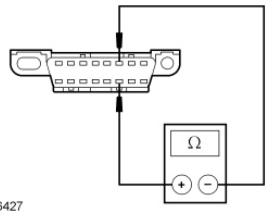
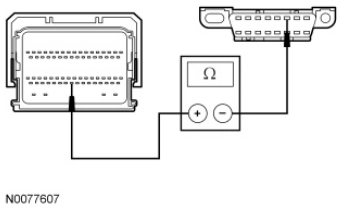
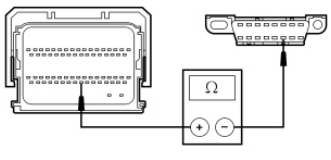
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

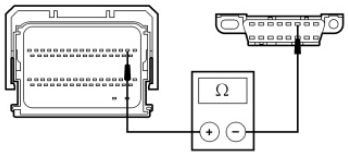
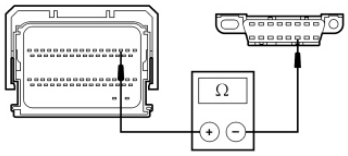
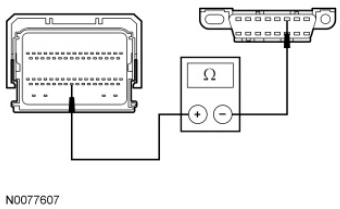
NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test.

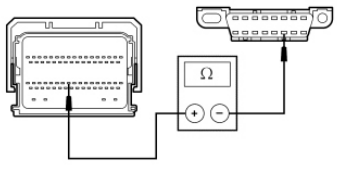
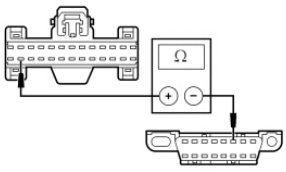
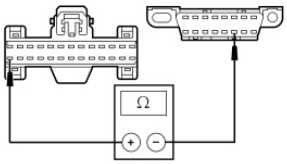
NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

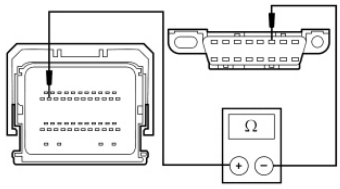
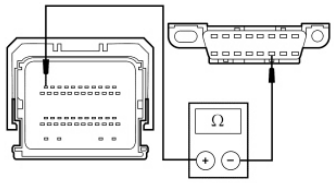
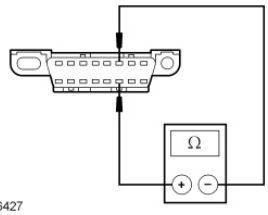
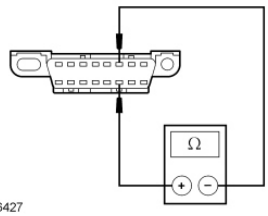
Test Step	Result / Action to Take
AE1 CHECK THE DLC PINS FOR DAMAGE	
• Ignition OFF. • Disconnect the scan tool cable from the Data Link Connector (DLC). • Inspect DLC pins 6 and 14 for damage.  A0093867 • **Are DLC pins 6 and 14 OK?**	**Yes** GO to AE2 . **No** REPAIR the DLC as necessary. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE2 CHECK THE HS-CAN TERMINATION RESISTANCE	
• Ignition OFF. • Disconnect: Negative Battery Cable . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** GO to AE3 . **No** GO to AE5 .

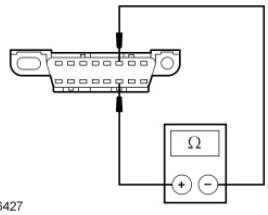
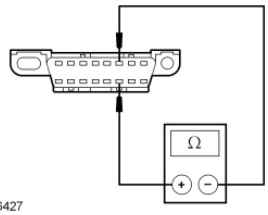
 N0026427 • **Is the resistance between 54 and 66 ohms?**	
AE3 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** GO to AE4 . **No** GO to AE28 .
AE4 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO VOLTAGE	
• Connect: Negative Battery Cable . • Ignition ON. • Measure the voltage between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002964 • **Are the voltages greater than 6 volts?**	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The HS-CAN has tested within specifications. GO to Pinpoint Test AD to diagnose an intermittent HS-CAN fault.
AE5 CHECK THE HS-CAN TERMINATION RESISTOR	
• Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** GO to AE6 . **No** GO to AE12 .

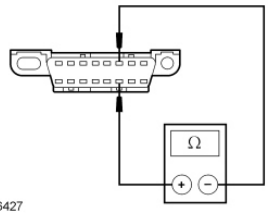
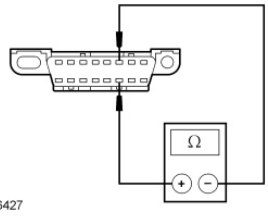
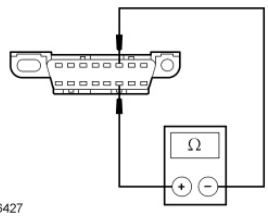
 N0026427 • **Is the resistance between 108 and 132 ohms?**	
AE6 CHECK THE HS-CAN TERMINATION RESISTOR WITH THE PCM DISCONNECTED	
• Disconnect: PCM C175b . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance between 108 and 132 ohms?**	**Yes** For 2.5L gas and 3.0L engine, GO to AE7 . For 3.5L engine, GO to AE8 . For 2.5L hybrid, GO to AE9 . **No** For 2.5L gas and 3.0L and 3.5L engine, GO to AE10 . For 2.5L hybrid, GO to AE11 .
AE7 CHECK THE HS-CAN CIRCUITS BETWEEN THE PCM AND THE DLC FOR AN OPEN - 2.5L GAS AND 3.0L	
• Measure the resistance between the PCM C175b-59, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0077607 • Measure the resistance between the PCM C175b-58, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0099486	**Yes** CONNECT the negative battery cable. GO to AE42 . **No** REPAIR the circuit in question. CONNECT the negativeattery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

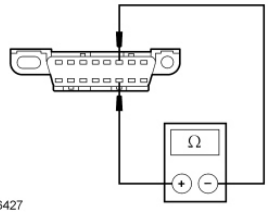
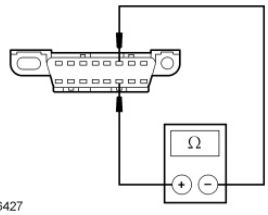
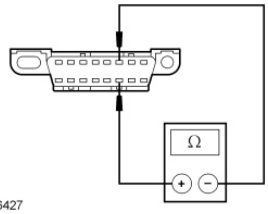
• **Are the resistances less than 5 ohms?**	
AE8 CHECK THE HS-CAN CIRCUITS BETWEEN THE PCM AND THE DLC FOR AN OPEN - 3.5L	
• Measure the resistance between the PCM C175b-2, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0026577 • Measure the resistance between the PCM C175b-3, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026578 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE42 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE9 CHECK THE HS-CAN CIRCUITS BETWEEN THE PCM AND THE DLC FOR AN OPEN - 2.5L HYBRID	
• Measure the resistance between the PCM C175b-59, circuit VDB04 (WH/BU), harness side and the DLC C251-6, circuit VDB04 (WH/BU), harness side.  N0077607 • Measure the resistance between the PCM C175b-43, circuit VDB05 (WH), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** CONNECT the negative battery cable. GO to AE42 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

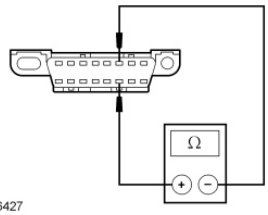
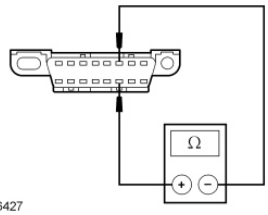
 N0077608 • **Are the resistances less than 5 ohms?**	
AE10 CHECK THE HS-CAN CIRCUITS BETWEEN THE IPC (GASOLINE ENGINE) AND THE DLC FOR AN OPEN	
• Disconnect: Instrument Panel Cluster (IPC) C220 . • Measure the resistance between the IPC C220-25, circuit VDB04 (WH/BU), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.  N0099492 • Measure the resistance between the IPC C220-26, circuit VDB05 (WH), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0099493 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE50 **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE11 CHECK THE HS-CAN CIRCUITS BETWEEN THE BECM (HYBRID) AND THE DLC FOR AN OPEN	
• Disconnect: Battery Energy Control Module (BECM) C4237a . • Measure the resistance between the BECM C4237a-22, circuit VDB04 (WH/BU), harness side and the DLC C251-3, circuit VDB06 (GY/OG), harness side.	**Yes** CONNECT the negative battery cable. GO to AE53 . **No** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.

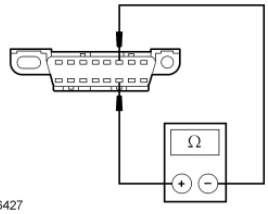
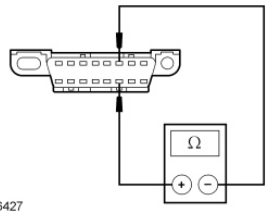
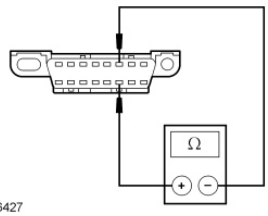
 N0099517 • Measure the resistance between the BECM C4237a-11, circuit VDB05 (WH), harness side and the DLC C251-11, circuit VDB07 (VT/OG), harness side.  N0099518 • **Are the resistances less than 5 ohms?**	
AE12 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** GO to AE14 . **No** GO to AE13 .
AE13 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR AN OPEN	
• Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR the circuit in question. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** A capacitor internal to a module may still be draining, causing irregular resistance readings. WAIT 5 minutes. REPEAT this pinpoint test.

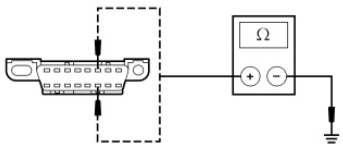
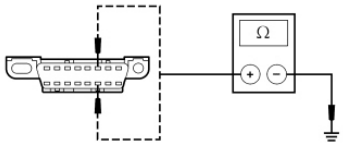
AE14 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE PCM DISCONNECTED	
• Disconnect: PCM C175b . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** If the vehicle is equipped with a Headlamp Control Module (HCM), GO to AE15 . If the vehicle is not equipped with an HCM , GO to AE16 . **No** CONNECT the negative battery cable. GO to AE42 .
AE15 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE HCM DISCONNECTED	
• Disconnect: HCM C1600 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** GO to AE16 . **No** CONNECT the negative battery cable. GO to AE43 .
AE16 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE ABS MODULE DISCONNECTED	
• Disconnect: ABS Module C135 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.	**Yes** If the vehicle is equipped with a 4X4 control module, GO to AE17 . If the vehicle is not equipped with a 4X4 control module, GO to AE18 . **No** CONNECT the negative battery cable. GO to AE44 .

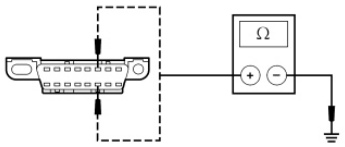
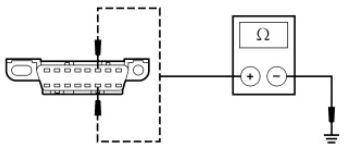
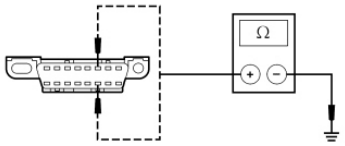
 N0026427 • **Is the resistance less than 5 ohms?**	
AE17 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE 4X4 CONTROL MODULE DISCONNECTED	
• Disconnect: 4X4 Control Module C3253 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** GO to AE18 . **No** CONNECT the negative battery cable. GO to AE45 .
AE18 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE RCM DISCONNECTED	
• Disconnect: Restraints Control Module (RCM) C310b . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** If the vehicle is equipped with a Power Steering Control Module (PSCM), GO to AE19 . If the vehicle is not equipped with a PSCM , GO to AE20 . **No** CONNECT the negative battery cable. GO to AE46 .
AE19 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE PSCM DISCONNECTED	

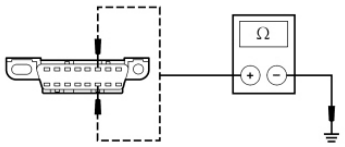
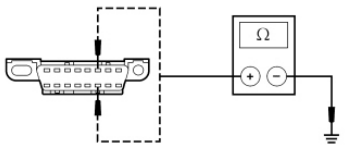
• Disconnect: Power Steering Control Module (PSCM) C1467b . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** GO to AE20 . **No** CONNECT the negative battery cable. GO to AE47 .
AE20 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE OCSM DISCONNECTED	
• Disconnect: Occupant Classification System Module (OCSM) C3159 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** If the vehicle is equipped with a Transmission Control Module (TCM), GO to AE21 . If the vehicle is not equipped with a TCM , GO to AE22 . **No** CONNECT the negative battery cable. GO to AE48 .
AE21 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE TCM DISCONNECTED	
• Disconnect: TCM C1458a (Hybrid) or C1533 (3.5L) . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** GO to AE22 . **No** CONNECT the negative battery cable. GO to AE49 .

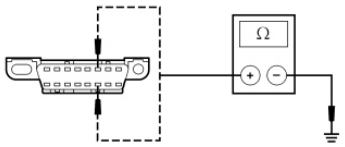
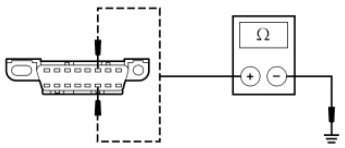
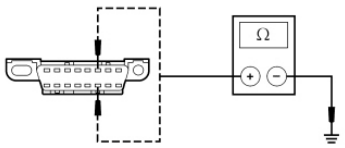
AE22 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE IPC DISCONNECTED	
• Disconnect: IPC C220 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** If the vehicle is equipped with an Accessory Protocol Interface Module (APIM), GO to AE23 . If the vehicle is not equipped with an APIM , GO to AE24 . **No** CONNECT the negative battery cable. GO to AE50 .
AE23 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE APIM DISCONNECTED	
• Disconnect: APIM C3338 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** For gasoline engine, REPAIR the circuits. CONNECT all modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool. For hybrid, GO to AE25 . **No** CONNECT the negative battery cable. GO to AE51 .
AE24 VERIFY VEHICLE EQUIPMENT - HYBRID	
• Verify whether the vehicle is a hybrid. • **Is the vehicle a hybrid?**	**Yes** GO to AE25 . **No** REPAIR the circuits. CONNECT all modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE25 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE ACCM DISCONNECTED	

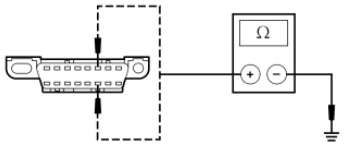
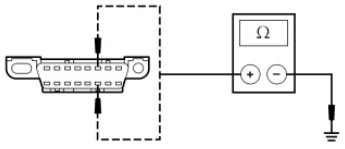
• Disconnect: Air Conditioning Compressor Module (ACCM) C1469a . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** GO to AE26 . **No** CONNECT the negative battery cable. GO to AE52 .
AE26 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE BECM DISCONNECTED	
• Disconnect: Battery Energy Control Module (BECM) C4237a . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** GO to AE27 . **No** CONNECT the negative battery cable. GO to AE53 .
AE27 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TOGETHER WITH THE DC/DC DISCONNECTED	
• Disconnect: DC/DC C1457d . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and the DLC C251-14, circuit VDB05 (WH), harness side.  N0026427 • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuits. CONNECT all modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** CONNECT the negative battery cable. GO to AE54 .

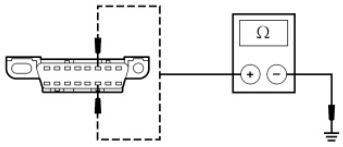
AE28 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE PCM DISCONNECTED	
• Disconnect: PCM C175b . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE42 . **No** If the vehicle is equipped with a Headlamp Control Module (HCM), GO to AE29 . If the vehicle is not equipped with an HCM , GO to AE30 .
AE29 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE HCM DISCONNECTED	
• Disconnect: HCM C1600 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE43 . **No** GO to AE30 .
AE30 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE ABS MODULE DISCONNECTED	
• Disconnect: ABS Module C135 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.	**Yes** CONNECT the negative battery cable. GO to AE44 . **No** If the vehicle is equipped with a 4X4 control module, GO to AE31 . If the vehicle is not equipped with a 4X4 control module, GO to AE32 .

 N0002963 • **Are the resistances greater than 1,000 ohms?**	
AE31 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE 4X4 CONTROL MODULE DISCONNECTED	
• Disconnect: 4X4 Control Module C3253 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE45 . **No** GO to AE32 .
AE32 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE RCM DISCONNECTED	
• Disconnect: Restraints Control Module (RCM) C310b . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE46 . **No** If the vehicle is equipped with a Power Steering Control Module (PSCM), GO to AE33 . If the vehicle is not equipped with a PSCM , GO to AE34 .
AE33 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE PSCM DISCONNECTED	

• Disconnect: Power Steering Control Module (PSCM) C1467b . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE47 . **No** GO to AE34 .
AE34 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE OCSM DISCONNECTED	
• Disconnect: Occupant Classification System Module (OCSM) C3159 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE48 . **No** If the vehicle is equipped with a Transmission Control Module (TCM), GO to AE35 . If the vehicle is not equipped with a TCM , GO to AE36 .
AE35 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE TCM DISCONNECTED	
• Disconnect: TCM C1458a (Hybrid) or C1533 (3.5L) . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.	**Yes** CONNECT the negative battery cable. GO to AE49 . **No** GO to AE36 .

 N0002963 • **Are the resistances greater than 1,000 ohms?**	
AE36 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE IPC DISCONNECTED	
• Disconnect: IPC C220 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE50 . **No** If the vehicle is equipped with an Accessory Protocol Interface Module (APIM), GO to AE37 . If the vehicle is not equipped with an APIM , GO to AE38 .
AE37 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE APIM DISCONNECTED	
• Disconnect: APIM C3338 . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE51 . **No** For gasoline engine, REPAIR the circuits. CONNECT all modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool. For hybrid, GO to AE39 .
AE38 VERIFY VEHICLE EQUIPMENT - HYBRID	
• Verify whether the vehicle is a hybrid. • **Is the vehicle a hybrid?**	**Yes** GO to AE39 . **No** REPAIR the circuits. CONNECT all modules. CONNECT the negative

	battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE39 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE ACCM DISCONNECTED	
• Disconnect: Air Conditioning Compressor Module (ACCM) C1469a . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE52 . **No** GO to AE40 .
AE40 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE BECM DISCONNECTED	
• Disconnect: Battery Energy Control Module (BECM) C4237a . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.  N0002963 • **Are the resistances greater than 1,000 ohms?**	**Yes** CONNECT the negative battery cable. GO to AE53 . **No** GO to AE41 .
AE41 CHECK THE HS-CAN (+) AND HS-CAN (-) CIRCUITS FOR A SHORT TO GROUND WITH THE DC/DC DISCONNECTED	
• Disconnect: DC/DC C1457d . • Measure the resistance between the DLC C251-6, circuit VDB04 (WH/BU), harness side and ground; and between the DLC C251-14, circuit VDB05 (WH), harness side and ground.	**Yes** CONNECT the negative battery cable. GO to AE54 . **No** REPAIR the circuits. CONNECT all

 N0002963 • **Are the resistances greater than 1,000 ohms?**	modules. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE42 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to the appropriate section in Section 303-14A , Section 303-14B or Section 303-14C . CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE43 CHECK FOR CORRECT HCM OPERATION	
• Disconnect the HCM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the HCM connector and make sure it seats correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new HCM . REFER to Section 417-01 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE44 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect the ABS module connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the ABS module connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Section 206-09 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. C CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

AE45 CHECK FOR CORRECT 4X4 CONTROL MODULE OPERATION	
• Disconnect the 4X4 control module connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the 4X4 control module connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new 4X4 control module. REFER to Section 308-07A . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE46 CHECK FOR CORRECT RCM OPERATION	
• Disconnect all the RCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the RCM connectors and make sure they seat correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new RCM . REFER to Section 501-20B . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE47 CHECK FOR CORRECT PSCM OPERATION	
• Disconnect all the PSCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the PSCM connectors and make sure they seat correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PSCM . REFER to Section 211-05 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. REPEAT the network test with the scan tool.
AE48 CHECK FOR CORRECT OCSM OPERATION	
• Disconnect the OCSM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the OCSM connector and make sure it seats correctly. • Verify the concern is still present.	**Yes** INSTALL a new OCSM . REFER to Section 501-20B . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been

• **Is the concern still present?**	caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE49 CHECK FOR CORRECT TCM OPERATION	
• Disconnect the TCM connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the TCM connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new TCM . REFER to Section 307-01B . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE50 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE51 CHECK FOR CORRECT APIM OPERATION	
• Disconnect all the APIM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the APIM connectors and make sure they seat correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new APIM . REFER to Section 415-00 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE52 CHECK FOR CORRECT ACCM OPERATION	
• Disconnect all the ACCM connectors. • Check for: ♦ corrosion ♦ damaged pins	**Yes** INSTALL a new ACCM . REFER to Section 412-01 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

♦ pushed-out pins • Connect all the ACCM connectors and make sure they seat correctly. • Verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE53 CHECK FOR CORRECT BECM OPERATION	
NOTE: Do not disconnect the high voltage cables or connectors in the following step. • Disconnect all the BECM **LOW VOLTAGE** connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the BECM **LOW VOLTAGE** connectors and make sure they seat correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new BECM . REFER to Section 414-03 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.
AE54 CHECK FOR CORRECT DC/DC OPERATION	
• Disconnect all the DC/DC **LOW VOLTAGE** connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the DC/DC **LOW VOLTAGE** connectors and make sure they seat correctly. • Verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DC/DC . REFER to Section 414-05 . CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CONNECT all modules. CLEAR the DTCs. REPEAT the network test with the scan tool.

Pinpoint Test AF: No Power To The Scan Tool

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

The scan tool is connected to the Data Link Connector (DLC) to communicate with the High Speed Controller Area Network (HS-CAN) and the Medium Speed Controller Area Network (MS-CAN) communications network.

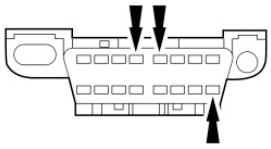
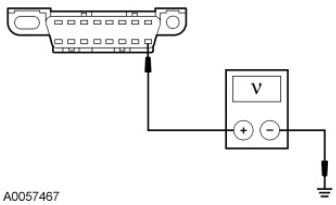
A loss of ground or poor ground at the DLC may result in HS-CAN or MS-CAN faults while the scan tool is connected.

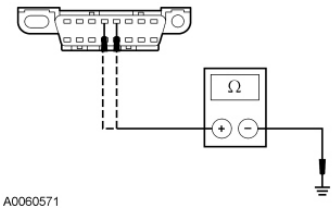
This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Scan tool

PINPOINT TEST AF: NO POWER TO THE SCAN TOOL

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
AF1 CHECK THE DLC PINS FOR DAMAGE	
NOTE: Most faults are due to connector and/or wiring concerns. Carry out a thorough inspection and verification before proceeding with the pinpoint test. • Disconnect the scan tool cable from the DLC . • Inspect DLC pins 4, 5 and 16 for damage.  N0050767 • **Are DLC pins 4, 5 and 16 OK?**	**Yes** GO to AF2 . **No** REPAIR the DLC as necessary. CLEAR the DTCs. REPEAT the network test with the scan tool.
AF2 CHECK THE DLC VOLTAGE SUPPLY FOR AN OPEN	
• Measure the voltage between the DLC C251-16, circuit SBP20 (GN/RD), harness side and ground.  A0057467 • **Is the voltage greater than 10 volts?**	**Yes** GO to AF3 . **No** VERIFY the Smart Junction Box (SJB) fuse 20 (15A) is OK. If OK, REPAIR the circuit. REPEAT the network test with the scan tool.
AF3 CHECK THE DLC GROUND CIRCUITS FOR AN OPEN	

• Disconnect: Negative Battery Cable . • Measure the resistance between the DLC C251-4, circuit GD116 (BK/VT), harness side and ground; and between the DLC C251-5, circuit GD116 (BK/VT), harness side and ground.  A0060571 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. REPAIR the scan tool. REPEAT the network test with the scan tool. **No** CONNECT the negative battery cable. REPAIR the circuit in question. REPEAT the network test with the scan tool.

Module Configuration

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Principles of Operation

Configurable modules accommodate a variety of vehicle options, eliminating the need for many unique modules for one vehicle line. These modules must be configured when replaced as part of a repair procedure. Configurable modules should not be exchanged between vehicles since the settings are unique to each vehicle. Failure to configure a new module may result in improper operation and/or DTCs setting.

The 3 different methods of configuration are:

- Programmable Module Installation (PMI)
- Module reprogramming ("flashing")
- Programmable parameters

Some modules do not support all 3 methods.

Definition of Terms

The definitions of configuration terms are:

Programmable Module Installation (PMI)

PMI is a scan tool process which configures settings in a new module. Data used for the PMI process is automatically downloaded from the original module and stored when a scan tool session is started. If this data cannot be retrieved from the module being replaced, the scan tool may prompt for As-Built data entry or display a list of parameter values that need to be manually selected. Some modules are reprogrammed during PMI when a strategy/calibration update is available. To carry out PMI , refer to Programmable Module Installation (PMI) in this section.

NOTE: It is important that the scan tool identifies the vehicle and obtains configuration data prior to removing any modules. The new module must be able to communicate with the scan tool in order to carry out PMI .

Module Reprogramming

Module reprogramming (also referred to as "flashing") is a scan tool process which updates the strategy/calibration in a module. Reprogramming a module with the same level of software will not improve module operation or repair a hardware failure. Module reprogramming is automatically carried out during PMI when a later strategy/calibration is available.

NOTE: Module reprogramming should be limited to circumstances where a published TSB procedure recommends doing so.

NOTE: A module cannot communicate with other modules on the communication network while being reprogrammed. Clear any network communication DTCs which may have been set in other modules during the reprogramming process.

Accessory Protocol Interface Module (APIM) Programming

APIM programming is a process that updates the APIM Consumer Interface Processor (CIP) and Vehicle Interface Processor (VIP) software. The VIP programming updates the calibration files in the portion of the APIM which interfaces with the Controller Area Network (CAN). The CIP programming updates calibration files in the portion of the APIM that interfaces with mobile phones and other customer devices.

APIM programming uses the VCM to read and program the VIP software through the Data Link Connector (DLC). A web-based On-Line Automotive Service Information System (OASIS) application is used to read and program the CIP software via a Universal Serial Bus (USB) cable between the scan tool and vehicle USB port. Both the VCM and OASIS application must be running on the scan tool during APIM programming. To carry out APIM programming, refer to Accessory Protocol Interface Module (APIM) Programming in this section. To carry out APIM software level check, refer to Section 415-00 .

Programmable Parameters

Programmable parameters are customer preference items that may be modified by the dealer via scan tool or in some cases modified by the customer following a procedure listed in the vehicle Owner's Literature. While many configuration options may exist for a module, only a few of these options are programmable parameters.

Adaptive Learning and Calibration

Some modules require a separate learning procedure be carried out if replaced as part of a repair procedure. For adaptive learning and calibration instructions, refer to the specific module removal and installation procedures.

Vehicle Identification (VID) Block

Some PCMs contain a memory area called a Vehicle Identification (VID) block. The PCM VID block commonly stores powertrain configuration items such as Vehicle Identification Number (VIN), tire size, axle ratio, and whether or not the vehicle is equipped with speed control.

Module Address

A unique module address is assigned to each module on the network for identification.

As-Built Data

As-Built data is a VIN -specific module configuration record. During vehicle build, the configuration from all modules is downloaded and stored in the As-Built database. As-Built data will not reflect customer preference items that have been changed from the default state. These items will need to be changed using programmable parameters after the module is configured.

NOTE: It is not necessary to obtain As-Built data unless directed to do so by the scan tool. This data may be accessed from the technician service publication website.

The following chart lists As-Built data addresses and describes specific module configuration information:

Module Configuration and Parameter Chart

Module	Module Address	Requires PMI	Reprogram/ Flash Capable	Requires Adaptive Learning or Calibration	Available Programmable Parameters
4X4 control module	761	No	No	No	None
ABS module	760	Yes	Yes	No	None
Accessory Protocol Interface Module (APIM)	7D0	Yes	Yes	No	None
Air Conditioning Compressor Module (ACCM) (Hybrid only)	7C7	No	No	No	None
Audio Front Control Module (ACM)	727	Yes	Yes	No	• Phone module • Satellite Digital Audio Receiver System (SDARS) Canadian content • Tuner frequency setting
Audio Digital Signal Processing (DSP) module	783	Yes	Yes	No	None
Battery Energy Control Module (BECM) (Hybrid only)	7E4	Yes	No	No	• Configure battery end of life counter • Configure hybrid battery state of charge • Configure charge since rebalance • Configure battery age
DC to DC Converter Control Module (DC/DC) (Hybrid only)	746	No	No	No	None
Driver Door Module (DDM)	740	Yes	Yes	No	None
Driver Seat Module (DSM)	744	Yes	Yes	No	• Easy entry/exit
Dual Climate Controlled Seat	776	Yes	Yes	No	None

Module (DCSM)					
Front Controls Interface Module (FCIM)	7A7	No	No	No	None
Front Display Interface Module (FDIM)	7A6	Yes	Yes	No	• Cell phone module
Global Positioning System Module (GPSM)	701	No	No	No	None
Headlamp Control Module (HCM)	734	No	No	No	None
HVAC module	733	No	No	No	None
Interior Lighting Control Module (ILCM)	7B5	Yes	Yes	No	None
Instrument Panel Cluster (IPC)	720	Yes	Yes	No	None
Occupant Classification System Module (OCSM)	765	No	No	• Seat weight sensor re-zero	None
Parking Aid Module (PAM)	736	Yes	Yes	No	None
PCM	7E0	Yes	Yes	• Adaptive airflow • Idle speed • Refueling event • Fuel trim	None
Power Steering Control Module (PSCM)	730	Yes	Yes	No	None
Restraints Control Module (RCM)	737	Yes	Yes	• Seat weight sensor re-zero	• Driver Belt-Minder® • Passenger Belt-Minder®
Side Obstacle Detection Control Module - Left (SOD-L)	7C4	Yes	Yes	No	None
Side Obstacle Detection Control Module - Right (SOD-R)	7C6	Yes	Yes	No	None
Smart Junction Box (SJB)	726	Yes	Yes	• Tire Pressure Monitoring	• Auto locking • Auto unlocking

				System (TPMS) sensor calibration	• Global open (Lincoln only) • Lamps outage enable • Perimeter lighting feature • Daytime Running Lamps (DRL) present • Tire placard pressure
Transmission Control Module (TCM)	7E1	No	No	Yes	None

Inspection and Verification

This section provides step-by-step module configuration procedures. Carry out the Programmable Module Installation (PMI) procedure in this section when another workshop manual section directs to carry out configuration or when DTCs from the below list are present:

DTC Chart

NOTE: Some modules on this vehicle utilize a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous Memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Source	Action
B2477	Module Configuration Failure	• Driver Door Module (DDM) • Driver Seat Module (DSM) • Dual Climate Controlled Seat Module (DCSM) • Front Display Interface Module (FDIM) • Parking Aid Module (PAM) • Smart Junction Box (SJB)	CARRY OUT Programmable Module Installation (PMI). REFER to Programmable Module Installation (PMI) in this section.
B2900	VIN mismatch	• ABS module (except Hybrid) • 4X4 control module	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
P0602	Powertrain Control Module Programming Error	• PCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.

P0605	Internal Control Module Read Only Memory (ROM) Error	• PCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
P0613:45	TCM Processor: Program Memory Failure	• Transmission Control Module (TCM) (Hybrid only)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
P0613:46	TCM Processor: Calibration / Parameter Memory Failure	• TCM (Hybrid only)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
P1639	Vehicle ID Block Corrupted, Not Programmed	• PCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U0300	Internal Control Module Software Incompatibility	• PCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U0300:00	Internal Control Module Software Incompatibility: No Sub Type Information	• DC to DC Converter Control Module (DC/DC) (Hybrid only) • Restraints Control Module (RCM)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U0300:05	Internal Control Module Software Incompatibility: System Programming Failure	• Battery Energy Control Module (BECM) (Hybrid only)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U0300:51	Internal Control Module Software Incompatibility: Not Programmed	• ABS module (Hybrid only)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U0335:00	Software Incompatibility with Hybrid Battery Pack Sensor Module: No Sub Type Information	• BECM (Hybrid only)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U0336:00	Software Incompatibility with Restraints Control Module: No Sub Type Information	• BECM (Hybrid only)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U201A:51	Control Module Main Calibration Data: Not Programmed	• Audio Digital Signal Processing (DSP) module • Audio Front Control Module (ACM) • Front Controls Interface Module (FCIM)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.

U2050	No Application Present	• 4X4 control module • ABS module (except Hybrid) • ACM • DCSM • DDM • DSM • FDIM • FCIM • Interior Lighting Control Module (ILCM) • SJB • Transmission Control Module (TCM) (except Hybrid)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2051	No Application Present	• 4X4 control module • ACM • FCIM • FDIM • PAM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	• ABS module (Hybrid only) • ACM • Audio DSP module • HVAC module • Instrument Panel Cluster (IPC) • Power Steering Control Module (PSCM) • RCM • Side Obstacle Detection Control Module - Left (SOD-L) • Side Obstacle Detection Control Module - Right (SOD-R)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2100:00	Initial Configuration Not Complete: No Sub Type Information	• Accessory Protocol Interface Module (APIM)	CARRY OUT APIM programming. REFER to Accessory Protocol Interface Module (APIM) Programming in this section.

U2100:56	Initial Configuration Not Complete: Invalid / Incompatible Configuration	• ABS module (Hybrid only)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U2101:00	Control Module Configuration Incompatible: No Sub Type Information	• ACM • Audio DSP module • PSCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U3000:45	Control Module: Program Memory Failure	• DC/DC (Hybrid only)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U3000:46	Control Module: Calibration / Parameter Memory Failure	• Accessory Protocol Interface Module (APIM) • Headlamp Control Module (HCM) • IPC • PSCM • RCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U3000:54	Control Module: Missing Calibration	• Occupant Classification System Module (OCSM)	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.
U3002:62	Vehicle Identification Number: Signal Compare Failure	• ABS module (Hybrid only) • HVAC module • RCM	CARRY OUT PMI . REFER to Programmable Module Installation (PMI) in this section.

Programmable Module Installation (PMI)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is Available

NOTE: Following module installation, some modules require a separate procedure be carried out. For instructions, refer to the specific module removal and installation procedures.

1. Connect the IDS and identify the vehicle as normal.
2. From the Toolbox icon, select Module Programming and press the check mark.
3. Select Programmable Module Installation.
4. Select the module that is being replaced.
5. Follow the on-screen instructions, turn the ignition key to the OFF position, and press the check mark.
6. Install the new module and press the check mark.
7. Follow the on-screen instructions, turn the ignition key to the ON position, and press the check mark.
8. The IDS downloads the data into the new module and displays Module Configuration Complete.
9. Test module for correct operation.

Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available

NOTE: Following module installation, some modules require a separate procedure be carried out. For instructions, refer to the specific module removal and installation procedures.

1. Install the new module.
2. Connect the IDS and identify the vehicle as normal.
3. From the Toolbox icon, select Module Programming and press the check mark.
4. Select Programmable Module Installation.

5. Select the module that was replaced.
6. Follow the on-screen instructions, turn the ignition key to the OFF position, and press the check mark.
7. Follow the on-screen instructions, turn the ignition key to the ON position, and press the check mark.
8. If the data is not available, the IDS displays a screen stating to contact the As-Built Data Center. Retrieve the data from the technician service publication website at this time and press the check mark.
9. Enter the module data and press the check mark.
10. The IDS downloads the data into the new module and displays Module Configuration Complete.
11. Test module for correct operation.

Accessory Protocol Interface Module (APIM) Programming

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST3051-A	Universal Serial Bus (USB) Male-A to Male-A Cable CCMUSB2-AM-AM-10 or equivalent

Accessory Protocol Interface Module (APIM) Programming Using the Integrated Diagnostic System (IDS)

NOTE:

- If a new Accessory Protocol Interface Module (APIM) is being installed, install a new APIM before carrying out the following procedure. For additional information, refer to Section 415-00 .
- When carrying out the programming procedures, follow the scan tool on-screen directions.
- Make sure the battery is fully charged before carrying out the programming steps.
- A hardwired internet connection is strongly recommended when programming.
- If unable to complete programming because operation stops or errors are received, internet browser settings may need to be configured. From the on-line OASIS tab, select the "Service Tips" tab, then select "SYNC Software Programming" under "Job Aids".

NOTE:

- For APIM flash programming:
  - The scan tool and a USB male A to male A cable (CCMUSB2-AM-AM-10 or equivalent) are required.
  - The flash procedure deletes any paired phones that were in the SYNC® system.
  - The file for the flash needs to be downloaded from the online database. Allow for extra time for the file to download. The files are approximately 80 megabyte.

1. **NOTE:** The IDS program must be closed before attempting to program the APIM .

   Open a session for the vehicle from the technician service publication web site, and run On-Line Automotive Service Information System (OASIS) using "Read VIN and DTC's".

2. From the OASIS tab, select the "SYNC" button.

3. There are 3 available options for APIM programming:
   - Standard latest version of current software and applications): Use this option to update the APIM to the latest software level.
   - Custom (show what's available, and let me choose): Use this option to show all the available options that can be programmed, or if a Technical Service Bulletin (TSB) directs for specific software version to be programmed.

- Module Replacement (restore software for newly installed hardware): Use this option when the APIM has been replaced.

4. After selecting 1 of the 3 options (Standard, Custom or Module Replacement), click the "Read SYNC" button to verify the current APIM , Vehicle Interface Processor (VIP) and Consumer Interface Processor (CIP) software levels.
    - The versions are compared to a online database. After the comparison, the available software is displayed.

5. **NOTE:** Do not disconnect the Vehicle Communication Module (VCM) or the USB cable during APIM programming.

   When carrying out the programming procedures, follow the scan tool on-screen directions.

   NOTE: If unable to complete programming because operation stops or errors are received, interned browser settings may need to be configured. From the on-line OASIS tab, select the "Service Tips" tab, then select "SYNC Software Programming" under "Job Aids".

   Select the "Program SYNC" button to begin the APIM programming process.

6. Follow the scan tool on-screen directions for APIM programming.
    - After programming is complete the scan tool displays "Programming has been completed successfully."

Anti-Theft

NOTE: The Integrated Keyhead Transmitter (IKT) key is a standard Passive Anti-Theft System (PATS) key with a Remote Keyless Entry (RKE) transmitter incorporated into the keyhead. For PATS , refer to Section 419-01B or Section 419-01C . For RKE , refer to Section 501-14 .

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The perimeter anti-theft system consists of the following:

- Door ajar switches (located in the latches)
- Exterior lamps
- Hood switch (located in the left front of the engine compartment, on the core support)
- Horn (located forward of the RF wheel well)
- Key-in-ignition switch
- Keyless entry keypad (if equipped)
- Luggage compartment lid disarm switch (located in the luggage compartment lid lock cylinder) (also known as the anti-theft inhibit switch)
- RKE transmitter (part of the IKT key)
- SJB (located under the instrument panel on the left side)

The perimeter anti-theft feature is controlled by the SJB . The alarm can be armed by using 1 of 3 commands:

- Pressing the LOCK button on the IKT key
- Pressing the door lock control switch to LOCK with the accompanying door open, then close the door
- Pressing the 7/8 and 9/0 buttons simultaneously on the keyless entry keypad (if equipped)

The SJB monitors the door ajar switches, the hood switch and the luggage compartment lid disarm switch (all doors, hood and luggage compartment lid must be closed and the key must be out of the ignition lock cylinder). The SJB arms the perimeter alarm after all of the inputs are closed for 20 seconds. From the time each individual input is closed, to the time the perimeter alarm is armed for that particular input (approximately 20 seconds), is the "pre-arm phase". The pre-arm phase is separate for each individual input. If the door lock control switch is pressed to LOCK with the accompanying door open, all of the inputs that are closed (hood, luggage compartment lid) immediately begin their pre-arm phase. After the door that was open is closed, that door begins its pre-arm phase. This causes all other entry points to be armed a few seconds before the last open entry point. The perimeter alarm arms in stages in relation to which input was closed first after the arming command was given.

In the event of an unauthorized entry, the SJB activates the alarm. When the alarm is activated, the SJB intermittently grounds the horn relay, causing the horn to sound in regular intervals, and intermittently powers the turn signals, causing the turn signals to flash in regular intervals.

An unauthorized entry is identified by the SJB when a door, hood or luggage compartment lid ajar switch is detected by the SJB as having been opened and no electronic unlock function (the RKE transmitter unlock button being pressed) was received. If an unauthorized entry occurs at a passenger door, hood or luggage compartment lid, the SJB activates the perimeter alarm.

If an unauthorized entry occurs at the driver door with the SJB detecting the driver door ajar switch as being opened (with no electronic unlock command detected by the SJB), there is a 12-second delay with the Instrument Panel Cluster (IPC) issuing a chime during this 12-second delay. If a valid, programmed PATS

key does not turn the ignition switch to the ON position within 12 seconds of the driver door ajar switch being detected as open, the SJB considers this event to be an unauthorized entry and activates the perimeter alarm. At this time, the message center in the IPC will display "TO STOP ALARM, START VEHICLE".

An authorized entry is identified by the SJB as any of the ajar switches being opened after an electronic unlock command from a programmed RKE transmitter or keyless entry keypad (if equipped) has been detected by the SJB .

The door lock control switches cannot disarm the perimeter alarm.

The perimeter alarm can be disarmed only by:

- pressing the UNLOCK button on the RKE transmitter (part of the IKT key).
- using a valid programmed PATS key to turn the ignition switch to the ON position.
- entering the correct vehicle unlock code on the keyless entry keypad (if equipped).

The perimeter alarm can be deactivated (not disarmed) by pressing the PANIC button on the RKE transmitter (part of the IKT key). This action will not disarm the alarm, but stops the alarm from activation (horn sounding and turn signal lamps flashing). The perimeter alarm continues to be armed.

Perimeter Alarm Inhibit

The anti-theft inhibit switch (also known as the luggage compartment lid disarm switch) can be used to inhibit (stop/prevent) an armed system from activating the alarm. If the luggage compartment lid is opened by turning the key in the luggage compartment lid lock cylinder, the SJB will not activate the perimeter alarm. The perimeter alarm will continue to be armed for the other closures (all of the doors and the hood), but the alarm will not activate with the luggage compartment lid open.

If the luggage compartment lid is released using the luggage compartment lid release button on the IKT key, the perimeter alarm will be disarmed for the luggage compartment lid only. The rest of the vehicle closures will continue to be armed.

Anti-Theft

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit 105-R025D or equivalent

Principles of Operation

Perimeter Anti-Theft

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The perimeter anti-theft system (integral to the SJB) provides for vehicle security through an audible and visual notification if the vehicle doors, luggage compartment lid, or hood are opened while the system is armed. The system arms when:

- the doors, the luggage compartment lid, and the hood are closed.
- the key is in the OFF position.
- the vehicle is electronically locked using the lock button on the Remote Keyless Entry (RKE) transmitter (part of the Integrated Keyhead Transmitter (IKT) key), the keyless entry keypad (if equipped), or a door lock control switch (with a front door open, then closed).

There is a 20-second pre-arm delay after which each door, luggage compartment lid, and hood is armed. If a door, luggage compartment lid, or hood is open, the system still arms all the other closures. Only the open door, luggage compartment lid, or hood remains disarmed until it is closed. When the open entry point is closed, that entry point enters a 20-second pre-arm delay, then arms.

The hood switch and door ajar switches register as normally closed. The luggage compartment lid ajar switch registers as a normally closed switch. The SJB monitors the status of the hood switch, the luggage compartment lid ajar switch and door ajar switches. If these switches indicate an open entry point, the SJB energizes the horn and flasher relays, causing the horn to sound and the turn signal lamps to flash. The SJB disarms the perimeter alarm when it receives:

- an UNLOCK command through the keyless entry keypad (if equipped).
- an UNLOCK command through the RKE transmitter (part of the IKT key).
- a valid Passive Anti-Theft System (PATS) ignition key is turned to the ON position.

Alarm Event PIDs

The SJB has PIDs available that show what caused the last alarm events. The SJB has 4 alarm event PIDs and are AL_EVT1 through 4. The most recent alarm event is always listed in the first alarm event or trigger PID. These PIDs display what caused the alarm to trigger and can be a very useful tool when trying to identify the cause of a false alarm trigger.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Hood switch • Luggage compartment lid disarm switch	• Wiring, terminals or connectors • Smart Junction Box (SJB)

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

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

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

DTC Charts

Smart Junction Box (SJB) DTC Chart

DTC	Description	Action
B1520	Hood Switch Circuit Open	GO to Pinpoint Test B .
B2108	Trunk Key Cylinder Switch Failure	GO to Pinpoint Test D .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The Alarm System Does Not Operate Correctly - From The Driver Door

Normal Operation

If an unauthorized entry occurs at the driver door with the Smart Junction Box (SJB) detecting the driver door ajar switch as being opened (with no electronic unlock command detected by the SJB), there is a 12-second delay with the Instrument Panel Cluster (IPC) issuing a chime during this 12-second delay. If a valid, programmed Passive Anti-Theft System (PATS) key does not turn the ignition switch to the ON position within 12 seconds of the driver door ajar switch being detted as open, the SJB considers this event to be an unauthorized entry and activates the perimeter alarm.

This pinpoint test is intended to diagnose the following:

- Door ajar switch(es)
- SJB

PINPOINT TEST A: THE ALARM SYSTEM DOES NOT OPERATE CORRECTLY - FROM THE DRIVER DOOR

Test Step	Result / Action to Take
A1 CHECK THE OPERATION OF THE INTERIOR LAMPS	
• Connect: Close all doors.	**Yes** GO to A2 .

• Disconnect: Open the driver door. • **Do the interior lamps illuminate correctly?**	**No** REFER to Section 417-02 .
A2 CHECK THE DRIVER DOOR AJAR SWITCH INPUT	
• Ignition OFF. Connect: Close all doors. • Lock the vehicle electronically, using either the door lock control switch, the Remote Keyless Entry (RKE) transmitter (part of the Integrated Keyhead Transmitter (IKT) key) or the keypad (if equipped). • Wait for 30 seconds as the vehicle arms the perimeter alarm. • Open the driver door using the interior door handle. • **Does the IPC issue a chime for approximately 12 seconds, then does the perimeter alarm activate?**	**Yes** The vehicle is operating to design intent. INSTRUCT the customer on the correct operation of the vehicle and the perimeter alarm system. **No** GO to A3 .
A3 CHECK THE SJB FOR CORRECT OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CYCLE each key to the ON position for a minimum of 6 seconds to PROGRAM the RKE function of the IKT key. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test B: The Alarm System Does Not Operate Correctly - Alarm Does Not Activate With Hood Ajar/Open

Refer to Wiring Diagrams Cell 117 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Remote Keyless Entry and Alarm for schematic and connector information.

Normal Operation

The hood switch is a normally closed switch. The Smart Junction Box (SJB) receives the hood switch status through circuit CPL25 (hood switch ajar sense circuit), the hood switch, and the hood switch ground circuit GD123. When the hood is open, the hood switch opens, removing the ground to the SJB .

- DTC B1520 (Hood Switch Circuit Open) - an on-demand DTC that sets when there is an open in the circuit between the hood switch and the SJB , an open in the ground circuit to the hood switch, or the hood switch is stuck open during the on-demand self-test. If the hood is detected as always being

open, the perimeter alarm will never arm for the hood.

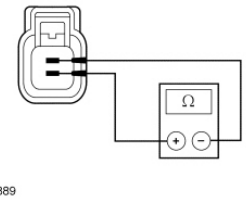
This pinpoint test is intended to diagnose the following:

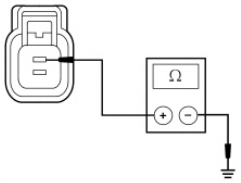
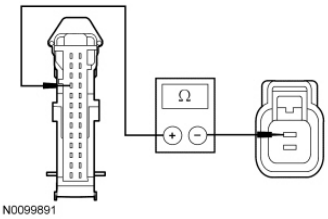
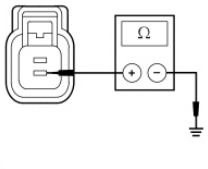
- Wiring, terminals or connectors
- Hood switch
- SJB

PINPOINT TEST B: THE ALARM SYSTEM DOES NOT OPERATE CORRECTLY - M DOES NOT ACTIVATE WITH HOOD AJAR/OPEN

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
B1 CHECK THE HOOD SWITCH	
• Ignition OFF. • Disconnect: Hood Switch C127. • Measure the resistance between the hood switch C127-1, component side and the hood switch C127-2, component side while pressing the hood switch plunger in and then releasing it.  N0099889 • **Is the resistance less than 5 ohms with the hood switch plunger pressed and greater than 10,000 ohms with the hood switch plunger released?**	**Yes** GO to B2 . **No** INSTALL a new hood switch. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B2 CHECK THE HOOD SWITCH CIRCUIT CPL25 (HOOD SWITCH AJAR SENSE CIRCUIT) FOR A SHORT TO GROUND	
• Disconnect: SJB C2280f. • Measure the resistance between the hood switch C127-1, circuit CPL25 (BU/OG), harness side and ground.	**Yes** GO to B3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0099890 • **Is the resistance greater than 10,000 ohms?**	
B3 CHECK CIRCUIT CPL25 (HOOD SWITCH AJAR SENSE CIRCUIT) FOR AN OPEN	
• Measure the resistance between the SJB C2280f-10, circuit CPL25 (BU/OG), harness side and the hood switch C127-1, circuit CPL25 (BU/OG), harness side.  N0099891 • **Is the resistance less than 5 ohms?**	**Yes** GO to B4 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B4 CHECK CIRCUIT GD123 (HOOD SWITCH GROUND CIRCUIT) FOR AN OPEN	
• Disconnect: Negative Battery Cable. • Measure the resistance between the hood switch C127-2, circuit GD123 (BK/GY), harness side and ground.  N0099892 • **Is the resistance less than 5 ohms?**	**Yes** GO to B5 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the self-test.
B5 CHECK THE SJB FOR CORRECT OPERATION	
• Connect: Negative Battery Cable. • Disconnect all the SJB connectors. • Check for: ♦ corrosion	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CYCLE each key to the ON position for a minimum of 6 seconds to PROGRAM the Remote Keyless Entry (RKE) function of the Integrated Keyhead

♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	Transmitter (IKT) keys. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test C: The Alarm System Does Not Operate Correctly - Flashers Or Horn Do Not Cycle During Anti-Theft Activation

Normal Operation

When an alarm event occurs, the Smart Junction Box (SJB) triggers the turn signals and the horn to signal an attempted theft.

This pinpoint test is intended to diagnose the following:

- Horn system concern
- Turn signals system concern
- SJB

PINPOINT TEST C: THE ALARM SYSTEM DOES NOT OPERATE CORRECTLY- FLASHERS OR HORN DO NOT CYCLE DURING ANTI-THEFT ACTIVATION

Test Step	Result / Action to Take
C1 CHECK THE ALARM ACTIVATION	
• Roll down the driver window and arm the perimeter alarm. After the alarm is armed (after a minimum of 20 seconds), open the driver door with the interior door handle to trigger the alarm. • **Do the horn and turn signals cycle on and off?**	**Yes** The alarm outputs are functioning correctly. TEST the system for normal operation. **No** If the turn signal lamps do not flash, GO to C2 . If the horn does not cycGO to C3 .
C2 CHECK THE TURN SIGNAL LAMPS OPERATION	
• Ignition ON. • Use the multifunction switch to activate the turn signals, and observe the turn signal lamps. • **Do the turn signal lamps operate correctly?**	**Yes** GO to C4 . **No** REFER to Section 417-01 .
C3 CHECK THE HORN OPERATION	
• Ignition ON.	**Yes** GO to C4 .

• Operate the horn by pressing the panic button on the IKT key. • **Does the horn operate correctly?**	**No** REFER to Section 413-06 .
C4 CHECK THE SJB FOR CORRECT OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CYCLE each key to the ON position for a minimum of 6 seconds to PROGRAM the Remote Keyless Entry (RKE) function of the Integrated Keyhead Transmitter (IKT) keys. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test D: The Alarm System Does Not Operate Correctly - The Alarm Does Not Arm/Inhibit From The Luggage Compartment Lid

Refer to Wiring Diagrams Cell 117 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Remote Keyless Entry and Alarm for schematic and connector information.

Normal Operation

The Smart Junction Box (SJB) monitors the luggage compartment lid disarm switch on circuit CRT18 (luggage compartment lid disarm switch senscircuit) for a ground signal. The luggage compartment lid disarm switch is a normally open switch. When the key is turned to the unlock position, the disarm switch completes the circuit to ground on ground circuit GD171 signaling the SJB that an authorized entry to the luggage compartment is occurring. The SJB inhibits the alarm from activating until the luggage compartment lid is closed, then adds the luggage compartment lid to the protected entry points.

- DTC B2108 (Trunk Key Cylinder Switch Failure) - an on-demand DTC that sets when there is a short to ground in the circuit between the luggage compartment lid disarm switch and the SJB , or the luggage compartment lid disarm switch is shorted closed internally.

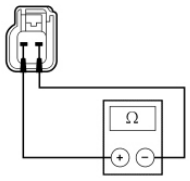
This pinpoint test is intended to diagnose the following:

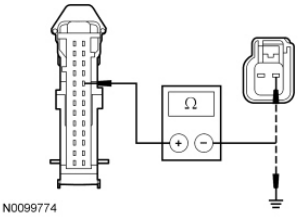
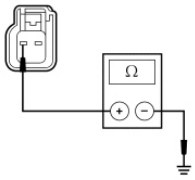
- Wiring, terminals or connectors
- Luggage compartment lid disarm switch
- SJB

PINPOINT TEST D: THE ALARM SYSTEM DOES NOT OPERATE CORRECTLY - THE ALARM DOES NOT ARM/INHIBIT FROM THE LUGGAGE COMPARTMENT LID

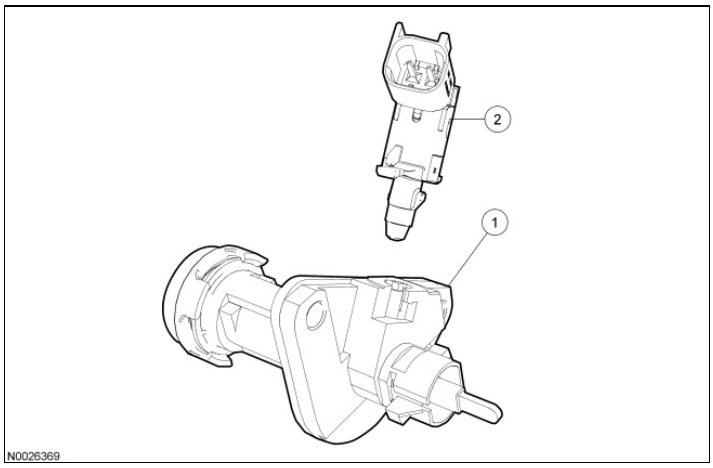
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
D1 CHECK THE LUGGAGE COMPARTMENT LID DISARM SWITCH	
NOTE: The luggage compartment lid disarm switch does not disarm (only inhibits) the perimeter alarm system. Once armed, the perimeter alarm can only be disarmed using the Integrated Keyhead Transmitter (IKT) key, the keyless entry keypad (if equipped), or if a valid Passive Anti-Theft System (PATS) key turns the ignition switch to the ON position. • Ignition OFF. • Disconnect: Luggage Compartment Lid Disarm Switch C4320. • Measure the resistance between the luggage compartment lid disarm switch C4320-1, component side and the luggage compartment lid disarm switch C4320-2, component side while turning the luggage compartment lid lock cylinder to the unlock position, then to the at-rest position.  N0099893 • **Is the resistance less than 5 ohms with the luggage compartment lid lock cylinder in the unlock position and greater than 10,000 ohms with the luggage compartment lid lock cylinder in the at-rest position?**	**Yes** GO to D2 . **No** INSTALL a new luggage compartment lid disarm switch. REFER to Luggage Compartment Lid Lock Cylinder in Section 501-14 . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D2 CHECK CIRCUIT CRT18 (LUGGAGE COMPARTMENT LID DISARM SWITCH INPUT) FOR AN OPEN OR A SHORT TO GROUND	
• Disconnect: SJB C2280c. • Measure the resistance between the SJB C2280c-22, circuit CRT18 (YE/GY), harness side and the luggage compartment lid disarm switch C4320-1, circuit CRT18 (YE/GY), harness side; and between the SJB C2280c-22, circuit CRT18 (YE/GY), harness side and ground.	**Yes** GO to D3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 N0099774 • **Is the resistance less than 5 ohms between the SJB and the luggage compartment lid disarm switch; and greater than 10,000 ohms between the SJB and ground?**	
D3 CHECK CIRCUIT GD171 (LUGGAGE COMPARTMENT LID DISARM SWITCH GROUND CIRCUIT) FOR AN OPEN	
• Disconnect: Negative Battery Cable. • Measure the resistance between the luggage compartment lid disarm switch C4320-2, circuit GD171 (BK/GY), harness side and ground.  N0077720 • **Is the resistance less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to D4 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D4 CHECK THE SJB FOR CORRECT OPERATION	
• Disconnect all the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Section 419-10 . CYCLE each key to the ON position for a minimum of 6 seconds to PROGRAM the Remote Keyless Entry (RKE) function of the IKT keys. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Anti-Theft Inhibit Switch - Luggage Compartment



Item	Part Number	Description
1	5443262	Luggage compartment lid lock cylinder
2	13713	Luggage compartment anti-theft inhibit switch

Removal and Installation

1. Remove the luggage compartment lid lock cylinder. For additional information, refer to Section 501-14 .
2. Lift the retaining tabs, turn the switch clockwise and remove the luggage compartment anti-theft inhibit switch (also known as the luggage compartment lid disarm switch).
3. To install, reverse the removal procedure.

Anti-Theft

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The Passive Anti-Theft System (PATS) consists of the following components:

- Anti-theft indicator (located in the Instrument Panel Cluster (IPC))
- Encoded ignition Integrated Keyhead Transmitter (IKT) PATS key(s) (the key contains a transponder and a Remote Keyless Entry (RKE) transmitter)
- PATS transceiver (located around the ignition lock cylinder and under the lower steering column shroud)
- IPC
- PCM (located under the battery tray in the engine compartment)

PATS uses radio frequency identification technology to deter a drive-away theft. Passive means that it does not require any activity by the user.

The vehicle is equipped with 2 IKT PATS keys. The IKTs operate as a standard PATS key with an RKE transmitter incorporated into the keyhead. The IKTs require batteries for the RKE transmitter to operate. A maximum of 4 IKT keys can be programmed to operate the vehicle. If more than 4 IKT keys are programmed, the RKE portion of the additional keys do not operate. These additional keys start the vehicle, but do not operate the RKE system. If additional PATS keys are desired, a standard PATS key (a non- IKT key) can be used. For the purposes of this section, the PATS portion of the IKT key is referred to as a PATS key.

Passive Anti-Theft System (PATS) Function

The PATS function is controlled by the IPC . The PATS uses the IPC to carry out all of the PATS functions such as receiving the identification code from the PATS key, issuing a signal to the PCM to control the starter and fuel injectors enable, and initiating the key interrogation sequence when the ignition key is turned to the ON or START position. Because of the interaction between the IPC and the PCM, there are parameters that must be set if the IPC or the PCM (or both) are replaced. Refer to Passive Anti-Theft System (PATS) Parameter Reset in this section. If the IPC must be replaced for any reason (PATS concerns or an IPC concern), the PATS keys also must be programmed into the new IPC . Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. All elements of PATS must be functional before the vehicle starts. If any of the components are not working correctly, the vehicle does not start.

PATS is active only for a few seconds when the vehicle is starting. It is not a PATS concern if the vehicle stalls after it has been running for a minimum of 3 seconds. PATS cannot disable a running vehicle.

PATS may cause a vehicle no start due to either the fuel injectors or the starter not operating (starter relay does not close) or both. Always check for PATS DTCs from the IPC and DTCs from the PCM when a no-crank or no-start condition exists. A low state of charge in the vehicle battery may cause the PATS to allow starter operation, but prevent the fuel injectors from operating.

If the anti-theft indicator does not prove out (it may be either flashing or glowing steadily) and one (or both) of the previous conditions (fuel injectors and/or starter inoperative) are present, it may be due to a PATS concern. If the anti-theft indicator proves out, it may not be a PATS concern. If the anti-theft indicator does not illuminate at all, it may be an IPC concern. Refer to the Symptom Chart in this section.

PATS is not compatible with aftermarket remote start systems, which allow the vehicle to be started from the exterior of the vehicle. These systems may reduce the security of the vehicle, and also may be the cause of no-start concerns. Remote start systems must be removed from the vehicle before any PATS -related no-start concerns are investigated.

Unlimited Key Mode

PATS contains a feature called unlimited key mode. This feature allows a customer to program more than 8 vehicle keys, if requested. Each vehicle in unlimited key mode is set up with a special unlimited transponder security key code. This allows all the customer vehicles to share the same mechanically cut keys. For an individual customer, any randomly selected security key that has been previously mechanically cut and electronically programmed to the vehicle is acceptable.

If unlimited key mode is enabled, a maximum of 4 IKT keys can be programmed to the vehicle for RKE functionality. If more keys are required, they should be standard PATS keys. If more than 4 IKT keys are programmed to the vehicle, only 4 IKT keys have RKE functionality, however, all of them start the vehicle, if programmed correctly. Refer to Spare Key Programming â Unlimited Key Mode in this section.

MyKeyÂ® Feature

The MyKeyÂ® feature allows a restricted driving mode to be programmed into one (or more) key(s) supplied with the vehicle or into any (PATS) programmed spare key(s) to promote good driving habits. The MyKeyÂ® is a restricted key for all consecutive key cycles until the MyKeyÂ® restricted key is cleared. The remaining key(s) is referred to as an "administrator key" or admin key. There must always be at least one admin key. The IPC does not allow the last admin key to be programmed into a MyKeyÂ® restricted key. Both the admin key and the MyKeyÂ® can be used to see how many admin keys and MyKeyÂ® restricted keys are programmed to the vehicle, and how many total miles have been driven with the MyKeyÂ® restricted key active.

When the MyKeyÂ® feature is programmed, several features are modified including:

Standard Restricted Features

- **NOTE:** The standard restricted features below cannot be configured in any way.

  Belt-MinderÂ® chimes periodically with the audio system muted until the driver safety belt is buckled. If Belt-MinderÂ® has been disabled when the admin key is in the ignition lock cylinder, Belt-MinderÂ® still functions for the MyKeyÂ® driver. Belt-MinderÂ® cannot be disabled by the MyKeyÂ® driver.
- Audible and visual low fuel warnings are issued when the programmed Distance To Empty (DTE) value is reached (typically 75 miles).
- The parking aid system (if equipped), Blind Spot Information System (BLISÂ®) with cross traffic alert (if equipped) cannot be turned off.

Optional Restricted Features

- **NOTE:** The optional restricted features below can be configured to the customer preferences.

  The volume of the audio system can be programmed to limit the volume to 45% of the maximum volume.
- Vehicle speed can be programmed to be limited to 130 km/h (80 mph). Audible and visual warnings are issued when the vehicle speed of 130 km/h (80 mph) is attained.
- Audible and visual warnings are issued when the preselected vehicle speed of 75, 90 or 105 km/h (45, 55 or 65 mph) is attained.
- The AdvanceTracÂ® always on feature can be configured on or off. If configured to always on, at

this time the traction control cannot be disabled by the MyKeyÂ® driver.

Refer to Information and Message Center in the Description and Operation portion of Section 413-01 for all of the MyKeyÂ® system checks and system warning displays.

Refer to MyKeyÂ® Programming in this section or to the Owner's Literature for MyKeyÂ® programming information.

Check MyKeyÂ® System Status

The vehicle system check provides the status of the following MyKeyÂ® parameters:

- MYKEY DISTANCE â This odometer only tracks mileage when a MyKeyÂ® is used. If mileage does not accumulate, the intended MyKeyÂ® is not being used. The only way to reset this odometer to zero is by clearing the MyKeyÂ®. If this odometer is lower than the last time it was checked, the MyKeyÂ® system has been cleared.
- MYKEY(S) PROGRAMMED â Indicates how many MyKeysÂ® are programmed to the vehicle. It can also be used to determine if a MyKeyÂ® has been cleared.
- ADMIN KEYS PROGRAMMED â Indicates how many admin keys are programmed to the vehicle. It can also be used to determine if an additional spare key has been programmed to the vehicle.

Refer to the Owner's Literature for information on accessing the MyKeyÂ® system status in the message center.

Using MyKeyÂ® with Aftermarket Remote Start System

When using an aftermarket remote start system, the default settings recognize the remote start system as an additional admin key. If the remote start system has not been programmed as a MyKeyÂ® and the driver is a MyKeyÂ® driver, the driver could drive the vehicle using the remote start system as an admin key with no MyKeyÂ® restrictions. If requested by the customer to resolve this concern, the aftermarket remote start system needs to be programmed as a MyKeyÂ®. For information on programming the aftermarket remote start system as a MyKeyÂ®, refer to MyKeyÂ® Programming in this section.

Anti-Theft

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit 300-NUD105-R025DE or equivalent
 ST3104-A	Backprobe Pins POM6411 or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

Anti-Theft Indicator

NOTE: Replacement of the Passive Anti-Theft System (PATS) transceiver does not require the PATS keys to be programmed into the Instrument Panel Cluster (IPC) again.

NOTE: Make sure any aftermarket remote start systems have been removed from the vehicle before any PATS -related no-start concerns are investigated.

NOTE: A minimum of 2 PATS keys must be programmed into the IPC before the vehicle starts. They do not need to be Integrated Keyhead Transmitter (IKT) keys. Either 2 IKT keys, or 2 standard PATS keys, or a combination of an IKT key and a standard PATS key is sufficient for the vehicle to start.

NOTE: If the IPC or the PCM is being replaced (or both), the parameters must be reset in both modules or the vehicle experiences a PATS no-start. Refer to Passive Anti-Theft System (PATS) Parameter Reset in this section.

PATS uses a visual anti-theft indicator located in the IPC . The indicator proves out for 3 seconds when the ignition key is in the ON or START position under normal operation. If there is a PATS concern, this anti-theft indicator either flashes rapidly or glows steadily when the ignition key is turned to the ON or START position. PATS also flashes the anti-theft indicator every 2 seconds when the ignition key is in the OFF position to act as a visual theft deterrent. Refer to Section 413-01 for the anti-theft indicator.

Encoded Passive Anti-Theft System (PATS) Keys

PATS uses a special ignition key, called an IKT key that is larger than a conventional ignition key. It contains a permanently installed electronic device called a transponder and also has the Remote Keyless Entry (RKE) transmitter integrated into the keyhead. Each transponder contains a unique encrypted identification code which is one of a very large number of combinations. The addition of this transponder to the key makes it an "encoded" key. The PATS portion of the IKT key does not require batteries and should last the lifetime of the vehicle. The transmitter portion of the IKT key has a battery. Each PATS key must be programmed into the IPC before it can be used to start the vehicle. A maximum of 4 IKT keys can be programmed to start the vehicle and also operate the RKE functions. If more than 4 IKT keys are programmed, the RKE portion of the additional IKT keys do not operate and the SJB sets a memory full DTC (B1138 - Memory Full) with the IPC setting the DTC B109E:42 (Remote Keyless Entry: General Memory Failure). These additional keys start the vehicle, but does not operate the RKE system. If additional PATS keys are desired, a standard PATS key (a non- IKT key) can be used. There are specific general procedures described in this section that must be carried out if a new PATS key is necessary. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment or Key Programming Using Two Programmed Keys in this section.

Passive Anti-Theft System (PATS) Transceiver

The PATS transceiver is located under the steering column shroud and communicates with the encoded ignition key. During each vehicle start sequence, the PATS transceiver reads the encoded ignition key identification code and sends data to the IPC . The IPC validates the code, and if it is the correct code, sends a message to the PCM to ground the starter relay solenoid coil and to also allow the fuel injectors to operate.

Passive Anti-Theft System (PATS) Operation

The PATS function is controlled by the IPC . With this type of PATS , there are parameters that need to be reset if either the IPC or the PCM (or both) are replaced. Refer to Passive Anti-Theft System (PATS) Parameter Reset in this section. When the PATS key is turned to the ON or START position, the IPC initiates the key interrogation sequence by sending a voltage signal to the PATS transceiver. The transceiver then uses its antenna to bounce a signal off the transponder in the PATS key. This process "reads" the PATS key identification code and sends the key identification code back to the IPC , which interprets it and determines if it matches one of the stored key codes. If it does match one of the stored key codes, the IPC sends a message to the PCM to ground the starter relay solenoid coil and to also allow the fuel injectors to operate. If it does not match one of the stored key codes, or it is only a partial key read or no key read, the IPC sends a message to the PCM to not ground the starter relay solenoid coil and not allow fuel injector operation. The anti-theft indicator in the IPC flashes (or may glow steadily) and the IPC stores one or more DTCs. All elements of PATS must be functional before the vehicle starts. If any of the components are not working correctly, the vehicle does not start. If the IPC must be replaced for any reason (PATS concerns or IPC concerns), the PATS keys must also be programmed into the new IPC . Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section.

PATS disables the vehicle from starting if there is:

- a damaged PATS key.
- a non-programmed PATS key.
- a non- PATS key (key has no electronics).
- damaged wiring.
- a damaged transceiver.
- a damaged IPC .
- a damaged PCM.

Passive Anti-Theft System (PATS) PIDs

Monitoring the PATS PIDs can be very useful in determining which diagnostic steps to follow. Viewing the MASTERKEY (master key) PID with both keys determines if the key is a programmed key and may also be

used to prove out the transceiver, circuitry and the IPC . IPC Viewing the MIN_KEYS (minimum number of keys) PID (this PID does not change) determines the minimum number of keys that must be programmed into the IPC . There must be at least 2 keys programmed into the IPC in this type of PATS before the vehicle starts. Viewing the N_KEYCODE (number of keys programmed) PID determines if the minimum number of keys have been programmed into the IPC . If the N_KEYCODE PID reads 0 or 1, additional key(s) needs to be programmed into the IPC in order to meet the minimum of 2 keys. If the N_KEYCODE PID reads 0 or 1, and the MASTERKEY PID reads Not Present, that particular key must be programmed into the IPC . If the N_KEYCODE PID reads 1, and the MASTERKEY PID reads Present, that particular key is already programmed into the IPC . In this particular case, though, there are not enough keys programmed (a minimum of 2 are needed before the vehicle starts) into the IPC and at least 1 more key needs to be programmed before the vehicle starts. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section.

Also, if the unlimited key mode has been enabled, the N_KEYCODE PID always reads 2, after the first 2 keys are programmed into the IPC , regardless of how many additional keys are added.

If the IPC was replaced, the parameters in the IPC , and the parameters in the PCM needs to be reset. When the parameters are reset, it clears (erases) the PCM ID from the IPC . A parameter reset causes the PCM to send a PCM ID to the IPC that is necessary for the system to operate. Make sure to cycle the key at least once, then turn the key ON and make an attempt to start the vehicle for 3-5 seconds before attempting more procedures. If only a PCM parameter reset occurs, the ID stored in the IPC does not match the ID being sent by the PCM, and may cause a PATS -related no-start. Carry out a PATS parameter reset, then turn the key ON and make an attempt to start the vehicle for 3-5 seconds before attempting more procedures.

If the PCM_ID (PCM id status) PID reads Stored, the IPC has a PCM ID stored. If it reads Not Stored, a parameter reset may resolve this concern. If the PATSENABL (vehicle enable status) PID reads Disabled, and the N_KEYCODE PID reads 2 or more and the MASTERKEY PID reads Present, the IPC and the PCM needs to have their parameters reset. Refer to Passive Anti-Theft System (PATS) Parameter Reset in this section.

If the PATSENABL PID reads Disabled, and the N_KEYCODE PID reads 1 and the MASTERKEY PID reads Present, or if the N_KEYCODE PID reads 0 and the MASTERKEY PID reads Not Present, a minimum of 2 keys need to be programmed into the IPC . Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section.

If the MASTERKEY PID continues to read Not Present after programming, this may indicate a defective key. The SPAREKEY PID is defaulted to Enable. With the SPAREKEY PID displaying Enable, the IPC accepts more than 2 keys (up to a maximum of 8) being programmed into the IPC using Key Programming Using Two Programmed Keys in this section. It can be toggled to Disable if the customer wants to disable the customer spare key programming function. Refer to Key Programming Switch State Control in this section. This switch state control does not affect the Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment procedure.

In summary, in order for the vehicle to start, the PATS PIDs and the correct state they must be in are as following:

PID	Normal State
N_KEYCODE	must read 2 or more
MASTERKEY	must read Present
PATSENABL	must read Enabled

PCM_ID	must read Stored
PCM_VFY	must read Yes

Use of Standard Passive Anti-Theft System (PATS) Keys

When using a standard (non- IKT) PATS key to start the vehicle, an IKT key (from another vehicle) on the same key ring may possibly be programmed into the vehicle for remote entry functionality, resulting in the IKT key being able to operate the lock and unlock functions of the vehicle (but the IKT key cannot start the vehicle). This should not cause a PATS no-start of either the first or the second vehicle, but the IKT key may be able to operate the lock and unlock functions of both vehicles. The IKT key is able to start the original vehicle to which it is programmed and does start the second vehicle. At this time, it is necessary to carry out an Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment procedure and then to make certain the IKT key for the second vehicle is removed from the key ring in order to prevent this concern from occurring again. Also, if an IKT key is used to start the vehicle, the vehicle only reads the IKT key in the ignition lock cylinder and does not read the second IKT on the key ring. Using an IKT key to start both vehicles, rather than standard PATS keys, prevents the second IKT (transmitter portion only) from being programmed into the first vehicle.

Unlimited Key Mode

PATS contains a feature called unlimited key mode and uses the UNL_KEY_MODE PID. This feature allows a customer to program more than 8 keys to their vehicle if they request it. Each vehicle in unlimited key mode is set up with a special unlimited transponder security key code. This allows all the customer vehicles to share the same mechanically cut keys, but no other keys from outside can be used to operate the vehicles. For an individual customer, any randomly selected security key that has been previously mechanically cut and electronically programmed to the vehicle is acceptable. Refer to Spare Key Programming - Unlimited Key Mode in this section.

Inspection and Verification

1. Verify the customer ncern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• PATS key • Use of a non- PATS key or incorrect PATS key • Remote start system installed	• Smart Junction Box (SJB) fuse 36 (5A) • Wiring, terminals or connectors • Instrument Panel Cluster (IPC) • PCM

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **NOTE:** Make sure to use the latest scan tool software release.

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the IPC .

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

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

DTC Charts

Instrument Panel Cluster (IPC) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B109E:42	Remote Keyless Entry: General Memory Failure	The Smart Junction Box (SJB) has 4 Integrated Keyhead Transmitters (IKTs) stored in memory and cannot program any more IKTs into the SJB memory. REFER to the Principles of Operation in this section to determine this is normal operation for this system.
B10D5:13	PATS Antenna: Circuit Open	There has been a Passive Anti-Theft System (PATS) transceiver antenna failure. GO to Pinpoint Test A .
B10D7:05	PATS Key: System Programming Failures	There was a failure in key programming. GO to Pinpoint Test I .
B10D7:51	PATS Key: Not Programmed	There is an unprogrammed PATS key. GO to Pinpoint Test C .
B10D7:87	PATS Key: Missing Message	No PATS key has been read by the IPC . GO to Pinpoint Test B .
B10D7:8F	PATS Key: Erratic	Only a partial PATS key was read. GO to Pinpoint Test D .
B10D8:00		

	PATS Key Less Than Minimum Programmed: No Sub Type Information	If DTCs B10D7:87, B10D7:51, B10D7:8F, B10D9:87 or B10D5:13 are present, they must be addressed first. If DTC B10D8:00 is the only DTC present, PROGRAM additional keys. REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.
B10D9:87	PATS Transponder: Missing Message	The Instrument Panel Cluster (IPC) did not receive the PATS transceiver signal. GO to Pinpoint Test E .
B10DA:51	PATS PCM Identifier: Not Programmed	There is no PCM ID stored in the IPC . CARRY OUT a parameter reset of the IPC and the PCM, then CYCLE the ignition and make an attempt to start the vehicle. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. CLEAR the DTCs. REPEAT the self-test.
B10DA:61	PATS PCM Identifier: Signal Calculation Failure	CARRY OUT a parameter reset of the IPC and the PCM and CYCLE the ignition 3-5 times, making an attempt to start the vehicle each key cycle. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.
B10DA:86	PATS PCM Identifier: Signal Invalid	**NOTE:** If DTCs B10DA:61 and B10DA:86 are both present, address DTC B10DA:61 first. GO to Pinpoint Test G .
U0100:00	Lost Communication With ECM /PCM "A": No Sub Type Information	**NOTE:** If DTCs U0100:00 and B10DA:61 are both present, address DTC B10DA:61 first. GO to Pinpoint Test G .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

PCM DTC Chart

DTC	Description	Action
P1260	Theft Detected, Vehicle Immobilized	If there are any Passive Anti-Theft System (PATS) DTCs present in the Instrument Panel Cluster (IPC), ADDRESS them first. This DTC can also indicate a Controller Area Network (CAN) concern or a parameter reset concern. Make sure to verify if there are any communication concerns/DTCs with any modules. REFER to Section 418-00 . If DTC P1260 is the only DTC present, there may be a parameter reset concern or a power or ground concern with the PCM. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. If necessary, CHECK the powers and grounds to the PCM. REFER to the Wiring Diagrams Manual to determine the PCM power and ground circuits.
P1602	Immobilizer/ ECM Communication Error	**NOTE:** If IPC DTC B10DA:61 is also present, address IPC DTC B10DA:61 first. GO to Pinpoint Test G .
P1622	Immobilizer ID Does Not Match	CARRY OUT a parameter reset of the IPC and the PCM. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. CLEAR the DTCs. CYCLE the ignition 3-5 times, making an attempt to start the vehicle each key

		cycle. REPEAT the self-test.
All other DTCs	-	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: DTC B10D5:13

Normal Operation

- DTC B10D5:13 (PATS Antenna: Circuit Open) - a continuous and on-demand DTC that sets when there has been a Passive Anti-Theft System (PATS) transceiver antenna failure. The PATS transceiver may need to be replaced.

This pinpoint test is intended to diagnose the following:

- PATS transceiver

PINPOINT TEST A: DTC B10D5:13

Test Step	Result / Action to Take
A1 INSPECT THE PATS TRANSCEIVER FOR CORRECT INSTALLATION	
NOTE: Replacement of the PATS transceiver does not require the PATS keys to be programmed into the Instrument Panel Cluster (IPC) again. • Ignition OFF. • Verify the PATS transceiver is correctly installed. Refer to Passive Anti-Theft System (PATS) Transceiver in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Is DTC B10D5:13 retrieved?**	**Yes** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. **No** The system is OK.

Pinpoint Test B: DTC B10D7:87

Normal Operation

- DTC B10D7:87 (PATS Key: Missing Message) - a continuous and on-demand DTC that sets when no Passive Anti-Theft System (PATS) key has been read by the Instrument Panel Cluster (IPC).

This pinpoint test is intended to diagnose the following:

- PATS key
- PATS transceiver
- IPC

PINPOINT TEST B: DTC B10D7:87

NOTE: Large metallic objects, electric devices on the key ring that can be used to purchase gasoline or similar items, or a second key on the same key ring as the PATS key can cause vehicle starting concerns and record DTCs under certain conditions. If a fault cannot be identified, examine the customer key ring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS key while starting the engine. These objects and devices cannot damage the PATS key, but can cause a momentary concern if they are too close to the key during engine start. If a concern occurs, turn the key off and restart the engine with all other objects on the key ring held away from the ignition key. Check to make sure the PATS key used by the customer is an approved Ford PATS key. (PATS keys from Ford, Rotunda, Strattec or Huf are approved Ford PATS keys.)

NOTE: This vehicle uses a Huf Integrated Keyhead Transmitter (IKT) key. If replacing an IKT key for any of these vehicles, it is recommended that the original Huf IKT key be replaced with another Huf IKT key. There are minor visual differences both externally and internally between the Huf IKT key and IKT keys used on other Ford and Lincoln vehicles that may be noticed by the customer. These visual differences do not affect the IKT key functionality in any way. Rotunda should supply a Huf IKT key when ordering replacement/new keys for this vehicle. The Owner's Literature can provide additional information concerning these differences. If replacing an IKT key (or adding another key) with a standard PATS key (not an IKT key), any of the brands (Ford, Rotunda, Strattec or Huf) can operate the system.

Test Step	Result / Action to Take
B1 RETRIEVE THE DTCs	
• Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Is DTC B10D7:87 retrieved?**	**Yes** GO to B2 . **No** If any other IPC DTCs are retrieved, REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 . If no DTCs are retrieved, the system is OK.
B2 CHECK BOTH PATS KEYS	
• Obtain both PATS keys from the customer and follow the procedure using one PATS key, then the other. If the customer only has one PATS key, it is necessary to cut a new PATS	**Yes** If DTC B10D7:87 was present for both keys or the new key (if present), GO to B3 . If DTC B10D7:87 was not present for the new key, the original key may be damaged and should be replaced. REPLACE the damaged key with a new key. REFER to Integrated Keyhead

key. • If it is necessary to cut a new PATS key, program the new PATS key. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Using all existing keys, then the newly programmed key (if applicable), is DTC B10D7:87 present?**	Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation. **No** If any other IPC DTCs are retrieved, REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 . If no IPC DTCs are retrieved, the system is OK.
B3 INSTALL A NEW PATS TRANSCEIVER	
NOTE: Replacement of the PATS transceiver does not require the PATS keys to be programmed into the IPC again. **NOTE:** Do not use the PATS key that may have been programmed in Step B2. • Ignition OFF. • Install a new PATS transceiver. Refer to Passive Anti-Theft System (PATS) Transceiver in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Turn the key to the ON position using an existing customer PATS key. • Retrieve the IPC DTCs. • **Is DTC B10D7:87 retrieved?**	**Yes** GO to B4 . **No** The system is OK.
B4 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present.	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the PCM. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. **No**

• **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

Pinpoint Test C: DTC B10D7:51

Normal Operation

- DTC B10D7:51 (PATS Key: Not Programmed) - a continuous and on-demand DTC that sets when there is an unprogrammed Passive Anti-Theft System (PATS) key. There may not be a concern with the PATS key itself, but the key must be programmed into the PATS memory (unless the maximum number of keys are already programmed).

This pinpoint test is intended to diagnose the following:

- PATS key
- Instrument Panel Cluster (IPC)

PINPOINT TEST C: DTC B10D7:51

NOTE: Large metallic objects, electronic devices on the key ring that can be used to purchase gasoline or similar items, or a second key on the same key ring as the PATS key can cause vehicle starting concerns and record DTCs under certain conditions. If a fault cannot be identified, examine the customer key ring for such objects or devices. If present, inform the customer that they need to keep these objects from toucng the PATS key while starting the engine. These objects and devices cannot damage the PATS key, but can cause a momentary concern if they are too close to the key during engine start. If a concern occurs, turn the ignition switch off and restart the engine with all other objects on the key ring held away from the ignition key. Check to make sure the PATS key used by the customer is an approved Ford PATS key. (PATS keys from Ford, Rotunda, Strattec or Huf are approved Ford PATS keys.)

NOTE: Only 8 PATS keys can be programmed into the IPC during normal programming procedures (with the unlimited key mode being the exception). If the N_KEYCODE (number of keys programmed) PID reads more than 2 and less than 8, the concern may be the PATS key being used is an unprogrammed key. Verify this by also viewing the MASTERKEY (verifies if the key is programmed) PID. It must read Present for the key to be valid.

NOTE: This vehicle uses a Huf Integrated Keyhead Transmitter (IKT) key. If replacing an IKT key for any of these vehicles, it is recommended that the original Huf IKT key be replaced with another Huf IKT key. There are minor visual differences both externally and internally between the Huf IKT key and IKT keys used on other Ford and Lincoln vehicles that may be noticed by the customer. These visual differences do not affect the IKT key functionality in any way. Rotunda should supply a Huf IKT key when ordering replacement/new keys for this vehicle. The Owner's Literature can provide additional information concerning these differences. If replacing an IKT key (or adding another key) with a standard PATS key (not an IKT key), any of the brands (Ford, Rotunda, Strattec or Huf) can operate the system.

Test Step	Result / Action to Take
C1 RETRIEVE THE DTCs	
• **NOTE:** Follow this procedure using both PATS keys (using one at a time).	**Yes** GO to C2 . **No** If DTC B10D7:51 is retrieved for one PATS key, REPLACE that

• If only one key is available, cut a new key and program the keys. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. • If both keys are available, program the keys. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Is DTC B10D7:51 retrieved for both PATS keys?**	key and PROGRAM all the keys. REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. If DTC B10D7:51 is not retrieved for either key, the system is OK. CHECK all customer PATS keys by attempting to start the vehicle with each key to verify all other PATS keys are programmed.
C2 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the PCM. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

Pinpoint Test D: DTC B10D7:8F

Normal Operation

- DTC B10D7:8F (PATS Key: Erratic) - a continuous and on-demand DTC that sets when only a partial Passive Anti-Theft System (PATS) key was read. Remote starter equipment can also cause this DTC.

This pinpoint test is intended to diagnose the following:

- PATS key
- PATS transceiver
- Instrument Panel Cluster (IPC)

PINPOINT TEST D: DTC B10D7:8F

NOTE: Large metallic objects, electronic devices on the key ring that can be used to purchase gasoline or similar items, or a second key on the same key ring as the PATS key can cause vehicle starting concerns and record DTCs under certain conditions. If a fault cannot be identified, examine the customer key ring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS key while starting the engine. These objects and devices cannot damage the PATS key, but can cause a momentary concern if they are too close to the key during engine start. If a concern occurs, turn the ignition off and restart the engine with all other objects on the key ring held away from the ignition key. Check to make sure the PATS key used by the customer is an approved Ford PATS key. (PATS keys from Ford, Rotunda, Strattec or Huf are approved Ford PATS keys.)

NOTE: This vehicle uses a Huf Integrated Keyhead Transmitter (IKT) key. If replacing an IKT key for any of these vehicles, it is recommended that the original Huf IKT key be replaced with another Huf IKT key. There are minor visual differences both externally and internally between the Huf IKT key and IKT keys used on other Ford and Lincoln vehicles that may be noticed by the customer. These visual differences do not affect the IKT key functionality in any way. Rotunda should supply a Huf IKT key when ordering replacement/new keys for this vehicle. The Owner's Literature can provide additional information concerning these differences. If replacing an IKT key (or adding another key) with a standard PATS key (not an IKT key), any of the brands mentioned above (Ford, Rotunda, Strattec or Huf) can operate the system.

Test Step	Result / Action to Take
D1 RETRIEVE THE DTCs	
• **NOTE:** Follow this procedure using both PATS keys (using one at a time). • If only one key is available, cut a new key and program the keys. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Is DTC B10D7:8F retrieved for one or both PATS keys?**	**Yes** If DTC B10D7:8F is retrieved for one key, REPLACE that key and PROGRAM the new key. REFER to Spare Key Programming - Using Diagnostic Equipment in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. If DTC B10D7:8F is retrieved for both PATS keys, GO to D2 . **No** The system is OK. CHECK all the customer PATS keys by attempting to start the vehicle with each key to verify all other PATS keys are programmed.
D2 INSTALL A NEW PATS TRANSCEIVER	
NOTE: Replacement of the PATS transceiver does not require the PATS keys to be programmed into the IPC again. • Ignition OFF. • Install a new PATS transceiver. Refer to Passive Anti-Theft	**Yes** GO to D3 . **No** The system is OK. CHECK all the customer PATS keys by attempting to start the vehicle with each key to verify all other PATS keys are programmed.

System (PATS) Transceiver in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Are any PATS DTCs retrieved?**	
D3 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the PCM. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

Pinpoint Test E: DTC B10D9:87

Refer to Wiring Diagrams Cell 112 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Passive Anti-Theft System for schematic and connector information.

Normal Operation

The Passive Anti-Theft System (PATS) transceiver receives voltage from the Smart Junction Box (SJB) fuse 36 (5A) on circuit CBP36 (vehicle power circuit) and is grounded on circuit GD116 (ground circuit). The PATS transceiver and the Instrument Panel Cluster (IPC) communicate on circuits VRT24 (receive circuit) and VRT23 (transmit circuit). The IPC compares the key code stored in memory and sends a signal to the PCM to enable the starter and the fuel injectors if the key code is correct.

- DTC B10D9:87 (PATS Transponder: Missing Message) - a continuous and on-demand DTC that sets when the PATS transceiver signal is not received by the IPC . This DTC can be caused by circuits between the PATS transceiver and the IPC , or circuits to the PATS transceiver. This can also be caused by using the incorrect PATS transceiver part number.

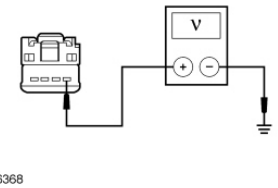
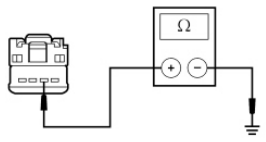
This pinpoint test is intended to diagnose the following:

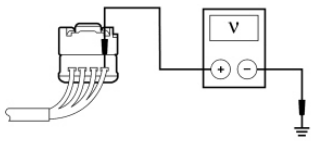
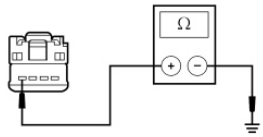
- Fuse
- Wiring, terminals or connectors
- PATS transceiver
- IPC

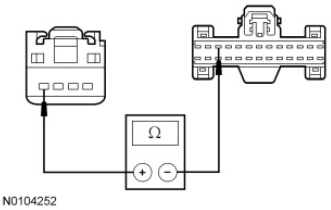
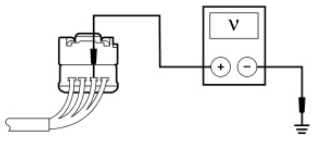
PINPOINT TEST E: DTC B10D9:87

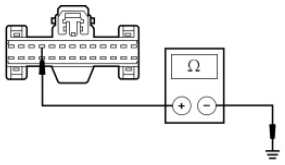
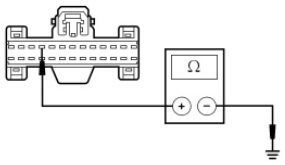
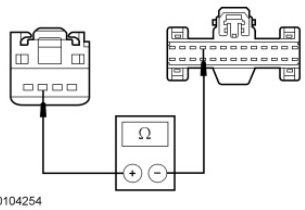
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

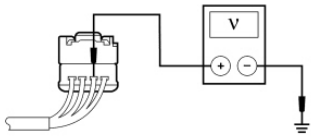
NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

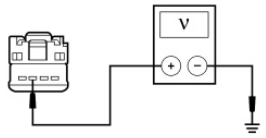
Test Step	Result / Action to Take
E1 CHECK THE PATS TRANSCEIVER POWER CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Disconnect: PATS Transceiver C252. • Ignition ON. • Measure the voltage between the PATS transceiver C252-1, circuit CBP36 (BU/BN), harness side and ground.  A0096368 • **Is the voltage greater than 10 volts?**	**Yes** GO to E2 . **No** VERIFY the SJB fuse 36 (5A) is OK. If OK, REPAIR the circuit for an open. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
E2 CHECK THE PATS TRANSCEIVER GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable. • Measure the resistance between the PATS transceiver C252-2, circuit GD116 (BK/VT), harness side and ground.  A0096369 • **Is the resistance less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to E3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.
E3 CHECK THE PATS TRANSCEIVER RECEIVE CIRCUIT FOR VOLTAGE	

NOTICE: **This pinpoint test step directs using a back-probe method. Use the special back-probe tool specified in the tool list in this section. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors and subsequent electrical faults.** • Connect: PATS Transceiver C252. • Ignition ON. • Measure the voltage by backprobing between the PATS transceiver C252-4, circuit VRT24 (YE/OG), harness side and ground.  A0096370 • **Is the voltage greater than 8 volts?**	**Yes** GO to E6 . **No** GO to E4 .
E4 CHECK THE PATS TRANSCEIVER RECEIVE CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: IPC C220. • Disconnect: PATS Transceiver C252. • Measure the resistance between the PATS transceiver C252-4, circuit VRT24 (YE/OG), harness side and ground.  A0096371 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to E5 . **No** REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. If DTC B10D9:87 is retrieved again, GO to E12 .
E5 CHECK THE PATS TRANSCEIVER RECEIVE CIRCUIT FOR AN OPEN	

• Measure the resistance between the PATS transceiver C252-4, circuit VRT24 (YE/OG), harness side and the IPC C220-11, circuit VRT24 (YE/OG), harness side.  N0104252 • **Is the resistance less than 5 ohms?**	**Yes** GO to E12 . **No** REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.
E6 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR VOLTAGE	
NOTICE: **This pinpoint test step directs using a back-probe method. Use the special back-probe tool specified in the tool list in this section. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors and subsequent electrical faults.** **NOTE:** Replacement of the PATS transceiver does not require the PATS keys to be programmed into the IPC again. • Measure the voltage by backprobing between the PATS transceiver C252-3, circuit VRT23 (VT/GY), harness side and ground.  A0096373 • **Is the voltage greater than 8 volts?**	**Yes** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. If DTC B10D9:87 is retrieved again, GO to E12 . **No** GO to E7 .
E7 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR A SHORT TO GROUND WITH THE PATS TRANSCEIVER CONNECTED	

• Ignition OFF. • Disconnect: IPC C220. • Measure the resistance between the IPC C220-10, circuit VRT23 (VT/GY), harness side and ground.  N0104253 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to E9 . **No** GO to E8 .
E8 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR A SHORT TO GROUND WITH THE PATS TRANSCEIVER DISCONNECTED	
NOTE: Replacement of the PATS transceiver does not require the PATS keys to be programmed into the IPC again. • Disconnect: PATS Transceiver C252. • Measure the resistance between the IPC C220-10, circuit VRT23 (VT/GY), harness side and ground.  N0104253 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. **No** REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.
E9 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR AN OPEN	
• Disconnect: PATS Transceiver C252. • Measure the resistance between the PATS transceiver C252-3, circuit VRT23 (VT/GY), harness side and the IPC C220-10, circuit VRT23 (VT/GY), harness side.  N0104254 • **Is the resistance less than 5 ohms?**	**Yes** GO to E10 . **No** REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

E10 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR VOLTAGE WHILE COMMANDED ON	
NOTICE: **This pinpoint test step directs using a back-probe method. Use the special back-probe tool specified in the tool list in this section. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors and subsequent electrical faults.** **NOTE:** Replacement of the PATS transceiver does not require the PATS keys to be programmed into the IPC again. • Connect: PATS Transceiver C252. • Connect: IPC C220. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger. • Trigger the IPC active command TRANSMIT (this is the TX circuit ON/OFF) to ON. • Measure the voltage by backprobing between the PATS transceiver C252-3, circuit VRT23 (VT/GY), harness side and ground.  A0096373 • **Is the voltage less than 5 volts?**	**Yes** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. **No** GO to E11 .
E11 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: IPC C220. • Disconnect: PATS Transceiver C252. • Ignition ON. • Measure the voltage between the PATS transceiver C252-3, circuit VRT23 (VT/GY), harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. **No** GO to E12 .

 A0096377 • **Is any voltage indicated?**	
E12 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the PCM. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

Pinpoint Test F: The Anti-Theft Indicator Is Always/Never On

Normal Operation

The Passive Anti-Theft System (PATS) uses a visual anti-theft indicator located in the Instrument Panel Cluster (IPC). The anti-theft indicator proves out for 3 seconds when the key is turned to the ON or START position. If there is a PATS concern, the anti-theft indicator either flashes rapidly or glows steadily (for more than 3 seconds) when the key is turned to the ON or START position. PATS also flashes the anti-theft indicator every 2 seconds at key off to act as a visual theft deterrent. The anti-theft indicator operation is controlled by the IPC .

This pinpoint test is intended to diagnose the following:

- IPC

PINPOINT TEST F: THE ANTI-THEFT INDICATOR IS ALWAYS/NEVER ON

Test Step	Result / Action to Take
F1 CHECK THE ANTI-THEFT INDICATOR FOR CORRECT OPERATION	

• Ignition OFF. • Press and hold the message center RESET button. • Ignition ON. • Continue holding the RESET button until ENGINEERING TEST MODE is displayed. • Release the RESET button. • Press and release the RESET button to advance through each stage of the IPC self-test. • Press and release RESET button until TELLTALE TEST is displayed. • **Does the anti-theft indicator illuminate, then turn off?**	**Yes** GO to F2 . **No** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the PCM. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test.
F2 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the PCM. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

Pinpoint Test G: DTC B10DA:86 and/or DTC U0100:00

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

During each vehicle start sequence, when the key is turned to the START or ON position, the Passive Anti-Theft System (PATS) transceiver reads the PATS key identification code and sends the data to the Instrument Panel Cluster (IPC). If there is no communication on the High Speed Controller Area Network (HS-CAN) between the IPC and the PCM, DTCs U0100:00 and/or B10DA:86 can set in the IPC and the vehicle can experience a PATS no-start.

If DTC B10DA:61 is present, refer to DTC Charts in this section.

- DTC B10DA:86 (PATS PCM Identifier: Signal Invalid) - a continuous DTC that sets only when the IPC does not receive the expected response from the PCM over the HS-CAN and the fault may not be present at the time of testing. The data sent by the PCM does not match the data expected by t IPC and this DTC is set. This DTC can be caused by the HS-CAN circuits between the IPC and the PCM or by either module. This DTC can also be set if the battery voltage is low.
- DTC U0100:00 (Lost Communication With ECM /PCM "A": No Sub Type Information) - a continuous DTC that sets only when the IPC loses communication with the PCM and the fault may not be present at the time of testing. This DTC can be caused by an HS-CAN circuit concern, the IPC or the PCM.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Low battery state of charge
- IPC
- PCM

PINPOINT TEST G: DTC B10DA:86 AND/OR DTC U0100:00

Test Step	Result / Action to Take
G1 CHECK THE BATTERY STATE OF CHARGE	
• Ignition OFF. • Check the battery state of charge with the battery condition test. Refer to Section 414-01 . • **Does the battery pass the battery condition test?**	**Yes** GO to G2 . **No** INSTALL a new battery. REFER to Section 414-01 .
G2 CHECK FOR MODULE COMMUNICATION ON THE HS-CAN	
• Connect the scan tool. • Ignition ON. • Carry out the network test using the scan tool. • **Is the scan tool unable to communicate with any of the modules on the HS-CAN ?**	**Yes** REFER to Section 418-00 to diagnose the module that is not communicating with the scan tool. **No** GO to G3 .
G3 INSPECT THE HS-CAN CIRCUITRY	
• Ignition OFF. • Inspect all of the HS-CAN circuitry, including the pin crimps, connector fit, corroded/bent/pushed-out/damaged pins and splice integrity in the 4 splices and 36 connections (8 connectors) between the PCM and the IPC . • **Does the HS-CAN circuitry pass the component inspection?**	**Yes** GO to G4 . **No** REPAIR the HS-CAN circuitry as necessary. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation.
G4 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for:	**Yes** INSTALL a new PCM. Refer to the appropriate section in Group 303 for the

♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	procedure. RESET the parameters in both the IPC and the PCM. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation. If the concern is still present, GO to G5 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation.
G5 CHECK FOR CORRECT IPC OPERATION • Disconnect all the IPC connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the IPC connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the PCM. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test H: The Vehicle Does Not Start

Normal Operation

During each vehicle start sequence, when the key is turned to the START or ON position, the Passive Anti-Theft System (PATS) transceiver reads the PATS key identification code and sends the data to the Instrument Panel Cluster (IPC). If the concern is due to a PATS concern, PATS DTCs should be set in the IPC and DTC P1260 in the PCM. If it is due to a starting system, or a driveability concern, there is no PATS DTCs in the IPC or DTC P1260 in the PCM.

This pinpoint test is intended to diagnose the following:

- Starting system concern
- PATS concern

PINPOINT TEST H: THE VEHICLE DOES NOT START

Test Step	Result / Action to Take
H1 CHECK FOR COMMUNICATION WITH THE PCM AND THE IPC	
• Connect the scan tool. • Ignition ON. • Carry out the network test using the scan tool. • **Does the scan tool establish communication with the PCM and the IPC ?**	**Yes** GO to H2 . **No** REFER to Section 418-00 to diagnose the module that is not communicating with the scan tool.
H2 CHECK FOR IPC DTCs	
• Retrieve the IPC continuous and on-demand DTCs. • **Are any IPC DTCs present?**	**Yes** REFER to DTC Charts in this section. **No** The no-start condition is not PATS -related. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnose the cause of the no-start condition.

Pinpoint Test I: DTC B10D7:05

Normal Operation

During each vehicle start sequence, when the key is turned to the START or ON position, the Passive Anti-Theft System (PATS) transceiver reads the PATS key identification code and sends the data to the Instrument Panel Cluster (IPC). If there is a bad transponder in the Integrated Keyhead Transmitter (IKT) key that is in the ignition lock cylinder, or if there was a concern during the programming of the IKT key, DTC B10D7:05 can set, and the vehicle experiences a PATS no-start.

- DTC B10D7:05 (PATS Key: System Programming Failures) - a continuous C that sets when there is a failure during the key programming procedure.

This pinpoint test is intended to diagnose the following:

- PATS key programming concern
- PATS key concern (transponder)

PINPOINT TEST I: DTC B10D7:05

Test Step	Result / Action to Take
I1 CHECK BOTH PATS KEYS	
NOTE: Check to make sure the new PATS keys are approved Ford encoded PATS keys. Unapproved PATS keys do not always operate correctly over various	**Yes** REPLACE the damaged key with the new key that was cut (if present), or CUT a new key to replace the damaged key. DISCARD the damaged key. PROGRAM the keys. REFER to Integrated

temperature ranges. (PATS keys from Ford, Rotunda, Strattec or Huf are approved Ford PATS keys.) **NOTE:** Follow this procedure using both PATS keys (using one at a time). • Obtain both PATS keys from the customer and follow the procedure using one PATS key, then the other. If the customer only has one PATS key, it is necessary to cut a new PATS key (does not have to be an IKT key). • If it is necessary to cut a new PATS key, cut the new key to match the original key. Program the PATS keys. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Is DTC B10D7:05 present with either key?**	Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation. **No** If other IPC DTCs are retrieved, REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 . If no IPC DTCs are retrieved, the system is OK.

MyKey® Restrictions on Vehicle Operation

Principles of Operation

MyKey® Operation

The MyKey® feature allows a restricted driving mode to be programmed into one (or more) key(s) supplied with the vehicle or into any (Passive Anti-Theft System (PATS)) programmed spare key(s) to promote good driving habits. The MyKey® is a restricted key for all consecutive key cycles until the MyKey® restricted key is cleared. The remaining key(s) is referred to as an "administrator key(s)" or admin key(s). There must always be at least one admin key. The Instrument Panel Cluster (IPC) does not allow the last administrator key to be programmed as a MyKey® restricted key. Both the admin key and the MyKey® can be used to see how many admin keys and MyKey® restricted keys are programmed to the vehicle, and how many total miles have been driven with the MyKey® active.

When the MyKey® feature is programmed, severalodified for the MyKey® driver only.

Inspection and Verification

1. Verify the customer concern.
2. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
3. If the cause is not visually evident, verify the symptom. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Key Programming Using Two Programmed Keys

NOTE: This procedure only works if 2 or more programmed ignition keys (they do not have to be Integrated Keyhead Transmitter (IKT) keys) are present. If 2 programmed Passive Anti-Theft System (PATS) keys are not available, refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section.

NOTE: The Instrument Panel Cluster (IPC) PID SPAREKEY must be enabled for this procedure to operate. If this PID is not enabled, refer to ref="SCS~us~en~file=SCSJ1B06.HTM~gen~ref.HTM" >Key Programming Switch State Control in this section, in order to enable the customer spare key programming PID. The PID SPAREKEY is set to Enable when the vehicle is built.

NOTE: If the programming procedure is successful, the new key(s) starts the vehicle and the anti-theft indicator proves-out for approximately 3 seconds. If the programming procedure is not successful and the new key(s) does not start the engine, leave the key in the ON position for at least 3 seconds, then turn the key off. Repeat the key programming procedure from Step 1. If the failure repeats, refer to Anti-Theft in the Diagnosis and Testing portion of this section to review the DTCs and carry out the appropriate pinpoint tests.

NOTE: A minimum of 2 PATS keys must be programmed into the IPC before the vehicle starts.

NOTE: If the vehicle is in unlimited key mode, this spare key programming procedure still functions. Any 2 keys that can start the vehicle can be used to program an additional unlimited key.

NOTE: If additional keys are to be programmed, and the remaining keys are with the customer, or are not available, instruct the customer to refer to the Owner's Literature for instructions on programming the remaining keys. In this case, the IPC PID SPAREKEY must be set to Enable.

NOTE: If the steps are not carried out as outlined, the programming procedure ends.

NOTE: Ignition keys must have a correct mechanical key cut for the vehicle and must be PATS encoded keys (contain a transponder). The key does not have to be an IKT key.

NOTE: This procedure is not necessary if only the PATS transceiver was replaced. Replacement of the transceiver does not erase the PATS key codes in the IPC .

NOTE: A maximum of 8 ignition keys can be programmed to a PATS vehicle, of which up to 4 can be IKT keys. If an attempt to program more than 4 IKT keys occurs, the Smart Junction Box (SJB) sets a memory full DTC B1138 with the IPC setting a memory full DTC B109E:42, and the additional IKT keys do not have any Remote Keyless Entry (RKE) function capability. If the vehicle is equipped with a message center, the IPC displays the message INT KEY COULD NOT PROGRAM. The PATS portion of the additional key functions, but the RKE transmitter function is inoperative.

NOTE: When in the unlimited key mode (after the first 2 keys have been programmed to the vehicle), the N_KEYCODE PID always reads 2, no matter how many keys are programmed to the vehicle.

1. Insert a programmed ignition key (can be an IKT or a standard PATS key) into the ignition lock cylinder and turn the key from the OFF position to the ON position.

2. Leave the key in the ON position for 3 seconds, but not longer than 10 seconds.

3. Turn the key to the OFF position and remove the first key.

4. Within 10 seconds of turning the key to the OFF position, insert a second programmed ignition key (can be an IKT or a standard PATS key) into the ignition lock cylinder and turn the key from the OFF position to the ON position.

5. Leave the key in the ON position for 3 seconds, but not longer than 10 seconds.

6. Turn the key to the OFF position and remove the second key.

7. Within 20 seconds of turning the key to the OFF position, insert the unprogrammed ignition key (new PATS or IKT key) into the ignition lock cylinder and turn the key from the OFF position to the ON position. Leave the key in the ON position for a minimum of 6 seconds (this additional 3 second time frame allows for the RKE data transfer to take place, if programming an IKT key).

8. **NOTE:** The new key now starts the vehicle and also operates the RKE functions, if there are 4 or fewer IKT keys programmed to the vehicle.

   Start the vehicle with the new key.

   - If it is an IKT key, verify the RKE functions operate correctly.

9. If additional programmed keys are desired, repeat Steps 1-8.

Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: This procedure is used when a customer needs more than one key programmed into the system aoes not have 2 programmed ignition keys available. This procedure is also useful when a programmed ignition key(s) is lost or the ignition lock cylinder is replaced, and it is desired to erase key code(s) from the Passive Anti-Theft System (PATS) memory.

NOTE: This procedure erases all programmed ignition keys from the vehicle memory and the vehicle cannot start until 2 keys are programmed to the vehicle. This procedure also erases the Integrated Keyhead Transmitter (IKT) Transmitter Identification Codes (TICs) from the Smart Junction Box (SJB), preventing the erased IKT key from operating the Remote Keyless Entry (RKE) functions on the vehicle.

NOTE: A minimum of 2 PATS keys must be programmed into the Instrument Panel Cluster (IPC) before the vehicle starts.

NOTE: Two PATS encoded (contains a transponder) keys (or IKTs) with the correct mechanical cut must be available to carry out this procedure. One or both of them may be the customer's original keys. One or both of them may be an IKT or a standard PATS key.

NOTE: If additional keys are to be programmed, refer to Key Programming Using Two Programmed Keys in this section. If the remaining keys are with the customer and are not available with the vehicle, instruct the customer to refer to the Owner's Literature for instructions on programming the remaining keys. In this case, the IPC PID SPAREKEY must be enabled.

NOTE: This procedure is not necessary if only the PATS transceiver was replaced. Replacement of the transceiver does not erase the PATS key codes in the IPC .

1. Turn the key from the OFF position to the ON position.

2. From the scan tool, enter TOOLBOX. Select BODY-SECURITY-PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.

3. From the scan tool menu select: Ignition Key Code Erase. Follow all IDS screen instructions until the key erase procedure completes. The scan tool additionally instructs you to program 2 keys in order to complete the process.

4. Turn the key to the OFF position and disconnect the scan tool (the key does not need to be removed at this time).

5. **NOTE:** The RKE data transfer takes place between the key and the IPC first. After both keys are programmed into the IPC , then the RKE data transfers from the IPC to the SJB . Until the final data

transfer takes place to the SJB , the RKE functions does not operate.

Turn the first PATS key to the ON position for a minimum of 6 seconds (this additional 3 second time frame allows for the RKE data transfer to take place).

6. Remove the first PATS key from the ignition lock cylinder.
7. Insert the second PATS key into the ignition lock cylinder and turn the key to the ON position for a minimum of 6 seconds (this additional 3 second time frame allows for the RKE data transfer to take place).
8. Remove the second PATS key from the ignition lock cylinder.
9. The vehicle should now start with both PATS keys and the RKE transmitter portion of an IKT key should function.
10. If it is desired to program additional key(s) (only up to 8 keys total can be programmed into the IPC), refer to Key Programming Using Two Programmed Keys in this section for each additional key that needs to be programmed.

Key Programming Switch State Control

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: The spare key programming switch is a programmable switch which provides the capability to enable/disable the normal customer spare key programming procedure detailed in the Owneriterature. It must read Enable if more than 2 keys need to be programmed into the Instrument Panel Cluster (IPC). For additional information, refer to Key Programming Using Two Programmed Keys in this section. This programmable switch is provided as a convenience for rental company fleets or other fleet purchasers who may not want the spare key programming procedure available to the vehicle driver.

NOTE: The spare key programming switch state can be viewed with the IPC PID SPAREKEY.

NOTE: If the PID SPAREKEY reads Enable, up to 8 keys total can be programmed into the IPC using Key Programming Using Two Programmed Keys in this section. If the PID SPAREKEY reads DISABLE, the Key Programming Using Two Programmed Keys procedure does not function. This switch is set to Enable when the vehicle is built. This PID only affects the Key Programming Using Two Programmed Keys procedure.

1. Insert a programmed Passive Anti-Theft System (PATS) key (or Integrated Keyhead Transmitter (IKT) key) into the ignition lock cylinder and turn the key from the OFF position to the ON position.

2. From the scan tool, enter TOOLBOX. Select BODY-SECURITY-PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.

3. **NOTE:** The default setting on delivery of all new vehicles is ENABLE, when viewing the IPC PID SPAREKEY.

   From the scan tool menu select: CUSTOMER SPARE KEY PROGRAMMING Enable and follow the IDS on-screen instructions in order to complete the procedure.

   - CUSTOMER SPARE KEY PROGRAMMING Enable - spare key programming procedure is accessible.
   - CUSTOMER SPARE KEY PROGRAMMING DISABLE - spare key programming procedure is not accessible.

Spare Key Programming - Unlimited Key Mode

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Enabling Unlimited Key Mode

NOTE: Unlimited key mode is intended for use by those customers who need more than 8 keys for their vehicle.

NOT> If unlimited key mode is enabled (or disabled), a maximum of 4 Integrated Keyhead Transmitter (IKT) keys can be programmed to the vehicle for Remote Keyless Entry (RKE) functionality. If more keys are required, they should be standard Passive Anti-Theft System (PATS) keys. If more than 4 IKT keys are programmed to the vehicle, the Smart Junction Box (SJB) sets DTC B1138 (Memory Full), the IPC sets DTC B109E:42 (Remote Keyless Entry: General Memory Failure) and only 4 IKT keys have RKE functionality, however, all of them start the vehicle, if programmed correctly.

NOTE: Before programming, the new key(s) must have the correct mechanical cut for the ignition lock cylinder.

NOTE: The unlimited key mode is set up by creating a special, unique unlimited transponder security key code and programming this key code into all of the vehicle keys so they contain the same key code.

NOTE: When in the unlimited key mode, the N_KEYCODE PID in the IPC always reads 2, no matter how many keys are programmed to the vehicle (after the first 2 keys have been programmed).

1. The customer must choose an 8-digit number (except for 00000000 or 00000001) to be programmed to all of their vehicles. All customer vehicles need to use the same number. Valid digits are 0-9 and the letters A-F.

2. **NOTE:** If the IPC PID UNL_KEY_ID is not available, unlimited key mode is turned on and must be turned off before viewing the stored code. At this time, unlimited keys can be programmed to the vehicle. To view/disable/change the stored code, follow the procedure for disabling the unlimited key mode below.

   Monitor the IPC PID UNL_KEY_ID and compare its value against the code chosen in Step 1. It should not be the same key code.

3. From the scan tool, enter TOOLBOX. Select BODY-SECURITY-PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.

4. Once in security access, select: "program unlimited key code" and follow the IDS on-screen instructions. Enter the 8-digit code chosen by the customer in Step 1 of this procedure and follow the IDS on-screen instructions.

5. Select: "unlimited key mode ON" and follow the IDS on-screen instructions.
6. Select: "Ignition Key Code Erase" and follow the IDS on-screen instructions.
7. Disconnect the scan tool and turn the ignition switch to OFF (the key does not need to be removed at this time).
8. Turn the first PATS key to the ON position for 3 seconds (6 seconds if it is an IKT key).
9. Turn the first PATS key to the OFF position and remove the key from the ignition lock cylinder.
10. Insert the second PATS key into the ignition lock cylinder and turn the key to the ON position for 3 seconds (6 seconds if it is an IKT key).
11. Start the vehicle with both PATS keys. The vehicle now starts with both PATS keys.
12. If it is desired to program additional key(s), refer to Key Programming Using Two Programmed Keys in this section for each additional key that needs to be programmed.

Disabling Unlimited Key Mode

NOTE: By disabling the unlimited key mode, the previous access code no longer operates the vehicle.

1. From the scan tool, enter TOOLBOX. Select BODY-SECURITY-PATS Functions and follow the IDS on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.
2. Select: "unlimited key mode OFF" and follow the IDS on-screen instructions.
3. Select: "Ignition Key Code Erase" and follow the IDS on-screen instructions.
4. Disconnect the scan tool and turn the ignition switch to OFF (the key does not need to be removed at this time).
5. Turn the first PATS key to the ON position for 3 seconds (6 seconds if it is an IKT key).
6. Turn the first PATS key to the OFF position and remove the key from the ignition lock cylinder.
7. Insert the second PATS key into the ignition lock cylinder and turn the key to the ON position for 3 seconds (6 seconds if it is an IKT key).
8. Start the vehicle with both PATS keys. The vehicle now starts with both PATS keys.
9. **NOTE:** With the unlimited key mode turned off, a maximum of 8 keys can be programmed into the IPC using the Key Programming Using Two Programmed Keys procedure in this section. The IPC PID SPAREKEY must be enabled.

   If it is desired to program additional key(s), refer to Key Programming Using Two Programmed Keys in this section for each additional key that needs to be programmed. The PID SPAREKEY must be enabled.

Spare Key Programming - Using Diagnostic Equipment

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: This procedure is used when a customer needs to have an additional key programmed into the vehicle without erasing stored key codes, but does no programmed keys available. This procedure is also useful when attempting to determine if an ignition key is defective, as a new key can be installed without erasing keys or without having 2 programmed keys available.

NOTE: Before programming, the new key must have the correct mechanical cut for the ignition lock cylinder.

NOTE: If 8 keys are already programmed, this procedure does not allow any more ignition keys to be programmed. The number of keys that are programmed into the Passive Anti-Theft System (PATS) can be determined by viewing the Instrument Panel Cluster (IPC) PID N_KEYCODE.

1. Turn the new, unprogrammed PATS key from the OFF position to the ON position.

2. From the scan tool, enter TOOLBOX. Select BODY-SECURITY-PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.

3. **NOTE:** Make sure the selection made is "Program additional ignition key". If the "Ignition Key Code Erase" selection is made, all of the keys are erased from the system.

   From the scan tool menu select: "Program additional ignition key".

4. Turn the key to the OFF position and disconnect the scan tool (the key does not need to be removed at this time).

5. Start the vehicle with the new PATS key. The vehicle now starts with the new PATS key and also with the original PATS keys. If it is an IKT key, verify the RKE functions (if there are 4 or fewer IKT keys programmed).

Anti-Theft Security Access

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: The anti-theft security access procedure is used to obtain Passive Anti-Theft System (PATS) security access. PATS security access must be granted to erase ignition key codes, program ignition key codes, enable/disable unlimited key mode, set unlimited transponder key ID, reset n title="Passive Anti-Theft System" class="popup" onmouseover="this.className='popupnounderline';" onmouseout="this.className='popup';">PATS parameters in the IPC and the PCM and enable/disable the spare key programming switch (Instrument Panel Cluster (IPC) PID SPAREKEY). The anti-theft security access procedure invokes a 10-minute time delay prior to granting security access during which the scan tool must remain connected to the vehicle. Once security access is granted, a security access command menu is displayed which offers various command options.

NOTE: Once security access has been granted, multiple security access commands should be executed (if necessary) prior to exiting the command menu. This avoids an additional security access procedure and the associated 10 minute time delay.

1. From the scan tool, enter TOOLBOX. Select: BODY-SECURITY-PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS. This procedure takes approximately 10 minutes to carry out, during which time the ignition switch must be in the ON position and the scan tool must be connected to the vehicle.

2. After the 10-minute security access procedure is completed, follow the IDS on-screen instructions and a new menu is displayed with command options. Select only those functions required before exiting out of this menu. Do not select more functions than the procedure calls for or a PATS no-start may occur. Once exited out of this menu, the security access procedure must be repeated again to carry out additional commands.

Passive Anti-Theft System (PATS) Parameter Reset

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: A minimum of 2 Passive Anti-Theft System (PATS) keys must be programmed into the Instrument Panel Cluster (IPC) to complete this procedure and allow the vehicle to start.

1. Turn the key from the OFF position to the ON position.
2. From the scan tool, follow on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.
3. From the scan tool, select: Parameter Reset and follow the on-screen instructions.
4. **NOTE:** If the IPC or the IPC and the PCM were replaced, updated or reconfigured, follow Steps 4-9. All vehicle keys are erased during the parameter reset procedure. Verify at least 2 vehicle keys are available prior to carrying out the PATS parameter reset. If only the PCM was replaced, go to Step 9.

   From the scan tool, select: Ignition Key Code Erase and follow the on-screen instructions.
5. Turn the key to the OFF position and disconnect the scan tool.
6. Turn the key to the ON position for 6 seconds.
7. Turn the key to the OFF position and remove the key.
8. Insert the second PATS key into the ignition lock cylinder and turn the key to the ON position for 6 seconds.
9. Both keys now start the vehicle.
10. If more keys are required to be programmed, refer to Key Programming Using Two Programmed Keys in this section.

MyKey® Programming

Program a MyKey®

NOTE: After a MyKey® has been programmed, the remaining standard key(s) (the key[s] that is not programmed with the MyKey® feature) is referred to as an "administrator key(s)" or "admin" key(s). There must always be at least one admin key.

NOTE: The MyKey® feature can be cleared within the same key cycle that it was programmed. Follow the Clear MyKey® procedure in this section to clear the key of any restricted MyKey® status. If the key has been cycled, an admin key is required to clear the MyKey® programming.

1. Insert a programmed PATS ignition key into the ignition lock cylinder and turn the key from the OFF position to the RUN position. This key must be the one that is being programmed to the MyKey® restricted status.

2. Usi center buttons:
    1. Press the SETUP button until PRESS RESET TO CREATE MYKEY appears in the message center display.
    2. Press and release the RESET button. HOLD RESET TO CONFIRM MYKEY is displayed.
    3. Press and hold the RESET button (for approximately 2 seconds) until MARK THIS KEY AS RESTRICTED is displayed.
    4. Wait until KEY RESTRICTED AT NEXT START is displayed, then release the RESET button.

3. The MyKey® feature (standard restricted features) is successfully programmed into this particular key. Make sure it is labeled for easy identification. If you would like to customize the MyKey® with the audio volume limited, maximum speed limit, speed alert chimes, and AdvanceTrac® on/off restrictions, refer to Configuring MyKey® Optional Restricted Features in this section.
    - If the vehicle is equipped with remote start, also refer to Using MyKey® with Aftermarket Remote Start Systems in this section.

Configuring MyKey® Optional Restricted Features

1. To configure the MyKey® optional restricted features, carry out the following:
    1. Using an admin key that has not been programmed as a MyKey®, turn the ignition ON.
    2. Press and hold the SETUP button until RESET FOR MYKEY SETUP is displayed.
    3. Press and release the RESET button to display the MyKey® setup menus. The first programmable feature is: MYKEY MAX MPH OFF.
        - ♦ If you do not want to change the status of a feature that appears, press SETUP to accept the current setting and the message center displays the next feature.
        - ♦ If you want to change the status of the feature that is displayed, press RESET to turn a feature on/off (or toggle between choices). After the feature selection has been madand release SETUP to accept and the message center displays the next feature.
    4. Repeat the process for the next features of:
        - ♦ MYKEY MPH TONES 45 55 65 (choose the desired speed for the chime to sound)
        - ♦ MYKEY VOLUME LIMIT OFF (choose the audio volume to be limited to 45%)
        - ♦ MYKEY ADVTRAC CTRL ON (choose for the AdvanceTrac® to be automatically locked on or able to be turned on or off by the MyKey® driver)

Clear MyKeyTM

1. **NOTE:** This procedure is used to clear the MyKey® feature on all of the keys that are programmed to the vehicle. All of the keys then operate as normal (admin) keys with no restrictions.

   Using an admin key, turn the ignition ON.

2. Press SETUP until PRESS RESET TO CLEAR MYKEY appears.

3. Press and release the RESET button until HOLD RESET TO CONFIRM CLEAR is displayed.

4. Press and hold the RESET button until ALL MYKEYS CLEARED is displayed.
   - A MyKey® can also be cleared during the same key cycle that it was programmed by following Steps 2, 3 and 4 of this procedure.

Using MyKey® with Aftermarket Remote Start System

Program Remote Start System as a MyKey®

1. Enter the vehicle and close all doors.

2. Remote start the vehicle using a remote start fob.

3. Follow Steps 1-3 of the Program a MyKey® procedure in this section.

Clear MyKey® with the Remote Start System

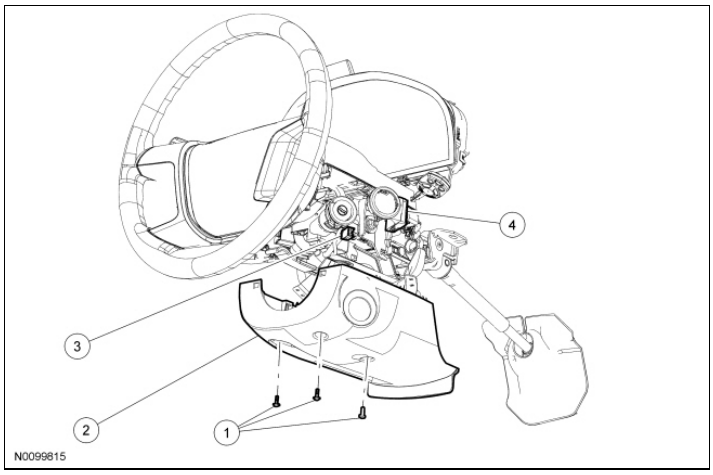
NOTE: It is possible to program all of the keys as MyKeys®, with the remote start system being the only admin key. This procedure clears MyKey® in the event of the aftermarket remote start system being proghe only admin key.

1. Enter the vehicle and close all doors.

2. Remote start the vehicle using the remote start fob.

3. Follow Steps 1-4 of the Clear MyKey® procedure in this section.

Passive Anti-Theft System (PATS) Transceiver



Item	Part Number	Description
1	3K512	Steering column shroud screws (3 required)
2	3530	Steering column shroud (lower)
3	-	Passive Anti-Theft System (PATS) transceiver electrical connector (part of 14401)
4	15607	transceiver

Removal and Installation

1. Remove the 3 screws and the lower steering column shroud.

2. Disconnect the electrical connector and remove the Passive Anti-Theft System (PATS) transceiver.

3. **NOTE:** Replacement of the PATS transceiver does not require the PATS keys to be programmed into the Instrument Panel Cluster (IPC) again.

   To install, reverse the removal procedure.

Anti-Theft

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The Passive Anti-Theft System (PATS) consists of the following components:

- Anti-theft indicator (located in the Instrument Panel Cluster (IPC))
- Encoded ignition Integrated Keyhead Transmitter (IKT) PATS key(s) (the key contains a transponder and a Remote Keyless Entry (RKE) transmitter)
- PATS transceiver (located around the ignition lock cylinder and under the lower steering column shroud)
- IPC
- Transmission Control Module (TCM) (located inside the transaxle)

PATS uses radio frequency identification technology to deter a drive-away theft. Passive means that it does not require any activity by the user.

The vehicle is equipped with 2 IKT PATS keys. The IKTs operate as a standard PATS key with an RKE transmitter incorporated into the keyhead. The IKTs require batteries for the RKE transmitter to operate. A maximum of 4 IKT keys can be programmed to operate the vehicle. If more than 4 IKT keys are programmed, the RKE portion of the additional keys do not operate. These additional keys start the vehicle, but does not operate the RKE system. If additional PATS keys are desired, a standard PATS key (a non- IKT key) can be used. For the purposes of this section, the PATS portion of the IKT key is referred to as a PATS key.

Passive Anti-Theft System (PATS) Function

The PATS function is controlled by the IPC . PATS uses the IPC to carry out all of the PATS functions such as receiving the ID code from the PATS key, issuing a signal to the TCM to control the starting and fuel injectors enable, and initiating the key interrogation sequence when the ignition key is turned to the ON or START position. Because of the interaction between the IPC and the TCM , there are parameters that must be set if the IPC and/or TCM are replaced. Refer to Passive Anti-Theft System (PATS) Parameter Reset in this section. If the IPC must be replaced for any reason (PATS or IPC concerns), the PATS keys also must be programmed into the new IPC . Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. All elements of PATS must be functional before the vehicle starts. If any of the components are not working correctly, the vehicle does not start.

PATS is active only for a few seconds when the vehicle is starting. It is not a PATS concern if the vehicle stalls after it has been running for a minimum of 3 seconds. PATS cannot disable a running vehicle.

PATS can cause a vehicle no start due to either the TCM does not start the engine or the TCM does not move the vehicle electrically or both. Always check for PATS DTCs from the IPC and DTCs from the TCM when a no-crank or no-start condition exists.

If the anti-theft indicator does not prove out (it may be either flashing or glowing steadily) and one (or both) of the previous conditions (TCM does not start the engine or move the vehicle electrically) are present, it may be due to a PATS concern. If the anti-theft indicator proves out, it may not be a PATS concern. If the anti-theft indicator does not illuminate at all, it may be an IPC concern. Refer to the Symptom Chart in this section.

PATS is not compatible with non-Ford remote start systems, which allow the vehicle to be started from the exterior of the vehicle. These systems may reduce the security of the vehicle, and also may be the cause of no-start concerns. Remote start systems must be removed from the vehicle before any PATS -related no-start concerns are investigated.

Unlimited Key Mode

PATS contains a feature called unlimited key mode. This feature allows a customer to program more than 8 vehicle keys, if requested. Each vehicle in unlimited key mode is set up with a special unlimited transponder security key code. This allows all the customer vehicles to share the same mechanically cut keys. For an individual customer, any randomly selected security key that has been previously mechanically cut and electronically programmed to the vehicle is acceptable.

If unlimited key mode is enabled, a maximum of 4 IKT keys can be programmed to the vehicle for RKE functionality. If more keys are required, they should be standard PATS keys. If more than 4 IKT keys are programmed to the vehicle, only the first 4 IKT keys that were programmed have RKE functionality, however, all of them start the vehicle, if programmed correctly. Refer to Spare Key Programming - Unlimited Key Mode in this section.

MyKey® Feature

The MyKey® feature allows a restricted driving mode to be programmed into one (or more) key(s) supplied with the vehicle or into any (PATS) programmed spare key(s) to promote good driving habits. The MyKey® is a restricted key for all consecutive key cycles until the MyKey® restricted key is cleared. The remaining key(s) is referred to as an "administrator key" or admin key. There must always be at least one admin key. The IPC does not allow the last admin key to be programmed into a MyKey® restricted key. Both the admin key and the MyKey® can be used to see how many admin keys and MyKey® restricted keys are programmed to the vehicle, and how many total miles have been driven with the MyKey® restricted key active.

When the MyKey® feature is programmed, several features are modified including:

Standard Restricted Features

- **NOTE:** The standard restricted features below cannot be configured in any way.

  Belt-Minder® chimes periodically with the audio system muted until the driver safety belt is buckled. If Belt-Minder® has been disabled when the admin key is in the ignition lock cylinder, Belt-Minder® still functions for the MyKey® driver. Belt-Minder® cannot be disabled by the MyKey® driver.
- Audible and visual low fuel warnings are issued when the programmed Distance To Empty (DTE) value is reached (typically 75 miles).
- The parking aid system (if equipped), Blind Spot Information System (BLIS®) with cross traffic alert (if equipped) cannot be turned off.

Optional Restricted Features

- **NOTE:** The optional restricted features below can be configured to the customer preferences.

  The volume of the audio system can be programmed to limit the volume to 45% of the maximum volume.
- Vehicle speed can be programmed to be limited to 130 km/h (80 mph). Audible and visual warnings are issued when the vehicle speed of 130 km/h (80 mph) is attained.
- Audible and visual warnings are issued when the preselected vehicle speed of 75, 90 or 105 km/h (45, 55 or 65 mph) is attained.
- The AdvanceTrac® always on feature can be configured on or off. If configured to always on, at this time the traction control cannot be disabled by the MyKey® driver.

Refer to Information and Message Center in the Description and Operation p target="_parent" href="SCS~us~en~file=SCSSD10L.HTM~gen~ref.HTM" >Section 413-01 for all of the MyKey® system checks and system warning displays.

Refer to MyKey® Programming in this section or to the Owner's Literature for MyKey® programming information.

Check MyKey® System Status

The vehicle system check provides the status of the following MyKey® parameters:

- MYKEY DISTANCE - This odometer only tracks mileage when a MyKey® is used. If mileage does not accumulate, the intended MyKey® is not being used. The only way to reset this odometer to zero is by clearing the MyKey®. If this odometer is lower than the last time it was checked, the MyKey® system has been cleared.
- MYKEY(S) PROGRAMMED - Indicates how many MyKeys® are programmed to the vehicle. It can also be used to determine if a MyKey® has been cleared.
- ADMIN KEYS PROGRAMMED - Indicates how many admin keys are programmed to the vehicle. It can also be used to determine if an additional spare key has been programmed to the vehicle.

Refer to the Owner's Literature for information on accessing the MyKey® system status in the message center.

Using MyKey® with Aftermarket Remote Start System

When using an aftermarket remote start system, the default settings recognize the remote start system as an additional admin key. If the remote start system has not been programmed as a MyKeis a MyKey® driver, the driver could drive the vehicle using the remote start system as an admin key with no MyKey® restrictions. If requested by the customer to resolve this concern, the aftermarket remote start system needs to be programmed as a MyKey®. For information on programming the aftermarket remote start system as a MyKey®, refer to MyKey® Programming in this section.

Anti-Theft

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit 300-NUD105-R025DE or equivalent
 ST3104-A	Backprobe Pins POM6411 or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

Anti-Theft Indicator

NOTE: Replacement of the Passive Anti-Theft System (PATS) transceiver does not require the PATS keys to be programmed into the Instrument Panel Cluster (IPC) again.

NOTE: Make sure any non-Ford remote start systems have been removed from the vehicle before any PATS -related no-start concerns are investigated.

NOTE: A minimum of 2 PATS keys must be programmed into the IPC before the vehicle starts. They do not need to be Integrated Keyhead Transmitter (IKT) keys. Either 2 IKT keys, or 2 standard PATS keys, or a combination of an IKT key and a standard PATS key is sufficient for the vehicle to start.

NOTE: If the IPC and/or the Transmission Control Module (TCM) is being replaced, the parameters must be reset in both modules or the vehicle experiences a PATS no-start. Refer to Passive Anti-Theft System (PATS) Parameter Reset in this section.

PATS uses a visual anti-theft indicator located in the IPC . The indicator proves out for 3 seconds when the ignition key is in the ON or START position under normal operation. If there is a PATS concern, this anti-theft indicator either flashes rapidly or glows steadily when the ignition key is turned to the ON or START position. PATS also flashes the anti-theft indicator every 2 seconds when the ignition key is in the OFF position to act as a visual theft deterrent. Refer to Section 413-01 for the anti-theft indicator.

Encoded Passive Anti-Theft System (PATS) Keys

PATS uses a special ignition key, called an IKT key that is larger than a conventional ignition key. It contains a permanently installed electronic device called a transponder and also has the Remote Keyless Entry (RKE) transmitter integrated into the keyhead. Each transponder contains a unique encrypted identification code which is one of a very large number of combinations. The addition of this transponder to the key makes it an "encoded" key. The PATS portion of the IKT key does not require batteries and should last the lifetime of the vehicle. The transmitter portion of the IKT key has a battery. Each PATS key must be programmed into the IPC before it can be used to start the vehicle. A maximum of 4 IKT keys can be programmed to start the vehicle and also operate the RKE functions. If more than 4 IKT keys are programmed, the RKE portion of the additional IKT keys do not operate and the SJB sets DTC B1138, and the IPC sets DTC B109E:42 (both DTCs indicate a memory full condition). These additional keys start the vehicle, but cannot operate the RKE system, as only the first 4 IKT keys programmed have that RKE functionality. If additional PATS keys are desired, a standard PATS key (a non- IKT key) can be used. There are specific general procedures described in this section that must be carried out if a new PATS key is necessary. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment or Key Programming Using Two Programmed Keys in this section.

Passive Anti-Theft System (PATS) Transceiver

The PATS transceiver is located under the steering column shroud and communicates with the encoded ignition key. During each vehicle start sequence, the PATS transceiver reads the encoded ignition key ID code and sends data to the IPC . The IPC validates the code, and if it is the correct code, sends a message to the TCM to enable the engine and the electric drive.

Passive Anti-Theft System (PATS) Operation

The PATS function is controlled by the IPC . With this type of PATS , there are parameters that need to be reset if either the IPC and/or the TCM are replaced. Refer to Passive Anti-Theft System (PATS) Parameter Reset in this section. When the PATS key is turned to the ON or START position, the IPC initiates the key interrogation sequence by sending a voltage signal to the PATS transceiver. The transceiver then uses its antenna to bounce a signal off the transponder in the PATS key. This process "reads" the PATS key ID code and sends the key ID code back to the IPC , which interprets it and determines if it matches one of the stored key codes. If it does match one of the stored key codes, the IPC sends a message to the TCM to enable the engine and the electric drive. If it does not match one of the stored key codes, or it is only a partial key read or no key read, the IPC sends a message to the TCM to not enable the engine and the electric drive. The anti-theft indicator in the IPC flashes (or glows steadily) and the IPC stores one or more DTCs. All elements of PATS must be functional before the vehicle starts. If any of the components are not working correctly, the vehicle cannot start. If the IPC must be replaced for any reason, the PATS keys must also be programmed into the new IPC . Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section.

PATS disables the vehicle from starting if there is:

- a damaged PATS key.
- a non-programmed PATS key.
- a non- PATS key (key has no electronics).
- less than 2 keys programmed.
- damaged wiring.
- a damaged transceiver.
- a damaged IPC .
- a damaged TCM .

Passive Anti-Theft System (PATS) PIDs

Monitoring the PATS PIDs can be very useful in determining which diagnostic steps to follow. Viewing the

MASTERKEY (master key) PID with both keys determines if the key is a programmed key and can also be used to prove out the transceiver, circuitry and the IPC . A master key is a key that is programmed into the IPC . Viewing the MIN_KEYS (minimum number of keys) PID (this PID does not change) determines the minimum number of keys that must be programmed into the IPC . There must be at least 2 keys programmed into the IPC in this type of PATS before the vehicle starts. Viewing the N_KEYCODE (number of keys programmed) PID determines if the minimum number of keys have been programmed into the IPC . If the N_KEYCODE PID reads 0 or 1, additional key(s) need to be programmed into the IPC in order to meet the minimum of 2 keys. If the N_KEYCODE PID reads 0 or 1, and the MASTERKEY PID reads Not Present, that particular key must be programmed into the IPC . If the N_KEYCODE PID reads 1, and the MASTERKEY PID reads Present, that particular key is already programmed into the IPC . In this particular case, there are not enough keys programmed (a minimum of 2 are needed before the vehicle starts) into the IPC and at least 1 more key needs to be programmed before the vehicle starts. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section.

Also, if the unlimited key mode has been enabled, the N_KEYCODE PID always reads 2, after the first 2 keys are programmed into the IPC , regardless of how many additional keys are added.

When the parameters are reset, it clears (erases) the TCM ID from the IPC . A parameter reset causes the TCM to send a TCM ID to the IPC that is necessary for the system to operate. Make sure to cycle the key at least once, then turn the key ON and make an attempt to start the vehicle for 3-5 seconds before attempting more procedures. If only a TCM parameter reset occurs, the ID stored in the IPC does not match the ID being sent by the TCM , and can cause a PATS -related no-start. Carry out a PATS parameter reset, then turn the key ON and make an attempt to start the vehicle for 3-5 seconds before attempting more procedures.

If the PCM_ID (TCM id status) PID reads Stored, the IPC has a TCM ID stored. If it reads Not Stored, a parameter reset may resolve this concern. If the PATSENABL (vehicle enable status) PID reads Disabled, and the N_KEYCODE PID reads 2 or more and the MASTERKEY PID reads Present, the IPC and the TCM need to have their parameters reset. Refer to Passive Anti-Theft System (PATS) Parameter Reset in this section.

If the PATSENABL PID reads Disabled, and the N_KEYCODE PID reads 1 and the MASTERKEY PID reads Present, or if the N_KEYCODE PID reads 0 and the MASTERKEY PID reads Not Present, a minimum of 2 keys need to be programmed into the IPC . Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section.

If the MASTERKEY PID continues to read Not Present after programming, this may indicate a defective key. The SPAREKEY PID is defaulted to ENABLE. With the SPAREKEY PID displaying ENABLE, the IPC accepts more than 2 keys (up to a maximum of 8) being programmed into the IPC using Key Programming Using Two Programmed Keys in this section. It can be toggled to DISABLE if the customer wants to disable the customer spare key programming function. Refer to Key Programming Switch State Control in this section. This switch state control does not affect the Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment procedure.

In summary, in order for the vehicle to start, the PATS PIDs and their correct state they must be in are as following:

PID	Normal State
N_KEYCODE	must read 2 or more
MASTERKEY	must read Present
PCM_VFY	must read Yes

PATSENABL	must read Enabled
NOTE: The TCM ID PID in the IPC is displayed by the IDS scan tool as PCM_ID. PCM_ID	must read Stored

Use of Standard Passive Anti-Theft System (PATS) Keys

When using a standard (non- IKT) PATS key to start the vehicle, an IKT key (from another vehicle) on the same key ring can possibly be programmed into the vehicle for remote entry functionality, resulting in the IKT key being able to operate the lock and unlock functions of the vehicle (but the IKT key cannot start the vehicle). This should not cause a PATS no-start of either the first or the second vehicle, but the IKT key may be able to operate the lock and unlock functions of both vehicles. The IKT key is able to start the original vehicle to which it is programmed and is not able to start the second vehicle. At this time, it is necessary to carry out an Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment procedure and then to make certain the IKT key for the second vehicle is removed from the key ring in order to prevent this concern from occurring again. Also, if an IKT key is used to start the vehicle, the vehicle only reads the IKT key in the ignition lock cylinder and cannot read the second IKT on the key ring. Using an IKT key to start both vehicles, rather than standard PATS keys, prevents the second IKT (transmitter portion only) from being programmed into the first vehicle.

Unlimited Key Mode

PATS contains a feature called unlimited key mode and uses the UNL_KEY_MODE PID. This feature allows a customer to program more than 8 keys to their vehicle if they request it. Each vehicle in unlimited key mode is set up with a special unlimited transponder security key code. This allows all the customer vehicles to share the same mechanically cut keys, but no other keys from outside can be used to operate the vehicles. For an individual customer, any randomly selected security key that has been previously mechanically cut and electronically programmed to the vehicle is acceptable. Refer to Spare Key Programming - Unlimited Key Mode in this section.

Inspection and Verificaon

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Passive Anti-Theft System (PATS) key • Use of a non- PATS key or incorrect PATS key • Remote start system installed	• Smart Junction Box (SJB) fuse 36 (5A) • Wiring, terminals or connectors • Instrument Panel Cluster (IPC)

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the IPC and the Transmission Control Module (TCM).

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

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

DTC Charts

Instrument Panel Cluster (IPC) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B109E:42	Remote Keyless Entry: General Memory Failure	The Smart Junction Box (SJB) has 4 Integrated Keyhead Transmitters (IKTs) stored in memory and cannot program any more IKTs into the SJB memory. REFER to Principles of Operation in this section to determine if this is normal operation for this system.
B10D5:13	PATS Antenna: Circuit Open	There has been a Passive Anti-Theft System (PATS) transceiver antenna failure. GO to Pinpoint Test A .
B10D7:05	PATS Key: System Programming Failures	There was a failure in key programming. GO to Pinpoint Test I .
B10D7:51	PATS Key: Not Programmed	There is an unprogrammed PATS key. GO to Pinpoint Test C .
B10D7:87		

	PATS Key: Missing Message	No PATS key has been read by the Instrument Panel Cluster (IPC). GO to Pinpoint Test B .
B10D7:8F	PATS Key: Erratic	Only a partial PATS key was read. GO to Pinpoint Test D .
B10D8:00	PATS Key Less Than Minimum Programmed: No Sub Type Information	If DTC B10D7:87, B10D7:51, B10D7:8F, B10D9:87 or B10D5:13 is present, they must be addressed first. If DTC B10D8:00 is the only DTC present, PROGRAM additional keys. REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.
B10D9:87	PATS Transponder: Missing Message	The IPC did not receive the PATS transceiver signal. GO to Pinpoint Test E .
B10DA:51	PATS PCM Identifier: Not Programmed	There is no TCM ID stored in the IPC . CARRY OUT a parameter reset of the IPC and the TCM , then CYCLE the ignition and make an attempt to start the vehicle. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. CLEAR the DTCs. REPEAT the self-test.
B10DA:61	PATS PCM Identifier: Signal Calculation Failure	CARRY OUT a parameter reset of the IPC and the TCM and CYCLE the ignition 3-5 times, making an attempt to start the vehicle each key cycle. REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.
B10DA:86	PATS PCM Identifier: Signal Invalid	**NOTE:** If DTCs B10DA:61 and B10DA:86 are both present, address DTC B10DA:61 first. GO to Pinpoint Test G .
U0101:00	Lost Communication With TCM : No Sub Type Information	**NOTE:** If DTC U0101:00 or DTC B10DA:61 is present, address DTC B10DA:61 first. GO to Pinpoint Test G .
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Transmission Control Module (TCM) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
P1260:61	Theft Detected, Vehicle Immobilized: Signal Calculation Failure	If there are any Passive Anti-Theft System (PATS) DTCs present in the Instrument Panel Cluster (IPC), ADDRESS them first. This DTC can also indicate a Controller Area Network (CAN) concern or a parameter reset concern. Make sure to verify if there are any communication concerns/DTCs with any modules. REFER to Section 418-00 . If DTC P1260:61 is the only DTC present, there may be a parameter reset concern or a power or ground concern with the TCM . REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. If necessary, CHECK the powers and grounds to the TCM . REFER to the Wiring Diagrams Manual to determine the TCM

		power and ground circuits.
All other DTCs	-	REFER to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: DTC B10D5:13

Normal Operation

- DTC B10D5:13 (PATS Antenna: Circuit Open) - a continuous and on-demand DTC that sets when there has been a Passive Anti-Theft System (PATS) transceiver antenna failure. The PATS transceiver may need to be replaced.

This pinpoint test is intended to diagnose the following:

- PATS transceiver

PINPOINT TEST A: DTC B10D5:

Test Step	Result / Action to Take
A1 INSPECT THE PATS TRANSCEIVER FOR CORRECT INSTALLATION	
NOTE: Replacement of the PATS transceiver does not require the PATS keys to be programmed into the Instrument Panel Cluster (IPC) again. • Ignition OFF. • Verify the PATS transceiver is correctly installed. Refer to Passive Anti-Theft System (PATS) Transceiver in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Is DTC B10D5:13 retrieved?**	**Yes** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. **No** The system is OK.

Pinpoint Test B: DTC B10D7:87

Normal Operation

- DTC B10D7:87 (PATS Key: Missing Message) - a continuous and on-demand DTC that sets when no Passive Anti-Theft System (PATS) key has been read by the Instrument Panel Cluster (IPC).

This pinpoint test is intended to diagnose the following:

- PATS key
- PATS transceiver
- IPC

PINPOINT TEST B: DTC B10D7:87

NOTE: Large metallic objects, electronic devices on the key ring that can be used to purchase gasoline or similar items, or a second key on the same key ring as the PATS key can cause vehicle starting concerns and record DTCs under certain conditions. If a fault cannot be identified, examine the customer key ring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS key while starting the engine. These objects and devices cannot damage the PATS key, but can cause a momentary concern if they are too close to the key during engine start. If a concern occurs, turn the key off and restart the engine with all other objects on the key ring held away from the ignition key. Check to make sure the PATS key used by the customer is an approved Ford PATS key. (PATS keys from Ford, Rotunda, Strattec or Huf are approved Ford PATS keys.)

NOTE: This vehicle uses a Huf Integrated Keyhead Transmitter (IKT) key. If replacing an IKT key for any of these vehicles, it is recommended that the original Huf IKT key be replaced with another Huf IKT key. There are minor visual differences both externally and internally between the Huf IKT key and IKT keys used on other Ford and Lincoln vehicles that may be noticed by the customer. These visual differences does not affect the IKT key functionality in any way. Rotunda should supply a Huf IKT key when ordering replacement/new keys for this vehicle. The Owner's Literature can provide additional information concerning these differences. If replacing an IKT key (or adding another key) with a standard PATS key (not an IKT key), any of the brands (Ford, Rotunda, Strattec or Huf) can operate the system.

Test Step	Result / Action to Take
B1 RETRIEVE THE DTCs	
• Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Is DTC B10D7:87 retrieved?**	**Yes** GO to B2 . **No** If any other IPC DTCs are retrieved, REFER to Section 419-10 . If no DTCs are retrieved, the system is OK.
B2 CHECK BOTH PATS KEYS	
• Obtain both PATS keys from the customer and follow the procedure using one PATS key, then the other. If the customer only has one PATS key, it is necessary to cut a new PATS key. • If it is necessary to cut a new	**Yes** If DTC B10D7:87 was present for both keys or the new key (if present), GO to B3 . If DTC B10D7:87 was not present for the new key, the original key may be damaged and should be replaced. REPLACE the damaged key with a new key. REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. CYCLE the

PATS key, program the new PATS key. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Using all existing keys, then the newly programmed key (if applicable), is DTC B10D7:87 present?**	ignition. REPEAT the self-test. TEST the system for normal operation. **No** If any other IPC DTCs are retrieved, REFER to Section 419-10 . If no IPC DTCs are retrieved, the system is OK.
B3 INSTALL A NEW PATS TRANSCEIVER	
NOTE: Replacement of the PATS transceiver does not require the PATS keys to be programmed into the IPC again. **NOTE:** Do not use the PATS key that may have been programmed in Step B2. • Ignition OFF. • Install a new PATS transceiver. Refer to Passive Anti-Theft System (PATS) Transceiver in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Turn the key to the ON position using an existing customer PATS key. • Retrieve the IPC DTCs. • **Is DTC B10D7:87 retrieved?**	**Yes** GO to B4 . **No** The system is now OK. The concern was caused by a damaged PATS transceiver.
B4 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the Transmission Control Module (TCM). REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition.

• Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

Pinpoint Test C: DTC B10D7:51

Normal Operation

- DTC B10D7:51 (PATS Key: Not Programmed) - a continuous and on-demand DTC that sets when there is an unprogrammed Passive Anti-Theft System (PATS) key. There may not be an concern with the PATS key itself, but the key must be programmed into the PATS memory (unless the maximum number of keys are already programmed).

This pinpoint test is intended to diagnose the following:

- PATS key
- Instrument Panel Cluster (IPC)

PINPOINT TEST C: DTC B10D7:51

NOTE: Large metallic objects, electronic devices on the key ring that can be used to purchase gasoline or similar items, or a second key on the same key ring as the PATS key can cause vehicle starting concerns and record DTCs under certain conditions. If a fault cannot be identified, examine the customer key ring for such objects or devices. If present, inform the ctomer that they need to keep these objects from touching the PATS key while starting the engine. These objects and devices cannot damage the PATS key, but can cause a momentary concern if they are too close to the key during engine start. If a concern occurs, turn the ignition switch off and restart the engine with all other objects on the key ring held away from the ignition key. Check to make sure the PATS key used by the customer is an approved Ford PATS key. (PATS keys from Ford, Rotunda, Strattec or Huf are approved Ford PATS keys.)

NOTE: Only 8 PATS keys can be programmed into the IPC during normal programming procedures (with the unlimited key mode being the exception). If the N_KEYCODE (number of keys programmed) PID reads more than 2 and less than 8, the concern may be the PATS key being used is an unprogrammed key. Verify this by also viewing the MASTERKEY (verifies if the key is programmed) PID. It must read Present for the key to be valid.

NOTE: This vehicle uses a Huf Integrated Keyhead Transmitter (IKT) key. If replacing an IKT key for any of these vehicles, it is recommended that the original Huf IKT key be replaced with another Huf IKT key. There are minor visual differences both externally and internally between the Huf IKT key and IKT keys used on other Ford and Lincoln vehicles that may be noticed by the customer. These visual differences does not affect the IKT key functionality in any way. Rotunda should supply a Huf IKT key when ordering replacement/new keys for this vehicle. The Owner's Literature can provide additional information concerning these differences. If replacing an IKT key (or adding another key) with a standard PATS key (not an IKT key), any of the brands (Ford, Rotunda, Strattec or Huf) can operate the system.

Test Step	Result / Action to Take
C1 RETRIEVE THE DTCs	
	Yes GO to C2 .

• **NOTE:** Follow this procedure using both PATS keys (using one at a time). • If only one key is available, cut a new key and program the keys. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. • If both keys are available, program the keys. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Is DTC B10D7:51 retrieved for both PATS keys?**	**No** If DTC B10D7:51 is retrieved for one PATS key, REPLACE that key and PROGRAM all the keys. REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. If DTC B10D7:51 is not retrieved for either key, the system is OK. CHECK all customer PATS keys by attempting to start the vehicle with each key to verify all other PATS keys are programmed.
C2 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the Transmission Control Module (TCM). REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

Pinpoint Test D: DTC B10D7:8F

Normal Operation

- DTC B10D7:8F (PATS Key: Erratic) - a continuous and on-demand DTC that sets when only a partial Passive Anti-Theft System (PATS) key was read. Remote starter equipment can also cause this DTC.

This pinpoint test is intended to diagnose the following:

- PATS key

- PATS transceiver
- Instrument Panel Cluster (IPC)

PINPOINT TEST D: DTC B10D7:8F

NOTE: Large metallic objects, electronic devices on the key ring that can be used to purchase gasoline or similar items, or a second key on the same key ring as the PATS key can cause vehicle starting concerns and record DTCs under certain conditions. If a fault cannot be identified, examine the customer key ring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS key while starting the engine. These objects and devices cannot damage the PATS key, but can cause a momentary concern if they are too close to the key during engine start. If a concern occurs, turn the ignition off and restart the engine with all other objects on the key ring held away from the ignition key. Check to make sure the PATS key used by the customer is an approved Ford PATS key. (PATS keys from Ford, Rotunda, Strattec or Huf are approved Ford PATS keys.)

NOTE: This vehicle uses a Huf Integrated Keyhead Transmitter (IKT) key. If replacing an IKT key for any of these vehicles, it is recommended that the original Huf IKT key be replaced with another Huf IKT key. There are minor visual differences both externally and internally between the Huf IKT key and IKT keys used on other Ford and Lincoln vehicles that may be noticed by the customer. These visual differences does not affect the IKT key functionality in any way. Rotunda should supply a Huf IKT key when ordering replacement/new keys for this vehicle. The Owner's Literature can provide additional information concerning these differences. If replacing an IKT key (or adding another key) with a standard PATS key (not an IKT key), any of the brands mentioned above (Ford, Rotunda, Strattec or Huf) can operate the system.

Test Step	Result / Action to Take
D1 RETRIEVE THE DTCs	
• **NOTE:** Follow this procedure using both PATS keys (using one at a time). • If only one key is available, cut a new key and program the keys. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Is DTC B10D7:8F retrieved for one or both PATS keys?**	**Yes** If DTC B10D7:8F is retrieved for one key, REPLACE that key and PROGRAM the new key. REFER to Spare Key Programming - Using Diagnostic Equipment in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. If DTC B10D7:8F is retrieved for both PATS keys, GO to D2 . **No** The system is OK. CHECK all the customer PATS keys by attempting to start the vehicle with each key to verify all other PATS keys are programmed.
D2 INSTALL A NEW PATS TRANSCEIVER	
NOTE: Replacement of the PATS transceiver does not require the PATS keys to be programmed into the IPC	**Yes** GO to D3 . **No** The system is now OK. The concern was caused by a damaged

again. • Ignition OFF. • Install a new PATS transceiver. Refer to Passive Anti-Theft System (PATS) Transceiver in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Are any PATS DTCs retrieved?**	PATS transceiver. CHECK all the customer PATS keys by attempting to start the vehicle with each key to verify all other PATS keys are programmed.
D3 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the Transmission Control Module (TCM). REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

Pinpoint Test E: DTC B10D9:87

Refer to Wiring Diagrams Cell 112 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Passive Anti-Theft System for schematic and connector information.

Normal Operation

The Passive Anti-Theft System (PATS) transceiver receives voltage from the Smart Junction Box (SJB) fuse 36 (5A) on the vehicle power circuit and is grounded on the ground circuit. The PATS transceiver and the Instrument Panel Cluster (IPC) communicate on the receive circuit and on the transmit circuit. The IPC compares the key code stored in memory and sends a signal to the Transmission Control Module (TCM) to enable the starter and the fuel injectors if the key code is correct.

- DTC B10D9:87 (PATS Transponder: Missing Message) - a continuous and on-demand DTC that sets when the PATS transceiver signal is not received by the IPC . This DTC can be caused by circuits between the PATS transceiver and the IPC , or circuits to the PATS transceiver. This can also be caused by using the incorrect PATS transceiver part number.

This pinpoint test is intended to diagnose the following:

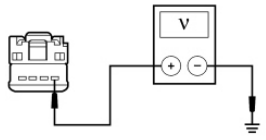
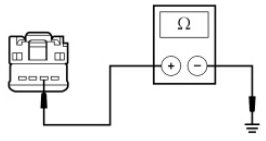
- Fuse
- Wiring, terminals or connectors
- PATS transceiver

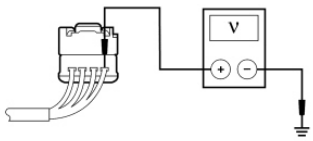
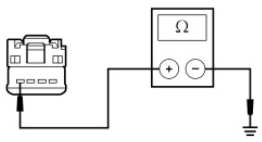
- IPC

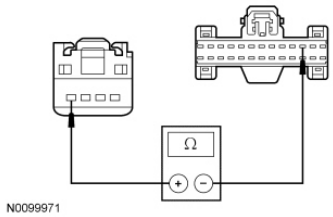
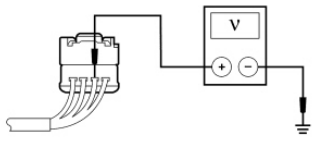
PINPOINT TEST E: DTC B10D9:87

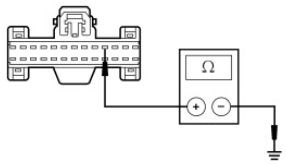
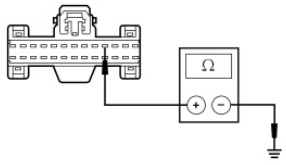
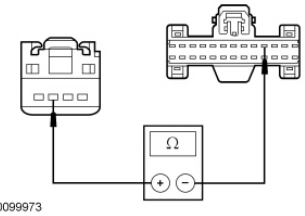
NOTICE: **Use the correct probe adapter(s) when making meurements. Failure to use the correct probe adapter(s) may damage the connector.**

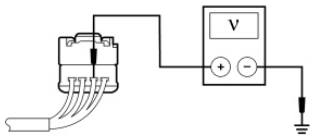
NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

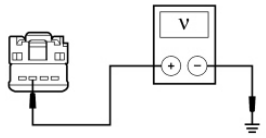
Test Step	Result / Action to Take
E1 CHECK THE PATS TRANSCEIVER POWER CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Disconnect: PATS Transceiver C252. • Ignition ON. • Measure the voltage between the PATS transceiver C252-1, circuit CBP36 (BU/BN), harness side and ground.  A0096368 • **Is the voltage greater than 10 volts?**	**Yes** GO to E2 . **No** VERIFY the SJB fuse 36 (5A) is OK. If OK, REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. If not OK, REFER to the Wiring Diagrams Manual to identify the possible causes of the circuit short.
E2 CHECK THE PATS TRANSCEIVER GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable. • Measure the resistance between the PATS transceiver C252-2, circuit GD116 (BK/VT), harness side and ground.  A0096369 • **Is the resistance less than 5 ohms?**	**Yes** GO to E3 . **No** REPAIR the circuit. CONNECT the negative battery cable. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.
E3 CHECK THE PATS TRANSCEIVER RECEIVE CIRCUIT FOR VOLTAGE	

NOTICE: **This pinpoint test step directs using a back-probe method. Use the special back-probe tool specified in the tool list in this section. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors and subsequent electrical faults.** • Connect: Negative Battery Cable. • Connect: PATS Transceiver C252. • Ignition ON. • Measure the voltage by backprobing between the PATS transceiver C252-4, circuit VRT24 (YE/OG), harness side and ground.  A0096370 • **Is the voltage greater than 8 volts?**	**Yes** GO to E6 . **No** GO to E4 .
E4 CHECK THE PATS TRANSCEIVER RECEIVE CIRCUIT FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: IPC C220. • Disconnect: PATS Transceiver C252. • Measure the resistance between the PATS transceiver C252-4, circuit VRT24 (YE/OG), harness side and ground.  A0096371 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to E5 . **No** REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. If DTC B10D9:87 is retrieved again, GO to E12 .
E5 CHECK THE PATS TRANSCEIVER RECEIVE CIRCUIT FOR AN OPEN	

• Measure the resistance between the PATS transceiver C252-4, circuit VRT24 (YE/OG), harness side and the IPC C220-3, circuit VRT24 (YE/OG), harness side.  N0099971 • **Is the resistance less than 5 ohms?**	**Yes** GO to E12 . **No** REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.
E6 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR VOLTAGE	
NOTICE: **This pinpoint test step directs using a back-probe method. Use the special back-probe tool specified in the tool list in this section. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors and subsequent electrical faults.** **NOTE:** Replacement of the PATS transceiver does not require the PATS keys to be programmed into the IPC again. • Measure the voltage by backprobing between the PATS transceiver C252-3, circuit VRT23 (VT/GY), harness side and ground.  A0096373 • **Is the voltage greater than 8 volts?**	**Yes** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. If DTC B10D9:87 is retrieved again, GO to E12 . **No** GO to E7 .
E7 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR A SHORT TO GROUND WITH THE PATS TRANSCEIVER CONNECTED	

• Ignition OFF. • Disconnect: IPC C220. • Measure the resistance between the IPC C220-4, circuit VRT23 (VT/GY), harness side and ground.  N0099972 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to E9 . **No** GO to E8 .
E8 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR A SHORT TO GROUND WITH THE PATS TRANSCEIVER DISCONNECTED	
NOTE: Replacement of the PATS transceiver does not require the PATS keys to be programmed into the IPC again. • Disconnect: PATS Transceiver C252. • Measure the resistance between the IPC C220-4, circuit VRT23 (VT/GY), harness side and ground.  N0099972 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. **No** REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.
E9 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR AN OPEN	
• Disconnect: PATS Transceiver C252. • Measure the resistance between the PATS transceiver C252-3, circuit VRT23 (VT/GY), harness side and the IPC C220-4, circuit VRT23 (VT/GY), harness side.  N0099973 • **Is the resistance less than 5 ohms?**	**Yes** GO to E10 . **No** REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

E10 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR VOLTAGE USING THE ACTIVE COMMAND	
NOTICE: **This pinpoint test step directs using a back-probe method. Use the special back-probe tool specified in the tool list in this section. Do not force test leads or other probes into connectors. Adequate care must be exercised to avoid connector terminal damage while ensuring that good electrical contact is made with the circuit or terminal. Failure to follow these instructions may cause damage to wiring, terminals, or connectors and subsequent electrical faults.** **NOTE:** Replacement of the PATS transceiver does not require the PATS keys to be programmed into the IPC again. • Connect: PATS Transceiver C252. • Connect: IPC C220. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger. • Trigger the IPC active command TRANSMIT (this is the TX circuit ON/OFF) to ON. • Measure the voltage by backprobing between the PATS transceiver C252-3, circuit VRT23 (VT/GY), harness side and ground.  A0096373 • **Is the voltage less than 5 volts?**	**Yes** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. **No** GO to E11 .
E11 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: IPC C220. • Disconnect: PATS Transceiver C252. • Ignition ON. • Measure the voltage between the PATS transceiver C252-3, circuit VRT23 (VT/GY), harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. **No** GO to E12 .

 A0096377 • **Is any voltage indicated?**	
E12 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the TCM . REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

Pinpoint Test F: The Anti-Theft Indicator Is Always/Never On

Normal Operation

The Passive Anti-Theft System (PATS) uses a visual anti-theft indicator located in the Instrument Panel Cluster (IPC). The anti-theft indicator proves out for 3 seconds when the key is turned to the ON or START position. If there is a PATS concern, the anti-theft indicator either flashes rapidly or glows steadily (for more than 3 seconds) when the key is turned to the ON or START position. PATS flashes the anti-theft indicator every 2 seconds at key off to act as a visual theft deterrent. The anti-theft indicator operation is controlled by the IPC .

This pinpoint test is intended to diagnose the following:

- IPC

PINPOINT TEST F: THE ANTI-THEFT INDICATOR IS ALWAYS/NEVER ON

Test Step	Result / Action to Take
F1 CHECK THE ANTI-THEFT INDICATOR FOR CORRECT	

OPERATION	
• Ignition OFF. • Connect the scan tool. • Ignition ON. • Enter the following diagnostic mode on the scan tool: IPC DataLogger. • Trigger the IPC active command THEFT_LMP (PATS indicator only) to ON, then OFF. • **Does the anti-theft indicator illuminate, then turn off?**	**Yes** GO to F2 . **No** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the Transmission Control Module (TCM). REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test.
F2 CHECK FOR CORRECT IPC OPERATION	
• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the TCM . REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test.

Pinpoint Test G: DTC B10DA:86 or DTC U0101:00

Refer to Wiring Diagrams Cell 14 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Module Communications Network for schematic and connector information.

Normal Operation

During each vehicle start sequence, when the key is turned to the START or ON position, the Passive Anti-Theft System (PATS) transceiver reads the PATS key ID code and sends the data to the Instrument Panel

Cluster (IPC). If there is no communication on the High Speed Controller Area Network (HS-CAN) between the IPC and the Transmission Control Module (TCM), DTC U0101:00 or DTC B10DA:86 can set in the IPC and the vehicle can experience a PATS no-start.

If DTC B10DA:61 is present, refer to DTC Charts in this section.

- DTC B10DA:86 (PATS PCM Identifier: Signal Invalid) - a continuous DTC that sets only when the IPC does not receive the expected response from the TCM over the HS-CAN and the fault may not be present at the time of testing. The data sent by the TCM does not match the data expected by the IPC and this DTC is set. This DTC can be caused by the HS-CAN circuits between the IPC and the TCM or by either module. This DTC can also be set if the battery voltage is low.
- DTC U0101:00 (Lost Communication With TCM : No Sub Type Information) - a continuous DTC that sets only when the IPC loses communication with the TCM and the fault may not be present at the time of testing. This DTC can be caused by a HS-CAN circuit concern, the IPC or the TCM .

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Low battery state of charge
- IPC
- TCM

PINPOINT TEST G: DTC B10DA:86 OR DTC U0101:00

Test Step	Result / Action to Take
G1 CHECK THE BATTERY STATE OF CHARGE	
• Ignition OFF. • Check the batry state of charge with the battery condition test. Refer to Section 414-01 . • **Does the battery pass the battery condition test?**	**Yes** GO to G2 . **No** INSTALL a new battery. REFER to Section 414-01 .
G2 CHECK FOR MODULE COMMUNICATION ON THE HS-CAN	
• Connect the scan tool. • Ignition ON. • Carry out the network test using the scan tool. • **Is the scan tool unable to communicate with any of the modules on the HS-CAN ?**	**Yes** REFER to Section 418-00 to diagnose the module that is not communicating with the scan tool. **No** GO to G3 .
G3 INSPECT THE HS-CAN CIRCUITRY	
• Ignition OFF. • Inspect all of the HS-CAN circuitry, including the pin crimps, connector fit, corroded/bent/pushed-out/damaged pins and splice integrity in the 4 splices and 36	**Yes** GO to G4 . **No** REPAIR the HS-CAN circuitry as necessary. CLEAR the DTCs. CYCLE the ignition. REPEAT

connections (8 connectors) between the TCM and the IPC . • **Does the HS-CAN circuitry pass the component inspection?**	the self-test. TEST the system for normal operation.
G4 CHECK FOR CORRECT TCM OPERATION	
• Disconnect all the TCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the TCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new TCM . REFER to Section 307-01C . RESET the parameters in both the IPC and the TCM . REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation. If the concern is still present, GO to G5 . **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation.
G5 CHECK FOR CORRECT IPC OPERATION	
• Disconnect all the IPC connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the IPC connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . RESET the parameters in both the IPC and the TCM . REFER to Passive Anti-Theft System (PATS) Parameter Reset in this section. PROGRAM the PATS keys into the new IPC . REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test H: The Vehicle Does Not Start

Normal Operation

During each vehicle start sequence, when the key is turned to the START or ON position, the Passive Anti-Theft System (PATS) transceiver reads the PATS key ID code and sends the data to the Instrument Panel Cluster (IPC). If the concern is due to a PATS concern, PATS DTCs can set in the IPC , and DTC P1260:61 in the Transmission Control Module (TCM). If it is due to a starting system, or a driveability concern, there is no PATS DTCs in the IPC or DTC P1260 in the PCM or DTC P1260:61 in the TCM .

This pinpoint test is intended to diagnose the following:

- Starting system concern
- PATS concern

PINPOINT TEST H: THE VEHICLE DOES NOT START

Test Step	Result / Action to Take
H1 CHECK FOR COMMUNICATION WITH THE TCM AND IPC	
• Connect the scan tool. • Ignition ON. • Carry out the network test using the scan tool. • **Does the scan tool establish communication with the TCM and the IPC ?**	**Yes** GO to H2 . **No** REFER to Section 418-00 to diagnose the module that is not communicating with the scan tool.
H2 CHECK FOR IPC DTCs	
• Retrieve the IPC continuous and on-demand DTCs. • **Are any IPC DTCs present?**	**Yes** REFER to DTC Charts in this section. **No** The no-start condition is not PATS -related. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnose the cause of the no-start condition.

Pinpoint Test I: DTC B10D7:05

Normal Operation

During each vehicle start sequence, when the key is turned to the START or ON position, the Passive Anti-Theft System (PATS) transceiver reads the PATS key ID code and sends the data to the Instrument Panel Cluster (IPC). If there is a bad transponder in the Integrated Keyhead Transmitter (IKT) key that is in the ignition lock cylinder, or if there was a concern during the programming of the IKT key, DTC B10D7:05 can set, and the vehicle experiences a PATS no-start.

- DTC B10D7:05 (PATS Key: System Programming Failures) - a continuous DTC that sets when there was a failure during the key programming procedure.

This pinpoint test is intended to diagnose the following:

- PATS key programming concern
- PATS key concern (transponder)

PINPOINT TEST I: DTC B10D7:05

Test Step	Result / Action to Take
I1 CHE BOTH PATS KEYS	

NOTE: Check to make sure the new PATS keys are approved Ford encoded PATS keys. Unapproved PATS keys do not always operate correctly over various temperature ranges. (PATS keys from Ford, Rotunda, Strattec or Huf are approved Ford PATS keys.) **NOTE:** Follow this procedure using both PATS keys (using one at a time). • Obtain both PATS keys from the customer and follow the procedure using one PATS key, then the other. If the customer only has one PATS key, it is necessary to cut a new PATS key (does not have to be an IKT key). • If it is necessary to cut a new PATS key, cut the new key to match the original key. Program the PATS keys. Refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. • Ignition ON. • Clear the IPC DTCs. • Ignition OFF. • Ignition ON. • Retrieve the IPC DTCs. • **Is DTC B10D7:05 present with either key?**	**Yes** REPLACE the damaged key with the new key that was cut (if present), or CUT a new key to replace the damaged key. DISCARD the damaged key. PROGRAM the keys. REFER to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. CYCLE the ignition. REPEAT the self-test. TEST the system for normal operation. **No** If other IPC DTCs are retrieved, REFER to Section 419-10 . If no IPC DTCs are retrieved, the system is now OK. The concern was caused by a PATS key programming concern.

MyKey® Restrictions on Vehicle Operation

Principles of Operation

MyKey® Operation

The MyKey® feature allows a restricted driving mode to be programmed into one (or more) key(s) supplied with the vehicle or into any (Passive Anti-Theft System (PATS)) programmed spare key(s) to promote good driving habits. The MyKey® is a restricted key for all consecutive key cycles until the MyKey® restricted key is cleared. The remaining key(s) is referred to as an "administrator key(s)" or admin key(s). There must always be at least one admin key. The Instrument Panel Cluster (IPC) does not allow the last administrator key to be programmed as a MyKey® restricted key. Both the admin key and the MyKey® can be used to see how many admin keys and MyKey® restricted keys are programmed to the vehicle, and how many total miles have been driven with the MyKey® active.

When the MyKey® feature is pral features are modified for the MyKey® driver only.

Inspection and Verification

1. Verify the customer concern.
2. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
3. If the cause is not visually evident, verify the symptom. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Key Programming Using Two Programmed Keys

NOTE: This procedure works only if 2 or more programmed ignition keys (they do not have to be Integrated Keyhead Transmitter (IKT) keys) are present. If 2 programmed Passive Anti-Theft System (PATS) keys are not available, refer to Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment in this section.

NOTE: The Instrument Panel Cluster (IPC) PID SPAREKEY must be enabled for this procedure to operate. If this PID is not enabled, refer to Key Programming Switch State Control in this section in order to enable the customer spare key programming PID. The IPC PID SPAREKEY is set to ENABLE when the vehicle is built.

NOTE: If the programming procedure is successful, the new key(s) starts the vehicle and the anti-theft indicator proves-out for approximately 3 seconds. If the programming procedure is not successful and the new key(s) does not start the engine, leave the key in the ON position for at least 3 seconds, then turn the key off. Repeat the key programming procedure from Step 1. If the failure repeats, refer to Anti-Theft in the Diagnosis and Testing portion of this section to review the DTCs and carry out the appropriate pinpoint tests.

NOTE: A minimum of 2 PATS keys must be programmed into the IPC before the vehicle starts.

NOTE: If the vehicle is in unlimited key mode, this spare key programming procedure still functions. Any 2 keys that start the vehicle can be used to program an additional unlimited key.

NOTE: If additional keys are to be programmed, and the remaining keys are with the customer, or are not available, instruct the customer to refer to the Owner's Literature for instructions on programming the remaining keys. In this case, the PID SPAREKEY must be enabled.

NOTE: If the steps are not carried out as outlined, the programming procedure ends.

NOTE: Ignition keys must have a correct mechanical key cut for the vehicle and must be PATS encoded keys (contain a transponder). The key does not have to be an IKT key.

NOTE: This procedure is not necessary if only the PATS transceiver was replaced. Replacement of the transceiver does not erase the PATS key codes in the IPC .

NOTE: A maximum of 8 ignition keys can be programmed to a PATS vehicle, of which up to 4 can be IKTs . If an attempt to program more than 4 IKTs occurs, the Smart Junction Box (SJB) sets DTC B1138, and the IPC sets DTC B109E:42 (both DTCs indicate a memory full condition), and the additional IKTs do not have any Remote Keyless Entry (RKE) function capability. If the vehicle is equipped with a message center, the IPC displays the message INT KEY COULD NOT PROGRAM. The PATS portion of the additional key(s) function, but the RKE transmitter function is inoperative.

NOTE: When in the unlimited key mode (after the first 2 keys have been programmed to the vehicle), the N_KEYCODE PID always reads 2, no matter how many keys are programmed to the vehicle.

1. Insert a programmed ignition key (can be an IKT or a standard PATS key) into the ignition lock cylinder and turn the key from the OFF position to the ON position.

2. Leave the key in the ON position for 3 seconds, but not longer than 10 seconds.

3. Turn the key to the OFF position and remove the first key.

4. Within 10 seconds of turning the key to the OFF position, insert a second programmed ignition key (can be an IKT or a standard PATS key) into the ignition lock cylinder and turn the key from the OFF position to the ON position.

5. Leave the key in the ON position for 3 seconds, but not longer than 10 seconds.

6. Turn the key to the OFF position and remove the second key.

7. Within 20 seconds of turning the key to the OFF position, insert the unprogrammed ignition key (new PATS or IKT key) into the ignition lock cylinder and turn the key from the OFF position to the ON position. Leave the key in the ON position for a minimum of 6 seconds (this additional 3 second time frame allows for the RKE data transfer to take place, if programming an IKT key).

8. **NOTE:** The new key now starts the vehicle and also operates the RKE functions, if there are 4 or fewer IKT keys programmed to the vehicle.

   Start the vehicle with the new key.

   - If it is an IKT key, verify the RKE functions.

9. If additional programmed keys are desired, repeat Steps 1-8.

Integrated Keyhead Transmitter (IKT) Key Programming Using Diagnostic Equipment

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: This procedure is used when a customer needs more than one key programmed into the system and 2 programmed ignition keys are not available. This procedure is also useful when a programmed ignition key(s) is lost or the ignition lock cylinder is replaced, and it is desired to erase key code(s) from the PassAnti-Theft System (PATS) memory.

NOTE: This procedure erases all programmed ignition keys from the vehicle memory and the vehicle does not start until 2 keys are programmed to the vehicle. This procedure also erases the Integrated Keyhead Transmitter (IKT) Transmitter Identification Codes (TICs) from the Smart Junction Box (SJB), preventing the erased IKT from operating the Remote Keyless Entry (RKE) functions on the vehicle.

NOTE: A minimum of 2 PATS keys must be programmed into the Instrument Panel Cluster (IPC) before the vehicle starts.

NOTE: Two PATS encoded (contains a transponder) keys (or IKTs) with the correct mechanical cut must be available to carry out this procedure. One or both of them can be the customer's original keys. One or both of them may be an IKT or a standard PATS key.

NOTE: If additional keys are to be programmed, refer to Key Programming Using Two Programmed Keys in this section. If the remaining keys are with the customer and are not available with the vehicle, instruct the customer to refer to the Owner's Literature for instructions on programming the remaining keys. In this case, the IPC PID SPAREKEY must be enabled.

NOTE: This procedure is not necessary if only the PATS transceiver was replaced. Replacement of the transceiver does not erase the PATS key codes in the IPC .

1. Turn the key from the OFF position to the ON position.

2. From the scan tool, enter TOOLBOX. Select BODY-SECURITY-PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.

3. From the scan tool menu select: Ignition Key Code Erase. Follow all IDS screen instructions until key erase procedure completes. The scan tool additionally instructs you to program 2 keys to complete the process.

4. Turn the key to the OFF position and disconnect the scan tool.

5. **NOTE:** The RKE data transfer takes place between the key and the IPC first. After both keys are programmed into the IPC , then the RKE data transfers from the IPC to the SJB . Until the final data transfer takes place to the SJB , the RKE functions do not operate.

Insert the first PATS key into the ignition lock cylinder and turn the key to the ON position for a minimum of 6 seconds (this additional 3 second time frame allows for the RKE data transfer to take place).

6. Remove the first PATS key from the ignition lock cylinder.
7. Insert the second PATS key into the ignition lock cylinder and turn the key to the ON position for a minimum of 6 seconds.
8. Remove the second encoded key from the ignition lock cylinder.
9. The vehicle should now start with both ignition keys and the RKE transmitter portion of an IKT should function.
10. If it is desired to program additional key(s) (only up to 8 keys total can be programmed into the IPC), refer to Key Programming Using Two Programmed Keys in this section for each additional key that needs to be programmed.

Key Programming Switch State Control

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: The spare key programming switch is a programmable switch which provides the capability to enable/disable the normal customer spare key programming procedure detailed in the Owner's Literature. It must read ENABLE if more than 2 keys need to be programmed into the Instrument Panel Cluster (IPC). For additional information, refer to Key Programming Using Two Programmed Keys in this section. This programmable switch is provided as a convenience for rental company fleets or other fleet purchasers who may not want the spare key programming procedure available to the vehicle driver.

NOTE: The spare key programming switch state can be viewed with the IPC SPAREKEY PID.

NOTE: If the IPC SPAREKEY PID reads ENABLE, up to 8 keys total can be programmed into the IPC using the Key Programming Using Two Programmed Keys procedure in this section. If the SPAREKEY PID reads DISABLE, the Key Programming Using Two Programmed Keys procedure does not function. This switch is set to ENABLE when the vehicle is built. This PID only affects the Key Programming Using Two Programmed Keys procedure.

1. Insert a programmed Passive Anti-Theft System (PATS) key (or Integrated Keyhead Transmitter (IKT)) into the ignition lock cylinder and turn the key from the OFF position to the ON position.

2. From the scan tool, enter TOOLBOX. Select BODY-SECURITY-PATS Functions and follow the IDS on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.

3. **NOTE:** The default setting on delivery of all new vehicles is ENABLE, when viewing the IPC SPAREKEY PID.

   From the scan tool menu select: Customer Spare Key Programming Enable and follow the IDS on-screen instructions in order to complete the procedure.

   - CUSTOMER SPARE KEY PROGRAMMING ENABLE - spare key programming procedure is accessible.
   - CUSTOMER SPARE KEY PROGRAMMING DISABLE - spare key programming procedure is not accessible.

Spare Key Programming - Unlimited Key Mode

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Enabling Unlimited Key Mode

NOTE: Unlimited key mode is intended for use by those customers who need more than 8 keys for their vehicle.

NOTE: If unlimited key mode is enabled, a maximum of 4 Integrated Keyhead Transmitter (IKT) keys can be programmed to the vehicle for Remote Keyless Entry (RKE) functionality. If more keys are required, they shouandard Passive Anti-Theft System (PATS) keys. If more than 4 IKT keys are programmed to the vehicle, the Smart Junction Box (SJB) sets DTC B1138, and the IPC sets DTC B109E:42 (both DTCs indicate a memory full condition), and only 4 IKT keys have RKE functionality, however, all of them start the vehicle, if programmed correctly.

NOTE: Before programming, the new key(s) must have the correct mechanical cut for the ignition lock cylinder.

NOTE: The unlimited key mode is set up by creating a special, unique unlimited transponder security key code and programming this key code into all of the vehicle keys so they contain the same key code.

NOTE: When in the unlimited key mode, the N_KEYCODE PID always reads 2, no matter how many keys are programmed to the vehicle (after the first 2 keys have been programmed).

1. The customer must choose an 8-digit number (except for 00000000 or 00000001) to be programmed to all of their vehicles. All customer vehicles need to use the same number. Valid digits are 0-9 and the letters A-F.

2. **NOTE:** If the PID UNL_KEY_ID is not available, unlimited key mode is turned on and must be turned off before viewing the stored code. At this time, unlimited keys can be programmed to the vehicle. To view/disable/change the stored code, follow the procedure for disabling the unlimited key mode below.

   Monitor the PID UNL_KEY_ID and compare its value against the code chosen in Step 1. It should not be the same key code.

3. From the scan tool, enter TOOLBOX. Select BODY-SECURITY-PATS Functions and follow the IDS on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.

4. Once in security access, select: "program unlimited key code" and follow the IDS on-screen instructions. Enter the 8-digit code chosen by the customer in Step 1 of this procedure and follow the IDS on-screen instructions.

5. Select: "unlimited key mode ON" and follow the IDS on-screen instructions.
6. Select: "Ignition Key Code Erase" and follow the IDS on-screen instructions.
7. Disconnect the scan tool and turn the ignition switch to OFF.
8. Insert the first PATS key into the ignition lock cylinder and turn the key to the ON position for 3 seconds (6 seconds if it is an IKT key).
9. Remove the first PATS key from the ignition lock cylinder.
10. Insert the next PATS key into the ignition lock cylinder and turn the key to the ON position for 3 seconds (6 seconds for an IKT key).
11. If it is desired to program additional key(s), refer to Key Programming Using Two Programmed Keys in this section for each additional key that needs to be programmed.

Disabling Unlimited Key Mode

NOTE: By disabling the unlimited key mode, the previous access code no longer operates the vehicle.

1. From the scan tool, enter TOOLBOX. Select BODY-SECURITY-PATS Functions and follow the IDS on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.
2. Select: "unlimited key mode OFF" and follow the IDS on-screen instructions.
3. Select: "Ignition Key Code Erase" and follow the IDS on-screen instructions.
4. Disconnect the scan tool and turn the ignition switch to OFF.
5. Insert the first PATS key into the ignition lock cylinder and turn the key to the ON position for 3 seconds (6 seconds for an IKT key).
6. Remove the first PATS key from the ignition lock cylinder.
7. Insert the next PATS key into the ignition lock cylinder and turn the key to the ON position for 3 seconds (6 seconds for an IKT key).
8. **NOTE:** With the unlimited key mode turned off, a maximum of 8 keys can be programmed into the IPC using the Key Programming Using Two Programmed Keys procedure in this section. The IPC PID SPAREKEY must be enabled.

   If it is desired to program additional key(s), refer to Key Programming Using Two Programmed Keys in this section for each additional key that needs to be programmed.

Spare Key Programming - Using Diagnostic Equipment

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: This procedure is used when a customer needs to have an additional key programmed into the vehicle without erasing stored key codes, but 2 programmed keys are not available. This procedure is also useful when attempting to determine if an ignition key is damaged, as a new key can be installed without erasing keys or without having 2 programmed keys availablep>**NOTE:** Before programming, the new key must have the correct mechanical cut for the ignition lock cylinder.

NOTE: If 8 keys are already programmed, this procedure does not allow any more ignition keys to be programmed. The number of keys that are programmed into the Passive Anti-Theft System (PATS) can be determined by viewing the Instrument Panel Cluster (IPC) PID N_KEYCODE.

1. Turn the new key to be programmed from the OFF position to the ON position.

2. From the scan tool, enter TOOLBOX. Select BODY-SECURITY-PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.

3. **NOTE:** Make sure the selection made is "program additional ignition key". If the "Ignition Key Code Erase" selection is made, all of the keys are erased from the system.

   From the scan tool menu select: "program additional ignition key".

4. Turn the key to the OFF position and disconnect the scan tool.

5. Start the vehicle with the new PATS key. The vehicle now starts with the new PATS key and also with the original PATS keys. If it is an IKT key, verify the RKE functions (if there are 4 or fewer IKT keys programmed).

Anti-Theft Security Access

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: The anti-theft security access procedure is used to obtain Passive Anti-Theft System (PATS) security access. PATS security access must be granted to erase ignition key codes, program ignition key codes, enable/disable unlimited key mode, set unlimited transponder ID and enable/disable the spare key programming switch (Instrument Panel Cluster (IPC) PID SPAREKEY). The anti-theft security access procedure invokes a 10-minute time delay prior to granting security access during which the scan tool must remain connected to the vehicle. Once security access is granted, a security access command menu is displayed which offers various command options.

NOTE: Once security access has been granted, multiple security access commands can be executed (if necessary) prior to exiting the command menu. This avoids an additional security access procedure and the associated 10 minute time delay.

1. From the scan tool, enter TOOLBOX. Select: BODY-SECURITY-PATS Functions and follow the Integrated Diagnostic System (IDS) on-screen instructions to ENTER SECURITY ACCESS. This procedure takes approximately 10 minutes to carry out, during which time the ignition switch must be in the ON position and the scan tool must be connected to the vehicle.

2. After the 10-minute security access procedure is completed, follow the IDS on-screen instructions and a new menu is displayed with command options. Select only those functions required before exiting out of this menu. Do not select more functions than the procedure calls for. Once exited out of this menu, the security access procedure must be repeated again to carry out additional commands.

Passive Anti-Theft System (PATS) Parameter Reset

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

NOTE: A minimum of 2 Passive Anti-Theft System (PATS) keys must be programmed into the Instrument Panel Cluster (IPC) to complete this procedure and allow the vehicle to start.

1. Turn the key from the OFF position to the ON position.
2. From then tool, follow the on-screen instructions to ENTER SECURITY ACCESS. For additional information, refer to Anti-Theft Security Access in this section.
3. From the scan tool, select: Parameter Reset and follow the on-screen instructions.
4. **NOTE:** If the IPC or the IPC and the PCM were replaced, updated or reconfigured, follow Steps 4-9. All vehicle keys are erased during the parameter reset procedure. Verify at least 2 vehicle keys are available prior to carrying out the PATS parameter reset. If only the PCM was replaced, go to Step 9.

   From the scan tool, select: Ignition Key Code Erase and follow the on-screen instructions.
5. Turn the key to the OFF position and disconnect the scan tool.
6. Turn the key to the ON position for 6 seconds.
7. Turn the key to the OFF position and remove the key.
8. Insert the second PATS key into the ignition lock cylinder and turn the key to the ON position for 6 seconds.
9. Both keys now start the vehicle.
10. If more keys are required to be programmed, refer to Key Programming Using Two Programmed Keys in this section.

MyKey® Programming

Program a MyKey®

NOTE: After a MyKey® has been programmed, the remaining standard key(s) (the key[s] that is not programmed with the MyKey® feature) is referred to as an "administrator key(s)" or "admin" key(s). There must always be at least one admin key.

NOTE: The MyKey® feature can be cleared within the same key cycle that it was programmed. Follow the Clear MyKey® procedure in this section to clear the key of any restricted MyKey® status. If the key has been cycled, an admin key is required to clear the MyKey® programming.

1. Insert a programmed PATS ignition key into the ignition lock cylinder and turn the key from the OFF position to the RUN position. This key must be the one that is being programmed to the MyKey® restricted status.

   Using the message center buttons:

   1. Press the SETUP button until PRESS RESET TO CREATE MYKEY appears in the message center display.
   2. Press and release the RESET button. HOLD RESET TO CONFIRM MYKEY is displayed.
   3. Press and hold the RESET button (for approximately 2 seconds) until MARK THIS KEY AS RESTRICTED is displayed.
   4. Wait until KEY RESTRICTED AT NEXT START is displayed, then release the RESET button.

3. The MyKey® feature (standard restricted features) is successfully programmed into this particular key. Make sure it is labeled for easy identification. If you would like to customize the MyKey® with the audio volume limited, maximum speed limit, speed alert chimes, and AdvanceTrac® on/off restrictions, refer to Configuring MyKey® Optional Restricted Features in this section.
   - If the vehicle is equipped with remote start, also refer to Using MyKey® with Aftermarket Remote Start Systems in this section.

Configuring MyKey® Optional Restricted Features

1. To configure the MyKey® optional restricted features, carry out the following:
   1. Using an admin key that has not been programmed as a MyKey®, turn the ignition ON.
   2. Press and hold the SETUP button until RESET FOR MYKEY SETUP is displayed.
   3. Press and release the RESET button to display the MyKey® setup menus. The first programmable feature is: MYKEY MAX MPH OFF.
      - ♦ If you do not want to change the status of a feature that appears, press SETUP to accept the current setting and the message center displays the next feature.
      - ♦ If you want to change the status of the feature that is displayed, press RESET to turn a feature on/off (or toggle between choices). After the feature sele been made, press and release SETUP to accept and the message center displays the next feature.
   4. Repeat the process for the next features of:
      - ♦ MYKEY MPH TONES 45 55 65 (choose the desired speed for the chime to sound)
      - ♦ MYKEY VOLUME LIMIT OFF (choose the audio volume to be limited to 45%)
      - ♦ MYKEY ADVTRAC CTRL ON (choose for the AdvanceTrac® to be automatically locked on or able to be turned on or off by the MyKey® driver)

Clear MyKeyTM

1. **NOTE:** This procedure is used to clear the MyKey® feature on all of the keys that are programmed to the vehicle. All of the keys then operate as normal (admin) keys with no restrictions.

   Using an admin key, turn the ignition ON.

2. Press SETUP until PRESS RESET TO CLEAR MYKEY appears.

3. Press and release the RESET button until HOLD RESET TO CONFIRM CLEAR is displayed.

4. Press and hold the RESET button until ALL MYKEYS CLEARED is displayed.
   - A MyKey® can also be cleared during the same key cycle that it was programmed by following Steps 2, 3 and 4 of this procedure.

Using MyKey® with Aftermarket Remote Start System

Program Remote Start System as a MyKey®

1. Enter the vehicle and close all doors.

2. Remote start the vehicle using a remote start fob.

3. Follow Steps 1-3 of the Program a MyKey® procedure in this section.

Clear MyKey® with the Remote Start System

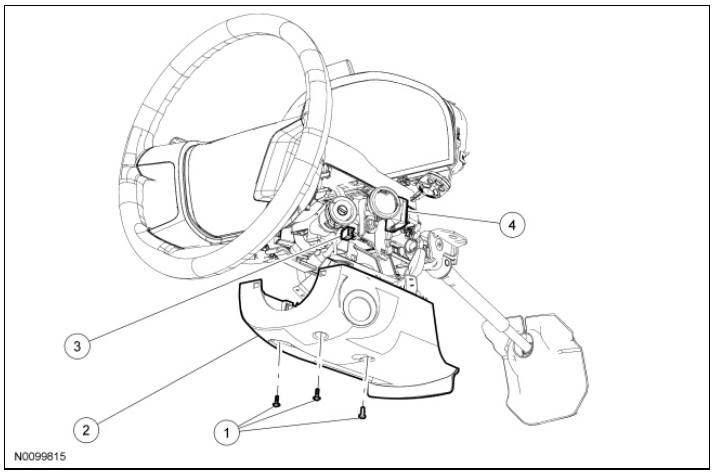
NOTE: It is possible to program all of the keys as MyKeys®, with the remote start system being the only admin key. This procedure clears MyKey® in the event of the aftermarket remote startng programmed as the only admin key.

1. Enter the vehicle and close all doors.

2. Remote start the vehicle using the remote start fob.

3. Follow Steps 1-4 of the Clear MyKey® procedure in this section.

Passive Anti-Theft System (PATS) Transceiver



Item	Part Number	Description
1	3K512	Steering column shroud screws (3 required)
2	3530	Steering column shroud (lower)
3	-	Passive Anti-Theft System (PATS) transceiver electrical connector (part of 14401)
4	15607	PATS transceiver

Removal and Installation

1. Remove the 3 screws and the lower steering column shroud.

2. Disconnect the electrical connector.

3. Using a suitable tool such as a dentist pick, pull the tangs outward and remove the Passive Anti-Theft System (PATS) transceiver.

4. **NOTE:** Replacement of the PATS transceiver does not require the PATS keys to be programmed into the Instrument Panel Cluster (IPC) again.

   To install, reverse the removal procedure.

Switch Settings

Switch Position	1	2	3	4	5	6	7	8	9	10	11	12
Up, + or On	Left	Left	Left	Left	Left	Left	Left	Left	Left	Left	Left	Left
Middle, 0 or Neutral	Middle	Middle	Middle	Middle	Middle	Middle	Middle	Middle	Middle	Middle	Middle	Middle
Down, - or Off	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right

Universal Transmitter

On early build vehicles, the universal transmitter can be identified by the Homelink® symbol and one red indicator light.

On late build vehicles, the universal transmitter uses the Lear Car2U® System. It is identified by the lack of a symbol, but with 3 red indicator lights. Each of the 3 buttons has a red indicator light located behind the 3 buttons.

The universal transmitter is an integral part of the LH sun visor and provides a convenient way to substitute up to 3 hand-held transmitters with a single built-in device. The universal transmitter can learn the radio frequency codes of most current transmitters. The universal transmitter:

- operates garage doors, gates and home/office lighting and security systems.
- learns and transmits the radio frequency of up to 3 hand-held transmitters from any of the systems mentioned above.
- is powered by the vehicle battery and charging system.

Universal Transmitter

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical	Electrical
• Universal transmitter	• Wiring, terminals or connectors

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The Universal Transmitter is Inoperative

Refer to Wiring Diagrams Cell 89 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Interior Lamps for schematic and connector information.

Normal Operation

The universal transmitter receives voltage through the battery saver relay power output circuit. The power and ground circuits are shared with the LH vanity mirror lamp.

When a programmed button is pressed on the universal transmitter, a wireless signal is sent to the receiver unit.

This pinpoint test is intended to diagnose the following:

- Interior lighting concerns
- Universal transmitter
- Receiver unit

PINPOINT TEST A: THE UNIVERSAL TRANSMITTER IS INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK THE LH SUN VISOR VANITY MIRROR OPERATION	
• Check the illumination of the LH sun visor vanity mirror lamps. • **Do the vanity mirror lamps illuminate?**	**Yes** GO to A2 . **No** REFER to Section 417-02 to continue diagnosis of the vanity mirror lamps.
A2 PROGRAM A HAND-HELD TRANSMITTER INTO THE UNIVERSAL TRANSMITTER	
• Program the universal transmitter. Refer to Universal Transmitter Programming in this section. • **Does the universal transmitter program successfully?**	**Yes** The universal transmitter is OK. VERIFY the receiver unit operates correctly by attempting to operate the device. **No** INSTALL a new LH sun visor assembly. REFER to Section 501-05 . TEST the system for normal operation.

Universal Transmitter Programming

Universal Transmitter Programming (Fixed Code) - Early Build (Homelink®)

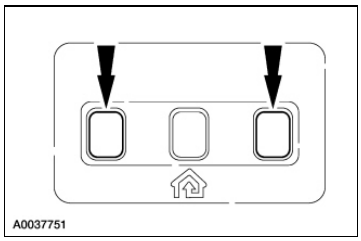
NOTE: A new battery in the hand-held transmitter may allow quicker and easier training due to a more accurate transmission of the radio frequency signal.

NOTE: This procedure is for early build vehicles only.

1. Verify the hand-held transmitter is operative by pressing a button and observing the illumination of the indicator on the hand-held transmitter.

2. Turn the ignition to the ON position.

3. Prepare for programming the universal transmitter by erasing all 3 channels by holding down the 2 outside buttons until the red light begins to flash (20-30 seconds). Release both buttons.

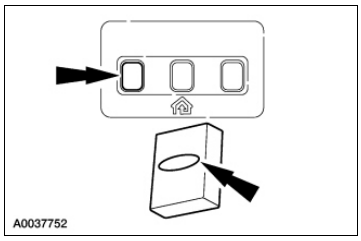


4. Select 1 of the 3 universal transmitter buttons to be used for programming.

5. Hold the end of the hand-held transmitter 25-51 mm (1-2 in) from the front surface of the universal transmitter so that the red light on the universal transmitter can still be seen.

6. **NOTE:** During programming, the hand-held transmitter may automatically stop transmitting after 2 seconds, which may not be long enough to program the universal transmitter. If programming with this type of hand-held transmitter, continue to hold the button on the universal transmitter while pressing and releasing the hand-held transmitter button every 2 seconds.

   At the same time, press the hand-held transmitter button and the desired button on the universal transmitter until the red light on the universal transmitter flashes first slowly, and then rapidly. Release both bons when the rapid flashing begins.



7. Firmly press and hold for 5 seconds and release the just-trained universal transmitter button up to 2 separate times to activate the garage door. If, after 2 separate times, the garage door still does not activate, press and hold the just-trained universal transmitter button and observe the red indicator light.

- If the red indicator light stays on constantly, the programming is complete and the device should activate when the universal transmitter button is pressed and released.
- If the red indicator light blinks rapidly for 2 seconds and then turns to a constant light, carry out the Training a Garage Door Opener Equipped With "Rolling Codes" - Early Build procedure to complete the programming of a rolling code-equipped device (most commonly a garage door opener).

Universal Transmitter Programming (Rolling Code) - Early Build (Homelink®)

NOTE: It may be helpful to have an assistant with this procedure.

1. At the garage door opener receiver (the motor-head unit) in the garage, locate the "learn" or "smart" button. This can usually be found near where the hanging antenna wire is attached to the motor-head unit; or it may be under the light bulb cover of the motor-head unit.

2. Turn the ignition to the ON position.

3. **NOTE:** Step 4 must be initiated within 30 seconds of pressing and releasing the "learn" or "smart" button.

   Firmly press and release the "learn" or "smart" button. (The name and cof the button may vary by manufacturer).

4. Return to the vehicle and firmly press, hold for 2 seconds and release the programmed universal transmitter button. Repeat the press/hold/release sequence a second time and depending on the brand of the garage door opener (or other rolling code-equipped device), repeat this sequence a third time to complete the programming process.

Universal Transmitter Programming (Rolling Code) - Late Build (Lear Car2U®)

⚠ WARNING: To avoid the risk of serious injury from the door closing, make sure that people and objects are clear of the garage door opener or security device that is being programmed. When programming a garage door, it is advised to park outside of the garage.

NOTE: Read the instructions completely before attempting to program the Lear Car2U® System. Because of the steps involved, it may be helpful to have an assistant when programming the universal transmitter. Programming the rolling code garage door opener involves time-sensitive actions. Read the entire procedure before beginning so the procedure can be carried out in a timely fashion. If the time-sensitive actions are not carried out in a timely fashion, the device times out and the procedure needs to be repeated.

NOTE: Make sure to keep the original remote control transmitter for use in other vehicles as well as for future Lear Car2U® System programming. It is only needed for fixed code device programming.

NOTE: This procedure is for rolling code devices. In order to determine if you have a fixed code or a rolling code device, open the garage door opener transmitter and if is a panel of coded dip switches present, the device is a fixed code device. If there are no coded dip switches present, the device is a rolling code device.

1. Turn the ignition to the ON position.

2. At the same time, firmly press the 2 outside Lear Car2U® System buttons for 1-2 seconds, then release the buttons.

3. **NOTE:** Step 4 must be initiated within 30 seconds of pressing and releasing the "learn" or "smart" button.

At the garage door opener receiver (the motor-head unit) in the garage, locate the "learn" or "smart" button. This can usually be found near where the hanging antenna wire is attached to the motor-head unit; or it may be under the light bulb cover of the motor-head unit.

- For technical assistance, refer to the Owner's Literature.

4. Return to the vehicle and firmly press and hold for 5-20 seconds the universal transmitter button that is desired to be programmed. During this time, the selected button red indicator light blinks slowly. Once the garage door begins to move, within one second, release the button. With the button released, the red indicator light begins to blink rapidly until programming is complete. Repeat the press/hold/release sequence a second time and depending on the brand of the garage door opener (or other rolling code equipped device), repeat this sequence a third time to complete the programming process.

5. After successful programming, the Lear Car2U® System operates the garage door opener using the button that was programmed. The red indicator light in front of the programmed button illuminates to confirm the Lear Car2U® System is responding (and is programmed) to the button command.

Erasing the Lear Car2U® System Buttons (Rolling Code) - Late Build

1. To erase the rolling code programming from the Lear Car2U® Sysrn the ignition key to the on position, firmly press and hold the 2 outside Lear Car2U® System buttons at the same time for approximately 20 seconds until the 3 red indicator lights begin to blink rapidly.

2. When the 3 red indicator lights begin to blink, release the buttons. The codes for all of the 3 buttons are erased.

Universal Transmitter Programming (Fixed Code) - Late Build (Lear Car2U®)

⚠ WARNING: To avoid the risk of serious injury from the door closing, make sure that people and objects are clear of the garage door opener or security device that is being programmed. When programming a garage door, it is advised to park outside of the garage.

NOTE: Do not use the Lear Car2U® System with any garage door opener that does not have a "stop and reverse" feature. This includes any garage door opener model manufactured before April 1, 1982.

NOTE: Read the instructions completely before attempting to program the Lear Car2U® System. Because of the steps involved, it may be helpful to have an assistant when programming the universal transmitter.

NOTE: Make sure to keep the original remote control transmitter for use in other vehicles as well as for future Lear Car2U® System programming. It is only needed for fixed code device programming.

NOTE: This procedure is for fixed code devices. In order to determine if you have a fixed code or a rolling code device, open the garage door opener transmitter and if there is a panel of coded dip switches present, the device is a fixed code device. If there are no coded dip switches present, the device is a rolling code dIf so, refer to the Training a Garage Door Opener Equipped With "Rolling Codes" - Late Build procedure.

NOTE: In order to program a fixed code device, paper and a pen or pencil is necessary.

1. **NOTE:** When a switch is in the Up, +, or On position, circle "Left". When a switch is in the Middle, 0 or Neutral position, circle "Middle". When a switch is in the Down, -, or Off position, circle "Right".

   Open the battery cover of the universal transmitter and record the dip switch settings from left to right

for all 8 to 12 switches. For additional information, refer to Specifications in this section.

2. Turn the ignition to the ON position.

3. To input these positions into the Lear Car2U® System, at the same time, press all 3 Lear Car2U® System buttons for a few seconds and then release to put the device into the programming mode. The 3 red indicator lights blink slowly. Within 2.5 minutes, enter the corresponding dip switch settings from left to right (starting with number 1) into the Lear Car2U® System by pressing and releasing the buttons corresponding to the settings you circled.
    - For example, if the dip switch settings were 1 (Left), 2 (Middle), 3 (Middle), 4 (Right), etc., press and release the left Lear Car2U® System button, then the middle button, then the middle button, then the right button, etc.

4. After inputting the dip switch settings, at the same time, press and release all 3 Lear Car2U® System buttons. The 3 red indicator lights are turned on continuously.

5. Press and hold the Lear Car2U® System button you would like to use to control the garage door.

6. Once the garage door starts to move, within one second, release the button. During this time, the selected button indicator light blinks slowly. Do not release the button until the garage door movesmay take anywhere from 5-55 seconds, depending on the make/model of the garage door opener.

7. The 3 red indicator lights begin to blink rapidly until programming is complete. If the garage door opener does not operate, repeat Steps 1-6.
    - For technical assistance, refer to the Owner's Literature.

8. After successful programming, the Lear Car2U® System operates the garage door opener using the button that was programmed. The red indicator light in front of the programmed button turns on to confirm the Lear Car2U® System is responding (and is programmed) to the button command.

Erasing the Lear Car2U® System Buttons (Fixed Code) - Late Build

1. To erase the fixed code programming from the Lear Car2U® System, turn the ignition key to the on position, firmly press and hold the 2 outside Lear Car2U® System buttons at the same time for approximately 20 seconds until the 3 red indicator lights begin to blink rapidly.

2. When the 3 red indicator lights begin to blink, release the buttons. The codes for all of the 3 buttons are erased.

Cruise Control

The cruise control system consists of the following components:

- Cruise control switches
- Cruise control deactivator switch (part of the stoplamp switch)
- Stoplamp switch
- Cruise control indicator
- Clutch pedal cruise control deactivator switch (manual transaxle)
- PCM
- Electronically-controlled throttle body
- Clockspring

The cruise control system is electronically controlled by the PCM. The cruise control system is designed to maintain a selected vehicle speed between 40 km/h (25 mph) and the maximum limited vehicle speed.

During normal driving, the vehicle speed may vary slightly from the set speed due to road conditions. The vehicle speed may fluctuate when driving up and down a steep hill. If the vehicle speed decreases more than 16 km/h (10 mph) below the set speed, the cruise control disengages.

Cruise Control

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit 300-NUD105-R025DE or equivalent

Principles of Operation

The cruise control system is controlled by the PCM. The cruise control system is designed to maintain a selected vehicle speed above 37 km/h (23 mph) to the maximum limited vehicle speed. The cruise control system is controlled by the steering wheel mounted switches, the stoplamp switch, the clutch pedal cruise control deactivator switch (manual transaxle), and the cruise control deactivator switch (part of the stoplamp switch). The steering wheel mounted switches are hardwired to the PCM through the clockspring.

Pressing and releasing the ON switch turns the cruise control system on. Pressing and releasing the SET+ or SET- switch while the vehicle is traveling at the desired speed activates the cruise control system.

For early build vehicles, the cruise control indicator in the Instrument Panel Cluster (IPC) illuminates when the system is engaged. For late build vehicles, the cruise control system has 2 indicators in the IPC . The cruise control amber indicator illuminates when the system is on. The cruise control green indicator illuminates when the system is engaged.

Tapping the SET+ or the SET- switch while in the set mode increases or decreases the maintained vehicle speed by 1.6 km/h (1 mph) per tap. If the respective switch is pressed and held, the vehicle speed continues to accelerate or decelerate until the switch is released.

Pressing and releasing the OFF switch, or switching the ignition switch to the OFF position, turns the cruise control system off. Applying the brake pedal or the clutch pedal (manual transaxle) puts the cruise control system into the standby mode. Pressing the RESUME or RSM switch when the cruise control system is in the standby mode causes the vehicle to accelerate to the last set speed. Resume does not function if the OFF switch is pressed, the ignition switch is in the OFF position, or if the current vehicle speed is below the minimum operational speed.

The clutch pedal cruise control deactivator switch is incorporated on vehicles equipped with a manual transaxle. When the clutch pedal is applied with the vehicle cruise control system engaged, the normally closed switch opens and signals the PCM to deactivate the cruise control.

Whenever the cruise control system is engaged and active, a cruise control icon on the IPC is illuminated.

The cruise control deactivator switch (part of the stoplamp switch) is provided as an additional safety feature. When the brake pedal is pressed, an electrical signal is sent from the stoplamp switch to the PCM to deactivate the cruise control system. The PCM sends a message to the IPC and the illuminated cruise control icon is turned off. Under increased brake pedal effort, the deactivator switch opens and removes the voltage signal from the PCM input circuit, deactivating the cruise control system.

The clockspring provides the electrical interface between the steering column wiring and the cruise control switches in the steering wheel.

The inputs to the PCM are:

- Output Shaft Speed (OSS) sensor
- Digital Transmission Range (TR) sensor (automatic transaxle)
- Cruise control switch
- Clutch pedal cruise control deactivator switch (manual transaxle)
- Cruise control deactivator switch (part of the stoplamp switch)
- Accelerator pedal position sensor
- Parking brake

The outputs of the PCM are:

- Cruise control indicator lamp
- Throttle command

The cruise control system throttle position is completely controlled by the PCM through the electronically controlled throttle body. Cruise control electronics are contained entirely within the PCM.

For non-hybrid vehicles, when the cruise control system is active, the PCM corrects for deviations in the actual vehicle speed by proportionally moving the throttle plate. The PCM modulates the throttle to minimize error between actual and desired vehicle speed. The PCM strategy uses the throttle control for smooth accelerations.

For hybrid vehicles, when the electric traction motor is powering the vehicle and the cruise control is active, the electronic actuator corrects for deviations in the actual vehicle speed by proportionally applying wheel torque. The control electronics modulate the wheel torque to minimize error between the actual vehicle speed and the desired speed.

The PCM sends a message over the Controller Area Network (CAN) to the IPC whenever the cruise control indicator should be turned on or off.

For non-hybrid vehicles, in the event of an off command or a deactivation request from any source, the cruise control system carries out a deactivation and immediately returns the throttle to the idle position.

For hybrid vehicles, in the event of an off command or a deactivation request from any source except a brake pedal tap, the system carries out a hard deactivation and immediately returns control to the accelerator pedal.

The cruise control system provides self-diagnostics. Cruise control is disabled anytime an error is detected in the system. No IPC indicator or message center messages are displayed when faults occur. Fault codes are logged by the PCM.

An Electronic Throttle Control (ETC) system fault also causes the cruise control system to be disabled. In this case, an ETC system warning indicator or message center message is displayed.

Additionally, the following conditions cause the cruise control system to deactivate:

- Transmission gear selector in a position other than D or OD (automatic transaxle)
- Vehicle clutch pedal is applied (manual transaxle)
- Cruise control set speed is over-ridden with the accelerator pedal for a period longer than 5 minutes
- Vehicle speed loss from set speed of greater than 16 km/h (10 mph) occurs
- Vehicle speed falls below the minimum allowable limit of 37 km/h (23 mph)
- Cruise control switch is pressed or stuck for longer than 2 minutes
- ABS fault

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
• Throttle body • Stoplamp Switch	• Battery Junction Box (BJB) fuse(s): ♦ 49 (15A), 2.5L or 3.0L engine ♦ 49 (20A), 3.5L engine • Wiring, terminals or connectors • Cruise control switch • Clutch pedal cruise control deactivator switch (manual transaxle) • Stoplamp switch • PCM

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

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

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

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

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
    - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
    - If the network test passes, retrieve and record the continuous memory DTCs.
8. Clear the continuous DTCs and carry out the self-test diagnostics for the PCM.
9. If the DTCs retrieved are related to the concern, go to DTC Charts. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in Section 419-10 .
10. If no DTCs related to the concern are retrieved, GO to Symptom Chart .

DTC Charts

PCM DTC Chart

DTCs	Description	Action
P0572	Brake Switch A Circuit Low	GO to Pinpoint Test B .
P0573	Brake Switch A Circuit High	GO to Pinpoint Test B .
P0579	Cruise Control Multifunction Input A Circuit Range/Performance	GO to Pinpoint Test C .
P0581	Cruise Control Multifunction Circuit High	GO to Pinpoint Test C .
P1703	Brake Switch Out of Self-Test Range	GO to Pinpoint Test B .
All other DTCs	-	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis.

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The Cruise Control Is Inoperative

Refer to Wiring Diagrams Cell 31 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Speed Control for schematic and connector information.

Normal Operation

A reference voltage is sent from the PCM to the steering wheel cruise control switches. When a switch is pressed, the voltage is routed through a specific resistor value for each function. The PCM provides the ground for the reference voltage. The PCM uses this reference voltage to determine which control input function has been selected. When the brake pedal is applied the PCM deactivates the cruise control, if engaged.

The cruise control deactivator switch (part of the stoplamp switch) interrupts the voltage signal to the PCM when the brake pedal is applied. This is a redundant signal to the PCM.

Vehicles equipped with a manual transaxle have an additional clutch pedal cruise control deactivator switch. The clutch pedal cruise control deactivator switch provides a ground signal to the PCM. When the clutch pedal is applied, the normally closed clutch pedal cruise control deactivator switch opens and removes the ground signal to the PCM which deactivates the cruise control, if engaged.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- PCM not configured for cruise control
- Stoplamp switch
- Clutch pedal cruise control deactivator switch
- Cruise control switch
- Digital Transmission Range (TR) sensor
- Vehicle speed signal
- ABS fault
- PCM
- Transmission Control Module (TCM)

PINPOINT TEST A: THE CRUISE CONTROL IS INOPERATIVE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
A1 VERIFY PCM CONFIGURATION	
• Enter the following diagnostic mode on the scan tool: Programmable Parameters. • Verify that the cruise control is enabled in the PCM. • **Is the cruise control enabled?**	**Yes** GO to A2 . **No** ENABLE the cruise control in the PCM using the scan tool programmable parameters menu. TEST the system for normal operation.
A2 CHECK FOR PCM DTCs	
• Review the recorded DTCs from the PCM self-test. • **Are any non-cruise control DTCs recorded?**	**Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. REPAIR all PCM DTCs and RETEST the cruise control. **No** GO to A3 .
A3 CHECK FOR ABS DTCs	
• Review the recorded DTCs from the ABS self-test. • **Are any DTCs recorded?**	**Yes** REFER to the Section 206-09 . REPAIR all ABS DTCs and RETEST the cruise control system for normal operation.

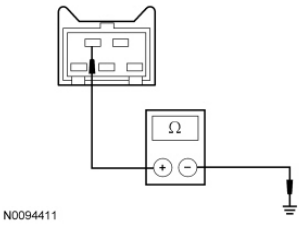
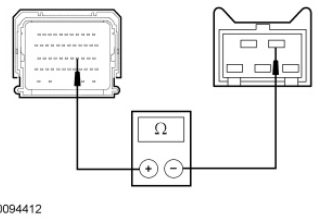
	No GO to A4 .
A4 CHECK THE VEHICLE SPEED	
• Check for correct operation of the speedometer. • **Does the speedometer operate correctly?**	**Yes** For 3.5L engines, GO to A6 . Otherwise, GO to A5 . **No** REFER to the Section 413-01 to diagnose the speedometer.
A5 CHECK THE STOPLAMP SWITCH (BOO1 AND BOO2) PIDs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: PCM DataLogger. • Monitor the PCM PIDs BOO1 (brake pedal top travel) and BOO2 (brake pedal bottom travel) while applying and releasing the brake pedal as follows: • **Do the PID values agree with the brake pedal positions?**	**Yes** If equipped with an automatic transaxle, GO to A9 . If equipped with a manual transaxle, GO to A7 . **No** GO to Pinpoint Test B .
A6 CHECK THE STOPLAMP SWITCH (BOO AND BPA) PIDs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: PCM DataLogger. • Monitor the PCM PIDs BOO (brake pedal top travel) and BPA (brake pedal bottom travel) while applying and releasing the brake pedal as follows:	**Yes** GO to A8 . **No** GO to Pinpoint Test B .

Brake Pedal Position	BOO1 PID	BOO2 PID
Released	Off	Off
Applied firmly	On	On

Brake Pedal Position	BOO PID	BPA PID
Released	Off	Off
Applied firmly	On	On

• **Do the PID values agree with the brake pedal positions?**	
A7 CHECK THE CLUTCH PEDAL CRUISE CONTROL DEACTIVATOR SWITCH (CPP_TOP) PID	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger. • Monitor the PCM PID (CPP_TOP) while pressing and releasing the clutch pedal. • **Does the PID value read NO with the clutch pedal released and YES with the clutch pedal applied?**	**Yes** GO to A10 . **No** GO to A11 .
A8 MONITOR THE TCM TR PID	
• Enter the following diagnostic mode on the scan tool: TCM DataLogger. • Monitor the TCM PID (TR). • Select DRIVE. • **Does the PID value agree with the TR selector lever position?**	**Yes** GO to A10 . **No** REFER to Section 307-01A to continue diagnosis of the digital TR sensor.
A9 MONITOR THE PCM TR PID	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger. • Monitor the PCM PID (TR). • Select DRIVE. • **Does the PID value agree with the TR selector lever position?**	**Yes** GO to A10 . **No** REFER to Section 307-01B or Section 307-01C to continue diagnosis of the digital TR sensor.
A10 CHECK THE CRUISE CONTROL SWITCH	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger. • Press each cruise control switch while monitoring the cruise control switch PID (SCCS).	**Yes** GO to A13 . **No** If only one switch does not display the correct PID value, INSTALL a new cruise control switch. REFER to Cruise Control Switch in this section. TEST the system for normal operation. Otherwise, GO to Pinpoint Test C .

Cruise Control Switch	SCCS PID Value
-	NONE Pressed
RESUME (non-hybrid)	RESUME
RSM (hybrid)	RESUME
CNCL RSM (late build)	RESUME
OFF	Off
ON	On
ON OFF (late build)	On/Off
SET +	SET/+
SET -	SET/-

• **Does the PID value agree with thewitch position?**	
A11 CHECK THE CLUTCH PEDAL CRUISE CONTROL DEACTIVATOR SWITCH GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Clutch Pedal Cruise Control Deactivator Switch C2070. • Disconnect: Negative Battery Cable. • Measure the resistance between the clutch pedal cruise control deactivator switch C2070-5, circuit GD120 (BK/GN), harness side and ground.  • **Is the resistance less than 5 ohms?**	**Yes** GO to A12 . **No** REPAIR the circuit. TEST the system for normal operation.
A12 CHECK THE CLUTCH PEDAL CRUISE CONTROL DEACTIVATOR SWITCH CIRCUIT FOR AN OPEN	
• Disconnect: PCM C175t. • Measure the resistance between the PCM C175t-27, circuit CE904 (GN/VT), harness side and the clutch pedal cruise control deactivator switch C2070-4, circuit CE904 (GN/VT), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new clutch pedal cruise control deactivator switch. REFER to Cruise Control Deactivator Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
A13 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No**

• Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: DTC P0572, P0573 Or P1703

Refer to Wiring Diagrams Cell 31 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Speed Control for schematic and connector information.

Normal Operation

When the brake pedal is applied, the normally open stoplamp switch closes and sends a voltage to the PCM disengaging the cruise control.

The normally closed cruise control deactivator switch (part of the stoplamp switch), opens and removes the voltage signal to the PCM when the brake pedal is applied firmly. This is a redundant cruise control deactivation signal to the PCM.

- DTC P0572 (Brake Switch A Circuit Low) - sets when the PCM senses a short to ground in the stoplamp switch circuits.
- DTC P0573 (Brake Switch A Circuit High) - sets when the PCM senses a open or a short to voltage in the stoplamp switch circuits.
- DTC P1703 (Brake Switch Out Of Self Test Range) - sets when there is an open or short in the deactivator switch circuits or when there is an open or short in the stoplamp circuits when the PCM self test is carried out.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors

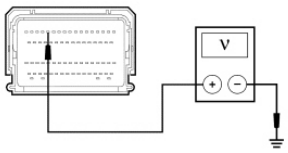
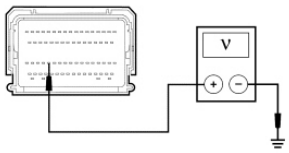
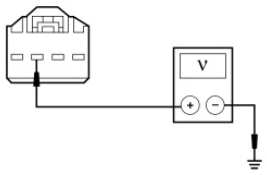
- ABS module
- PCM

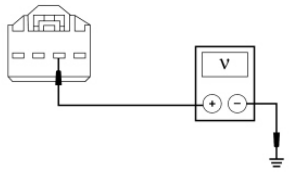
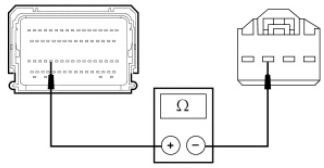
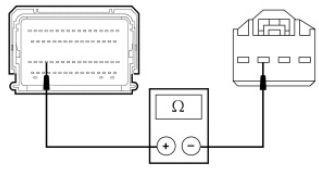
PINPOINT TEST B: DTC P0572, P0573 OR P1703

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CHECK THE OPERATION OF THE STOPLAMPS	
• Ignition ON. • Operate the stoplamps. • **Do the stoplamps operate correctly?**	**Yes** GO to B2 . **No** REFER to Section 417-01 to continue diagnosis of the stoplamps.
B2 CHECK FOR ABS DTCs	
	Yes

• Review the recorded DTCs from the ABS self-test. • **Are any DTCs recorded?**	REFER to Section 206-09 . REPAIR all ABS module DTCs and RETEST the cruise control. **No** For 3.5L engines, GO to B3 . Otherwise, GO to B4 .
B3 CHECK THE STOPLAMP SWITCH (BOO AND BPA) PIDs	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger. • Monitor the PCM PIDs BOO (brake pedal top travel) and BPA (brake pedal bottom travel) while applying and releasing the brake pedal as follows: **Brake Pedal Position** / **BOO PID** / **BPA PID** Released / Off / Off Applied firmly / On / On • **Do the PID values agree with the brake pedal position?**	**Yes** GO to B9 . **No** For an incorrect BOO1 PID value, GO to B5 . If the BOO2 PID value reads On, GO to B7 . If the BOO2 PID value reads OFF, GO to B6 .
B4 CHECK THE STOPLAMP SWITCH (BOO1 AND BOO2) PIDs	
• Enter the following diagnostic mode on the scan tool: PCM DataLogger. • Monitor the PCM PIDs BOO1 (brake pedal top travel) and BOO2 (brake pedal bottom travel) while applying and releasing the brake pedal as follows: **Brake Pedal Position** / **BOO1 PID** / **BOO2 PID** Released / Off / Off Applied firmly / On / On • **Do the PID values agree with the brake pedal position?**	**Yes** GO to B9 . **No** For an incorrect BOO1 PID value, GO to B5 . If the BOO2 PID value reads On, GO to B7 . If the BOO2 PID value reads OFF, GO to B6 .
B5 CHECK THE STOPLAMP SWITCH CIRCUIT FOR VOLTAGE	
• Ignition OFF. • Disconnect: PCM C175b. • Ignition ON. • For vehicles with 2.5L and 3.0L engines, while applying the brake pedal, measure the voltage between the PCM C175b-13, circuit CCB08 (VT/WH), harness side and	**Yes** GO to B9 . **No** REPAIR the circuit for an open. CLEAR the DTCs. TEST the system for normal operations.

ground.  N0077669 • For vehicles with 3.5L engines, while applying the brake pedal, measure the voltage between the PCM C175b-46, circuit CCB08 (VT/WH), harness side and ground.  N0038827 • **Is the voltage greater than 10 volts with the brake pedal applied and 0 volts with the brake pedal released?**	
B6 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH CIRCUIT FOR A SHORT TO VOLTAGE	
• Disconnect: Stoplamp Switch C278. • Measure the voltage between the stoplamp switch C278-3, circuit CES09 (VT/OG), harness side and ground.  N0094436 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operations. **No** INSTALL a new stoplamp switch. REFER to Section 417-01 . CLEAR the DTCs. TEST the system for normal operations.
B7 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Disconnect: Stoplamp Switch C278. • Measure the voltage between the stoplamp switch C278-2, circuit CBK02 (GN), harness side and ground.	**Yes** GO to B8 . **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operations.

 N0038829 • **Is the voltage greater than 10 volts?**	
B8 CHECK THE CRUISE CONTROL DEACTIVATOR SWITCH CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: PCM C175b. • For vehicles with 2.5L and 3.0L engines, measure the resistance between the PCM C175b-46, circuit CES09 (VT/OG), harness side and the stoplamp switch C278-3, circuit CES09 (VT/OG), harness side.  N0085686 • For vehicles with 3.5L engines, measure the resistance between the PCM C175b-47, circuit CES09 (VT/OG), harness side and the stoplamp switch C278-3, circuit CES09 (VT/OG), harness side.  N0038831 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new stoplamp switch. REFER to Section 417-01 . CLEAR the DTCs. TEST the system for normal operations. **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operations.
B9 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: The Cruise Control Switches Do Not Operate Correctly

Refer to Wiring Diagrams Cell 31 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Speed Control for schematic and connector information.

Normal Operation

Voltage is sent from the PCM to the cruise control switches. When a switch is pressed, the voltage is routed through a specific resistor value for each function and the PCM grounds the reference voltage. The PCM uses this reference voltage to determine which cruise control input function has been selected.

- DTC P0579 (Cruise Control Multifunction Input A Circuit Range/Performance) - sets when the cruise control switch circuits are open, shorted to voltage or ground.
- DTC P0581 (Cruise Control Multi-Function Input A Circuit High) - sets when the cruise control switch circuits are open or shorted to voltage.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Clockspring
- Cruise control switches
- PCM

&;

PINPOINT TEST C: THE CRUISE CONTROL SWITCHES DO NOT OPERATE CORRECTLY

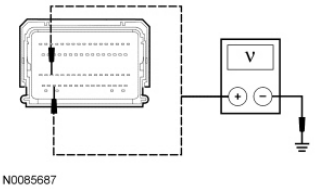
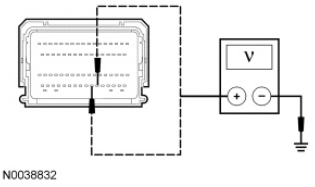
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

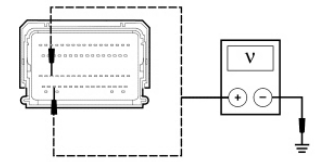
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>C1 CHECK THE CRUISE CONTROL SWITCH</td><td></td></tr>
<tr><td>• Enter the following diagnostic mode on the scan tool: PCM DataLogger.
• Press each cruise control switch while monitoring the cruise control switch PID (SCCS).

<table><tr><th>Cruise Control Switch</th><th>SCCS PID Value</th></tr><tr><td>-</td><td>NONE Pressed</td></tr><tr><td>RESUME (non-hybrid)</td><td>RESUME</td></tr><tr><td>RSM (hybrid)</td><td>RESUME</td></tr><tr><td>CNCL RSM (late build)</td><td>RESUME</td></tr><tr><td>OFF</td><td>Off</td></tr><tr><td>ON</td><td>On</td></tr><tr><td>ON OFF (late build)</td><td>On/Off</td></tr><tr><td>SET +</td><td>SET/+</td></tr><tr><td>SET -</td><td>SET/-</td></tr></table></td><td>Yes
GO to C11 .

No
If only one switch does not display the correct PID value, INSTALL a new cruise control switch. REFER to Cruise Control Switch in this section. TEST the system for normal operation.

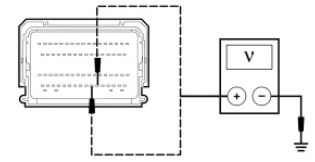
Otherwise, GO to C2 .</td></tr>
</table>

• **Does the PID value agree with the switch position?**	
C2 CHECK THE CRUISE CONTROL SWITCH CIRCUITRY FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: PCM C175b. • Ignition ON. • Turn the parking lamps on. • For vehicles with 2.5L and 3.0L engines, measure the voltage between the PCM C175b-64, circuit VES10 (WH), harness side and ground; and between the PCM C175b-48, circuit RES08 (GN/BN), harness side and ground.  N0085687 • For vehicles with 3.5L engines, measure the voltage between the PCM C175b-56, circuit VES10 (WH), harness side and ground; and between the PCM C175b-57, circuit RES08 (GN/BN), harness side and ground.  N0038832 • **Is any voltage present?**	**Yes** TURN the parking lamps off. GO to C3 . **No** TURN the parking lamps off. GO to C6 .
C3 CHECK THE CRUISE CONTROL SWITCH CIRCUITRY FOR A SHORT TO VOLTAGE WITH THE CLOCKSPRING DISCONNECTED	
• Ignition OFF. • Disconnect: Clockspring C218a. • Ignition ON. • For vehicles with 2.5L and 3.0L engines, measure the voltage between the PCM C175b-64, circuit VES10 (WH), harness side and ground; and between the PCM C175b-48, circuit RES08 (GN/BN), harness side and ground.	**Yes** REPAIR the circuit in question. CLEAR the DTCs. TEST the system for normal operation. **No** GO to C4 .



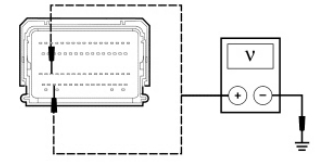
N0085687

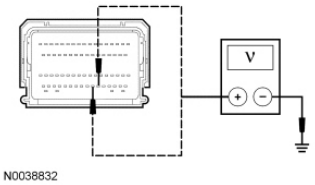
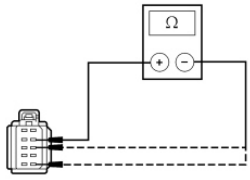
- For vehicles with 3.5L engines, measure the voltage between the PCM C175b-56, circuit VES10 (WH), harness side and ground; and between the PCM C175b-57, circuit RES08 (GN/BN), harness side and ground.

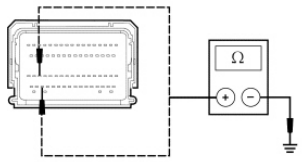
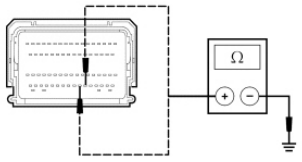
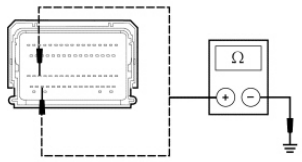
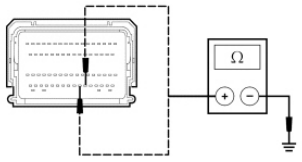


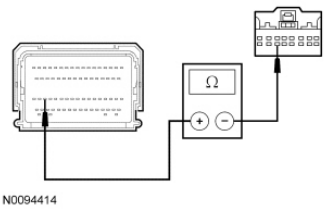
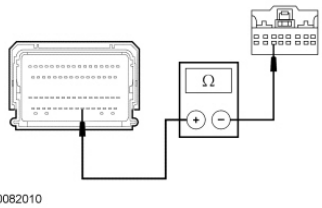
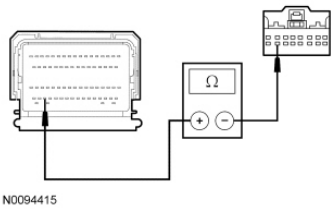
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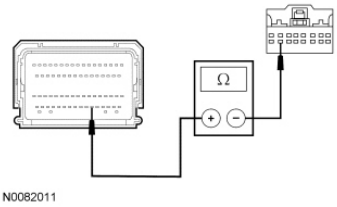
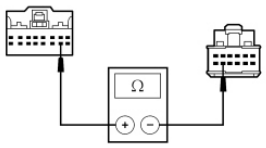
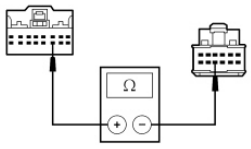
- **Is any voltage present?**

C4 CHECK THE CLOCKSPRING FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Connect: Clockspring C218a. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Remove the driver air bag module. Refer to Section 501-20B . • Disconnect: Upper Clockspring Connector C218b. • Connect the battery. • Ignition ON. • Turn the parking lamps on. • For vehicles with 2.5L and 3.0L engines, measure the voltage between the PCM C175b-64, circuit VES10 (WH), harness side and ground; and between the PCM C175b-48, circuit RES08 (GN/BN), harness side and ground.  N0085687 • For vehicles with 3.5L engines, measure the voltage between the PCM C175b-56, circuit VES10 (WH), harness side and ground; and between the PCM C175b-57, circuit RES08 (GN/BN), harness side and ground.	**Yes** INSTALL a new clockspring. INSTALL the driver air bag module. REFER to Section 501-20B . CLEAR the DTCs. TEST the system for normal operation. **No** GO to C5 .

 N0038832 • **Is any voltage present?**	
C5 CHECK THE STEERING WHEEL CRUISE CONTROL SWITCH CIRCUITS FOR A SHORT TO THE STEERING WHEEL ILLUMINATION CIRCUIT	
• Measure the resistance between the steering wheel cruise control switch C2998-2, circuit VLN04 (VT/GY), harness side and the steering wheel cruise control switch C2998-3, circuit RES08 (GN/BN), harness side; and between the steering wheel cruise control switch C2998-2, circuit VLN04 (VT/GY), harness side and the steering wheel cruise control switch C2998-5, circuit VES10 (WH), harness side.  N0094413 • **Are the resistances greater than 10,000?**	**Yes** INSTALL a new cruise control switch. REFER to Cruise Control Switch in this section. INSTALL the driver air bag module. REFER to Section 501-20B . CLEAR the DTCs. TEST the system for normal operation. **No** INSTALL a new steering wheel. REFER to Section 211-04 . CLEAR the DTCs. TEST the system for normal operation.
C6 CHECK THE CRUISE CONTROL SWITCH CIRCUITRY FOR A SHORT TO GROUND	
• Ignition OFF. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Remove the driver air bag module. Refer to Section 501-20B . • Disconnect: Upper Clockspring Connector C218b. • For vehicles with 2.5L and 3.0L engines, measure the resistance between the PCM C175b-64, circuit VES10 (WH), harness side and ground; and between the PCM C175b-48, circuit RES08 (GN/BN), harness side and ground.	**Yes** GO to C8 . **No** GO to C7 .

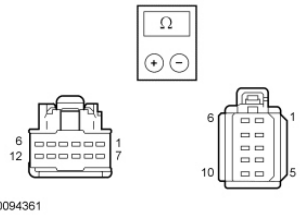
 N0085688 • For vehicles with 3.5L engines, measure the resistance between the PCM C175b-56, circuit VES10 (WH), harness side and ground; and between the PCM C175b-57, circuit RES08 (GN/BN), harness side and ground.  N0038833 • **Are the resistances greater than 10,000 ohms?**	
C7 CHECK THE CLOCKSPRING FOR A SHORT TO GROUND	
• Disconnect: Clockspring C218a. • For vehicles with 2.5L and 3.0L engines, measure the resistance between the PCM C175b-64, circuit VES10 (WH), harness side and ground; and between the PCM C175b-48, circuit RES08 (GN/BN), harness side and ground.  N0085688 • For vehicles with 3.5L engines, measure the resistance between the PCM C175b-56, circuit VES10 (WH), harness side and ground; and between the PCM C175b-57, circuit RES08 (GN/BN), harness side and ground.  N0038833 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new clockspring. INSTALL the driver air bag module. REFER to Section 501-20B . CLEAR the DTCs. TEST the system for normal operation. **No** GO to C10 .

C8 CHECK THE CRUISE CONTROL SWITCH CIRCUITRY FOR AN OPEN	
• Disconnect: Clockspring C218a. • For vehicles with 2.5L and 3.0L engines, measure the resistance between the PCM C175b-48, circuit RES08 (GN/BN), harness side and the clockspring C218a-14, circuit RES08 (GN/BN), harness side.  N0094414 • For vehicles with 3.5L engines, measure the resistance between the PCM C175b-57, circuit RES08 (GN/BN), harness side and the clockspring C218a-14, circuit RES08 (GN/BN), harness side.  N0082010 • For vehicles with 2.5L and 3.0L engines, measure the resistance between the PCM C175b-64, circuit VES10 (WH), harness side and the clockspring C218a-15, circuit VES10 (WH), harness side.  N0094415 • For vehicles with 3.5L engines, measure the resistance between the PCM C175b-56, circuit VES10 (WH), harness side and the clockspring C218a-15, circuit VES10 (WH), harness side.	**Yes** GO to C9 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

 N0082011 • **Are the resistances less than 5 ohms?**	
C9 CHECK THE CLOCKSPRING FOR AN OPEN	
• Disconnect: Clockspring C218b. • ⚠ **WARNING: Make sure no one is in the vehicle and there is nothing blocking or placed in front of any air bag module when the battery is connected. Failure to follow these instructions may result in serious personal injury in the event of an accidental deployment.** • Remove the driver air bag module. Refer to Section 501-20B . • Measure the resistance between the clockspring C218a pin 15, component side and the upper clockspring C218b pin 8, component side.  N0094416 • Measure the resistance between the clockspring C218a pin 14, component side and the upper clockspring C218b pin 9, component side.  N0094417 • **Are the resistances less than 5 ohms?**	**Yes** GO to C10 . **No** INSTALL a new clockspring. INSTALL the driver air bag module. REFER to Section 501-20B . CLEAR the DTCs. TEST the system for normal operation.
C10 CHECK THE CIRCUITS TO THE STEERING WHEEL CRUSIE CONTROL SWITCH CIRCUITRY FOR AN OPEN OR SHORT TO GROUND	
NOTE: Circuit RES08 (GN/BN) does not need to be checked for a short to ground. • Ignition OFF. • Measure the resistance between the clockspring, harness side and the steering wheel controls, harness side; and between the clockspring, harness side and ground as follows:	**Yes** INSTALL a new cruise control switch. REFER to Cruise Control Switch in this section. INSTALL the driver air bag module. REFER to Section 501-20B . CLEAR the DTCs. TEST the system for normal

	operation. **No** INSTALL a new steering wheel. REFER to Section 211-04 . CLEAR the DTCs. TEST the system for normal operation.

Inoperative Switch	Positive Meter Lead	Negative Meter Lead	Circuit
Cruise control switch	C218b-8 C218b-9	C2998-5, then ground C2998-3	VES10 (WH) RES08 (GN/BN)



N0094361

- **Is the resistance less than 5 ohms between the clockspring and the steering wheel controls, and greater than 10,000 ohms between the clockspring and ground?**

C11 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . INSTALL the driver air bag module. REFER to Section 501-20B . TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. INSTALL the driver air bag module. REFER to Section 501-20B . CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test D: The Cruise Control Does Not Disengage When The Clutch Is Applied

Refer to Wiring Diagrams Cell 31 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Speed Control for schematic and connector information.

Normal Operation

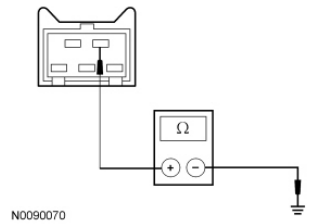
Vehicles equipped with a manual transaxle have an additional clutch pedal cruise control deactivator switch. The PCM receives a ground signal through the normally closed clutch pedal cruise control deactivator switch. When the clutch pedal is applied, the clutch pedal cruise control deactivator switch opens and removes the ground signal to the PCM disengaging the cruise control.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Clutch pedal cruise control deactivator switch
- PCM

PINPOINT TEST D: THE CRUISE CONTROL DOES NOT DISENGAGE WHEN THE CLUTCH IS APPLIED

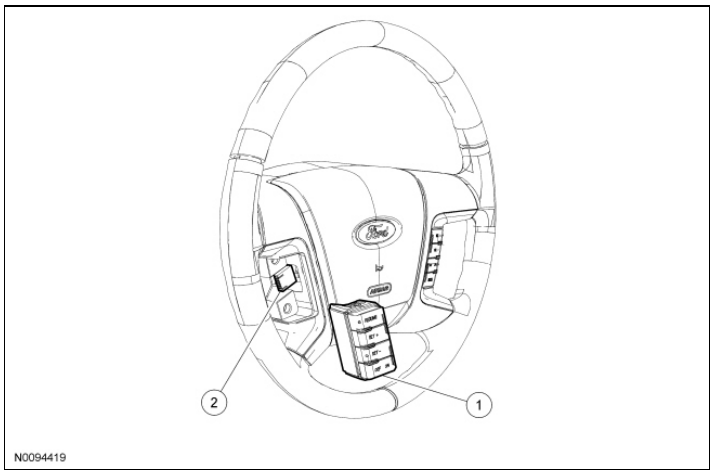
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
D1 CHECK THE CPP SWITCH (CPP_TOP) PID	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: PCM DataLogger. • While applying and releasing the clutch pedal monitor the PCM PID (CPP_TOP). • **Does the PID value read NO with the clutch pedal released and YES with the clutch pedal applied?**	**Yes** GO to D4 . **No** GO to D2 .
D2 CHECK THE CLUTCH PEDAL CRUISE CONTROL DEACTIVATOR SWITCH GROUND CIRCUIT FOR A SHORT TO GROUND	
• Disconnect: Clutch Pedal Cruise Control Deactivator Switch C2070. • Disconnect: PCM C175b. • Measure the resistance between the clutch pedal cruise control deactivator switch C2070-4, circuit CE904 (GN/VT), harness side and ground.  • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new clutch pedal cruise control deactivator switch. REFER to Cruise Control Deactivator Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
D3 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins	**Yes** INSTALL a new PCM. REFER to Section 303-14A , Section 303-14B or Section 303-14C . TEST the system for normal operation.

• Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

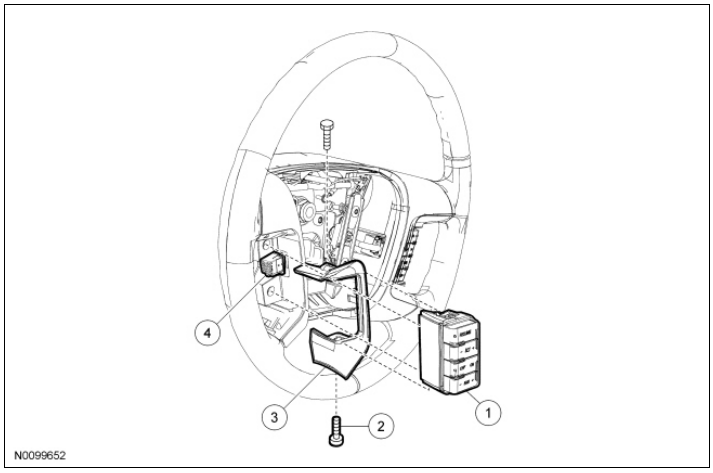
Cruise Control Switch

Without Bezel



Item	Part Number	Description
1	9C888	Cruise control switch
2	-	Cruise control switch electrical connector (part of 14672)

With Bezel



Item	Part Number	Description
1	9C888	Cruise control switch
2	-	Steering wheel controls bezel screws (2 required)
3	3D758	Steering wheel controls bezel
4	-	Cruise control switch electrical connector (part of 14672)

Removal and Installation

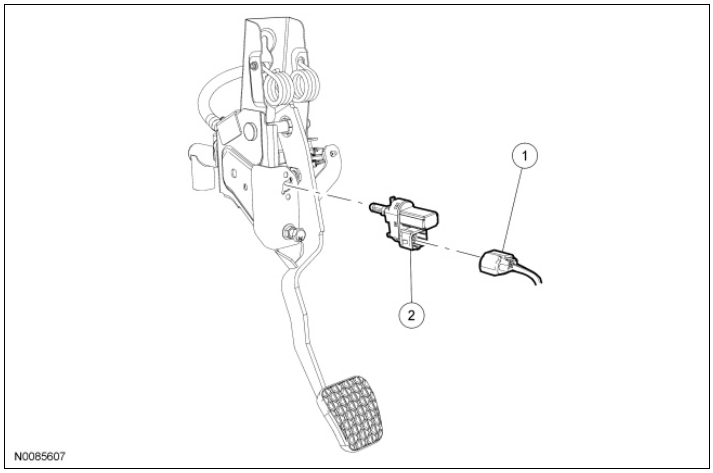
1. Remove the center steering wheel bezel. For additional information, refer to Section 211-04 .

2. Remove the cruise control switch and bezel by prying the switch with a suitable tool, such as a flat bladed screw driver, toward the rear of the vehicle.
    - Disconnect the electrical connector.

3. Remove the screws and the steering wheel controls bezel, if equipped.

4. To install, reverse the removal procedure.

Cruise Control Deactivator Switch



Item	Part Number	Description
1	-	Cruise control deactivator switch electrical connector (part of 14290 harness)
2	7C534	Cruise control deactivator switch

Removal and Installation

1. Disconnect the electrical connector.
2. Rotate the cruise control deactivator switch counterclockwise one-quarter turn.
3. Remove the cruise control deactivator switch.
4. **NOTE:** When installing the cruise control deactivator switch, it is automatically self-adjusting to the correct position. Do not pull up or push down on the pedal during installation. Initial installation of the cruise control deactivator switch allows for one adjustment. If additional adjustments are necessary, install a new switch.

   To install, reverse the removal procedure.

Blind Spot Monitoring

NOTE: The Blind Spot Information System (BLISTM) and Cross Traffic Alert (CTA) system share the same exterior mirror LEDs, Side Obstacle Detection Control Module - Left (SOD-L) and Side Obstacle Detection Control Module - Right (SOD-R) for system components.

BLISTM consists of:

- SOD-L (located at the lower LH rear quarter panel behind the rear bumper cover)
- SOD-R (located at the lower RH rear quarter panel behind the rear bumper cover)
- BLISTM customer ON/OFF feature (integral to the Instrument Panel Cluster (IPC) message center)
- Exterior mirror BLISTM / CTA LEDs (integral to the left and right exterior mirrors)

BLISTM is a vehicle feature that aids the driver in assessing whether another vehicle is within an area to either side of the vehicle extending rearward to approximately 3 m (10 ft) beyond the rear bumper. This area is known as the blind zone. The BLISTM alerts the driver to the presence of vehicles in the blind zone while driving on roads and freeways. The system is not designed to prevent contact with other vehicles or objects. BLISTM is designed to provide a warning to assist the driver in detecting vehicles in the blind zone.

Cross Traffic Alert (CTA)

NOTE: The BLISTM and CTA system share the same exterior mirror LEDs, SOD-L and SOD-R for system components.

The CTA system consists of:

- SOD-L (located at the lower LH rear quarter panel behind the rear bumper cover)
- SOD-R (located at the lower RH rear quarter pa behind the rear bumper cover)
- **NOTE:** CTA customer ON/OFF feature is not available on early build hybrid vehicles.

  CTA customer ON/OFF feature (integral to the IPC message center)
- Exterior mirror BLISTM / CTA LEDs (integral to the left and right exterior mirrors)

The CTA system assists the driver in backing out of a parking space. The CTA system uses the SOD-L , SOD-R , exterior mirror BLISTM / CTA LEDs, a warning chime from the parking aid speaker and a message in the IPC message center to notify the driver of impending traffic.

When the vehicle is in REVERSE (R) the CTA system can detect a vehicle that is approaching at a speed up to 24 km/h (15 mph) and is approximately 13.7 m (45 ft) from the side of the vehicle on the left or right side. The CTA system's response time and performance can degrade if vehicles are approaching at speeds greater than 24 km/h (15 mph).

Blind Spot Monitoring

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

NOTE: If the vehicle is towing a trailer, the Blind Spot Information System (BLISTM) or Cross Traffic Alert (CTA) system might detect the trailer, causing a false alert.

NOTE: The BLISTM and CTA system both utilize the Side Obstacle Detection Control Module - Left (SOD-L), Side Obstacle Detection Control Module - Right (SOD-R) and the exterior mirror BLISTM / CTA LEDs.

The SOD-L and SOD-R run a self diagnostic check on each vehicle start cycle and illuminate the exterior mirror BLISTM / CTA amber LED for approximately 3 seconds indicating that the BLISTM and CTA system is operational. For BLISTM , the exterior mirror BLISTM / CTA LED is at 95 percent illumination to be seen clearly during the day and is dimmed down to 10 percent at night. For the CTA system, the exterior mirror BLISTM / CTA LED is always at 85 percent illumination.

Blind Spot Information System (BLISTM)

When the vehicle is started, both exterior mirror BLISTM / CTA amber LEDs briefly illuminate to indicate that the system is operating. If a BLISTM fault is present, the LEDs remain illuminated and a message in the message center displays BLIND SPOT SYSTEM FAULT. System faults car that cause the associated left or right exterior mirror BLISTM / CTA amber LED not to illuminate; only the message center message fault is displayed.

BLISTM becomes active the first time the transaxle is placed in DRIVE (D) after starting the engine and driving forward at a vehicle speed greater than 5 km/h (3 mph). Upon that initial sequence, BLISTM remains active for all speeds including 0 km/h (0 mph). BLISTM is also active if the transaxle is placed in NEUTRAL (N). If the transaxle is selected out of DRIVE (D) or NEUTRAL (N) the system has entered the CTA mode. When the transaxle is shifted back into DRIVE (D), BLISTM is activated once the vehicle is driven above 5 km/h (3 mph).

NOTE: BLISTM does not normally detect parked vehicles, pedestrians or objects such as fences, rails, trees, etc. BLISTM does not provide any additional warning when the turn signal is activated.

BLISTM can trigger an alert for vehicles that enter the blind zone from the rear or merge into the blind zone from the side. The exterior mirror BLISTM / CTA amber LED illuminates in the right and/or left exterior mirror. For vehicles that are being passed or vehicles that enter the blind zone from the front, the system can trigger an alert only after the vehicle is present in the blind zone for more than 2 seconds. For vehicles that pass through the blind zone quickly, typically less than 2 seconds, BLISTM cannot trigger an alert.

BLISTM utilizes 2 modules that have integral radar sensors located rearward of the rear wheel under the rear bumper cover. The 2 modules, SOD-L and SOD-R , are hardwired to the exterior mirrors to illuminate the LEDs. For correct operation of BLISTM , the rear side bumper cover should be free of obstructions such as a large build up of mud, snow or ice. Small build up of debris and materials does not hinder the operation of the system. There should be no bumper stickers of any type placed in this area of the bumper cover.

Due to the nature of radar technology, false alerts and missed targets may occur under certain circumstances. False alerts are when the LED illuminates with no target present. False alerts up to 3% (3 out of 100 targets) is normal operation. Circumstances that cause false alerts are freeway divider, concrete walls, cyclone fencing, sharp turns around a pole or building and coming to a stop with a vehicle directly behind and very close. False alerts are temporary and self-correct.

Missed targets are when a target is present and the LED does not illuminate. Missed targets up to 1% (1 out of 100 targets) is normal operation. Circumstances that cause missed targets are:

- Debris build up on the rear quarter panel fascias
- Certain maneuvering of vehicles entering and exiting the blind zone
- Vehicles passing through the blind zone at very fast rates
- Severe weather conditions
- When several vehicles forming a convoy pass through the blind zone

The exterior mirror indicators may not operate correctly when the vehicle accelerates from a standing-start with a vehicle alongside.

BLISTM can be turned off by selecting the blind spot ON/OFF function in the message center. BLISTM is turned off in the IPC by selecting the blind spot system with the SETUP switch for the message center and selecting the system on or off with the RESET switch. The message BLIND SPOT SYS OFF is displayed in the message center. When turning BLISTM from on to off or off to on, the exterior mirror BLISTM / CTA amber LEDs flash twice. When BLISTM is off, the driver cannot receive any alerts. The system is reactivated on the next ignition cycle.

BLISTM can be disabled permanently (even after an ignition cycle) by using a scan tool. When using the scan tool disable function in the programmable parameters menu, BLISTM remains disabled until it is reactivated using the scan tool. When the system is disabled the message center displays BLIND SPOT DISABLED. A system fault occurs if BLISTM is not disabled in both the SOD-L and the SOD-R .

There are some system faults that can set DTCs which are logged in the SOD-L or SOD-R . These DTCs can set a message in the message center that displays BLIND SPOT SYSTEM FAULT. There are also symptom based faults that do not set a DTC. GO to Symptom Chart .

Cross Traffic Alert (CTA) System

NOTE: The BLISTM and CTA system both utilize the SOD-L SOD-R and the exterior mirror BLISTM / CTA LEDs.

NOTE: The CTA system faults may not occur until the transaxle is placed in REVERSE (R).

The CTA system is an alert feature that assists the driver in backing out of a front-in parking space. When the transaxle is in REVERSE (R) the CTA system is active. The driver is warned of an approaching vehicle when an audio alert chime from the parking aid speaker sounds, the right or left exterior mirror BLISTM / CTA amber LED flashes, and the message center displays VEHICLE COMING FROM RIGHT or VEHICLE COMING FROM LEFT to warn the driver from which direction vehicles are approaching.

The CTA system detects vehicle approaching up to 14 m (45 ft) away (approximately the width of 5 parking spaces). Backing out of parking spots slowly increases the radar sensor coverage in close proximity situations. The CTA system coverage also decreases when parking at shallow angles, which is described in the Owner's Literature.

The CTA system utilizes the same SOD-L and SOD-R as BLISTM .

The CTA system cannot normally detect stationary vehicles, humans, animals or objects such as fences, guard rails or trees. The system does not function when the transaxle is not in REVERSE (R).

The CTA system has detection limitations due to the nature of the radar technology for the SOD-L and SOD-R . There can be certain instances where vehicles entering and exiting the blind spot zone may not be detected. The circumstances that may cause non-detection are:

- Debris build up on the rear quarter panel fascias
- The rear quarter panel of the vehicle is obstructed or partially obstructed by an adjacently parked vehicle or object
- Approaching vehicle passing at speeds greater than 24 km/h (15 mph)
- Severe weather conditions
- Driving in reverse (R) faster than 5 km/h (3 mph)
- Backing out of an angled parking spot

Due to the nature of radar technology, there may be certain instances when the CTA system alerts the operator, however no objects or vehicles are present when backing up. This is known as a false alert. False alert rate of up to 5% (5 times out of 100 reversals) is normal. Circumstances that may cause a false alert when backing up are backing out of a garage, backing into a parking space and objects or vehicles that are very close to the radar sensors. False alerts are temporary and self-correct.

NOTE: The CTA system customer ON/OFF feature is not available on early build hybrid vehicles.

The CTA system can be turned off by selecting the CTA system ON/OFF function in the message center. The CTA system is turned off in the message center by selecting the CTA system with the SETUP switch for the message center and selecting the system on or off with the RESET switch. The message CTA SYSTEM OFF is displayed in the message center. The CTA system cannot be deactivated in the message center when the transaxle is in REVERSE (R). The system is reactivated on the next ignition cycle.

The CTA system can be disabled permanently (even after an ignition cycle) by using a scan tool. When using the scan tool disable function in the programmable parameters menu, the CTA system remains disabled until it is reactivated using the scan tool. When the system is disabled the message center displays CTA DISABLED. A system fault occurs if the CTA system is not disabled in both the SOD-L and the SOD-R .

There are some system faults that set DTCs which are logged in the SOD-L or SOD-R . These DTCs that are logged can set a message in the message center that displays CTA SYSTEM FAULT. There are also some symptom based faults that do not set a DTC. GO to Symptom Chart .

Blocked Sensor

NOTE: The CTA system faults may not occur until the transaxle is placed in REVERSE (R).

An excessive build up of materials on the left and/or right rear quarter panel fascias, such as mud or snow, can cause the BLISTM or CTA system functionality to degrade. Heavy rain can have the same effect. If the system is in a blocked state, the radar misses targets, but still counts them.

After approximately 4 counted/missed targets, the system sends a blocked sensor message over the Medium Speed Controller Area Network (MS-CAN) to the . The message center displays BLIND SPOT NOT AVAILABLE or CTA NOT AVAILABLE message. The not available message is followed by a BLOCK SENSOR SEE MANUAL message in the message center. If the blocked condition is determined by either system the message center displays BLIND SPOT NOT AVAILABLE or CROSS TRAFFIC NOT AVAILABLE and the appropriate left and/or right exterior mirror BLISTM / CTA LED illuminates.

The message center warning can be cleared by the driver but the exterior mirror BLISTM / CTA LED remains illuminated. Once the blockage is removed, the system requires some drive time and a system detection of at least 2 vehicle objects prior to realizing it is unblocked. The ignition key can also be cycled off to clear the blocked state. However, if the blockage is still present after the key cycle and after some drive time, the system detects again that it is blocked. The blocked message is displayed again in the message center.

Due to the nature of radar technology, it is possible to get a blockage warning and not actually be blocked. This is rare and known as a false blockage warning. A false blocked condition either self-clears or clears after an ignition cycle.

There are several conditions that cause the BLISTM or CTA system to not operate correctly These conditions include:

- Ice, snow or soil adhering to the rear quarter panel surface around the radar sensor.
- Adverse weather conditions such as heavy rain or heavy snow or under conditions where water is sprayed.

The rear quarter panels and rear bumper cover should be cleaned of mud, snow, ice or any obstruction to restore normal operation.

Network Communication

While there are numerous messages internal to the SOD-L and SOD-R , the following messages are utilized by the BLISTM and CTA system.

BLISTM and CTA System Network Communication Messages

NOTE: Both the Medium Speed Controller Area Network (MS-CAN) and the High Speed Controller Area Network (HS-CAN) are used for intermeddle communication. A gateway message is transferred from one network to another network through e IPC . Refer to Section 418-00 for network communication information.

Broadcast Message	Originating Module	Network Type	Receiving Module
Ignition switch position	SJB	MS-CAN	SOD-R and SOD-L
Instrument illumination level	SJB	MS-CAN	SOD-R and SOD-L
Park lamp status	SJB	MS-CAN	SOD-R and SOD-L
Side obstacle detection cross traffic alert	SOD-L	MS-CAN	IPC PAM
Side obstacle detection cross traffic alert	SOD-R	MS-CAN	

			IPC PAM
Side obstacle detection cross traffic status	SOD-L	MS-CAN	IPC
Side obstacle detection cross traffic status	SOD-R	MS-CAN	IPC
Side obstacle detection system status	SOD-L	MS-CAN	IPC
Side obstacle detection system status	SOD-R	MS-CAN	IPC
Side obstacle detection cross traffic command	IPC	MS-CAN	SOD-R and SOD-L
Side obstacle detection enabled status	IPC	MS-CAN	SOD-R and SOD-L
Transmission selector (PRNDL) status	PCM	HS-CAN	IPC
Transmission selector (PRNDL) status (gateway)	IPC	MS-CAN	SOD-R and SOD-L
Vehicle speed	PCM	HS-CAN	IPC
Vehicle speed (gateway)	IPC	MS-CAN	SOD-R and SOD-L

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Rear bumper cover • Lower rear bumper quarter panel splash shield	• Smart Junction Box (SJB) fuse 35 (10A) • Left and right exterior mirrors

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **NOTE:** Make sure to use the latest scan tool software release.

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).
5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM .

   If the scan tool does not communicate with the VCM :

   - Check the VCM connection to the vehicle.
   - Check the scan tool connection to the VCM .
   - Refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - Verify the ignition key is in the ON position.
   - Verify the scan tool operation with a known good vehicle.
   - Refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
    - If the scan tool responds with no communication with the Side Obstacle Detection Control Module - Right (SOD-R), GO to Symptom Chart .
    - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
    - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SOD-R and Side Obstacle Detection Control Module - Left (SOD-L).

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

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

DTC Charts

Side Obstacle Detection Control Module - Left (SOD-L) and Side Obstacle Detection Control Module - Right (SOD-R) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
B11D6:11	Driver Display Alert LED: Circuit Short To Ground	GO to Pinpoint Test D .
B11D6:15	Driver Display Alert LED: Circuit Short To Battery Or Open	GO to Pinpoint Test D .
U2100:00	Initial Configuration Not Complete: No Sub Type Information	The Side Obstacle Detection Control Module - Left (SOD-L) or Side Obstacle Detection Control Module - Right (SOD-R) is not configured. REFER to Section 418-01 for Programmable Module Installation (PMI) to configure the SOD-L or SOD-R . CLEAR all DTCs. TEST the system for normal operation.
U0155:00	Lost Comunitcation With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information	GO to Pinpoint Test J .
U0423:00	Invalid Data Received From Instrument Panel Cluster Control Module: No Sub Type Information	DTC U0423:00 is set when the SOD-L or SOD-R receives invalid network data from the IPC . RETRIEVE and REPAIR all non-network DTCs in the IPC . REFER to Section 413-01 .
U3000:44	Control Module: Data Failure	GO to Pinpoint Test H .
U3000:45	Control Module: Program Memory Failure	GO to Pinpoint Test H .
U3000:46	Control Module: Calibration/Parameter Memory Failure	GO to Pinpoint Test H .
U3000:48		GO to Pinpoint Test H .

	Control Module: Supervision Software Failure	
U3000:49	Control Module: Internal Electronic Failure	GO to Pinpoint Test H .
U3000:4A	Control Module: Incorrect Component Installed	GO to Pinpoint Test H .

Instrument Panel Cluster (IPC) DTC Chart

NOTE: This module utilizes a 5-character DTC followed by a 2-character failure-type code. The failure-type code provides information about specific fault conditions such as opens, or shorts to ground. Continuous memory DTCs have an additional 2-character DTC status code suffix to assist in determining DTC history.

DTC	Description	Action
U0232:00	Lost Communication With Side Obstacle Detection Control Module Left: No Sub-Type Information	REFER to Section 413-01 .
U0233:00	Lost Communication With Side Obstacle Detection Control Module Right: No Sub-Type Information	REFER to Section 413-01 .

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: The Blind Spot Information System (BLISTM) Is Inoperative/Does Not Operate Correctly Or Poor Performance And No Message Center Warning Message Or Warning Led Indicators Present

Normal Operation

On each ignition cycle, the Side Obstacle Detection Control Module - Right (SOD-R) and Side Obstacle Detection Control Module - Left (SOD-L) run a self diagnostic check during which the exterior mirror Blind Spot Information System (BLISTM)/Cross Traffic Alert (CTA) LEDs illuminate for 3 seconds then turn off indicating the system is operational. BLISTM is enabled when the ignition switch is in the RUN position and the DRIVE (D) gear is selected.

NOTE: BLISTM is turned off for one key cycle only when using the message center switches. Permanently disabling BLISTM is carried out in the Integrated Diagnostic System (IDS) programmable parameters menu.

The SOD-R and SOD-L receive a drive gear input and a vehicle speed signal message from the Instrument Panel Cluster (IPC) through the Medium Speed Controller Area Network (MS-CAN). For non-hybrid and late build hybrid vehicles, The system can be disabled through the message center which is part of the IPC .

The SOD-L and SOD-R are identical modules except that the SOD-R uses an address ground pin for configuration. The address ground is necessary so that BLISTM can decipher between the SOD-L and SOD-R .

BLISTM can miss vehicles in the blind zone, indicate false alerts and operate poorly due to extreme weather conditions or a build up of debris over the SOD-L and SOD-R .

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- BLISTM is not configured on with the scan tool
- IPC
- SOD-L
- SOD-R
- Vehicle speed signal

PINPOINT TEST A: BLISTM IS INOPERATIVE/DOES NOT OPERATE CORRECTLY OR POOR PERFORMANCE AND NO MESSAGE CENTER WARNING MESSAGE OR WARNING LED INDICATORS PRESENT

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
A1 CARRY OUT THE SOD-L AND SOD-R DIAGNOSTIC SYSTEM CHECK	
• Start the engine. • Observe the left and right exterior mirror BLISTM / CTA LEDs. • **Do the left and right BLISTM / CTA LEDs illuminate and turn off after 3 seconds?**	**Yes** GO to A2 . **No** GO to Pinpoint Test D .
A2 VERIFY BLISTM OPERATION	
• Drive the vehicle and test BLISTM to verify the customer's concern. • **Does BLISTM operate correctly?**	**Yes** The fault may have been caused by an intermittent condition such as poor weather conditions or customer's perception of how BLISTM operates. REFER to Owner's Literature. TEST the system for normal operation. **No** GO to A3 .
A3 CHECK FOR SOD-L AND SOD-R OBSTRUCTIONS	
• Check the lower rear side bumper cover fascia and lower rear bumper cover splash shield for a build up of mud, bumper stickers or any obstruction.	**Yes** CLEAN and REMOVE all obstructions from the lower rear side bumper cover fascia and lower rear bumper cover splash shield. TEST the system for normal operation. **No**

• **Are any obstructions present?**	GO to A4 .
A4 CHECK FOR DAMAGE TO THE LOWER REAR SIDE BUMPER COVER OR THE SOD-L AND SOD-R	
• Check the lower rear side bumper cover fascia, lower rear bumper cover splash shield and the SOD-L and SOD-R mounting bracket for damage. • **Is any damage present?**	**Yes** REPAIR or INSTALL any damaged parts. TEST the system for normal operation. **No** GO to A5 .
A5 VERIFY THE SOD-L AND SOD-R PASS THE NETWORK TEST	
• Enter the following diagnostic mode on the scan tool: Network Test . • Verify that the SOD-L and SOD-R pass the network test. • **Do the SOD-L and SOD-R pass the network test?**	**Yes** GO to A6 . **No** For SOD-L , REFER to Section 418-00 , The SOD-L Does Not Respond To The Scan Tool. For SOD-R , GO to Pinpoint Test E .
A6 VERIFY BLISTM CONFIGURATION	
NOTE: BLISTM must be enabled in both the SOD-L and the SOD-R . • Enter the following diagnostic mode on the scan tool: Programmable Parameters . • Verify that BLISTM is enabled in the SOD-L and SOD-R . • **Is BLISTM enabled?**	**Yes** GO to A7 . **No** ENABLE an title="Blind Spot Information System" class="popup" onmouseover="this.className='popupnounderline';" onmouseout="this.className='popup';">BLISTM in the SOD-L and SOD-R using the scan tool programmable parameters menu. TEST the system for normal operation.
A7 CHECK THE DTCs FROM BOTH THE CONTINUOUS AND ON-DEMAND SOD-L AND SOD-R SELF-TESTS	
• Check the SOD-L and SOD-R DTCs from the continuous and on-demand self-tests. • **Are any SOD-L and SOD-R DTCs recorded?**	Yes REFER to DTC Charts in this section. **No** GO to A8 .
A8 CHECK FOR VEHICLE SPEED SIGNAL DTCs	
• Enter the following diagnostic mode on the scan tool: IPC CMDTCs .	**Yes** REFER to Section 419-10 for a list of all DTCs. **No** For an inoperative SOD-L , GO to A9 .

• Check for correct operation of the speedometer in the IPC . • **Are vehicle speed display faults and DTCs related to vehicle speed present?**	For an inoperative SOD-R , GO to A10 .
A9 CHECK FOR CORRECT SOD-L OPERATION	
• Disconnect the SOD-L connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SOD-L connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SOD-L . REFER to Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
A10 CHECK FOR CORRECT SOD-R OPERATION	
• Disconnect the SOD-R connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SOD-R connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SOD-R . REFER to Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test B: The Cross Traffic Alert (CTA) System Is Inoperative/Does Not Operate Correctly Or Poor Performance And No Warning Led Indicators Present

NOTE: The Cross Traffic Alert (CTA) system customer ON/OFF feature in the Instrument Panel Cluster (IPC) is not available on early build hybrid vehicles.

Normal Operation

On each ignition cycle, the Side Obstacle Detection Control Module - Right (SOD-R) and Side Obstacle Detection Control Module - Left (SOD-L) run a self diagnostic check during which the exterior mirror Blind Spot Information System (BLISTM)/ CTA LEDs illuminate for 3 seconds then turn off indicating the system is operational. The CTA system is enabled when the ignition switch is in the RUN position and the REVERSE (R) gear is selected. For non-hybrid and late build hybrid vehicles, the system can be turned off through the message center which is part of the IPC .

NOTE: The CTA system is turned off for one key cycle only when using the message center switches. Permanently disabling the CTA system is carried out in the Integrated Diagnostic System (IDS) programmable parameters menu.

The SOD-R and SOD-L receive a reverse gear input and a vehicle speed signal message from the IPC through the Medium Speed Controller Area Network (MS-CAN). The CTA system, SOD-R and SOD-L send a message through the MS-CAN to the Parking Aid Module (PAM) to signal an audible tone to alert the driver.

The SOD-L and SOD-R are identical modules except that the SOD-R uses an address ground pin for configuration. The address ground is necessary so that the CTA system can decipher between the right and the left module.

The CTA system may operate poorly in extreme weather conditions or when a build up of debris over the SOD-L and SOD-R is present.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- CTA system is not configured on with the scan tool
- IPC
- PAM
- SOD-L
- SOD-R
- Vehicle speed signal

PINPOINT TEST B: THE CTA SYSTEM IS INOPERATIVE/DOES NOT OPERATE CORRECTLY OR POOR PERFORMANCE AND NO WARNING LED INDICATORS PRESENT

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
B1 CARRY OUT THE SOD-L AND SOD-R DIAGNOSTIC SYSTEM CHECK	
• Start the engine. • Observe the left and right exterior mirror BLISTM / CTA LEDs. • **Do the left and right BLISTM / CTA LEDs illuminate and turn off after 3 seconds?**	**Yes b> GO to B2 .** **No GO to Pinpoint Test D .**
B2 VERIFY THE CTA SYSTEM OPERATION	
• **NOTE:** The CTA system only operates in reverse (R) while backing out of a front-in parking space. • Test the CTA system to verify the customer's concern. • **Does the CTA system operate correctly?**	**Yes** The fault may have been caused by an intermittent condition such as poor weather conditions or customer's perception of how the CTA system operates. REFER to Owner's Literature. TEST the system for normal operation. **No** GO to B3 .
B3 CHECK FOR SOD-L AND SOD-R OBSTRUCTIONS	
	Yes CLEAN and REMOVE all obstructions from the

• Check the lower rear side bumper cover fascia and lower rear bumper cover splash shield for a build up of mud, bumper stickers or any obstruction. • **Are any obstructions present?**	lower rear side bumper cover fascia and lower rear bumper cover splash shield. TEST the system for normal operation. **No** GO to B4 .
B4 CHECK FOR DAMAGE TO THE LOWER REAR SIDE BUMPER COVER OR THE SOD-L AND SOD-R	
• Check the lower rear side bumper cover fascia, lower rear bumper cover splash shield and the SOD-L and SOD-R mounting bracket for damage. • **Is any damage present?**	**Yes** REPAIR or INSTALL any damaged parts. TEST the system for normal operation. **No** GO to B5 .
B5 VERIFY THE SOD-L AND SOD-R PASS THE NETWORK TEST	
• Enter the following diagnostic mode on the scan tool: Network Test . • Verify that the SOD-L and SOD-R pass the network test. • **Do the SOD-L and SOD-R pass the network test?**	**Yes** GO to B6 . **No** For SOD-L , REFER to Section 418-00 , The SOD-L Does Not Respond To The Scan Tool. For SOD-R , GO to Pinpoint Test E .
B6 VERIFY THE CTA SYSTEM CONFIGURATION	
NOTE: The CTA must be enabled in both the SOD-L and the SOD-R . • Enter the following diagnostic mode on the scan tool: Programmable Parameters . • Verify that the CTA system is enabled in the SOD-L and SOD-R . • **Is the CTA system enabled?**	**Yes** GO to B7 . **No** ENABLE the CTA system in the SOD-L and SOD-R using the scan tool programmable parameters menu. TEST the system for normal operation.
B7 CHECK THE DTCs FROM BOTH THE CONTINUOUS AND ON-DEMAND SOD-L AND SOD-R SELF-TESTS	
• Check the SOD-L and SOD-R DTCs from the continuous and on-demand self-tests. • **Are any SOD-L and SOD-R DTCs recorded?**	**Yes** REFER to DTC Charts in this section. **No** GO to B8 .
B8 CHECK THE DTCs FROM BOTH THE CONTINUOUS AND ON-DEMAND PAM SELF-TESTS	
• Check the PAM DTCs from the continuous and on-demand self-tests. • **Are any PAM DTCs recorded?**	**Yes** REFER to Section 413-13 . REPAIR all PAM DTCs and TEST the CTA system for normal operation.

	No GO to B9 .
B9 CHECK FOR VEHICLE SPEED SIGNAL DTCs	
• Enter the following diagnostic mode on the scan tool: IPC CMDTCs . • Check for correct operation of the speedometer in the IPC . • **Are vehicle speed display faults and DTCs related to vehicle speed present?**	**Yes** REFER to Section 419-10 for a list of all DTCs. **No** GO to B10 .
B10 CHECK FOR CORRECT PRNDL DISPLAY OPERATION	
• Enter the following diagnostic mode on the scan tool: IPC CMDTCs . • Check for correct operation of the PRNDL in the IPC . • **Are PRNDL display faults and DTCs related to the PRNDL present?**	**Yes** REFER to Section 413-01 . **No** For an inoperative SOD-L , GO to B11 . For an inoperative SOD-R , GO to B12 .
B11 CHECK FOR CORRECT SOD-L OPERATION	
• Disconnect the SOD-L connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SOD-L connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SOD-L . REFER to Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
B12 CHECK FOR CORRECT SOD-R OPERATION	
• Disconnect the SOD-R connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SOD-R connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SOD-R . REFER to Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test C: The Left Or Right Exterior Mirror Blind Spot Information System (BLISTM)/Cross Traffic Alert (CTA) LED Is Constantly On And A Message In The Instrument Panel Custer (IPC) Message Center Is Present, But No DTCs Are Recorded

Refer to Wiring Diagrams Cell 136 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Emergency Messageing System for schematic and connector information.

NOTE: The Cross Traffic Alert (CTA) system customer ON/OFF feature in the Instrument Panel Cluster (IPC) is not available on early build hybrid vehicles.

Normal Operation

On each ignition cycle, the Side Obstacle Detection Control Module - Right (SOD-R) and Side Obstacle Detection Control Module - Left (SOD-L) run a self diagnostic check during which the exterior mirror Blind Spot Information System (BLISTM)/ CTA LEDs illuminate for 3 seconds then turn off indicating the system is operational. The CTA system is enabled when the ignition switchis in the RUN position and the REVERSE (R) gear is selected. For non-hybrid and late build hybrid vehicles, the system can be turned on and off through the message center, which is part of the IPC .

The SOD-R and SOD-L receive a PRNDL gear input and a vehicle speed signal message from the IPC through the Medium Speed Controller Area Network (MS-CAN). The CTA system, SOD-R and SOD-L send a message through the MS-CAN to the Parking Aid Module (PAM) to signal an audible tone to alert the driver.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- SOD-L
- SOD-R
- Parking Aid Module (PAM)

PINPOINT TEST C: THE LEFT OR RIGHT EXTERIOR MIRROR BLISTM / CTA LED IS CONSTANTLY ON AND A MESSAGE IN THE IPC MESSAGE CENTER IS PRESENT, BUT NO DTCs ARE RECORDED

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
C1 VERIFY THE SOD-L AND SOD-R PASS THE NETWORK TEST	
• Enter the following diagnostic mode on the scan tool: Network Test . • Verify that the SOD-L and SOD-R pass the network test. • **Do the SOD-L and SOD-R pass the network test?**	**Yes** GO to C2 . **No** For SOD-L , REFER to Section 418-00 , The SOD-L Does Not Respond To The Scan Tool. For SOD-R , GO to Pinpoint Test E .
C2 CHECK FOR VEHICLE SPEED SIGNAL DTCs	
• Enter the following diagnostic mode on the scan tool: IPC CMDTCs . • Check for correct operation of the speedometer in the IPC .	**Yes** REFER to Section 419-10 for a list of all DTCs. **No** GO to C3 .

• **Are vehicle speed display faults and DTCs related to vehicle speed present?**	
C3 CHECK FOR PRNDL DTCs	
• Enter the following diagnostic mode on the scan tool: IPC CMDTCs . • Check for correct operation of the PRNDL in the IPC . • **Are PRNDL display faults and DTCs related to the PRNDL present?**	**Yes** REFER to Section 413-01 . **No** For a BLISTM fault, GO to Pinpoint Test A . For a CTA system fault, GO to C4 .
C4 CHECK FOR PAM DTCs	
• Enter the following diagnostic mode on the scan tool: PAM CMDTCs . • Check DTCs in the PAM . • **Are DTCs present?**	**Yes** REFER to Section 413-13 . **No** GO to Pinpoint Test B .

Pinpoint Test D: DTC B11D6:11 Or DTC B11D6:15 (LED MAY ALWAYS BE ON)

Refer to Wiring Diagrams Cell 136 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Emergency Messaging System for schematic and connector information.

Normal Operation

On each ignition cycle, the Side Obstacle Detection Control Module - Right (SOD-R) and Side Obstacle Detection Control Module - Left (SOD-L) run a self-diagnostic check during which the exterior mirror Blind Spot Information System (BLISTM)/Cross Traffic Alert (CTA) LEDs illuminate for 3 seconds then turn off indicating the system is operational. If a DTC fault is present, a system fault message is displayed in the message center.

- DTC B11D6:11 (Driver Display Alert LED: Circuit Short To Ground) - sets when the SOD-R or SOD-L detect a short to ground on the exterior mirror BLISTM / CTA LED supply circuit.
- DTC B11D6:15 (Driver Display Alert LED: Circuit Short To Battery or open) - sets when the SOD-R or pan title="Side Obstacle Detection Control Module - Left" class="popup" onmouseover="this.className='popupnounderline';" onmouseout="this.className='popup';">SOD-L detect a short to battery voltage or an open on the exterior mirror BLISTM / CTA LED supply circuit.

This pinpoint test is intended to diagnose the following:

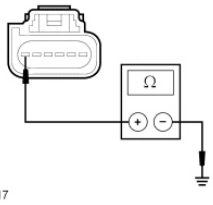
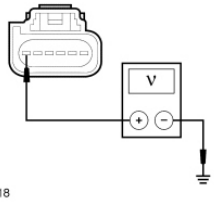
- Wiring, terminals or connectors
- SOD-L
- SOD-R
- Exterior mirror BLISTM / CTA LED

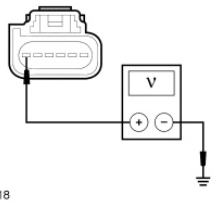
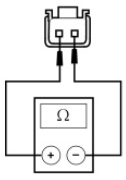
PINPOINT TEST D: DTC B11D6:11 OR DTC B11D6:15 (LED MAY ALWAYS BE ON)

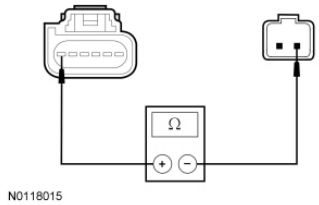
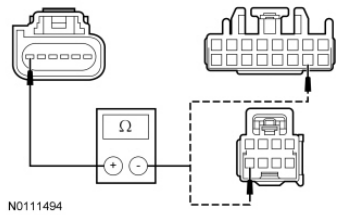
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

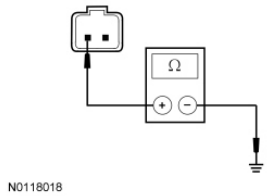
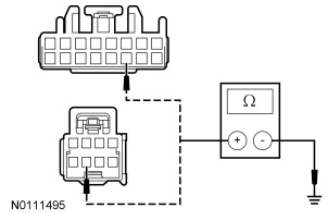
NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
D1 CHECK THE DTCs FROM THE SOD-L AND SOD-R SELF-TESTS	
• For a LH concern, check the SOD-L DTCs from the self-tests. • For a RH concern, check the SOD-R DTCs from the self-tests. • **Are any SOD-L or SOD-R DTCs recorded?**	**Yes** For DTC B11D6:11, GO to D2 . For DTC B11D6:15, GO to D5 . For all other DTCs, REFER to DTC Charts in this section. **No** GO to D6 .
D2 CHECK THE EXTERIOR MIRROR BLISTM / CTA LED FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Left Exterior Mirror BLISTM / CTA LED C576 (LH concern) . • Disconnect: Right Exterior Mirror BLISTM / CTA LED C676 (RH concern) . Ignition ON. • **NOTE:** It is normal for DTC B11D6:15 to set when carrying out this step. It can be ignored. • For a LH concern, clear the SOD-L DTCs. Repeat the self-test. • For a RH concern, clear the SOD-R DTCs. Repeat the self-test. • **Is DTC B11D6:11 retrieved?**	**Yes** GO to D3 . **No** INSTALL a new exterior mirror glass for the one in question. REFER to Section 501-09 . CLEAR any DTCs. TEST the system for normal operation.
D3 CHECK THE EXTERIOR MIRROR FOR A SHORT TO GROUND	
• Ignition OFF. • Disconnect: Left Exterior Mirror C517 or C522 (LH concern) . • Disconnect: Right Exterior Mirror C625 or C626 (RH concern) . • Ignition ON. • **NOTE:** It is normal for DTC B11D6:15 to set when carrying out this step. It can be ignored. • For a LH concern, clear the SOD-L DTCs. Repeat the self-test. • For a RH concern, clear the SOD-R DTCs. Repeat the self-test. • **Is DTC B11D6:11 retrieved?**	**Yes** GO to D4 . **No** INSTALL a new exterior mirror for the one in question. REFER to Section 501-09 . CLEAR any DTCs. TEST the system for normal operation.
D4 CHECK THE EXTERIOR MIRROR BLISTM / CTA LED SUPPLY CIRCUIT FOR A SHORT TO GROUND	

• Ignition OFF. • Disconnect: SOD-L C4230 (LH concern) . • Disconnect: SOD-R C4229 (RH concern) . • For a LH concern, measure the resistance between the SOD-L C4230-6, circuit CRB04 (YE/GN), harness side and ground. • For a RH concern, measure the resistance between the SOD-R C4229-6, circuit CRB02 (BU/BN), harness side and ground.  N0099817 • **Is the resistance greater than 10,000 ohms?**	**Yes** For a LH concern, GO to D13 . For a RH concern, GO to D14 . **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.
D5 CARRY OUT THE SOD-L AND SOD-R DIAGNOSTIC SYSTEM CHECK	
• Start the engine. • Observe the left and right exterior mirror BLISTM / CTA LEDs. • **After 5 seconds does the LED in question remain illuminated?**	**Yes** GO to D6 . **No** GO to D8 .
D6 CHECK THE EXTERIOR MIRROR BLITM / CTA LED SUPPLY CIRCUIT FOR A SHORT TO VOLTAGE	
• Ignition OFF. • Disconnect: SOD-L C4230 (LH concern) . • Disconnect: SOD-R C4229 (RH concern) . • Ignition ON. • For a LH concern, measure the voltage between the SOD-L C4230-6, circuit CRB04 (YE/GN), harness side and ground. • For a RH concern, measure the voltage between the SOD-R C4229-6, circuit CRB02 (BU/BN), harness side and ground.  N0099818 • **Is any voltage present?**	**Yes** GO to D7 . **No** For a LH concern, GO to D13 . For a RH concern, GO to D14 .
D7 CHECK THE EXTERIOR MIRROR FOR A SHORT TO VOLTAGE	

• Ignition OFF. • Disconnect: Left Exterior Mirror C517 or C522 (LH concern) . • Disconnect: Right Exterior Mirror C625 or C626 (RH concern) . • Ignition ON. • For a LH concern, measure the voltage between the SOD-L C4230-6, circuit CRB04 (YE/GN), harness side and ground. • For a RH concern, measure the voltage between the SOD-R C4229-6, circuit CRB02 (BU/BN), harness side and ground.  N0099818 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation. **No** INSTALL a new exterior mirror for the one in question. REFER to Section 501-09 . CLEAR the DTCs. TEST the system for normal operation.
D8 CHECK THE EXTERIOR MIRROR GLASS BLISTM / CTA LED FOR AN OPEN	
• Ignition OFF. • Disconnect: Left Exterior Mirror BLISTM / CTA LED C576 (LH concern) . • Disconnect: Right Exterior Mirror BLISTM / CTA LED C676 (RH concern) . • For a LH concern, measure the resistance betweene BLISTM / CTA LED C576-1, component side and the BLISTM / CTA LED C576-2, component side. • For a RH concern, measure the resistance between the BLISTM / CTA LED C676-1, component side and the BLISTM / CTA LED C676-2, component side.  N0118014 • **Is the resistance less than 2000 ohms?**	**Yes** GO to D9 . **No** INSTALL a new exterior mirror glass for the one in question. REFER to Section 501-09 . CLEAR the DTCs. TEST the system for normal operation.
D9 CHECK THE EXTERIOR MIRROR BLISTM / CTA LED SUPPLY CIRCUIT FOR AN OPEN	

• Disconnect: SOD-L C4230 (LH concern) . • Disconnect: SOD-R C4229 (RH concern) . • For a LH concern, measure the resistance between the SOD-L C4230-6, circuit CRB04 (YE/GN), harness side and the left exterior mirror BLISTM / CTA LED C576-1, harness side. • For a RH concern, measure the resistance between the SOD-R C4229-6, circuit CRB02 (BU/BN), harness side and the right exterior mirror BLISTM / CTA LED C676-1, harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to D11 . **No** GO to D10 .
• Disconnect: Left Exterior Mirror C517 or C522 (LH concern) . • Disconnect: Right Exterior Mirror C625 or C626 (RH concern) . • For a LH concern, measure the resistance between the SOD-L C4230-6, circuit CRB04 (YE/GN), harness side and the left exterior mirror C522-10 or C517-8, circuit CRB04 (YE/GN), harness side. • For a RH concern, measure the resistance between the SOD-R C4229-6, circuit CRB02 (BU/BN), harness side and the right exterior mirror C626-10 or C625-8, circuit CRB02 (BU/BN), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new exterior mirror for the one in question. REFER to Section 501-09 . CLEAR any DTCs. TEST the system for normal operation. **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.
D11 CHECK THE EXTERIOR MIRROR BLISTM / CTA LED GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Negative Battery Cable . • For a LH concern, measure the resistance between the left exterior mirror BLISTM / CTA LED C576-2, harness side and ground.	**Yes** For a LH concern, GO to D13 . For a RH concern, GO to D14 . **No** GO to D12 .

• For a RH concern, measure the resistance between the right exterior mirror BLISTM / CTA LED C676-2, harness side and ground.  N0118018 • **Is the resistance less than 5 ohms?**	
D12 CHECK THE EXTERIOR MIRROR GROUND CIRCUIT FOR AN OPEN	
• Disconnect: Left Exterior Mirror C517 or C522 (LH concern) . • Disconnect: Right Exterior Mirror C625 or C626 (RH concern) . • For a LH concern, measure the resistance between the left exterior mirror C522-11 or C517-7, circuit GD126 (BK/WH), harness side and ground. • For a RH concern, measure the resistance between the right exterior mirror C626-11 or C625-7, circuit GD139 (BK/YE), harness side and ground.  N0111495 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new exterior mirror for the one in question. REFER to Section 501-09 . CLEAR any DTCs. TEST the system for normal operation. **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.
D13 CHECK FOR CORRECT SOD-L OPERATION	
• Connect all the disconnected connectors. • Disconnect the SOD-L connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SOD-L connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SOD-L . REFER to Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
D14 CHECK FOR CORRECT SOD-R OPERATION	
• Connect all the disconnected connectors.	**Yes** INSTALL a new SOD-R . REFER to

• Disconnect the SOD-R connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SOD-R connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test E: The Side Obstacle Detection Control Module - Right (SOD-R) Does Not Respond To The Scan Tool Or Cannot Be Configured

Refer to Wiring Diagrams Cell 136 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Emergency Messaging System for schematic and connector information.

Normal Operation

The Side Obstacle Detection Control Module - Left (SOD-L) and Side Obstacle Detection Control Module - Right (SOD-R) are identical modules except that the SOD-R uses an address ground pin for configuration. The address ground is necessary so that the Blind Spot Information System (BLISTM) or the Cross Traffic Alert (CTA) system can decipher beteen the SOD-R and the SOD-L during configuration. The SOD-R communicates over the Medium Speed Controller Area Network (MS-CAN).

This pinpoint test is intended to diagnose the following:

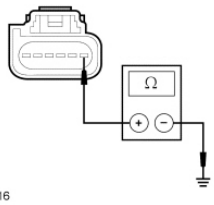
- Wiring, terminals or connectors
- SOD-R

PINPOINT TEST E: THE SOD-R DOES NOT RESPOND TO THE SCAN TOOL OR CANNOT BE CONFIGURED

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
E1 VERIFY THE SOD-R PASSES THE NETWORK TEST	
• Enter the following diagnostic mode on the scan tool: Network Test . • Verify that the SOD-R passes the network test. • **Does SOD-R pass the network test?**	**Yes** The system is operating correctly at this time. The concern may have been caused by high network traffic or an intermittent problem. TEST the system for normal operation. **No** GO to E2 .
E2 CHECK THE SOD-R ADDRESS GROUND CIRCUIT FOR AN OPEN	

• Disconnect: Negative Battery Cable . • Disconnect: SOD-R C4229 . • Measure the resistance between the SOD-R C4229-1, circuit GD171 (BK/GY), harness side and ground.  N0099816 • **Is the resistance less than 5 ohms?**	**Yes** CONFIGURE the SOD-R . REFER to Section 418-01 . **No** REPAIR the circuit in question. TEST the system for normal operation.

Pinpoint Test F: The Instrument Panel Cluster (IPC) Message Center Displays A Blocked Sensor Message

Normal Operation

A blocked sensor message indicates that there is an obstruction on the rear bumper cover fascia that does not allow the radar from the Side Obstacle Detection Control Module - Right (SOD-R) and Side Obstacle Detection Control Module - Left (SOD-L) to penetrate. Wet mud, thick mud, heavy rain, heavy road splash from rain, snow or ice are possible obstructions.

If the system is in a blocked state, the radar misses targets, but still counts them. After approximately 4 counted/missed targets, the system sends a BLOCK SENSOR and BLIND SPOT NOT AVAILABLE or CTA NOT AVAILABLE message to the Instrument Panel Cluster (IPC).

This pinpoint test is intended to diagnose the following:

- SOD-L
- SOD-R

PINPOINT TEST F: THE IPC MESSAGE CENTER DISPLAYS A BLOCKED SENSOR MESSAGE

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

Test Step	Result / Action to Take
F1 INSPECT REAR BUMPER FASCIA COVER FOR DAMAGE	
• Inspect for damage on the rear bumper fascia cover and proper bracket connection to sheet metal .	**Yes** For the rear bumper cover, REPAIR or REPLACE the rear bumper cover as necessary. REFER to Section 501-19 . For the SOD-L or the SOD-R bracket, REPAIR or REPLACE the SOD-L or the SOD-R bracket. REFER to Side Obstacle Detection

• **Is the rear bumper fascia cover damaged or incorrect bracket connection?**	(SOD) Module in this section. TEST the system for normal operation. **No** GO to F2 .
F2 INSPECT THE SOD-R AND SOD-L FOR DEBRIS, MUD, SNOW OR ICE	
• Inspect for debris, mud, snow or ice on the rear bumper fascia cover and SOD-R and SOD-L module housing. • **Is the rear bumper fascia cover and radar unit obstructed or blocked due to the concerns above?**	**Yes** REMOVE and CLEAN the rear bumper fascia cover and module as necessary. Once the vehicle is cleaned, complete one key cycle and test drive the vehicle. The blocked module needs to detect an unblocked situation or 2 good detected vehicles or targets before clearing. TEST the system for normal operation. **No** For an inoperative SOD-L , GO to F3 . For an inoperative SOD-R , GO to F4 .
F3 CHECK FOR CORRECT SOD-L OPERATION	
• Disconnect the SOD-L connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SOD-L connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SOD-L . REFER to Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
F4 CHECK FOR CORRECT SOD-R OPERATION	
• Disconnect the SOD-R connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SOD-R connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SOD-R . REFER to Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test G: The Blind Spot Information System (BLISTM) and Cross Traffic Alert (CTA) System Cannot Be Turned Off In The Instrument Panel Cluster (IPC) Message Center

NOTE: The CTA system customer ON/OFF feature in theInstrument Panel Cluster (IPC) is not available on early build hybrid vehicles.

Normal Operation

The Side Obstacle Detection Control Module - Right (SOD-R) and Side Obstacle Detection Control Module - Left (SOD-L) communicate over the Medium Speed Controller Area Network (MS-CAN) with the Instrument Panel Cluster (IPC). The Blind Spot Information System (BLISTM) and the Cross Traffic Alert (CTA) system can be turned on and off through the message center which is part of the IPC . The CTA system cannot be disabled in the message center when the transaxle selector gear is in REVERSE (R).

NOTE: The BLISTM and/or CTA system are turned off for one key cycle only when using the message center switches. Permanently disabling the BLISTM and/or CTA system is carried out in the Integrated Diagnostic System (IDS) programmable parameters menu.

This pinpoint test is intended to diagnose the following:

- IPC
- SOD-R
- SOD-L

PINPOINT TEST G: THE BLISTM AND CTA SYSTEM CANNOT BE TURNED OFF IN THE IPC MESSAGE CENTER

Test Step	Result / Action to Take
G1 CHECK THE DTCs FROM BOTH THE CONTINUOUS AND ON-DEMAND IPC , SOD-R AND SOD-L SELF-TESTS	
• Check the IPC , SOD-R and SOD-L DTCs from the continuous and on-demand self-tests. • **Are any IPC , SOD-R or SOD-L DTCs recorded?**	**Yes** For IPC , REFER to Section 413-01 . REPAIR all IPC DTCs and RETEST the BLISTM and CTA system for normal operation. For SOD-R or SOD-L DTCs, REFER to the DTC Charts in this section. **No** GO to G2 .
G2 CHECK THE MESSAGE CENTER FOR CORRECT OPERATION	
• Check the message center for correct operation, while turning the BLISTM and CTA system off and on. • **Does the message center operate correctly?**	**Yes** The system is operating correctly at this time. **No** REFER to Section 413-01 to diagnose the message center not operating correctly.

Pinpoint Test H: DTC U3000:44,45,46,48,49 Or 4A /b>

Normal Operation

On each ignition cycle, the Side Obstacle Detection Control Module - Right (SOD-R) and Side Obstacle Detection Control Module - Left (SOD-L) run a self-diagnostic check during which the exterior mirror BLISTM / CTA LEDs illuminate for 3 seconds then turn off indicating the system is operational. If a DTC fault is present, a system fault message is displayed in the message center.

DTC Description	Fault Trigger Conditions
• DTC U3000:44 - Control Module: Data Failure	sets when the SOD-R or SOD-L detects an internal RAM memory failure.
• DTC U3000:45 - Control Module: Program Memory Failure	sets when the SOD-R or SOD-L detects an internal softwareure.
• DTC U3000:46 - Control Module: Calibration/Parameter Memory Failure	sets when the SOD-R or SOD-L detects a failure with the EEPROM.
• DTC U3000:48 - Control Module: Supervision Software Failure	sets when the SOD-R or SOD-L detects a calibration failure.
• DTC U3000:49 - Control Module: Internal Electronic Failure	sets when the SOD-R or SOD-L detects an internal electronic communication failure.
• DTC U3000:4A - Control Module: Incorrect Component Installed	sets when the SOD-R or SOD-L detects a weak or no sample radar signal.

This pinpoint test is intended to diagnose the following:

- SOD-R
- SOD-L

PINPOINT TEST H: DTC U3000:44,45,46,48,49 OR 4A

Test Step	Result / Action to Take
H1 CHECK THE SOD-R and SOD-L FOR DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SOD-R and SOD-L Module Self-Test . • Clear the DTCs. • Ignition OFF. • Wait 5 seconds • Ignition ON.	**Yes** INSTALL a new SOD-R or SOD-L . REFER to Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by an intermittent problem.

• Repeat the SOD-R and SOD-L module self-test. • **Are any U3000 DTCs present?**	

Pinpoint Test I: The Left Or Right Exterior Mirror Blind Spot Information System (BLISTM)/Cross Traffic Alert (CTA) LED Appears Dim Or Does Not Illuminate With No DTC Or Message In The Instrument Panel Cluster (IPC) Message Center Present

Refer to Wiring Diagrams Cell 136 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Vehicle Emergency Messaging System for schematic and connector information.

Normal Operation

For the Blind Spot Information System (BLISTM), the exterior mirror BLISTM /Cross Traffic Alert (CTA) LED is at 95 percent illumination to be seen clearly during the day and is dimmed down to 10 percent at night. For the CTA system, the exterior mirror BLISTM / CTA LED is always at 85 percent illumination.

This pinpoint test is intended to diagnose the following:

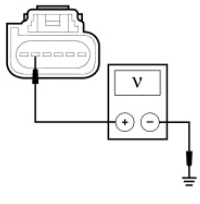
- Wiring, terminals or connectors
- Side Obstacle Detection Control Module - Right (SOD-R)
- Side Obstacle Detection Control Module - Left (SOD-L)
- Exterior mirror BLISTM / CTA LED

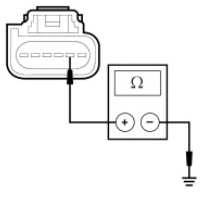
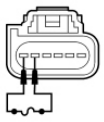
PINPOINT TEST I: THE LEFT OR RIGHT EXTERIOR MIRROR BLISTM / CTA LED APPEARS DIM OR DOES NOT ILLUMINATE WITH NO DTC OR MESSAGE IN THE IPC MESSAGE CENTER PRESENT

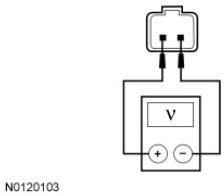
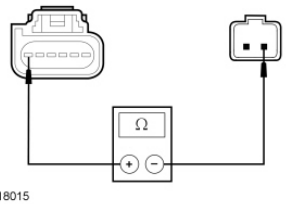
NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
I1 VERIFY THE CUSTOMER'S CONCERN	
• Carry out the diagnostic system check. • Start the engine. • Observe the left and right exterior mirror BLISTM / CTA LEDs and compare the illumination in each mirror. • **Is one LED noticeably dimmer than the other?**	**Yes** GO to I2 . **No** The concern may be due to customer perception or ambient lighting conditions. TEST the system for normal operation.
I2 VERIFY THE EXTERIOR MIRROR BLISTM / CTA LED OPERATION	
• Ignition OFF. • Apply the park brake. • Ignition ON. • Select REVERSE. • Enter the following diagnostic mode on the scan tool: SOD-R and/or SOD-L DataLogger .	**Yes** The concern may be due to customer perception, ambient lighting conditions or system functionality. TEST the system for normal operation. **No**

• **NOTE:** The SOD-R and SOD-L are separate modules and the active command PID needs to be commanded on in each individual module. • Select the SOD-R or SOD-L PID (CTALERT) and active command the LED ON. • Observe the left and/or right exterior mirror BLISTM / CTA LED and message center. • **Does the LED blink brightly, audible tone and a message in the message center display CTA ALERT?**	GO to I3 .
I3 CHECK THE SOD-R OR SOD-L VOLTAGE SUPPLY CIRCUIT	
• Ignition OFF. • Disconnect: SOD-L C4230 (LH concern) . • Disconnect: SOD-R C4229 (RH concern) . • Ignition ON. • For a LH concern, measure the voltage between the SOD-L C4230-5, circuit CBP35 (YE/GY), harness side and ground. • For a RH concern, measure the voltage between the SOD-R C4229-5, circuit CBP35 (YE/GY), harness side and ground.  N0099536 • **Is the voltage greater than 10 volts?**	**Yes** GO to I4 . **No** REPAIR the circuit in question. TEST the system for normal operation.
I4 CHECK THE SOD-R OR SOD-L GROUND CIRCUIT FOR AN OPEN	
• Ignition OFF. • Disconnect: Negative Battery Cable . • For a LH concern, measure the resistance between the SOD-L C4230-2, circuit GD171 (BK/GY), harness side and ground. • For a RH concern, measure the resistance between the SOD-R C4229-2, circuit GD171 (BK/GY), harness side and ground.	**Yes** GO to I5 . **No** REPAIR the circuit in question. TEST the system for normal operation.

 N0099537 • **Is the resistance less that 5 ohms?**	
I5 CHECK THE SUSPECTED EXTERIOR MIRROR BLISTM / CTA LED FOR ILLUMINATION	
• Connect: Negative Battery Cable . • Ignition OFF. • For a LH concern, connect a fused jumper wire between the SOD-L C4230-5, circuit CBP35 (YE/GY), harness side and the SOD-L C4230-6, circuit CRB04 (YE/GN), harness side. • For a RH concern, connect a fused jumper wire between the SOD-R C4229-5, circuit CBP35 (YE/GY), harness side and the SOD-R C4229-6, circuit CRB02 (BU/BN), harness side.  N0102472 • Ignition ON. • **Does the LED appear dim?**	**Yes** GO to I6 . **No** For a LH concern, INSTALL a new SOD-L . REFER to Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation. For a RH concern, INSTALL a new SOD-R . REFER to Side Obstacle Detection (SOD) Module in this section. TEST the system for normal operation.
I6 CHECK THE SUSPECTED EXTERIOR MIRROR BLISTM / CTA LED CIRCUITS	
• Ignition OFF. • Disconnect: Left Exterior Mirror BLISTM / CTA LED C576 (LH concern) . • Disconnect: Right Exterior Mirror BLISTM / CTA LED C676 (RH concern) . • Ignition ON. • For a LH concern, measure the voltage between the left exterior mirror BLISTM / CTA LED C576-1, harness side and the left exterior mirror BLISTM / CTA LED C576-2, harness side. • For a RH concern, measure the voltage between the right exterior mirror BLISTM / CTA LED C676-1, harness side and the right exterior mirror BLISTM / CTA LED C676-2, harness side.	**Yes** INSTALL a new exterior mirror glass for the LED in question. REFER to Section 501-09 . TEST the system for normal operation. **No** GO to I7 .

 N0120103 • **Is the voltage greater than 10 volts?**	
I7 CHECK THE SUSPECTED EXTERIOR MIRROR BLISTM / CTA LED VOLTAGE SUPPLY CIRCUIT FOR AN OPEN	
• Ignition OFF. • For a LH concern, measure the resistance between the SOD-L C4230-6, circuit CRB04 (YE/GN), harness side and left exterior mirror BLISTM / CTA LED C576-1, harness side. • For a RH concern, measure the resistance between the SOD-R C4229-6, circuit CRB02 (BU/BN), harness side and the right exterior mirror BLISTM / CTA LED C676-1, harness side.  N0118015 • **Is the resistance less than 5 ohms?**	**Yes** For a LH concern, REPAIR circuit GD126 (BK/WH) for an open. TEST the system for normal operation. For a RH concern, REPAIR circuit GD139 (BK/YE) for an open. TEST the system for normal operation. **No** For a LH concern, REPAIR circuit CRB04 (YE/GN) for an open. TEST the system for normal operation. For a RH concern, REPAIR circuit CRB02 (BU/BN) for an open. TEST the system for normal operation.

Pinpoint Test J: DTC U0155:00

Normal Operation

The Side Obstacle Detection Control Module - Right (SOD-R) and Side Obstacle Detection Control Module - Left (SOD-L) receive network messages from the Instrument Panel Cluster (IPC) via the Medium Speed Controller Area Network (MS-CAN). The following information is included in the messages:

- Transmission gear selected
- Vehicle speed

As more than one module receives these messages, all modules receiving a particular message should exhibit a symptom if the message is missing.

- DTC U0155:00 (Lost Communication With Instrument Panel Cluster (IPC) Control Module: No Sub Type Information) - set by the SOD-R or the SOD-L when network messages are missing from the IPC for greater than 2 seconds with the ignition in RUN.

This pinpoint test is intended to diagnose the following:

- Communication network concern

- Blind Spot Information System (BLISTM)/Cross Traffic Alert (CTA) system concern
- IPC

PINPOINT TEST J: DTC U0155:00

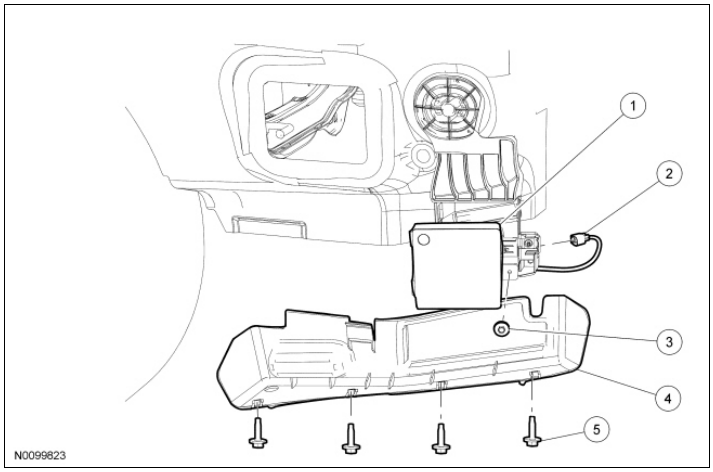
Test Step	Result / Action to Take
J1 VERIFY THE CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to J2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
J2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the IPC pass the network test?**	**Ye** GO to J3 . **No** REFER to Section 418-00 .
J3 RECHECK THE SOD-R OR THE SOD-L DTCs	
• Clear the DTCs. Repeat the SOD-R or the SOD-L self-test. • **Is DTC U0155:00 still present?**	**Yes** GO to J4 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
J4 CHECK FOR LOST COMMUNICATION DTCs	
• Ignition ON. • Clear continuous DTCs from all modules. • Ignition OFF. • Ignition ON. • Wait at least 10 seconds. • Retrieve all continuous DTCs from all modules. • **Is DTC U0155:00 set in any module?**	**Yes** GO to J5 . **No** The system is operating correctly at this time. The DTC may have been set due to an intermittent fault in the network wiring.
J5 CHECK FOR CORRECT IPC OPERATION	

• Disconnect the IPC connector. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the IPC connector and make sure it seats correctly. • **Is the concern still present?**	**Yes** INSTALL a new IPC . REFER to Section 413-01 . CLEAR all continuous DTCs. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR all continuous DTCs. REPEAT the self-test for the module(s) that set DTC U0155:00.

Side Obstacle Detection (SOD) Module

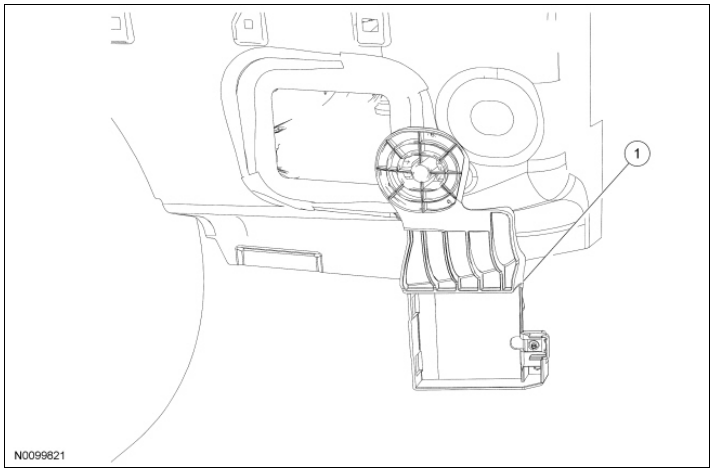
NOTE: Rear bumper cover removed for clarity.

NOTE: Left rear quarter panel shown, right side similar.



Item	Part Number	Description
1	14C689	Side Obstacle Detection Control Module - Left (SOD-L)/Side Obstacle Detection Control Module - Right (SOD-R)
2	-	SOD-L / SOD-R electrical connector (part of 15K868)
3	W705796	SOD-L / SOD-R screw and washer
4	-	Lower rear bumper quarter panel splash shield
5	-	Lower rear bumper quarter panel splash shield screws

Bracket



Item	Part Number	Description
1	14D190/14D189	SOD-L bracket/ SOD-R bracket

Removal and Installation

Side obstacle detection (SOD) module only

1. **NOTE:** Module configuration is only required if a new Side Obstacle Detection Control Module - Left (SOD-L) or Side Obstacle Detection Control Module - Right (SOD-R) is being installed. Upload the SOD-L or SOD-R module configuration information to the scan tool. For additional information, refer to Programmable Module Installation (PMI) in Section 418-01

   With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02 .

2. Remove the 3 rear fender splash shield push pins. For additional information, refer to Front End Body Panels - Exploded View in Section 501-19 .

3. Remove the 4 lower rear bumper quarter panel splash shield screws.

4. Remove the rear bumper cover screw and gently flex it to access the SOD-L or the SOD-R .
   - Remove the screw and washer.
   - Disconnect the electrical connector.

5. Remove the SOD-L or the SOD-R .

6. To install, reverse the removal procedure.
   - Download the SOD-L or the SOD-R configuration information. For additional information, refer to Section 418-01 .
   - **NOTE:** When enabling the Blind Spot Information System (BLIS®) and Cross Traffic Alert (CTA) system make sure to enable the systems in both the SOD-L and the SOD-R . Failure to do so results in a mismatch system fault.

     Verify in the programmable parameters that the Blind Spot Information System (BLIS®) and Cross Traffic Alert (CTA) system are enabled in the SOD-L and SOD-R .
   - After the SOD-L or the SOD-R is configured, shift the selector lever though all the transaxle gear positions (PRNDL).

SOD-L / SOD-R Bracket only

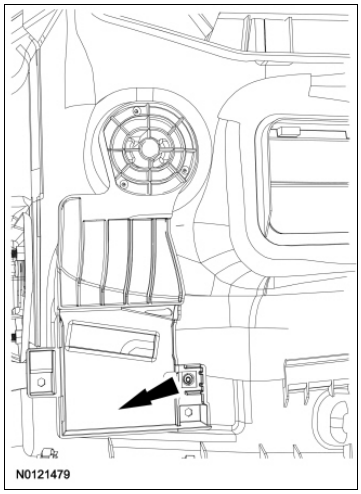
1. Remove the rear bumper cover. For additional information, refer to Section 501-19 .

8. Remove the SOD-L or the SOD-R .
   - Remove the screw and washer.
   - Disconnect the electrical connector and the wiring harness retainer.

9. **NOTE:** The SOD-L / SOD-R bracket has a strip of adhesive tape that holding it to the vehicle.

   Using a suitable tool, such as a flat-bladed scraper, pry the SOD-L / SOD-R bracket away from the vehicle.

   - To install, apply hand pressure over the adhesive tape bonding area for a minimum of 15 seconds.

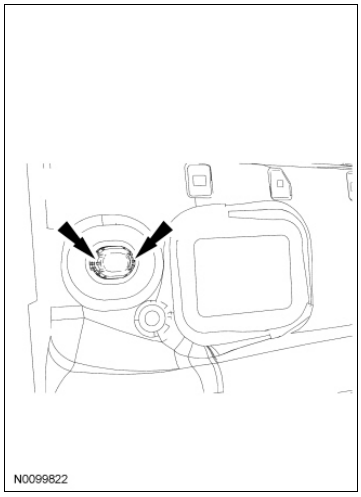


10. **NOTE:** Remove the adhesive tape protective cover before installing the retaining tabs in the vehicle body.

    NOTE: When installing the new SOD-L / SOD-R bracket, make sure the retaining tab portion of the SOD-L / SOD-R bracket snaps firmly into the vehicle and 2 audible clicks are heard.

    Using a suitable tool, such as pliers, squeeze the retaining tabs of the SOD-L / SOD-R bracket, located in the luggage compartment behind the side carpet panel, and remove the SOD-L / SOD-R bracket.

    - Discard the SOD-L / SOD-R bracket.



11. **NOTE:** Allow the adhesive tape bonding surface to completely dry before installing the new SOD-L / SOD-R bracket.

    Clean the adhesive tape bonding surface.

    - Using a flat bladed wood or plastic scraper remove the remaining adhesive from the vehicle body.
    - Clean the adhesive tape bonding surface on the vehicle body with isopropyl alcohol (obtain locally).

12. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Driver Door Module (DDM) nuts	3	27
Smart Junction Box (SJB) nuts	5	44

Module Controlled Functions

Smart Junction Box (SJB)

The Smart Junction Box (SJB) is located on the LH side cowl under the instrument panel and has control of the following systems:

- Interior lighting
- Exterior lighting
- Dimmable backlighting
- Battery saver function
- Delayed accessory relay function
- Global open function (MKZ)
- Horn
- Heated rear window
- Brake shift interlock
- Power door locks
- Remote Keyless Entry (RKE) system
- Perimeter alarm
- Tire Pressure Monitoring System (TPMS)

Refer to the appropriate section in this manual for system specific information and diagnostics.

Battery Saver

NOTE: Time-out is 1 minute if the vehicle has less than 80 km (50 miles).

The SJB provides automatic shut-off of some system controlled components after a time-out period in order to save battery voltage. A timer in the SJB is started when the ignition is turned OFF and all the doors are closed. When 10 minutes have elapsed, the voltage is automatically shut off by the SJB . While the SJB has voltage disabled, if the ignition changed out of OFF, any door becomes ajar, the UNLOCK button of the RKE transmitter is pressed, a valid keypad code is entered, or the instrument panel dimmer switch is pressed, the SJB restores voltage and starts the timer again.

Post Crash Alert Feature

The post crash alert is a function controlled by the SJB . If the Restraints Control Module (RCM) determines an impact of enough severity (the air bags may or may not be deployed), the post crash alert function is activated. The post-crash alert function activates the hazard lamp function and cycles the horn on 3 times, then off for 4 seconds, and repeats this cycle until the battery is discharged or the function is turned off. The post crash alert function can be turned off by:

- pressing the hazard flasher lamp switch (which may need to be pressed twice).
- pressing the RKE transmitter UNLOCK button.
- pressing the RKE transmitter PANIC button.

Diagnostic Trouble Code (DTC) Chart

Each module has a comprehensive DTC chart listed in an appropriate section. Refer to the table below for the appropriate section.

Master DTC Index

Module	Reference
ABS Module	REFER to Section 206-09 .
Accessory Protocol Interface Module (APIM)	REFER to Section 415-00 .
Air Conditioning Compressor Module (ACCM)	REFER to Section 412-00B .
Audio Control Module (ACM)	REFER to Section 415-00 .
Battery Energy Control Module (BECM)	REFER to Section 414-03 .
Digital Signal Processing (DSP)	REFER to Section 415-00 .
Driver Door Module (DDM)	REFER to Section 501-14 .
Driver Seat Module (DSM)	REFER to Section 501-10 .
Dual Climate Controlled Seat Module (DCSM)	REFER to Section 501-10 .
Front Controls Interface Module (FCIM)	REFER to Section 415-00 .
Front Display Interface Module (FDIM)	REFER to Section 415-00 .
Global Positioning System Module (GPSM)	REFER to Section 415-00 .
Headlamp Control Module (HCM)	REFER to Section 417-01 .
HVAC Module	For non-hybrid vehicles, REFER to Section 412-00A . For hybrid vehicles, REFER to Section 412-00B .
Instrument Panel Cluster (IPC)	REFER to Section 413-01 .
Interior Lighting Control Module (ILCM)	REFER to Section 417-02 .
Occupant Classification System Module (OCSM)	REFER to Section 501-20B .
Parking Aid Module (PAM)	REFER to Section 413-13 .
PCM	REFER to Section 303-14A , Section 303-14B , Section 303-14C or Section 303-14D .
Power Steering Control Module (PSCM)	REFER to Section 211-00A or Section 211-00B .
Restraints Control Module (RCM)	REFER to Section 501-20B .
Side Obstacle Detection Control Module - Left (SOD-L)	REFER to Section 419-04 .
Side Obstacle Detection Control Module - Right (SOD-R)	REFER to Section 419-04 .

Smart Junction Box (SJB)	REFER to the Smart Junction Box (SJB) DTC Chart in this section.
Transmission Control Module (TCM) (Aisin AW21)	REFER to Section 307-01A .
4X4 control module	REFER to Section 308-07A .
DC to DC Converter Control Module (DC/DC)	REFER to Section 414-05 .

Smart Junction Box (SJB)

Special Tool(s)

 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent

Principles of Operation

NOTE: The Smart Junction Box (SJB) is also known as the Generic Electronic Module (GEM).

The SJB controls various systems (such as exterior lighting, interior lighting, power door locks, anti-theft system, dimmable backlighting and the battery saver feature) by monitoring inputs from switches, sensors and messages sent from other modules on the Medium Speed Controller Area Network (MS-CAN). Based on the inputs received, the SJB activates outputs. For example, the SJB monitors the headlamp switch position. Based on this input, the SJB may provide voltage to the exterior lamps.

Field-Effect Transistor (FET) Protection

A Field-Effect Transistor (FET) is a type of transistor that when used with module software can be used to monitor and control current flow on module outputs. The FET protection strategy is used to prevent module damage in the event of excessive current flow.

The SJB utilizes an FET protective circuit strategy for many of its outputs (for example, a headlamp output circuit). Output loads (current level) are monitored for excessive current (typically short circuits) and are shut down (turns off the voltage or ground provided by the module) when a fault event is detected. A short circuit DTC is stored at the fault event and a cumulative counter is started.

When the demand for the output is no longer present, the module resets the FET circuit protection to allow the circuit to function. The next time the driver requests a circuit to activate that has been shut down by a previous short (FET protection) and the circuit is still shorted, the FET protection shuts off the circuit again and the cumulative counter advances.

When the excessive circuit load occurs often enough, the module shuts down the output until a repair procedure is carried out. Each FET protected circuit has 3 predefined levels of short circuit tolerance based on the harmful effect of each circuit fault on the FET and the ability of the FET to withstand it. A module lifetime level of fault events is established based upon the durability of the FET . If the total tolerance level is determined to be 600 fault events, the 3 predefined levels would be 200, 400 and 600 fault events.

When each tolerance level is reached, the short circuit DTC that was stored on the first failure cannot be cleared by a command to clear the continuous DTCs. The module does not allow this code to be cleared or the circuit restored to normal operation until a successful self-test proves that the fault has been repaired. After the self-test has successfully completed (no on-demand DTCs present), DTC B106E and the associated DTC (the DTC related to the shorted circuit) automatically clears and the circuit function returns.

When each level is reached, the DTC associated with the short circuit sets along with DTC B106E. These DTCs can be cleared using the module on-demand self-test, then the Clear DTC operation on the scan tool (if the on-demand test shows the fault corrected). The module never resets the fault event counter to zero and continues to advance the fault event counter as short circuit fault events occur.

If the number of short circuit fault events reach the third level, then DTCs B106F and B1342 set along with the associated short circuit DTC. DTC B106F cannot be cleared and the module must be replaced after the repair.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Smart Junction Box (SJB) fuse 5 (10A) • Wiring, terminals or connectors • Smart Junction Box (SJB)

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

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

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

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

   If the scan tool does not communicate with the VCM

   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00 , No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:
   - verify the ignition is ON.

- ♦ The air bag warning indicator prove-out confirms ignition ON (other indicators may not prove ignition ON). If the ignition does not turn on, refer to Section 211-05 to diagnose no power in RUN.
- verify the scan tool operation with a known good vehicle.
- refer to Section 418-00 to diagnose no response from the PCM.

7. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00 .
   - If the network test passes, retrieve and record the continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the SJB .

9. If the DTCs retrieved are related to the concern, go to DTC Charts. For all other DTCs, refer to Diagnostic Trouble Code (DTC) Chart in this section.

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

DTC Charts

Smart Junction Box (SJB) DTC Chart

DTC	Description	Action
B106B	Tire Pressure Sensor Low Battery	REFER to Section 204-04 .
B106D	Tire Pressure Monitor System (TPMS) Initiators Not Configured	REFER to Section 204-04 .
B106E	Solid State Driver Disabled Due to Short Circuit	GO to Pinpoint Test A .
B106F	Module Disabled Due to External Fault	GO to Pinpoint Test A .
B1138	Memory Full	REFER to Section 419-01B .
B1139	Invalid Transmitter Identification Code	REFER to Section 501-14 .
B1302	Accessory Delay Relay Coil Circuit Failure	REFER to Section 501-11 .
B1304	Accessory Delay Relay Coil Circuit Short to Battery	REFER to Section 501-11 .
B1317	Battery Voltage High	GO to Pinpoint Test B .
B1318	Battery Voltage Low	GO to Pinpoint Test C .
B1320	Driver Door Ajar Circuit Open	REFER to Section 417-02 .
B1328	Passenger Door Ajar Circuit Open	REFER to Section 417-02 .
B1331	Decklid Ajar Rear Door Circuit Failure	REFER to Section 417-02 .
B1336	Door Ajar RR Circuit Open	REFER to Section 417-02 .
B1342	ECU is Faulted	DIAGNOSE all other DTCs first. If no other DTCs are present, INSTALL a new SJB . REFER to Smart Junction Box (SJB) in this

		section. TEST the system for normal operation.
B1352	Ignition Key-In Circuit Failure	REFER to Section 413-01 .
B1472	Lamp Headlamp Input Circuit Short to Ground	REFER to Section 417-01 .
B1485	Brake Pedal Input Short to Battery	REFER to Section 417-01 .
B1510	Flash to Pass Switch Circuit Short to Ground	REFER to Section 417-01 .
B1520	Hood Switch Circuit Open	REFER to Section 419-01A .
B1572	Door Ajar LR Circuit Open	REFER to Section 417-02 .
B1578	Lamp Park Input Circuit Short to Ground	REFER to Section 417-01 .
B1624	Lamp Keypad Output Open Circuit	REFER to Section 501-14 .
B1626	Lamp Keypad Output Short Circuit to Ground	REFER to Section 501-14 .
B1696	Autolamp On Circuit Short to Ground	REFER to Section 417-01 .
B1791	Autolamp Sensor Input Circuit Open	REFER to Section 417-01 .
B1793	Autolamp Sensor Input Circuit Short To Ground	REFER to Section 417-01 .
B2008	Wipers On Signal Circuit Short To Ground	REFER to Section 417-01 .
B2044	Left Rear Stop Lamp Circuit Short To Ground	REFER to Section 417-01 .
B2045	Left Rear Stop Lamp Circuit Open	REFER to Section 417-01 .
B2046	Right Rear Stop Lamp Circuit Short To Ground	REFER to Section 417-01 .
B2047	Right Rear Stop Lamp Circuit Open	REFER to Section 417-01 .
B2048	Left Rear Turn Lamp Circuit Short To Ground	REFER to Section 417-01 .
B2049	Left Rear Turn Lamp Circuit Open	REFER to Section 417-01 .
B2050	Right Rear Turn Lamp Circuit Short To Ground	REFER to Section 417-01 .
B2051	Right Rear Turn Lamp Circuit Open	REFER to Section 417-01 .
B2071	Hazard Switch Signal Short To Ground	REFER to Section 417-01 .
B2100	Door Driver Key Cylinder Switch Failure	REFER to Section 419-01A .
B2108	Trunk Key Cylinder Switch Failure	REFER to Section 419-01A .
B213A		REFER to Section 413-00 .

	Digital Dimmer Switch Input Circuit Failure	
B2254	Front Fog Lamp Switch Failure	REFER to Section 417-01 .
B2276	Less Than 2 Transmitters Programmed	REFER to Section 501-14 .
B2281	Right Turn Switch Short To Ground	REFER to Section 417-01 .
B2282	Left Turn Switch Short To Ground	REFER to Section 417-01 .
B2425	Remote Keyless Entry Out Of Synchronization	REFER to Section 501-14 .
B2477	Module Configuration Failure	CARRY OUT Programmable Module Installation (PMI) on the SJB . REFER to Section 418-01 .
B2479	Park Brake Switch Circuit Short To Ground	REFER to Section 413-01 .
B2498	Headlamp Switch Multiple Signals Input Active	REFER to Section 417-01 .
B2572	Brake Shift Interlock Output Circuit Failure	For non-Hybrid vehicles, REFER to Section 307-05A . For Hybrid vehicles, REFER to Section 307-05B .
B2667	Liftglass Release Switch Circuit Failure	REFER to Section 501-14 .
B2844	Ignition Fault	REFER to Section 211-05 .
B2868	Left Front Tire Pressure Sensor Fault	REFER to Section 204-04 .
B2869	Right Front Tire Pressure Sensor Fault	REFER to Section 204-04 .
B2870	Right Rear Tire Pressure Sensor Fault	REFER to Section 204-04 .
B2871	Left Rear Tire Pressure Sensor Fault	REFER to Section 204-04 .
B2872	Tire Pressure Sensor Fault	REFER to Section 204-04 .
B287A	Tire Pressure System Fault	REFER to Section 204-04 .
B2947	Global Opening/Closing Circuit Open	REFER to Section 501-11 .
B2949	Global Opening/Closing Circuit Short to Battery	REFER to Section 501-11 .
B29B7	White Lighting Output Circuit Open	REFER to Section 413-00 .
B29B8	White Lighting Output Circuit Short To Ground	REFER to Section 413-00 .
B2A20	Ignition Stuck In START	REFER to Section 211-05 .
B2A21	One or More Configuration Files Missing Or Corrupt	CARRY OUT Programmable Module Installation (PMI) on the SJB . REFER to Section 418-01 . CLEAR the DTCs. REPEAT the self-test. If DTC B2A21 is retrieved again, INSTALL a new SJB . REFER to Smart Junction Box (SJB) in this section. TEST the system for normal operation.

B2A22	Headlamp OFF Circuit Open	REFER to Section 417-01 .
B2A23	High Beam Input Circuit Short To Ground	REFER to Section 417-01 .
B2A24	Turn Signal Input Circuit Failure	REFER to Section 417-01 .
B2A25	Trim Panel Lock Switch Circuit Failure	REFER to Section 501-14 .
B2A26	Keypad Switch Circuit Failure	REFER to Section 501-14 .
B2A27	Right Front Turn Lamp Circuit Open	REFER to Section 417-01 .
B2A28	Right Front Turn Lamp Circuit Short To Ground	REFER to Section 417-01 .
B2A29	Left Front Turn Lamp Circuit Open	REFER to Section 417-01 .
B2A2A	Left Front Turn Lamp Circuit Short To Ground	REFER to Section 417-01 .
B2A2E	Right Front Lamp Low Beam Circuit Open	REFER to Section 417-01 .
B2A2F	Right Front Lamp Low Beam Circuit Short To Ground	REFER to Section 417-01 .
B2A30	Left Front Lamp Low Beam Circuit Open	REFER to Section 417-01 .
B2A31	Left Front Lamp Low Beam Circuit Short To Ground	REFER to Section 417-01 .
B2A32	LED Backlighting Output Circuit Open	REFER to Section 413-00 .
B2A33	LED Backlighting Output Circuit Short To Ground	REFER to Section 413-00 .
B2A35	Interior Lighting Output Circuit Open	REFER to Section 417-02 .
B2A36	Interior Lighting Output Circuit Short To Ground	REFER to Section 417-02 .
B2A39	Puddle Lamp Output Circuit Open	REFER to Section 417-02 .
B2A3A	Puddle Lamp Output Circuit Short To Ground	REFER to Section 417-02 .
C1125	Brake Fluid Level Sensor Input Circuit Failure	REFER to Section 413-01 .
C2780	ECU in Manufacturer Sub-State	REFER to Section 204-04 .
P062F	Internal Control Module EEPROM Error	CARRY OUT Programmable Module Installation (PMI). REFER to Section 418-01 . CLEAR the DTCs. REPEAT the self-test. If DTC P062F is retrieved again, INSTALL a new SJB . REFER to Smart Junction Box (SJB) in this section. TEST the system for normal operation.
U0155	Lost Communication With Instrument Panel Cluster	GO to Pinpoint Test D .

	(IC) Control Module	
U2050	No Application Present	CARRY out Programmable Module Installation (PMI) for the SJB . REFER to Section 418-01 . CLEAR the DTCs. REPEAT the self-test. If DTC U2050 is retrieved again, INSTALL a new SJB . REFER to Smart Junction Box (SJB) in this section. TEST the system for normal operation.
U2472	Unexpected Ignition State	REFER to Section 211-05 .
U2473	Unexpected Vehicle Speed (VSS)	**NOTE:** Sets during the self-test if vehicle speed exceeds 3 mph (5 kph) or vehicle speed cannot be determined by the SJB . VERIFY the speedometer operates correctly. If the speedometer does not operate correctly, REFER to Section 413-01 . If the speedometer operates correctly, the self-test is carried out while the vehicle is moving. STOP the vehicle and REPEAT the self-test.

Symptom Chart

Symptom Chart

Pinpoint Tests

Pinpoint Test A: DTCs B106E, B106F

Normal Operation

The Smart Junction Box (SJB) controls the output of several vehicle systems by means of solid state drivers. A DTC sets when an overload occurs on any of these drivers. The module also tracks the number of repetitive faults on each of these circuits, and then it compares said number of overloads to 3 progressive thresholds established for each circuit. If the third threshold has not been met, the DTC for the affected circuit can be cleared by eliminating the fault, clearing the DTCs and then running a self-test.

At the point that each of the first 2 thresholds is met, DTC B106E sets along with a DTC related to the affected circuit. Once the final (third) threshold has been met, the affected output is permanently disabled, and DTC B106F sets, at which time the SJB must be replaced.

- DTC B106E (Solid State Driver Disabled Due to Short Circuit) - a continuous DTC that sets when the SJB has disabled an output circuit due to a repetitive fault that overloads said circuit. A corresponding DTC for the circuit in question is also set.

- DTC B106F (Module Disabled Due to External Fault) - a continuous DTC that sets when the SJB has permanently disabled one or more output functions due to a repetitive circuit overload. DTC B1342 also sets at this time.

When DTC B1342 is set because the module has reached a third threshold and the SJB has permanently disabled an output, no DTCs can be cleared from the SJB . Using the module self-test to confirm a repair is not possible and a measurement using a digital multimeter of the affected output circuit is required to make

sure the fault condition no longer exists.

This pinpoint test is intended to diagnose the following:

- Output circuit short
- SJB

PINPOINT TEST A: DTCs B106E, B106F

Test Step	Result / Action to Take
A1 REVIEW THE DTCs	
NO: **First follow the necessary diagnostics to resolve DTC B106E and any other present DTCs (ignoring B106F). DTC B106E is only present when there is another DTC due to software or circuitry issues that must be resolved before another self-test is run. DTC B106F is only present once the final threshold has been met. Failure to correct the fault condition first may cause damage to the new SJB , resulting in a repeat repair.** • Review the DTCs from the SJB self-test. • **Are any other DTCs present, besides B106E, B106F or B1342?**	**Yes** CORRECT the DTCs. REFER to the Smart Junction Box (SJB) DTC chart in this section. After the repair, GO to A2 . **No** GO to A2 .
A2 REPEAT THE SJB SELF-TEST	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Clear the DTCs and repeat the SJB self-test. • **Is DTC B106F or DTC B1342 present?**	**Yes** INSTALL a new SJB . REFER to Smart Junction Box (SJB) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The circuit short has been repaired.

Pinpoint Test B: DTC B1317

Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

Normal Operation

- DTC B1317 (Battery Voltage High) - a continuous and on-demand DTC that sets when the SJB detects battery voltage above 15.5 volts.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- SJB

PINPOINT TEST B: DTC B1317

NOTE: DTC B1317 may be stored in the module memory due to previous battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
B1 CHECK FOR DTC B1317, B1676 OR P0563 SET IN OTHER MODULES	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: (All Modules) Self-Test. • Retrieve the continuous memory DTCs from all modules. • **Is DTC B1317, B1676 or P0563 (PCM) set in more than one module?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to B2 .
B2 CHECK THE BATTERY VOLTAGE	
• Turn off all interior/exterior lights and accessories. • Start and run the engine at approximately 2,000 rpm for 3 minutes while monitoring the battery voltage. • **Does the battery voltage rise to 15.5 volts or higher?**	**Yes** REFER to Section 414-00 to diagnose an overcharging condition. **No** GO to B3 .
B3 RECHECK FOR DTC B1317	
• Turn the engine off. • Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Clear the continuous memory DTCs. • Carry out the SJB self-test. • **Is DTC B1317 present?**	**Yes** INSTALL a new SJB . REFER to Smart Junction Box (SJB) in this section. TEST the system for normal operation. **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.

Pinpoint Test C: DTC B1318

Refer to Wiring Diagrams Cell 13 (Fusion/MKZ , Fusion Hybrid/MKZ Hybrid), Power Distribution/SJB for schematic and connector information.

Normal Operation

- DTC B1318 (Battery Voltage Low) - a continuous and on-demand DTC that sets when the SJB detects battery voltage below 10 volts.

This pinpoint test is intended to diagnose the following:

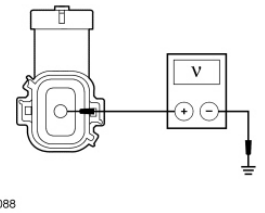
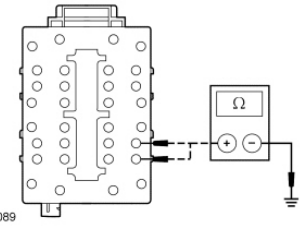
- Wiring, terminals or connectors
- High circuit resistance
- SJB

PINPOINT TEST C: DTC B1318

NOTICE: **Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

NOTE: Failure to disconnect the battery when instructed will result in false resistance readings. Refer to Section 414-01 .

Test Step	Result / Action to Take
C1 RECHECK THE SJB DTCs	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: SJB Self-Test. • Clear the DTCs. Repeat the SJB self-test. • **Is DTC B1318 still present?**	**Yes** GO to C2 . **No** The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.
C2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM	
• Enter the following diagnostic mode on the scan tool: PCM Self-Test. • Retrieve the continuous memory DTCs from the PCM. • **Is DTC P0620, P0625, P0626 or P065B set in the PCM?**	**Yes** REFER to Section 414-00 . **No** GO to C3 .
C3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE	
• Ignition OFF. • Check the battery condition and verify the battery is fully charged. Refer to Section 414-01 . • **Is the battery OK and fully charged?**	**Yes** GO to C4 . **No** REFER to Section 414-00 .
C4 CHECK THE SJB VOLTAGE SUPPLY	
• Measure and record the voltage at the battery. • Disconnect: SJB C2280G. • Ignition ON. • Measure the voltage between the SJB C2280G-1, circuit SDC02 (RD), harness side and ground.	**Yes** GO to C5 . **No** REPAIR the circuit for high resistance. CLEAR the DTC. REPEAT the self-test.

 N0082088 • **Is the voltage within 0.2 volt of the recorded battery voltage?**	
C5 CHECK THE SJB GROUND CIRCUIT	
• Ignition OFF. • Disconnect: Negative Battery Cable. • Disconnect: SJB C2280D. • Measure the resistance between the SJB C2280D-8, circuit GD126 (BK/WH), harness side and ground; and between the SJB C2280D-12, circuit GD126 (BK/WH), harness side and ground.  N0082089 • **Are the resistances less than 5 ohms?**	**Yes** CONNECT the negative battery cable. GO to C6 . **No** REPAIR the circuit for high resistance. CONNECT the negative battery cable. TEST the system for normal operation.
C6 CHECK FOR CORRECT SJB OPERATION	
• Disconnect the SJB connectors. • Check for: ♦ corrosion ♦ damaged pins ♦ pushed-out pins • Connect the SJB connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new SJB . REFER to Smart Junction Box (SJB) in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

Pinpoint Test D: DTC U0155

Normal Operation

- DTC U0155 (Lost Communication With Instrument Panel Cluster (IC) Control Module) - a continuous DTC that sets when the SJB does not receive messaged data (loses communication) from the Instrument Panel Cluster (IPC) for longer than 5 minutes.

This pinpoint test is intended to diagnose the following:

- Module communication
- IPC

- SJB

PINPOINT TEST D: DTC U0155

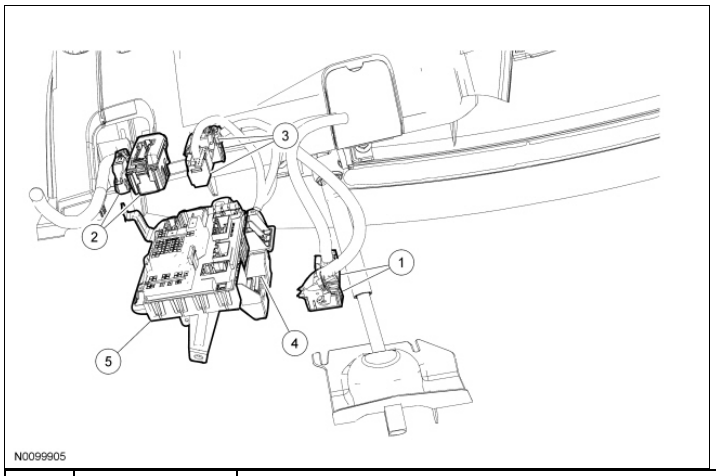
Test Step	Result / Action to Take
D1 VERIFY CUSTOMER CONCERN	
• Ignition ON. • Verify that there is an observable symptom present. • **Is an observable symptom present?**	**Yes** GO to D2 . **No** The system is operating normally at this time. The DTC may have been set due to high network traffic or intermittent fault condition.
D2 CHECK THE COMMUNICATION NETWORK	
• Ignition ON. • Enter the following diagnostic mode on the scan tool: Network Test . • Carry out the network test. • **Does the IPC pass the network test?**	**Yes** GO to D3 . **No** REFER to Section 418-00 , The IPC Does Not Respond To The Scan Tool.
D3 RETRIEVE THE RECORDED DTCs FROM THE SELF-TEST	
• Check for recorded SJB DTCs from the self-test. • **Is DTC B1317 or B1318 recorded?**	**Yes** For DTC B1317, GO to Pinpoint Test B . For DTC B1318, GO to Pinpoint Test C . **No** GO to D4 .
D4 RECHECK THE SJB DTCs	
NOTE: If new modules were installed prior to the DTC being set, the module configuration may be incorrectly set during Programmable Module Installation (PMI) or the PMI may not have been carried out. • Clear the DTCs. Repeat the SJB self-test. • **Is DTC U0155 still present?**	**Yes** GO to D5 . **No** The system is operating correctly at this time. The DTC may have been set due to high network traffic or intermittent fault condition.
D5 CHECK FOR DTC U0155 OR DTC U0155:00 IN OTHER MODULES	
• Clear the DTCs. • Ignition OFF. • Ignition ON. • Wait 10 seconds.	**Yes** INSTALL a new IPC . REFER to Section 413-01 . TEST the system for normal operation. **No**

• Enter the following diagnostic mode on the scan tool: Self-Test . • Retrieve the continuous memory DTCs from all modules. • **Is DTC U0155 or DTC U0155:00 set in any other module?**	INSTALL a new SJB . REFER to Smart Junction Box (SJB) in this section. TEST the system for normal operation.

Smart Junction Box (SJB)

Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool



Item	Part Number	Description
1	-	Smart Junction Box (SJB) electrical connectors (part of 14401) (2 required)
2	-	SJB electrical connectors (part of 14A005) (2 required)
3	-	SJB electrical connectors (part of 14290) (2 required)
4	-	SJB locking tab
5	-	SJB

Removal

NOTICE: **Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage to the module may result.**

NOTE: Prior to the removal of the module, it is necessary to upload the module configuration information to the appropriate scan tool. This information needs to be downloaded into the new module once installed. For additional information, refer to Section 418-01 .

NOTE: The Tire Pressure Monitoring System (TPMS) functionality is integral to the Smart Junction Box (SJB).

NOTE: A new SJB is delivered in a "manufacturing mode" with 7 pre-set DTCs. In order to clear the 7 pre-set manufacturing mode DTCs, the following must occur:

- A successful configuration of the SJB .

- A successful TPMS sensor training.
- A successful self-test including the clearing of all DTCs.

NOTE: The DTC B106D is present when the SJB is not configured, even on applications that are not equipped with initiators.

- The 7 manufacturing mode DTCs are:
  - ♦ B106D (Tire Pressure Monitor System [TPMS] Initiators Not Configured)
  - ♦ B2477 (Module Configuration Failure)
  - ♦ B2868 (Left Front Tire Pressure Sensor Fault)
  - ♦ B2869 (Right Front Tire Pressure Sensor Fault)
  - ♦ B2870 (Right Rear Tire Pressure Sensor Fault)
  - ♦ B2871 (Left Rear Tire Pressure Sensor Fault)
  - ♦ C2780 (ECU in Manufacturer Sub-State)

1. **NOTE:** This step is only necessary if the SJB is being replaced.

   Upload the module configuration information from the SJB into the scan tool. For additional information, refer to Section 418-01 .

2. Disconnect the 7 electrical connectors.

3. Lift the SJB locking tab outward and slide the SJB upward to disengage it from the SJB bracket.

Installation

1. Position the SJB into the 3 keyholes of the SJB bracket and slide it downward until the SJB locking tab snaps into place.

2. **NOTE:** If the SJB is not being replaced, this is the last step that is necessary.

   Connect the 7 electrical connectors.

3. **NOTE:** If the Programmable Module Installation (PMI) procedure was not followed when a new SJB was installed, the Remote Keyless Entry (RKE) function (from the Integrated Keyhead Transmitter (IKT)) of the SJB must be programmed, or the IKT RKE functions is inoperative. IKTs can be programmed to the new SJB by cycling each IKT key to the ON position for a minimum of 6 seconds. If a new Instrument Panel Cluster (IPC) was installed, the IKT keys must be programmed to the new IPC . For additional information, refer to Section 419-01B .

   NOTE: DTC B2276 may be set, indicating there are less than 2 transmitters programmed to the SJB . For additional information, refer to Section 501-14 .

   Download the SJB configuration information from the scan tool to the SJB . For additional information, refer to Section 418-01 .

4. Train the tire pressure sensors. For additional information, refer to Section 204-04 .

5. **NOTE:** DTC C2780 cannot be cleared if any other DTCs are present in the SJB . When successful, this step clears the DTC C2780.

   Carry out the SJB self-test (must include an on-demand self-test) by clearing the DTCs, and then retrieving the DTCs to confirm all DTCs have been cleared.

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Interior Trim - Exploded View

A-Pillar Trim Panel

B-Pillar Trim Panel

C-Pillar Trim Panel

Door Trim Panel - Front

Door Trim Panel - Rear

Headliner

Parcel Shelf

Scuff Plate Trim Panel - Front

Scuff Plate Trim Panel - Front, Lighted Outer

Scuff Plate Trim Panel - Rear

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GROUP 01: Body

SECTION 501-08:
Exterior Trim and Ornamentation

SPECIFICATIONS

REMOVAL AND INSTALLATION

Radiator Grille - MKZ

Radiator Grille - Fusion

Spoiler

Applique - Luggage Compartment Lid

Beltline Moulding - Front Door

Beltline Moulding - Rear Door

Rocker Panel Moulding

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GROUP 01: Body

SECTION 501-09:
Rear View Mirrors

SPECIFICATIONS

DESCRIPTION AND OPERATION

Rear View Mirrors

Exterior Mirrors

Interior Mirror

DIAGNOSIS AND TESTING

Rear View Mirrors - Exterior

Principles of Operation

Inspection and Verification

DTC Charts

Driver Door Module (DDM) DTC Chart

Driver Seat Module (DSM) DTC Chart

Symptom Chart - Exterior Mirrors

Symptom Chart - NVH

Pinpoint Tests

Rear View Mirrors - Interior

Principles of Operation

Inspection and Verification

Symptom Chart - Interior Mirror

Symptom Chart - NVH

Pinpoint Tests

REMOVAL AND INSTALLATION

Exterior Mirrors - Exploded View

Exterior Mirror

Exterior Mirror Glass

Exterior Mirror Motor

Exterior Mirror Cover

Exterior Mirror Control Switch

Interior Rear View Mirror

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GROUP 01: Body

SECTION 501-10:
Seating

SPECIFICATIONS

DESCRIPTION AND OPERATION

Seats

Front Seats

Rear Seats

DIAGNOSIS AND TESTING

Seats

Medium Speed Controller Area Network (MS-CAN)

Principles of Operation

Driver and Passenger Power Seats Without Memory

Power Driver Seat With Memory

Easy Exit/Easy Entry

Heated Seats

Climate Controlled Seat System

Heating Characteristics

Cooling Characteristics

Climate Controlled Seat System Recovery Mode

Inspection and Verification

DTC Charts

Driver Door Module (DDM) DTC Chart

Driver Seat Module (DSM) DTC Chart

Dual Climate Controlled Seat Module (DCSM) DTC Chart

HVAC Module DTC Chart

Symptom Chart

Pinpoint Tests

Component Test

Component Testing - Thermo-Electric Device (TED) Cooling Performance

GENERAL PROCEDURES

Heated Seat Module Reset

Memory Position Programming

Programming Memory Positions

Recalling a Stored Memory Position

Seat Latch Adjustment - Rear

REMOVAL AND INSTALLATION

Seat - Front

Seat - Exploded View, Front

Head Restraint Guide Sleeve

Seat Backrest - Front

Seat Backrest Cover - Front

Seat Cushion Cover - Front

Seat Track

Seat Recliner Motor

Lumbar Assembly

Seat Backrest Thermo-Electric Device

Seat Cushion Thermo-Electric Device

Dual Climate Controlled Seat Module (DCSM)

Heated Seat Module

Driver Seat Module (DSM)

Seat Control Switch

Memory Set Switch

Seat - Exploded View, Rear

Seat Backrest - Rear

Seat Backrest Cover - Rear, 40 Percent

Seat Backrest Cover - Rear, 60 Percent

Seat Armrest - Rear

Seat Backrest Latch - Rear

Seat Cushion - Rear

Seat Cushion Cover - Rear

Seat Bolster - Rear

DISASSEMBLY AND ASSEMBLY

Seat Backrest - Front

Seat Cushion - Front

Seat Backrest - Rear, 60 Percent

Seat Backrest - Rear, 40 Percent

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 01: Body

SECTION 501-11:
Glass, Frames and Mechanisms

SPECIFICATIONS

DESCRIPTION AND OPERATION

Glass, Frames and Mechanisms

Global Open (If Equipped)

Rear Window Defrost

DIAGNOSIS AND TESTING

Glass, Frames and Mechanisms

Principles of Operation

Rear Window Defrost

Inspection and Verification

DTC Charts

HVAC Module DTC Chart

Symptom Chart

Pinpoint Tests

Component Test

GENERAL PROCEDURES

Window Grid Wire Repair

Lead Terminal Repair

Window Motor Initialization

Glass Reseal - Windshield

Glass Reseal - Rear

REMOVAL AND INSTALLATION

Glass, Frames and Mechanisms - Exploded View, Front Door

Window Glass - Front Door

Window Regulator Motor

Window Regulator and Motor - Front Door

Door Glass Top Run - Front

Glass, Frames and Mechanisms - Exploded View, Rear Door

Window Glass - Rear Door

Window Regulator and Motor - Rear Door

Door Glass Run and Bracket - Rear

Window Control Switch

Window Glass - Rear

Window Glass - Rear Door, Fixed

Windshield Glass

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GROUP 01: Body

SECTION 501-12:
Instrument Panel and Console

SPECIFICATIONS

REMOVAL AND INSTALLATION

Instrument Panel - Exploded View

Instrument Panel

Instrument Panel Upper Section

Instrument Cluster Finish Panel - Fusion

Instrument Cluster Finish Panel - MKZ

Instrument Panel Finish Panel - Center

Storage Compartment - Upper

Console - Floor, Fusion

Console - Floor, MKZ

Console - Overhead

Power Point

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GROUP 01: Body

SECTION 501-14:
Handles, Locks, Latches and Entry Systems

SPECIFICATIONS

DESCRIPTION AND OPERATION

Handles, Locks, Latches and Entry Systems

DIAGNOSIS AND TESTING

Handles, Locks, Latches and Entry Systems

Principles of Operation

Inspection and Verification

DTC Charts

Driver Door Module (DDM) DTC Chart

Instrument Panel Cluster (IPC) DTC Chart

Smart Junction Box (SJB) DTC Chart

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Remote Keyless Entry (RKE) Transmitter Programming

Keyless Entry Keypad Code Programming

Remote Memory Activation

Remote Memory Deactivation

Autolock and Auto-Unlock Programming

Stepped Unlock Programming

Latch Lubrication

REMOVAL AND INSTALLATION

Hood Latch

Hood Latch Release Handle

Hood Latch Release Handle - Secondary

Front Door Handles, Locks and Latches - Exploded View

Rear Door Handles, Locks and Latches - Exploded View

Interior Door Handle

Exterior Door Handle

Front Door Latch

Door Handle Reinforcement - Exterior, Front

Rear Door Latch

Door Handle Reinforcement - Exterior, Rear

Door Latch Release Cable

Luggage Compartment Lid Latch

Ignition Lock Cylinder

Door Lock Cylinder

Luggage Compartment Lid Lock Cylinder

Door Lock Control Switch

Luggage Compartment Lid Release Switch

Keyless Entry Keypad

Driver Door Module (DDM)

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GROUP 01: Body

SECTION 501-16:
Wipers and Washers

SPECIFICATIONS

DESCRIPTION AND OPERATION

Wipers and Washers

DIAGNOSIS AND TESTING

Wipers and Washers

Principles of Operation

Inspection and Verification

DTC Chart

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Wiper Blade and Pivot Arm Adjustment

REMOVAL AND INSTALLATION

Wiper and Washer System - Exploded View

Wiper Pivot Arm

Wiper Mounting Arm and Pivot Shaft

Wiper Motor

Washer Pump

Washer Reservoir

Rain Sensor

Rain Sensor Bracket

Wiper/Washer Module

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GROUP 01: Body

SECTION 501-17:
Roof Opening Panel

SPECIFICATIONS

DESCRIPTION AND OPERATION

Roof Opening Panel

Global Open

Roof Opening Panel Drain Hose Routing

DIAGNOSIS AND TESTING

Roof Opening Panel

Principles of Operation

Global Open

Inspection and Verification

Symptom Chart - Roof Opening Panel

Symptom Chart - NVH

Pinpoint Tests

GENERAL PROCEDURES

Roof Opening Panel Alignment

Roof Opening Panel Motor Initialization

REMOVAL AND INSTALLATION

Roof Opening Panel - Exploded View

Roof Opening Panel Glass

Roof Opening Panel Shield

Roof Opening Panel Motor

Air Deflector

Roof Opening Panel Frame

Trough Assembly

Roof Opening Panel Control Switch

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 01: Body

SECTION 501-19:
Bumpers

SPECIFICATIONS

REMOVAL AND INSTALLATION

Bumper - Exploded View, Front

Fusion

MKZ

Bumper Cover - Front

Bumper - Front

Bumper - Exploded View, Rear

Bumper Cover - Rear

Bumper - Rear

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GROUP 01: Body

SECTION 501-20A:
Safety Belt System

SPECIFICATIONS

DESCRIPTION AND OPERATION

Safety Belt System

Safety Belt Retractors

Safety Belt Buckles

Child Safety Seat Restraints

DIAGNOSIS AND TESTING

Safety Belt System

Principles of Operation

Safety Belt Warning System

Belt-Minder®

Inspection and Verification

Symptom Chart

Component Test

Functional Test - Buckle and Tongue

Functional Test - Safety Belt Retractor

Functional Test - Safety Belt Retractor, Automatic Locking Retractor (ALR) Mode

Functional Test - Safety Belt Retractor, Road Test Inspection

GENERAL PROCEDURES

Safety Belt Cleaning

Safety Belt Maintenance

Safety Belt Procedure After a Collision

Safety Belt Tongue Rotated on Belt

Safety Belt Twisted at the Safety Belt Guide

REMOVAL AND INSTALLATION

Safety Belt Retractor and Pretensioner

Safety Belt Retractor - Rear, Center

Safety Belt Retractor - Rear, Outboard

Safety Belt Shoulder Height Adjuster

Safety Belt Buckle - Front

Safety Belt Buckle - Rear

Child Safety Seat Tether Anchor

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 01: Body

SECTION 501-20B:
Supplemental Restraint System

SPECIFICATIONS

DESCRIPTION AND OPERATION

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

DIAGNOSIS AND TESTING

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Principles of Operation

Air Bag Warning Indicator

Clockspring

Driver Air Bag Module

High Speed Controller Area Network (HS-CAN)

Impact Sensors

Occupant Classification System (OCS) System

Passenger Air Bag Deactivation (PAD) Indicator

Passenger Air Bag Module

Restraints Control Module (RCM)

Safety Belt Retractor Pretensioners

Safety Belt Buckle Switches

Seat Track Position Sensor

Secondary Air Bag Warning (Chime)

Seat Side Air Bag Module

Side Air Curtain Module

Driver Knee Bolster Air Bag Module (Hybrid Vehicles Only)

Inspection and Verification

DTC Charts

Restraints Control Module (RCM) DTC Chart

Occupant Classification System Module (OCSM) DTC Chart

Symptom Chart

Pinpoint Test - Supplemental Restraint System (SRS)

GENERAL PROCEDURES

Supplemental Restraint System (SRS) Depowering and Repowering

Depowering Procedure

Repowering Procedure

Supplemental Restraint System (SRS) Deactivation and Reactivation

Deactivation

Reactivation

Inspection and Repair After a Supplemental Restraint System (SRS) Deployment

Occupant Classification Sensor (OCS) System Reset

Occupant Classification Sensor (OCS) System Zero Seat Weight Test

Pyrotechnic Device Disposal

Disposal of Deployable Devices and Pyrotechnic Devices That are Undeployed/Inoperative

Disposal of Deployable Devices and Pyrotechnic Devices That Are Deployed

Disposal of Deployable Devices and Pyrotechnic Devices That Require Manual Deployment

Driver Air Bag Module, Passenger Air Bag Module, Knee Air Bag Module and Seat Side Air Bag Module - Remote Deploynt

Safety Belt Anchor Pretensioners, Safety Belt Buckle Pretensioners, Safety Belt Retractor Pretensioners, Adaptive Load Limiting Safety Belt Retractors and Safety Belt Inflators - Remote Deployment

Safety Belt Anchor Pretensioners, Safety Belt Buckle Pretensioners, Safety Belt Retractor Pretensioners and Load Limiting Safety Belt Retractors - In-Vehicle Deployment

Safety Canopy® Modules and Side Air Curtain Modules - In-Vehicle Deployment

Deployable Steering Column - In-Vehicle Deployment

Rivet Nut Replacement

REMOVAL AND INSTALLATION

Clockspring

Driver Air Bag Module

Front Impact Severity Sensor

Knee Air Bag Module

Occupant Classification System Module (OCSM)

Occupant Classification Sensor

Passenger Air Bag Deactivation (PAD) Indicator

Passenger Air Bag Module

Restraints Control Module (RCM)

Side Air Curtain Module

Seat Position Sensor

Side Air Bag Module

Side Impact Sensor - Front Door

Side Impact Sensor - C-Pillar

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GROUP 01: Body

SECTION 501-35:
Body Repairs

SPECIFICATIONS

DESCRIPTION AND OPERATION

Body

Underhood Dimensions

Body Side Closure Dimensions

Rear Opening Dimensions

Underbody Dimensions

Welding Precautions - Steel

Sound Deadeners and Insulators

Plastic Components

Sealers

Adhesives

GENERAL PROCEDURES

Sectioning Guidelines

Restoring Corrosion Protection Following Repair

Body and Frame Undercoating

Refinishing - Environmental Damage

Iron Oxide (Rail Dust) or Acid Rain Decontamination

Surface Finishing Following Decontamination

Refinishing - Manufacturing Damage

Weld-Bonding

Weld-Bonding - Squeeze-Type Resistance Spot Welding (STRW) Method

Weld-Bonding - Metal Inert Gas (MIG) Welding Method

Plastics Identification

Plastics Refinishing

Plastics Repair

Sheet-Molded Composite (SMC) Panel Repair

Thermoplastic Compounds

Tab Repair - Bumper

REMOVAL AND INSTALLATION

Inner Body Reinforcing Panels

Roof Panel

Door Outer Panel

Frame Members - Front

Frame Members - Rear

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 02: Frame and Mounting

SECTION 502-00:
Uni-Body, Subframe and Mounting System

SPECIFICATIONS

DESCRIPTION AND OPERATION

Subframe and Mounting Systems

REMOVAL AND INSTALLATION

Subframe - Front

Subframe - Rear

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 03: Engine

SECTION 303-00:
Engine System - General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine

DIAGNOSIS AND TESTING

Engine

Inspection and Verification - Engine Performance

Inspection and Verification - NVH

Symptom Chart - Engine Performance

Symptom Chart - NVH

Component Tests

Engine Oil Leaks

Compression Test - Hybrid

Compression Test - All Vehicles Except Hybrid

Cylinder Leakage Detection

Excessive Engine Oil Consumption

Intake Manifold Vacuum Test

Oil Pressure Test

Valve Train Analysis

GENERAL PROCEDURES

Sprockets

Camshaft Bearing Journal Diameter

Camshaft Journal to Bearing Clearance - OHC Engines

Camshaft End Play - OHC Engines

Camshaft Surface Inspection

Camshaft Lobe Lift

Camshaft Runout

Crankshaft Main Bearing Journal Diameter

Cranksft Main Bearing Journal Taper and Out-of-Round

Crankshaft Main Bearing Journal-to-Bearing Clearance

Crankshaft End Play

Connecting Rod Bearing Journal Taper and Out-of-Round

Cylinder Bore Taper

Cylinder Bore Out-of-Round

Piston Inspection

Piston Pin Bore Diameter

Piston Diameter

Piston To Cylinder Bore Clearance

Piston Selection

Piston Ring End Gap

Piston Ring-to-Groove Clearance

Piston Pin Diameter

Connecting Rod Cleaning

Connecting Rod Large End Bore

Connecting Rod Bushing Diameter

Connecting Rod Bend

Connecting Rod Twist

Connecting Rod Bearing Journal-to-Bearing Clearance

Connecting Rod to Crankshaft Side Clearance

Valve Stem Diameter

Valve Inspection

Valve Guide Inner Diameter

Valve Stem to Valve Guide Clearance

Valve Spring Installed Length

Valve Spring Free Length

Valve Spring Squareness

Valve Spring Strength

Valve Seat Inspection

Valve and Seat Refacing Measurements

Valve Seat Width

Valve Seat Runout

Flexplate Inspection

Flywheel Inspection

Cylinder Head Distortion

Cylinder Block Distortion

Cylinder Bore Cleaning

Bearing Inspection

Exhaust Manifold Cleaning and Inspection

Spark Plug Inspection

Core Plug Replacement

Valve Tappet Inspection

Roller Follower Inspection

Hydraulic Lash Adjuster Inspection

Powertrain/Drivetrain Mount Neutralizing

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 03: Engine

SECTION 303-01A:
Engine - 2.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine

Engine Identification

Engine Code Information Label

Engine Cylinder Identification

Exhaust Emission Control System

Induction System

PCV System

Lubrication System

DIAGNOSIS AND TESTING

Engine

GENERAL PROCEDURES

Valve Clearance Check

Balance Shaft Backlash

IN-VEHICLE REPAIR

Intake Manifold

Valve Cover

Crankshaft Pulley and Crankshaft Front Seal - Exploded View

Crankshaft Pulley

Crankshaft Front Seal

Flexplate or Flywheel and Crankshaft Rear Seal - Exploded View

Flexplate

Flywheel

Crankshaft Rear Seal

Engine Front Cover

Timing Drive Components

Variable Camshaft Timing (VCT) System Oil Filter

Camshafts

Camshaft Phaser and Sprocket

Valve Train Components - Exploded View

Valve Springs

Valve Seals

Valve Tappets

Cylinder Head

Engine Lubrication Components - Exploded View

Transmission Bolts for Oil Pan Removal

Oil Pan, Oil Pump Screen and Pickup Tube

Oil Pump

Oil Filter Adapter

Engine Oil Pressure (EOP) Switch

Oil Pan

Oil Pump Screen and Pickup Tube

Oil Pump

Exhaust Manifold

Engine Mount

REMOVAL

Engine - Automatic Transaxle

Engine - Manual Transaxle

DISASSEMBLY

Engine

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Cylinder Head

Piston

ASSEMBLY

Engine

Lower Engine Block (View 1)

Lower Engine Block (View 2)

Front Engine Block

Cylinder Head

Intake Manifold

INSTALLATION

Engine - Automatic Transaxle

Engine - Manual Transaxle

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GROUP 03: Engine

SECTION 303-01B:
Engine - 3.0L (4V)

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine

Engine Identification

Engine Code Information Label

Engine Cylinder Identification

Exhaust Emission Control System

Induction System

Valve Train

Variable Camshaft Timing (VCT) System

PCV System

Lubrication System

Oil Pump

Cooling System

DIAGNOSIS AND TESTING

Engine

IN-VEHICLE REPAIR

Upper Intake Manifold

Lower Intake Manifold

Valve Cover - LH

Valve Cover - RH

Crankshaft Pulley and Crankshaft Front Seal - Exploded View

Crankshaft Pulley

Crankshaft Front Seal

Flexplate or Flywheel and Crankshaft Rear Seal - Exploded View

Flexplate

Crankshaft Rear Seal

Engine Front Cover

Timing Drive Components

Valve Train Components - Exploded View

LH Side Roller Follower, Hydraulic Lash Adjuster and Valve Spring

LH Side Intake and Exhaust Camshafts

Coolant Pump Belt and Pulley

RH Side Roller Follower, Hydraulic Lash Adjuster and Valve Spring

RH Side Intake and Exhaust Camshaft

Camshaft Phaser and Sprocket

Variable Camshaft Timing (VCT) System Oil Filter

Camshafts - LH

Camshafts - RH

Camshaft Roller Follower

Hydraulic Lash Adjuster

Valve Spring, Retainer, and Seal

Cylinder Head - RH

Cylinder Head - LH

Engine Lubrication Components - Exploded View

Oil Pan, Oil Pan Baffle and Oil Pump Screen and Pickup Tube

Oil Pump

Oil Pan

Oil Pumreen and Pickup Tube

Oil Pan Baffle

Oil Pump

Engine Oil Pressure (EOP) Switch

Oil Level Indicator and Tube

Exhaust Manifold - RH

Engine Mount

REMOVAL

Engine

DISASSEMBLY

Engine

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Cylinder Head

Piston

ASSEMBLY

Engine

Lower Engine Block (View 1)

Lower Engine Block (View 2)

Cylinder Heads and Intake Manifolds

INSTALLATION

Engine

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 03: Engine

SECTION 303-01C:
Engine - 3.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine

Engine Identification

Engine Code Information Label

Engine Cylinder Identification

Exhaust Emission Control System

Induction System

Valve Train

Variable Camshaft Timing (VCT) System

PCV System

Lubrication System

Oil Pump

Cooling System

DIAGNOSIS AND TESTING

Engine

GENERAL PROCEDURES

Valve Clearance Check

IN-VEHICLE REPAIR

Upper Intake Manifold

Lower Intake Manifold

Valve Cover - LH

Valve Cover - RH

Crankshaft Puland Crankshaft Front Seal - Exploded View

Crankshaft Pulley

Crankshaft Front Seal

Flexplate or Flywheel and Crankshaft Rear Seal - Exploded View

Flexplate

Crankshaft Rear Seal

Oil Filter Adapter

Engine Oil Pressure (EOP) Switch

Exhaust Manifold - LH

Exhaust Manifold - RH

Engine Mount

Oil Pan

Oil Pump Screen and Pickup Tube

Crankshaft Rear Seal with Retainer Plate

REMOVAL

Engine

Engine Front Cover

Timing Drive Components

Camshaft

Valve Tappets

Valve Spring, Retainer and Seal

Cylinder Head - RH

Cylinder Head - LH

Oil Pump

DISASSEMBLY

Engine

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Cylinder Head

Piston

ASSEMBLY

Engine

Engine Upper

Engine Upper - LH Cylinder Head

Engine Upper - RH Cylinder Head

Engine Front

Timing Drive Components

Engine Lower (View 1)

Lower Engine Block (View 2)

INSTALLATION

Engine

Engine Front Cover

Timing Drive Components

Camshaft

Valve Tappets

Valve Spring, Retainer and Seal

Cylinder Head - RH

Cylinder Head - LH

Oil Pump

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 03: Engine

SECTION 303-01D:
Engine - 2.5L Hybrid

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine

Engine Identification

Engine Code Information Label

Engine Cylinder Identification

Exhaust Emission Control System

Induction System

Lubrication System

DIAGNOSIS AND TESTING

Engine

GENERAL PROCEDURES

Valve Clearance Check

Balance Shaft Backlash

IN-VEHICLE REPAIR

Intake Manifold

Valve Cover

Crankshaft Pulley and Crankshaft Front Seal - Exploded View

Crankshaft Pulley

Crankshaft Front Seal

Flexplate or Flywheel and Crankshaft Rear Seal - Exploded View

Flywheel

Crankshaft Rear Seal

Engine Front Cover

Timing Drive Components

Variable Camshaft Timing (VCT) System Oil Filter

Camshafts

Camshaft Phaser and Sprocket

Valve Train Components - Exploded View

Valve Springs

Valve Seals

Valve Tappets

Cylinder Head

Engine Lubrication Components - Exploded View

Oil Filter AdapterOil Filter and Engine Oil Pressure (EOP) Switch

Oil Pan, Oil Pump Screen and Pickup Tube

Oil Pump

Oil Filter Adapter

Engine Oil Pressure (EOP) Switch

Oil Pan

Oil Pump Screen and Pickup Tube

Oil Pump

Engine Mount

REMOVAL

Engine

DISASSEMBLY

Engine

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Cylinder Head

Piston

ASSEMBLY

Engine

Lower Engine Block (View 1)

Lower Engine Block (View 2)

Front Engine Block

Cylinder Head

Intake Manifold

INSTALLATION

Engine

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 03: Engine

SECTION 303-03A:
Engine Cooling

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Cooling

Fail Safe Cooling

Coolant Flow Diagram

2.5L

3.0L

3.5L

DIAGNOSIS AND TESTING

Engine Cooling

Principles of Operation

Inspection and Verification

DTC Chart

Symptom Chart

Pinpoint Tests

Component Tests

Cooling System Pressure Test

Thermostat

Radiator Leak Test, Removed From Vehicle

GENERAL PROCEDURES

Cooling System Draining, Filling and Bleeding

Draining

Filling and Bleeding with a Vacuum Cooling System Filler - 2.5L and 3.0L Engines

Filling and Bleeding without a Vacuum Cooling System Filler - 2.5L and 3.0L Engines

Filling and Bleeding - 3.5L Engine

Cooling System Flushing

REMOVAL AND INSTALLATION

Block Heater

Thermostat Housing - 2.5L

Thermostat - 3.0L (4V)

Thermostat - 3.5L

Thermostat Housing - 3.5L

Bypass Tube - 2.5L

Coolant Inlet Pipe - 3.0L (4V)

Coolant Pump - 2.5L

Coolant Pump Housing - 3.0L (4V)

Coolant Pump - 3.0L (4V)

Coolant Pump - 3.5L

Cooling Fan Motor and Shroud - 2.5L, 3.0L (4V)

Cooling Fan Motor and Shroud - 3.5L

Radiator - 3.5L

Radiator - 2.5L, 3.0L (4V)

Degas Bottle

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 03: Engine

SECTION 303-03B:
Engine Cooling - Hybrid

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Cooling

Coolant Flow Diagram

DIAGNOSIS AND TESTING

Engine Cooling

Principles of Operation

Inspection and Verification

DTC Chart

Symptom Chart

Pinpoint Tests

Component Tests

Cooling System Pressure Test

Thermostat

Radiator Leak Test, Removed From Vehicle

GENERAL PROCEDURES

Cooling System Draining, Filling and Bleeding

Draining

Filling and Bleeding with a Vacuum Cooling System Filler

Filling and Bleeding without a Vacuum Cooling System Filler

Cooling System Flushing

REMOVAL AND INSTALLATION

Block Heater

Thermostat Housing

Bypass Tube

Coolant Pump

Cooling Fan Motor and Shroud

Radiator

Degas Bottle

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 03: Engine

SECTION 303-04A:
Fuel Charging and Controls - 2.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

Throttle Body (TB)

Fuel Injectors

Fuel Rail

Fuel Pump (FP) Control Module

DIAGNOSIS AND TESTING

Fuel Charging and Controls

REMOVAL AND INSTALLATION

Throttle Body

Fuel Rail and Fuel Injector - Exploded View

Fuel Rail

Fuel Injectors

Fuel Rail

Fuel Injectors

Fuel Pump Control Module

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 03: Engine

SECTION 303-04B:
Fuel Charging and Controls - 3.0L (4V)

SPECIFICATIONS

DESCRIPTION AND OPERATION

Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

Throttle Body (TB)

Fuel Injectors

Fuel Rail

Fuel Pump (FP) Control Module

DIAGNOSIS AND TESTING

Fuel Charging and Controls

REMOVAL AND INSTALLATION

Throttle Body

Fuel Rail and Fuel Injector - Exploded View

Fuel Rail

Fuel Injector

Fuel Rail

Fuel Injectors

Fuel Pump Control Mole

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 03: Engine

SECTION 303-04C:
Fuel Charging and Controls - 3.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

Throttle Body (TB)

Fuel Injectors

Fuel Rail

DIAGNOSIS AND TESTING

Fuel Charging and Controls

REMOVAL AND INSTALLATION

Throttle Body

Fuel Rail and Fuel Injector - Exploded View

Fuel Rail

Fuel Injectors

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GROUP 03: Engine

SECTION 303-04D:
Fuel Charging and Controls - Hybrid

SPECIFICATIONS

DESCRIPTION AND OPERATION

Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

Throttle Body (TB)

Fuel Injectors

Fuel Rail

Fuel Pump (FP) Control Module

DIAGNOSIS AND TESTING

Fuel Charging and Controls

REMOVAL AND INSTALLATION

Throttle Body

Fuel Rail and Fuel Injector - Exploded View

Fuel Rail

Fuel Injectors

Fuel Rail

Fuel Injectors

Fuel Pump Control Modu

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GROUP 03: Engine

SECTION 303-05A:
Accessory Drive - 2.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Accessory Drive

Accessory Drive Belt Routing

Belt Tensioner

DIAGNOSIS AND TESTING

Accessory Drive

Inspection and Verification

Symptom Chart

Component Tests

Drive Belt - Noise/Flutter

Drive Belt - Incorrect Installation

Belt Tensioner - Mechanical

Belt Tensioner - Dynamics

REMOVAL AND INSTALLATION

Front End Accessory Drive (FEAD) - Exploded View

Accessory Drive Belt

Accessory Drive Belt Tensioner

Accessory Drive Belt Idler Pulley

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GROUP 03: Engine

SECTION 303-05B:
Accessory Drive - 3.0L (4V)

SPECIFICATIONS

DESCRIPTION AND OPERATION

Accessory Drive

Accessory Drive Belt Routing

Accessory Drive Belt

Coolant Pump Drive Belt

Belt Tensioner

DIAGNOSIS AND TESTING

Accessory Drive

Inspection and Verification

Symptom Chart

Component Tests

Drive Belt - Noise/Flutter

Drive Belt - Incorrect Installation

Belt Tensioner - Mechanical

Belt Tensioner - Dynamics

REMOVAL AND INSTALLATION

Front End Accessory Drive (FEAD) - Exploded View

Accessory Drive Belt

Accessory Drive Belt Tensioner

Coolant Pump Belt

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GROUP 03: Engine

SECTION 303-05C:
Accessory Drive - 3.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Accessory Drive

Accessory Drive Belt Routing

Front End Accessory Drive (FEAD) Belt

Power Steering Pump Belt

Belt Tensioner

DIAGNOSIS AND TESTING

Accessory Drive

Inspection and Verification

Symptom Chart

Component Tests

Drive Belt - Noise/Flutter

Drive Belt - Incorrect Installation

Belt Tensioner - Mechanical

Belt Tensioner - Dynamics

REMOVAL AND INSTALLATION

Front End Accessory Drive (FEAD) - Exploded View

Accessory Drive Belt

Accessory Drive Belt Tensioner

Power Steering Pump Belt

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GROUP 03: Engine

SECTION 303-05D:
Accessory Drive - Hybrid

SPECIFICATIONS

DESCRIPTION AND OPERATION

Accessory Drive

Accessory Drive Belt Routing

Belt Tensioner

DIAGNOSIS AND TESTING

Accessory Drive

Inspection and Verification

Symptom Chart

Component Tests

Drive Belt - Noise/Flutter

Drive Belt - Incorrect Installation

Belt Tensioner - Mechanical

Belt Tensioner - Dynamics

REMOVAL AND INSTALLATION

Front End Accessory Drive (FEAD) - Exploded View

Accessory Drive Belt

Accessory Drive Belt Tensioner

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GROUP 03: Engine

SECTION 303-06:
Starting System

SPECIFICATIONS

DESCRIPTION AND OPERATION

Starting System

One-Touch Integrated Start (OTIS)

DIAGNOSIS AND TESTING

Starting System

Hybrid

Principles of Operation

Inspection and Verification

DTC Chart

PCM DTC Chart

Symptom Chart

Pinpoint Tests

Component Tests

Starter Motor - Motor Feed Circuit

Starter Motor - Ground Circuit

REMOVAL AND INSTALLATION

Starter Motor - 2.5L

Starter Motor - 3.0L

Starter Motor - 3.5L

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GROUP 03: Engine

SECTION 303-07A:
Engine Ignition - 2.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Ignition

DIAGNOSIS AND TESTING

Engine Ignition

REMOVAL AND INSTALLATION

Engine Ignition Components - Exploded View

Ignition Coil-On-Plug

Spark Plugs

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GROUP 03: Engine

SECTION 303-07B:
Engine Ignition - 3.0L (4V)

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Ignition

DIAGNOSIS AND TESTING

Engine Ignition

REMOVAL AND INSTALLATION

Engine Ignition Components - Exploded View

LH Side

RH Side

Ignition Coil-On-Plug

Spark Plugs

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GROUP 03: Engine

SECTION 303-07C:
Engine Ignition - 3.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Ignition

DIAGNOSIS AND TESTING

Engine Ignition

REMOVAL AND INSTALLATION

Engine Ignition Components - Exploded View

LH Side

RH Side

Ignition Coil-On-Plug

Spark Plugs

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GROUP 03: Engine

SECTION 303-08A:
Engine Emission Control - 2.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Emission Control

EGR system

PCV system

DIAGNOSIS AND TESTING

Engine Emission Control

REMOVAL AND INSTALLATION

Exhaust Gas Recirculation (EGR) Valve

Crankcase Vent Oil Separator

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GROUP 03: Engine

SECTION 303-08B:
Engine Emission Control - 3.0L (4V)

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Emission Control

EGR system

PCV system

DIAGNOSIS AND TESTING

Engine Emission Control

REMOVAL AND INSTALLATION

Exhaust Gas Recirculation (EGR) System Components - Exploded View

Exhaust Gas Recirculation (EGR) Valve

Exhaust Manifold to Exhaust Gas Recirculation (EGR) Valve Tube

Positive Crankcase Ventilation (PCV) Valve

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GROUP 03: Engine

SECTION 303-08C:
Engine Emission Control - 3.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Emission Control

PCV System

DIAGNOSIS AND TESTING

Engine Emission Control

REMOVAL AND INSTALLATION

Positive Crankcase Ventilation (PCV) Valve

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GROUP 03: Engine

SECTION 303-08D:
Engine Emission Control - Hybrid

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Emission Control

EGR System

PCV system

DIAGNOSIS AND TESTING

Engine Emission Control

REMOVAL AND INSTALLATION

Exhaust Gas Recirculation (EGR) Valve

Coolant Hoses

Motor Electronics Cooling System (MECS) Expansion Tank

Transaxle High-Voltage Electrical Wire Harness

Engine Wire Harness

Coolant Outlet Adapter

EGR Valve

Crankcase Vent Oil Separator

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GROUP 03: Engine

SECTION 303-12A:
Intake Air Distribution and Filtering - 2.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Intake Air Distribution and Filtering

DIAGNOSIS AND TESTING

Intake Air Distribution and Filtering

REMOVAL AND INSTALLATION

Intake Air System Components - Exploded View

Air Cleaner

Air Cleaner Outlet Pipe

Intake Air Resonator

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GROUP 03: Engine

SECTION 303-12B:
Intake Air Distribution and Filtering - 3.0L (4V)

SPECIFICATIONS

DESCRIPTION AND OPERATION

Intake Air Distribution and Filtering

DIAGNOSIS AND TESTING

Intake Air Distribution and Filtering

REMOVAL AND INSTALLATION

Intake Air System Components - Exploded View

Air Cleaner

Air Cleaner Outlet Pipe

Intake Air Resonator

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GROUP 03: Engine

SECTION 303-12C:
Intake Air Distribution and Filtering - 3.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Intake Air Distribution and Filtering

DIAGNOSIS AND TESTING

Intake Air Distribution and Filtering

REMOVAL AND INSTALLATION

Intake Air System Components - Exploded View

Air Cleaner

Air Cleaner Outlet Pipe

Intake Air Resonator

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GROUP 03: Engine

SECTION 303-12D:
Intake Air Distribution and Filtering - Hybrid

SPECIFICATIONS

DESCRIPTION AND OPERATION

Intake Air Distribution and Filtering

DIAGNOSIS AND TESTING

Intake Air Distribution and Filtering

REMOVAL AND INSTALLATION

Intake Air System Components - Exploded View

Air Cleaner

Air Cleaner Outlet Pipe

Intake Air Resonator

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GROUP 03: Engine

SECTION 303-13A:
Evaporative Emissions

SPECIFICATIONS

DESCRIPTION AND OPERATION

Evaporative Emissions

Vehicle Emission Vacuum Routing

2.5L

3.0L (4V)

All-Wheel Drive (AWD) Vehicles

Front Wheel Drive (FWD) Vehicles

3.5L

All-Wheel Drive (AWD) Vehicles

Front Wheel Drive (FWD) Vehicles

DIAGNOSIS AND TESTING

Evaporative Emissions

GENERAL PROCEDURES

Evaporative Emission System Leak Test

Phase 1 - Leak Verification

Phase 2 - System Leak Check

REMOVAL AND INSTALLATION

Evaporative Emission Canister Purge Valve

Evaporative Emission Canister

Fuel Vapor Tube Assembly - All Wheel Drive (AWD)

Fuel Vapor Tube Assembly - Front Wheel Drive (FWD)

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GROUP 03: Engine

SECTION 303-13B:
Evaporative Emissions - Hybrid

SPECIFICATIONS

DESCRIPTION AND OPERATION

Evaporative Emissions

Vehicle Emission Vacuum Routing

DIAGNOSIS AND TESTING

Evaporative Emissions

GENERAL PROCEDURES

Evaporative Emission System Leak Test

REMOVAL AND INSTALLATION

Evaporative Emission Canister Purge Valve

Evaporative Emission Canister

Fuel Vapor Tube Assembly

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GROUP 03: Engine

SECTION 303-14A:
Electronic Engine Controls - 2.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Electronic Engine Controls

DIAGNOSIS AND TESTING

Electronic Engine Controls

DTC Charts

PCM DTC Chart

REMOVAL AND INSTALLATION

Camshaft Position (CMP) Sensor

Crankshaft Position (CKP) Sensor

Powertrain Control Module (PCM)

Mass Air Flow (MAF) Sensor

Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor - Exploded View

Non-Partial Zero Emissions Vehicle (PZEV)

Partial Zero Emissions Vehicle (PZEV)

Heated Oxygen Sensor (HO2S)

Catalyst Monitor Sensor

Cylier Head Temperature (CHT) Sensor

Clutch Pedal Position (CPP) Switch

Knock Sensor (KS)

Variable Camshaft Timing (VCT) Oil Control Solenoid

Manifold Absolute Pressure (MAP) Sensor

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GROUP 03: Engine

SECTION 303-14B:
Electronic Engine Controls - 3.0L (4V)

SPECIFICATIONS

DESCRIPTION AND OPERATION

Electronic Engine Controls

DIAGNOSIS AND TESTING

Electronic Engine Controls

DTC Charts

PCM DTC Chart

REMOVAL AND INSTALLATION

Camshaft Position (CMP) Sensor

Crankshaft Position (CKP) Sensor

Powertrain Control Module (PCM)

Mass Air Flow (MAF) Sensor

Cylinder Head Temperature (CHT) Sensor

Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor - Exploded View

Heated Oxygen Sensor (HO2S)

Catalyst Monitor Sensor

Variable Camshaft Timing (VCT) Oil Control Solenoid

Knock Sensor (KS)

Cylinder-Head Mounted Knock Sensor (KS)

Cylinder-Block Mounted Knock Sensor (KS)

Manifold Absolute Pressure (MAP) Sensor

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GROUP 03: Engine

SECTION 303-14C:
Electronic Engine Controls - 3.5L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Electronic Engine Controls

DIAGNOSIS AND TESTING

Electronic Engine Controls

DTC Charts

PCM DTC Chart

REMOVAL AND INSTALLATION

Camshaft Position (CMP) Sensor

Crankshaft Position (CKP) Sensor

Powertrain Control Module (PCM)

Mass Air Flow (MAF) Sensor

Cylinder Head Temperature (CHT) Sensor

Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor - Exploded View

RH Sensors

LH Sensors

Heated Oxygen Sensor (HO2S)

Catalyst Monitor Sensor

Variable Camshaft Timing (VCT) Oil Control Solenoid

Knock Sensor (KS)

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GROUP 03: Engine

SECTION 303-14D:
Electronic Engine Controls - Hybrid

SPECIFICATIONS

DESCRIPTION AND OPERATION

Electronic Engine Controls

DIAGNOSIS AND TESTING

Electronic Engine Controls

DTC Charts

PCM DTC Chart

REMOVAL AND INSTALLATION

Camshaft Position (CMP) Sensor

Crankshaft Position (CKP) Sensor

Powertrain Control Module (PCM)

Mass Air Flow (MAF) Sensor

Heated Oxygen Sensor (HO2S) and Catalyst Monitor Sensor - Exploded View

Heated Oxygen Sensor (HO2S)

Catalyst Monitor Sensor

Cylinder Head Temperature (CHT) Sensor

Knock Sensor (KS)

Variable Camshaft Timing (VCT) Oil Control Solenoid

Manifold Absolute Pressure (MAP) Sensor

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GROUP 04: Suspension

SECTION 204-00:
Suspension System - General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Wheel Alignment Angles

Camber

Caster

Wander

Shimmy

Nibble

Poor Returnability/Sticky Steering

Drift/Pull

DIAGNOSIS AND TESTING

Suspension System

Inspection and Verification

Symptom Chart - Suspension System

Symptom Chart - NVH

Pinpoint Tests

Component Tests

GENERAL PROCEDURES

Ride Height Measurement

Front Ride Height Measurement

Rear Ride Height Measurement

Caster Adjustment - Front

Camber Adjustment - Rear

Toe Adjustment - Front

Toe Adjustment - Rear

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GROUP 04: Suspension

SECTION 204-01:
Front Suspension

SPECIFICATIONS

DESCRIPTION AND OPERATION

Front Suspension

DIAGNOSIS AND TESTING

Front Suspension

REMOVAL AND INSTALLATION

Wheel Bearing and Wheel Hub

Wheel Studs

Lower Arm - Front

Lower Arm - Rear

Upper Arm

Stabilizer Bar Link

Stabilizer Bar Bushing

Stabilizer Bar

Wheel Knuckle

Shock Absorber and Spring Assembly

DISASSEMBLY AND ASSEMBLY

Shock Absorber and Spring Assembly

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GROUP 04: Suspension

SECTION 204-02:
Rear Suspension

SPECIFICATIONS

DESCRIPTION AND OPERATION

Rear Suspension

DIAGNOSIS AND TESTING

Rear Suspension

REMOVAL AND INSTALLATION

Wheel Bearing and Wheel Hub

Wheel Studs

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Lower Arm

Upper Arm

Toe Link

Trailing Arm

Stabilizer Bar and Link

Spring

Shock Absorber

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GROUP 04: Suspension

SECTION 204-04:
Wheels and Tires

SPECIFICATIONS

DESCRIPTION AND OPERATION

Wheels And Tires

Safety Precautions

Tire Pressure Monitoring System (TPMS)

Tire Pressure Monitoring System (TPMS) Module

Tire Pressure Monitoring System (TPMS) Pressure Sensor

DIAGNOSIS AND TESTING

Wheels And Tires

Inspection and Verification

Tire Wear

Symptom Chart - Tire Wear

Symptom Chart - NVH

Pinpoint Tests

Component Tests

Radial Runout

Loadenout Measurement (Hunter Road Force® 9700 Series Wheel Balancer)

Runout Measurement (Dial Indicator)

Match Mounting

Wheel-to-Hub Optimization

Tire Pressure Monitoring System (TPMS)

Principles of Operation

Ambient Temperature Change and Tire Pressure

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

Tire Pressure Monitoring System (TPMS) Indicator Illuminates Continuously

Tire Pressure Monitoring System (TPMS) Indicator Flashes

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

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Pinpoint Tests

GENERAL PROCEDURES

Tire Pressure Monitoring System (TPMS) Sensor Training

Tire Pressure Monitoring System (TPMS) Sensor Activation

REMOVAL AND INSTALLATION

Wheel and Tire

DISASSEMBLY AND ASSEMBLY

Wheel and Tire

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Tire Pressure Monitoring System (TPMS) Sensor

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GROUP 05: Driveline

SECTION 205-00:
Driveline System - General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Driveline System

Driveshaft

U-joints

Halfshafts

Halfshaft Handling

DIAGNOSIS AND TESTING

Driveline System

Principals of Operation

Driveline System - General Information

Driveshaft Center U-Joint and CV Joint Inspection

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Analysis of Leakage

GENERAL PROCEDURES

Driveline Angle Measurement

Driveshaft Runout and Balancing

Driveshaft Inspection

Driveshaft Runout

Driveshaft Balancing - Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix)

Driveshaft Balancing - Hose Clamp Method

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GROUP 05: Driveline

SECTION 205-01:
Driveshaft

SPECIFICATIONS

DESCRIPTION AND OPERATION

Driveshaft

Universal Joints

DIAGNOSIS AND TESTING

Driveshaft

REMOVAL AND INSTALLATION

Driveshaft

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GROUP 05: Driveline

SECTION 205-02:
Rear Drive Axle/Differential

SPECIFICATIONS

DESCRIPTION AND OPERATION

Rear Drive Axle and Differential

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Rear Drive Axle and Differential

IN-VEHICLE REPAIR

Stub Shaft Seal

Drive Pinion Seal

Differential Housing Cover

REMOVAL AND INSTALLATION

Axle Assembly

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GROUP 05: Driveline

SECTION 205-04:
Front Drive Halfshafts

SPECIFICATIONS

DESCRIPTION AND OPERATION

Front Drive Halfshafts

DIAGNOSIS AND TESTING

Front Drive Halfshafts

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Halfshaft

Intermediate Shaft - Front Wheel Drive (FWD)

Intermediate Shaft - All Wheel Drive (AWD)

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GROUP 05: Driveline

SECTION 205-05:
Rear Drive Halfshafts

SPECIFICATIONS

DESCRIPTION AND OPERATION

Rear Drive Halfshafts

Halfshaft Joint

Halfshaft Handling

DIAGNOSIS AND TESTING

Rear Drive Halfshafts

REMOVAL AND INSTALLATION

Halfshaft

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GROUP 06: Brake System

SECTION 206-00:
Brake System - General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Brake System

Conventional Brake System (Non-Hybrid Vehicles)

Regenerative Braking System (Hybrid Vehicles)

DIAGNOSIS AND TESTING

Principles of Operation

Conventional Brake System

Brake Master Cylinder Compensator Ports

Red Brake Warning Indicator

Inspection And Verification

Symptom Chart

Symptom Chart - Brake System (Non-Hybrid Vehicles)

Symptom Chart - Brake System (Hybrid Vehicles)

Symptom Chart - NVH

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Component Tests

Brake Booster (Non-Hybrid Vehicles)

Brake Master Cylinder - Bypass Condition

Brake Master Cylinder - Compensator Port

GENERAL PROCEDURES

Brake System Inspection

Brake Pads

Brake Discs

Brake Calipers

Brake Caliper Guide Pins

Brake Flexible Hoses and Tubes

Brake Master Cylinder

Brake Booster (Non-Hybrid Vehicles)

Brake Booster (Hybrid Vehicles)

Brake Disc Machining

Brake System Bleeding

Pressure Bleeding

Hydraulic Control Unit (HCU) Bleeding

Component Bleeding

Master Cylinder

Front Brake Caliper

Rear Brake Caliper

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GROUP 06: Brake System

SECTION 206-03:
Front Disc Brake

SPECIFICATIONS

DESCRIPTION AND OPERATION

Front Disc Brake

DIAGNOSIS AND TESTING

Front Disc Brake

REMOVAL AND INSTALLATION

Brake Pads

Brake Caliper

Brake Caliper Anchor Plate

Brake Disc

Brake Flexible Hose

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GROUP 06: Brake System

SECTION 206-04:
Rear Disc Brake

SPECIFICATIONS

DESCRIPTION AND OPERATION

Rear Disc Brake

DIAGNOSIS AND TESTING

Rear Disc Brake

REMOVAL AND INSTALLATION

Brake Pads

Brake Caliper

Brake Disc

Brake Disc Shield - Front Wheel Drive (FWD)

Brake Disc Shield - All Wheel Drive (AWD)

Brake Flexible Hose

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GROUP 06: Brake System

SECTION 206-05:
Parking Brake and Actuation

SPECIFICATIONS

DESCRIPTION AND OPERATION

Parking Brake

DIAGNOSIS AND TESTING

Parking Brake

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Parking Brake Cable Adjustment

REMOVAL AND INSTALLATION

Parking Brake Warning Indicator Switch

Parking Brake Control

Parking Brake Cable - Rear

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GROUP 06: Brake System

SECTION 206-06:
Hydraulic Brake Actuation

SPECIFICATIONS

DESCRIPTION AND OPERATION

Hydraulic Brake Actuation

Hydraulic Brake Actuation

Brake Pedal Assembly - Hybrid

DIAGNOSIS AND TESTING

Hydraulic Brake Actuation

REMOVAL AND INSTALLATION

Brake Pedal and Bracket - Non-Hybrid

Brake Pedal and Bracket - Hybrid

Brake Master Cylinder

Brake Pedal Angle Sensor

Brake Pressure Control Valve

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GROUP 06: Brake System

SECTION 206-07:
Power Brake Actuation

SPECIFICATIONS

DESCRIPTION AND OPERATION

Brake Booster

DIAGNOSIS AND TESTING

Power Brake System

REMOVAL AND INSTALLATION

Brake Booster - Exploded View

Brake Booster - Hybrid Vehicles

Brake Booster - Non-Hybrid Vehicles

Vacuum Pump - Hybrid Vehicles

Vacuum Sensor - 3.0L All-Wheel Drive (AWD) and 3.5L Vehicles

Brake Booster - Hybrid

Brake Booster - Non-Hybrid

Brake Booster Travel Sensor - Hybrid

Brake Booster Vacuum Sensor - Hybrid

Brake Booster Vacuum Sensor - Non-Hybrid

Brake Vacuum Pump

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GROUP 06: Brake System

SECTION 206-09:
Anti-Lock Brake System (ABS) and Stability Control

SPECIFICATIONS

DESCRIPTION AND OPERATION

Anti-Lock Control

ABS with AdvanceTrac® Stability Enhancement System

Anti-Lock Braking

Electronic Brake Distribution (EBD)

AdvanceTrac® Stability Enhancement System

Traction Control Switch

Stability/Traction Control Indicators

Optimized Hydraulic Braking (3.0L All-Wheel Drive (AWD) and 3.5L only)

Hybrid Braking System

Regenerative Braking

Brake-By-Wire

DIAGNOSIS AND TESTING

Anti-Lock Control - Non-Hybrid

Principles of Operations

Anti-Lock Braking

Electronic Brake Distribution (EBD)

Optimized Hydraulic Braking (3.0L All-Wheel Drive (AWD) and 3.5L only)

AdvanceTrac® Stability Enhancement System

Traction Control Switch

Stability Control Sensors

Steering Wheel Position Information

ABS Module Calibration

Inspection and Verification

DTC Charts

Symptom Chart

Pinpoint Tests

Anti-Lock Control - Hybrid

Principles of Operation

Regenerative Braking

Conventional Friction Braking

Brake-By-Wire

Brake Pedal Feel Simulator and Cut-Off Device

Active Brake Booster

Electric Vacuum Pump

Anti-Lock Braking

Electronic Brake Distribution (EBD)

AdvanceTrac® Stability Enhancement System

Traction Control Switch

Stability Control Sensors

Steering Wheel Position Information

ABS Module Calibration (Multi-Calibration Routine)

Inspection and Verification

DTC Charts

Symptom Chart

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REMOVAL AND INSTALLATION

Hydraulic Control Unit (HCU)

Hydraulic Control Unit (HCU) - Hybrid

Anti-Lock Brake System (ABS) Module

Anti-Lock Brake System (ABS) Module - Hybrid

Wheel Speed Sensor - Front

Wheel Speed Sensor - Rear, Front Wheel Drive (FWD)

Wheel Speed Sensor - Rear, All Wheel Drive (AWD)

Traction Control Switch

Steering Wheel Rotation Sensor

2012 Fusion, MKZ, Fusion Hybrid, MKZ Hybrid Contents/Index

GROUP 07: Automatic Transmission

SECTION 307-01A:
Automatic Transaxle/Transmission - Aisin AW21

SPECIFICATIONS

DESCRIPTION AND OPERATION

Transaxle Description

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Range Selection

Range Selection

Park

Reverse

Neutral

Drive

Manual

Select Shift Transmission Selector Lever

Gear Availability

Shift Patterns

Downshifts

Coastdown

Torque Demand

Kickdown

Transaxle Operational Strategies

Automatic Gearshift Control

Driver Adaptive Shift Control

Gear Shift Control

Reverse Converter Control

Torque Converter Clutch (TCC)

Torque Converter

Geartrain

Differential

Apply Components

C1 Drive Clutch

C2 Drive Clutch

C3 Drive Clutch

B1 Brake Clutch

B2 Brake Band

F1 One-Way Clutch

Hydraulic Systems

Transaxle Electronic Control System

Transmission Control Module (TCM) Control Function

Transmission Range (TR) Sensor

Brake Pedal Position (BPP)

Transmission Fluid Temperature (TFT) Sensor

Transaxle Shift Solenoids SSA, SSB

Shift Control Solenoids (SSC, SSD, SSE, SSF)

Line Pressure Control (LPC)

Speed Sensor

Adaptive Shift Control

Torque Converter Clutch (TCC) Solenoid

DIAGNOSIS AND TESTING

Diagnostic Strategy

Preliminary Inspection

Diagnostics

Diagnostic Flow Chart

Preliminary Inspection

Know and Understand the Concern

Verification of Condition

Check Transmission Fluid Level and Condition

Water in Transmission Fluid

Road Testing Vehicle

Shift Point Road Test

Torque Converter Diagnosis

Torque Converter Operation Test

Visual Inspection

Selector Lever Linkage Check

Check TSBs

Diagnostics

Self Diagnosis Function

On-Board Diagnostic (OBD) With Scan Tool

Diagnostic Parameters Identification (PID) Chart

Transaxle Drive Cycle Test

After On-Board Diagnostic (OBD)

Before Pinpoint Tests

Diagnostic Trouble Code (DTC) Charts

Transaxle Connector Layouts

Pinpoint Tests - OSC Equipped Vehicle

Pinpoint Tests

Special Testing Procedures

Engine Idle Speed Check

Pressure Test

Stall Speed Test

Leakage Inspection

External Sealing

Transmission Fluid Leakage in Torque Converter Area

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GROUP 07: Automatic Transmission

SECTION 307-01B:
Automatic Transaxle/Transmission - 6F35

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Downshifts

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Torque Demand

Kickdown

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Low One-Way Clutch (OWC)

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Hydraulic Circuit Identification and Function

Line Pressure Hydraulic Circuits

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Throttle Position (TP) Sensor

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Torque Converter Clutch (TCC) Solenoid

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5th Gear

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Solenoid Body Strategy Data Download

Solenoid Body Strategy Drive Cycle

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Output Shaft Speed (OSS) Sensor

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Halfshaft Seal - RH, Front Wheel Drive (FWD)

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Transaxle Support Insulator - 2.5L

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GROUP 07: Automatic Transmission

SECTION 307-01C:
Automatic Transaxle/Transmission - Electronically Controlled Continuously Variable Transmission (eCVT)

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GROUP 07: Automatic Transmission

SECTION 307-02A:
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GROUP 07: Automatic Transmission

SECTION 307-02B:
Transaxle/Transmission Cooling - Hybrid

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GROUP 07: Automatic Transmission

SECTION 307-05A:
Automatic Transaxle/Transmission External Controls - Aisin AW21/6F35

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Selector Lever - MKZ

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GROUP 07: Automatic Transmission

SECTION 307-05B:
Automatic Transaxle/Transmission External Controls - Hybrid

SPECIFICATIONS

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SECTION 308-00:
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GROUP 08: Manual Transmission, Clutch and Transfer Case

SECTION 308-01:
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GROUP 08: Manual Transmission, Clutch and Transfer Case

SECTION 308-02:
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SECTION 308-03:
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GROUP 08: Manual Transmission, Clutch and Transfer Case

SECTION 308-06:
Manual Transaxle/Transmission External Controls

SPECIFICATIONS

DESCRIPTION AND OPERATION

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SECTION 308-07A:
Four Wheel Drive (4WD) Systems

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GROUP 08: Manual Transmission, Clutch and Transfer Case

SECTION 308-07B:
Transfer Case - Power Transfer Unit (PTU)

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GROUP 09: Exhaust System

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3.5L (View 3 of 3)

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GROUP 10: Fuel System

SECTION 310-00:
Fuel System - General Information

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GROUP 10: Fuel System

SECTION 310-01A:
Fuel Tank and Lines

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Fuel Tank and Filler Pipe (AWD Vehicles)

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Fuel Tank Filler Pipe - Front Wheel Drive (FWD)

Fuel Tank Filler Pipe - All Wheel Drive (AWD)

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GROUP 10: Fuel System

SECTION 310-01B:
Fuel Tank and Lines - Hybrid

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GROUP 10: Fuel System

SECTION 310-02:
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GROUP 11: Steering System

SECTION 211-00A:
Steering System - Electronic Power Assist Steering (EPAS)

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Electronic Power Assist Steering (EPAS) System

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GROUP 11: Steering System

SECTION 211-00B:
Steering System - Hydraulic Power Assist Steering (HPAS)

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GROUP 11: Steering System

SECTION 211-02:
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Steering Gear - 2.5L Non-Hybrid and 3.0L Front Wheel Drive (FWD)

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GROUP 11: Steering System

SECTION 211-04:
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GROUP 11: Steering System

SECTION 211-05:
Steering Column Switches

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GROUP 12: Climate Control System

SECTION 412-00A:
Climate Control System - General Information and Diagnostics

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Electronic Manual Temperature Control (EMTC) System

Dual Automatic Temperature Control (DATC) System

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System Airflow Description - Electronic Manual Temperature Control (EMTC)

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The Refrigerant Cycle

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Temperature Sensor - In-Vehicle

Temperature Sensor - Ambient

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Temperature Blend Door Actuator

Evaporator Discharge Air Temperature Sensor

Heater Core

Heater Core - Plugged

Heater Core - Pressure Test

Heater Core - Bench Test

Evaporator/Condenser Core - On-Vehicle Leak Test

A/C Compressor - External Leak Test

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Procedure 1 - Ambient Temperature at or Below 38°C (100°F)

Procedure 2 - Ambient Temperature Above 38°C (100°F)

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Fluorescent Dye Leak Detection

Fluorescent Dye Injection - Using an R-134a Refrigerant Management Center and Dye/Lubricant Injector (Non-Hybrid Only)

Fluorescent Dye Injection - Using an R-134a Loop/Add On Injector Kit-Set (Non-Hybrid Only)

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Refrigerant System Evacuation Using a R-134a Manifold Gauge Set and Vacuum Pump

Refrigerant System Charging Using a R-134a Refrigerant Management Machine

Refrigerant System Charging Using a R-134a Manifold Gauge Set and Automatic Refrigerant Charging Meter

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Refrigerant System Filtering Following Air Conditioning (A/C) Compressor Installation

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Adding Refrigerant Oil After A/C Compressor Replacement - Non-Hybrid

Adding Refrigerant Oil After Electric A/C Compressor Replacement - Hybrid

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GROUP 12: Climate Control System

SECTION 412-00B:
Climate Control System - General Information and Diagnostics - Hybrid

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Hybrid Climate Control System Operation

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HVAC Module DTC Chart

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GROUP 12: Climate Control System

SECTION 412-01:
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Thermostatic Expansion Valve (TXV)

Evaporator Discharge Air Temperature Sensor

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Service Gauge Port Valves

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Air Distribution and Filtering

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Heater Core and Evaporator Core Housing

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Air Conditioning (A/C) Compressor - 2.5L

Air Conditioning (A/C) Compressor - 3.0L, 3.5L

Air Conditioning (A/C) Compressor - Hybrid

Air Conditioning (A/C) Evaporator Discharge Air Temperature Sensor

Air Conditioning (A/C) Pressure Transducer

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Blower Motor

Blower Motor Resistor

Blower Motor Speed Control

Cabin Air Filter

Clutch and Clutch Field Coil

Compressor Manifold and Tube Assembly - 2.5L

Compressor Manifold and Tube Assembly - 3.0L, 3.5L

Compressor to Condenser Discharge Line - Hybrid

Condenser Core - 2.5L, 3.0L, Hybrid

Condenser Core - 3.5L

Evaporator Core

Evaporator to Compressor Suction Line - Hybrid

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Heater Core And Evaporator Core Housing

Heating Ventilation Air Conditioning (HVAC) Module - Fusion, Milan

Heating Ventilation Air Conditioning (HVAC) Module - MKZ

In-Vehicle Temperature and Humidity Sensor - Hybrid

In-Vehicle Temperature Sensor - Fusion, Milan

In-Vehicle Temperature Sensor - MKZ

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Register - Center, Fusion/Milan

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Register - Driver and Passengusion/Milan

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Temperature Blend Door Actuator - RH, Dual-Zone EATC

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Thermostatic Expansion Valve Manifold and Tube Assembly

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GROUP 13: Instrumentation and Warning Systems

SECTION 413-00:
Instrument Cluster and Panel Illumination

DESCRIPTION AND OPERATION
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Instrument Cluster and Panel Illumination

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GROUP 13: Instrumentation and Warning Systems

SECTION 413-01:
Instrumentation, Message Center, and Warning Chimes

DESCRIPTION AND OPERATION
Instrument Panel Cluster (IPC)

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DIAGNOSIS AND TESTING

Instrumentation, Message Center and Warning Chimes

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Instrument Panel Cluster (IPC)

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Instrument Panel Cluster (IPC) DTC Chart

Smart Junction Box (SJB) DTC Chart

PCM DTC Chart

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Message Center Configuration

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GROUP 13: Instrumentation and Warning Systems

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GROUP 13: Instrumentation and Warning Systems

SECTION 413-13:
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GROUP 14: Battery and Charging System

SECTION 414-00:
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GROUP 14: Battery and Charging System

SECTION 414-01:
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GROUP 14: Battery and Charging System

SECTION 414-03:
High Voltage Traction Battery

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GROUP 14: Battery and Charging System

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Principles of Operation - High-Voltage Cable Assembly

Principles of Operation - DC/AC Inverter and AC Power Point

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GROUP 15: Audio Systems

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Audio Digital Signal Processing (DSP) Module DTC Chart - Sony® Sound

Audio Digital Signal Processing (DSP) Module DTC Chart - THX® Sound

Accessory Protocol Interface Module (APIM) DTC Chart

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GROUP 17: Lighting

SECTION 417-02:
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GROUP 18: Electrical Distribution

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Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available

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GROUP 19: Electronic Feature Group

SECTION 419-01A:
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GROUP 19: Electronic Feature Group

SECTION 419-01B:
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GROUP 19: Electronic Feature Group

SECTION 419-01C:
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Key Programming Switch State Control

Spare Key Programming - Unlimited Key Mode

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Anti-Theft Security Access

Passive Anti-Theft System (PATS) Parameter Reset

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GROUP 19: Electronic Feature Group

SECTION 419-02:
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GROUP 19: Electronic Feature Group

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GROUP 19: Electronic Feature Group

SECTION 419-04:
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GROUP 19: Electronic Feature Group

SECTION 419-10:
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